

Astrochemistry lectures

Prof. dr. E.F. van Dishoeck

May 17-26 2011 in Leiden (NL)

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The space between the stars is not empty but filled with a very dilute gas with extremely low densities and temperatures, providing a unique laboratory with conditions not normally encountered on Earth. A surprisingly rich chemistry occurs in these so-called interstellar clouds, as evidenced by the discovery of nearly 150 different molecules.

Some of these species were found in space before they were identified in a laboratory on Earth. How are these molecules formed? Where are they found and how do astronomers identify them? How do their abundances differ from place to place and what does this tell us about the evolution of the region?

The lecture series starts with a description of the basic principles of gas-phase and gas-grain chemical reactions. Subsequently the chemistry in the early Universe, in diffuse and translucent clouds, in photon- and X-ray dominated regions, and in shocks is discussed. Finally the evolution of molecular abundances from dark pre-stellar cores to star-forming regions and protoplanetary disks is presented and links with with early solar-system material, in particular that found in comets, are made.

Lecturer: Prof. dr. E.F. van Dishoeck
Assistant: I. San Jose-Garcia
Target group: Master students (astronomy, physics and chemistry students), Starting PhD students
Period: block of lectures May 17-26 2011
Programme form: 7 lectures and 2 exercise sessions
Exam: oral (by appointment) + presentation (3 EC)
Level: 500

Literature: handouts of lecture notes

Background material: The physics and chemistry of the interstellar medium, 2005, A.G.G.M. Tielens (Cambridge University Press), chapters 4, 5, 9, 10.

Schedule:

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Tuesday May 17:

11:15-13:00: L1: Basic molecular processes I

13:45-15:30: L2: Basic molecular processes II

Thursday May 19:

11:15-13:00: L3: Chemistry in the early universe

13:45-15:30: Exercise session 1: molecular excitation and radiative transfer (using RADEX on the web)

Friday May 20:

11:15-13:00: L4: Chemistry in diffuse+translucent clouds, PDRs

Monday May 23:

11:15-13:00: L5: Chemistry in shocks

13:45-15:30: L6: Chemistry in dark clouds

Tuesday May 24:

11:15-13:00: L7: Chemistry in star-forming regions, disks, comets

13:45-15:30: Exercise session 2: chemical models (using UMIST code)

Thursday May 26:

11:15-13:00: Student presentations

More information: <http://www.strw.leidenuniv.nl/education/courses/astrochem.php?node=34>