

COMMISSION B5

LABORATORY ASTROPHYSICS

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Div. C / Commission B5 WG

Spectroscopic and Radiative Data for Molecules

Div. C / Commission B5 WG

**Laboratory Astrophysics Data
Compilation, Validation and
Standardization: from the Laboratory
to FAIR Usage in the Astronomical
Community
(Joint with Commission B2)**

TRIENNIAL REPORT 2021-2024

1. Background

The purpose of the Laboratory Astrophysics commission is to address the multidisciplinary needs and requirements of modern astronomy and planetary science in terms of basic data and understanding of fundamental processes. As a result, the commission encompasses the four fundamental research areas that cover these needs and generate such data: atomic and molecular astrophysics, physics and chemistry of solid materials and condensed matter (dust and ices), plasma astrophysics, and nuclear and particle astrophysics. The commission embraces interdisciplinary studies crossing physical, chemical, biological, and geological sciences of relevance to astronomy, including experiment, theory, and modelling, from the nuclear and atomic/molecular level to application on astronomical scales.

Very often these astrophysical data needs are critical to obtaining the highest scientific returns from the very significant investments in missions and observations. As the era of “big data” evolves, this issue is being further recognised and becoming a greater challenge, and the Laboratory Astrophysics commission works to ensure astrophysical data is given strong referencing, appropriate databasing, and recognition for its role in modern astronomy research, whilst promoting the IAU and its mission beyond the confines of astronomy researchers.

By its nature Laboratory Astrophysics is a cross-disciplinary subject, and therefore interacts with many different IAU commissions, and tries to engage with different areas of astrophysics research. Further, the commission introduces non-IAU members to IAU

events; we face the challenge that many working in our field are members of professional bodies that are not the national nominating bodies for the IAU, and therefore not IAU members — nevertheless, we work hard to cooperate and work with IAU efforts and activities.

2. Developments within the past triennium

2.1. *Commission membership*

Presently the commission has 161 members, compared to 153 in 2021 (Fraser 2018). Of these, roughly 2% are junior members, and 23% are female, which can be compared with the percentages in the IAU of 9% and 22%, respectively. The members are distributed geographically as follows: Europe 53%, North America 28%, Asia 14%, South America 2%, with Africa and Oceania having only one member each (<1%).

2.2. *Communication*

Communication continues through occasional emails to the commission members via the IAU, through the commission web pages (https://www.iau.org/science/scientific_bodies/commissions/B5/info/), and through meetings including at the IAU general assembly (see below) and associated proceedings articles, as well as regular IAU annual and triennial reports. In addition, a Zenodo community (<https://zenodo.org/communities/cb5-labastro/>) has been started to collect and make public documents related to the commission’s activities, including past annual and triennial reports.

2.3. *Working groups*

In 2021, the commission had two working groups namely “Spectroscopic and Radiative Data for Molecules”, and “High-Accuracy Stellar Spectroscopy”. The former was continued for another three-year cycle, and provides useful, regular summaries of advances in the field. The latter was wound up after running its course of two three-year cycles. During the period, a new Inter-Commission B2-B5 working group on “Laboratory Astrophysics Data Compilation, Validation and Standardisation: from the Laboratory to FAIR Usage in the Astronomical Community” was formed; see Wilkinson et al. (2016) for a description of FAIR (Findable, Accessible, Interoperable, and Reusable) usage. The currently active working groups will present separate reports on their activities and developments in their fields.

2.4. *Meetings and symposia*

The commission held two sessions at the General Assembly in August 2022 in Busan, South Korea. One session was a general business meeting for the commission, including presentations of national and regional activities in laboratory astrophysics, and the other session based around the activities of the new working group on “Laboratory Astrophysics Data Compilation, Validation and Standardisation”. The agenda for the business meeting is given at <https://zenodo.org/records/7051332>, and included reviews of Laboratory Astrophysics activities in Korea, South America, Japan, the USA, and Europe, and of work in Quantum Sensing in Astronomy being done in Singapore. The presentations are all available at the Zenodo community (<https://zenodo.org/communities/cb5-labastro/>) and a proceedings article summarising the session was published (Barklem et al 2024). The agenda for the working group meeting is given at <https://zenodo.org/records/7050655>, and again all presentations have been collected at the Zenodo community, and a proceedings paper published (Dubernet et al 2024a).

The commission supported and was involved in IAU Symposium 371, “Honoring Charlotte Moore Sitterly: Astronomical spectroscopy in the 21st century”, held as a focus meeting at the General Assembly in Busan. This was an important recognition of Charlotte Moore Sitterly’s fundamental contributions to the field of astrophysical spectroscopy, particularly in understanding atomic energy levels, atomic transitions, and ultimately solar and stellar spectra. The meeting reflected the current needs and applications in atomic spectroscopy and its astrophysical applications, as well needs for molecules, ices, dust, aerosols, in application to a wide array of astrophysical objects and conditions.

The commission also supported and was involved in IAU Symposium 383, “Astrochemistry VIII: From the First Galaxies to the Formation of Habitable Worlds”, held in Traverse City, Michigan, USA during 2023, and proposed by commission H2.

3. Conclusion and future plans

Though the membership of the commission is growing, a clear challenge is to increase the number of junior members, and to expand in regions where participation is low, for example into South America, Africa and Oceania, and to encourage more participation from other regions, in particular Asia and North America. This should be achieved by making sure early career scientists and laboratory astrophysicists, in the broadest possible sense, are encouraged to join the IAU, encouraged and supported in their work, and invited and assisted in attending relevant IAU and laboratory astrophysics events.

In Europe and North America, it is important that activity in coordinating laboratory astrophysics is continually developed. In the USA, the Laboratory Astrophysics Division of the American Astronomical Society (AAS, <https://lad.aas.org>) and its meetings play a very important role. In Europe attempts to improve information flow and coordination include the web site (<https://astrochemistry.eu>), and an email list. The Symposium “European Laboratory Astrophysics in the JWST era” (https://eas.unige.ch/EAS_meeting/session.jsp?id=S6) has been selected for the next European Astronomical Society (EAS) meeting in Padova, Italy during July 2024, and is a first step in an attempt to organise regular meetings on laboratory astrophysics at the annual EAS meetings.

A long term goal is to establish a “Global Network of Laboratory activities and data for astrophysics”; see Dubernet et al (2024b) and Barklem et al (2024).

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