Interstellar Spectroscopy at the Madrid DSN Station

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### Host Country Radio Astronomy at MDSCC

The NASA Deep Space Network is a worldwide Network of antennas dedicated mainly to the tracking of NASA’s spacecraft. There are three main tracking complexes: Goldstone (California, USA), Canberra (Australia) and in Robledo de Chavela (Madrid, Spain). The Madrid Deep Space Communication Complex (MDSCC) is operated by OPTA/ARRM for 4PL. Spanish antennas can use up to 4% of the total antenna time at MDSCC, for radio astronomy observations. This "host-country" time is managed and assigned by the Laboratorio de Astronomía Espacial y Física Fundamental (LEAF) of the Spanish Instituto Nacional de Técnica Aeroespacial (INTA).

### Spectroscopy with DSN 70 m

Nowadays, only the 70 m antenna in the MDSCC is technically suited for radio spectroscopy research. We can observe at K-band, with a resolving frequency bandwidth between 10 and 20 GHz. The receiver of this antenna is a heterodyne cooled HEMT. Spectroscopy studies are carried out using a 256-channel autocorrelation spectrometer, with a variable bandwidth between 1 and 10 MHz.

### DSS 63 capabilities

The 70 m antenna at MDSCC is one of the best radio telescopes in the world. Its sensitivity and angular resolution (55\textdegree) at K-band are close to those of the largest single-dish antennas: GBT and Effelsberg 100m (Figs 1 and 2).

### Surveys

At this moment there are three important research projects that take place during the host-country time:

- **Water maser in planetary nebulae**
- **CCS survey in star forming region**
- **Water maser survey in Bok Globules**

### Water maser in planetary nebulae

Recently, Miranda et al. (2003) discovered the first planetary nebula (PN) with radio maser emission. The kind of emission was previously thought to be impossible to happen in PNs due to rapid destruction of water molecules. In 2008 a survey of water maser emission towards 27 PNe was started, using the MDSCC. Thissurvey reveals the VLA and Medicina 32m. The result of this work (Heras et al. 2006) is a new detection of the source IRAS 16569-2412 and other candidates.

### CCS survey in star forming region

We are also carrying out a survey of CCS (singlet-singlet transition) emission in star forming region. The CCS transition lines are very well defined to study the structure and the physical conditions in dark clouds because they are not very opaque. They are abundant and abundant in dark clouds, and they show bimodal clumping. All these facts make them useful for kinematical studies. CCS is a gas tracer whose lines are intense in cold dark clouds and less abundant when signs of cirrus star formation are manifested. This phenomenon can be explained in terms of chemical cloud evolution, and it can be used as a kind of clock to date the age of dense cores.

### Water maser survey in Bok Globules

Bok globules are cold dark molecular clouds of small sizes (\textcirca{} 0.01 pc). Low-mass star formation can take place in some of them, as supported by several radio and optical observations. They can be in different evolutionary stages, from prestellar dark clouds to protostars (McKee & Ostriker 1989). Class 0 sources are the transient evolutionary stages of YSOs and can carry energetic maser magnetic fields, associated with jets, molecular outflows and Herbig-Haro objects.

### References