Il Colle di Galileo

Astrochemistry@Arcetri: an international Conference and a School to study the chemistry of the interstellar medium

Fractionation of Isotopes in Space: from the Solar System to Galaxies (Istituto di Fisica A. Garbasso, Firenze, October 10-13, 2016)

Organisers: M. Beltrán, INAF-Arcetri, F. Fontani, INAF-Arcetri, T. Bergin, University of Michigan, D. Bockelée-Morvan, Observatoire de Paris, P. Caselli, Max-Planck-Institute für extraterrestrische Physik, C. Codella, INAF-Arcetri, S. Martín, ESO, T. Pillai, Max Planck Institut für Radioastronomie, S. Schlemmer, Universitat zu Köln, L. Testi, ESO and INAF-Arcetri

III KROME School on Computational Astrophysics (Villa il Gioiello, Firenze, September 19-21, 2016)

Organisers: S. Bovino, Hamburger Sternwarte, Andrea Ferrara, Scuola Normale Superiore, D. Galli, INAF-Arcetri, T. Grassi, STARPLAN, T. Haugbølle, STARPLAN, D. Schleicher, Universidad de Concepción

Abstract. A brief report on a conference and a school focused on the chemical properties of the interstellar medium, held in Arcetri in the Fall of 2016.

Keywords. Arcetri Astrophysical Observatory, interstellar medium, chemistry.

Chemistry plays a crucial role in the evolution of the interstellar medium and the process of star formation. Chemical reactions control the ionization of the gas, and hence the coupling with the Galactic magnetic field, regulate the cooling and the heating of the gas, and foster the formation of molecules and ions of increasing complexity. The emission of the most abundant molecules present in the interstellar medium, detected by ground-based radio telescopes and infrared satellites, is one of the best tools for determining the physical characteristics of dense molecular clouds and star-forming regions. The field of astrochemistry has

ISSN 2281-7727 (print)
ISSN 2281-9711 (online)
Vol. 6, 1, 2017, pp. 45-47
DOI: 10.13128/Colle_Galileo-20561
www.fupress.com/cdg

had an enormous boost since the advent of the Atacama Large Millimeter Array (ALMA), an interferometer consisting of 66 12-metre and 7-metre diameter radio telescopes observing at millimeter and submillimeter wavelengths. Thanks to the unprecedented spatial resolution and sensitivity of the ALMA, new and important developments are expected in forthcoming years for the study of astrochemistry, and of star and planet formation in general. For this reason, the time was ripe for the star-formation group at the Arcetri Astrophysical Observatory to organize an international conference and a school for PhD students to address observational and theoretical aspects of this blossoming field of research.

The international conference *Fractionation of Isotopes in Space: from the Solar System to Galaxies,* held at the A. Garbasso Physics Institute from October 10 to 13, 2016, was focused on the issue of the isotopic enrichment of molecules, a process known as *fractionation*. Space missions have shown that, among the most abundant elements in the Universe, three – hydrogen, oxygen and nitrogen – reveal isotopic enrichments (abundance greater than those of the Solar nebula) in comets, carbonaceous chondrites and other pristine small Solar System bodies. How these enrichments took place, and what are the possible links with the host environment and its past chemical history, is still a mystery. The main goal of this conference was to bring together observers, theoreticians and experimentalists from any type of astrophysical background interested in the fractionation of elements: in particular, star formation in the Milky Way (from the early pre-stellar core phase up to the protoplanetary disk phase), small Solar System bodies, and the chemical composition of Galaxies.

The *III KROME School on Computational Astrophysics*, held at Villa il Gioiello, from September 19 to 21, 2016, was aimed at introducing PhD students to the methods of computational astrochemistry, and consisted of morning lectures delivered by leading experts in the field, followed by afternoon hands-on tutorials and guided exercises. The latter were based on the freely distributed software package KROME, developed especially for astrochemical applications. To include a comprehensive chemical model in a simulation is in general a complicated issue, as the chemistry per se presents several bottlenecks: solution of stiff ordinary differential equations, tight coupling with the thermal evolution of the gas, computational efficiency, selection of relevant processes etc. Many simulations are therefore still based on simplified frameworks where a particular network is hard-coded, often involving simple and not very efficient solvers. By integrating chemical networks with the specially-designed KROME package and post-processing the output with radiative transfer, a link can be established between theory and observations.

The conference and the school were attended by about 50 and 35 participants, respectively.

Group picture of the Fractionation of Isotopes in Space conference (*courtesy L. Carbonaro*)