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Editorial: Presentations at the 4th Workshop of the German Astrobiological Society (DAbG) on Astrobiology, 26–27 September 2019, Vienna, Austria

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Editorial on the Research Topic

Presentations at the 4th Workshop of the German Astrobiological Society (DAbG) on Astrobiology, 26–27 September 2019, Vienna, Austria

Astrobiology investigates the origin, evolution, occurrence of past, present and future life in the Universe. The questions on how and when life originated on Earth are therefore linked to any astrobiological reasoning (Cottin et al., 2017a; Cottin et al., 2017b). It is a multidisciplinary science that embraces a variety of scientific disciplines including but not limited to physics, chemistry, biology, paleontology, geology, space exploration, planetary science, astronomy, and astrophysics (Martins et al., 2017; Cottin et al., 2017a; Cottin et al., 2017b). There are numerous universities and research institutions in the German-speaking world where both astrobiology research and teaching are being conducted. As a common umbrella organization for the astrobiology researchers working in those institutions, the German Astrobiological Society Deutsche Astrobiologische Gesellschaft, 2020, which started its activities in 2016, seeks to increase the international visibility of astrobiology in Germany and in other German speaking countries by bringing together astrobiology researchers to stimulate their collaboration across the borders. The DAbG considers itself as a part of the European Astrobiology Network Association (EANA) (Rettberg et al., 2015). According to its statutes, the DAbG is committed to serve to both scientific community and to the general public.

The goals and objectives of the DAbG are, in particular (Deutsche Astrobiologische Gesellschaft, 2020):

(1) Promoting research, teaching and education activities in the field of astrobiology.
(2) Promoting and maintaining the scientific exchange of information in the field of astrobiology between people from German-speaking countries and German-speaking persons living abroad.
(3) Facilitating collaboration with international organizations active in the field of astrobiology, in particular with the European Astrobiology Network Association (EANA) (Rettberg et al., 2015).
(4) Advocating scientific cooperation in the field of astrobiology, in particular at universities and other research institutions.

(5) Promoting university teaching in the field of astrobiology.
(6) Promoting early career scientists.
(7) Promoting the astrobiology publications and information systems in the German-speaking areas.
(8) Popularizing astrobiology for the German-speaking public.

The fourth DAbG workshop was organized under the overarching theme "Life in the Universe". The sessions of the workshop were dedicated to space biology, origin of life, prebiotic chemistry, habitability, biosignatures, extremophiles, exoplanets, and space missions and technologies. In this context, this Research Topic aims to bring together contributions from scientists working in various disciplines who have a common interest in astrobiology at diverse scales and in a variety of extreme environments. The scientific disciplines involved include extreme microbiology, geomicrobiology, biogeochemistry, astrochemistry, space engineering, philosophy in science, and these articles demonstrate the diversity and the breadth of astrobiology topics. In this research collection we present two mini reviews, two original research papers, two brief research reports, one Hypothesis and Theory article, and one perspective article.

The topic opens with a hypothesis and theory article by Witzany on a definition of life for astrobiological research. Witzany proposes a novel twenty-first century definition of life based on communicative interactions that are inherent to all processes of life. He formulates life as primarily communicative interaction between cells, viruses, and RNA networks. Witzany's life definition emphasizes biocommunicative structure of life, which was rather ignored by the mechanistic understanding of life that prevailed in the 20th century. Several further papers in this Research Topic are focused on the question of life search and detection of traces of life. The perspective article by Groemer and Ozdemir delivered a robust "Exploration Cascade" of planetary analog field operations which helps to optimize the search for extinct and/or extant traces of life, the scientific output of planetary surface missions and also helps to characterize the geological context of the exploration sites. Albu et al. presented in their research article a novel correlative microscopic method to structurally characterize extraterrestrial minerals. This method is a promising next generation technique which should be included in a toolbox for the astrobiological assessments of various astromaterials, e.g., enabling a detailed investigation of meteorites down to the nano- and atomic range and a characterization of primordial conditions in the Universe. Bredehöft comprehensively reviewed the most recent astrochemical research on abiotic CO_2 formation and radiation induced reactions between carbon monoxide and water on grain surfaces of interstellar dust. This work discusses the role of the HOCO radical in the abiotic oxidation of carbon monoxide. Skladnev et al. proposed a nanobiotechnological approach for life detection in extraterrestrial low-temperature environments.

Microbial life under multiple extremes was a topic of several other papers in this Research Topic. Microbial preservation under low temperature was investigated by Milojevic et al., their work showed that the optimized nutrient fitness favors microbial preservation in extreme stressful conditions. Verseux reviewed extensively bacterial behavior under low pressure conditions and provided insights on physiological adaptation of bacteria to hypobaria. Kölbl et al. investigated the influence of long-term desiccation on the mineral-grown polyextremophilic archaeon *Metallosphaera sedula* and described several specific metal-bearing substrates which were particularly beneficial to preserve a viability and cellular integrity of dehydrated metal-encrusted microbial cells.

In summary, this Research Topic of Frontiers in Astronomy and Space Science shows that astrobiology is an actively developing research field supported by vibrant and dynamic contributions of DAbG scientific community.

AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.