

# Mirinae

미리내 The Milky Way



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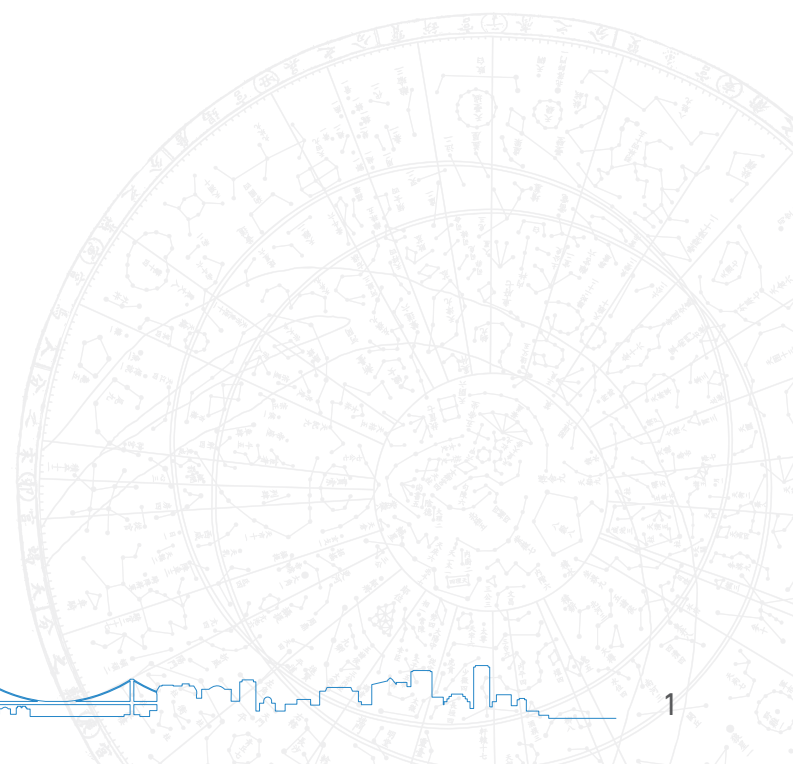
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# XXXIst General Assembly Opening Address

**Debra Elmegreen**, IAU President

Greetings to our honored guests and to our IAU community here and around the world! I'm Debra Elmegreen, President of the IAU. It is such a delight finally to be able to hold the XXXIst General Assembly of the IAU. We have witnessed too many global tragedies since the XXXth General Assembly in Vienna, and our thoughts are with all of those who have been affected. For the next two weeks, it will be a welcome change to focus on astronomical discoveries and endeavors, to honor achievements, and to share the many efforts in which astronomy is used in development, education, and outreach.

A transition of IAU Officers takes place after General Assemblies, held every three years according to our Bye-laws. We held the XXXIst General Assembly Business Sessions virtually in August 2021, and celebrated the terms of then-outgoing President Ewine van Dishoeck and General Secretary Teresa Lago. Because of the pandemic delay of the Scientific Sessions until now, it is appropriate for me and the current General Secretary, Jose Miguel Rodriguez Espinosa, to share the Opening Ceremony with them.



This is the first General Assembly to be held in the Republic of Korea in the 103-year history of the IAU. The Republic of Korea has been a National Member of the IAU since 1973. It has a vibrant astronomical community, with over 200 Individual Members. It hosted the 7th Asia-Pacific IAU Regional Meeting (APRIM) in 1996, the 12th APRIM in 2014, and IAU Symposium 197 on Astrochemistry in 1999. I thank the National Organizing Committee and its chair, Professor Hyesung Kang (who is Korea's first IAU Vice President) for their many years of preparation for this gathering, including their additional efforts to make it the first hybrid General Assembly.

We have nearly 1700 registered participants for the meeting. I'm also happy to welcome over 500 new Individual Members and Junior Members to the IAU. We have an exciting schedule planned, with lectures from international prize laureates plus talks and posters including many by early career astronomers. The plenary talks, invited discourses, Symposia, Focus Meetings, including one with our new Center for the Protection of Dark and Quiet Skies from Satellite Constellation Interference, Meetings of the Offices, Executive Committee Working Groups, Division Days, and Women in Astronomy and Young Astronomer Lunches encompass all aspects of IAU activities.

These events reflect the goals as laid out in our 2020-2030 Strategic Plan presented at the General Assembly in Vienna, which are well underway; namely: to coordinate research efforts and communicate astronomical knowledge among professional astronomers, to promote the inclusive advancement of astronomy in every country, to promote the use of astronomy as a tool for development in every country, to engage the public in astronomy through access to and communication of astronomical information, and to stimulate the use of astronomy for teaching and education.



# The General Assembly of the International Astronomical Union is a meeting place

**Jose Miguel Espinosa**, IAU General Secretary



The General Assembly 2022 is here now. It has been hard work due to the Pandemia. But it has been a great success which our Korean colleagues must be happy about. But most of all Prof. Hyesung Kang whose leadership and guidance brought us from one year to the next. Thanks to all the members in her team. You have been hard workers, you have been enthusiastically diligent. The General Assembly has been a well deserved success, after all the work you have invested in it. But it is not only the General Assembly what is at stake. The great city of Busan with its people, its technology, its Universities, its beaches, its mountains has welcomed us all. Thanks for this very warm welcome. The General Assembly will no doubt offer many surprises, both the GAIA and JWST are offering its first data, so we will hear many new results from the Galaxy and beyond and many new opportunities for discussions. The GA is also a great place for meeting people, for discussing with colleagues and for chatting with renowned professors. The General Assembly has a special place within the astronomical community. It is a place to meet every three years and a place where many discussions take place with people from remote places on Earth. The General Assembly is special due to its overarching coverage of topics and the many students with grants that makes the GA a young place. The General Assembly is a meeting place for Astronomy.



# Welcome by KAS President

**Myeong-Gu Park**, KAS President

Even after many decades of my scientific life, I still have great respect especially for astronomers, who hold such a passion for something that does not make any good money. Korean people also have had the greatest respect for scholars rich in knowledge and poor in money.

Korea has a long history of observing and recording astronomical events. Dolmens in the bronze age, murals in ancient royal tombs, and the official chronicles of the Korean dynasties spanning more than two millennia still tell us how our human ancestors had been watching the sky and listening to the celestial messages. Hence, I personally believe Korea is the perfect festive place for astronomers, who observe the universe in the past to understand the present and future of the universe.

Many astronomers including myself have not participated in overseas meetings for far too long. All the wonderful achievements in modern astronomy would not have been possible without international communication, cooperation, and collaboration. Now we are together again. I heartily welcome you to Busan, one of the most beautiful and vibrant Korean cities.

Let's do some astronomy, and be happy again.





# Welcome by KASI President

Young-Deuk Park, KASI President



As the president of Korea Astronomy and Space Science Institute(KASI), the co-host of the 31st IAU General Assembly, I extend to all the IAU members my warm fraternal greetings and compliments. It is my great pleasure to be able to welcome you to Busan, one of the most beautiful maritime cities in South Korea. The COVID-19 pandemic has challenged our daily activities and we could not even guarantee if indeed we can gather in one place face-to-face. And now, we are almost there for this global astronomy festival again.

South Korea has a relatively short modern history of astronomy and space science compared to other countries apart from its traditional inheritance. However, the academic advancement, despite the disadvantages of latecomer, has been constant and drastic enough to take shape for prominent observational infrastructures such as GMT, KMTNet, K-DRIFT, OWL-Net and SNIPE. Furthermore, the international collaboration especially in space science is on a steep rise in line with the worldwide attention to space exploration and Korea-US agreements for space development recently, which led KASI to go hand in hand with NASA for SPHEREx, KPLO and CLPS.

As it happens, KASI gets to celebrate the 50th anniversary in 2024, and organizes two main international meetings, IAU GA in 2022 and COSPAR SA in 2024, just before the special celebration. I am proud that a series of these host events indicates the leading status of KASI and Korean astronomy and space science in the world.

I, the president of KASI and a member of KAS at the same time, cannot weigh how challenging a turning point the Korean astronomy community is facing now. KASI, as we always have done, will take the lead and do our best to hold the GA professionally and successfully along with KAS in order to make the gathering as a new forum for scientific ideas and cultural exchange.

I do hope each of you have a memorable time exchanging your research ideas with peers and enjoy the blue water of the bay at Busan as well. I wish the 31st IAU GA will become yet another great event which makes you experience overwhelming moments off the computer screen. "Astronomy for All" is just waiting for you.



# Welcome by Mayor of Busan

**Heong-joon Park**, Mayor of Busan

On behalf of Busan citizens, I wish to extend my warmest welcome to all members of the International Astronomical Union (IAU) who are participating in IAU GA 2022 via on and off-line channels.

The IAU, as the largest international institution within the field of astronomy in the world, has official authority to designate the names of celestial bodies, and has accomplished numerous astronomical discoveries that it has shared with all of humanity since its establishment in the early 20<sup>th</sup> century.

As for the Republic of Korea, the Korean Astronomical Society joined the IAU at the 1973 IAUGA, while the 1996 APRIM was successfully held in Busan.

During the Chosun Dynasty era of the 15th century, King Sejong developed astronomy to the world's highest standards of the day. To honor such achievements, National Treasure No.250, a Celestial Globe, is engraved on the 10,000 won bill to commemorate its great value up to this day. In the past, our ancestors expressed astronomical tools that benefited all of humanity using the symbol of a plate. They creatively invented tools in various shapes and uses, such as the Celestial Globe and Hemispherical Sundial, to predict changes in time and season by measuring altitude and bearing, as well as the exact length of day and night. Based on such predictions, people who mostly survived by farming could forecast proper planting and harvest times.

Today, Busan is home to the 'Jang Yeong-sil Science Garden' to commemorate the great scientist of the King Sejong era, 'Jang Yeong-sil', and exhibit the astronomical tools he invented in order to help raise public interest in astronomy by experiencing the tools he used to study space.

Busan, as the second largest city of Korea and global maritime city on the southernmost tip of the Korean Peninsula, came together to secure peace and offer security to war time refugees during the Korean War, while later serving as the foundation for economic growth in Korea.

In addition, as the best convergence city in Korea, Busan is putting its every effort into winning the bid to host the 2030 World Expo, driven by its excellent city branding power and successful cultural mix as a city of international conferences and film.



Mayor of Busan, Park Heong-joon, represented Busan's Suyeong-gu District as a National Assembly member from 2004 to 2008, appointed as a special advisor on social issues to the President in 2011, served as the Secretary-General of the National Assembly from 2014 to 2016 and is now dedicated to his role as the Mayor of Busan from April 7th to present.

부산 먼저 미래로  
그린스마트 도시 부산

This year's IAUGA 2022 in Busan will provide a golden opportunity for around 2,000 astronomers from across the world to share their new research and discuss future developments in the field that will broaden global cooperation via various events such as, a congress, seminars, academic sessions and exhibitions. Meanwhile, I cordially ask for your kind interest and great support for Busan to win the bid to host the 2030 World Expo.

Lastly, I wish to express my sincere gratitude to all relevant officials from the IAU, the Korean Astronomical Society, and the Korea Astronomy and Space Science Institute for their hard work thus far to prepare for the successful hosting of IAUGA 2022.

I hope this conference will be a fruitful and successful occasion.



# Welcome by Minister of Science and ICT

**Jong-Ho Lee**, Minister of Science and ICT



I extend my heartfelt congratulations on the successful hosting of the 31st General Assembly of the International Astronomical Union (IAU). I would like to convey my utmost respect and gratitude to the IAUGA 2022 National Organizing Committee and members of the Korean Astronomical Society and the Korean Astronomy and Space Science Institute for organizing the IAU General Assembly. I also take this opportunity to warmly welcome the members of the IAU and astronomers from across the world.

In the age of space, astronomy is an essential field of basic science that involves state-of-the-art technologies. I commend the hard work and dedication of astronomers and am always grateful for their passion and efforts. I am more than delighted to convey my support and appreciation, albeit through this newsletter.

Year after year, astronomers have used their collective wisdom to contribute to enhancing our understanding on the origins of our universe and unveiling the wonders of the universe. Yet, it's even more special this year. For one thing, in May, the Event Horizon Telescope (EHT) project led by a team of multinational astronomers succeeded in observing Sagittarius A, the supermassive black hole at the center of our Galaxy. We are also one step closer to looking for exoplanets with the potential for life as the James Webb Space Telescope (JWST), the world's largest and most powerful space telescope ever built in human history, began its mission. Both the EHT project and JWST are products of the collaborative efforts of numerous astronomers around the world over a long period of time. As these major achievements indicate, international cooperation is crucial for the development of big science, such as astronomy. I hope that this year's IAUGA will be a venue to expand exchanges and advance discussions on cutting-edge research in each country, further contributing to the development and well-being of mankind.

I also have high expectations for the General Assembly hosted in Busan this year. It is a meaningful event where the Korean people and the world can witness the astonishing progress in astronomy, which is a remarkable achievement made possible through efforts from across the world. Furthermore, the successful launch of the Korea Space Launch Vehicle-II (KSLV-II), aka Nuri, in June this year has significantly piqued the Korean people's and the government's interest in space. In May last year, the Ministry of Science and ICT (MSIT) of Korea signed the Artemis Accords, a U.S.-led lunar exploration alliance. As part of the Artemis program, Korea's domestically-developed Korea Pathfinder Lunar Orbiter (KPLO), aka Danuri, will be launched in August this year.

More than anything, the Korean government will continue to make bold investments in astronomy and space development with a long-term vision and a strong drive.

When Neil Armstrong stepped out onto the Moon's surface and became the first person to walk on the moon, he proclaimed, "That's one small step for a man, one giant leap for mankind." Just like an astronaut's very first steps on the moon, Though making progress may feel like a small step for each astronomer attending this IAUGA, I am confident that in the end, your efforts and hard work will shape the foundation for a giant leap forward that will uncover the answers to mankind's questions about the universe.

Once again, congratulations on the successful opening of the IAU General Assembly, and I hope that all participants will engage in meaningful and productive conversations in Busan. Thank you.





# Astronomy for All Opening Ceremony

August 2, 17:00 – 18:30 BEXCO Auditorium

## IAUGA 2022

XXXI<sup>st</sup> General Assembly  
International Astronomical Union  
**IAUGA 2022**

## Welcome to Festival of Astronomy !



## Opening Ceremony

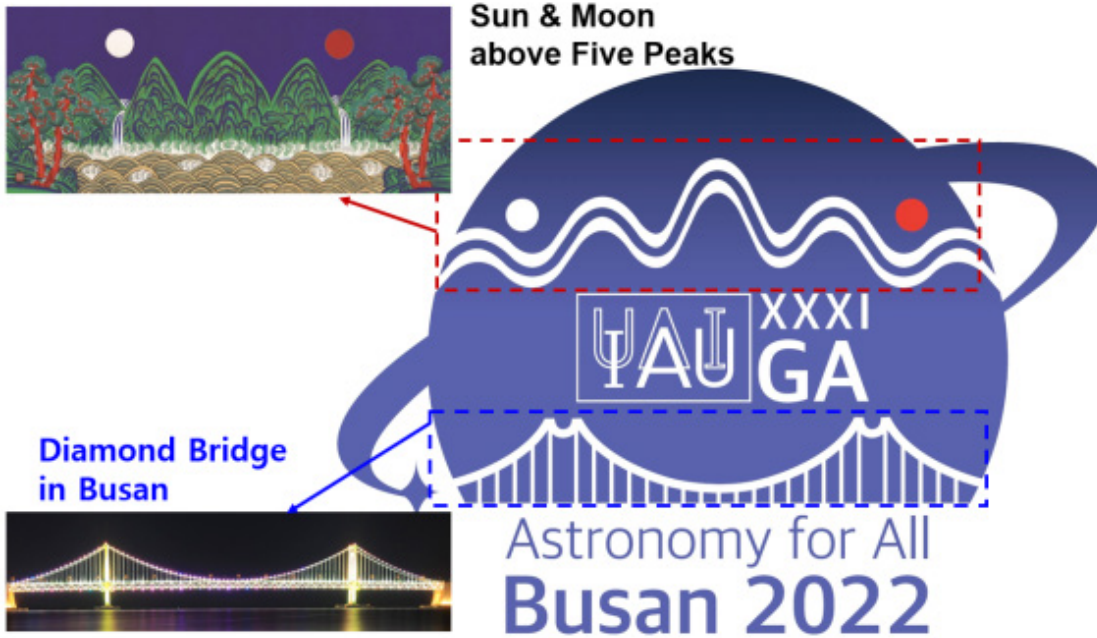
WHERE **Auditorium**

WHEN **August 2, 17:00 – 18:30**

### Part I. Program

1. Opening Performance: Korean Traditional Dance
2. Opening Announcement by Aeree Chung
3. Opening Video
4. Opening Address: Debra Elmegreen
5. Introduction of Guests
6. Welcoming Address: Tae-seog Oh, vice Minister of Science ICT
7. Welcoming Video: Heong-joon Park, Mayor of Busan
8. Welcoming Address: Myeong-Gu Park, KAS President
9. Brief Reflections on Past Triennium: Ewine van Dishoek
10. Brief Reflections on Past Triennium: Teresa Lago





**Part II. Program**

1. Gruber Foundation Prize Awards:  
Ewine van Dishoeck, Sarah Hreha, Teresa Lago
2. IAU ODE Prize Awards: Ewine van Dishoeck
3. IAU PhD Prize Award: Jose Miguel Rodriguez Espinosa
4. Close of ceremony: Debra Elmegreen

**Welcome Reception**

WHERE **Auditorium Lobby**  
 WHEN **August 2, 18:30 – 20:00**

IAU EXECUTIVE COMMITTEE MEMBERS

- Debra Elmegreen (President; USA)
- Jose Miguel Rodriguez Espinosa (General Secretary; Spain)
- Willy Benz (President-elect; Switzerland)
- Diana Worrall (Assistant General Secretary; UK)
- Daniela Lazzaro (Vice-President; Brazil)
- Laura Ferrarese (Vice-President; Canada)
- Junichi Watanabe (Vice-President; Japan)
- Hyesung Kang (Vice-President; Republic of Korea)
- Solomon Tessema (Vice-President; Ethiopia)
- Ilya Usoskin (Vice-President; Finland)
- Ewine van Dishoeck (Past President, Advisor; Netherlands)
- Teresa Lago (Past General Secretary, Advisor; Portugal)

IAUGA2022 NATIONAL ORGANIZING COMMITTEE

- Deokkeun An, Ewha Womans Univ
- Jungyeon Cho, Chungnam National Univ
- Joon-Young Choi, Busan Nat’al Science Museum
- Aeree Chung Yonsei Univ
- Junga Hwang, KASI
- Ho-Seong Hwang, Seoul National Univ
- Hyesung Kang (Chair), Pusan National Univ
- Chunglee Kim, Ewha Womans Univ
- Dohyeong Kim, Pusan National Univ
- Ji-hoon Kim, Seoul National Univ
- Jongsoo Kim, KASI
- Minjin Kim, Kyungpook National Univ
- Sungsoo S. Kim, Kyung Hee Univ
- Woong-Tae Kim, Seoul National Univ
- Woojin Kwon, Seoul National Univ
- Jeong-Eun Lee, Kyung Hee Univ
- Kang Hwan Lee, Institute Pasteur Korea
- Sang-Sung Lee, KASI
- Seo-gu Lee, KASI
- Byeong-Gon Park (Vice-Chair), KASI
- Soo-Chang Rey, Chungnam National Univ
- Hyunjin Shim, Kyungpook National Univ
- In-Ok Song, Korea Science Academy of KAIST
- Hong-Jin Yang, KASI
- Suk-Jin Yoon, Yonsei Univ
- Sung-Chul Yoon, Seoul National Univ



## Focus Meeting 4

# UV Insights to Massive Stars and Young Stellar Clusters

By DANIELLE BERG & CLAUS LEITHERER

Massive stars and young stellar clusters are cosmic drivers of galaxy evolution and are key to understanding the formation and ionization of the early universe. While the light from massive stars influences all observable facets of star-forming galaxies, the interplay between stars and gas is not well understood. Gas is accreted onto galaxies from the cosmic web, settles into their gravitational wells, and is converted into young stellar clusters. The massive stars in these clusters ionize the surrounding gas, produce nebular emission, and drive outflows. Such feedback drives chemical evolution and can modulate or limit accretion processes, thereby regulating the subsequent growth of galaxies.

The effects of massive stars are broad reaching. Therefore, answers to the critical questions surrounding galaxy formation and the early universe, as well as cosmic galaxy evolution, requires understanding the astrophysical properties and lifecycles of massive stars and stellar clusters.

The rest-frame far-ultraviolet (FUV) offers the best observational window to study the properties of massive stars and the resulting physical conditions on the gas. In particular, FUV spectra contain features that characterize the ionizing stellar population, the imprint of their injected energy on the outflowing gas, and the physical conditions of the nebular gas within the same galaxies. This unparalleled diagnostic power is posed for rapid growth in utility, as it will be vital to the interpretation of the intermediate- and high-redshift galaxies that will be observed with future space- (JWST) and ground-based (ELTs) facilities in the next decades.

Currently, we are unprepared to interpret the UV spectra produced by massive stars and stellar clusters, especially at low-metallicities, and are facing the impending loss of access to the observed-frame FUV. Many important unknowns remain that thwart our understanding of massive stars, and, as a result, high-redshift galaxies and galaxy evolution. Fortunately, several observing campaigns have been designed to specifically tackle these challenges, such as the Hubble UV Legacy Library of Young Stars as Essential Standards (ULLYSES) initiative, The COS Legacy Archive Spectroscopic Survey (CLASSY): A UV Treasury of Star-Forming Galaxies, and others. How we will use the existing FUV astronomical database and these coming programs to answer these key questions will be addressed in Focus Meeting 4. Within the session topics, we will conduct high-level discussions of the details of massive stars and clusters, including less understood phenomena such as the rotation and mass-loss rates, enhanced  $\alpha/\text{Fe}$  ratios, stripped stars and other remnants of binary star evolution, W-R stars, and more.



Danielle Berg is an Assistant Professor at The University of Texas, Austin (USA). Her research focuses on bridging our understanding of galaxies, which comes from connecting the local galaxies in our backyard with the first seeds of galaxies in the very distant universe.



Claus Leitherer is an Astronomer at Space Telescope Science Institute, Baltimore (USA). He combines research on individual massive stars and on the integrated star-formation properties of galaxies using the population synthesis code Starburst99.

## Focus Meeting 4: UV Insights to Massive Stars and Young Stellar Clusters

START DATE	Tuesday, 2 August
END DATE	Wednesday, 3 August
ORAL SESSIONS	Room 202, Convention Hall, 2 <sup>nd</sup> Floor
POSTERS	e-Poster Zone, Convention Hall, 3 <sup>rd</sup> Floor

*For details on presenters, topics, and times see the online program or the FM 4 website*





## Focus Meeting 5

# Broader look at the planet habitability

By Heidi Korhonen

## Focus Meeting 5: Beyond the Goldilocks Zone - The Effect of Stellar Magnetic Activity on Exoplanet Habitability

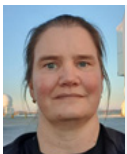
START DATE	Tuesday, 2 August
END DATE	Wednesday, 3 August
ORAL SESSIONS	Room 103, Convention Hall, 1 <sup>st</sup> Floor
POSTERS	e-Poster Zone, Convention Hall, 3 <sup>rd</sup> Floor

For details on presenters, topics, and times see the online program on the GA website

Our Sun harbours magnetic fields which cause a myriad of phenomena, among them flares and coronal mass ejections that are crucial ingredients in the changing environmental conditions of near-Earth space. Similarly, the magnetic activity of other stars modulate their immediate environments, and in the case of strong magnetic activity also potentially affect the habitability of the orbiting planets. Focus Meeting 5 “Beyond the Goldilocks zone: the effect of stellar magnetic activity on exoplanet habitability” takes advantage of the recent progress in studies of the Sun and the heliosphere to explore stellar activity and its impact on habitability of exoplanets.

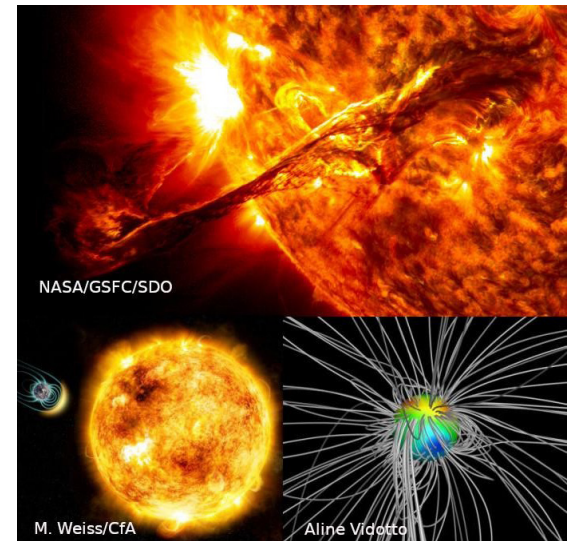
The magnetic activity of cool stars in the form of flares, winds, and coronal mass ejections has a direct impact on planets. This activity varies with the mass, age, and rotation rate of the star and can be damaging for life, even in the case of a fairly inactive star like the Sun. During periods of intense solar activity, the solar wind is enhanced and geomagnetic storms produce auroras, disrupt radio transmissions, affect power grids, damage orbiting satellites, and can be hazardous to astronauts. By analogy, the magnetic activity of young cool stars, which exhibit much higher activity levels than the Sun, may be hazardous for the creation and development of life. Therefore, knowledge of magnetic activity of the host star is of crucial importance when determining the habitability of a planet. In close-in worlds, like in the habitable zone of an M dwarf, stellar magnetic activity could have a catastrophic impact on the actual habitability of the planet. Even the planets further away from the star are significantly affected, as is seen in the solar wind stripping of Mars’ atmosphere, and in the enhanced ion escape from the Martian atmosphere in connection to coronal mass ejection events.

Focus Meeting 5 will take place on August 1 & 2 and during it we will discuss different aspects of solar and stellar magnetic activity and their effects on (exo)planets. The talks include observational and theoretical aspects of magnetic activity from solar and stellar flares and coronal mass ejections to dynamo theory and planetary magnetic fields. One important focus in the meeting is on the effect the magnetic activity has on the orbiting planets, both in our Solar System and also around other stars.



Heidi Korhonen is an Operations Staff Astronomer at European Southern Observatory in Chile. She is the president of Commission E4 and her scientific interests focus on stellar activity and its effects of exoplanets and their detection.

We hope to see many people participating in this interdisciplinary Focus Meeting that concerns many exciting aspects of stellar astrophysics and (exo)planetary research.





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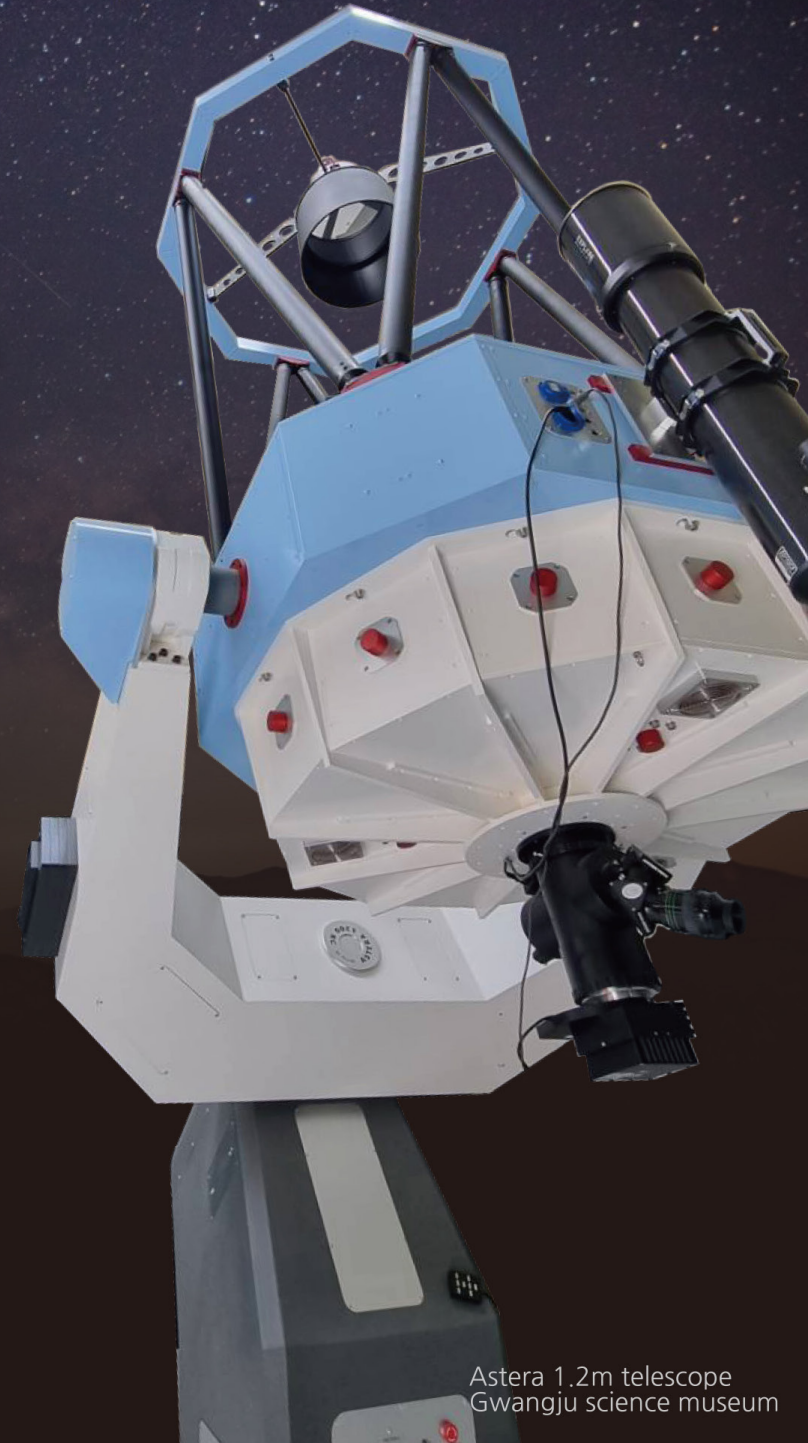
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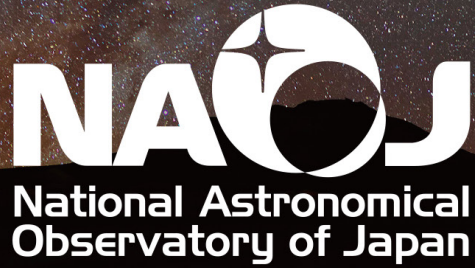


Astera 1.2m telescope  
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NAOJ ALMA Project



Subaru Telescope



Gravitational Wave Science Project



Thirty Meter Telescope (TMT) Project



Center for Computational Astrophysics (CfCA)



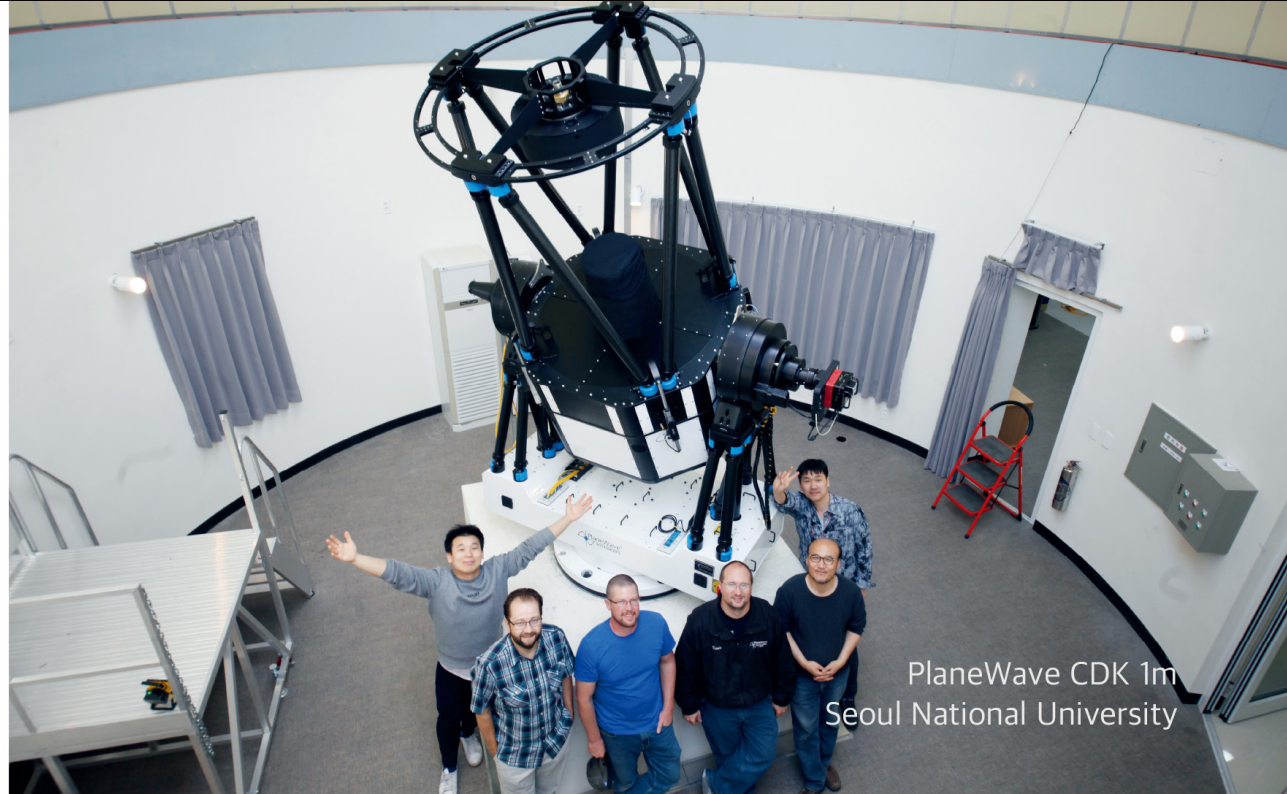
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Credit: Teruomi Tsuno/NAOJ

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