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COMPUTATIONAL ASTROPHYSICS

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TRIENNIAL REPORT 2018–2021

Activities of IAU Commission B1 during 2018-2021

The main goal of the Commission B1 in the past triennium was to strengthen the computational astrophysics community and, by the end of this term, to mitigate the pandemic consequences.

First and foremost, especially after XXX GA IAU (August 2018), our main efforts have been aimed at the Commission build-up. For that purpose, we have advertised our activities at various workshops, including IAU Symposia and ASTRONUM conferences. Also during this time we promoted the ways to become a commission member, sent numerous personal invitations in order to encourage interested people to join the commission. These efforts have led to a significant growth of the Commission membership (from less than 250 in 2018 to well over 300 by the spring of 2021) and to establishing tighter connections between the CB1 members.

An important tool facilitating the Commission growth and one of the major attributes of any public body is an information channel that would allow spreading any useful information pertinent to the Commission activity. With this in mind, in the beginning of the triennium we have initiated publishing the Commission newsletter, which is used to inform the computational astrophysics community about important news, forthcoming conferences and other events. We also use the newsletter to collect community opinions on various questions related to the CB1 activity and to computational astrophysics in general. Since 2018, nine issues of the newsletter have been published. We deem important that some students are among the newsletter subscribers. We intend to continue advertising the newsletter among young researchers that cannot be IAU junior members at this stage of their careers. Yet another activity that is related to the newsletter and which is still has not gained enough attention from the community is collection of abstracts of any papers related to computational astrophysics. We strongly encourage the community to submit their works to the Commission B1 secretary.

Along with the newsletter, as a primary location to disseminate all the necessary information, a Commission B1 web site had been opened in September 2018 at

http://www.icehap.chiba-u.jp/IAU_B1/index.html.

Later it has been transferred to the IAU web site and is now available at

https://iau.org/science/scientific_bodies/commissions/B1/info/.

There one can find a general description of the Commission, contact information, an archive of past newsletter issues, a list of relevant meetings, a list of commonly used public astrophysical simulation codes, and FAQs. Note that the original version of the web page is still maintained and hosted by the Chiba University (Japan).

A significant part of our housekeeping activity in the past triennium was related to conferences, both in terms of organizing them and of providing informational supports to other meetings connected to computational astrophysics, like Workshops on Numerical Modeling in MHD and Plasma Physics in 2019 and 2020.

Such conferences seem to be a vital component of the Commission agenda. Computational astrophysics is at the forefront of every major advance in modern astronomy, linking together very different aspects of the physical world operating at different scales. This implies a necessity to bring together experts from different fields and astronomy branches. A capacity building workshop was long overdue, where participants would take an active part in the coordination and furtherance of computational techniques in a wide range of research areas (stellar evolution, cosmology, accretion phenomena, planetology, etc.). We proposed to the commission members and to all interested colleagues, to hold a workshop aimed at building up momentum in our community around key computational challenges. We hoped that it will bring together experts in each of a broad range of fields, to set the stage for exchanges and to promote collaborations between participants.

And such a workshop has indeed been organized by the Commission B1 organizing committee in September, 2019, in St. Petersburg, Russia. Its title was “Challenges and Innovations in Computational Astrophysics” (ChaICA). The conference has been attended by 102 researchers from 14 countries and turned out to be a vivid demonstration of the diversity of topics in modern computational astrophysics. About 50 talks have been given by the conference participants. These talks covered a wide variety of subjects, ranging from relativistic hydrodynamics to Big Data and machine learning. Despite weather and quite a tight conference schedule, the participants also had a chance to exchange opinions and to enjoy the beauty of Saint Petersburg. Information on the conference is available at

<http://agora.guru.ru/display.php?conf=comp-astrophys-2019>.

But that was still only a first step to a more important initiative, an IAU symposium. While there have been some IAU symposia in which computational astrophysics was an important component, the IAUS 270 *Computational star formation* (Barcelona, Spain) held in 2010 is the only one explicitly dedicated to computational fluid dynamics in an astrophysical context. Of course, many IAU symposia include aspects of computational astrophysics dedicated to their respective fields. This can also be said about conferences held by self-organizing consortia of astrophysicists (like the European Science Foundation’s ASTROSIM, MODEST Consortium, and ASTRONUM Consortium). Many members of the Commission B1 are members of these consortia too, and have actively participated in these conferences. While these efforts are in line with the goals of the Commission, they are restricted to a narrower research profile and/or to specific geographic regions. Even such meetings as the 2011 meeting in Cefalu on *Advances in Computational Astrophysics* and the 2008 meeting in Ascona on *Frontiers in Computational Astrophysics: The Origin of Stars, Planets and Galaxies*, while covering a wide range of topics, at the same time stayed sufficiently focused.

This is why our next great plan was to organize a IAU Symposium on computational astrophysics. The preparation has started in 2018, and our proposal has been successful in securing the IAU support for a symposium. This has resulted in the approved IAU Symposium 362 to be held in Chamonix, France, in June 2020.

A great deal of work has been done in preparation to the Symposium. It was widely

advertised at national and international levels through newsletters (e.g., national astronomy societies, ESO), social media (Astronomy-devoted Facebook groups and Twitter) to boost regular postings at websites with high visibility. The aim was to attract half or more of the commission membership to gather momentum in this field of research. An the goal was close: the list of registered participants had peaked at 160 in March, 2020. A great job has also been done by the SOC to distribute travel grants among young scientists, under-represented states, and groups. This job spurred lots of discussions and trade-ins, but eventually we had managed to allocate support for almost 50 participants. Unfortunately, the COVID-19 situation has forced us to suspend all these activities and to shift the Symposium dates to November, 2021. All the up-to-date information can be found at

<http://iaus362.astro.unistra.fr/IAUS362.html>.

We still hope that these efforts will no be in vain, and the same venue and SOC/LOC configuration of the IAUS 362 will help to restart the process successfully, but we are also prepared to organize a hybrid symposium. In November, 2020, we held a virtual workshop nicknamed ChaICA-II (with the St. Petersburg workshop becoming ChaICA-I). Prior to that, we have distributed a questionnaire among the CB1 members to collect their opinions on the best ways to organize such a conference. Their valuable feedback has been extensively used in the meeting planning.

The ChaICA-II meeting has been held on November 18-21, 2020, and turned out to be quite successful, with the number of registered participants of 149. Speakers from 16 countries have presented 41 talks with topics ranging from celestial mechanics to theoretical cosmology. The final program of the meeting can be found at

<https://cb1-chaica2020.astro.unistra.fr/Programme.html>,

and all the recorded presentations are published at

<http://www.icehap.chiba-u.jp/IAU.B1/chaica2020/session1.html>.

We are very grateful to those participants who have agreed to share their contributions. Recorded talks will definitely become an indispensable resource in the future. We want to stress that the ChaICA-II meeting has been held without a registration fee, which opened doors for participants from economically less privileged countries. We plan to continue this series of virtual meetings, and the next online meeting (ChaICA-III) is tentatively planned for mid-summer, 2021.

Dmitry V. Bisikalo
President of the Commission