Cosmic-ray ionisation of molecular gas
HCO+ mapping with ATCA

Nick Tothill

with Chris Jordan (ICRAR), Shari Breen (SKAO) & Max Voronkov (CASS)

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Cosmic-ray ionisation of molecular gas

Molecular gas is generally neutral; but there is some ionisation.

1. ionisation allows magnetic regulation of cloud dynamics eg star formation
2. molecular ions drive chemistry through ion-molecule reactions

Photoionisation happens through UV flux at cloud 'surfaces'
Cosmic rays ionise material deep inside the cloud
We generally use ζ — the rate of cosmic-ray ionisation in s^{-1}

Cosmic-ray ionisation and CTA

We know that it's more complex than ζ
CTA is a machine to image the interaction of cosmic rays with molecular gas
We want to compare maps of molecular gas, molecular ions, and cosmic-ray interaction

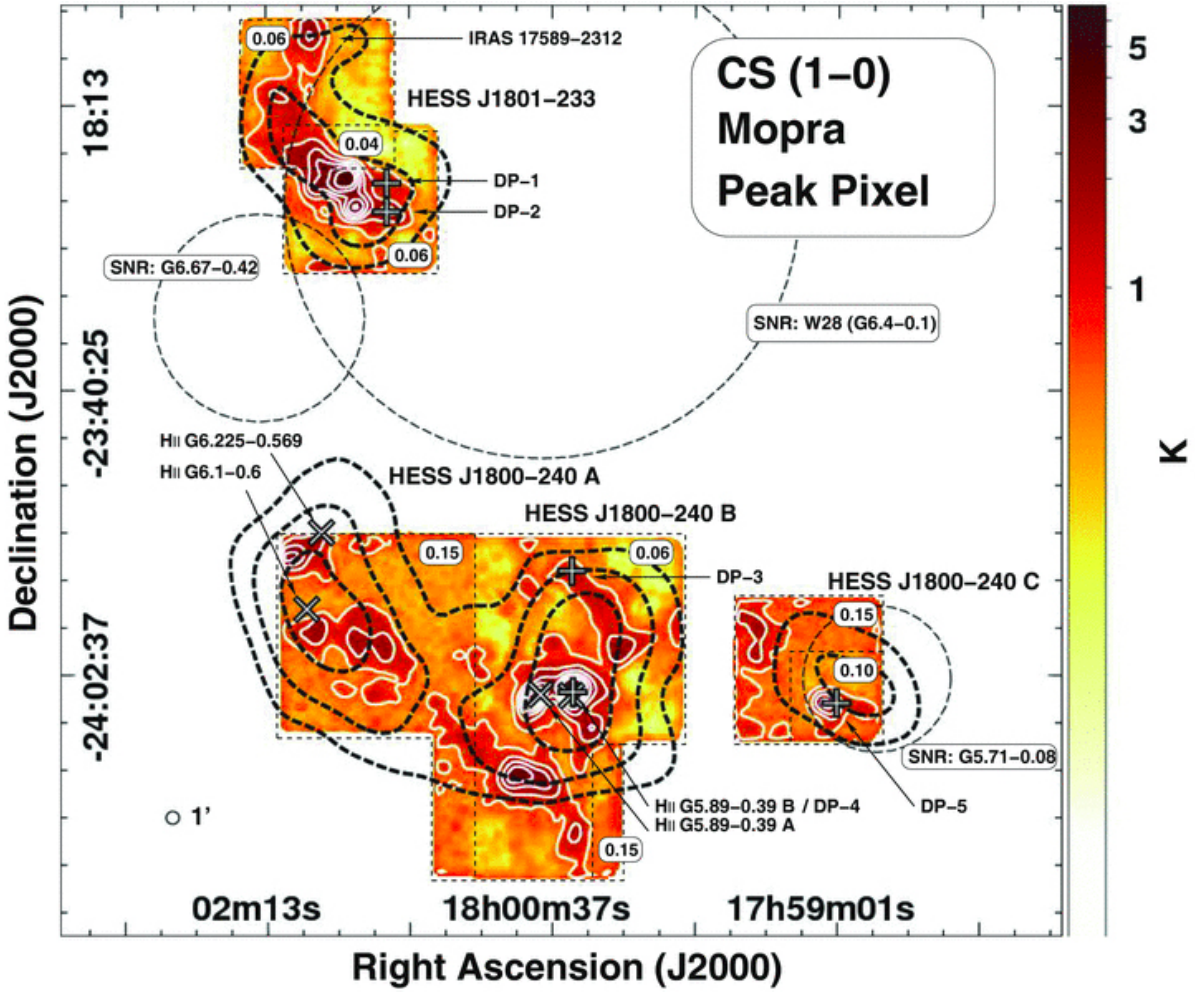
HCO+ as a tracer

HCO+ is the molecular-ion equivalent to CO; fairly abundant, easy to detect
HCO+/CO can be used to estimate the ionisation rate ζ (Caselli et al 1998)
DCO+/HCO+ can be used to estimate the electron density n_e;
but DCO+ is difficult to observe

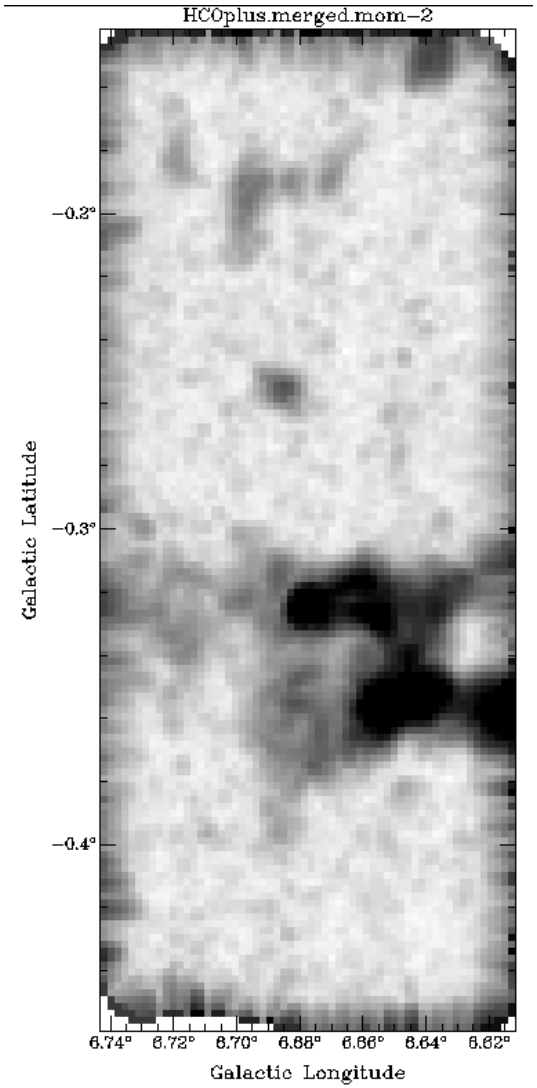
Mapping with ATCA

HCO+ 1–0 is at 89.2 GHz, well within the capability of ATCA 3mm band ($<\sim$ 110 GHz)
ATCA has a demonstrated capability to use 5 antennae as single-dish telescopes simultaneously
(originated by Chris Jordan for MALT45, StarFISH…)
So we should be able to use the same technique for 3mm

Pilot project — W28



Early results



HESS J1801-233
northern blob:
gal: $\ell = 6.66 - 6.68, b = -0.32$;
eq:
$(\alpha, \delta) = (18:01:55, -23:21:29) - (18:01:57, -23:20:27)$
southern blob:
gal: $\ell = 6.64 - 6.66, b = -0.36$;
eq:
$(\alpha, \delta) = (18:02:01, -23:23:43) - (18:02:04, -23:22:41)$

Moving on

Mapping works!
We have maps of other parts of W28 as well, but there are some processing issues to be sorted out.
More observing time awarded this winter. Priorities:

- Science!
- Can we go faster?
- Do we need to basket-weave?