Contents

I  About KASI
II  Facilities
III Research Projects
IV  IR and Space Technologies
V  Collaborations and Opportunities
ABOUT KASI
Vision

Exploring the knowledge of the Universe benefits the humankind.

Mission

- We are performing creative and challenging research.
- We are promoting research co-operations with active communication.
- We are contributing to the society, exploring the knowledge of the universe.
Institute General : History

1974 Foundation of Korea Astronomy Observatory (KAO) as the national observatory
1978 Sobaeksan Optical Astronomy Observatory (SOAO) was built on Mt. Sobaek
1985 Taeduk Radio Astronomy Observatory (TRAO) was built in Daejeon
1986 **KAO was renamed as the Institute of Space Science and Astronomy (ISSA)**
1992 The first Global Positioning System (GPS) Station of Korea was built in ISSA
1996 Bohyunsan Optical Astronomy Observatory (BOAO) was built on Mt. Bohyun
1999 ISSA became an independent organization as a government-funded research institute under the administration of KRCF (Korea Research Council of Fundamental Science and Technology)
2002 Solar Imaging Spectrograph Telescope was built in ISSA
2003 Lemmonsan Optical Astronomy Observatory (LOAO) was built on Mt. Lemmon, in Arizona, USA
The first Korean Space telescope FIMS (Far-ultraviolet Imaging Spectrograph) onboard STSAT-1
2004 **ISSA was renamed as the Korea Astronomy and Space Science Institute (KASI)**
2005 International Center for Astrophysics was established in KASI
2006 Space Geodesy Division was established and the International GNSS Service GDC(Global Data Center) started operation in KASI
2007 The Space Weather Monitoring Lab was established in KASI
2008 The construction of the Korea VLBI Network (KVN) was completed
2009 Data Center for Astronomical Almanac was appointed officially by the Ministry of Knowledge Economy Participation in the GMT (Giant Magellan Telescope) project
2012 Korea-Japan VLBI Correlation Center open
2013 MIRIS, IGRINS, 4-Channel Observation of KVN, KVN+VERA, KMTNet, OWL, SLR
2015 **Korea Microlensing Telescope Network (KMTNet) was established**
Human Resources & Budget

**Human Resources** (2016. 04.)

- Total Number of staffs 376
- Research Staffs 213 (25*)
  * foreign researchers
- Engineers & Technicians 23
- Administrative Staffs 82
- UST Students & Interns 58

**Budget FY2016**

- Total 65 Million USD
- Research 43 Million USD
Organization

- 3 Divisions and 4 Centers

Diagram showing the organizational structure with key positions and divisions.
FACILITIES
KASI Facilities

- Overseas
SOAO

- Sobaeksan Optical Astronomy Observatory
- built in 1978
- a 61cm reflecting telescope
- Instrument
  - 2K CCD camera
- ~10 observational research programs/year
- Main Researches Fields
  - Variable stars
  - Transits of extra-solar planets
  - AGNs, GRBs
- Education programs
- Public outreach programs
Bohyunsan Optical Astronomy Observatory

- built in 1996
- a 1.8m reflecting telescope

Instruments
- 4k CCD camera
- BOES (Bohyunsan Optical Echelle Spectrograph)
- Near Infrared Camera System (KASINICS)

~60 observation programs in average
6 international programs

Main Research Fields
- Star Formation
- Galaxy formation
- Quasars
System overview

- 1.6m telescope with FOV 2 deg x 2 deg and 340Mpixel CCD Camera
- Three identical systems installed at CTIO in Chile, SAAO in South Africa, SSO in Australia.
- 24-hours uninterrupted monitoring of night sky at Southern Hemisphere
KMTNet
Main Science

Monitoring the Galactic Bulge

Detection of micro-Gravitational Lensing events

Discovery of extra-solar planets
Galactic Bulge Season (Red)
- Search for Extra-solar Planets, especially, Earth-mass Planets in the Habitable Zone, using the micro-lensing technique
- Survey of Transiting Planets & Variable Stars

Non-Bulge Season (Blue)
- Survey of Supernovae
- Survey of Asteroids and Comets especially, NEOs (Near-Earth Objects)
- Multiband Photometry of External Galaxies
- Others (e.g. Collaboration with Host Countries, Target of Opportunity)
KMTNet Early Results

- Cluster of galaxies on 21 February, 2015 at CTIO. 120 seconds exposure with R filter

FOV $\sim 6 \times 6$ arcmin$^2$
FWHM $\sim 1.0$ arcsec
• Galactic Bulge on 21 March, 2015 at SAAO. 60 seconds exposure with I filter
• Complete light curve of OGLE-BLG-RRLYR-7412 (Kim et al. 2016, JKAS 49, 37)

Figure 6. Sample light curves of the RR Lyr-type pulsating star OGLE-BLG-RRLYR-7412 in the Galactic bulge field, which was observed continuously at the three KMTNet sites on June 20, 2015. The flux is in arbitrary units. The upper right corner shows the star’s pulsation phase diagram.
- **Korean VLBI Network**
  - Three 21-m radio telescope in Seoul, Ulsan, and Jeju (Tamna)

- **Completed in 2008**

- **Simultaneous 4-band observations**
  - Detection of fringes simultaneously at 4 frequency-bands with 3 KVN-stations

- **Expansion: Successful VLBI observations with Japan, Europe, and Australia**
  - KVN + VERA
  - KVN + EVN
Multi-Frequency Receiving System
- simultaneous multi-frequency observation @ 22/43/86/129 GHz to compensate atmospheric phase fluctuation using phase solution of low frequency
- **Korea-Japan Correlation Center (KJCC)**
  - Joint development and operation of VLBI Correlator System by KASI and NAOJ
  - VLBI data correlations of domestic (3 KVN-stations) and international VLBI observations (7 [KVN+VERA]-stations)
  - A Hub for international collaborations on the East Asian VLBI research activities
Jet velocity was measured as ~80% of c at the distance of 5ly from the central blackhole, previous measurement was 10% ~ 30%
Forecasting of Space Disaster due to the rapid change in space environment and solar activity.

In order to protect against:
- satellite lifetime shortening,
- satellite body exposure,
- satellite communication failure.

Solar Dynamics Observatory Data Center (2012)
- Space weather forecast with the highest resolution SDO solar image.

Radiation Belt Storm Probe Data Center (2012)
RBSP Satellite Data receiving and distributing.
III

RESEARCH PROJECTS
Optical Characteristics

- Seven 8.4m primary segments
  - Total diameter: 25.4m (area equiv. to 22m)
- Seven 1.06m secondary segments
  - Total diameter: 3.2m
  - Fast Steering Mirrors & Adaptive Secondary Mirrors
- Gregorian Focus
  - f/8, FOV ~ 20 arcmin

Alt-Azimuth Mount

Dimension

- Height: 38.7m
- Weight: 1,123 ton

Site: Las Campanas Peak, Chile
GMT Partners

- **U.S.A.** – 7 institutions
  - Carnegie Observatories
  - Harvard University
  - Smithsonian Institute
  - University of Arizona
  - University of Texas
  - Texas A&M University
  - Chicago University

- **Australia**
  - Australian National University
  - Astronomy Australia Limited

- **Korea**
  - KASI

- **Brazil**
  - FAPESP (San Paulo Research Foundation)
Korean GMT Participation

- **Acquire 10% share of the GMT**

- **Promotion of Korean Research Capability**
  - Access to 4m ~ 8m class telescope for Korean community
  - International collaboration with GMT partner institutions
  - Participation in survey projects
  - Annual summer school for students

- **Promotion of Korean Technical Capability**
  - Development of GMT secondary mirrors (FSM)
  - Participation in the development of GMT 1st generation instruments (G-CLEF, GMTNIRS)

- **Encourage of Industrial Participation in GMT Construction**
  - Participation in the bidding for
    - enclosure
    - telescope mechanical mount
    - Precision drives, HSB, etc.
− **Optical Wide-field patroL (OWL) (2016)**

− **Electro-optic Space Surveillance System**
  - Multiple stations with 0.5m optical telescope located worldwide

− **Protecting national space asset against hazardous space objects**
  - Optical tracking of Korean LEO satellites
  - Optical surveillance of the GEO belt covering Korean peninsula
  - Optical surveillance of space debris hazardous to Korean satellites
Satellite Laser Ranging System

- Development of Mobile SLR system (40cm, 2012)
- Development of Fixed SLR system (1m, 2015)
- Development of SLR data processing technology
  - High-precision orbit determination (mm accuracy)
  - Space geodesy research using SLR data
  - Supporting the national space surveillance system
IV
IR AND SPACE TECHNOLOGIES
Space Observation Programs

- **Science & Technology Satellite Series (KARI)**
  - 1\(^{st}\) Satellite: FIMS (Far-ultraviolet Imaging Spectrograph, KASI) (2003)
  - 2\(^{nd}\) Satellite: Observation of Space environment by Korean Launcher Naro
  - 3\(^{rd}\) Satellite: MIRIS (Multipurpose Infrared Imaging System, KASI) (2013)

(Seon et al. 2011)
Multi-purpose InfraRed Imaging System

Specifications of Space Observation Camera
- Wavelength: 0.9 ~ 2μm
- Aperture: 80 mm
- Pixel FOV: 51.6 arcsec (c.f. Nyq. sampling @ 1.6μm = 4.1 arcsec)
- Detector FOV: 3.67° x 3.67°
- 5 Filters: I (1.05μm), H (1.6μm), blank, Pa α (1.876μm), Pa α Cont

Collaboration with ISAS/JAXA → Technical consultation & Science

Launch: November in 2013
MIRIS Scientific Objectives

- **Paα Emission Line Survey**: Galactic plane & WIM
- **Origin of Warm Ionized Medium**
  - Previous study of WIM: Photoionization model
  - Recent study of WIM from FIMS: dust scattering
  - Verification of the dust scattering theory
- **Physical properties of interstellar turbulence**
  - Structure of WIM
  - Comparison between Paα (MIRIS) vs. Hα

- Monte-Carlo simulation
  - Uniform dust distribution; E(B-V) = 0.1
  - Point source or Spherical H II region
Observation of Cosmic Infrared Background (CIB)

- CIB from POPIII stars
- Spectral peak of CIB
- Large scale fluctuation of CIB

Large-scale structure of CIB from IRTS observation
- Phase I observation: CIB observation
- In Phase II: Paα survey of GP (2014)
MIRIS Images (preliminary)
Basic Design Concept of Project

- Near-IR Instrument onboard small satellite (NEXTSat-1)
  - Small mechanical cooler/ radiative cooling: near-IR range
  - Recent observations in the near-infrared
    → Wide-area survey & low-resolution spectroscopy in space
- Cosmic Star formation history
  - Efficient observation in space
  - Near-IR observation: local / distant Universe
  - Wide FoV
    → Near-Infrared Imaging Spectroscopy

Development Period : 2012.12 ~ 2017.05 (4.5 yrs)
Launch : 2017. 07
NISS Project

- **Wide FoV & Improved Resolution**
  - (~ 4 sq. deg., 15 arcsec pixel, 150 mm)

- **Near-Infrared Imaging Spectroscopy**
Near-IR Imaging Spectroscopy
- Large Nearby galaxies / Clusters of galaxies
- Star-forming regions
- Cosmic Near-Infrared Background

Near-Infrared Emission Lines

<table>
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<tr>
<th>( \lambda ) (( \mu \text{m} ))</th>
<th>line</th>
<th>Type</th>
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<td>1.26, 1.64</td>
<td>[Fe II]</td>
<td>Emission</td>
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<tr>
<td>1.875</td>
<td>Pa( \alpha )</td>
<td>Emission</td>
</tr>
<tr>
<td>1.96</td>
<td>[Si IV]</td>
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<td>2.212</td>
<td>H(_2) 1-0 S(1)</td>
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<td>3.05</td>
<td>H(_2)O Ice</td>
<td>Absorption</td>
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<tr>
<td>3.3</td>
<td>PAH</td>
<td>Emission</td>
</tr>
</tbody>
</table>

Multi-wavelength observation for M55
NISS: Complementary information in NIR
Roadmap for Space Science in Korea

1st Stage: NEXTSat Series - Demonstration of Space Technologies - Preceding Study of Space Sciences

2nd Stage: International Collaboration in Large Space Project

3rd Stage: Korean Space Telescope - Challenging Mission - Korea-leading Large Space Mission

Synergy with GMT

Space Vision 2030

LEO (7x10^2 km)

Moon (3.8x10^4 km)

L2 (1.5x10^5 km)
COLLABORATIONS AND OPPORTUNITIES
Regional and Global Collaborations

- **EACOA and EAO (http://www.eacoa.net)**
  - EACOA (East Asian Core Observatories Association) since 2005 by KASI, NAOJ, NAOC and ASIAA
  → EACOA Fellowship Program, East Asian Meeting for Astronomers
  - EAO (East Asian Observatory) since 2015 by EACOA member institutes
    → First EAO telescope : JCMT

- **COSPAR (For Korea: http://cospar.kasi.re.kr/eng/index.php)**
  - COSPAR (Committee on SPace Research) since 2012
  - 3rd COSPAR Scientific Symposium in 2017 will be held in Korea

- **SCOSTEP (Scientific Committee on Solar-Terrestrial Physics), ILWS (International Living With a Star), etc.**
Research Opportunities in KASI

- University of Science and Technology
- KASI Post Doc. Fellowship
- KASI Fellowship
- KASI Distinguished Scholar
- National Research Foundation Brain Pool Program
Conclusions

- We are making **steady progress** in research and instrument developments.

- We expect fast growth in both quantity and quality of research output, moving from fast follower to **First Mover**.

- We are strengthening **international collaboration**.
Thank you!