

INTER-DIVISION E-F-G

WORKING GROUP

IMPACT OF MAGNETIC ACTIVITY ON SOLAR AND STELLAR ENVIRONMENTS

CHAIR

WG MEMBERS

Heidi Korhonen

Sacha Allan Brun, Edward Cliver,
Maria Cremades Fernandez, Rim Fares,
Sarah Gibson, Manuel Güdel,
Margit Haberreiter, Emre Isik,
Silva Järvinen, Kanya Kusano,
Duncan Mackay, Cristina Mandrini,
Stephen Marsden, David Montes,
Dibyendu Nandi, Pascal Petit,
Pete Riley, Ilya Usoskin,
Aline Vidotto, David Webb

TRIENNIAL REPORT 2018–2021

1. Introduction

The Working Group *Impact of Magnetic Activity on Solar and Stellar Environments* was formed in the IAU General Assembly in Beijing, 2012. The main aim of the WG is to facilitate interdisciplinary science in understanding the impact of solar and stellar magnetic activity on their space environments and orbiting (exo)planets. This is done by bringing together theorists, modellers and observers working in the relevant fields of astronomy. With our recent advances in studies of Sun, Heliosphere, stellar magnetic activity and exoplanets this aim is even more topical than it was in 2012. Therefore, over this three year period we have worked to broaden the scope of the WG.

First, we proposed to make the Working Group an Inter-Division WG shared between divisions E, F and G. This is well justified, as the activities and interests of this WG have a large overlap with the interests of all the three Divisions. This proposal was accepted in the IAU Executive Committee meeting in May 2019.

Secondly, for taking the next step and bringing together a larger number of theorists, modellers and observers working in the relevant fields of astronomy, we proposed to make the Inter-Division WG *Impact of Magnetic Activity on Solar and Stellar Environments* into an Inter-Division E-F-G Commission. This was accepted by IAU Executive Committee in their meeting in January 2021.

Therefore, in August 2021 the Inter-Division E-F-G WG *Impact of Magnetic Activity on Solar and Stellar Environments* will cease to exist, and in its stead there will be Inter-Division Commission E4 *Impact of Magnetic Activity on Solar and Stellar Environments*.

2. Overview of Working Group Activities (2018-2021)

Below we provide a summary of activities of this WG during the period 2018-2021, which include efforts funded by the IAU as well as capacity building efforts led by WG members. We also note that several of the planned activities have had to be postponed due to COVID-19 pandemic.

2.1. IAU supported activities

Our WG members have always been actively taking part in organising IAU sponsored events. In IAU General Assembly in Vienna in 2018 our WG members were in the SOC of two events: *IAUS 345 Origins: From the Protosun to the First Steps of Life* (co-chaired by our WG member) and *Focus Meeting FM9 Solar Irradiance: Physics-Based Advances*. Additionally, in 2019 one of our WG members took part in organising *IAUS 354 Solar and Stellar Magnetic Fields: Origins and Manifestations* and several WG members gave invited talks in this symposium.

2.2. Working Group Member led Capacity Building Activities

The following activities, including workshop and meeting organization were facilitated by WG members through independent (non-IAU) support.

- Virtual meeting Cool Stars 20.5 was organised in 2-4 March 2021, with several of our WG members taking part in the organisation. For example two of the co-chairs of the meeting were from our WG.
- Additionally, Cool Stars 20.5 featured nine Topical Interest Rooms proposed by the participants. One such Interest Room was *Solar/Stellar Activity and the local environments* initiated partly by our WG members. This Interest Room attracted some 100 participants and resulted in very interesting and lively discussions.
- Some of our WG members also participated in the community-wide joint study of extreme solar events (superflares), including both terrestrial cosmogenic data and sun-like start statistics from Kepler data. The activity started as a ISEE (Institute of Space-Earth Environmental Research) International Workshop *Extreme solar events: How hostile can the Sun be?* organized in Nagoya University during 2018 October 02–06. This activity is continued via an ISSI teamwork *Solar Extreme Events: Setting Up a Paradigm (SEESUP)* in 2020-2021.
- Whole Heliosphere and Planetary Interactions (WHPI), an international initiative focused around the solar minimum period that aims to understand the interconnected sun-heliospheric-planetary system, was initiated with 730 registered participants. Between 2019-2021 WHPI convened multiple virtual activities, including focused sprint activities, a monthly colloquia and quarterly show and tell days in which pre-recorded tutorials on how to access and use observations from solar, geospace and planetary observatories/missions were presented with live Q&A.
- Our WG members also participated in organising *Bcool 2019* meeting in Exeter and the ISSI meeting *The Solar and Stellar Wind Connection* in May 2018 and June 2019

2.3. Highlight of Major Publications

Since the last IAU General Assembly, the follow major publications were led by WG members. Only reviews, reports and books are highlighted here.

- A major review on evolution of the solar wind was authored by a member of this WG and published in *Living Reviews in Solar Physics* (Vidotto 2021)

- A major review on evolution of the solar magnetic activity through time was authored by a member of this WG and published in *Space Science Reviews* (Güdel 2020)
- The ISEE brainstorming workshop lead to the publication of the first community-consensus book on the current status of a new paradigm of extreme solar events. One of our WG members is an editor of this book (Miyake et al. 2019).

3. Future

In August 2021 the new inter-division E-F-G Commission E4 Impact of Magnetic Activity on Solar and Stellar Environments will start its work. With pre-registration for the new Commission we tripled our membership in comparison to the Working Group and have also had several interested people contacting us after the deadline. I am sure the new commission will have a bright future.

Our Working Group has been very active in organising meetings. For example there are two events in XXXI IAU General Assembly in Busan that are at the core of the science interests of the WG and are also lead by our members: *IAUS370 Winds of Stars and Exoplanets* and *FM5 Beyond the Goldilocks Zone: the Effect of Stellar Magnetic Activity on Exoplanet Habitability*. In addition, the Cool Stars 21, which is to be organised in Toulouse in June 2022, has a very strong participation by the members of the WG (and the new Commission). As a Commission we are very well placed to continue these activities and aim to:

- organise an IAU GA Focus Meeting or a Symposium approximately every 4 years
- encourage hosting of local team meetings in various parts of the world led by members of the commission
- host regular online talks by experts in the field
- potentially organise student training workshops (modelled after the Basics of Astrobiology workshop preceding the IAUS 345 in the GA in Vienna).

In addition to organising meetings and workshops we would also increase our joint research activities by:

- catalysing closer collaboration between community members
- writing joint review papers on specific topics of common interest
- targeting 2-3 grand challenges in Star Planet Interactions and Habitability that requires interdisciplinary expertise (possibly applying for ISSI support for this work)

In the end I want thank everyone who has been involved in the WG and I am looking forward to all the exciting things the new Commission E4 will achieve.

Heidi Korhonen
Chair of Working Group

References

- "The evolution of solar wind", Vidotto A.A., Living Reviews in Solar Physics, in press, 26 figures, 88 pages (doi:10.1007/s41116-021-00029)
- "The Sun Through Time", Güdel M., Space Science Reviews, Volume 216, Issue 8, article id.143 (doi:10.1007/s11214-020-00773-9)
- "Extreme Solar Particle Storms: the hostile Sun", Editors: Miyake, F., I. Usoskin, S. Poluianov, 2019, IOP Publ., Bristol UK (doi: 10.1088/2514-3433/ab404a)