

Matter and radiation at extremes: Prospects and impacts

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High-energy-density science (HEDS) has been recognized as a comprehensive new area of physical science, with the potential to revolutionize various scientific and technological fields, including nuclear fusion, particle acceleration, astrophysics, and the properties of condensed matter under extreme conditions. That is why this journal, *Matter and Radiation at Extremes* (MRE), was established five years ago by the China Academy of Engineering Physics (CAEP) with the mission of informing the worldwide scientific community about progress related to HEDS, whether this be in the basic physics, its applications, or engineering.¹ New developments in HEDS have been enabled by the high-power pulsed machines and facilities that have come into operation during the last decade. From megajoule-class lasers, Z pinches to x-ray free-electron lasers (XFELs), these facilities provide routes toward inertial confinement fusion (ICF) ignition as well as overcoming a number of challenges in laboratory astrophysics. In this context, MRE seeks to become the major journal documenting developments in this exciting new discipline where the properties and behavior of matter and radiation in extreme states intertwine.

Important support and encouragement has been given to MRE by many individuals and institutions. The journal would not exist without the huge contribution of Academician Professor Yu Min, the recipient in 2014 of the prestigious Chinese State Supreme Science and Technology Award. In that same year, Professor Yu came up with the name for CAEP's new international journal, *Matter and Radiation at Extremes*, and participated actively in its development. On the occasion of this fifth anniversary, MRE wishes especially to recognize

Professor Yu for his deep contributions to science and to scientific publishing in HEDS. For its first three years, from 2016 until the end of 2018, the journal's publisher was Elsevier, and 92 high-quality papers contributed from all over the world were published during that period. MRE thanks Elsevier, the journal's editors and board members, and its authors, readers, and reviewers for this success.

On January 1, 2019 a new partnership began between MRE and AIP Publishing, one of the world's leading publishers in the physical sciences. This new partnership, aiming to increase the global impact of MRE and help achieve its goal of providing the scientific community with the best papers in the field, has already proven itself by the increased number of papers published, the optimization of publication times, and the number of citations. Since 2016, 174 papers have been published, with an average number of 30 in each of the first three years and a significant increase in 2019 to 50. In July 2020, MRE reached a particularly important milestone when it received its first official impact factor of 2.931. Other measures are also encouraging, such as the 25th position out of 85 in physics and multidisciplinary reviews within AIP Publishing, which indicates the high quality of the papers published to date. This outstanding success can be attributed to the strong commitment and valuable contributions from all the authors, editors, reviewers, readers, and editorial staff, both the previous and current publishing partners (Elsevier and AIP Publishing) and, of course, the hosting organization, CAEP. In particular, MRE would like to express deep appreciation to Dr. E. M. Campbell of the Laboratory for Laser Energetics (LLE), Rochester University, the former Co-Editor-in-Chief, who contributed greatly to the successful growth of the journal.

The year 2021 marks the beginning of an important new chapter for MRE. The time has now come to enhance its role as the most influential platform for researchers and particularly for young scientists (Ph.D. students and postdocs) in HEDS. To this end, several actions are being implemented at the beginning of 2021 to achieve MRE's mission of publishing high quality research to serve the community. The first, which has already been put in place, involves the reorganization of the different thematic sections of the journal. There are now four of these, each focusing on related areas involving similar physics.

The first thematic section, **Fundamental Physics at Extreme Light**, is dedicated to all physical phenomena related to the interaction of high-power (i.e., multi-petawatt) lasers with matter. The underlying physical processes, the possibility of extreme secondary sources based on particle acceleration and x-ray/gamma-ray generation, and applications to the understanding of ultrarelativistic astrophysical phenomena are considered. This section will provide a discussion ground for laser-induced quantum phenomena such as those that will be studied in upcoming multi-petawatt laser facilities.

As captured in the section on **Inertial Confinement Fusion Physics**, the quest for net fusion energy release in the laboratory through bringing materials to a sufficiently high energy density remains a great challenge. In this subject area, the journal seeks to publish papers describing concepts and designs for ICF driven by lasers, pulsed power, or particle beams, as well as the experimental techniques and facilities, drivers, targets, and diagnostics required for the achievement of net energy from fusion in the laboratory. All recent developments both in the quest for ignition itself and in understanding the underlying physical processes involved in ICF have their place in this section of the journal. We also include many important engineering challenges in areas such as driver technology, capsule fabrication, and innovative diagnostics.

The third theme, **Radiation and Hydrodynamics**, highlights the foundations of MRE, namely, radiation, hydrodynamics, and all of the associated physics. The papers in this section will concern the most recent developments in this continually expanding field of research. Research articles and reviews will address the following topics: atomic physics, warm dense matter, planetary physics, interaction of radiation with matter, hydrodynamic instabilities, and magnetized plasmas.

Finally, the fourth thematic section, **High Pressure Physics and Materials Science**, will gather together papers in this rapidly evolving field. The application of high pressure has fundamental effects on all states of matter, but for many years, the limitations of available experimental techniques meant that these effects were poorly understood. Recently, however, advances in diamond-cell technology, coupled with the availability of a wide array of diagnostic probes using optical and x-ray radiation from lasers and synchrotron sources, have provided unprecedented access to a wide range of phenomena occurring at high pressures. MRE will provide a forum for publication of key discoveries in high-pressure physics, chemistry, geoscience, and materials science.

The success of MRE relies greatly on its Editorial Board, which includes a panel of internationally recognized Associate Editors, each

with a particular field of competence, together with a diverse Editorial Advisory Board. At the beginning of 2021, as part of the reorganization of the journal, there have been changes to both the Editorial Board and the Editorial Advisory Board, with new members coming on to replace previous members reaching the end of their two-year terms. Each thematic section has Associate Editors responsible for its smooth management, dispatching papers to reviewers with the help of Editorial Advisory Board members and their assistants, as well as promoting MRE worldwide. They are supported by assistants from around the world with the aim of enhancing the journal's international coverage.

MRE plays an important role in the education of young scientists, in encouraging their development, and in helping them to gain recognition. A group of Early Career Collaborators has been established to help advertise MRE as a platform for potential authors among young scientists to advance their careers by publishing in the journal.

MRE also aims to have a strong impact with regard to issues of diversity both in terms of a wide geographical distribution of authors (31% from China, 15% from the USA, 34% from Europe, and 20% from the rest of the world) and by a substantial increase in the number of women on the different boards (where there has been an increase from 5% to 14% overall).

Finally, to further enhance the reputation of MRE, the Editorial Board has organized a series of webinars to highlight papers published in the journal or to cover hot topics in HEDS. These webinars will have a one-month periodicity in 2021, the first being planned for January 14, with H.-K. Mao, Co-Editor-in-Chief, as the speaker. Details of these webinars are available on the MRE website (<https://aip.scitation.org/mre/info/webinar>).

With the release of MRE's first impact factor and with the renewal of the Editorial and Editorial Advisory Boards, the journal is entering a new phase. It will continue its commitment to publication of original and influential research articles and reviews that address the physics of extreme states of matter and radiation, together with the associated engineering and technological aspects. It should be noted that the open access nature of the journal facilitates worldwide dissemination of the latest and most significant research.

As well as its primary role in publishing high-quality papers, MRE organizes the International Conference on Matter and Radiation at Extremes (ICMRE), which has been convened annually since 2016. This conference provides an effective communication platform for experts worldwide in the field of matter and radiation at extremes, both as authors and as readers. It also acts as a useful stimulus for new collaborative projects and for the generation of future papers.

REFERENCE

- ¹W. Zhang and E. M. Campbell, "Progress and prospect," *Matter Radiat. Extremes* **4**, 013001 (2019).