RIGS: Radiofrequency Interstellar Gas System for Molecular Spectroscopy

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The radiofrequency interstellar gas system (RIGS) is designed to simulate the evolution and reactivity in some key molecules of the interstellar medium (ISM) under intense ultraviolet (UV) illumination in order to study their rotational spectra using new broad band receivers in the 75-110 GHz and 33-50GHz domains developed for pure spectroscopy information of species of astrophysical interest and to follow their chemical evolution under extreme conditions.

The astrophysical interpretation of molecular line surveys at millimeters and submillimeter wavelengths is based on molecular spectroscopy of gas phase species, so modelling of this data requies a large amount of laboratory information concerning the reactivity of these species in the gas phase. Consequently we have designed and developed a RIGS dedicated to laboratory simulations guided by targeted astrophysical observations.

RIGS mainly consists of a cylindrical shaped chamber with broad band radiofrequency receivers on the outside. The chamber is a stainless steel cylinder of 90 cm long and 50 cm of diameter giving a total volume of 177 liters approximately, built with numerous mounting and access ports to allow a range of instrumentation, pumping systems, sensors and measurement instrumentation to be coupled to the chamber (figure 1). The main evacuation system is a turbomolecular pump with 950 l/s of pumping which provides several advantages as wide pressure range operation for different experiments and fast partial chamber cleaning between experiments. The photochemical studies will be carried out by UV lamps with emissions peaked at 185 and 254 nm and mounted parallel to the cylinder principal axis. The chamber is designed with non-parallel entrance windows (made of pure or hybrid polymer materials) to avoid multiple reflections at their surfaces during the spectra acquisition with the radiofrequency receivers. The versatility of RIGS lies on a design that allows not only further coupling of other systems (gas/radiation sources, detection instrumentation…) but also its integration as a module of the Stardust machine (see *K. Lauwaet et al.* and *G. Santoro et al.* abstracts).

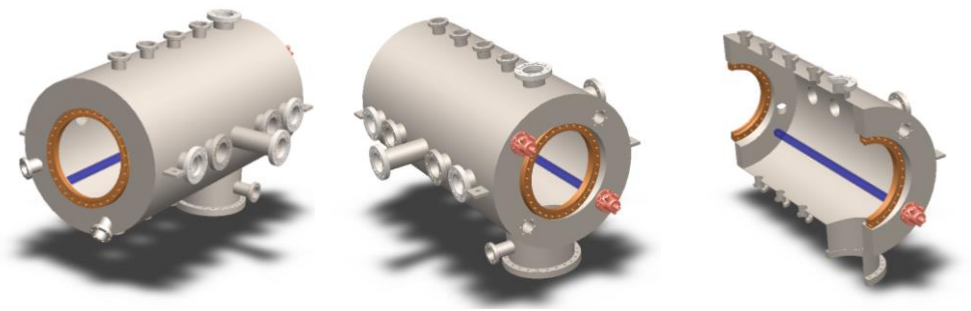

Fig. 1: RIGS desing from different views and cross section.

Regarding the detection and analysis systems, new radiofrequency receivers based on high electron mobility transistors (HEMT) with high sensitivity in 30-50GHz and 70-110 GHz bands will be developed and a quadrupole mass spectrometer with a 0-200 amu range will be used as a tool for better control of the chemical processes during experiments. The fact that these HEMT receivers are suitable for a gas phase simulation chamber has been successfully proved by a set of experiments performed with a prototype chamber in the 40 m radiotelescope of Yebes Observatory (Guadalajara, Spain) where methanol and OCS were detected (see *I.Tanarro et al.* abstract)

In conclusion, RIGS has been designed to simulate the origin and evolution of interstellar molecules under UV illumination, by their emission in the 30-50 GHz and 70-115 GHz domains with the new developed HEMT receivers, which will contribute to the interpretation of radiofrequency observations and to the development of instrumentation in the radioastronomy laboratory scope.