Dissecting the G333 Giant Molecular Cloud
The Mopra DQS† Survey

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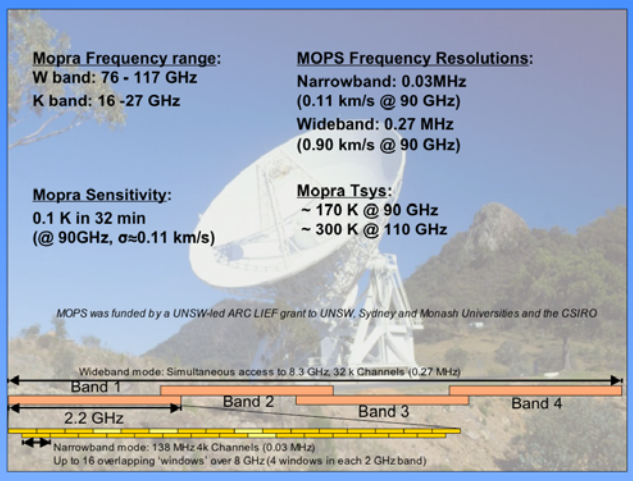
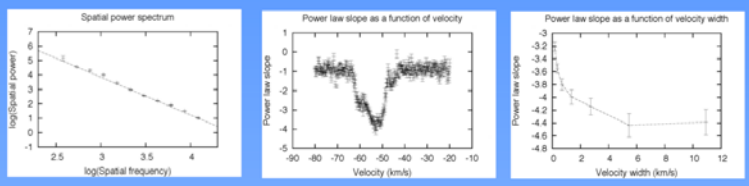
We have undertaken a molecular line mapping survey of the G333 GMC-complex – *the DQS survey* – using the 22-m Mopra millimetre-wave telescope in Australia, equipped with a new 8 GHz bandwidth digital filter bank (the MOPS). We have mapped the spatial and velocity distribution of ~20 different molecules and isotopomers emitting in the 3mm-band. Our aim is to obtain a comprehensive picture of star formation through an entire GMC, with an emphasis on the role of turbulence in its regulation. In this poster we present an overview of the results, including some of the specific investigations underway on interesting objects found at early stages of the star formation process.

Overview:

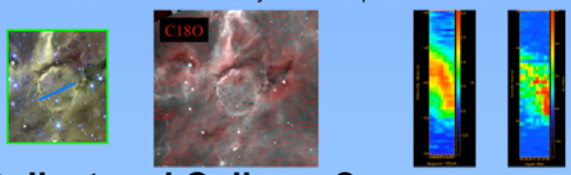
The *DQS* survey takes in a 1°.2x0°.6 (80x40pc) region covering the ~$10^6 M_\odot$ G333 GMC (including RCW 106), 3.6kpc away in the southern Galactic Ring. This includes the complete range of phenomenon associated with star formation. It uses a 35″ (0.6pc) beam and 0.1 km/s spectral resolution. The first measurements, of the ^{13}CO line, used an SIS receiver and 64 MHz correlator (see Bains *et al.* 2006, MN, **367**, 1609). With the commissioning of the MOPS 8 GHz spectrometer (see figure to right), allowing the simultaneous measurement of 8 lines, we have now obtained velocity cubes in ~20 molecular species.





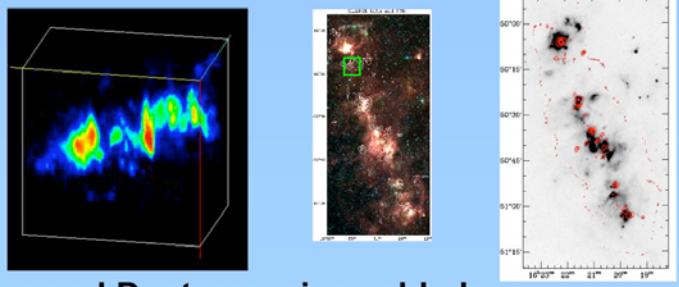
The Turbulent Power Spectrum

(L) The *Spatial Power Spectrum* obtained from the Fourier transform of the sum of the data planes that contain C^{18}O line emission. It shows a clear power law fit as a function of spatial frequency, as energy cascades from large scales to small (i.e. from 12pc to 1.2pc in this example). (C) The slope of the *Spatial Power Spectrum* (SPS) across the velocity of the C^{18}O line. It shows a clear power law at line centre, as well as 'red' noise in the continuum channels outside those of the line emission. (R) *Velocity Component Analysis* (VCA) – the power spectrum slope, as a function of velocity width, for the C^{18}O line emission. This shows how the SPS slope changes from 'thin' to 'thick' velocity slices, once the turbulent line width is reached. Further analysis will be presented in Jones *et al.* 2008.



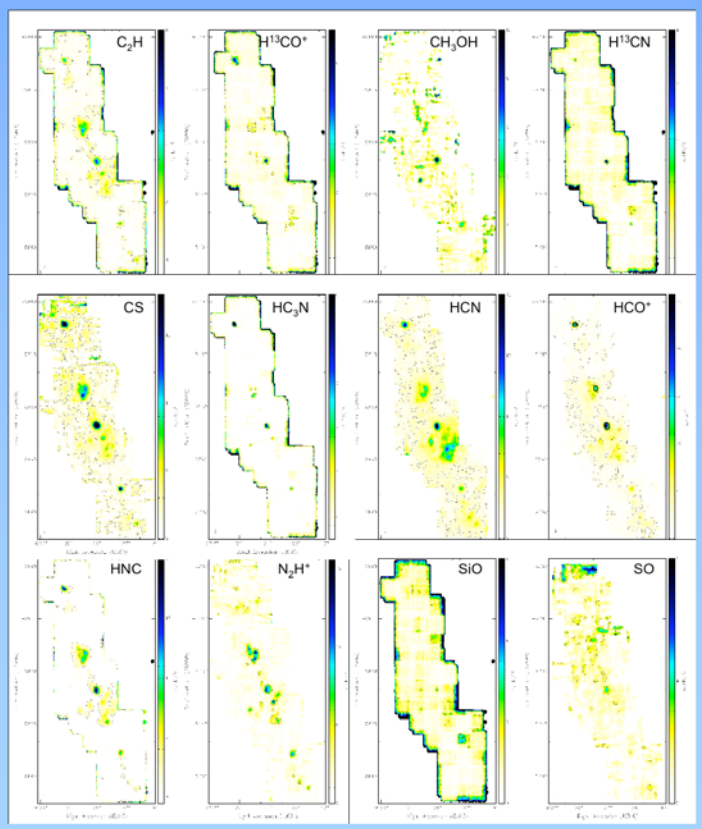
Collect and Collapse?

One example of an intriguing source within the *DQS*. A ring of PAHs emission seen by Spitzer at 8μm (L) appears to be expanding into and compressing molecular gas (C^{18}O; C), with a velocity gradient of ~4 km/s across it, seen in the slices in both C^{18}O and CS (R) – collect and collapse star formation at work? Further analysis will be presented in Cunningham *et al.* 2008.



Gas and Dust: massive cold, dense cores

Three views of the *DQS*: (L) 3D velocity cube in the ^{13}CO line (velocity axis in red), revealing the ~5 km/s velocity width of individual cores and a ~0.2 km/s/pc gradient along the 70pc-long axis of the GMC (5 x galactic rotation) – see Bains *et al.* 2006 and Wong *et al.* 2008. (C) Spitzer GLIMPSE view, at 3.6+4.5+8.0μm, overlaid with the Mopra N_2H^+ contours revealing where the dense gas cores are. (R) Dust emission – 21μm image (MSX) overlaid by contours of 1.2mm (SEST/SIMBA; Mookerjea *et al.* 2004) – seen to have a similar distribution to dense gas tracers such as N_2H^+. Many dust cores are only seen at 1mm, showing that they are extremely cold (i.e. < 50K). See Burton *et al.* 2008 for further analysis, with a particularly cold core with evidence for an outflow examined in detail in Lo *et al.* 2007, MN, in press.



The Mopra Molecular Line Maps

Velocity-integrated maps of the molecular line emission from 12 species in the *DQS*. These maps were obtained with just 2 separate settings of the MOPS correlator, and made using on-the-fly (OTF) mapping. The overall map is a mosaic of individual scans each covering 5'x5', scanned in both RA and Dec directions. See Lo *et al.* 2008 for further description and analysis.

†*DQS = Delta Quadrant Survey*