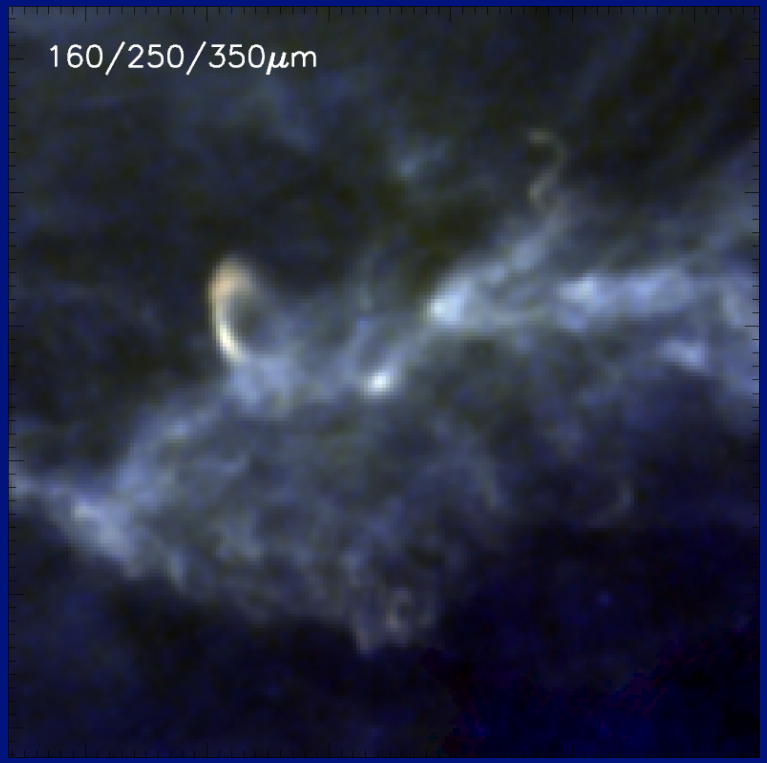
Starless cores in the Polaris Flare



Derek Ward-Thompson
on behalf of Spire SAG3 and the Gould Belt key programme

ESLAB, May 5th, 2010

Background

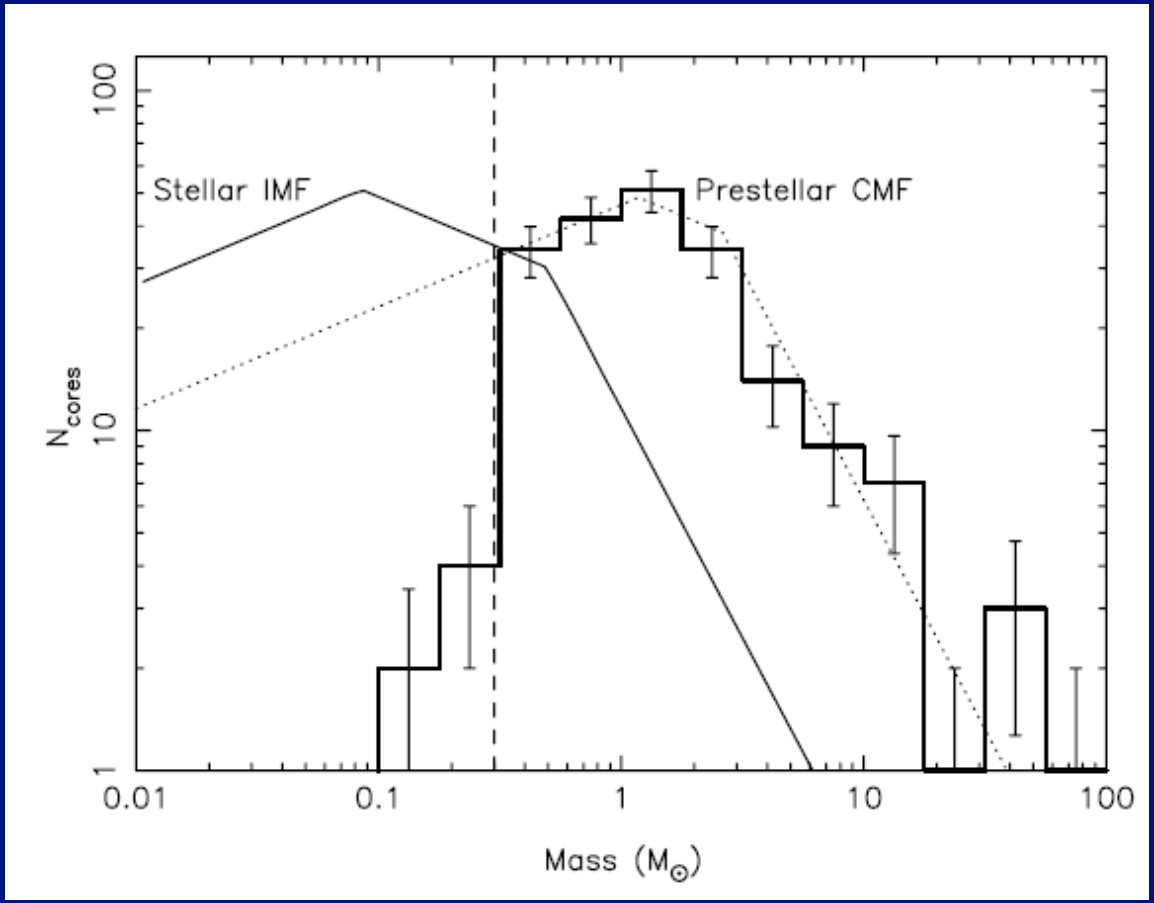
- The initial conditions of star formation
- The earliest stage - starless cores
- Core mass function (CMF) determines IMF
- Environmental effects
- Need to observe many different regions
- Aquila and Polaris observed so far
- Very different results

Herchel Gould Belt Survey

Main science questions:

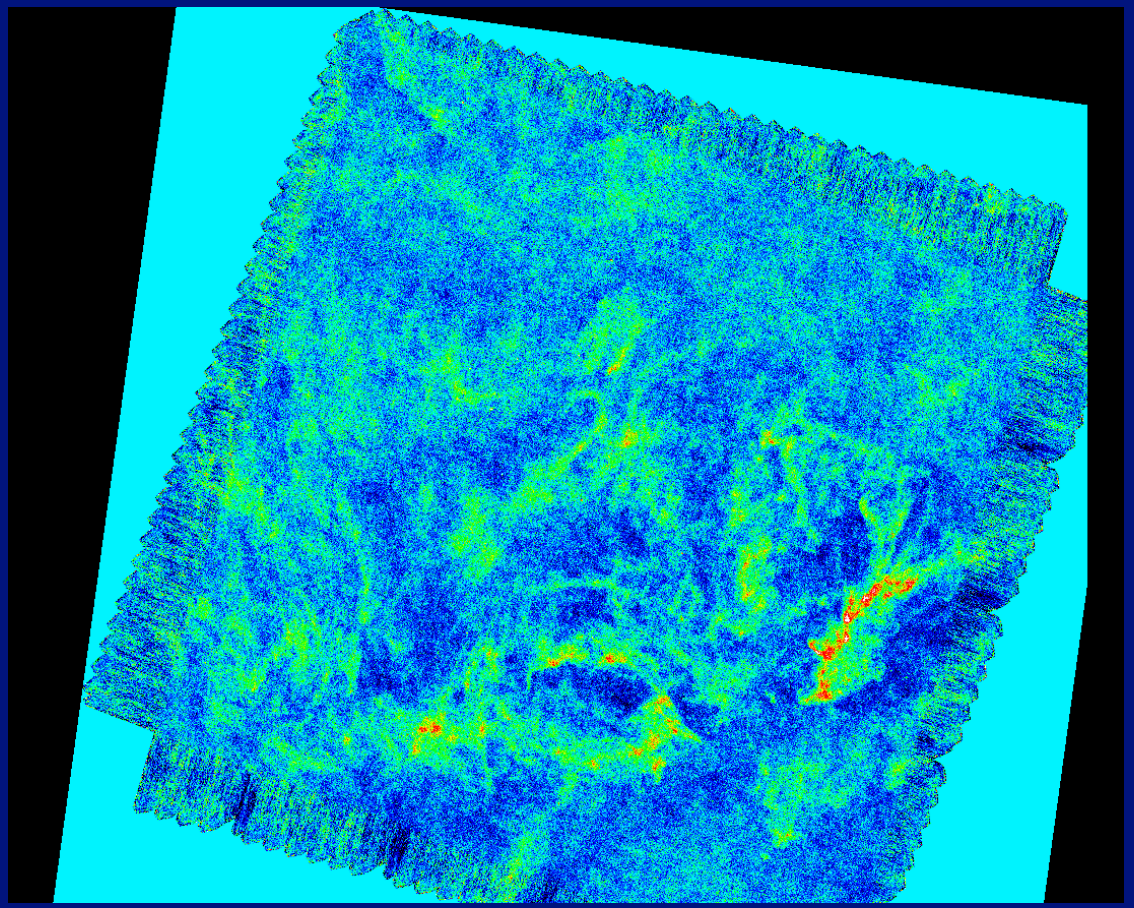
- What determines the IMF?
- Clarify link between CMF & IMF
- What generates pre-stellar cores?
- What governs pre-stellar core evolution?
- What is the timescale of core & star evolution?
- Is it slow and quasi-static? (eg B-field dominates)
- Is it fast? (eg turbulence dominates)

Core mass function

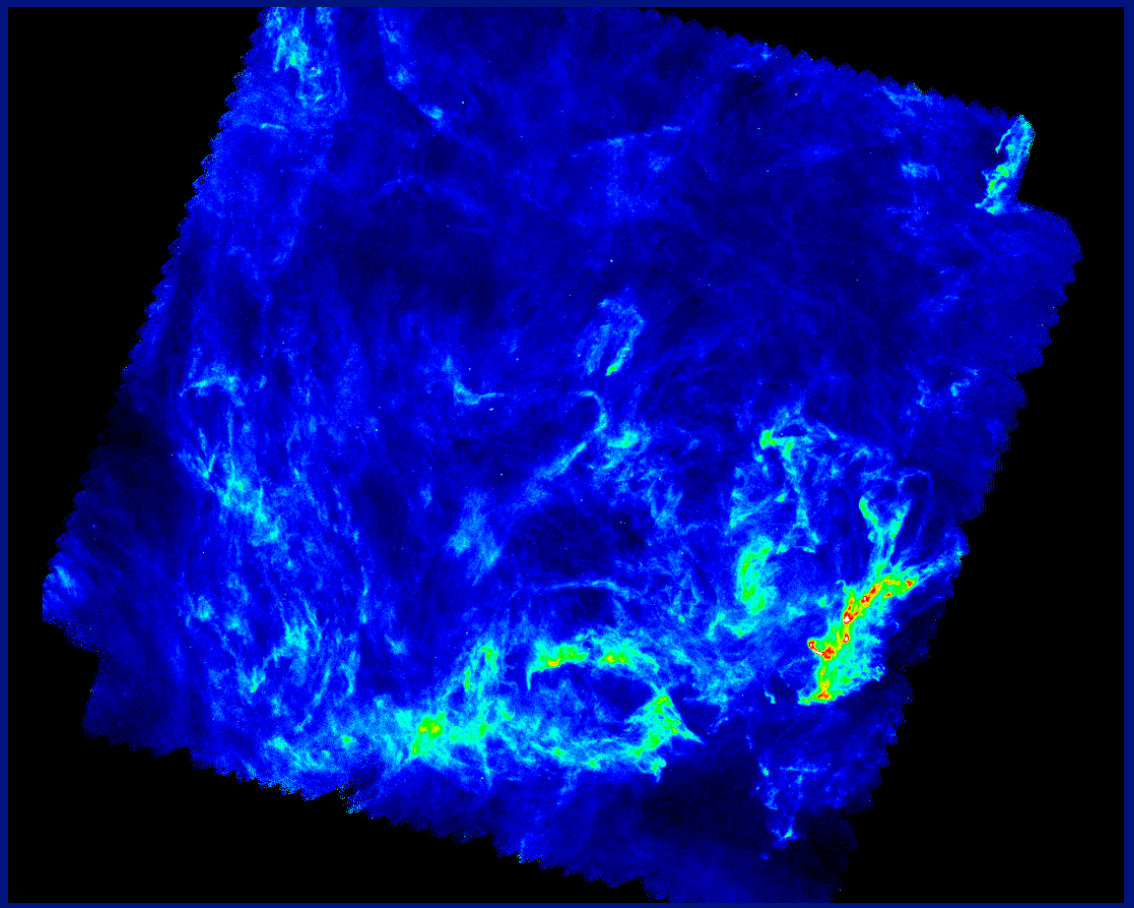


Orion:- Nutter & Ward-Thompson, 2007, MN, 374, 1413

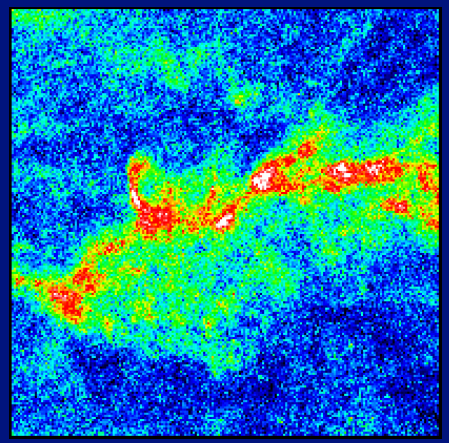
PACS at 160 um

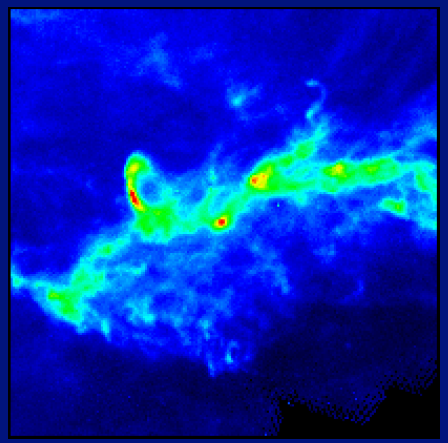


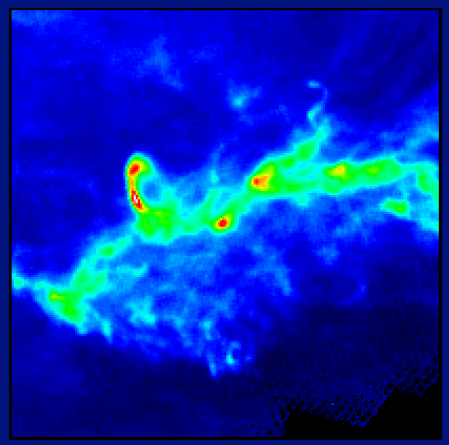
SPIRE at 250 um

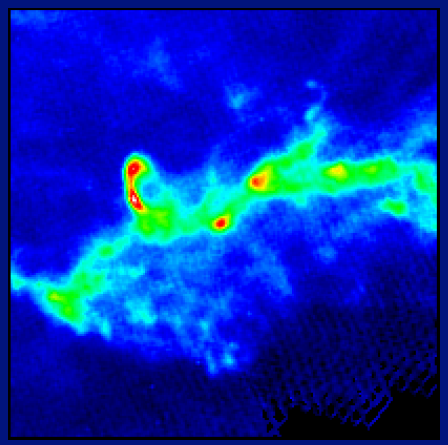


MCLD 123

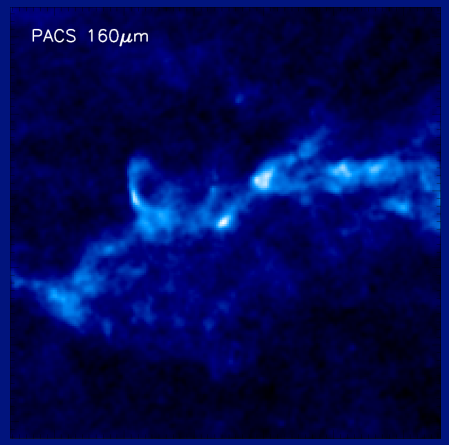


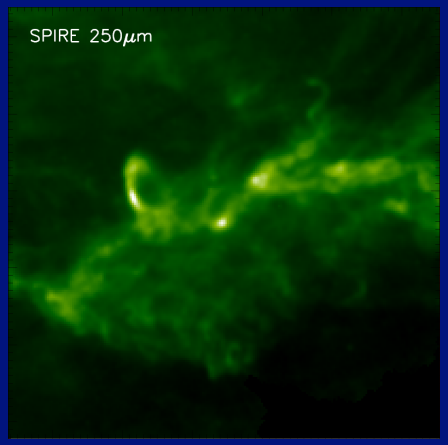


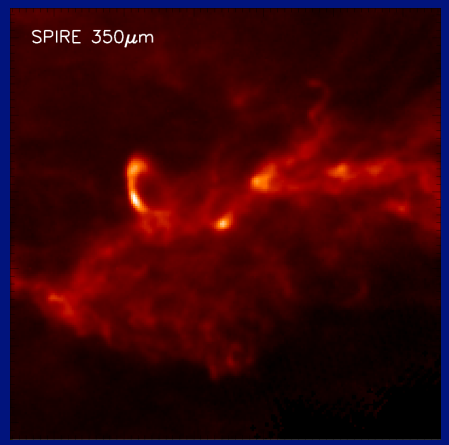


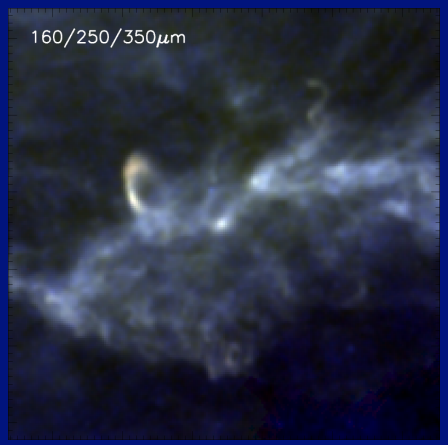


MCLD 123 and Loop 1

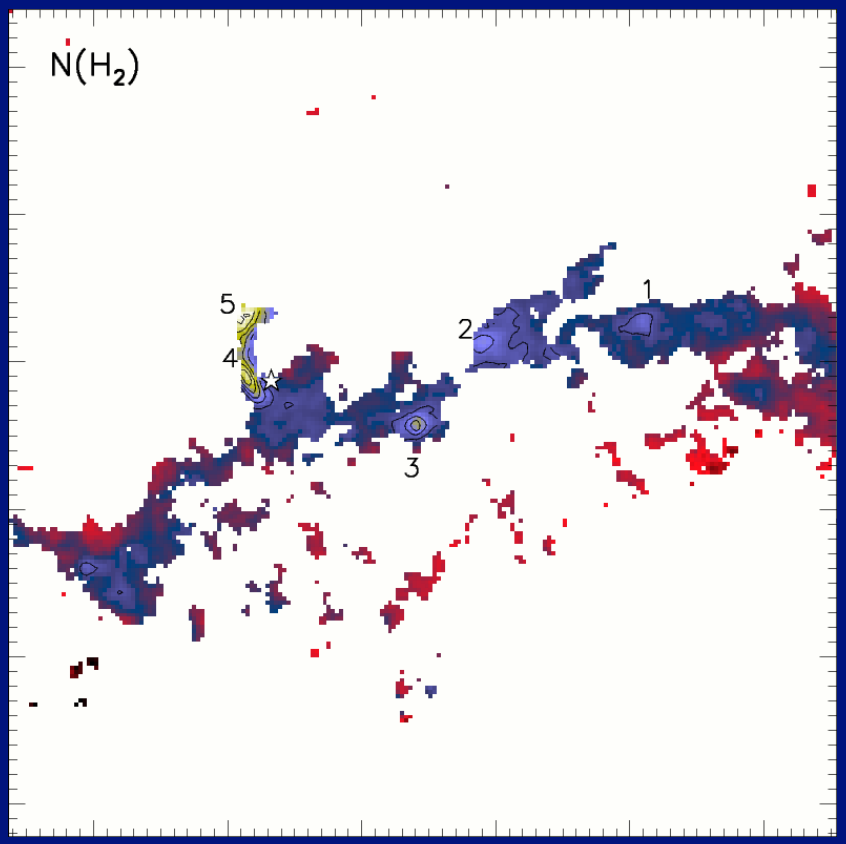


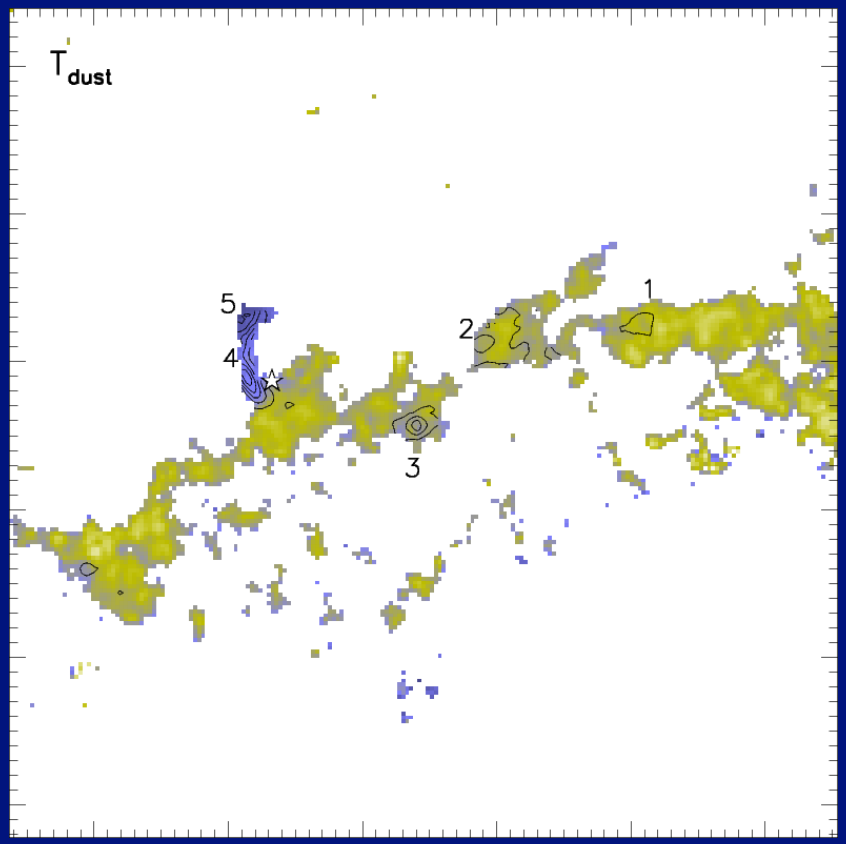






Column density and temperature

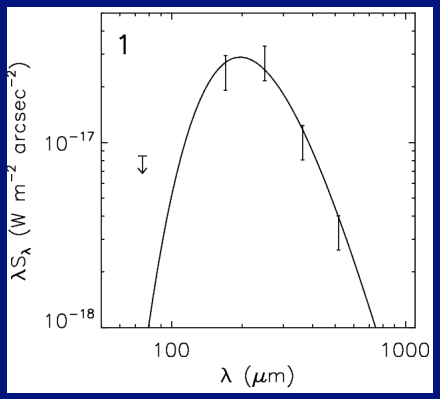


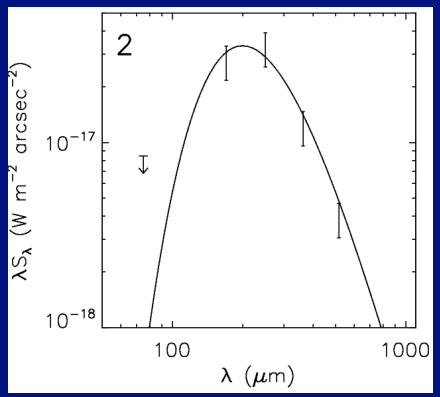


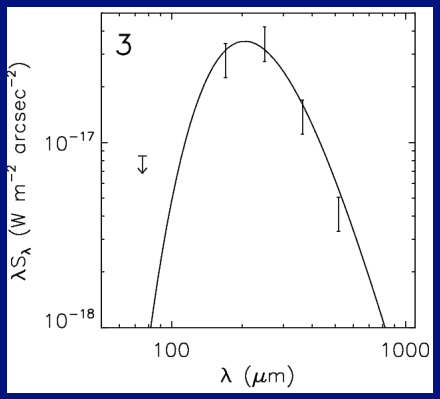
Range: ~6-12 x 10^{21}cm^{-2}

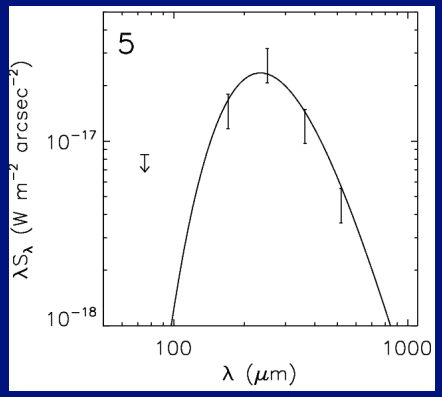
Range: ~10-12K

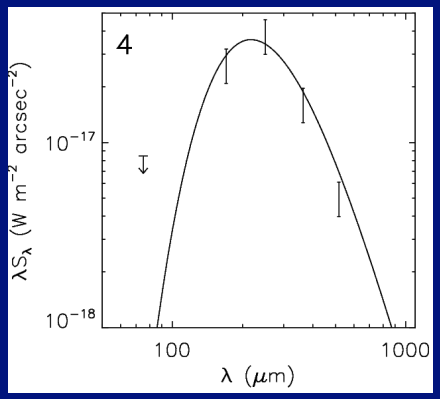
SEDs


1
10^{-17}
10^{-18}
100
1000
λ (μm)
λSλ (W m^{-2} arcsec^{-2})

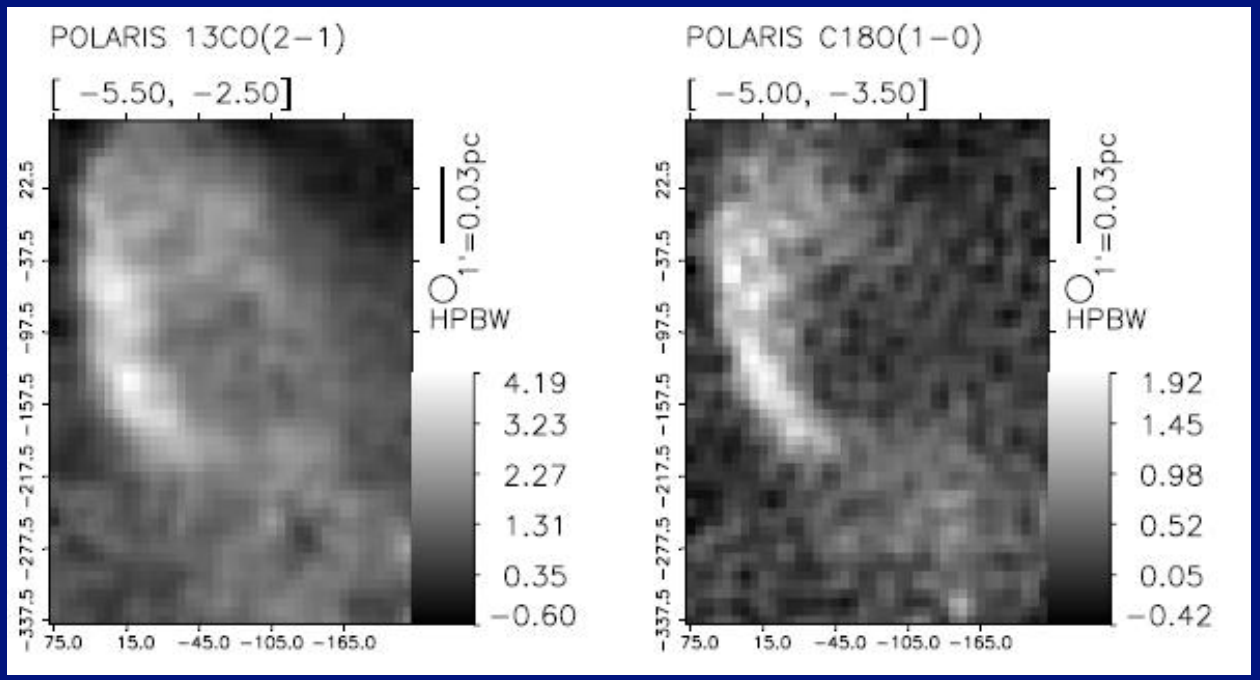

2
10^{-17}
10^{-18}
100
1000
λ (μm)
λSλ (W m^{-2} arcsec^{-2})


3
10^{-17}
10^{-18}
100
1000
λ (μm)
λSλ (W m^{-2} arcsec^{-2})


5
10^{-17}
10^{-18}
100
1000
λ (μm)
λSλ (W m^{-2} arcsec^{-2})

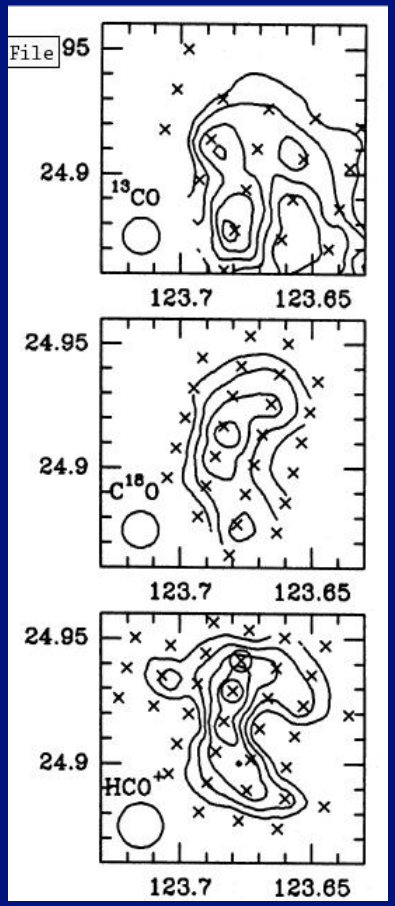

4
10^{-17}
10^{-18}
100
1000
λ (μm)
λSλ (W m^{-2} arcsec^{-2})

MCLD 123 in CO



Falgarone et al 1998

MCLD 123 in CO & HCO+



Heithausen et al 2008

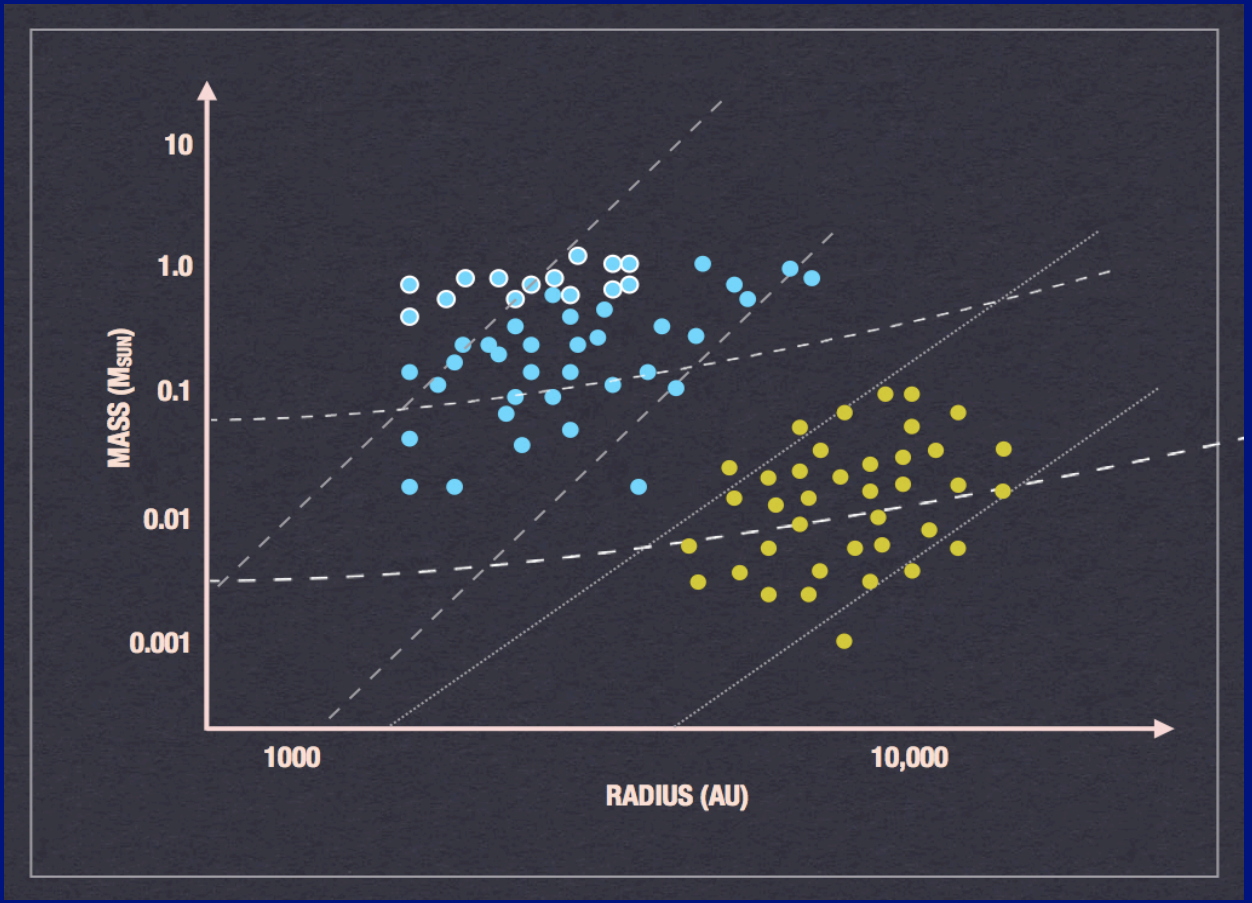
Linewidths

- Range of line-widths in different lines
- CO ~ 0.4 km/s (Falgarone et al 2009)
- HCO+ ~ 0.2 km/s (Heithausen et al 2008)
- We adopt 0.2 – 0.4
- Gives a range of unceratinty ~x4 in Mvir

Core properties

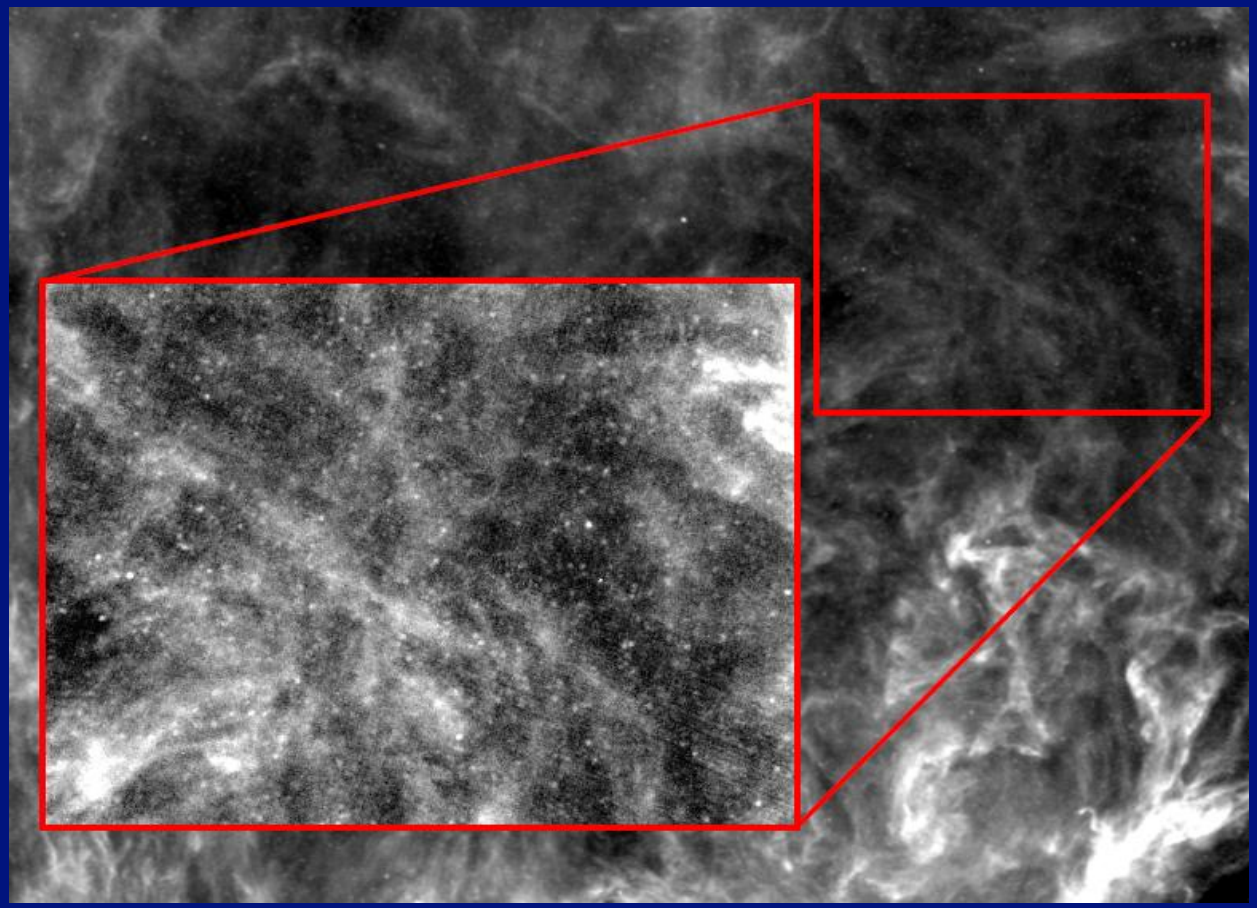
Core	1	2	3	4	5	
T (K)	12	12	12	11	10	+/-2
N(H2)	6	7	9	13	13	$x10^{21} cm^{-1}$
M(Mo)	0.1	0.3	0.3	0.4	0.5	+/-50%
n(H2)	$5x10^4$	$4x10^4$	$4x10^4$	$5x10^4$	$7x10^4$	cm^{-3} +/-50%
Mvir	0.1-0.5	0.4-1.5	0.3-1.0	0.4-1.5	0.4-1.5	Mo

Mass-size relation



Simpson et al (2010)

Polaris



Conclusions

- Stars form in molecular cloud cores
- Core mass function determines IMF
- Need to understand physics of cores
- Need to observe different environments
- Have observed Aquila and Polaris
- Best 5 examples in Polaris were presented
- At most: just virialised
- More data to come – watch this space!