New quests in stellar astrophysics IV astrochemistry, astrobiology and the origin of life

Puerto Vallarta, Mexico, March 31st - April 5th, 2019

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FOREWORD

Among the most fundamental questions of humankind has been whether there are other worlds as our that host life forms, at least as we know them on Earth. The implicit question ”Are we alone?” can be traced back to Democritus and Epicurus and has transcended for more than 2000 years. In a time when the ever growing number of confirmed exoworlds has reached more than 4100 and hundreds of analogs of the asteroid and Edgeworth-Kuiper belts in our solar system have been detected with infrared and (sub-)millimeter infrastructures, it is easy to think that finding life beyond Earth seems plausible. Such possibility has triggered enormous multidisciplinary efforts to connect stellar and planet formation processes to the emergence of life in the solar system and possibly in the progeny around other stars.

Several scientific branches, such as Biology, Astrophysics, Geophysics, Geology and even Sociology, are amalgamated through the relative new discipline of Astrobiology that has become one of the most vibrant fields of research. This connection has been enabled and boosted by the availability of new instrumentation from space and from the ground that have deeply impacted our understanding of the properties of celestial bodies in a wide variety of astrophysical scenarios of astrobiological interest. Notably, for instance, the *Rosetta* and *Cassini* probes have provided spectacular results on the contents of organics in comets and in the icy world Enceladus. Multiwavelength observations of exoplanets and state of the art theoretical models have provided important clues for understanding their atmospheres, and, therefore, on their formation and evolution as well as on the potential presence of biomarkers.

Additionally, world-class infrastructures sensitive in the (sub-)millimeter, a band particularly rich in molecular transitions, are having and will have a profound impact in studies of the chemical properties and networks associated with different phases in the formation of stars. Studies with the Atacama Large Millimeter Array (ALMA) are now complemented by the largest single dish millimeter wave antenna, the Large Millimeter Telescope Alfonso Serrano (LMT) that started operations with its full 50m diameter dish in 2018. The LMT, with its state-of-the-art spectrometers and continuum cameras, will provide the sensitivity, resolution, and mapping speed for cutting edge investigations of the organic chemistry of galactic and extragalactic interstellar molecular clouds, protoplanetary disks, material around mature stars, and solar system objects.

The International Conference *Astrochemistry, Astrobiology and the Origin of Life*, held in Puerto Vallarta, Mexico on March 31st - April 5th, is the fourth of the ”New Quests in Stellar Astrophysics” meeting series aimed at stressing the importance of stellar physics to understand the properties of stars, their progeny and stellar systems at different scales. In the first meeting, in 2001, we reviewed the impact of stellar physics on global properties of stellar aggregates up to cosmological scales. In the second meeting, held in 2007, we focused on the ultraviolet interval to review our current knowledge on the properties of nearby and distant evolved stellar populations. The conference in 2012 was devoted to the multiwavelength perspective of solar-like (H-fueled) stars and addressed some of the important findings related to exoplanet searches.

The 2019 event gathered more than 130 participants from 20 countries that delivered a total of 85 contributions (invited and contributed talks, and poster presentations), most of which are included in this volume. The goal of the meeting was to convene researchers and young scholars from several fields to show the latest results on a number of interdisciplinary topics and enable cross-fertilization between scientists in the various disciplines. It also represented a good opportunity to gain insight into the future instrumentation from the ground and space that will substantially contribute to the exploration of the solar system and beyond, in search of clues for understanding how life emerged from cosmic and planetary precursors.

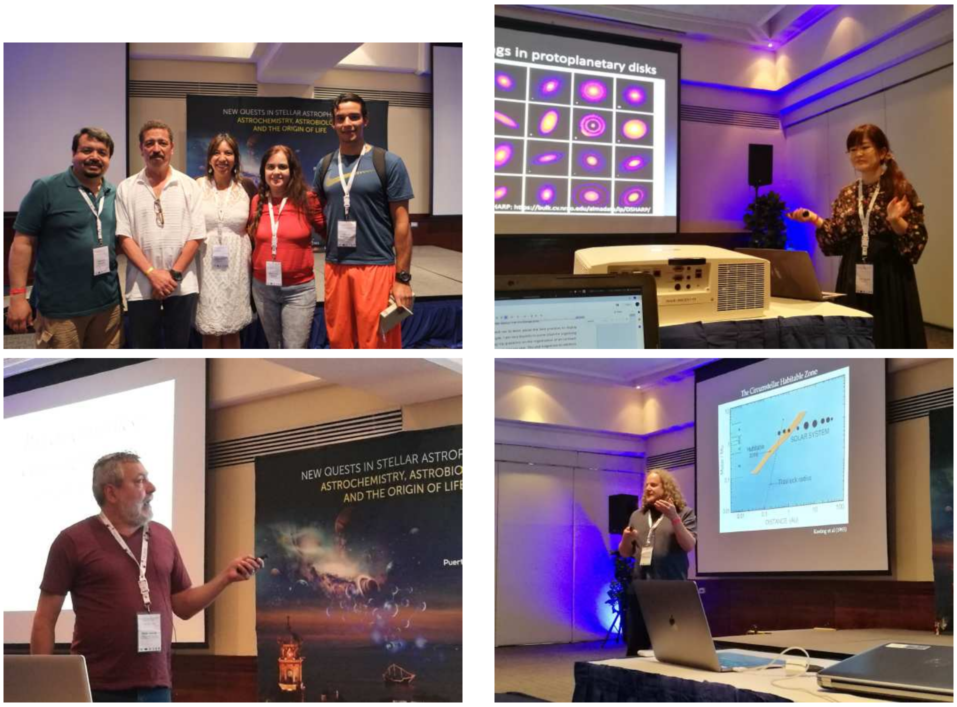
As it has been the case in the previous three events, we again had numerous young graduate and undergraduate participants that showed results of their investigations and participated in vivid and enlightening talks and discussions with world experts in the wide diversity of fields treated during the Conference (see program in https://www.inaoep.mx/~puerto19/).

The organizers are thankful to all the participants of the Conference and, in particular, to those who made the effort to prepare the contributions included in this volume. We are indebted to INAOE and the Consejo Nacional de Ciencia y Tecnología (CONACyT), through grants CB-2015-256961 (M. Chavez PI) and FORDECYT-297324 (D. H. Hughes PI) for the invaluable financial support, without which the meeting would not have been possible. Our gratitude also goes to the Centro Universitario de la Costa (CUC) of the University of Guadalajara for the logistic help and for providing spaces for the public talks.

We finally want to acknowledge the fantastic organizing work from the members of the Scientific and Local Committees and INAOE's technical staff. Their advice and guidance resulted in a very successful meeting.

Editors: M. Chavez Dagostino, E. Bertone, O. Vega and R. M. Chavez Dagostino

Waiting for the green flash.



Participants at work.

Participants at work.

Participants at work.

Participants at work and at dinner.

Participants at dinner.