

# 中華民國天文學會

## 2011 年年會

2011 ASROC Annual Meeting

議程 & 論文摘要

Program & Abstract Book

27-29 May 2011

國立科學工藝博物館 · 高雄市

National Science and Technology Museum

Kaohsiung City, Taiwan

主辦單位：  中華民國天文學會

協辦單位：  高雄市天文學會、  國立科學工藝博物館

贊助單位：  行政院國家科學委員會

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# 年會議程委員會

## Program Committee

### 年會議程委員：

- 呂聖元 (中央研究院天文與天文物理研究所)  
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Chou, Yi (NCU)  
Hwang, Chorng-Yuan (NCU)  
Kuan, Yi-Jehng (NTNU)  
Lai, Shih-Ping (NTHU)  
Liu, Sheng-Yuan (ASIAA)  
Sun, Wei-Hsin (NTU)

# ASROC 2011

# 年會組織委員會

## Organizing Committee

### 年會組織委員：

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鄭文光（高雄市天文學會）

### *Organizing Committee :*

Chen, Shiunn-Shyang (NSTM)

Chen, Lin-Wen (NTNU, Co-Chair)

Chen, Tsung-Ching (KHAS, Co-Chair)

Cheng, Wen-Kuang (KHAS)

Su, Ming-Jun (KHAS)

# 大會議程

## ASROC 2011 Program

### **May 27 (Friday)**

18:30-20:30 Reception & Registration

### **May 28 (Saturday)**

08:00-09:00 Registration

09:00-09:10 Opening remark

09:10-10:00 Plenary talk, 'Crystal Ball Gazing for this Decade: Transients (from PTF to LSST)',  
by Prof. Shri Kulkarni

10:00-10:15 Group photo

10:15-10:45 Break

10:45-12:15 Oral session A (O01-O05, Chair: Yi-Jehng Kuan)

12:15-14:00 Lunch

12:30-13:30 Yong Astronomer Meeting (Chair: Shih-Ping Lai)

14:00-14:50 Plenary talk, 'Introducing ICRR – Cosmic Rays, Neutrinos and Gravitational Waves',  
by Prof. Takaaki Kajita

14:50-15:20 General Assembly

15:20-16:30 Break & Poster session (authors must be on site)

16:30-18:00 Oral session B (O06-O11, Chair: Chorng-Yuan Huang)

### **May 29 (Sunday)**

09:00-10:30 Oral session C (O12-O17, Chair: Shih-Ping Lai)

10:30-11:00 Break

11:00-12:30 Oral session D (O18-O22, Chair: Lin-Wen Chen)

12:30-14:00 Lunch

13:00-13:30 Council election ballot counting

14:00-14:50 Popular talk, 'Different faces of stars', by Dr. Yao-Huan Tseng

14:50-15:35 Oral session E (O23-O25, Chair: Yi Chou)

15:35-16:00 Break

16:00-17:00 Oral session F (O26-O29, Chair: Yi-Nan Chin)

17:00-17:30 Best poster presentation (Chair: Yi-Nan Chin)

17:30-17:40 Closing remark

# ASROC 2011

## 一、大會邀請演講

5/28 (六)

09:10-10:00

Prof. Shri Kulkarni

Director of Caltech Optical Observatories, Caltech

主講：『Crystal Ball Gazing for this Decade: Transients (from PTF to LSST)』

14:00-14:50

Prof. Takaaki Kajita

Director of Institute of Cosmic Ray Research (ICRR), University of Tokyo

主講：『Introducing ICRR – Cosmic Rays, Neutrinos and Gravitational Waves』

## 二、大會通俗演講

5/29 (日)

14:00-14:50

曾耀寰博士

中央研究院天文及天文物理研究所

主講：『星星面面觀』

# 口頭論文目錄

## List of Oral Presentation

Oral presentations are all 15 minutes each, including Q&A, except for O04\* and O19\*, which are 30 minutes each.

| Code | Title   | Presenting Author  | Affiliation* |
|------|---|--------------------|--------------|
| O01  | Progress Report of PS1TW  | W. P. Chen         | NCU          |
| O02  | State of MIOSOTYS Project   | I-Chun Shih        | NTHU         |
| O03  | Current Status of Visible 4-Color Simultaneous Imager Development                                 | Kinoshita Daisuke  | NCU          |
| O04* | The Next Generation CFHT  | Alan McConnachie   | HIA          |
| O05  | The ALMA Project; Status, Progress, and the First Call for the Proposal                           | Shigehisa Takakuwa | ASIAA        |
| O06  | The Onset of Silicate Crystallization in the Early Stage of Star Formation                        | Sean Chapman       | ASIAA/UM     |
| O07  | Planetesimal Formation around the Young Abruptive Variable GM Cephei                              | Chia-Ling Hu       | NCU          |
| O08  | Searching for Young Stellar Objects with Multi-wavelength Observations toward Ophiuchus Molecular | Chi-Hung Yan       | ASIAA/NTNU   |
| O09  | VLA1623: a Non-coeval Triple System with a First Core Candidate                                   | Nadia M. Murillo   | NTHU         |
| O10  | Extended Infrared Emission Associated with Protostars: Views from Spitzer IRAC                    | Hiro Takami        | ASIAA        |
| O11  | Quadrupolar Outflow of NGC 1333 IRAS 2A   | Arthur Tsai        | NTHU         |
| O12  | Chemical Stratification in the L1448C Region  | Naomi Hirano       | ASIAA        |
| O13  | Submillimeter Observation of Low-mass Star Forming Region L1157                                   | Wen-Cheng Wu       | NTU/ASIAA    |
| O14  | Outflows and Envelopes around Two Protostellar Sources, NGC-1333 IRAS4a1 and 4a2                  | Sheng-Feng Yen     | ASIAA        |
| O15  | Finding Dense Clouds from the 2MASS and GLIMPSE360 Data   | Cosmos C. Yeh      | ASIAA/NTHU   |
| O16  | Measurement of the Scattering of Helioseismic Waves by a Sunspot                                  | Zhi-Chao Liang     | NTHU         |
| O17  | Searching for T Dwarfs in the Rho Oph. Star-forming Region  | Po-Shih Chiang     | NCU          |
| O18  | Discovery of Variable Stars in the Field of the Galactic Open Cluster NGC 7039                    | Juei-Hwa Hu        | NCU          |
| O19* | The Next-generation Space Infrared Astronomy Mission SPICA  | Takao Nakagawa     | JAXA         |

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| Code | Title   | Presenting Author  | Affiliation* |
|------|---|--------------------|--------------|
| O20  | The UFFO (Ultra Fast Flash Observatory) Pathfinder: Science and Mission                     | Ming-Huey A. Huang | NUU/NTU      |
| O21  | Observing with the Fermi Gamma-ray Space Telescope  | Albert Kong        | NTHU         |
| O22  | Fundamental planes of Gamma-ray Emission from Globular Clusters                             | P.H. Thomas Tam    | NTHU         |
| O23  | Chandra and HST studies of the X-ray Sources in Galactic Globular Clusters                  | Ting-Ni Lu         | NTHU         |
| O24  | Feasibility of Determining X-ray Emitting Region Size in Scorpius X-1 with TNO Occultations | Kuan-Ting Chen     | NTHU         |
| O25  | Why do Gamma-ray Pulsars Show Hard Spectra in the Second Peaks of Their Light Curves?       | Kouichi Hirotsu    | ASIAA/TIARA  |
| O26  | The Significance of Molecular Superbubbles and Outflows on Starburst Galaxies               | An-Li Tsai         | NTNU/ASIAA   |
| O27  | The Star Formation Activity in the Shapley Supercluster                                     | Pei-Li Ho          | NTNU/CWB     |
| O28  | Merger Rate Evolution from UKIDSS-UDS   | Pin-Wei Wang       | NTNU         |
| O29  | The Taiwan Extragalactic Astronomical Data Center   | Sebastien Foucaud  | NTNU         |

\*The full spellings of the abbreviated affiliations are as follow:

ASIAA=Academia Sinica Institute of Astronomy and Astrophysics

HIA=NRC Herzberg Institute of Astrophysics

JAXA=Japan Aerospace Exploration Agency

NCU=National Central University

NTHU=National Tsing Hua University

NTNU=National Taiwan Normal University

NTU=National Taiwan University

NUU=National United University

UM=University of Manchester

# 壁報論文目錄

## List of Poster Presentation

| Code | Title  | Presenting Author | Affiliation* |
|------|--|-------------------|--------------|
| P01  | Variable Stars & Period Search Methods   | D.C. Chang        | NCU          |
| P02  | Searching for Supernova Events in Circumnuclear Starburst Region around AGN                            | I-Chenn Chen      | NCU          |
| P03  | Observations of Jovian Trojans from the Pan-STARRS Project   | Shao-Hsuan Chen   | NCU          |
| P04  | Evaluating Performance of the CCD Camera with a Hand-made Integrating Sphere                           | Tse-Chuan Chen    | NCU          |
| P05  | The Binary Program with Speckle Interferometry of NTNU   | Hsien-Lung Cheng  | NTNU         |
| P06  | Photometric Study and Time-Series Analysis of the Open Cluster NGC 1513                                | Ping-Han Cheng    | NCU          |
| P07  | Dynamical Evolution of the Hilda and Quasi-Hilda Asteroids   | Yu-Chi Cheng      | NCU          |
| P08  | Overview of the Nuclear Compton Telescope (NCT)  | Jeng-Lun Chiu     | NTHU         |
| P09  | Optical Identification of un-ID Fermi GeV sources  | Chia-Jung Chuang  | NCU          |
| P10  | The Return of Comet Hartley 2  | Yo-Ling Chuang    | NTNU         |
| P11  | The CCD BV Photometry of Variable Stars in the Globular Cluster M5                                     | Hsieh-Hai Fu      | NTNU         |
| P12  | Numerical Experiments for the Binary-Single TNO Scattering Process                                     | Sie-Zong Fu       | NCU          |
| P13  | Numerical Simulation of the Phase-transition-induced Collapse of Neutron Stars Using 2DGR Code         | Yu-Hoi Fung       | HKU          |
| P14  | Pan-STARRS Data Server and Tenagra Follow-up Observation   | Jhen-Kuei Guo     | NCU          |
| P15  | A correlation Study of High-redshift Galaxies  | Kuan-chou Hou     | NTNU         |
| P16  | Mapping and Photometry of the Planetary Nebula M 1-11 in the Visual and Infrared                       | Chih-Hao Hsia     | HKU          |
| P17  | Outflow Observations Toward Extremely Young YSOs   | Tien-Hao Hsieh    | NTHU         |
| P18  | Charge Exchange and Collisional Interaction of the Saturnian Corating Plasma with Enceladus Gas Plumes | Jen-Kai Hsu       | NCU          |
| P19  | SiO observations of an MYSO candidate G2.54+0.20   | Yu-Sen Hsu        | NTNU         |
| P20  | Photometric and Astrometric Characterization of Galactic Open Clusters by the Pan-STARRS 1 Dataset     | Chung-Kai Huang   | NCU          |
| P21  | Infrared H2 Survey of the Star Forming Complex M17   | J. Y. Huang       | NCU          |
| P22  | Photometric Study of Morphologically Identified Merging Galaxies                                       | Jen-Chao Huang    | NCU          |

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| Code | Title   | Presenting Author     | Affiliation* |
|------|---|-----------------------|--------------|
| P23  | Physical Characteristics of the River Valleys of the Hellas Basin on Mars   | Li-Ching Huang        | NCU          |
| P24  | Searching For The First "Radio-Quiet" Gamma-ray Emitting Millisecond Pulsar   | Regina Huang          | NTHU         |
| P25  | Outreach Education for Primary School Level Astronomy Using Digital Planetarium in Taipei Astronomical Museum         | Jim Ching-Chuan Hung  | TAM          |
| P26  | Optical and X-ray Observations of the Nova KT Eridani   | Li-Wen Hung           | NCU          |
| P27  | Moving Needles in a Haystack --- Finding Asteroids in Pan-STARRS Images   | Ruo-Lan Jin           | TFG          |
| P28  | Spectroscopic Observations of Low Luminosity YSOs   | Jennifer Karr         | ASIAA        |
| P29  | Optical Monitoring of Lensed Quasars  | Ekaterina Koptelova   | NTU          |
| P30  | Mock Galaxy Catalogs for Hyper Suprime-Cam Survey   | Ting-Wen Lan          | ASIAA        |
| P31  | Dust Around Be Studied by Submillimeter Observation   | Chien-De Lee          | NCU          |
| P32  | Formation of an Extended Halo of Hot Oxygen Atoms in the Wake Region of Venus   | Ying Liao             | NCU          |
| P33  | The Mass Function and Origins of Intermediate-mass Black Holes in the Local Universe                                  | Chun-Cheng Lin        | NTNU         |
| P34  | Probing the Starburst/AGN Contribution of X-ray $70\mu\text{m}$ Selected Galaxies in the COSMOS field                 | Ming-Yi Lin           | NTNU         |
| P35  | Blue Merging Galaxies   | Yi-Fan Lin            | NCU          |
| P36  | Identification of Extremely Red Galaxies  | Wei-Fang Liu          | NCU          |
| P37  | UV-Luminosity function at $z=1-3$ with the UKIDSS-UDS survey  | Ching-Min Lo          | NTNU         |
| P38  | An Ultrasoft X-ray Emission from Galaxy GSN69: Candidate of X-ray Outburst due to Stellar Capture                     | Li Kwan Lok           | HKU          |
| P39  | Statistical Tests for the Metallicity Dependency of the Theoretical Cepheid Period-Luminosity Relations in IRAC Bands | Chow-Choong Ngeow     | NCU          |
| P40  | Searching for Variable Stars in the Selected TAOS Fields and Optical Follow-up Observations                           | Sherry Kang-Shian Pan | NCU          |
| P41  | Long-Period Comet C/2007 W1 and Jupiter-Family Comet 73P  | Wei-Hsiang Pan        | NTNU         |
| P42  | Dispersal and Core Formation of Stellar Clusters in Different Virial Ratio  | Chih-Han Peng         | NCU          |
| P43  | Global near Infrared Colour Distribution from 2MASS   | Ting-Hung Peng        | NCU          |
| P44  | Development of Control Software for 4-color Simultaneous Imager   | Pei-Hsien Shen        | NCU          |

| Code | Title   | Presenting Author | Affiliation*  |
|------|---|-------------------|---------------|
| P45  | Near Infrared Polarimetric Imaging of Carina Nebula   | Bo He Su          | NCU           |
| P46  | Constraint on the Spin of the Black Hole in GX 339-4 from X-ray Continuum                               | Yi-Hao Su         | NCU           |
| P47  | Validation of the Very Low Luminosity Object Candidates in Taurus                                       | Ren-Shiang Sung   | NTHU          |
| P48  | Multicolor Photometry of Small Solar System Bodies by Subaru Telescope                                  | Chih-Yang Tai     | NCU           |
| P49  | A Detailed Analysis of Spitzer IRAC Emission in High Mass Star Forming Regions                          | Hiro Takami       | ASIAA         |
| P50  | Planet Destruction Rate of Occurrence and Observability   | Stuart Taylor     | NTHU          |
| P51  | Constraining MOND by Gravitational Redshift Experiment in Matter Wave Interference                      | Yong Tian         | NCU           |
| P52  | Star Formation Law in Circumnuclear Region of Galaxies  | Mengchun Tsai     | NCU           |
| P53  | Orphan GRB Search in Subaru Deep Field  | Patrick P. Tsai   | NCU           |
| P54  | Energetic Particle Injection Events in the Saturnian Magnetosphere                                      | Chia-Yu Tzou      | NCU           |
| P55  | Observational Constraints on the Physical Conditions that Determine the Evolution of Circumstellar Disk | Jia-Wei Wang      | NTHU          |
| P56  | Detection of Star Clusters in a Sky Survey --- Is the Fainter the Better?                               | Ping-Fang Wang    | NCU           |
| P57  | Spectral Imaging towards Class I Young Stellar Objects IRS 44 and 46                                    | Wen-Wei Wang      | NTU           |
| P58  | Current Development Status of y-band Camera for 2m telescope Instrument                                 | Ching-Huang Wu    | NCU           |
| P59  | The Astronomical Refraction of the Setting Sun  | Yu-Lun Wu         | NTNU          |
| P60  | Dynamics of Charged Nano-dust and Pickup Ions from Sun-grazing Comets                                   | Tai-Hao Yan       | NCU           |
| P61  | Molecular Gas of HBLR and Non-HBLR Seyfert 2 Galaxies   | Po-Chieh Yu       | NCU           |
| P62  | A Study on Late Time Evolution of Gamma-ray Burst Afterglows  | Clark Chiu        | NTU/<br>ASIAA |

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ASIAA=Academia Sinica Institute of Astronomy and Astrophysics

HKU=University of Hong Kong

NCU=National Central University

NTHU=National Tsing Hua University

NTNU=National Taiwan Normal University

NTU=National Taiwan University

TAM=Taipei Astronomical Museum

TFG=Taipei First Girls High School

### O01

#### **Title: Progress Report of PS1TW**

##### **Authors:**

1. *W. P. Chen\* (National Central University)*
2. *Taiwan Team of the Pan-STARRS 1*

##### **Abstract:**

Pan-STARRS 1, the prototype of the Panoramic Survey Telescope & Rapid Response System, is a 1.8 m optical telescope equipped with a 1.4 giga-pixel orthogonal-transfer CCD camera, located in Haleakala, Hawaii, USA. PS1 started the routine sky survey in mid-May 2010, and so far has covered the entire visible sky several times in multiple wavelength bands. In addition to transient science, such as supernovae, GRBs, and NEO discoveries and characterization, many "static" universe programs also began to turn in results. I will report on the current status of the PS1 operations, with emphasis on results and contributions made by PS1TW members in Taiwan.

### O02

#### **Title: State of MIOSOTYS project**

##### **Authors:**

1. *I-Chun Shih\* (National Tsing Hua University)*
2. *Hsing-Kuang Chang (National Tsing Hua University)*
3. *Alain Doressoundiram (LESIA, Observatoire de Paris)*
4. *Françoise Roques (LESIA, Observatoire de Paris)*

##### **Abstract:**

MIOSOTYS (Multi-object Instrument for Occultations in the SOLar system and TransitorY Systems) is a Taiwan-France joint-project aiming to develop a fibre-based, high time resolution photometer for the studies of (1er) trans-Neptune objects (TNOs) and (2nd) other rapid time-domain astronomical phenomena. We have been operating the instrument using the 1.93 m telescope at Observatoire de Haute-Provence (OHP), France since 2010. In this presentation, we will describe the characteristics of the instrument, and the preliminary results of past missions. We also discuss the impacts and challenges with the new CCD camera technology, such as low light level (L3), for future astronomical observations.

### O03

#### Title: Current Status of Visible 4-Color Simultaneous Imager Development

**Authors:**

1. Kinoshita Daisuke\* (National Central University)
2. Ching-Huang Wu (National Central University)
3. Tse-Chuan Chen (National Central University)
4. Pei-Hsien Shen (National Central University)
5. Ru-Huei Huang (National Central University)
6. Hui-Hsin Yang (National Central University)

**Abstract:**

In order to carry out immediate follow-up observations for large scale astronomical surveys, a visible 4-color simultaneous imager is being developed. Three dichroic mirrors are used to split the beam from the telescope, and images at four different pass bands are recorded simultaneously by four CCD cameras. The main scope of this instrument is to conduct efficient and reliable color measurements of moving and transient objects, such as asteroids and supernovae. Simultaneous imaging is able to provide accurate color determinations even under relatively poor condition nights, while conventional multi-color photometry by exchanging filters may produce false colors due to the time lag between image acquisitions. We report the scientific objectives, design, development strategy, and current status of the instrument development. We also introduce preliminary results of test observations using one of unit cameras at Lulin observatory in April 2011.

### O04

#### Title: The Next Generation CFHT

**Authors:**

1. Alan McConnachie (NRC Herzberg Institute of Astrophysics)

**Abstract:**

The 3.6m Canada-France-Hawaii telescope (CFHT) is one of the world's most versatile astronomical research facilities. Since 2002, ROC astronomers have been part of the CFHT scientific community and have actively participated in shaping its future through new instrumentation. Here, we detail progress of an ongoing Concept Study to upgrade the CFHT to a 10m-class facility with a dedicated wide-field (1.5 sq.degree), highly multi-plexed ( $N > 3000$ ) spectrograph with low ( $R=1500$ ), medium ( $R=5000$ ) and high ( $R=20000$ ) resolutions. This "next generation" CFHT - made possible within a new and expanded partnership - will be an incredibly powerful research tool serving an extremely broad user-base. It will uniquely be able to address some of the key science questions in astronomy, such as the equation of state of the Universe and the reconstruction of the formation history of the Milky Way. It will be the sole facility capable of providing dedicated wide-field spectroscopic follow-up observations for facilities like HSC, LSST and Euclid. We will discuss progress in the scientific and technical aspects of ngCFHT and discuss ways in which interested scientists can get involved to help shape, and ultimately realize, this exciting astronomical facility.

**O05**

**Title: The ALMA Project; Status, Progress, and the First Call for the Proposal**

**Authors:**

1. Shigehisa Takakuwa\* (*Academia Sinica Institute of Astronomy and Astrophysics*)
2. The ALMA-T members

**Abstract:**

In this talk, we will report the latest status and progress of the Atacama Large Millimeter and submillimeter Array (ALMA) Project. ALMA is an international collaborative project among U.S., Europe, Japan, and Taiwan, to construct a large millimeter and submillimeter interferometric array telescope at the Atacama Desert in northern Chile. At present, ten parabolic antennas have been constructed in the site, and the test observations of the astronomical sources are undergoing. ALMA has by far the best sensitivity, spatial and the spectral resolutions, and with ALMA we anticipate epoch-making discovery and progress in the field of astronomy and astrophysics, ranging from our solar system, star and planet formation, extra-galaxies, to cosmology. This year, the ALMA early science observations will start, and the first call for the proposals has been issued on March 31, 2011. We will ask all the Taiwanese Physicists and Astrophysicists to submit their observing plans with ALMA.

**O06**

**Title: The Onset of Silicate Crystallization in the Early Stages of Star Formation**

**Authors:**

1. S. D. Chapman\* (*Academia Sinica Institute of Astronomy and Astrophysics, and The University of Manchester, UK*)
2. F. Kemper (*Academia Sinica Institute of Astronomy and Astrophysics*)

**Abstract:**

Silicates form a common dust component in the diffuse interstellar medium, and dense molecular clouds. As star formation initiates within these dense molecular clouds, dust within these clouds are incorporated into protoplanetary disks, or the newly formed stars themselves. The mineralogy and crystallinity of silicate dust varies with its environment. Processes such as thermal annealing, grain destruction, gas phase condensation and amorphization alter the structure and composition of the dust. Infrared observations allow us to analyze dust properties. The silicate 10 micron feature is a diagnostic tool to understanding the mineralogy, crystallinity and size of dust along astrophysical sightlines. Spectra along interstellar sightlines indicate that silicates in the diffuse interstellar medium are completely amorphous (Kemper et al. 2004, ApJ 609, 826), while silicate dust around Herbig Ae/Be stars is shown to have a crystalline fraction of ~10% (Juhász et al. 2010, ApJ 721, 431). Radiative or shock heating may raise the temperature of amorphous silicate grains enough to anneal into the crystalline form. In this work, we aim to determine the onset of silicate crystallization in the very early stages of star formation by comparing spectra along different evolutionary sightlines. We used Spitzer and ISO spectroscopy of interstellar, molecular cloud, and protostellar sightlines, showing all the silicate features in absorption. We determined the optical depth profiles and fitted them with laboratory spectra of astrophysically relevant minerals. This allows us to determine mass fractions of the mineralogical components present in these sightlines. We have determined the crystalline fraction, as well as the mineralogical properties of the silicates, as they change with evolutionary stage. In particular, we have studied the olivine/pyroxene ratio and the Mg/Fe ratio. Regions of high mass and low mass star formation are also compared.

**O07**

**Title: Planetesimal Formation around the Young Abruptive Variable GM Cephei**

**Authors:**

1. Chia-Ling Hu\* (National Central University, and Taipei Astronomical Museum)
2. W. P. Chen (National Central University)
3. The Young Exoplanet Transit Initiative (YETI) consortium

**Abstract:**

GM Cep, a solar-type variable in the young (~4 Myr) open cluster Trumpler 37, exhibits an unusual brightness variation. The star is thought to be a classical T Tauri star, that is, a protosun with active accretion in its circumstellar disk, where protoplanets may be in the process of formation. In our monitoring campaign observations in 2009-2010, GM Cep experienced a ~0.82 mag brightness decrease lasting for ~40 days, plus several abrupt episodes of brightening lasting for ~10 days. The brightening was accompanied by a bluer color, consistent with intermittent increased accretion activity. Oddly, the star also became bluer during the 40-day fading. Such fading seems to have a quasi-cyclic period of 311 days, as hinted in photometric measurements of photographic plates dated way back since 1890s (Xiao et al 2010), but revealed only now because of our high cadenced, continuous observations. Under the hypothesis that the fading is caused by obscuration of starlight by an orbiting clump of circumstellar dust, we derived, from the time scales and amount of extinction, a clump mass comparable to a pro-Ceres. The inhomogeneity may be manifest of the transition phase between grain coagulation and planetesimal formation in a circumstellar T Tauri disk.

**O08**

**Title: Searching for Young Stellar Objects with Multi-wavelength Observations toward Ophiuchus Molecular Cloud**

**Authors:**

1. Chi-Hung Yan (Academia Sinica Institute of Astronomy and Astrophysics, and National Taiwan Normal University)

**Abstract:**

Studying the processes of low-mass star formation is a key for understanding the formation and evolution of our solar system. The dust properties, evolution of circumstellar disks and the disk rate of cluster stars all played important roles during the formation of a planetary system. By collecting large amount of spectral energy distribution (SED) of young stellar objects (YSO), one is able to analyze YSO properties through a statistic manner and understand their physics. In this project, we aim to study YSO properties along with their evolution in molecular cloud as well as the ambient environment by using newly developed SED fitting tool. Together with Spitzer IRAC/MIPS catalog, we have carried out 10 square degree YSO survey toward star formation region  $\rho$  Oph. It is one of the nearby star formation regions with age to be less than 1 Myr and distance 140~160 pc. Using SED analysis technique, we find a spatial density of 0.02 YSO per square arcmin. The major contamination comes from distant galaxies. Most of YSOs, ~ 80%, are low-mass pre-main sequence stars. The population of different YSOs are also determined and this provide a unique information on disk evolution. We plan to identify sources with signatures of planet-forming systems for follow-up observation in near future.

**O09**

**Title: VLA1623: a non-coeval triple system with a First Core candidate?**

**Authors:**

1. Nadia M. Murillo\* (National Tsing Hua University)
2. Shih-Ping Lai (National Tsing Hua University)

**Abstract:**

The frequency of multiple stars is known to be higher than that of single stars and it has been thoroughly shown that multiple systems are commonplace at every stage of stellar evolution. Yet a large gap in our understanding of multiple protostar formation and evolution exists. Multiple protostellar systems are true star formation "Laboratories", exhibiting a wide range of phenomena under a common environment. In addition non-coeval systems, product of multi-epoch fragmentation, can be ideal harbors of the earliest stage of star formation: the First Core. It is thus crucial for star formation in general to study multiple protostellar systems. We present the results of our work on the so-called prototypical Class 0 source VLA1623 located in Rho Ophiuchus ( $d=125\text{pc}$ ). The multiplicity and outflow structure of VLA1623 have been widely debated. Using submillimeter continuum and infrared data along with previous work, we identified a new source and find that VLA1623 is in fact a non-coeval triple protostellar system with a possible First Core candidate. We also find that VLA1623's outflow, traced in  $^{12}\text{CO}$ , is composed of three outflows that appear to merge into a single outflow. VLA1623's envelope presents a curious structure that varies for each component in the system, in composition as well as in kinematics.

**O10**

**Title: Extended Infrared Emission Associated with Protostars - Views from Spitzer IRAC**

**Authors:**

1. Hiro Takami\* (Academia Sinica Institute of Astronomy and Astrophysics)
2. Jennifer Karr (Academia Sinica Institute of Astronomy and Astrophysics)
3. How-Huan Chen (Academia Sinica Institute of Astronomy and Astrophysics, and National Tsing Hua University)
4. Haegon Koh (Sejong University, Korea)
5. Hsu-Tai Lee (Academia Sinica Institute of Astronomy and Astrophysics)
6. Shih-Ping Lai (National Tsing Hua University)

**Abstract:**

The Infrared Array Camera on Spitzer Space Telescope has observed extended infrared emission at 3.6/4.5/5.8/8.0  $\mu\text{m}$  associated with a number of young stellar objects and star forming regions. These are in many cases attributed to either shocks in molecular gas, scattered continuum in the outflow cavity, or PAH emission due to illumination by ultraviolet radiation. We present our recent studies of such emission, and show that such emission holds keys for understand important issues for star formation: e.g., driving and propagation of jet flows, evolution, circumstellar environments and the mechanism of mass accretion for high-mass protostars.

## O11

### Title: Quadrupolar Outflow of NGC 1333 IRAS 2A

#### Authors:

1. Arthur Tsai (National Tsing Hua University)
2. Vivien Chen (National Tsing Hua University)
3. Chin-Fei Lee (Academia Sinica Institute of Astronomy and Astrophysics)

#### Abstract:

A Quadrupolar outflow driven by the class 0 protostar(s) IRAS 2A was observed by Submillimeter Array (SMA) and Berkeley-Illinois-Maryland Association (BIMA) Millimeter Array with angular resolutions of 3" and 7", respectively. A highly collimated east-west bipolar outflow exhibits clear knots meanwhile an extended north-south bipolar outflow shows cavity structure. To investigate outflow properties, we computed mass and momentum as a function of velocity. In particular, we discover in the east-west outflow a wiggling structure, which further strengthens the hypothesis of IRAS 2A being a proto-binary system. By studying the position distribution of knots in the wiggling structure, we also set constraints, such as orbital radius and total mass, to the properties of the hypothesized proto-binary system. The properties of the two bipolar outflows reflect their driving mechanism as well as possible configurations of the central source(s).

## O12

### Title: Chemical stratification in the L1448C region

#### Author:

1. Naomi Hirano (Academia Sinica Institute of Astronomy and Astrophysics)

#### Abstract:

A class 0 protostar L1448C was mapped with the SMA in the HCN J=4--3, CS J=7--6, HCO+ J=4--3, SO J\_K=8\_8--7\_7, 29SiO J=8--7 lines at an angular resolution of 2 arcsecond. The HCN, CS and HCO+ emission mainly comes from three regions; one is centered at the position of the northern protostar L1448C(N), the second one is around the position of another protostellar source L1448C(S), and the third one is at ~7" south of L1448C(S). The HCN line shows wings that extend to +/- 30 km/s from the cloud systemic velocity and extremely high-velocity (EHV) components at +/- 50 km/s. The EHV emission is also shown in the SO and 29SiO lines. On the other hand, the CS and HCO+ lines are much narrower than the HCN line, and show no hint of EHV component. Our results suggest that the HCN emission is significantly enhanced in the regions where the energetic jet traced by the SO and 29SiO lines impacts on the dense ambient gas observed in the CS and HCO+ lines. The origin of the compact EHV HCN component might be the strong shocks in the jet beam at the base.

**O13**
**Title: Submillimeter Observation of low-mass star forming region L1157**
**Authors:**

1. Wen-Cheng Wu\* (National Taiwan University, and Academia Sinica Institute of Astronomy and Astrophysics)
2. Naomi Hirano (Academia Sinica Institute of Astronomy and Astrophysics)

**Abstract:**

We present the high-resolution images of 230 and 337 GHz continuum, 12CO(2-1), 13CO(2-1), C18O(2-1), C17O(3-2), and H13CO+(4-3) lines from the low-mass star forming region L1157 observed with the Submillimeter Array. The 12CO(2-1) data suggest that the outflow consists of two velocity components (low V<sub>lsr</sub>: -4~8 km/s; high V<sub>lsr</sub>: -12~-4 (blue) & 8~16 (red) km/s). The high velocity emission is confined in narrow ridges whose position angles (PA=140 degree) coincide with the brighter walls of the V-shaped cavities. In the vicinity of the central source, the blueshifted and redshifted lobes are overlapping, suggesting that the inclination angle (from the line of sight) of the recent outflow is less than 15 degree, which is different from that of the large scale outflow (i=80 degree). The C17O (3-2) and H13CO+ (4-3) lines are detected around the central source at a 5 sigma level. Both C17O and H13CO+ maps are elongated along the axis of the 12CO outflow. The C17O map shows a V-shaped structure open to the NW direction, while the H13CO+ shows a similar V-shaped structure open to the SE direction. It is likely that these V-shaped structures are tracing the base of the cavity walls carved by the outflow. The mass of the protostellar envelope derived from the C18O data is 0.223 solar mass, while the mass from the C17O and H13CO+ are 0.054 and 0.014 solar mass, respectively. The different numbers may probably because different lines are sampling different regions.

**O14**
**Title: Outflows and Envelopes around Two Protostellar Sources, NGC-1333 IRAS4a1 and 4a2**
**Authors:**

1. Sheng-Feng Yen\* (Academia Sinica Institute of Astronomy and Astrophysics)
2. Naomi Hirano (Academia Sinica Institute of Astronomy and Astrophysics)

**Abstract:**

NGC1333 IRAS 4a1 and 4a2 are protobinary system with a separation of 2". We present the images of the 1.3mm (230GHz) continuum and <sup>12</sup>CO(2-1), <sup>13</sup>CO(2-1), SO(5-4) and C<sup>18</sup>O (2-1), observed with SMA. The beam size of our map was 2.6\*1.56". The CO 2-1 map reveals two outflows: one is elongated along the NE-SW direction passing through the position of IRAS 4a2, and the other is the N-S outflow centered at the position of IRAS 4a1. The redshifted lobe of the NE-SW outflow has a velocity gradient along its minor axis. However, this velocity gradient is opposite to that reported by Choi et.al in their SiO 1-0 map. The velocity gradient seen in CO map is probably due to the contamination of the N-S outflow. Toward the positions of IRAS 4a1 and 4a2, the <sup>13</sup>CO line exhibits an inverse P Cygni profile. The deep absorption is also seen in the line profiles of 12CO and SO observed at 4a1. On the other hand, the absorption is not significant in <sup>12</sup>CO and SO at position of 4a2. In the presentation, we discuss the possible origin of the observed absorption features.

## O15

### Title: Finding dense clouds from the 2MASS and GLIMPSE360 data

#### Authors:

1. *Cosmos C. Yeh (Academia Sinica Institute of Astronomy and Astrophysics)*
2. *Sheng-Yuan Liu (National Tsing Hua University)*

#### Abstract:

We generate and compare extinction maps of the outer Galaxy with various methods such as star count, color excess, SED fitting, and other feasible approaches. The observation in Spitzer mid-infrared bands could trace visual extinctions up to  $\sim 100$  mag ( $\sim$ column densities of  $9 \times 10^{22} \text{ cm}^{-2}$ ). Thus, the data allows the identification of new dense clouds, such as infrared dark clouds, in the absence of strong diffused galactic background emission. Due to the high-spatial resolution of GLIMPSE360, the data allows us to investigate the mass distribution from Galactic size-scales (spiral structures) down to individual clouds.

## O16

### Title: Measurement of the scattering of helioseismic waves by a sunspot

#### Authors:

1. *Zhi-Chao Liang\* (National Tsing Hua University)*
2. *Laurent Gizon (Max Planck Institute for Solar System Research, Germany)*
3. *Hannah Schunker (Max Planck Institute for Solar System Research, Germany)*

#### Abstract:

We study the scattering of acoustic wave packets by a sunspot. Wave traveltimes and amplitudes are measured by the cross-covariance function derived from series of tracked Doppler images. The averaging and filtering procedures are such that incident wave packets are plane wave packets in a regime where the wavelength is comparable to the size of the sunspot.

Observations show that the magnitude of the sunspot-induced traveltime perturbation diminishes as waves propagate away from the sunspot, which is known as a finite-wavelength phenomenon. Observations also show a reduction of the wave amplitudes after their passage through the sunspot. In addition to the physical absorption of waves, defocusing of wave energy due to the fast wave-speed perturbation caused by the sunspot may contribute to the amplitude reduction. Besides, we observe an enhancement of wave amplitude away from the central path. One explanation is that waves passing through the sunspot are refracted from the central path and converge on both sides.

**O17**
**Title: Searching for T dwarfs in the Rho Oph. star-forming region**
**Authors:**

 1. *Po-Shih Chiang (National Central University)*
**Abstract:**

We present our 54 T-dwarf candidates in the  $\rho$  Oph cloud \object{L1688}. These candidates are selected by methane absorption features, which define a T dwarf, in  $1.7\mu\text{m}$  and in  $3.3\mu\text{m}$ . We use our CFHT deep methane images and archival H band images to obtain  $\text{H-CH}_4$  index which represents methane absorption in  $1.7\mu\text{m}$ . For the  $3.3\mu\text{m}$  feature, the *Spitzer's*  $c_2d$  catalog is used to obtain  $[3.6]-[4.5]$  index. To determine selection criteria of candidates in  $\text{H-CH}_4$ , we selected 31 confirmed brown dwarfs and observed them also in H and  $\text{CH}_4$  with WIRCAM/CFHT. For criteria in  $[3.6]-[4.5]$ , we applied Patten's results \cite{Patten06}. The distribution of our candidates in the H and  $[3.6]-[4.5]$  color-magnitude diagram also suggest their substellar nature.

**O18**
**Title: Discovery of Variable Stars in the Field of the Galactic Open Cluster NGC 7039**
**Authors:**

1. *Juei-Hwa Hu\* (National Central University)*
2. *Hui-Chen Chen (National Central University)*
3. *Ying-Tung Chen (National Central University)*
4. *Ding-Cheng Chang (National Central University)*
5. *Hsing-Wen Lin (National Central University)*
6. *Chow-Choong Ngeow (National Central University)*
7. *W.P. Chen (National Central University)*
8. *Wing-Huen Ip (National Central University)*

**Abstract:**

We report variable stars identified in the field of the Galactic open cluster, NGC 7039. In the fall/winter of 2009, imaging photometry has been acquired, mainly in the R band, for 8 open clusters using the 81-cm Tenagra telescope in Arizona. We present the results for our first target, NGC 7039. We have found 42 new variable stars and 6 suspected variables stars. Among the variable stars, there are 14 eclipsing binaries including 1 RS Canum Venaticorum type system, 1 RR Lyrae, 2 Cepheid, 1 Beta-Cephei, 3 Delta-Scuti, 8 pulsating-like stars, 5 variable stars with periods longer than the observation window, 41 days, and 8 irregular variable stars. Two contact binary systems could be members of NGC 7039 because of their loci in the color-magnitude diagram and their distance moduli close to that of the open cluster. One of the contact binary systems shows infrared excess in the (J-H) and (H-K) diagram. It could have circumstellar dust. None of the pulsating stars belong to the open cluster.

## O19

### **Title: The next-generation space infrared astronomy mission SPICA**

**Authors:**

*Takao Nakagawa\* (Japan Aerospace Exploration Agency, Japan)*

**Abstract:**

SPICA (Space Infrared Telescope for Cosmology and Astrophysics) is an astronomical mission optimized for mid- and far-infrared astronomy with a cryogenically cooled 3-m class (3.2 m in the current design) telescope. Its high spatial resolution and unprecedented sensitivity in the mid- and far-infrared will enable us to address a number of key problems in present-day astronomy, ranging from the star-formation history of the universe to the formation of planets. To reduce the mass of the whole mission, SPICA will be launched at ambient temperature and cooled down on orbit by mechanical coolers on board with an efficient radiative cooling system, a combination of which allows us to have a 3-m class cooled (6 K) telescope in space with moderate total weight (3.7t). SPICA is proposed as a Japanese-led mission together with extensive international collaboration. The most important international partner is ESA. The assessment study on the European contribution to the SPICA project has started under the framework of the ESA Cosmic Vision 2015-2025. US and Korean participations are also being discussed extensively. The target launch year of SPICA is FY2018.

## O20

### **Title: The UFFO (Ultra Fast Flash Observatory) Pathfinder: Science and Mission**

**Authors:**

1. *Ming-Huey A. Huang\* (National United University, and National Taiwan University)*
2. *UFFO collaboration*

**Abstract:**

Hundreds of gamma-ray burst (GRB) optical light curves have been measured since the discovery of optical afterglows. Only a handful of measurements have been made soon (within a minute) after the gamma ray signal. This lack of early observations fails to address burst physics at short time scales associated with burst events and progenitors. The characteristics of the rise phase of optical light curve of GRB remain practically unknown. UFFO collaboration has developed methods for reaching sub-minute timescales. UFFO consists of two parts. UBAT is an X ray detector using coded mask for pointing and LYSO crystals for X ray detection. SMT consists of a diameter 110 mm Ritchey-Chretien telescope and a diameter 140 mm plane mirror for redirection of optical path. The UFFO Pathfinder will be placed on the Lomonosov satellite, which is scheduled to be launched in November 2011. We will describe the science and the mission of the current UFFO Pathfinder project, and our plan of a full-scale UFFO-100 as the next step.

## O21

### Title: Observing with the Fermi Gamma-ray Space Telescope

#### Authors:

1. Albert Kong\* (National Tsing Hua University), on behalf of the FAN Collaboration

#### Abstract:

With the launch of the Fermi Gamma-ray Space Telescope (Fermi) in mid-2008, we have entered a new era of high-energy astrophysics. At National Tsing Hua University, we are leading an effort of the Fermi Asian Network (FAN) to study exotic astrophysical objects using the Large Area Telescope (20MeV-300GeV) of Fermi. Together with collaborators from Taiwan, Hong Kong and Korea, we have already published 8 papers in the past year. We are also the first non-Fermi team to publish papers using Fermi data. In this talk, I will review some of our important discoveries including gamma-ray emission of globular clusters, the discovery of gamma-rays associated with a newly born millisecond pulsar, the first study using Fermi of a gamma-ray binary, and studies of unidentified Fermi objects. I will also describe some of the future activities.

## O22

### Title: Fundamental planes of gamma-ray emission from globular clusters

#### Authors:

1. P.H. Thomas Tam (National Tsing Hua University)
2. C. Y. Hui (Chungnam University, Korea)
3. Albert Kong (National Tsing Hua University), et al.

#### Abstract:

We report on the discovery of gamma-ray emission from several globular clusters (GCs), including Terzan 5, the second known gamma-ray GCs. By now, more than a dozen GCs are established gamma-ray sources, thus enabling us to carry out the first detailed correlation study with several cluster properties. We found strong correlations between the gamma-ray luminosities and four cluster parameters: stellar encounter rate, metallicity [Fe/H], and energy densities of the soft photons at the cluster locations. These "fundamental planes" of gamma-ray GCs put an intimate relation of the observed gamma-rays to the underlying millisecond pulsar population and have important implications on the origin of the gamma-ray emission of GCs.

## O23

### Title: Chandra and HST studies of the X-ray Sources in Galactic Globular Clusters

#### Authors:

1. Ting-Ni Lu\* (National Tsing Hua University)
2. Albert K. H. Kong (National Tsing Hua University, and Golden Jade Fellow of Kenda Foundation)
3. Frank Verbunt (Astronomical Institute, Utrecht University, the Netherlands, and SRON Netherlands Institute for Space Research, the Netherlands)
4. Walter H. G. Lewin (Kavli Institute for Astrophysics and Space Research, Massachusetts Institute of Technology, USA)
5. Scott F. Anderson (Department of Astronomy, University of Washington, USA)
6. David Pooley (Eureka Scientific, Inc., Austin, TX 78756, USA)

#### Abstract:

The binary content in globular clusters is crucial for the dynamical evolution of globular clusters. Studying the X-ray sources population would be an efficient method to explore the binary content since most of the X-ray sources in globular clusters are close binaries. The X-ray source population contains various exotic binaries: low-mass X-ray binaries, cataclysmic variables, millisecond pulsars, or chromospherically active binaries. By using Chandra and HST data, we would be able to observe and identify the X-ray sources in globular clusters. In order to study the possible formation origins of the X-ray sources in globular clusters, we aim to construct the correlation for the X-ray source number at different luminosity ranges with different globular cluster physical parameters (core radius, core density, and metallicity) from ~20 globular clusters. With the correlation, we would be able to construct the X-ray fundamental plane in globular clusters, and to constrain the X-ray source formation mechanisms -- if they are formed through dynamical interactions or from primordial binaries.

## O24

### Title: Feasibility of Determining X-ray Emitting Region Size in Scorpius X-1 with TNO Occultations

#### Authors:

1. Kuan-Ting Chen\* (National Tsing Hua University)
2. Hsiang-Kuang Chang (National Tsing Hua University)
3. Chih-Yuan Liu (National Tsing Hua University, and LESIA, Observatoire de Paris, 92195 Meudon Cedex, France)

#### Abstract:

Occultation technique provides a good method to probe the emitting regions of the background source. The dimension of the X-ray emitting area in Sco X-1 has been proposed in the literature to range from tens kilometers to tens of thousands kilometers, corresponding to regions from the neutron star vicinity to the extended corona in the inner part of the accretion disk. We computed diffraction patterns in TNO occultation light curves for different parameter sets. We looked for the required minimum photon count rate with which the X-ray emitting region can be distinguished from a point source. We found that, assuming an emitting region of 100,000 km, RXTE/PCA can achieve that for a central-crossing occultation event if its sensitivity is 10 times more. For other impact parameters, a sensitivity of 1000 times more is needed.

**O25**
**Title: Why do gamma-ray pulsars show hard spectra in the second peaks of their light curves?**
**Author:**

1. Kouichi Hirotani (*Academia Sinica Institute of Astronomy and Astrophysics, and Theoretical Institute for Advanced Research in Astrophysics*)

**Abstract:**

The Fermi Large Area Telescope (LAT) provides a wealth of new data on isolated, rotation-powered pulsars, increasing the number of detected gamma-ray pulsars from seven to more than sixty. The light curves and spectral evidence obtained by these observations suggest that the gamma-ray pulsars have high-altitude emission zones whose fan-like beams scan over a large fraction of the celestial sphere. In this talk, we quantitatively examine the electrodynamics of the high-altitude emission zones in a three-dimensional pulsar magnetosphere, and first demonstrate that the second light-curve peak exhibits a harder spectrum than the first peak, which is consistent with the observations of many LAT pulsars.

**O26**
**Title: The significance of molecular superbubbles and outflows on starburst galaxies**
**Authors:**

1. An-Li Tsai\* (*National Taiwan Normal University, and Academia Sinica Institute of Astronomy and Astrophysics*)
2. Matsushita, S. (*Academia Sinica Institute of Astronomy and Astrophysics*)
3. Nakanishi, K. (*Nobeyama Radio Observatory, Japan*)
4. Kohno, K. (*Institute of Astronomy, University of Tokyo, Japan*)

**Abstract:**

Starburst galaxies contain large amount of massive OB stars/SNe and create galactic-scale superbubbles and/or outflows. Outflows or superbubbles can be observed in hot/warm/cold phases in different wavebands. However, cold molecular superbubbles and outflows were rarely detected in the past due to their diffuse/extended feature and poor instrumental sensitivities on millimeter interferometry. Therefore, it is still not clear how significant of molecular superbubbles and outflows affect starburst activities.

Here we first provide the detail study of molecular superbubbles and outflows of two non-AGN edge-on starburst galaxies, NGC~2146 and NGC~3628. Our data are obtained from the Nobeyama Millimeter Array (NMA) CO(1-0) observation with high spatial resolution ( $< \sim 3''$ ), high velocity resolution ( $\sim 5 \text{ km s}^{-1}$ ), and low rms noise ( $\sim 10 \text{ mJy beam}^{-1} \text{ channel}^{-1}$ ). Hundreds-to-kpc-scale molecular superbubbles and outflows are detected. The kinetic energy is  $> \sim 10^{54-55} \text{ erg s}^{-1}$ , which corresponds to tens of thousands of supernova explosions. We compared our NMA CO(1-0) data with the Chandra X-ray Observatory (CXO) archival data, and our NMA 3-mm free-free continuum observation. The morphology, kinematics, and pressure properties indicate (I) The kpc-scale molecular outflows are still expanding. (II) The mass loss of molecular outflows is more significant than that of ionized outflows. (III) The molecular gas mass consumption through molecular outflows is faster than star formation.

## O27

### Title: The star formation activity in the Shapley Supercluster

#### Authors:

1. Pei-Li Ho\* (National Taiwan Normal University, and Central Weather Bureau)
2. Lin-Wen Chen (National Taiwan Normal University)

#### Abstract:

The Shapley supercluster (SSC) is the densest region in the local universe ( $z < 0.1$ ), a total of 102 clusters and groups are identified in this region ( $\sim 60 \times 70 \times 130 \text{ Mpc}^3$ ), of which 23 groups are identified in this study by detections of galaxy overdensities using archival data from Two Micro All Sky Survey (2MASS) and NASA Extragalactic Database (NED). In this region, 201 star forming galaxies with K-band apparent magnitude brighter than 13.5 are identified, of which 34 are early type. The K-band luminosity and star formation rate of early type ones are similar to those of late type, but the mean local galaxy density of early type ones is less dense. To understand the relation of star formation and local galaxy density, we divide the SSC into different galaxy density regions, our result shows that the fraction of galaxies with  $K < 13.5$  to be star forming galaxies is highly suppressed in denser regions, but the star formation rate does not show obvious dependence on local galaxy density, this result is probably due to that the star forming galaxies located mostly in lower density regions are less affected by cluster-specific effects such as strangulation and ram-pressure stripping.

## O28

### Title: Merger rate evolution from UKIDSS-UDS

#### Authors:

1. Pin-Wei Wang (National Taiwan Normal University)
2. Sebastien Foucaud (National Taiwan Normal University)

#### Abstract:

It is now clear that the epoch between  $1 < z < 2$  of the lifetime of the Universe is a crucial period during which galaxies assembled their mass and evolved into the galaxies we observe in the local Universe. However, only very few studies of mass assembly hence galaxy merging were conducted over  $z > 1$  and usually were relied on very small samples so far. Based on very deep near infrared survey data, the UKIDSS-Survey covers the largest volume of the universe at  $1 < z < 2$  ever taken. I exploited these data to explore the merging rate up to  $z = 2$  and discuss mass segregation, color bimodality and their implications on our understanding of galaxy evolution.

**O29**

**Title: The Taiwan Extragalactic Astronomical Data Center**

**Authors:**

1. *Sebastien Foucaud\** (National Taiwan Normal University)
2. *Yasuhiro Hashimoto* (National Taiwan Normal University)

**Abstract:**

The next generation of telescopes and instruments are producing data at a pace that beats all projections, and astronomers today are left in the face of an avalanche of data like never before. In order to cope with this problem, Data Centers were created in various locations and the concept of Virtual Observatories elaborated. The Taiwan Extragalactic Astronomical Data Center plan to join in global efforts by proposing 1Pb of data storage dedicated to extragalactic astronomy by 2015. In continuation with individual efforts in Taiwan over the past few years, this is the first stepping-stone towards the building of a National Virtual Observatory.

Our ultimate goal is to propose "on-the-fly" photometry measurements from public or private surveys: a unique way for cross-matching information. We will also offer access to raw and reducible data available from archives worldwide, allowing a friendly access to this goldmine of under-exploited information. Finally, we will develop our own specific analysis tools.

The current Data Storage Unit is capable of accumulating up to 36Tb of data. In this initial phase, we will propose access to a multiband catalogue cross-matching tool along with the latest public extragalactic datasets.

# 壁報論文摘要

## Abstracts of Poster Presentation

### P01

#### Title: Variable Stars & Period Search Methods

##### Authors:

1. D.C. Chang (National Central University)
2. C.C. Negow (National Central University)
3. W.P. Chen (National Central University)

##### Abstract:

In the analysis of variable stars, one of the most important information is its periods. There are various period-searching algorithm and codes, such as Lomb-Scargle algorithm, Phase Dispersion Minimization, Period04, SigSpec, and etc. When applying these methods, we have incorporated the calculation of Nyquist frequency, a key parameter that need to be determined from data. We have compared these different period search methods by testing the various type of pulsating stars found in OGLE-III database, and found that SigSpec gave the highest success rate when comparing the searched periods to the published periods. The next step in this project is to combine measurements taken at different wavelength, in contrast to the current method that apply in single band only, to improve the accuracy of the searched periods.

### P02

#### Title: Searching for Supernova Events in Circumnuclear Starburst Region around AGN

##### Authors:

1. I-Chenn Chen (National Central University)
2. Chorng-Yuan Hwang (National Central University)

##### Abstract:

Circumnuclear starburst region could strongly influence the structure and the dynamics of gas through the energy input of multiple supernova explosions (Watabe, 2008). To search for supernova events, hidden under the light of AGN, we plan to check the optical variation for Seyfert 2 galaxies, which have no optical variation themselves. We cross-correlate the "Quasars and Active Galactic Nuclei Catalog: 13th edition, Veron 2010" with the transient catalog to make the probe. We'll show our first-glanced result in this poster.

**P03**

**Title: Observations of Jovian Trojans from the Pan-STARRS Project**

**Authors:**

1. Shao-Hsuan Chen\* (National Central University)
2. Ying-Tung Chen (National Central University)
3. Chien-Cheng Lin (National Central University)
4. Wen-Ping Chen (National Central University)
5. Wing-Huen Ip (National Central University)

**Abstract:**

All-sky survey observations have been regularly carried out by the Pan-STARRS project which Taiwan is a member of the science consortium. One focus of the research team at NCU is to search for uncharted small bodies in the solar system, like near-Earth objects, main-belt asteroids and transneptunian objects. We have started a sub-project in identifying known Jovian Trojans in the Lagrangian L4 and L5 points with a view to produce a comprehensive data set on their size, color and shape and rotational periods. We have found 2922 out of 4832 known Jovian Trojans. We also examined the statistics of the limiting magnitudes in different bands (g, r, i, z,y). This information will allow us to gain more insight to the origin and dynamical evolution of these primitive bodies.

**P04**

**Title: Evaluating performance of the CCD camera with a hand-made integrating sphere**

**Authors:**

1. Tse-Chuan Chen\* (National Central University)
2. Kinoshita Daisuke (National Central University)
3. Chih-Hao Chang (Yuan Ze University)
4. Ching-Huang Wu (National Central University)
5. Pei-Hsien Shen (National Central University)
6. Ru-Huei Huang (National Central University)
7. Hui-Hsin Yang (National Central University)

**Abstract:**

We used an inexpensive method to make a simple optical integrating sphere - the body of the integrating sphere was made of styrofoam ball, there no any coating in the inner. Around the input port of the integrating sphere, we embedded in six low-power LEDs as the light source. In order to avoid the saturation of the CCD, we placed a ND filter between CCD camera and integrating sphere to diminish the intensity of the LED light source. Finally, we carried out the following experiments: determination of the shortest possible exposure time, linearity measurements, gain and readout noise estimates and measurement of the full well capacity of the CCD chip e2v CCD 44-82-1-D23. These experiments were done on the optical table in the dark room. We report the experiment settings, data acquisition procedures, and preliminary result of the analysis.

In the future, we plan to upgrade our integrating sphere. The simply styrofoam ball without coating will be replaced with BaSO<sub>4</sub> which is the standard material as the reflective layer for high quality integrating sphere. We also plan to add a smaller sphere and place LEDs to achieve better uniformity of the brightness. Otherwise, SORIC screen is also a good choice for an unifom plat that we are going to try this method. And compare the respective measurement result with those from the previous method.

## P05

### Title: The binary program with speckle interferometry of NTNU

#### Authors:

1. Hsien-Lung Cheng \* (National Taiwan Normal University)
2. Hsieh-Hai Fu (National Taiwan Normal University)

#### Abstract:

The speckle interferometry is an useful method for binary observation to reach the diffraction limit of the small or moderate sized telescopes. The total 43 binary system had been observed from the binary program of NTNU since 2006. The binaries stars with V magnitude brighter than 6.5 and angular separation between 0.3 to 5.3 are observed using a Skynyx2-1 CCD equipped on C14 or RC16, and the scale, 0.045"/pixel for C14 and 0.027"/pixel for RC 16.

## P06

### Title: Photometric Study and Time-Series Analysis of the Open Cluster NGC 1513

#### Authors:

1. Ping-Han Cheng\* (National Central University)
2. Juei-Hwa Hu (National Central University)
3. Hsing-Wen Lin (National Central University)
4. Wen-Ping Chen (National Central University)
5. Wing-Huen Ip (National Central University)

#### Abstract:

The young open cluster NGC 1513 has a metallicity of  $[M/H]=-0.10\pm 0.1$  dex and an age of  $\log(t/\text{yr})=8.40\pm 0.04$  (Bilir et al., *Astrophys. Space Sci.* 326, 139, 2010). Time-series photometric observations were carried over twenty-five nights in 2009 using the 81-cm Tenagra telescope in Arizona within the framework of a multi-year survey program of variable stars in open clusters. The analysis of NGC 1513 is a pilot study of this effort. In this poster presentation, the most up-to-date results on the number and types of variable stars identified will be reported.

**P07**

**Title: Dynamical Evolution of the Hilda and Quasi-Hilda Asteroids**

**Authors:**

1. Yu-Chi Cheng (National Central University)
2. Shao-Hsuan Cheng (National Central University)
3. W.-H. Ip (National Central University)

**Abstract:**

The Hilda asteroids orbiting outside the main asteroid belt are trapped in stable 3:2 mean motion resonance with Jupiter. They execute regular librations in their motion relative to Jupiter. A large number of objects, called quasi-Hildas, have been found in similar orbital region with semi-major axes of about 4 AU but with less well-defined orbital configurations. The quasi-Hildas are of interest because they might be representative of icy planetesimals injected from the Kuiper belt into the inner solar system. Some of them might evolve into short-period comets or near-Earth objects crossing the orbits of Mars and Earth. On the other hand, some of them could actually be defunct cometary nuclei before being lost. We have performed long-term direct integration of the orbital evolution of many such quasi-Hildas to chart the general nature of their dynamical paths. The statistics will be reported here.

**P08**

**Title: Overview of the Nuclear Compton Telescope (NCT)**

**Authors:**

1. Jeng-Lun Chiu\* (National Tsing Hua University)
2. Hsiang-Kuang Chang (National Tsing Hua University)
3. Steven E. Boggs (Space Sciences Laboratory, UC, Berkeley, USA), et al.

**Abstract:**

The Nuclear Compton Telescope (NCT) is a balloon-borne soft gamma-ray (0.2-10 MeV) telescope designed to study astrophysical sources of nuclear line emission and gamma-ray polarization. The heart of NCT is a compact array of cross-strip germanium detectors (GeDs), providing high spectral resolution (~0.3-0.9% FWHM at 662 keV for most channels) and capability of tracking each photon interaction with full 3D position resolution to 2 mm<sup>3</sup>. NCT has flown successfully on two conventional balloon flights to date, and the Crab Nebula was detected at a significance of 4 $\sigma$  in the second flight. Here we present an overview with current status of the joint effort among several institutions in Taiwan and in the US for this next-generation of Compton telescope.

## P09

### Title : Optical Identification of un-ID Fermi GeV sources

#### Author :

1. Chia-Jung Chuang\* (National Central University)
2. Yuji Urata (National Central University)
3. Kuiyun Huang (Academia Sinica Institute of Astronomy and Astrophysics) , et al.

#### Abstract :

Fermi satellite launched in 2008 and detected 1451 sources in gamma ray (100 MeV to 100 GeV). About half of them (630 sources) have no counterpart in other wavelength. In order to understand origin of unidentified (un-ID) sources, optical identification is essential. Because it is expected that large fraction of these sources at high Galactic latitude are Blazars/AGN. Based on the Fermi first year catalog we selected 16 objects which have flux high than  $1.5 \times 10^{-11}$  erg/cm<sup>2</sup>/s for optical identification using Lulin/LOT and SDSS(DR8). Then we look for objects in the Fermi position regions (typically 5 arcmin in radius) that have short time variability and blue color (or power law spectrum). In this presentation, we report the preliminary results.

## P10

### Title : The Return of Comet Hartley 2

#### Authors:

1. Yo-Ling Chuang\* (National Taiwan Normal University)
2. Yi-Jehng Kuan (National Taiwan Normal University, and Academia Sinica Institute of Astronomy and Astrophysics)
3. Steven B. Charnley (NASA Goddard Space Flight Center, USA)

#### Abstract:

Comets, relics of Solar System formation and possible association with protoplanetary disks, may provide vital information connecting interstellar clouds and solar-type YSOs. Study of the chemical and physical properties of comets thus enable us to better understand Solar System formation. Additionally, by observing important organic molecules, cometary study may also provide clues fundamental to our knowledge on the formation of prebiotically important molecules on the early Earth. As an Earth-based team member in support of NASA EPOXI comet-flyby mission, we therefore conducted methanol observations of Comet Hartley 2 during the perihelion in 2010 Oct and Nov. Our observations reveal temporal variations of CH<sub>3</sub>OH outgassing over days; much faster temporal variation in hours is also disclosed. The rotational temperature of CH<sub>3</sub>OH was the highest, rising from  $\sim 30$  to  $\sim 50$  K, when Hartley 2 was closest to Sun. Moreover, the methanol production rate was also the highest, reaching  $\sim 4 \times 10^{26}$  molecules/sec, at perihelion on Oct 24. Our study thus not only uncovers the rapid variation nature of the extent of CH<sub>3</sub>OH outgassing from cometary nucleus, but is also important in providing crucial information on the physical environment of Hartley 2 prior to the EPOXI flyby and at the encounter.

**P11**

**Title : The CCD BV Photometry of Variable stars in the Globular Cluster M5**

**Authors:**

1. *Hsieh-Hai Fu\* (National Taiwan Normal University)*
2. *Yu-lun Wu (National Taiwan Normal University)*
3. *Hsiang-Yu Hsieh (National Taiwan Normal University), et al.*

**Abstract:**

The globular cluster M5 is one of the closest globular clusters with rich variable stars. The B and V images of M5 are taken with the telescope c14 or RC16 located on campus of NTNU, Taipei, and the observation of total 21 nights were carried out during the period May 2007 through June 2009. The light curves of BV photometry for selected variable star are plotted.

**P12**

**Title: Numerical Experiments for the Binary-Single TNO Scattering Process**

**Authors:**

1. *Zong-Fu Sie\* (National Central University)*
2. *Wing-Huen Ip (National Central University)*
3. *Hsinwen Lin (National Central University)*
4. *Ying-Tong Chen (National Central University)*

**Abstract:**

Observations by using ground-based telescopes and Hubble Space Telescope have shown the presence of a significant number of transneptunian binary objects (TNBs). These important results suggest that formation of binary systems was a key process in the early solar system. A variety of theoretical models has been proposed to explain the formation and evolution of the TNBs in different regions of the transneptunian belt. Because all dynamical effects must involve either collisional impact or close encounters of the binary systems with other objects, either single or binary, we have initiated a computational project to investigate the gravitational interactions/encounters of different kinds. Some preliminary results will be presented in this work.

### P13

#### Title: Numerical Simulation of the Phase-transition-induced collapse of Neutron Stars Using 2DGR Code

##### Authors:

1. K. S. Cheng (Department of Physics, University of Hong Kong, China)
2. L. M. Lin (Department of Physics, The Chinese University of Hong Kong, China)
3. David H. F. Yu\* (Department of Physics, University of Hong Kong, China)

##### Abstract:

The core of neutron stars can be as dense as  $\sim 10^{15}$  g/cc. It has been proposed that strange quark matter (SQM), consisting of free u, d and s quarks, may be formed. The exact phase transition density is model dependent, ranging from 4 to 8  $\rho_{\text{nuc}}$  (Cheng & Dai 1998), where  $\rho_{\text{nuc}} = 2.8 \times 10^{14}$  g/cc. It is expected that SQM may be more stable than nuclear matter, and the SQM region may grow and the neutron star may become a strange quark star. In my study, a 2D general relativistic code is used to solve the Einstein equations coupling to hydrodynamic equations of perfect fluid. Parallel computing is employed in order to produce results in reasonable time. High resolution shock capturing (HRSC) schemes is used to solve the non-linear hyperbolic systems of conservation laws. The ADM formulation is used to solve for the configuration and evolution of the neutron star model. The code is used to study both the neutron star critical mass-power law index relationship, and the generated gravitational waveform due to the coupling of rotation and oscillation. The results show a linear plus higher order contribution behavior. We find that the critical mass only depends on numerical resolution weakly.

### P14

#### Title: Pan-STARRS Data Server and Tenagra Follow-up Observation

##### Authors:

1. Jhen-Kuei Guo\* (National Central University)
2. Wen-Ping Chen (National Central University)

##### Abstract:

The Pan-STARRS project is operated by an international consortium. Located in Haleakala, Hawaii, the Pan-STARRS telescope system patrols the entire visible sky several times a month. We have set up a data depository at NCU to serve the users in Taiwan. The massive amounts of Pan-STARRS data are downloaded via Internet from the Institute for Astronomy, University of Hawaii whenever new observations are obtained and processed. So far we have total 128TB disk array space and 109.7TB worth of data have been stored, mostly in the form of star and galaxy catalogs. We also use SAN switch to integrate these data storages and provide a high data transfer performance.

Tenagra II 32" (0.81 m) telescope, an automated one, is located in the Sonoran desert, Arizona, the United States. We submit observations via Internet to Tenagra FTP; then the telescope will observe our targets according to our requests. The observational data is taken unattended and we can download and analyze them immediately in Taiwan. We've used Tenagra to do Pan-STARRS follow-up observations. For Pan-STARRS NEOs candidates, we have obtained some results by identifying them.

We present here the latest status of our data server and how we proceed a Tenagra follow-up observation.

## P15

### Title: A correlation study of high-redshift galaxies

#### Authors:

1. Kuan-chou Hou\* (National Taiwan Normal University)
2. Lin-wen Chen (National Taiwan Normal University)

#### Abstract:

To study the environment of high-redshift star-forming galaxies --- submillimeter galaxies (SMGs) and Lyman alpha emitters (LAEs), and their role during large-scale structure formation, we have analyzed the cross correlation functions between optical selected galaxies with photometric redshift and these two high-redshift populations in COSMOS and ECDFS fields. Our results suggest a marginal cross-correlation between SMGs and optical selected galaxies at certain redshifts at angular size smaller than 1 arcmin (equivalent to 0.5 Mpc at these redshifts). An exception is that the AzTEC-selected SMGs in ECDFS have a relatively strong correlation with optical galaxies at  $z \sim 3.6$  on scales below 4 arcmin, whereas LAEs at the same redshift range do not show any signal. For a more detailed analysis, we select passive and starforming galaxies at similar redshift by optical and near infrared colors to investigate their degree of association with SMGs and LAEs; in addition, we also divide our galaxy sample into subsets by their luminosity for a similar analysis. Finally the implication from our results to the interconnection between high-redshift galaxy populations is discussed.

## P16

### Title: Mapping and Photometry of the planetary nebula M 1-11 in the visual and infrared

#### Authors:

1. Chih-Hao, Hsia\* (Department of Physics, The University of Hong Kong, China)
2. Hao-Yuan, Duan (National Taiwan Normal University)
3. Hsieh-Hai, Fu (National Taiwan Normal University)

#### Abstract:

Morphological shaping of planetary nebulae is believed to occur during the evolutionary transition from the ending of AGB to the PN phase. Many PNe reveal distinct bipolar structures after the stage of proto-PNe. The existence of binary systems has been proposed to be one possible cause of the observed bipolarity. To clarify this important issue, we performed a spectroscopic survey of the PN nuclei (PNNi) using the NAOC 2.16m telescope in 2008 and found that most PNe in our sample reveal absorption features of late-type stars. The distributions of single white dwarfs (WD) and WD + late type companions in the PNNi occupy distinct regions in the optical color-color diagram. Then 257 new binary candidates are identified using the selection criteria of  $V-R > 0$  and  $B-I > -0.5$  (Hsia, 2008). Planetary Nebula M 1-11 is one suspected target selected from our binary candidates. Here we present our first photometric result for this object showing periodic variation with amplitude of 0.1 mag which indicates it might be a binary system. In addition, one eclipsing binary and a variable star are also found in the same field of view. The related optical and infrared investigations of these sources are discussed.

**P17**

**Title: Outflow Observations Toward Extremely Young YSOs**

**Authors:**

1. Tien-Hao Hsieh (*National Tsing Hua University*)
2. Shih-Ping Lai (*National Tsing Hua University*)

**Abstract:**

We have used the Wide-field Infrared Camera (WIRCam) on the Canada France Hawaii Telescope (CFHT) to observe 20 faintest “low luminosity objects” identified by Dunham et al. (2008), 13 with intrinsic luminosity  $L_{int} < 0.1 L_{\odot}$  and 7 with  $0.1 L_{\odot} < L_{int} < 0.2 L_{\odot}$ , which are believed to be Young Stellar Objects (YSOs) in extremely early stage. We obtained Ks band images which trace the scattered light from the dusty cone swept by the outflows, thus our observations explore the existence of outflow in extremely early stage of star formation. Outflow signatures are clearly detected toward 6 objects (DCE024, 038, 064, 078, 090, 182) and undetected toward 7 objects (DCE001, 004, 031, 065, 081, 092, 185). The remaining 7 sources show extended or elliptical structures possibly associated with outflow features.

**P18**

**Title: Charge Exchange and Collisional Interaction of the Saturnian Corotating Plasma with Enceladus Gas Plumes**

**Authors:**

1. Jen-Kai Hsu\* (*National Central University*)
2. Wing-Huen Ip (*National Central University*)
3. Ying-Dong Jia (*Institute of geophysics and planetary physics, University of California, USA*)
4. Wei-Ling Tseng (*Department of Materials Science and Engineering, University of Virginia, USA*)

**Abstract:**

Interaction of the corotating thermal plasma with the extended gas plumes emitted from the south pole of Enceladus is a unique feature in the Saturnian magnetosphere. The corotating plasma flow is substantially slowed down in the vicinity of Enceladus because of the mass-loading effect of the newly created pickup ions. The strong collisional coupling between the incoming plasma flow and the neutral gas of mainly water molecules in composition leads to the production of water-group ions as in the case of the comet-solar wind interaction. Besides ion-molecule reactions, the interaction is also characterized by charge exchange and knock-on process which will produce a population of neutral atoms and molecules with speed varying from 10-20 km s<sup>-1</sup> to just a few km s<sup>-1</sup>. It is important to estimate how significant would such charge-exchanged neutrals contribute to the distributed neutral cloud of the Saturnian system. In this work we will make use of a MHD model of Enceladus interaction for the plasma flow in computing the production rate of such CXNs and their orbital distribution in the Saturnian magnetosphere.

**P19**

**Title: SiO observations of an MYSO candidate G2.54+0.20**

**Authors:**

1. Yu-Sen Hsu\* (National Taiwan Normal University)
2. Yi-Jehng Kuan (National Taiwan Normal University, and Academia Sinica Institute of Astronomy and Astrophysics)
3. Xi Chen (Shanghai Astronomical Observatory, Chinese Academy of Sciences, China)

**Abstract:**

We conducted SiO observations by using Submillimeter Telescope (SMT) toward G2.54+0.20, which is known as a extended green object (EGO) and a massive young stellar object (MYSO) candidate. Our preliminary results show that the SiO emission can be associated with the complex kinematics in G2.54+0.20.

**P20**

**Title: Photometric and Astrometric Characterization of Galactic Open Clusters by the Pan-STARRS 1 Dataset**

**Authors:**

1. Chung-Kai Huang\* (National Central University)
2. Ping-Fang Wang (National Central University)
3. Wen-Ping Chen (National Central University)

**Abstract:**

While Galactic formation and evolution models predict hundreds of thousand open clusters presently in the Milky Way, only a few thousands have been catalogued. Here we present a pilot study to use the Pan-STARRS 1 (PS1) data, to a magnitude of 23-24 mag in 5 optical bands, to search for uncharted Galactic open clusters. In addition to an enhanced stellar number density compared to the field, multi-epoch PS1 data provide proper motion measurements for membership determination in a star cluster. Imaging photometry is then used to estimate the age and distance. We first show the validation case of NGC 7380, a small cluster associated with an H II complex, OB stars, T Tauri stars, and molecular clouds, for which proper motions and radial velocity data exist for members. We then present a few open clusters found and characterized by our analysis pipeline.

## P21

### Title: Infrared H<sub>2</sub> Survey of the Star Forming Complex M17

#### Authors:

1. J. Y. Huang\* (National Central University)
2. M.R.Samal (2Aryabhata Research Institute of observational sciencES (ARIES), India)
3. J. K. Guo (National Central University)
4. W. P. Chen (National Central University)
5. The UWISH2 Team

#### Abstract:

It remains a mystery of how massive stars influence the star-forming process in molecular clouds, e.g., in a constructive (triggered star formation) versus a destructive (dispersion of gas and dust by intense stellar radiation and stellar wind) role. M17, also called the Omega nebula, about 7,000 light years from Earth, is an active star-forming region with prominent emission nebulosity, dark clouds, and a rich population of young stars. The UWISH2 (UKIRT Wide Field Infrared Survey for H<sub>2</sub>) project aims to survey in molecular hydrogen of the First Galactic Quadrant  $10 \text{ deg} < l < 65 \text{ deg}$ ;  $-1.3 \text{ deg} < b < +1.3 \text{ deg}$ . Here we present our preliminary analysis of the UWISH2 and UKIDSS K-band data to study the shock excited molecular hydrogen in this complex star-forming region, with emphasis on the interplay of massive stars, molecular clouds, and ongoing starbirth.

## P22

### Title: Photometric Study of Morphologically Identified Merging Galaxies

#### Authors:

1. Jen-Chao Huang\* (National Central University)
2. Chorng-Yuan Hwang (National Central University)

#### Abstract:

We investigate the photometry properties of merging galaxies identified morphologically in the Red Sequence Cluster Survey 2 (RCS2) of CFHT observations in 381 square degrees. We develop an adaptive aperture photometry technique and use it in our photometry work. The color-color diagrams produced by a set of empirical galaxy templates are used to study the color property and estimate the dry/wet percentage of these mergers. We discuss the properties of the mergers in different morphological labels and environments. We also discuss the possibility of those mergers that can't be classified by color-color diagrams.

**P23**

**Title: Physical Characteristics of the River Valleys of the Hellas Basin on Mars**

**Authors:**

1. *Li-Ching Huang (National Central University)*
2. *Wing-Huen Ip (National Central University)*
3. *Meng-Hua Zhu (Institute of Space Science, Macau University of Science and Technology, Macau, China)*
4. *Whyjay Zheng (National Taiwan University)*

**Abstract:**

The Hellas basin which has a diameter of more than 2000 km and a depth of 8 km contains many important clues to the evolutionary history of Mars. Its general structure is shaped by volcanic and sedimentary activity in different geological epochs. Two major river valleys, namely Dao and Harmakhis Valles, are of particular interest. In this work we combine the imaging and MOLA observations from Mars Express, the gamma-ray spectroscopic measurements from Mars Odysses, and the HiRISE data from Mars Reconnaissance to characterize the general morphologies and fine-scale structures of these river valley systems.

**P24**

**Title: Searching For The First "Radio-Quiet" Gamma-ray Emitting Millisecond Pulsar**

**Authors:**

1. *R. H. H. Huang\* (National Tsing Hua University)*
2. *A. K. H. Kong (National Tsing Hua University)*
3. *P. H. T. Tam (National Tsing Hua University)*

**Abstract:**

We report multi-wavelength observations of an unidentified Fermi object in the first-year Fermi catalog. The Fermi source has a candidate X-ray counterpart from Swift and Chandra data. We also identify a possible optical counterpart using the X-ray data. Its X-ray and gamma-ray properties are consistent with known gamma-ray millisecond pulsars. There is a possible X-ray modulation while optical/UV observations indicate that the system is likely in a low-mass X-ray binary system. No known radio source is associated with the proposed counterpart and we suggest that the source is the first "radio-quiet" gamma-ray emitting millisecond pulsar in a low-mass X-ray binary currently in quiescence.

**P25**

**Title: Outreach Education for Primary School Level Astronomy Using Digital Planetarium in Taipei Astronomical Museum**

**Authors:**

*Jim Ching-Chuan Hung (Taipei Astronomical Museum)*

**Abstract:**

A digital planetarium system with Uniview database and Zorro ultra-high contrast LCoS projectors had been inaugurated in Taipei Astronomical Museum since January 2011. The original old Zeiss VITD optical star-ball planetarium was kept in operation also in the dome of the museum. A self-produced planetarium program star show for primary school pupils in the form of outreach education will soon be resumed since this July. Effect comparison between traditional Zeiss VITD optical system and the new digital one will be discussed in the paper with an eye to reach the ultimate educational effectiveness. Implication of the potential of the digital system will also be reviewed using the data collected from the images captured from the planetarium dome projection and the on-site operation and programming procedure of the system. The museum staffs expect to heighten the dynamic freedom of the new digital star show programs to bring about the motivational orientation of the students from the primary schools in the outreach program.

**P26**

**Title: Optical and X-ray Observations of the Nova KT Eridani**

**Authors:**

1. *L. W. Hung (National Central University)*
2. *W. P. Chen (National Central University)*
3. *Frederick M. Walter (Department of Physics and Astronomy, Stony Brook University, USA)*

**Abstract:**

The nova KT Eri exploded in November 2009. The peak brightness reached 5.4 mag at 2009 November 14.63 UT. After then, the brightness has faded very fast and now is fairly stable near BVRI=15. On March 31, 2010, Swift undertook a 24-hour monitoring of this nova. Here we present ground-based CCD imaging photometric measurements taken with telescopes at Lulin (Taiwan), Tenagra (Arizona), and SMARTS/CTIO (Chile) covering the day before, during, and the day after the Swift campaign. The X-ray and optical light curves are compared. We also present long-term optical light curves taken from the AAVSO and own observations.

**P27**

**Title: Moving Needles in a Haystack --- Finding Asteroids in Pan-STARRS Images**

**Authors:**

1. Ruo-Lan Jin (*Taipei First Girls High School*)
2. Dah-Lih You (*Changhua Senior High School*)
3. Shih-Chao Lin (*National Dali Senior High School*)

**Abstract:**

Between March 28 and May 20, 2011, there is a Pan-STARRS Asteroid Search Campaign using images taken by the 1.8-m PS1 telescope located on Haleakala, Maui, in Hawaii, USA. The campaign is organized by the International Astronomical Search Collaboration (IASC) and in the current campaign draws 32 participating schools from Taiwan, Brazil, Bulgaria, Germany, Poland, Turkey and United States. Each school was paired with an oversea partner to work on the same set of 4-5 images every week.

In Taiwan, 3 high schools participated, 國立大里高中, 彰化高中, and 北一女中. The students are 曾泓祥 (Hong-Siang Zeng), 趙宥然 (You-Ran Jhao), 楊承域 (Cheng-Yu Yang), 陳冠綸 (Kuan-Lun Chen), & 蕭宇泰 (Yu-Tai Hsiao) from Chang-Hua, 陳聖丁 (Shung-ding Chen), 黃義雄 (Yi-hsiung Huang), 林學敏 (Hsueh-min Lin), 林峙宇 (Zhi-yu Lin), 李子駿 (Zi-chin Li), 陳琮涓 (Tsun-yu Chen), & 蔡仲霖 (Chung-lin Tsai) from Dali, and 沈亮欣 (Shen, Liang-Shin), 莊雅淳 (Chuang, Ya-Chung), 張瑄 (Chang, Hsuan), 林孝柔 (Lin, Hsiao-Jou), 黃鈺昕 (Huang, Yu-Sin), & 蔡佳蓉 (Tsai, Jia-Rong) from Taipei.

In the campaign, our students competed and collaborated with fellow teammates and with international teams, analyzed the images to make preliminary new identifications of asteroids, and combined local resources to secure the discoveries. Overall, our students excelled, and our efforts were acclaimed by the organizing committee. Students were thrilled about the experience. Here we report our results in the campaign.

**P28**

**Title: Spectroscopic Observations of Low Luminosity YSOs**

**Authors:**

1. Jennifer Karr\* (*Academia Sinica Institute of Astronomy and Astrophysics*)
2. Michihiro Takami (*Academia Sinica Institute of Astronomy and Astrophysics*)
3. Nagayoshi Ohashi (*Academia Sinica Institute of Astronomy and Astrophysics*)

**Abstract:**

(Very) Low Luminosity sources (VeLLOs) are a Spitzer identified class of low luminosity infrared sources with YSO like colours. The nature of these sources and explanation for their low luminosities are uncertain; they may be very young sources, very low mass, or in a quiescent phase of accretion. I will present NIR spectroscopic observations of a sample of such sources, in a project to investigate the nature of the central source.

## P29

### Title: Optical monitoring of lensed quasars

#### Authors:

1. Ekaterina Koptelova\* (National Taiwan University)
2. Wen-Ping Chen (National Central University)
3. Tzihong Chiueh (National Taiwan University), et al.

#### Abstract:

Variability in UV/optical/IR wavelengths is an intrinsic property of all quasars. In case of the lensed quasars when we observe two (or sometimes more) images of the same source (the quasar), all quasar images will repeat the variations of the quasar but not simultaneously. The quasar variability in the multiple images is seen at different moments of time due to the difference in lengths of the paths which travel light rays to form the images of the quasar. The difference in time (known as lensing time delay between variations in two images A and B of quasar,  $t_{AB}$ ) is related to the Hubble constant  $H_0$  as  $t_{AB} \sim 1/H_0$  (Refsdal 1964, MNRAS 128, 307). This relation gives a direct method of the Hubble constant determination which is independent of a distance ladder. In this work we present a program and results of optical monitoring of selected lensed quasars. We discuss the time delays measured from the optical light curves, the Hubble constant value estimated from the time delays and mass distribution in the lens galaxies.

## P30

### Title: Mock Galaxy Catalogs for Hyper Suprime-Cam Survey

#### Authors:

1. Ting-Wen Lan\* (Academia Sinica Institute of Astronomy and Astrophysics)
2. Yen-Ting Lin (Academia Sinica Institute of Astronomy and Astrophysics)

#### Abstract:

A method to construct mock galaxy catalogs based on the public release of Millennium database is described. We follow the procedure of Kitzbichler and White (2007) to build light cones without redundant structure. Each galaxy in the lightcones is assigned a best-fit spectral energy distribution (SED) by EAZY template fitting program. With a best-fit SED and redshift, the observational properties of each galaxy can be calculated under any survey condition. We produce a set of catalogs particularly for the future survey conducted by Hyper Suprime-Cam on Subaru Telescope by using this method. The catalogs contain the observational properties, such as apparent magnitudes and absolute rest frame magnitudes, as well as the properties of dark matter halos in which galaxies reside. Using these catalogs, we can not only test cluster finding algorithms, but also preview the outcome of future HSC survey. We plan to make the catalogs publicly available in the near future.

**P31**

**Title: Dust Around Be Studied by Submillimeter Observation**

**Authors:**

1. Chien-De Lee (National Central University)
2. Wen-Ping Chen (National Central University)

**Abstract:**

Classical Be stars are rotating at nearly critical velocity associated with infrared excess frequently attributed to free-free emission. However, a few which are far from star forming regions, with exceptionally large near-infrared excess emission, and with excess emission extending to mid- and far-infrared wavelengths must be accounted for by thermal emission from circumstellar dust. Here we present how millimeter and submillimeter observations will shed light on the condensation of dust around evolved Be stars.

**P32**

**Title: Formation of an Extended Halo of Hot Oxygen Atoms in the Wake Region of Venus**

**Authors:**

1. Ying Liao\* (National Central University)
2. Wing-Huen Ip (National Central University)

**Abstract:**

From the detailed measurements in Venus' ionosphere by the Pioneer Venus Orbiter, it was well known that there is a large day-to-night flow of ionospheric plasma with the horizontal speed reaching a value as high as 5 kilometer per second at 500-km altitude near the terminator. This large-scale anti-sunward convective motion could lead to a significant distortion of the hot oxygen corona maintained by oxygen atoms from  $\text{O}^+_{2}$  dissociation recombination into a tadpole-like structure. A Monte-Carlo model is developed to simulate the three-dimensional configuration of such a hot oxygen corona plus the corresponding escape rate of atmospheric mass via this channel.

**P33**

**Title: The mass function and origins of intermediate-mass black holes in the local universe**

**Authors:**

1. Chun-Cheng Lin\* (National Taiwan Normal University)
2. Lin-Wen Chen (National Taiwan Normal University)

**Abstract:**

We have merged ULXs (ultra-luminous X-ray sources,  $L_x > 10^{39}$  ergs/s) data obtained from XMM-Newton (Winter et al. 2006) and Chandra (Berghea et al. 2008) and identified 66 intermediate-mass black holes (IMBH,  $M > 20$  solar mass) from the compilation. We find that the ULX X-ray luminosity correlates relatively well with their intrinsic column density, suggesting a possible physical relationship between X-ray luminosity and local environment, and a clue to the hidden IMBH population located in a gas-poor environment. With our IMBH sample, we have constructed the luminosity function and mass function of the IMBH in the local universe, although the faint part is likely incomplete. Based on the X-ray data combined with follow-up observations in other wavelengths and the properties of the host galaxies, we have examined four scenarios for IMBH formation, and discuss the possible fate of IMBH as the supermassive black hole in the galactic center.

**P34**

**Title: Probing the starburst/AGN contribution of X-ray/70  $\mu$ m selected galaxies in the COSMOS field**

**Authors:**

1. Ming-Yi Lin\* (National Taiwan Normal University)
2. Lin-Wen Chen (National Taiwan Normal University)

**Abstract:**

To quantify the relative contributions from star formation (SF) and active galactic nuclei (AGN) to the total luminosity of galaxies can provide a crucial insight to the AGN-host galaxy co-evolution scenario. Previous studies have demonstrated that ultraluminous infrared galaxies (ULIRGs) have a strong connection with optical bright, infrared excess quasars in the local universe ( $z < 0.3$ ). In this work, we use Cosmic Evolution Survey (COSMOS) field which covers  $2 \text{ deg}^2$  with multi-wavelength observations, including 225 X-ray selected 70  $\mu$ m sources over a redshift range from the local universe to 4.25 in order to study the co-evolution scenario. We have subsequently estimated their total infrared luminosity based on Spitzer photometric data, and investigated their near infrared properties in comparison with local representative star formation (SF)-dominated (Arp220) and AGN-dominated (Mrk231) ULIRG respectively. Our results show that most X-ray selected 70  $\mu$ m galaxies have a mixture of AGN and star formation activity, which could help constraining the more complicated evolutionary phase where the dust produced by star formation process and the AGN activity might be connected. The characteristics of the AGN in these galaxies are also discussed based on their ratios of total infrared luminosity to 2-10 keV X-ray luminosity.

**P35**

**Title: Blue Merging Galaxies**

**Authors:**

1. Yi-Fan Lin \* (*National Central University*)
2. Chorng-Yuan Hwang (*National Central University*)

**Abstract:**

We investigate the physical properties of extremely blue merging systems in the Red-sequence Cluster Survey 2 observed with the CFHT (Canada France Hawaii Telescope). The merging systems were obtained from the morphologically-identified merging catalog of Hwang & Chang 2009 with morphological identification. Among the ~ 15,000 merging galaxy candidates identified by human eyes, 563 samples are extremely blue comparing with normal wet and dry mergers. The origin of the color is still unclear.

In this poster, we check the morphology and its properties at different wavebands to probe the origin of the colors of these blue merging systems.

**P36**

**Title: Identification of Extremely Red Galaxies**

**Authors:**

1. Wei Fang Liu\* (*National Central University*)
2. Chorng-Yuan Hwang (*National Central University*)

**Abstract:**

We study extremely red galaxies. First, we identify extremely red galaxies in the data of the Red Sequence Cluster Survey 2 (RCS2) of the Canada-France-Hawaii Telescope (CFHT) observations. We compare these EROs with different surveys and databases, including the Sloan Digital Sky Survey (SDSS) catalog, the UKIRT Infrared Deep Sky Survey (UKIDSS) catalog, the SWIRE catalog, and the VLA FIRST Survey catalog. We try to classify these EROs into different types of galaxies by multiband information. We also discuss the physical properties of some unidentified sources.

### P37

#### **Title: UV-Luminosity function at $z=1-3$ with the UKIDSS-UDS survey**

##### **Authors:**

1. Ching-Min Lo\* (*National Taiwan Normal University*)
2. Sebastien Foucaud (*National Taiwan Normal University*)

##### **Abstract:**

The star formation history is a key-element to understand galaxy evolution and formation. Recent studies have shown that the star-formation rate peaks at redshift  $z=1-3$  and then decline to its local value. The physical processes responsible for the sudden quenching of star-formation are still unknown. We also observe a unexpected phenomenon at high redshift, called "downsizing", where star-formation migrates from the most massive systems to the less massive ones. In order to better understand the origin of these effects, we propose in this study to use the UV-luminosity as an indicator of the Star-formation rate. We take advantage of our deep NIR/optical data from the UKIDSS-UDS/SXDS survey and our very deep CFHT U-band data to explore the evolution of the UV-Luminosity function of galaxies at  $z=1-3$ , according to their redshift and to their stellar masses.

### P38

#### **Title: An ultrasoft X-ray emission from galaxy GSN69: Candidate of X-ray outburst due to stellar capture**

##### **Authors:**

1. Kwan Lok Li\* (*Department of Physics, University of Hong Kong, China*)
2. Chun Shing Pun (*Department of Physics, University of Hong Kong, China*)

##### **Abstract:**

Tidal disruption of a star by the supermassive black hole (SMBH) in the center of the host galaxy may lead to giant X-ray outbursts. We have identified an ultrasoft (Blackbody  $kT = 45\text{eV}$ ) and bright ( $\log L = 42.4$  for  $0.3-2.0\text{ keV}$ ) source from the galaxy GSN69 through 21ksec of Swift observations between 2010 and 2011. The observed flux was at least a factor of 40 higher than the 1996 ROSAT archival data. The X-ray properties of GSN69 are similar to other tidal disruption candidates such as IC3599 and NGC5905. Unlike another plausible tidal disruption event Swift J1644+57 (GRB110328A) for which X-ray emission increased rapidly, GSN69 showed steady X-ray flux over the 9-month period of observations which suggested it was in a steady accretion phase. A series of Swift observations have been scheduled which would provide opportunity to study the long term evolution of such dramatic event. We acknowledge support of a RGC grant from the government of Hong Kong SAR.

**P39**

**Title: Statistical Tests for the Metallicity Dependency of the Theoretical Cepheid Period-Luminosity Relations in IRAC Bands**

**Authors:**

1. *Chow-Choong Ngeow\** (National Central University)
2. *Marcella Marconi* (Institut Nacional Andorrà de Finances, Andorra)
3. *Ilaria Musella* (Institut Nacional Andorrà de Finances, Andorra), et al.

**Abstract:**

The mid-infrared period-luminosity (P-L) relations for Cepheids will be important in the JWST era, as it holds the promise of deriving the Hubble constant within 2% accuracy. It is expected that the mid-infrared P-L to be insensitive to metallicity. In this work, we test this assumption of metallicity independent of the IRAC band P-L relation by applying well-known statistical methods to the theoretical P-L slopes from a series of pulsating models (with known metallicity). Three cases of the metallicity dependency of P-L slopes were considered in this work: (I) the P-L slopes are independent of metallicity; (II) the P-L slopes are linearly depending on metallicity; and (III) the P-L slopes are quadratically depending on metallicity. The statistical tests suggest that the P-L slopes in mid-infrared are linearly depending on metallicity.

**P40**

**Title: Searching for Variable Stars in the Selected TAOS Fields and Optical Follow-up Observations**

**Authors:**

1. *Sherry Kang-Shian Pan\** (National Central University)
2. *Chow-Choong Ngeow* (National Central University)
3. *Wen-Ping Chen* (National Central University)
4. *Ding-Cheng Chang* (National Central University)
5. *Zhi-Wei Zhang* (Academia Sinica Institute of Astronomy and Astrophysics)

**Abstract:**

The goal of our project is to obtain follow up time series observations for the unknown variable stars found in the TAOS project, and study these variables in details based on the data from TAOS and our project. The TAOS photometry allowed us to find roughly about 50 candidates (out of total of 2654 stars) in TAOS-060 field using the well developed variable stars finding algorithm. These 50 candidates were continuously observed in BVRI filters using the LOT and SLT telescopes available at the Lulin Observatory of Taiwan.

The BVRI photometry will permit some important parameters, for example extinction, colors and brightness, to be derived for these candidates. We used IRAF to reduce the imaging data, and applied SExtractor for cataloging and photometry measurement. Recently, using the Landolt Standard stars to calibration those data, we got the apparent magnitude. We present the preliminary results in this presentation.

## P41

### Title: Long-Period Comet C/2007 W1 and Jupiter-Family Comet 73P

#### Authors:

1. Wei-Hsiang Pan\* (National Taiwan Normal University)
2. Yi-Jehng Kuan (Academia Sinica Institute of Astronomy and Astrophysics)

#### Abstract:

Comets with typical brightness are usually not bright in radio wavelengths even at perihelion; thus good observational sensitivity is essential for successful radio observations of comets. When compared to interferometer arrays, higher detection rates are generally achieved via single-dish observations. In order to investigate cometary chemical composition in detail, we therefore employed two single-dish telescopes, the Submillimeter Telescope and the Kitt Peak 12m telescope of Arizona Radio Observatory, to observe two comets spectrally during their perihelion. Comet 73P/Schwassmann-Wachmann 3, a Jupiter-family comet, passed the Earth at a distance of mere 0.08 AU in May 2006, and comet C/2007 W1 (Boattini), an Oort Cloud comet, was at perihelion in June 2008 with a geocentric distance of, when closest, 0.21 AU.

Several different molecules are detected. HCN emission was only detected in comet 73P/S-W 3 but not in Boattini. In comparison, CS 3-2 line was only visible in Boattini but not in 73P/S-W 3.  $\text{C}_3\text{H}_2$  emission was tentatively detected in 73P-C on 2006 May 06 but faded away after the first 18-minute observation; if confirmed, this will be the first detection of cyclopropenylidene in any comet. Nevertheless, searches for  $\text{H}_2\text{CO}$  and its isotope HDCO were also attempted without success.

## P42

### Title: Dispersal and core formation of stellar clusters in different virial ratio

#### Authors:

1. Chih-Han Peng\* (National Central University)
2. Hui-Chen Chen (National Central University)
3. Chung-Ming Ko (National Central University), et al.

#### Abstract:

It is believed that most stars form in groups inside molecular clouds. After the natal cloud dispersed, the embedded stellar clusters may dissolve into field stars. We systematically study the future of these clusters for the case of high cloud dispersion rate. We use the code NBODY2-Hermite to do numerical experiments on clusters with different initial virial ratios (virial ratio =  $Q$  from 0.5 to 1.69,  $Q=0.5$  is called virial equilibrium). We found that for clusters with  $Q$  from 0.6 to 1.4 the outer part disperses but the inner part remains intact and forms a stable cluster. For  $Q>1.4$  the whole cluster is destroyed. Even if the initial total energy of the whole cluster is positive ( $Q>1$ ), the cluster does not disrupt completely and maintains a stable inner cluster. It is interesting that the time scale of stable cluster formation seems to be independent of the virial ratio.

**P43**

**Title: Global near infrared colour distribution from 2MASS**

**Authors:**

1. Shao-Yu Lai (National Central University)
2. Ting-Hung Peng\* (National Central University)
3. Chung-Ming Ko (National Central University)
4. Chan-Kao Chang (National Central University)

**Abstract:**

The whole sky J-Ks colour distribution with 16 degree resolution was carried out using 2MASS Point Source Catalogue (PSC). In general the distribution falls into two classes: uni-modal and bi-modal. Bi-modal distribution is dominant which accounts for 82.9% of the whole sky. The bi-modal distribution is fitted with two Gaussians. We create the maps of the colour difference (the difference of the two Gaussian means) and the peak ratio (the ratio of the height of the peak). The distributions are clearly divided into two regions: bi-modal in high latitude and uni-modal along the galactic plane. We focus on the high latitude regions and find that the colour difference distribution is rather narrow with a mean 0.35 and a width 0.08. The peak ratio is  $1.17 \pm 0.36$ .

**P44**

**Title: Development of Control Software for 4-Color Simultaneous Imager**

**Author:**

1. Pei-Hsien Shen\* (National Central University)
2. Kinoshita Daisuke (National Central University)
3. Ching-Huang Wu (National Central University)
4. Tse-Chuan Chen (National Central University)
5. Ru-Huei Huang (National Central University)
6. Hui-Hsin Yang (National Central University)

**Abstract**

We are developing the control software for 4-color Simultaneous imager which will be attached to 2-m telescope at Lulin observatory. The software consists of (1)CCD camera controllers(2)environment monitor (3)Communication function between components through the network (4)concurrent control layer (5)user interface. We have two different types of cameras for our instrument, and need to develop control software for each camera. We tried two sample codes and conformed basic operations of SI cameras. We are now developing our own codes to control cameras. UCAM team provided us a program that we successful took good images in December last year. We will use network to communicate between each components. In addition to the camera control software, we also need environment monitor to check the ambient temperature and humidity, concurrent control layer to realize the simultaneous control of four cameras, and user interface to allow observers to operate the instrument. We describe the design of the software and functions of each component. We also report the current status of the implementation and future plan for testing.

**P45**

**Title: Near Infrared Polarimetric Imaging of Carina Nebula**

**Author:**

*Bo-He Su (National Central University)*

**Abstract:**

Carina Nebula is one of the brightest nebulae, where one finds an excessive number of massive stars including the most massive star in the Milky Way, Eta Carina. We present near-infrared JHKs polarization images taken by SIRPOL, an infrared imaging polarimeter, mounted on the Infra-Red Survey Facility (IRSF) telescope in Sutherland, South Africa. We present diagnosis of the spatial distribution of circumstellar dust of embedded young stars, and the magnetic field structure in this turbulent cloud complex.

**P46**

**Title: Constraint on the Spin of the Black Hole in GX 339-4 from X-ray Continuum**

**Authors:**

1. *Y. H. Su\* (National Central University)*
2. *Y. Chou (National Central University)*
3. *T. C. Yang (National Central University)*
4. *C. P. Hu (National Central University)*

**Abstract:**

We present our analysis result for constraining the spin of the stellar-mass black hole (BH) in the X-ray binary GX 339-4 by fitting its X-ray continuum spectra. Reis et al. (2008) determined its spin to be  $a^*=0.935\pm 0.01$  by modeling the profile of Fe K  $\alpha$  line. However, Kolehmainen & Done (2010) concluded that its spin is no more than 0.9 from X-ray continuum fitting method. To resolve these contradictive results and estimate its spin, we first adopted two fully relativistic, thin accretion disk models combined with a simple comptonization model to fit X-ray continuum spectra of GX 339-4 observed by Proportional Counter Array (PCA) on Rossi X-Ray Timing Explorer (RXTE) during its 2002-2010 outbursts. We set up constraints suggested by McClintock et al. (2006) and Steiner et al. (2009a & 2010) to select the data suitable for thin accretion disk model to further analyze. We then used the most recently developed modified model (McClintock et al. 2006) to further constrain the black hole spin. Our result indicates that the BH spin is between  $a^*=0.94$  and  $a^*=0.95$ , which is likely favorable to the result from Reis et al. (2008).

**P47**

## **Validation of the Very Low Luminosity Object Candidates in Taurus**

### **Authors:**

1. Ren-Shiang Sung (National Tsing Hua University)
2. Shih-Ping Lai (National Tsing Hua University)

### **Abstract**

Observing protostars right after they formed from their parent cores is crucial for understanding the earliest phase of star formation. Discovered by Spitzer Space Telescope, Very Low Luminosity Objects (VeLLOs) are the faintest embedded sources currently known (internal luminosity,  $L_{int} < 0.1 L_{sun}$ ), hence the best targets for studying the star formation in the earliest stage. Since Taurus is one of the closest clouds, it provides the best possible spatial resolution for investigating the nature of VeLLOs. We searched for VeLLOs in Taurus adopting the color and luminosity criteria from Dunham et al. (2008), which are derived from known young Class 0/I objects. We further added two physical parameters, bolometric temperature and extinction value, to strengthen the possibility. As a result, we have select 11 VeLLO candidates in Taurus. Moreover, we present our observational results of  $^{13}CO$  ( $J=2-1$ ), C18O ( $J=1-0$ ), N2D+ ( $J=3-2$ ), and N2H+ ( $J=1-0$ ) with Arizona Radio Observatory (ARO). From CO isotopes, we could know the outflow dynamics, the structures of the dense core, and the core mass. The ratio of N2D+/N2H+ is known to trace the evolutionary stage of prestellar cores.

**P48**

## **Title: Multicolor Photometry of Small Solar System Bodies by Subaru Telescope**

### **Authors:**

1. Chih-Yang Tai\* (National Central University)
2. Fumi Yoshida (National Astronomical Observatory of Japan, Japan)
3. Ying-Tung Chen (National Central University)
4. Hsing-Wen Lin (National Central University)
5. Wing-Huen Ip (National Central University)

### **Abstract:**

Investigating colors of small solar system bodies (SSSBs) by multicolor photometry is essential to estimate their material compositions [1]. We observed the sky area of 1.5 square degrees near opposition on the ecliptic plane with the B,V,R,I-bands by Suprime-Cam which attached with the Subaru telescope on August 8-9, 2004. The limiting magnitude was  $R=25.1$  and 24.4 mag at each night respectively. In this work we combined data with Python pipelines to find SSSBs. We found about 800 SSSBs in total. Our observation, data reduction, and detection method of moving objects will be described in this presentation. At a first step, based on the velocity of each SSSB, the SSSBs will be divided into several dynamical groups. Next, by measuring the SSSB's colors (B-V, V-R, V-I) and deriving relative reflectance of each SSSB, we will classify them to several taxonomic types. Then, based on their brightnesses and their semi-major axes derived from their velocity, we will estimate their diameters. We have determined the size distribution of each taxonomic type in each dynamical population. Such information can be an important key for investigation of collisional properties between SSSBs [1] F. Yoshida and T. Nakamura, PSS 55, 1113-1125 (2007).

## P49

### Title: A Detailed Analysis of Spitzer IRAC Emission in High Mass Star Forming Regions

#### Authors:

1. How-Huan Chen (*Academia Sinica Institute of Astronomy and Astrophysics, and National Tsing Hua University*)
2. Hiro Takami\* (*Academia Sinica Institute of Astronomy and Astrophysics*)
3. Jennifer Karr (*Academia Sinica Institute of Astronomy and Astrophysics*)
4. Hsu-Tai Lee (*Academia Sinica Institute of Astronomy and Astrophysics*)
5. Shih-Ping Lai (*National Tsing Hua University*)

#### Abstract

The Spitzer IRAC camera has shown extended infrared emission (3.6/4.5/5.8/8.0  $\mu\text{m}$ ) towards a number of protostars and star forming regions. Such emission is often attributed to shocks, scattered continuum emission due to protostars, or PAH emission. Detailed analysis of this emission can provide a better understanding of the nature of high-mass protostellar candidates, and/or the environment of high-mass star forming sites.

We present diagnostics of IRAC colors of extended emission associated with a variety of high mass protostars. We show that color-color diagrams allow us to identify the physical nature of the extended emission. In particular, we find that bright extended emission observed at 4.5  $\mu\text{m}$  (extended green emission) is due to scattered continuum in most cases. We discuss the implications for dust distributions in these regions.

## P50

### Title: Planet Destruction Rate of Occurrence and Observability

#### Authors:

1. Stuart Taylor\* (*National Tsing Hua University*)
2. Ing-Guey Jiang (*National Tsing Hua University*)

#### Abstract:

Planet accretion and destruction will release more energy and material than any other planet-related event. It is expected to produce observational signatures ranging from luminosity from the energy release to signs of release of matter. We present work on the expected frequency of detecting planet destruction as a function of planet and star mass and other parameters. One form of planet destruction may have recently been detected, and how rapidly progressing theory shows that there are several different common planet destruction routes, including the most dramatic event of planets being scattered directly into the star. Roche lobe overflow may temporarily cause some planets to migrate outwards. We explain how the density of a planet can make the difference between slower Roche lobe overflow and outright collisions. We show that it is because planets are less able to spin up stars than are brown dwarfs that planet destruction can take on such different paths. Planet accretion is proving to be a rich area of study itself, which will also reveal much about stars and planets, and as planets are taken apart layer by layer.

**P51**

**Title: Constraining MOND by Gravitational Redshift Experiment in Matter Wave Interference**

**Authors:**

1. Yong Tian\* (National Central University)
2. Chung-Ming Ko (National Central University)
3. Li-Chi Chang (National Central University)

**Abstract**

In a recent experiment, based on quantum interference of atoms, gravitational redshift in different height has been improving from an accuracy of  $7 \times 10^{-5}$  to  $7 \times 10^{-9}$ . With such high accuracy, many modified gravity theories can be put to test. Modified Newtonian Dynamics (MOND) is an alternative to explaining missing acceleration in our universe (aka dark matter problem). Although MOND is aiming at very small acceleration regime ( $\sim 10^{-10} \text{m/s}^2$ ), it has some minute deviation from GR in larger acceleration regime. We find that certain functional forms in MOND can be ruled out or severely constrained.

**P52**

**Title: Star formation law in circumnuclear region of galaxies**

**Authors:**

1. Mengchun Tsai\* (National Central University)
2. Chorng-Yuan Hwang (National Central University)

**Abstract:**

We present the relation between star formation rate (SFR) surface density and the molecular mass surface density in circumnuclear region (CNR) of nearby active galaxy NGC~1068, NGC~2623, NGC~2903 and NGC~3982. Using molecular gas distribution in different condition traced by multi-transition CO line emission results by *SMA* and SFR derived by  $8\text{-}\mu\text{m}$  PAHs (polycyclic aromatic hydrocarbons) emission from *Spitzer* to check Schmidt-Kennicutt law,  $\Sigma_{\text{SFR}} \propto \Sigma_{\text{gas}}^n$ , in high density, temperature and small scale regions. We compare our results with previous studies and find that CNR obey similar relationship between molecular and SF but with a flatter slope. This result showing that in some specific conditions, SFR is possibly affected by other processes besides the self-gravity of the warm gas traced by high excitation CO state emission.

**P53**

**Title: Orphan GRB Search in Subaru Deep Field**

**Authors:**

1. Patrick P. Tsai\* (National Central University)
2. Yuji Urata (National Central University)
3. Naoki Yasuda (Institute for the Physics and Mathematics of the Universe, University of Tokyo, Japan), et al.

**Abstract:**

We present the result of orphan gamma-ray burst (GRB) search in the Subaru Deep Field (SDF). Since it has been suggested that GRBs are caused by collimated jets, there should be a larger amount of optical afterglows without the prompt gamma-ray emission. These are so-called "orphan GRBs". The existence of orphan GRB is a direct evidence of the collimated jets in GRBs, but it has never been discovered yet. One of the difficulties is that we need to make surveys with wide, long-term monitoring, and deep in longer wavelength (e.g. optical, IR). The SDF is one of the best surveys to perform this study. The field had been observed by Subaru Suprime-Cam (34'x27'FOV) with 20 epochs in i'-band for 6 years. The typical limiting magnitude of each epoch is about 26.0. The orphan GRB search process was starting with image subtraction for finding the variable sources in the field. Afterward we picked up the candidates for orphan GRBs according to their light curves and color information. Our preliminary result shows that 2 of them are considered as the candidate for orphan GRBs based on their patterns of light curves.

**P54**

**Title: Energetic Particle Injection Events in the Saturnian Magnetosphere**

**Authors:**

1. Chia-Yu Tzou\* (National Central University)
2. Norbert Krupp (Max Planck Institute for Solar System Research, Germany)
3. Wing-Huen Ip (National Central University)

**Abstract:**

One of the special features of the Saturnian magnetosphere is about the frequent injection events of energetic ions and electrons observed by the plasma instruments (i.e., MIMI/LEMMS) onboard the Cassini spacecraft. Such injection events could be triggered by the so-called interchange instability due to the mass-loading effect of the ions originated from the icy satellite, Enceladus. Following the work of Mauk et al., 2005 and Mueller et al., 2010, we have initiated a project to study the interrelation between the injection process (such as the distributions of the strength and duration of the injection events) and the orbital phase of Saturn around the Sun from Solstice to Equinox, possibly covering a solar cycle. Because of temporal variations of the Saturnian ionospheric conductivity and the ionization rates of Enceladus neutral cloud as a result of the changing sun-lit angle and shadow effect of the ring system, there might be corresponding changes in the co-rotation lag of the magnetospheric plasma and the frequency of interchange instability. The long-term measurements of Cassini from 2004 to 2017 are best suited for this investigation. In this presentation, a few snapshots of the observed injection events will be shown to explore the viability of this approach.

**P55**

**Title: Observational constraints on the physical conditions that determine the evolution of circumstellar disk**

**Authors:**

1. Jia-Wei Wang\* (National Tsing Hua University)
2. Shih-Ping Lai\* (National Tsing Hua University)

**Abstract**

We perform a statistical analysis on the morphology of the SEDs of transition disks in order to understand the physical process that leads to disk evolution. To describe the morphology of SED, we introduce two parameters  $\lambda_{\text{turnoff}}$  (wavelength where the disk and stellar flux is equal) and  $\alpha_{\text{excess}}$  (the spectral slope at wavelength longer than  $\lambda_{\text{turnoff}}$ ), and evaluate the relation between those parameters to the physical conditions with YSO models of Robitaille et al.(2006). We discover that the distribution of models in  $\alpha_{\text{excess}}-\lambda_{\text{turnoff}}$  space can represent different disk models such as canonical transition disks (inner hole  $>1\text{AU}$ ) and homologously depleted disks (inner hole  $<1\text{AU}$ ). We classify the YSOs selected from Core to Disk (c2d) Project according to their locations in  $\alpha_{\text{excess}}-\lambda_{\text{turnoff}}$  space, and the results can constrain the physical conditions of the circumstellar disks in c2d regions when compared to the YSO models. Our results show that in these regions, the disk inner hole is in general less than  $100\text{AU}$ , and only a few of them is larger than  $1\text{AU}$ . The results suggest that most circumstellar disks dissipate through homologously depletion, such as grain growth, and only a few of them evolve through photoevaporation-dominated process that creates larger inner hole.

**P56**

**Title : Detection of Star Clusters in a Sky Survey --- Is the fainter the better?**

**Authors:**

1. Ping-Fang Wang (National Central University)
2. Wen-Ping Chen (National Central University)

**Abstract :**

We present our study of the best sky survey, or data analysis, strategy to search for uncharted star clusters. An artificial cluster has been generated, assuming a nominal mass function and mass-luminosity relation, and then is simulated at different heliocentric distances against a general observed Galactic line of sight. Here we showcase the results of the simulations of such a cluster seen toward the Galactic center and the anticenter, based on the USNO catalog. We demonstrate how going fainter in the limiting magnitude, hence including more member stars in the cluster, extends proportionally much more field stars, thereby lessening the density constraint in a cluster search algorithm by star-counting. An optimal selection to crop the magnitude range in the analysis pipeline is discussed.

**P57**

**Title: Spectral Imaging towards Class I Young Stellar Objects IRS 44 and 46**

**Authors:**

1. Wen-Wei Wang\* (National Taiwan University)
2. Yi-Jehng Kuan (National Taiwan Normal University, and Academia Sinica Institute of Astronomy and Astrophysics)
3. Wei-Hsiang Pan (National Taiwan Normal University)
4. Yo-Ling Chuang (National Taiwan Normal University)

**Abstract:**

Simple organic molecules C<sub>2</sub>H<sub>2</sub>, CO and HCN in gas phase have been observed by the Spitzer c2d program towards the solar-type Class I YSO IRS 46 in its inner disk with an excitation temperature of several hundred degrees. With the Submillimeter Telescope (SMT), we detected organic molecules H<sub>2</sub>CO and CH<sub>3</sub>OH. These two organic molecules represent a hot-corino signature which has been known to be associated with Class 0 sources previously. The molecular emission towards IRS 46 may come from its inner region where icy mantles have been evaporated due to heating from the central protostar. Follow-up SMA observations reveal unusual CO 2–1 line profiles in IRS 46 neighborhood. We thus used the SMT, a single-dish telescope, to image the CO emission at 230 GHz further in the region centered at IRS 46 in order to recover the missing flux via full-synthesis mapping and to study the molecular gas distribution near IRS 44 and IRS 46 in the region. Our observations of CO and organic molecules show possible interaction between the two YSOs IRS 44 and IRS 46, and are helpful to our understanding of the evolution of low-mass YSOs, hence our Solar Nebula.

**P58**

**Title: Current Development Status of y-band Camera for 2m telescope Instrument**

**Authors:**

1. Ching-Huang Wu\* (National Central University)
2. Kinoshita Daisuke (National Central University)
3. Tse-Chuan Chen (National Central University)
4. Pei-Hsien Shen (National Central University)
5. Ru-Huei Huang (National Central University)
6. Hui-Hsin Yang (National Central University)

**Abstract:**

The 4-color simultaneous imager for Lulin Two-meter Telescope is now being built. The instrument consists of four sets of CCD camera, in addition to the optics part split the light into 4 bands, for PS1-compatible r, i, z, and y bands, by dichroic beam splitters and filters. We use three 1100-series CCD cameras manufactured by Spectral Instruments, equipped with E2V back-side illuminated deep depletion 2K x 4K CCD and Polycold PT-30 cryo-cooler, for r, i, and z bands.

The y-band camera is being developed by ourselves, we use thick fully depleted 2K x 4K CCD chip from Hamamatsu Photonics, and ACS-164 UCAM CCD controller of Astro Electronics Technology, and Polycold PT-30 cryo-cooler for this camera. We would like to thank the OIR(Optical and Infrared Astronomy) team of ASIAA(Academia Sinica Institute of Astronomy and Astrophysics) specially, cause the great sharing and help in this development.

Here, we introduce the current status with testing data of the y-band camera and optics.

**P59**

**Title: The astronomical refraction of the setting Sun**

**Authors:**

1. Yu-Lun Wu\* (*National Taiwan Normal University*)
2. Hsieh-Hai Fu (*National Taiwan Normal University*)

**Abstract:**

In this work, we try to calculate the astronomical refraction from the setting sun. The light path from a source outside the earth's atmosphere, is a curve due to the astronomical refraction, and the curve depends on the observed location and the angle between celestial body and the horizon, especially when the celestial body is near the horizon. The astronomical refraction is influenced by the density and temperature of the vertical atmosphere structure, we uses the CWB rawinsonde observed data to construct the vertical density structure of the atmosphere. The sunset images taken on the May 8, 2009 at Danshui is used to comparison of model and observed astronomical refraction of the setting sun.

**P60**

**Title: Dynamics of Charged Nano-dust and Pickup Ions from Sun-grazing Comets**

**Authors:**

1. Tai-Hao Yan (*National Central University*)
2. Ying Liaol (*National Central University*)
3. Wing-Huen Ip (*National Central University*)

**Abstract:**

The near-solar region within a few solar radii is constantly penetrated by the Kreutz group comets. The sublimation of the surface materials, either volatile ice or solid particles, will lead to the production of pickup ions and small grains which might be related to the high-speed nano-dust possibly detected by the plasma wave experiment on the STEREO spacecraft. In this work, we propose to re-examine the storage and acceleration of charged dust particles and pickup ions emitted by Sun-grazing comets using an idealized analytical magnetic field model derived by Banaszkiewicz, Axford and McKenzie (1998). Such dynamical effects might be relevant to the in-situ measurements of the Solar Probe at close encounter with the Sun since the chance of concurrent passage of a Sun-grazing comet in its vicinity might not be negligible. The acceleration effect of charged nano-dust and the corresponding dynamical motion in interplanetary space will be studied by joining the Banaszkiewicz-Axford-McKenzie field model with the classical Parker spiral at large radial distances.

## P61

### Title: Molecular Gas of HBLR and Non-HBLR Seyfert 2 Galaxies

#### Authors:

1. Po-Chieh Yu\* (National Central University)
2. Chorng-Yuan Hwang (National Central University)

#### Abstract:

We investigate molecular gas of HBLR and non-HBLR Seyfert 2 galaxies by comparing their CO(1-0) luminosities. The distribution of CO luminosities of the HBLR Seyfert 2 galaxies is similar to that of the non-HBLR ones. Both the HBLR and non-HBLR Seyfert 2 galaxies show tight FIR-CO correlation. However, the non-HBLR Seyfert 2 galaxies have tighter CO-radio correlation than HBLR ones. This result suggests that radio emission of HBLR and non-HBLR Seyfert 2 galaxies could originate from different mechanisms. The possible explanation would be discussed.

## P62

### A Study on Late Time Evolution of Gamma-ray Burst Afterglows

#### Authors:

1. Clark Chiu\* (National Taiwan University, and Academia Sinica Institute of Astronomy and Astrophysics)
2. Kuyun Huang (Academia Sinica Institute of Astronomy and Astrophysics)
3. Yuji Urata (National Central University)
4. Patrick Peikang Tsai (National Central University)

#### Abstract:

GRBs are among the most powerful explosions in the universe, also the least well understood. So far, we knew GRBs are cosmological and have afterglows in X-ray, optical, submm, and radio wavelengths. Some of the long-duration GRBs are associated with supernovae and GRBs display canonical behaviors in their X-ray temporal evolutions. Besides, the Swift/XRT found some GRB accompanied by X-ray flares or shallow decays, which implied various mechanisms of GRB jet injects into ambient environment. Moreover, several investigations suggest X-ray and optical emissions are from different mechanisms, because they usually display different behaviors and the GRB external shock model has failed to explain the combination of observed behaviors.

To clarify emission mechanism in X-ray and optical, and explain their complex behaviors, it is essential to have detailed multi-band measurements and find canonical behaviors in optical afterglows. In our study, we collect optical data of GRBs detected by the Swift satellite. Then examine their optical temporal evolution and color evolution to study their canonical behaviors. Finally, we investigate the combination of X-ray and optical light-curves to reveal possible reason that made some GRBs not correspond to the external shock model.

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