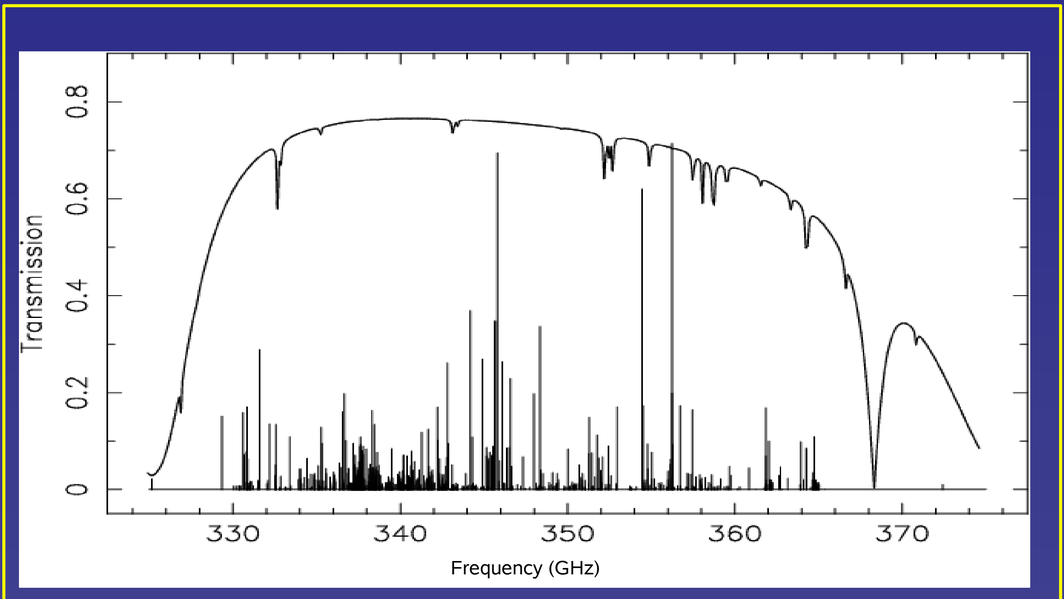
Legacy Surveys with the JCMT: The Spectral Legacy Survey (SLS)

The SLS Collaboration[1]

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 325 GHz to 375 GHz of two low mass protostars, an outflow and young high mass sources. A PDR and a prestellar core are 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 February 2007.

Table 1: SLS Targets

Source	Type
L1544	Starless Core
NGC1333 IRAS4	Low mass protostar (+ outflow)
LL1157	Low mass protostar + outflow
AFGL2591	Young high mass source
IRAS18182-1433	Young high mass source
IRAS21307+5049	Young high mass source
IRAS20126+4104	Young high mass source
W49	Massive star forming region
OrionBar	PDR

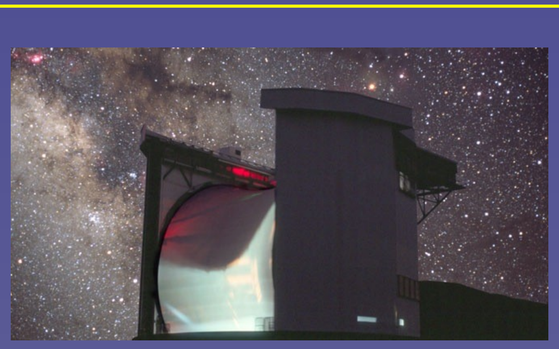


Plot of the atmospheric transmission (solid curve) across the HARP-B band to be covered by the SLS. The vertical lines indicate the location of the spectral lines listed in Lovas (2004).

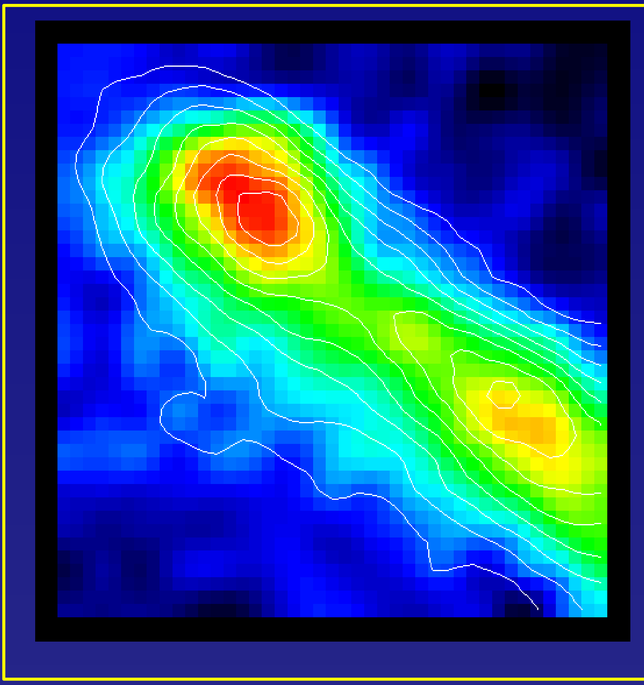
Instrument: A spectral imaging survey of the scale of the SLS is only feasible because of the commissioning of two new instruments on JCMT: HARP-B and ACSIS.

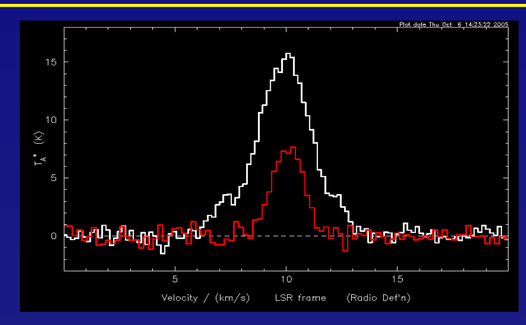
HARP-B: 4x4 pixel heterodyne array receiver with a 2'x2' field of view in a single footprint.

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

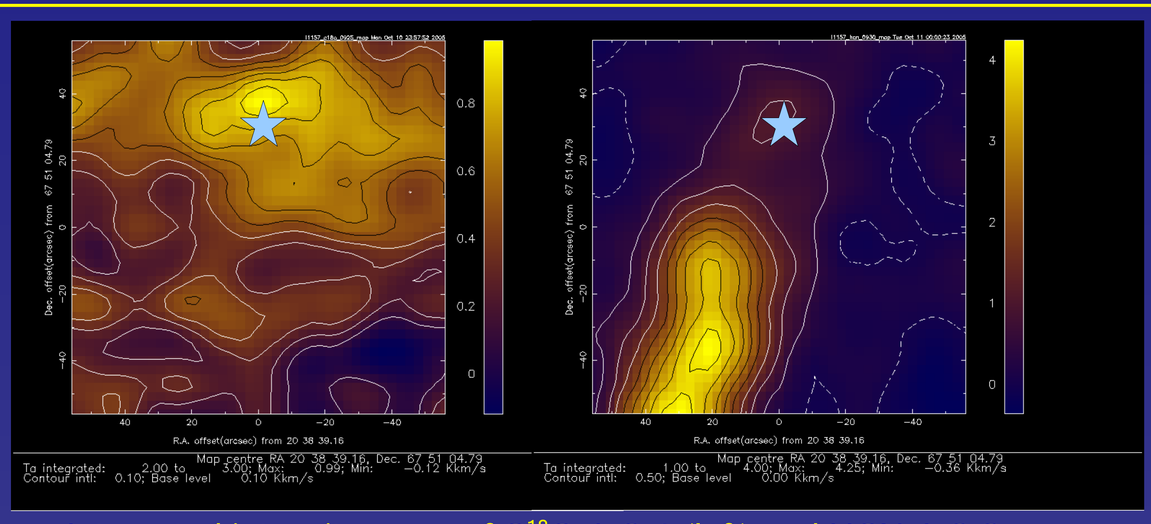


FIRST JCMT LEGACY DATA: Recently we have started obtaining JCMT observations of the SLS sources in the 230 GHz band. The goal of these observations is to obtain ancillary data which will help maximise the science available from the SLS observations. There are currently two components to this program. 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 examples of this 230 GHz data are shown below.





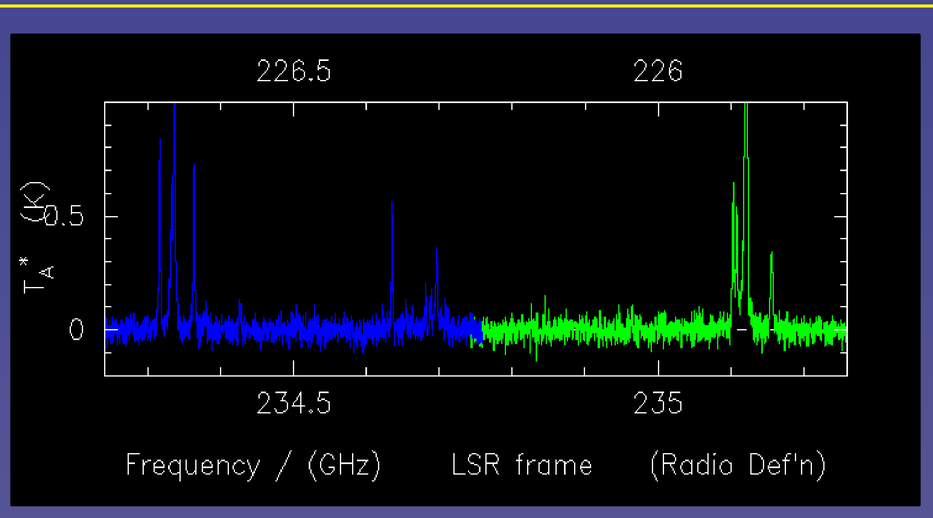
Orion Bar $C^{18}O$ J=1-0 (colour scale, red spectrum) and HCN J=3-2 (contours, white spectrum)



Integrated intensity maps of $C^{18}O$ J=2-1 (left) and HCN J=3-2 (right) towards the low mass protostar and outflow source in L1157. The blue star marks the location of the protostar.

Setting	Frequency	Species
1	216.6	DCO^+, DCN, SiO
2	219.5	$C^{18}O$, ^{13}CO
3	230.8	^{13}CS, N_2D+
4	242	CH_3OH
5	259.7	$H^{13}CO^+$, $H^{13}CN$
6	266	HCN, C_3H_2

Table 2: Frequency settings for 230GHz imaging observations.



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.

[1]Coordinators: G. Fuller (UK, Manchester), R. Plume (CA, Calgary), F. Helmich (NL, SRON). Members: John Richer (Cambridge) * Jane Buckle (Cambridge) * Jeremy Yates (UCL) * Mark Thompson (Hertfordshire) * Janet Bowey (UCL) * Jennifer Hatchell (University of Exeter) * Serena Viti (UCL) * Jonathan Rawlings (UCL) * Tom Millar (Manchester) * Helen Roberts (Manchester) * Toby Moore (Liverpool John Moores) * Glenn White (Kent/Open University/RAL) * CA: Henry Matthews (HIA/NRC Canada) * George Mitchell (St. Marys) * Andy Gibb (University of British Columbia) * NL: Michiel Hogerheijde (Leiden Observatory) * Xander Tielens (Kapteyn Astronomical Institute) * Ewine van Dishoeck (Leiden) * JAC: Harold Butner (Joint Astronomy Centre) * Jan Wouterloot (Joint Astronomy Centre) * Ming Zhu (Joint Astronomy Centre) * Per Friberg (Joint Astronomy Centre) * Bernd Weferling (Joint Astronomy Centre) *Others: Cecilia Ceccarelli (LAOG, Grenoble, France) * Emmanuel Caux (CESR, Toulose, France) * Peter Schilke (MPI, Bonn) *