Legacy Surveys with the JCMT: The Spectral Legacy Survey (SLS)

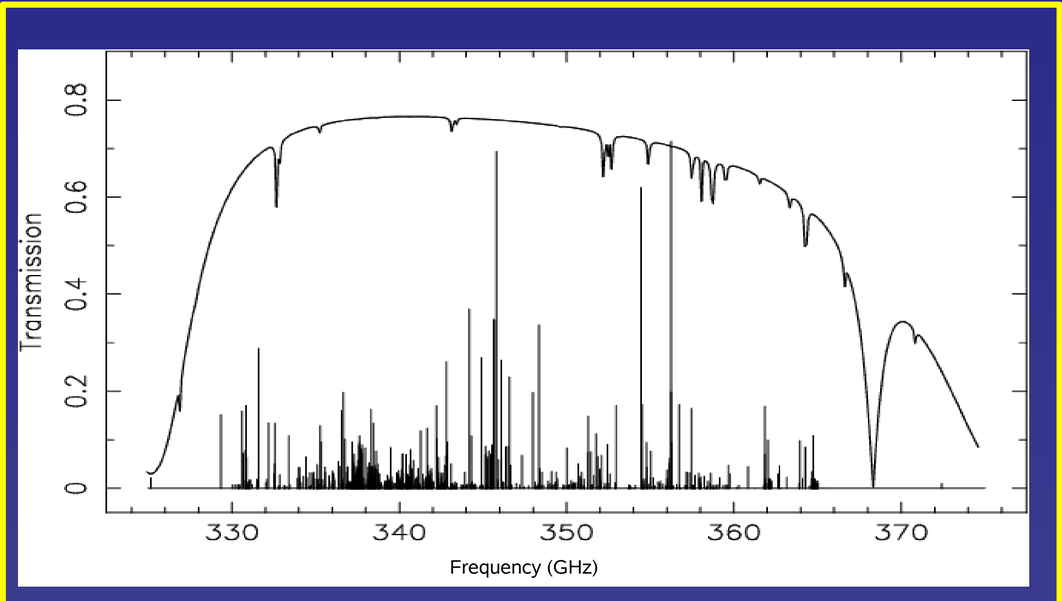
The SLS Collaboration[1]

www.manchester.ac.uk/jodrellbank/research/sls

The SLS: Stars form in the densest, coldest, most quiescent regions of molecular clouds. Molecules provide the only probes which can reveal the dynamics, physics, chemistry and evolution of these regions. However our current understanding of the molecular inventory of sources and how this is related to the physical environment and evolution of a source is rudimentary and incomplete. The Spectral Legacy Survey (SLS) will use the unique spectral imaging capabilities of HARP-B/ACSIS on the JCMT to study the molecular inventory, its evolution and the physical structure of a sample of objects spanning different evolutionary stages and physical environments in molecular clouds. The SLS will, for the first time, produce a spectral imaging survey of the content and distribution of all the molecules detected in an entire atmospheric window towards a sample of sources. Over two years the SLS will obtain fully sampled, single footprint (2'x2') complete spectral scans from 332 GHz to 373 GHz of a low mass protostar and its outflow outflow and three young high mass sources spanning a range of environments and evolutionary states. A PDR is also included in the survey. The targets for the SLS are shown in Table 1. Observations for the JCMT Legacy Surveys Programme, including the SLS, will start in early 2007. After a proprietary period all the data and data products from the SLS will become publicly available.

Table 1: SLS Targets

Source	Type
NGC1333 IRAS4	Low mass protostar (+ outflow)
AFGL2591	Young high mass source
IRAS20126+4104	Young high mass source
W49	Massive star forming region
OrionBar	PDR



Plot of the atmospheric transmission (solid curve) across the HARP-B band to be covered by the SLS. The vertical lines indicate the location of the spectral lines listed in Lovas (2004).

Instrument: A spectral imaging survey of the scale of the SLS is only feasible because of the commissioning of two new instruments on JCMT: HARP-B and ACSIS.

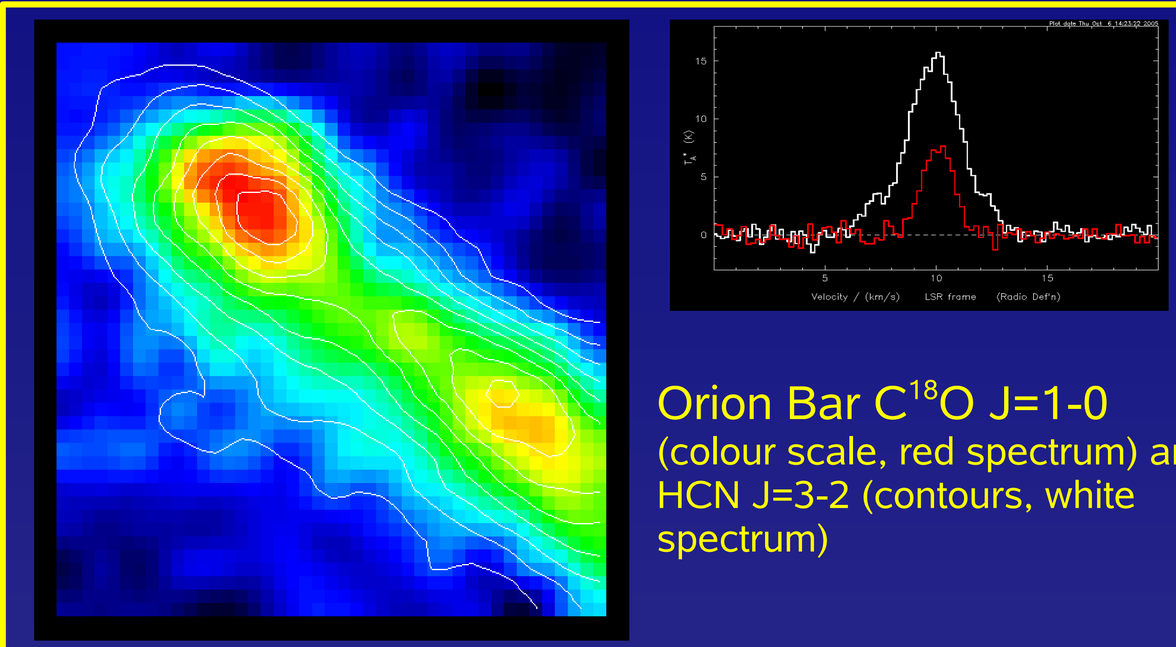
JCMT

HARP-B on JCMT

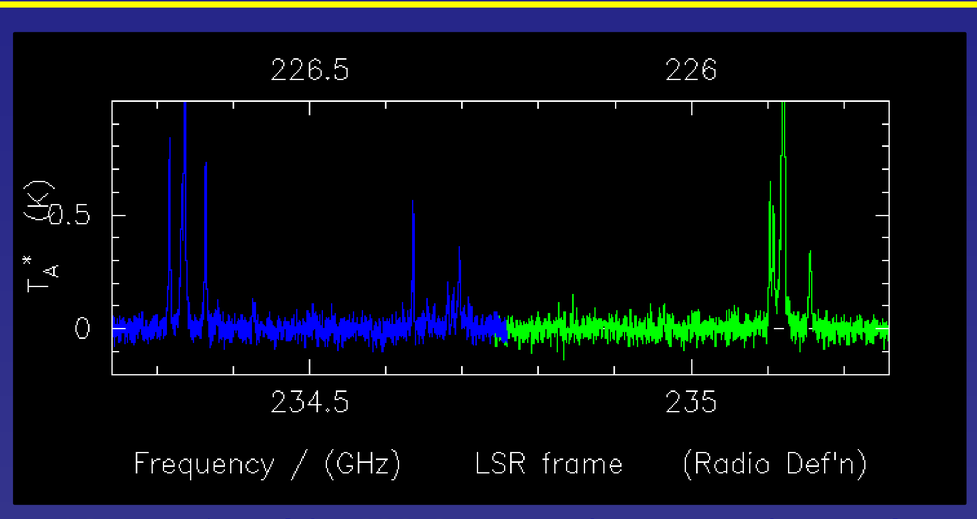
HARP-B: 4x4 pixel heterodyne array receiver with a 2'x2' field of view in a single footprint.

ACSIS: 16 IF input autocorrelator spectrometer with a maximum 2GHz bandwidth with 976kHz (~1.3 km/s) channels.

FIRST JCMT LEGACY DATA: Recently we have started obtaining JCMT observations of the SLS sources in the 230 GHz band. The goal of these observations is to obtain ancillary data which will help maximise the science available from the SLS observations. There are currently two components to this program. We are imaging 2'x2' fields (corresponding to a single HARP-B footprint) towards each of the SLS sources at six selected frequencies (Table 2). The frequency settings were chosen to target lines which will be important in the analysis of the SLS HARP-B data. In addition we are carrying out a complete spectral scan from 211 GHz to 279 GHz of the source AFGL2591. Some of these 230 GHz data are shown below.



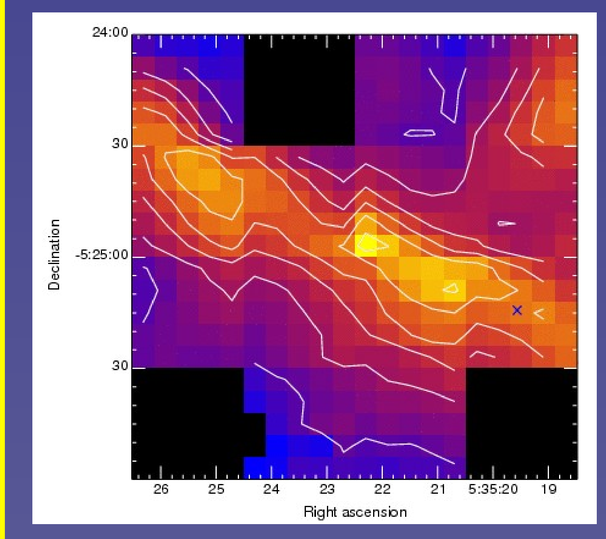
Orion Bar $C^{18}O$ J=1-0 (colour scale, red spectrum) and HCN J=3-2 (contours, white spectrum)

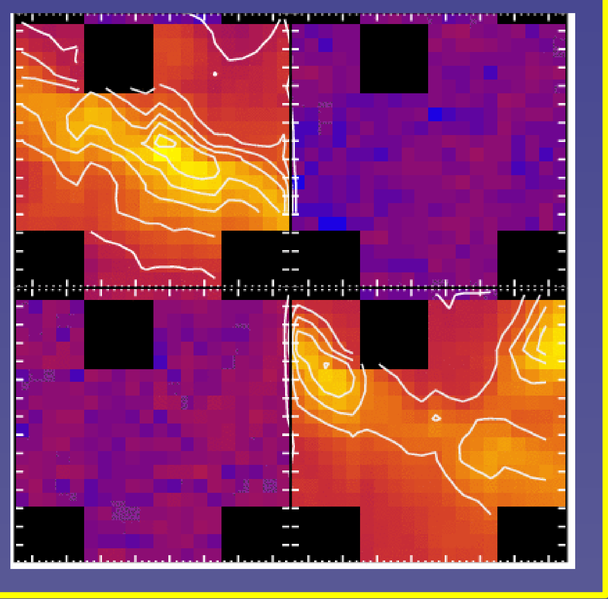


A 1GHz region of the 230 GHz complete spectral scan of AFGL2591 showing two of the 8 frequency settings which cover this frequency range. This is a double side band spectrum and the upper and lower axes show the frequency in each sideband.

FIRST HARP-B Test Data: The images below show part of a HARP-B cube of test data taken by John Richer, Jane Buckle and Bill Dent. The field covers the same region of the Orion Bar as shown above. The images clearly show that the emission from the two species is anticorrelated.

Left: Integrated intensity map of HCO^+ J=4-3. Right: Channels maps from the cube. Frequency increases from the top left panel to the bottom right panel. The first panel covers a line of SO_2 and the last panel HCO^+. (Note that three of the pixels were blanked during these observations.)





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