

IAU Symposium 354
“Solar and Stellar Magnetic Fields: Origins and Manifestations”
30 June - 6 July, 2019, Copiapo, Chile

Post Meeting Report

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(i) Final scientific program IAUS 354

June 30, 2019, Sunday. 17:30 Reception. Museo Mineralogico of the University of Atacama

July 1, 2019, Monday

9:00-9:30 Intro and welcome speeches

*Session I. New observational diagnostics of solar, stellar and interstellar magnetic fields
(Chair K. Strassmeier, Germany)*

9:30-10:00 Photospheric magnetic-field diagnostics in the Sun and the stars (Sami K. Solanki, MPS, Germany)

10:00-10:30 Probing the Chromosphere-Corona Transition Region via UV Spectropolarimetry (Javier Trujillo Bueno, IAC, Spain)

11:00-11:30 Magnetic field measurements with the Atacama Large Millimeter/Submillimeter Array (Sven Wedemeyer, Univ. Oslo, Norway)

11:30-11:45 Performance and first results with the Integral Field Unit of the GRIS spectrograph at GREGOR (Manuel Collados, IAC, Spain)

11:45-12:00 Diagnosing chromospheric magnetic field through simultaneous spectropolarimetry in H α and Ca II 854.2 nm (Nagaraju Krishnappa, Indian Institute of Astrophysics, India)

12:00-12:15 Diagnosing coronal magnetic fields with radio imaging-spectroscopy technique (Yihua Yan, NAO/CAS, China)

12:15-13:00 Contributed lightning talks:

- Ellerman bombs and UV bursts: Flux emergence and reconnection at different atmospheric layers (Viggo Hansteen, Norway)
- Spectropolarimetry with 854.2 nm compared with ALMA and scattering polarization theory (John Harvey, U.S.A.)
- The magnetic structure and dynamics of a decaying active region (Ioannis Kostogiannis, Greece)

- Would the Sun's photosphere be negatively charged? (Veronique Bommier, France)
- Magnetized downflows in the chromosphere (Sowmya Krishnamurthy, Germany)
- Magnetic properties of small solar intergranular bright points inferred from near infrared lines (Christoph Kuckein, Germany)
- Comparing Zeeman-Doppler imaging and Zeeman broadening observations

(Victor See, U.K.)

- High-resolution H-alpha observations of filigree in the vicinity of polar crown filaments and their connection to the magnetic field (Andrea Diercke, Germany)
- Global Evolution of Solar Magnetic Fields and Prediction of Solar Activity Cycles (Irina Kitiashvili, U.S.A.)
- Adaptive Optics at the 1.5m GREGOR Solar Telescope (Thomas Berkefeld, Germany)

Session 2. Progress in understanding the solar/stellar interior dynamics and dynamos
(Chair: A.Brandenburg, Sweden)

14:00-14:30 Global numerical MHD simulations (Gustavo Guerrero, UFMG, Brazil)

14:30-15:00 New concepts for dynamos and convection (Irina Kitiashvili, NASA/Ames, U.S.A.)

15:00-15:30 Helioseismic insights into the generation and evolution of the Sun's internal magnetic field (Anne-Marie Broomhall, Univ. Warwick, U.K.)

16:00- 17:30 Poster session

18:00-19:00 Public lecture. Prof. Mario Soto: "Dos minutos de noche durante el día. ECLIPSE 2019". Location: auditorium J. J. Vallejo in the Copiapó center. Lecture is in spanish. See poster.

July 2, 2019, Tuesday. Observation of Solar Eclipse

July 3, 2019, Wednesday

Session 3. Stellar rotation and magnetism
(Chair: S. Solanki, Germany)

9:00-9:30 Magnetic field evolution in solar-type stars (Axel Brandenburg, NORDITA,

Sweden)

9:30-10:00 Links between magnetic field and stellar rotation (Pascal Petit, IRAP Toulouse, France)

10:00 – 10:15 Dynamo transitions in simulations of Sun-like stars and understanding them (Mariagela Viviani, MPS, Germany)

10:15- 10:30 The past and the future of the Sun: What solar twins can tell us about the solar magnetic and rotational evolution? (Diego Lorenzo-Oliveira, Univ. de Sao Paulo, Brazil)

11:00-11:30 Asteroseismology of solar-like stars (Andrea Miglio, Univ. Birmingham, U.K.)

11:30-12:00 Characterization of stellar activity using transits and its impact on habitability (Raissa Estrela, Caltech, U.S.A.)

12:00-13:00 Contributed lightening talks

- Tuning in to the radio environment of HD189733b (Robert Kavanagh, Ireland)
- Solar and Stellar Rotation - Current Developments in Wind Braking (Adam J. Finley, U.K.)
- Cycle Period, differential rotation, and meridional flow of early M dwarf stars (Manfred Kueker, Germany)
- Solar Cycle 25 Predictions (Maria Weber, U.S.A.)
- TESS light curves of low-mass eclipsing binaries (Krzysztof Helminiak, Poland)
- The importance of data in understanding gyrochronology models of solar type stars (Angela Breimann, U.K.)
- Impact of small-scale emerging flux from the photosphere to the corona: a case study from IRIS (Salvo Guglielmino, Italy)
- How does the vertical magnetic field drive the formation of starspots? -The solar case (Marta Garcia-Rivas, Czech Republic)
- Dynamo Wave Patterns Inside the Sun Revealed by Torsional Oscillations (Alexander Kosovichev, U.S.A.)
- Radiative MHD Simulations of Starspots (Manyukh Panja, Germany)
- Evidence for a magnetic dynamo in hot Algols (Ronald Mennickent, Chile)
- Solar Rossby waves from 21 years of SOHO/MDI and SDO/HMI observations (Zhi-Chao Liang, Germany)
- Exploring Star-Planet Interactions with MHD Simulations (Fabian Marcel Menezes, Brazil)
- 3D Realistic Modeling of Solar Turbulent Dynamics from Subsurface to the Chromosphere and

Corona (Irina Kitiashvili, U.S.A.)

Session 4. Role of magnetic fields in solar and stellar variability
(Y. Yan, China)

14:00-14:30 Magnetoseismology of the Sun (Paul Cally, Monash Univ., Australia)

14:30-14:45 The solar clock (Christopher Russell, UCLA, U.S.A.)

14:45-15:00 Solar radius and asphericities variations: outstanding unsolved points (Jean-Pierre Rozelot, UCA-Nice, France)

15:00-15:15 Asymmetry in large scale plasma flows and the sunspot cycle (Lekshmi B, Center of Excellence in Space Sciences, India)

15:15-15:30 The dynamo-wind feedback loop: Characterising how the solar wind varies along the 11-year solar cycle (Barbara Perri, CEA Saclay, France)

15:30- 17:30 Poster session

July 4, 2019, Thursday

Session 5. Star-planet relations
(Chair: L. Campusano, Chile)

9:00-9:30 Solar activity and its influence on planetary atmosphere evolution (Janet Luhmann, UC Berkeley, U.S.A.)

9:30-10:00 Stellar magnetic activity and star-planet interactions (Aline Vidotto, TCD, Ireland)

10:00-10:15 From the Sun to solar-type stars: radial velocity, photometry, astrometry and log R'HK time series for late-F to early-K old stars (Nadege Meunier, UGA, Grenoble, France)

10:15-10:30 The UV/X-ray radiation and particle (CME) fields of M dwarf exoplanet host stars and how they evolve (Alexander Brown, Univ. Colorado, U.S.A.)

11:00-11:30 Modeling of CME and magnetosphere-wind interactions (Dmitry Bisikalo, INASAN, Russia)

11:30-12:00 Simulating coronal mass ejections in active stars (Julian Alvarado Gomez, CfA, U.S.A.)

12:00-12:15 Star-planet interaction through spectral lines (Carolina Villarreal D'Angelo, TCD, Ireland)

12:15-13:00 Contributed lightening talks

- Potential zones in Peru for Astronomical Observatories (Javier Ignacio Silva Navarrete, Peru)
- Structure and Dynamics of the Overshoot Layer in a Rotating Main-Sequence Star with Shallow Convection Zone (Irina Kitiashvili, U.S.A.)
- Temporal evolution of the velocity distribution in systems described by the Vlasov equation; Radiation Belts: Analytical and computational results (Abiam Tamburrini, Chile)
- Diagnostics of non-thermal distributions from solar flare EUV line spectra (Elena Dzifcakova, Czech Republic)
- Orbit and spot modelling of UX Arietis for the interpretation of radio flares (Christian Hummel, Germany)
- Semi-Empirical Model of Solar Wind (Edward Sittler, U.S.A.)
- Impact of stellar magnetism on star-planet tidal interactions (Aurelie Astoul, France)
- On the multi fractality of plasma turbulence in the solar wind (Sebastian Javier Echeverria, Chile)
- Resolving Power of Asteroseismic Inversion of the Kepler Legacy Sample (Alexander Kosovichev, U.S.A.)
- On the properties of magnetic peculiar B, A, and F-type stars (Kutluay Yuce, Turkey)
- Intermittency and coherent structures in solar and stellar magnetic fields (Rodrigo Miranda, Brazil)
- Magnetic field and prominences of the young, solar-like, ultra-rapid rotator AP 149 (Tianqi Cang, France)
- New Chromospherically Young and Kinematically Old objects (CYKOs) candidates (Eduardo Machado Pereira, Brazil)
- Magnetic loop asymmetry from flare observations of polarisation at millimeter wavelengths (Douglas F. Silva, Brazil)
- Solar open magnetic flux migration pattern over solar cycles (Chia Lin, Taiwan)

Session 6. Formation, structure and dynamics of solar and stellar coronae and winds
(Chair: J. Luhmann, U.S.A.)

14:00 – 15:30 Special session. First results from the Parker Solar Probe

14:00-14:30 Some first results from the FIELDS instrument suite on Parker Solar Probe
(Aleida Higginson, Johns Hopkins Univ., U.S.A.)

14:30-15:00 Integrated science investigation of the Sun (ISOIS): Overview and initial results (Ralph McNutt, Johns Hopkins Univ., U.S.A.)

15:00-15:15 Parker Solar Probe SWEAP thermal plasma measurements from the first encounter (Kelly Korreck, CfA, U.S.A.)

15:15-15:30 How collisionless are solar wind electrons? Collisional and collisionless effects in the solar wind heat-flux transport (Pablo Moya, Univ. Chile, Chile)

15:30-16:00 Observational constraints of solar-like stellar winds (Manuel Guedel, Univ. Vienna, Austria)

16:00-17:15 Poster session

July 5, 2019, Friday

Session 7. Mechanisms of flaring and CME activity on the Sun and stars
(Chair: E.Khomenko)

9:00-9:30 Trigger mechanisms of major solar flares (Shuhong Yang, NAO CAS, China)

9:30-10:00 Solar flares: spectropolarimetric diagnostics (Jaime de la Cruz Rodriguez, Stockholm Univ., Sweden)

10:00-10:15 Magnetic field changes in flares (Lucia Kleint, KIS, Germany)

10:15-10:30 The magnetic activity of Proxima Centauri during 2017-2018 (Gabriel Hickel, Univ. Federal de Itajuba, Brazil)

11:00-11:15 The solar and stellar flare connection (Lauren Doyle, Armagh Obs., U.K.)

11:15-11:30 Magnetic field time series in magnetic clouds (Victor Munoz, Univ. de Chile, Chile)

11:30-11:45 Coronal dimming as a proxy for stellar CMEs (Meng Jin, SETI, USA)

11:45-12:00 Slingshot prominences in solar-like stars (Moira Jardine, Univ. St.Andrews, U.K.)

12:00- 12:15 A large rotational structure around AB Doradus A (Juan Bautista Climent Oliver, Univ. Valencia, Spain)

Session 8. Surface magnetic fields of cool stars

(Chair: M. Jardín, U.K.)

14:00-14:30 The large-scale field of cool and solar-like stars (Thorsten A. Carroll, AIP, Germany)

14:30-15:00 Surface magnetic fields of solar analogs (Sandra V. Jeffers, Univ. Goettingen, Germany)

15:00-15:15 Flux emergence rates of sunspots (Aimee Norton, Stanford Univ., U.S.A.)

15:15-15:30 Simulations of flux emergence in cool stars: the role of convection, rotation, and stellar structure (Maria Weber, Univ. Chicago, U.S.A.)

16:00-16:30 Big trouble in little Cen. The complex atmosphere and flare activity of Proxima Cen and other M-dwarfs (Alejandro Suarez Mascareno, IAC, Spain)

16:30-16:45 Probing solar-cycle variations of magnetic fields in the convection zone using meridional flows (Chia-Hsien Lin, National Central Univ., Taiwan)

16:45-17:00 A spectroscopic analysis of the steady chromosphere of low-activity early-M dwarfs (Gaetano Scandariato, INAF Catania, Italy)

July 6, 2019, Saturday

Session 9. Observations of solar eclipses and exoplanetary transits (Open public session)
(Chair: I. Kitiashvili, U.S.A.)

9:00-9:30 Solar eclipses (Jay Pasachoff, U.S.A.)

9:30-10:00 Solar Astrometry with Planet Transits (Marcelo Emilio, Univ. Estadual de Ponta Grossa, Brazil)

10:00-10:30 Characterizing hot Jupiters via transmission spectroscopy (P. Wilson Cauley, Univ. Colorado, U.S.A.)

11:00-11:30 Terrestrial exoplanets in the Habitable Zone (J. S. Jenkins, Univ. de Chile, Chile)

11:30-11:45 Sun-as-a-star Observations of the 2017 August 21 Solar Eclipse (Ekaterina Dineva, AIP, Germany)

11:45-12:00 Imaging the Solar Corona during the March 2015 Solar Eclipse at Low Frequencies using LOFAR (Aiofe Maria Ryan, TCD, Ireland)

12:00-12:30 Concluding remarks

(ii) Summary of the scientific highlights of the meeting

The main goal of the Symposium was to bring together solar and stellar astronomers to discuss common problems related to the origin of solar and stellar magnetic fields, their atmospheric/coronal effects, and their impact on planetary atmospheres. Solar magnetic fields and their effects have been studied with high resolution and motivated detailed theoretical modeling. The results and concepts of solar research are applied to other stars. The Symposium showed that observations of stellar magnetic fields and activity have substantially expanded the framework of solar studies, and created new challenges. For example, the discovery of superflares on solar-type stars raised questions about the structure and dynamics of magnetic fields that can be substantially different from the case of solar flares. Investigations of stellar cycles have shown that the solar dynamo may be in a transition region between periods of high and low activity. Investigation of relationships between solar and stellar magnetism has become critically important for both fields.

An important key issue discussed at the Symposium was that the same or similar phenomena occur on the Sun and other stars under different conditions (different age, metallicity, rotation rate etc) and studying these similarities and differences helps to uncover the underlying physical mechanisms, their evolution in time and impacts. Specifically, new emerging topics discussed during the Symposium included magnetic field diagnostics of the chromosphere and corona using observations of chromospheric lines and initial data from ALMA, Chinese Radio Spectroheliograph and other instruments, detection of stellar magnetospheres, and detailed mapping of the magnetic fields on the surface of stars using new unique instrumentation, such as the PEPSI spectrograph that provided first high-resolution spectropolarimetry with a 12m telescope. Previously, such mapping was possible only for the Sun. The new observations stimulated very interesting and important discussions on intercomparison of the solar and stellar results, and on how the surface magnetism structure and evolution are related to the generation of magnetic in the solar and stellar interiors.

In this respect, tremendous progress has been achieved from analysis of helioseismology and asteroseismology data from SDO, Kepler and TESS, as well as from observations of the solar and stellar variability. Discussion of the current long-term trend of declining solar activity, and initial results on prediction of the next solar cycles were among hot topics debated at the Symposium. This long decline in solar activity is very important for our understanding of the place of the Sun in the general picture of stellar cycles. This picture that is emerging from analysis of the Kepler and supporting ground-based spectroscopic data reveals new scaling laws and relations that needs to be taken into account in solar magnetism studies. Recent theoretical studies based on advanced supercomputer simulations revealed a key role of magnetism in establishing the solar and stellar differential rotation laws, and now it is important to discuss observational tests of the theoretical predictions based on the currently available and future data.

One of the puzzles of solar and stellar magnetism is related to the origin of extreme flare events. Despite the very weak magnetic cycle the Sun produced, in the cycle declining phase in 2017, some of the strongest flares in the history of observations. This raised the question of how this phenomenon may be related to the magnetism of stars that produce superflares, and what physical mechanism may cause such extreme events. Another important topic of the joint solar-stellar discussions was the influence of magnetism on solar and stellar variability. The Symposium showed interest of stellar astronomers in details of solar variability (e.g. effects of magnetic fields on granulation), which is driven by the need to understand and characterize the stellar ‘jitter’ for detection of Earth-type planets.

Understanding the role of stellar magnetism in star-planet relations is important for determining conditions for habitability. In this aspect, the goal of this Symposium was to discuss properties of solar and stellar coronae and winds, and their interactions with planetary magnetospheres. Compared to the solar system, in many recently discovered planetary systems the stellar winds are substantially stronger, and planets are much closer to their parent stars. This creates extreme conditions for magnetic interactions and extreme radiation environments, which depend on the state of stellar magnetic activity. The discussion of this new problem was focused on new observational diagnostics as well as on large-scale realistic simulations using supercomputer systems. First results from the Parker Solar Probe presented at a special session revealed new properties of the our corona and solar wind, which challenge the current paradigms, and open new perspectives for deeper understanding of the solar and stellar coronae and winds.

The broad discussions of problems of solar-stellar magnetism and star-planet relations stimulated new interdisciplinary collaborations, and defined the scientific success of the Symposium.

(iii) **An Executive Summary of the Meeting**

The Symposium brought together solar and stellar astronomers to discuss key problems of solar and stellar magnetic fields, their origin, evolution, structure, atmospheric and coronal effects, as well as their impact on planetary atmospheres. During the Symposium experts from various fields of solar physics, observers, theorists and modelers, discussed recent advances, exchanged ideas, discussed future plans, and developed new collaborations. The Symposium was organized in the city of Copiapo, Chile, in close cooperation and support of the University of Atacama, other Chilean universities, as well as of local authorities. It was the first international astronomical symposium in Copiapo, and it played a very important educational and public outreach goal.

The Symposium was organized in conjunction with the total solar eclipse in Chile and Argentina. The solar eclipse drew tremendous public attention to astronomy. The SOC and LOC organized public lectures and a special session for the local community. In addition, Symposium participants performed scientific observations of the eclipse and presented their initial results at a special open session on the last day of the Symposium. In particular, the total solar eclipse provided unique high-resolution images of the low corona, which could not be obtained by any other means. In addition, the Symposium also included an open public session on solar eclipses and planetary transits. The goal of this session was to discuss how the eclipses and transits provide new information about solar and stellar magnetic fields. In addition, this session presented a broad historical overview of solar eclipses, planetary transits, their role in astronomy, as well as a general talk on habitability of exoplanets. The organized public lectures, discussions and other activities promoted astronomical education and research in Chile.

The Symposium science oral program included 9 sessions, 28 invited reviews, 26 contributed talks and 39 contributed lightning talks. In addition, about 70 contributions were presented at four poster sessions. More than 40 students, mostly from Latin American countries, participated in the Symposium.

The scientific outcome covers a broad range of observational and theoretical topics. It includes new observational results from space missions, such as the Solar Dynamics Observatory (SDO), Interface Region Imaging Spectrograph (IRIS), Kepler and others that were launched in the past 10 years, as well as from new space missions and large solar and stellar telescopes, and advanced instrumentation. Presentations of new results from the NASA's Transiting Exoplanet Survey Satellite (TESS), and from the Parker Solar Probe mission were of particular interest. The extraordinary results from the first two Solar Probe encounters completely change the current paradigms about the structure and dynamics of solar corona and origin of the solar wind. In general, the new observational and theoretical results, presented at the Symposium, have convincingly demonstrated that the progress in our understanding of how magnetic fields are generated, emerge from the interior, organize in active regions, and cause powerful eruptions are achieved only by developing a unified approach and studying relationships between solar and stellar magnetism. Developing a synergy of solar and stellar astronomy is essential in solving grand-challenge problems of the primary mechanisms of stellar magnetic activity and its effects on star-planet relations, and undoubtedly will be in the focus of future IAU activities.