

COMMISSION E4

IMPACT OF MAGNETIC ACTIVITY ON SOLAR AND STELLAR ENVIRONMENTS

PRESIDENT
VICE-PRESIDENT
ORGANIZING COMMITTEE

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TRIENNIAL REPORT 2021–2024

1. Introduction

The Working Group *Impact of Magnetic Activity on Solar and Stellar Environments* was formed in the IAU General Assembly in Beijing, 2012. In 2021 it was proposed to change this Working Group into an Inter-Division Commission. The proposal was accepted by the IAU Executive Committee in their meeting in January 2021 and since August 2022 the Working Group has been Inter-Division E-F-G Commission E4 *Impact of Magnetic Activity on Solar and Stellar Environments*.

The main aim of the Commission E4 is to advance our understanding of the solar and stellar magnetic activity and the influence it has on the solar and stellar environments. This is done by fostering collaboration among researchers, and promoting the exchange of ideas and expertise. The Commission aims to bring together theorists, modellers and observers working in this interdisciplinary field of astrophysics.

2. Membership in Commission E4 membership and Organizing Committee

In the pre-registration for the membership in the newly formed Commissions in early 2021, Commission E4 received 68 registrations. This set the recommended number of organizing committee members to four (in addition to the president and vice-president). For the posts of president and vice president only one candidate came forward for each post. Therefore, Heidi Korhonen (Denmark/Chile) and Dibyendu Nandi (India) were de-facto elected as the president and vice-president, respectively. For the four Organizing Committee posts six candidates came forward and after a vote the following candidates were elected: Rim Fares (United Arab Emirates), Emre Işık (Turkey/Germany), Silva P. Järvinen (Germany), and Krisztián Vida (Hungary).

After the initial call for membership, new call for joining the newly formed Commissions was made by IAU in September 2021. In this call more people joined the Commission E4 and currently there are 126 members. We are very happy to see the approximately fivefold increase in the membership from the original Working Group.

3. Overview of Commission Activities 2021-2024

Already in the Working Group times our members were extremely active in organising scientific meetings. This has also continued during this triennial period. The global pandemic put serious restrictions in organising in-person meetings during the first year of the triennial, though.

To alleviate the lack of opportunities to meet among colleagues, we organised an online talk on a topic that was of high interest to our members. Prof. Katja Poppenhaeger gave a virtual talk on 20 April 2022 on the topic "Magnetic activity as the landscaping force in stellar and exoplanetary systems". This interesting talk was well attended and resulted in lively discussions. However, as the pandemic situation was starting to improve and in-person meetings were becoming again possible, we decided to concentrate on in-person and hybrid meetings instead of fully virtual format. In the future, we will evaluate if regular virtual meetings would be of interest to our members.

Below we highlight some of the main events our members have helped to organise.

3.1. IAU Supported events

One of the main activities our Commission led during this triennial was the Focus Meeting 5 *Beyond the Goldilocks Zone: the Effect of Stellar Magnetic Activity on Exoplanet Habitability* in XXXI IAU General Assembly in Busan, South Korea. Even if the global pandemic made organising this Focus Meeting somewhat more challenging than originally anticipated, the meeting itself was very successful with many fruitful discussions. Each session was attended by some 30-50 on-site participant and some 10 virtual attendees. The scientific topics in this meeting included the newest observations of stellar magnetic activity, theoretical advances in dynamo theory to explain the observed activity, observations of energetic events on stars, and the most recent efforts to model the effect of activity on orbiting planets and their habitability. Especially the observations of energetic events on other stars than the Sun in the form of flares and coronal mass ejection and their potential impact on the habitability resulted in many discussions during the meeting.

Another meeting at the core of the science interests of the Commission E4 that took place in the XXXI IAU General Assembly, and was led by our Commission members, was IAU Symposium 370 *Winds of Stars and Exoplanets*. In addition, XXXI IAU GA hosted other events that were of interest to our members and had our member's involvement, like the Symposium *Astronomical Hazards for Life on Earth* that had a strong component on solar energetic phenomena.

In addition, one of the Symposia being organised in 2024 is of particular relevance to Commission E4, namely IAU Symposium 388 *Solar & Stellar Coronal Mass Ejections*. This symposium will take place in Krakow, Poland on 5-10 May, 2024. Several Commission E4 members are SOC members or invited speakers in this interesting event.

3.2. Other events

One of the main events organised outside the IAU framework was the Symposium *Stars, magnetic activity, and circumstellar environments - confronting simulations and observations* that was organised during the European Astronomical Society (EAS) Annual Meeting in 2023. One of the SOC chairs and several SOC members of this event were from Commission E4. This symposium brought together experts on theory and observation of solar and stellar magnetism, and exoplanetary science to answer questions such as i) what are the dynamo observables and what observing strategies are needed to improve the studies of stellar dynamos in different stages of stellar evolution; ii) how do

the dynamos operate in single stars and in close binary systems; iii) how does the stellar magnetism affect the nearby exoplanet(s); iv) what are the basic conditions for habitability in terms of magnetism. This event was one of the most attended meetings in the 2023 EAS

In addition, the Cool Stars 21, which was organised in Toulouse in July 2022, had a very strong participation by the members of the Commission E4. For example, the SOC chair and several SOC members were from Commission E4 and also several splinter sessions organised in this event had our members as co-organisers.

4. Future outlook

When the working group *Impact of magnetic activity on Solar and Stellar Environments* changed into Commission E4, one of the main aims we set for the new Commission was to organise IAU Symposium or Focus Meeting every four years. This aim was well reached during this triennial with the Focus Meeting 5 *Beyond the Goldilocks Zone: the Effect of Stellar Magnetic Activity on Exoplanet Habitability* taking place in IAU GA in Busan. We aim at having a follow-up meeting towards the end of the coming triennial.

One of the main goals for the new commission was to catalysing closer collaboration between community members. One of the suggestions that was made regarding this was to organise an International Space Science Institute (ISSI) supported event. The organising committee of E4 is now in the process of applying for an ISSI Workshop on the topic of the Commission. If this application is not successful, we should consider applying for a smaller ISSI supported event, e.g., International Team during the coming triennial.

Heidi Korhonen
President of Commission E4