

ALMA ACA 7m observations toward two Orion cores very close to the onset of star formation

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Planck Galactic Cold Clumps

$T_{\text{dust}} = 10\text{-}20\text{ K}, \sim 14.5\text{ K (median)}$

~ 1000 PGCCs were mapped with
JCMT SCUBA-2 (“SCOPE” project)

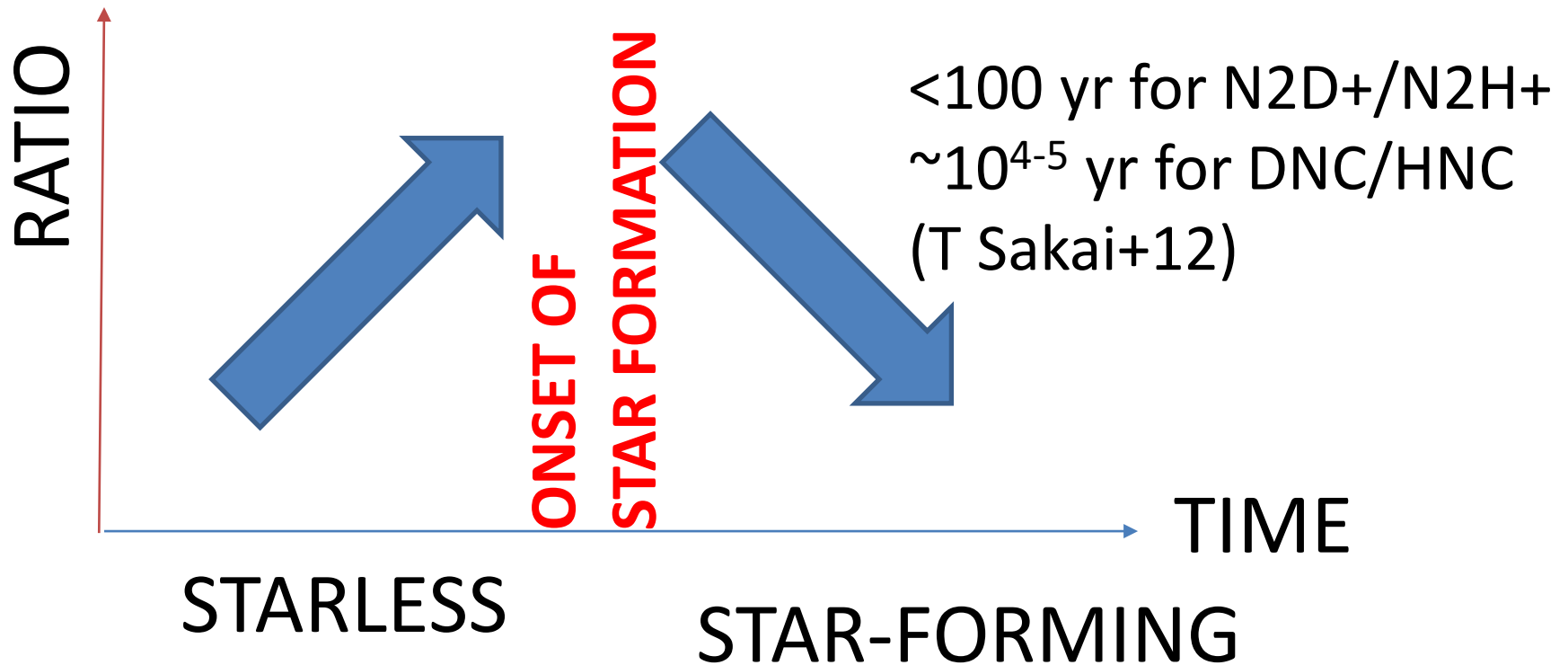
All-sky distribution of the 13188 PGCC sources (black dots) and the 2000 selected PGCC sources (open dots) overlaid on the 857 GHz Planck map.

N₂D⁺ intense cores



- **Nobeyama 45m follow-up:** 115 cores in Orion region (Ori A and B GMCs, λ Ori)
- **N₂D⁺** was detected toward \sim 40 cores out of 115 (**37%**)
- There are **several N₂D⁺ intense cores** in 115 cores.
- We select two N₂D⁺ intense Orion cores for **ALMA 7m observations** (Cycle 4 Suppl. call)
 - 5'' resolution, Band 6

N₂D⁺/N₂H⁺ or DNC/HNC
in cold (10-20 K) cloud cores

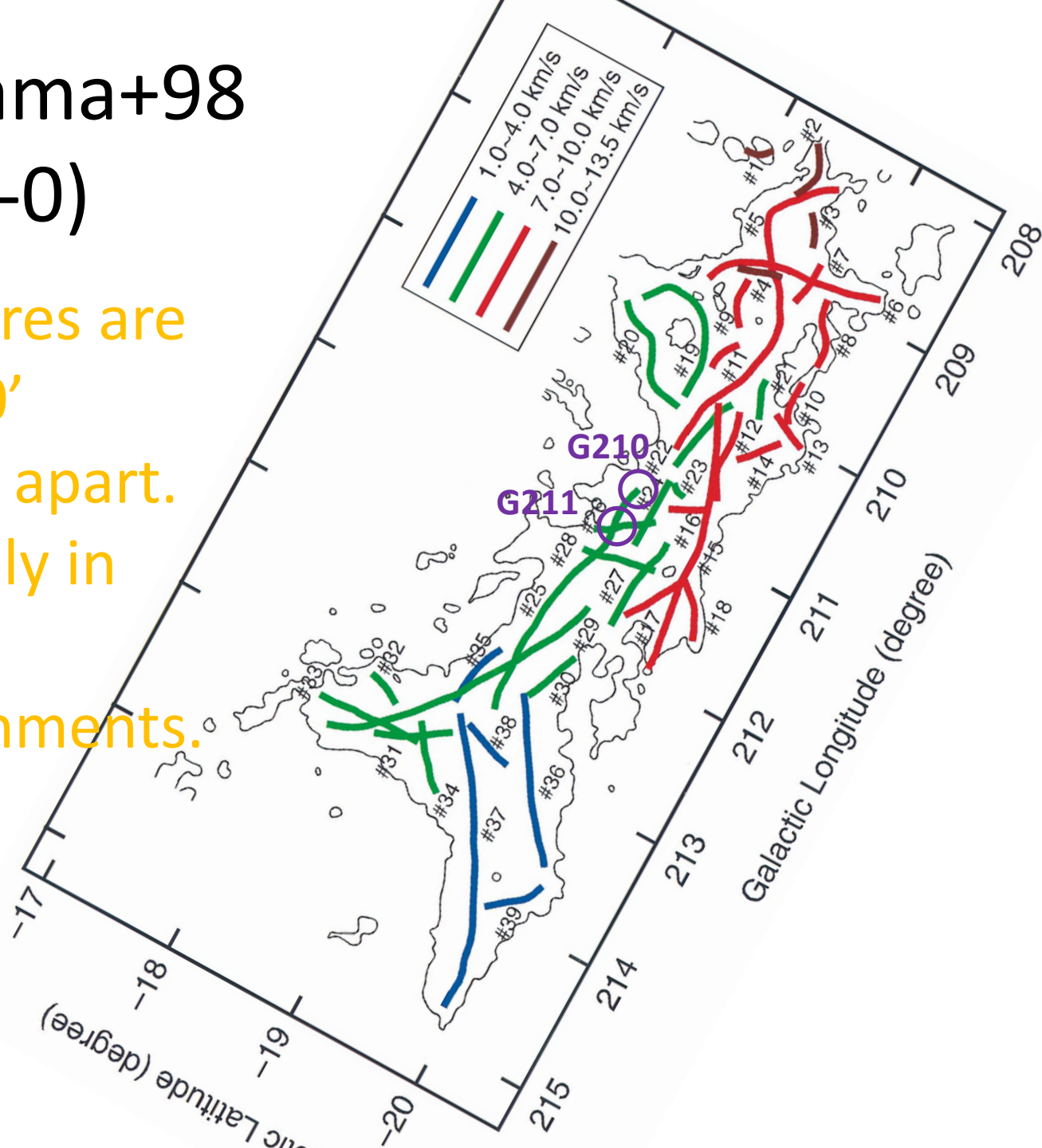


We can see how star formation starts!

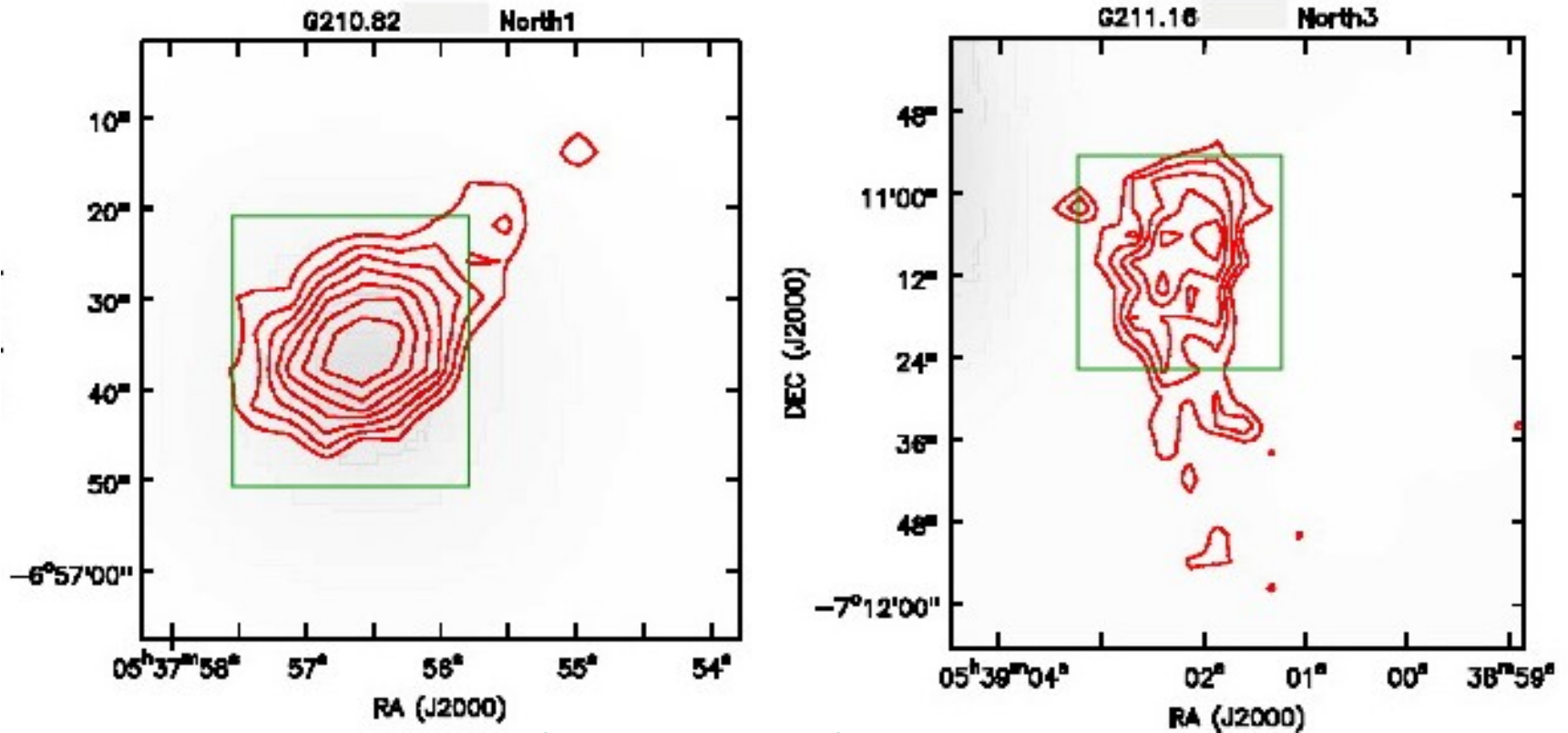
Nagahama+98

^{13}CO (1-0)

- Two cores are only 20' (2.6pc) apart. Probably in similar environments.



G210 and G211 SCUBA-2 850um map star-forming vs starless



Green box: ALMA 7m observing regions

SUMMARY

- Both cores were detected in N_2D^+ and DNC with Nobeyama 45m, but only G210 (star forming) was detected in these lines with ALMA 7m.
 - N_2D^+ and DNC distribution seem to be extended in ALMA 7m 5 arcsec resolution (resolved out) or $J=3-2$ is much less excited than $J=1-0$ for the starless core G211
- The starless core G211 was detected in DCO^+ , HCO^+ , CO. The DCO^+ linewidth is almost thermal.
- The star forming core G210 shows double peaks aside the dust continuum peak in N_2D^+ and DCO^+ .
- Both cores are about solar-mass, and close to virial equilibrium
- J/M for G210 in DCO^+ is close to the empirical relation of $J/M \propto R^{1.6}$ or a little higher in the J/M - R diagram (collapsing edge-on disk?).

THANK YOU!

- Note that the **deadline for Nobeyama 45 m**, which can observe **D molecules** with receiver T70, is **December 12**.