Observing Facilities for Astro-Chemistry: Evolution and Future Perspectives

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Abstract

Progress in unveiling the Molecular Universe has gone hand in hand with the development of IR, mm and submm observing facilities and their instrumentation. In particular in the early days, where the NRAO 12-meter antenna played a key role, every progress in receiver performance, in frequency coverage and sensitivity, paid off immediately in more detections of molecules and better understanding of the physics and chemistry of the ISM components. Soon more antennas were constructed and the Molecular Universe became an important and challenging science case for a global community. In parallel to ground-based facilities, IR and submm space observatories came into existence. In particular the first cooled observatory, ISO and its spectrometers, showed the power of space IR spectroscopy for molecular and ionic line investigations. This was further exploited by Spitzer and even more by Herschel's spectrometers.
Meanwhile the combined efforts from ESO, NRAO and NAOJ, to get ALMA project defined, funded and constructed, has ultimately resulted in an incredible tool for Astro-Chemistry, with ultra-sharp images in every observed spectral line. ALMA's development program goals are to get even higher spatial resolution with wider IF bandwidths for more instantaneous spectral coverage. There is now also the successful airborne SOFIA facility with a FIR heterodyne spectrometer, be it with limited observing time and some hindrance of the atmosphere. Nevertheless, new space missions have been or are being studied and defined to complement ALMA, in particular in the FIR domain where many hydride and ionic lines provide a unique ISM toolbox. A follow up for Herschel needs higher sensitivity and better angular resolution. Within a few years we expect data from JWST's MIRI instrument and there is a good chance for a future large IR/FIR space observatory through SPICA, Millimetron and OST. Fortunately, one of them, Millimetron, will have heterodyne receivers with the required high (106) spectral resolution and with a 10-meter aperture. These missions and their capabilities, to keep providing Xander cs with the necessary data, will be addressed in this presentation.

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