Issue 6 | August 9, 2022

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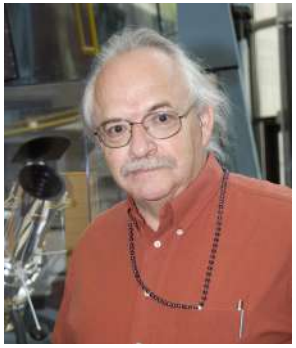
Charlotte Emma Moore Sitterly

David DeVorkin, S371 plenary speaker



In the late 1970s I worked for the American Institute of Physics in an oral history program sponsored by the NSF to create a collective portrait of 20th century astronomers by interviewing them to record and preserve their impressions of how astronomy changed during their careers. Using citation studies and lists of prize winners, as well as the advice of a senior advisory panel, and some thematic questions, like how physics became central to astronomical practice, we came up with an extensive list. Charlotte Emma Moore Sitterly of the National Bureau of Standards was of very high priority, for no less a reason that over her lifetime she was a central figure in the classification and analysis of solar and stellar spectra. In Donald Menzel's words, she "turned chaos into order" which was just a "little short of miraculous." I was honored to be able to interview her, travelling to Washington DC and visiting her home on Brandywine Street on July 15, 1978.

After graduating from Swarthmore with some exposure to general astronomy, Moore spent much of her professional life, starting in the 1920s, working for Henry Norris Russell at Princeton, the leading American astrophysical theorist of the first half of the Century. Menzel's comment above applied as well to how she organized and helped execute Russell's own research enthusiasms. She was a meticulous and steadfast worker, taking Russell's ideas and directives, applying them to the rapidly growing stores of spectroscopic data to turn them into new insights about the physical processes producing them. She soon met observational astronomers and physicists from many observatories and institutions, acting as a clearing house for their data. She also worked at the Mount Wilson Observatory for several years on leave from Princeton in the 1920s to be closer to the source of the data and returned there to complete her thesis at Berkeley on "Atomic Lines in the Solar Spectrum" in 1931. With Russell and others, she had already participated in a revision of Rowland's tables of the lines in the solar spectrum, and in 1931 returned to Princeton to work for Russell until his retirement in 1945. Her many close contacts since the 1920s included William Meggers of the National Bureau of Standards, who eagerly hired her to continue refinements of solar and stellar spectra, constantly improving the NBS "Multiplet Tables of Astrophysical Interest," a central resource for astrophysics.

She was an ardent member of the new IAU Commission 14 (then called "Fundamental Spectroscopic Data") eventually becoming its president in 1961, and helped it grow over the years because, in her words, astronomers had a "never ending demand for tables and data analysis." Here we provide a brief overview of Charlotte Moore Sitterly's life and how she came to be at the center of change. We will recount highlights of her early life, aspirations, training, and contributions during her years at Princeton, Berkeley, Mount Wilson, and the National Bureau of Standards.

(Left) Charlotte Moore circa 1919. (Right) Charlotte Moore working at her desk at the National Bureau of Standards in Washington, D. C. Courtesy of Michael Duncan via the M. D. Moore Family. From: https:/www.smithsonianmag.com/science-nature/how-charlotte-moore-sitterly-wrote-encyclodpedia-starlight-180973152/

IAU Symposium 371

Honoring Charlotte Moore Sitterly: Astronomical spectroscopy in the 21st century

Spectroscopy lies at the heart of our physical understanding of the universe and its constituents. And at the heart of spectroscopy is laboratory astrophysics. Although the lab work may not always be as conspicuous as other aspects of astronomy, progress would be impossible without it, especially as we extend our observations into new domains.

IAU Symposium 371: Honoring Charlotte Moore Sitterly - Astronomical Spectroscopy in the 21st Century	
START DATE	Tuesday, 9 August
END DATE	Thursday, 11 August
ORAL SESSIONS	Room 202, Convention Hall, 2nd Floor
POSTERS	e-Poster Zone, Convention Hall, 3rd Floor

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

Charlotte Moore Sitterly

Our knowledge of the grand cosmos depends primarily on the nanoscale quantum transitions within atoms and molecules. Our knowledge of those transitions, in turn, depends on laboratory-scale efforts, with a very special contribution from Charlotte Moore's multiplet table. Dr. Moore's work in the first half of the 20th century has been central to the successes of astronomical spectroscopy ever since. She started as a "computer" for Henry Norris Russell, discovered technetium in the Sun, and went on to the U.S. National Bureau of Standards, where she compiled the multiplet table and many other essential references. This IAU General Assembly symposium is in her honor. Moreover, the centennial of the IAU meshes perfectly with this subject, both because of the significance of her work over that time, but also because she worked directly with Henry Norris Russell, one of the IAU's founders.

The need for precise and accurate laboratory data has never been greater. Every time better spectrographs are built or new wavelength domains explored, we find critical information missing that is needed for analyses. As an example, the advent of ALMA forced a need for millimeter-wave laboratory data of a quality to match what was coming from the facility. And improved knowledge of physics leads to challenges in interpreting models of stars and planets. How much UV opacity are we still missing? How can we improve the interpretation of exoplanet observations, both from direct imaging and from transit spectroscopy? Do we truly know the absolute abundances in the Sun of such key elements as carbon, nitrogen, and oxygen? How can we extract the best information from the necessarily low-resolution of celestial objects to compare to high-resolution lab data? All of these areas are in flux.

This symposium addresses two main goals. First, we want to provide the broad astronomical audience of the IAU General Assembly with a view of the state of atomic and molecular studies that help move astrophysics forward. A key factor is bringing together the laboratory people with modelers and observers to learn more from each other. The second main goal is to provide a forum for the new work being done today by early-career researchers from all over the world.

This symposium encompasses nearly all the science themes that the IAU covers, from near to far in the universe, and at all wavelengths. We will particularly focus on emerging areas, which include near-infrared, mid-infrared (both about to be boosted by JWST) and sub-mm and millimeter. These regions provide the opportunity to greatly expand our understanding of molecules in planets, the ISM, and cool stars. Future x-ray studies promise much higher spectrum resolution and throughput, allowing significantly more detail to be derived from spectra.

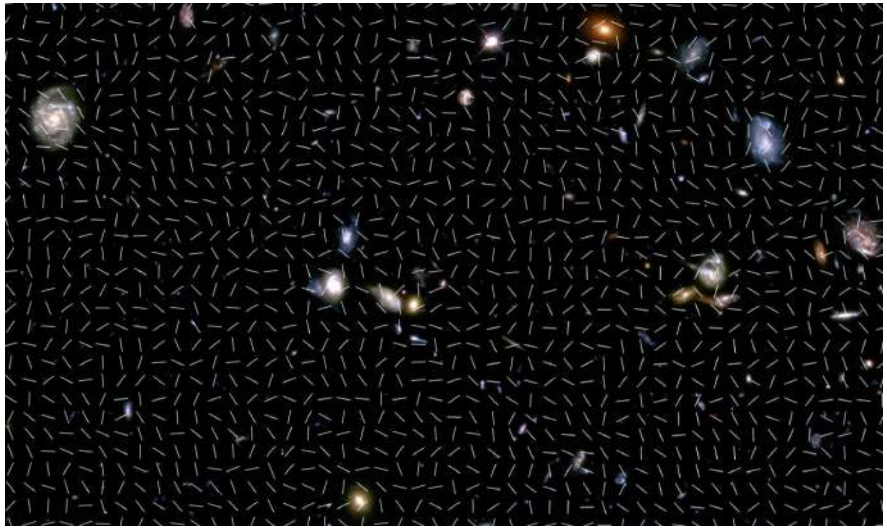
Our focal point for IAU Symposium 371 is Charlotte Moore Sitterly, a remarkable scientist who well deserves commemoration. I know her from her compilation "A Multiplet Table of Astrophysical Interest," which was my go-to resource for learning how to read stellar spectra when I was a graduate student. She did much more than that as a long-term scientist at the National Bureau of Standards (now the National Institute for Standards and Technology). The IAUS 371 SOC has selected two outstanding speakers to introduce members to Charlotte Moore Sitterly and her life, and also the significance of her work as astrophysics advances in the 21st century.

David Soderblom is the SOC Chair of the IAU Symposium 371.

Consensus Cosmic Shear in the 2020s

Focus Meeting 3: Consensus Cosmic Shear in the 2020s	
START DATE	Wednesday, 10 August
END DATE	Thursday, 11 August
ORAL SESSIONS	Room 103, Convention Hall, 1st Floor
POSTERS	e-Poster Zone, Convention Hall, 3rd Floor

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



Sketch of the shear field (white ticks) in the Hubble Ultra Deep Field (credits: image based on NASA/HST data, modified by N. Martinet). Cosmic shear exploits the gravitational shear field produced by the large scale structure to probe cosmology.

Recent measurements of the Hubble constant and (to a lesser extent) of the density and clustering strength of matter, hint at the possibility that cosmological parameters estimated at high- and low-redshift are inconsistent. Such a finding could be a sign that the highly successful Lambda CDM standard model of cosmology does not fully describe the true nature of our Universe, or could simply be a reflection of unrecognised systematics within one or more of these analyses. As a result, recent studies of low redshift probes utilising, in particular, the gravitational lensing of large scale structures (i.e. cosmic shear) have been particularly focused on the exploration and mitigation of systematic effects. At the sensitivity of current surveys, the community's understanding of cosmic shear systematics is largely acceptable. However with the immense statistical power of next generation cosmic shear surveys, it will soon become paramount for the community to understand these systematics with unprecedented accuracy, particularly before proposing extensions to the standard LCDM paradigm: i.e. via dark energy, modified gravity, massive neutrinos, etc. Moreover, with the start of Rubin's science operation and the launch of Euclid both in 2023, the IAU General Assembly 2022 is an extremely timely opportunity to address these questions. The aim of this focus meeting is therefore to bring together experts from the ongoing and future lensing surveys, thereby fostering collaboration between traditionally competitive teams, in order to build a consensus regarding cosmic shear methodologies, and identify the key systematics and cosmological models that will need to be tested in the 2020's.

Angus Wright (left) is a Research Fellow at the Ruhr-University Bochum, Germany. Nicolas Martinet (right) is Assistant Astronomer at Laboratoire d'Astrophysique de Marseille, France. They are both working on developing cosmic shear as a powerful cosmological probe for current and future large surveys.

Highlights of Women in Astronomy Lunch (August 8)

The Women in Astronomy Lunch at the IAUGA, which was held on Monday, 8 August, was opened with two speeches by Debra Meloy Elmegreen, IAU President to the Women in Astronomy, and professor Jinah Park at the KAIST and also Vice President of KWSE (Korean Woman Scientists and Engineers).

In the opening remarks at the event, Debra Meloy Elmegreen said, "The purpose of this lunch is to bring together young and senior women astronomers for networking and discuss topics of interesting concerns, regarding careers, family, ethics, and many, many issues. I am looking forward to hearing all discussions."

More than 180 female and male astronomers participated in the event, and two mentors were matched with 3-4 mentees per table. After having a short 20-minute lunch break during the speeches, a discussion between mentors and mentees began for about 90 minutes. A wide range of questions was raised at each table. "Why don't we have enough female astronomers at the science management level? What kind of leadership is required for a woman at the manager level? What can be done at the institutional level to enhance female astronomers' job security?" and "How to solve a 2-body problem while staying in academia?" Young female astronomers seriously listened to what seniors were saying.

As the Vice President of KWSE said in her opening remarks, it does not matter if you are a girl or a boy. We all wonder and look up at the sky with curiosity and imagination as a citizen of the earth, like the lyrics of the song we all sang when we were kids. "Twinkle, twinkle, little star, how I wonder what you are!"

Highlights of Public Lectures

Imaging a Supermassive Black Hole

Sheperd S. Doeleman (Harvard & Smithsonian Center for Astrophysics, USA)

During the 31st IAU General Assembly, which is being held under the theme of "astronomy for all", two open lectures were organized in an effort to deliver cutting-edge science to the public. On August 5th, the first public lecture was given by Professor Sheperd Doeleman (Harvard & Smithsonian Center for Astrophysics, USA) on the topic of "Imaging a Supermassive Black Hole". The lecture was held at the BEXCO Auditorium from 7:00 PM to 8:30 PM, and was broadcast live through the IAU and KAOS Science Foundation YouTube channels. In addition to a total of ~300 on-site public attendees, a number of IAU committee members and many conference volunteer students/postdocs attended the lecture. More than 500 people participated in the lecture through the two online channels. Live Q&A and comments were active during the lecture online. Starting with some basics of black holes and implications of the black hole image caught by the Event Horizon Telescope (EHT), Prof. Doeleman introduced the technical challenges and journeys leading to the success of the EHT project. He particularly emphasized the challenge of young researchers and the team spirit as the elements which led the EHT project to success. After the lecture, a long line formed as soon as participants were encouraged to ask questions. The direction of the questions varied broadly from the motivation for studying black holes, the nature of the supermassive black hole, and the technology of the radio interferometer to the difficulties in the research. Prof. Doeleman answered every single question with great enthusiasm, but among all, his comment on the value of astrophysics was quite moving: "If you only work on things that have applicable use you will really limit your understanding of the universe. The idea of doing basic research and astrophysics is that you cast a broad net intellectually." The lecture ended with Prof. Doeleman's thanks to the audience, including middle and high school students who left a deep impression on the lecturer with their enthusiasm and curiosity.

The State of the Universe

Brian P. Schmidt (Australian National University)

On August 6th, a hot sunny Saturday, we had the 2nd public lecture that was delivered by Professor Brian P Schmidt (Australian National University). The lecture title is "The State of the Universe." We have more than 350 audience on-site including IAUGA participants and a few hundreds participated in the lecture online. Prof. Schmidt started his lecture with a brief introduction about the IAUGA2022 itself. He then began his discussion with Hubble's law and Einstein's theory of general relativity and moved onto observational efforts such as CMB and supernovae surveys in the context of cosmology. Prof. Schmidt then expanded his discussion by asking astro-particle-cosmology questions "what is dark matter?", "what is dark energy?" and also commented on big questions in astronomy showing many recent and latest progresses made in the past years. SKA, JWST, TESS, LIGO, EHT and their implications were touched on. At the end of his lecture, Prof. Schmidt emphasized how understanding the universe can be useful. He concluded his lecture by commenting on the fate of the universe that is dominated by dark energy. Among the audience, many young children and students at all ages (from elementary school to graduate school) could be easily seen. All were very excited to meet Prof. Schmidt and took part in the Nobel Laureate's lecture on the universe. There was also a long queue for questions and we had questions from young children, secondary school students, university undergraduates, and a high school science teacher. After the Q&A session, a group photo with the speaker was suggested.

Overall, IAUGA2022 public lectures went smoothly and almost on schedule. Audience showed great enthusiasm and curiosity toward the contents of lectures. The audience was not just from the Busan area. Many students in the audience visited Busan from other parts of Korea in order to attend the public lecture(s). From the group photos you can see both speakers and audience seem happy with big smiles. We are very grateful to have Prof. Doeleman and Prof. Schmidt as public lecturers here in Busan, Bexco. Within a couple of days, we already have close to 10,000 views for the public lectures online. The online recording can be found in the IAU YouTube channel (https://www.youtube.com/channel/UCc3I9q-N0NA05vIYeNMmtTw).

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For the Korean Space Weather Center, a government agency responsible for space weather research and operation of the Republic of Korea since 2011, we have developed algorithms for 1) solar absolute radio flux calculation, 2) automatic classification of solar radio burst type II and III, 3) digital beamforming routine for low frequency InterPlanetary Scintillation (IPS) array, 4) algorithm for Geomagnetic Induced Current (GIC) calculation, 5) analysis and visualization of various space weather data etc. In the field of instrumentation, we have developed several space weather oriented equipment including 1) Solar 2.8 GHz absolute flux receiver, 2) Multi frequency solar radio flux receiver, 3) IPS array radio telescope for solar wind imaging, 4) GIC monitoring system.

Based on experience from space weather projects, we expanded our business area which develop both software and hardware of remote sensing instrument for scientific and civil usage. The first remote sensing instrument was High Frequency Surface wave Radar. HF ocean radars are efficient to monitor wide areas of ocean at low cost, and are used to measure ocean currents and waves in many countries. You can find specification/features and performance verification of developed HF ocean radar, called "SEODAE" on the company website, www.setsystem.co.kr. The same technique was applied to X-band patch array radar we have been developing recently, the X-band FMCW radar together with digital beam forming process allows various applications in real day like 1) basic testbed for the Space Surveillance Radar 2) detecting low RCS (radar cross section) targets, Drones, micro-UAVs.

Women in Astronomy Lunch