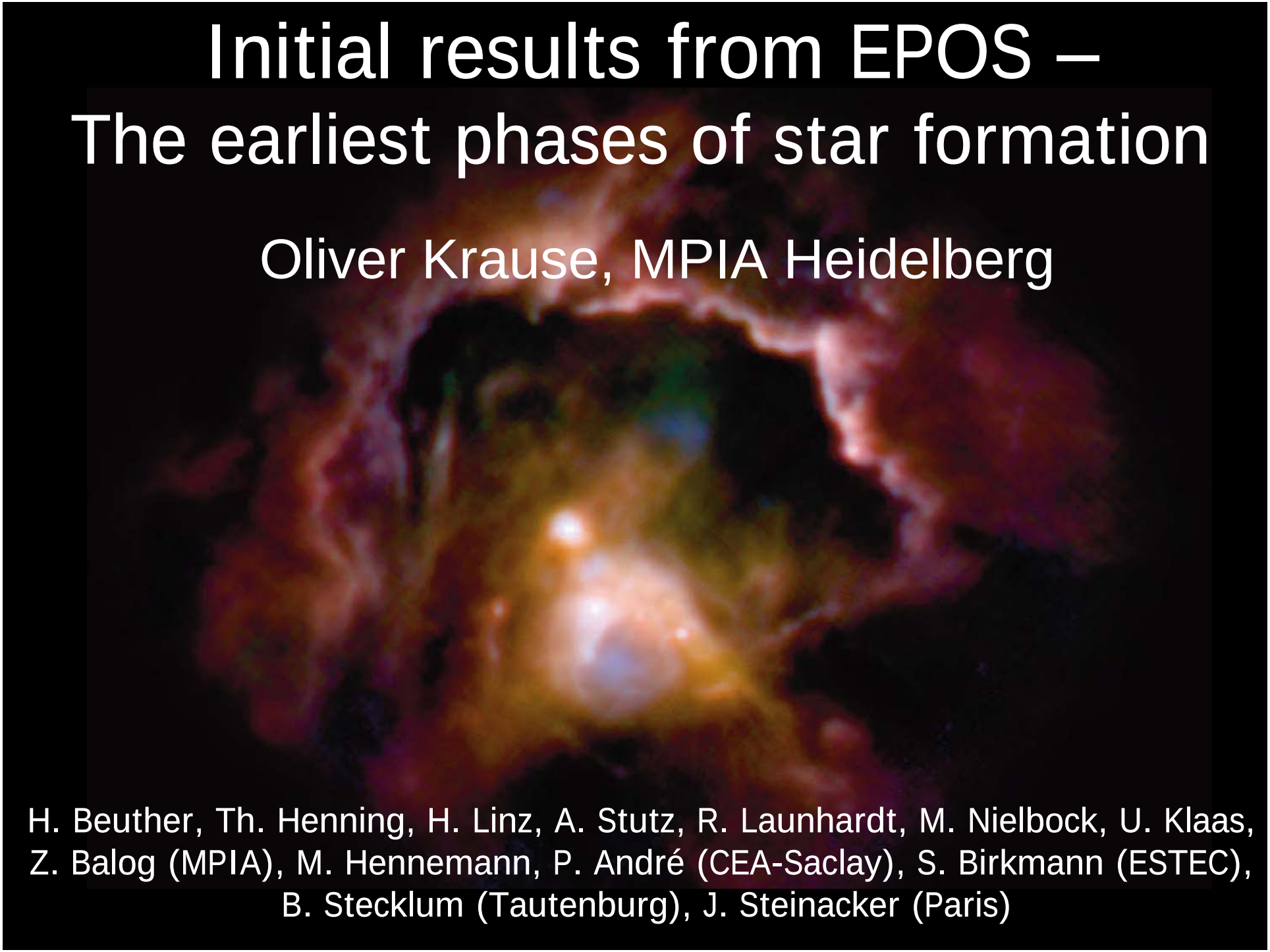
Initial results from EPOS – The earliest phases of star formation

Oliver Krause, MPIA Heidelberg



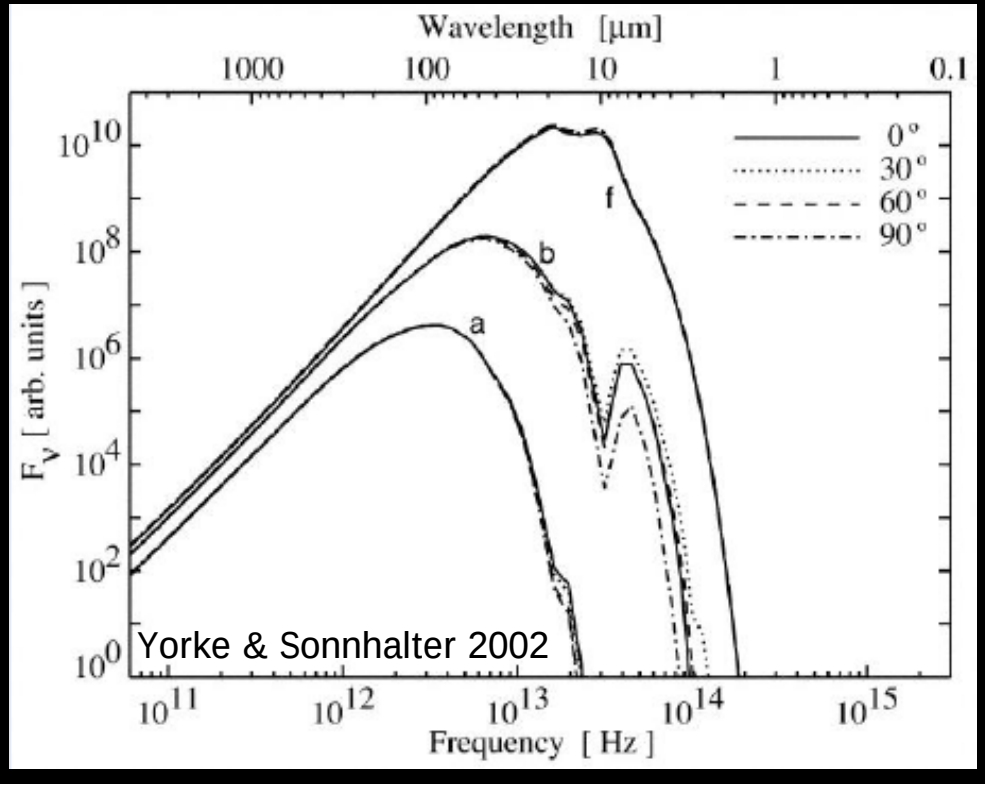
H. Beuther, Th. Henning, H. Linz, A. Stutz, R. Launhardt, M. Nielbock, U. Klaas, Z. Balog (MPIA), M. Hennemann, P. André (CEA-Saclay), S. Birkmann (ESTEC), B. Stecklum (Tautenburg), J. Steinacker (Paris)

Science Goals

During their earliest evolutionary phases protostars are deeply embedded in their parental cloud cores and emit the bulk of their luminosity in the FIR/SMM range.
Herschel 70-500 µm continuum observations at high spatial resolution are a powerful probe of their structure, physical conditions and formation scenario.

- Temperature density structure of the prestellar cores / protostars
- Fragmentation into (lower mass) objects in the vicinity of high-mass cores

Analysis via 3D radiative transfer



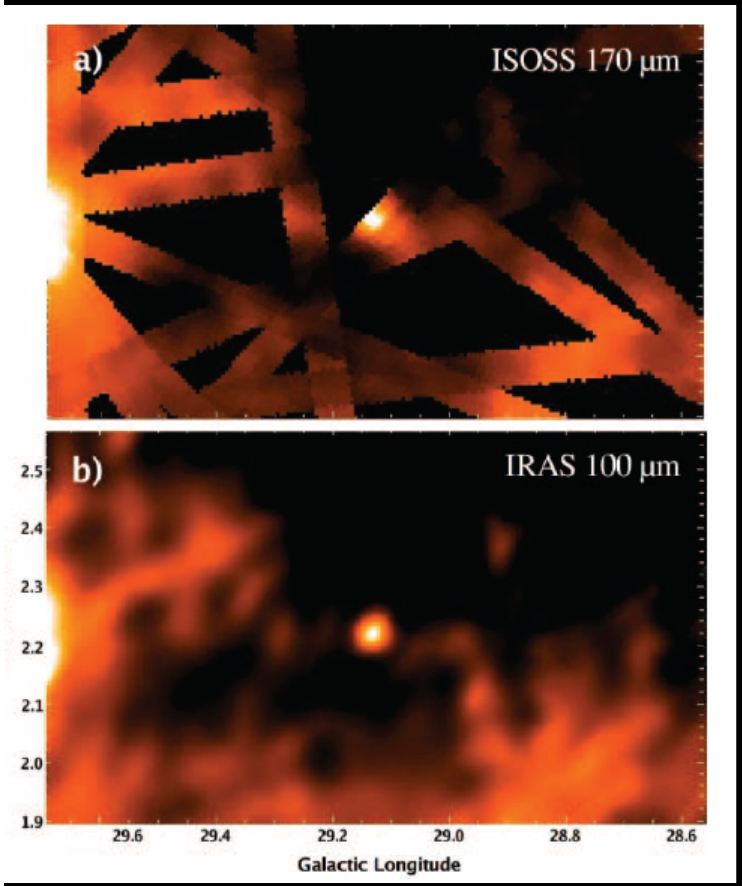
Implementation

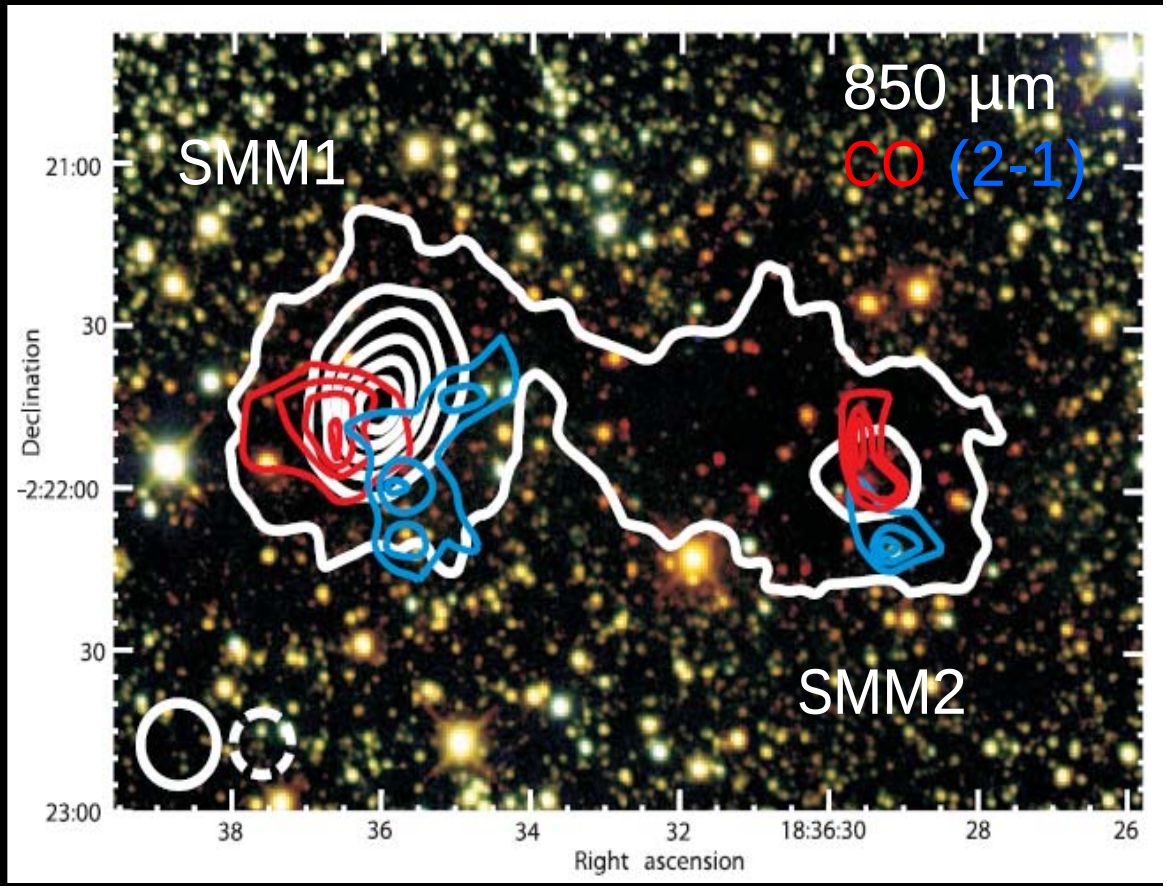
Follow-up observations of 60 objects ranging from prestellar cores to low and high mass protostars in early evolutionary stages

- 45 high mass objects based on (I) cold ISO 170 μm sources, (II) IRDCs, and (III) submm surveys
- 15 isolated low-mass cores in low background regions
- Availability of extensive ancillary data

Observing Strategy: 70, 100, 160, 250, 350, 500 μm scan maps

Case I: ISOSS J18364-0221

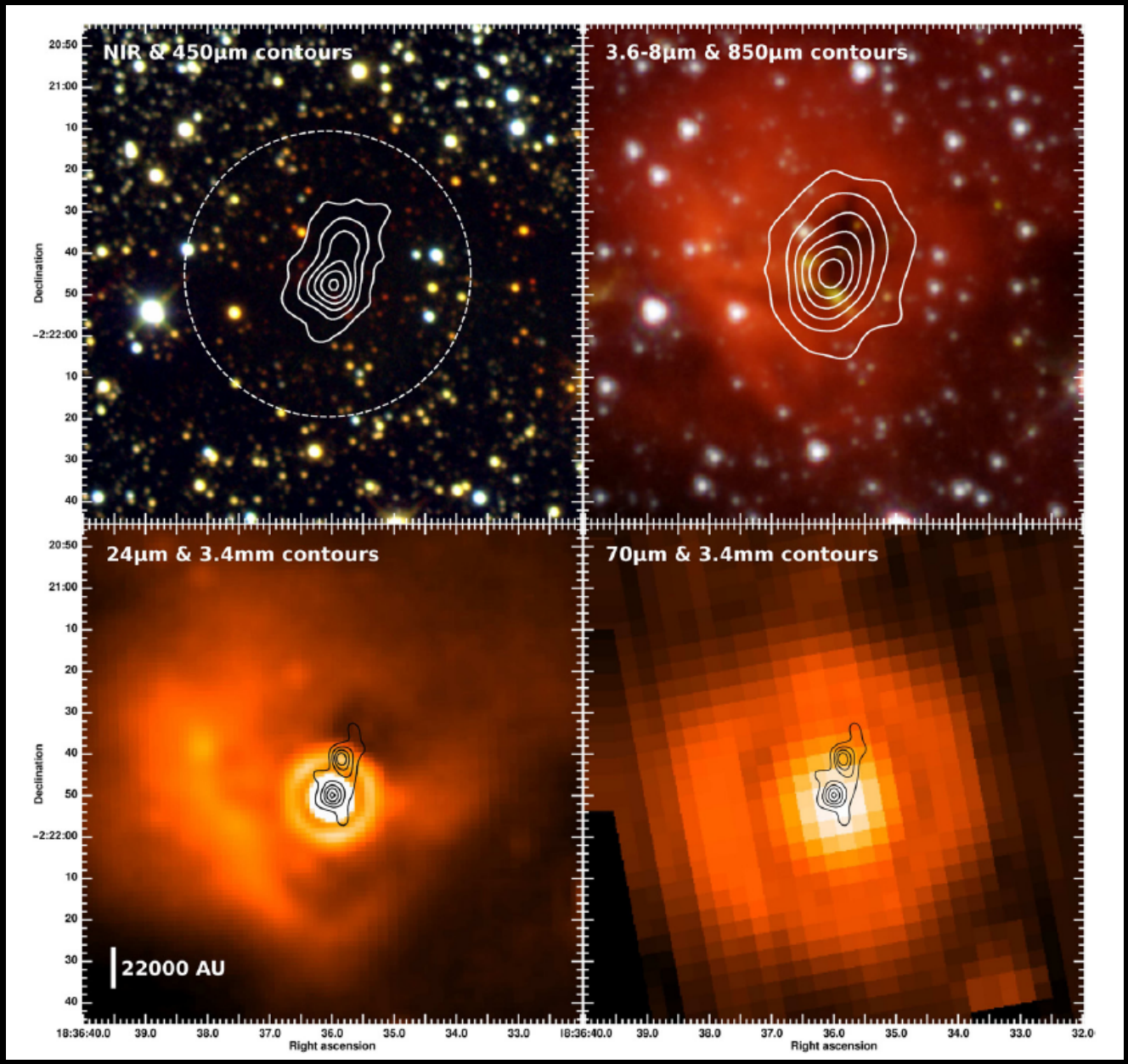




Birkmann et al. 2006

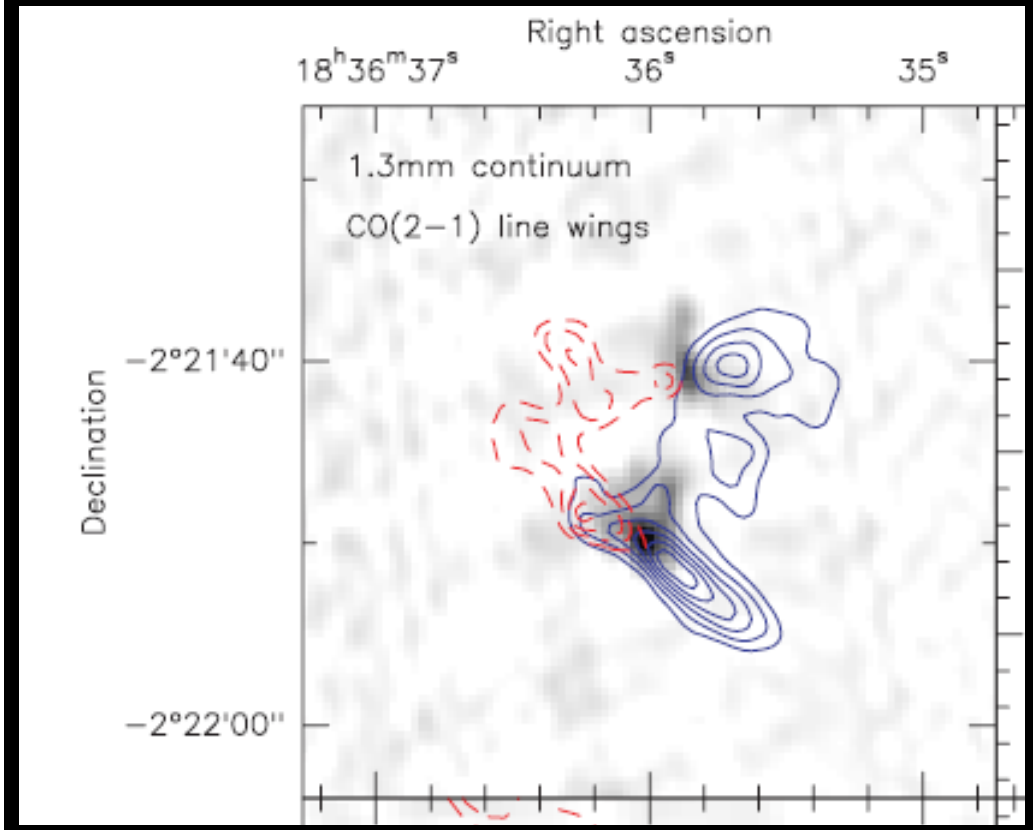
400 $M_\odot$ star-forming clump
D = 1.8 kpc

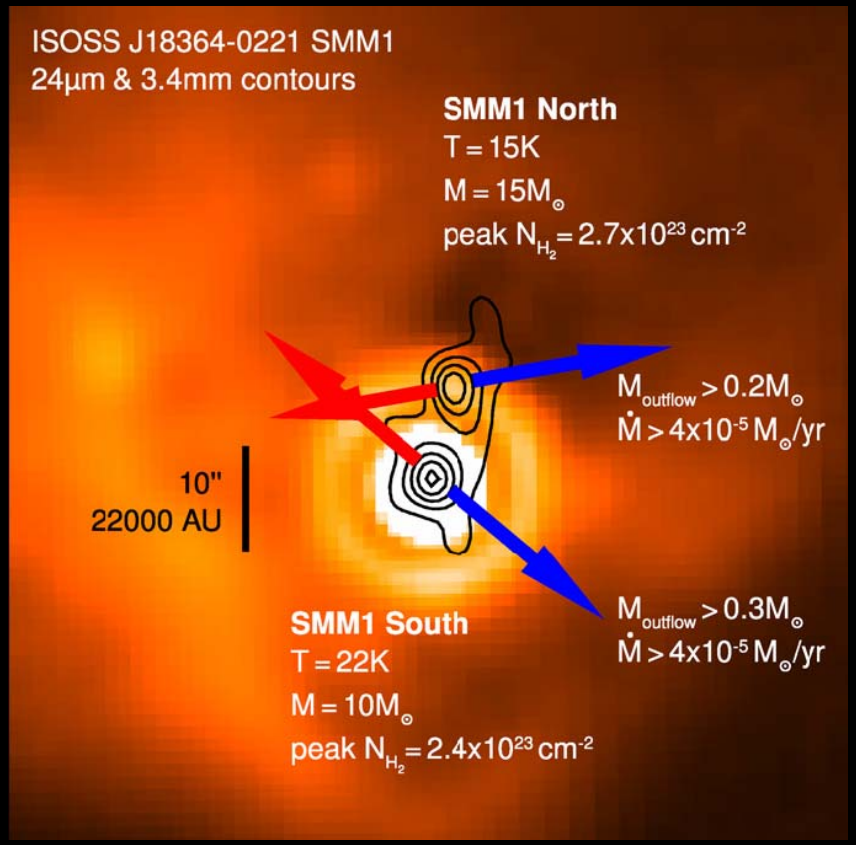
ISOSS J18364-0221 SMM1



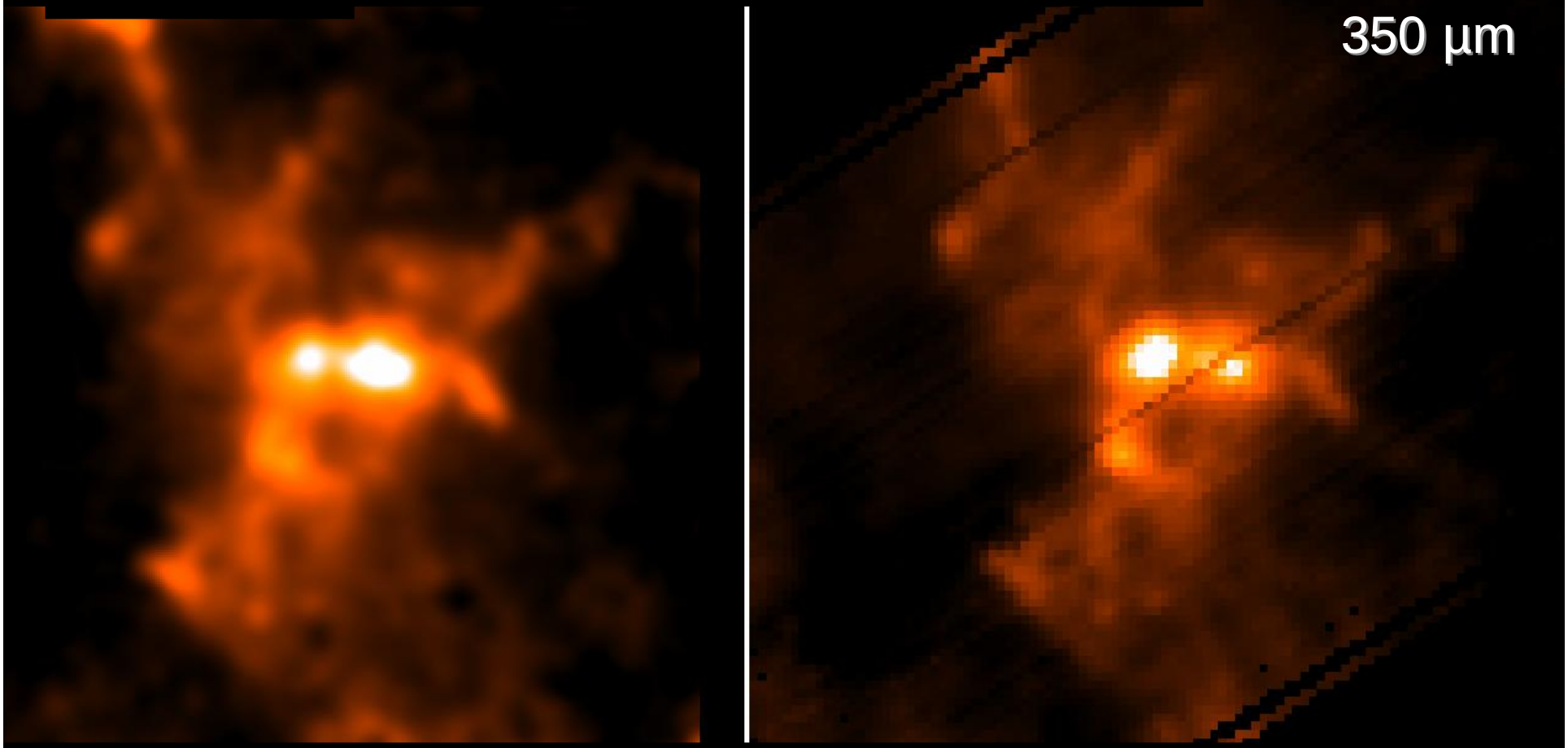
Hennemann et al. 2009

Two protostars with collimated outflows

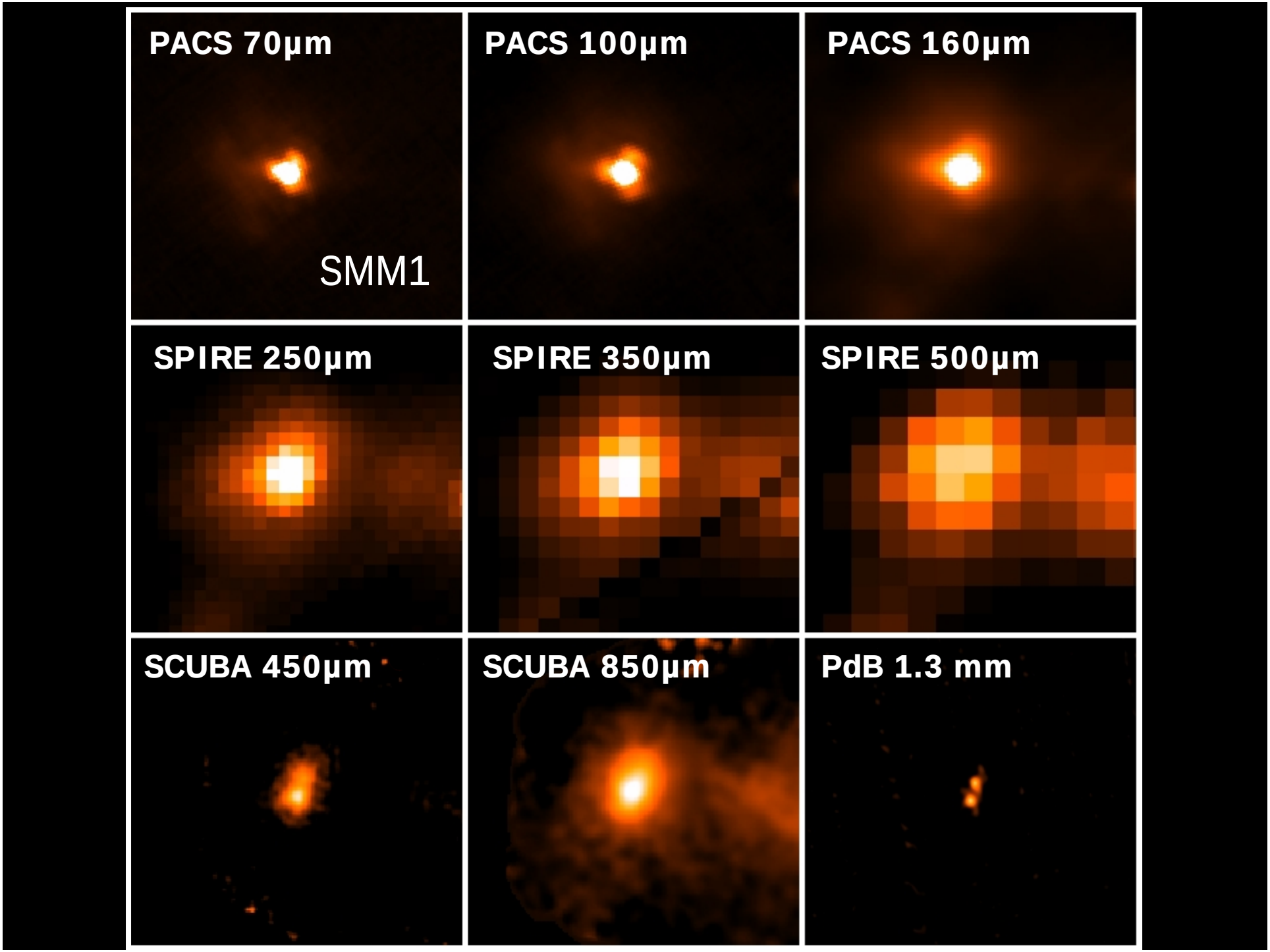


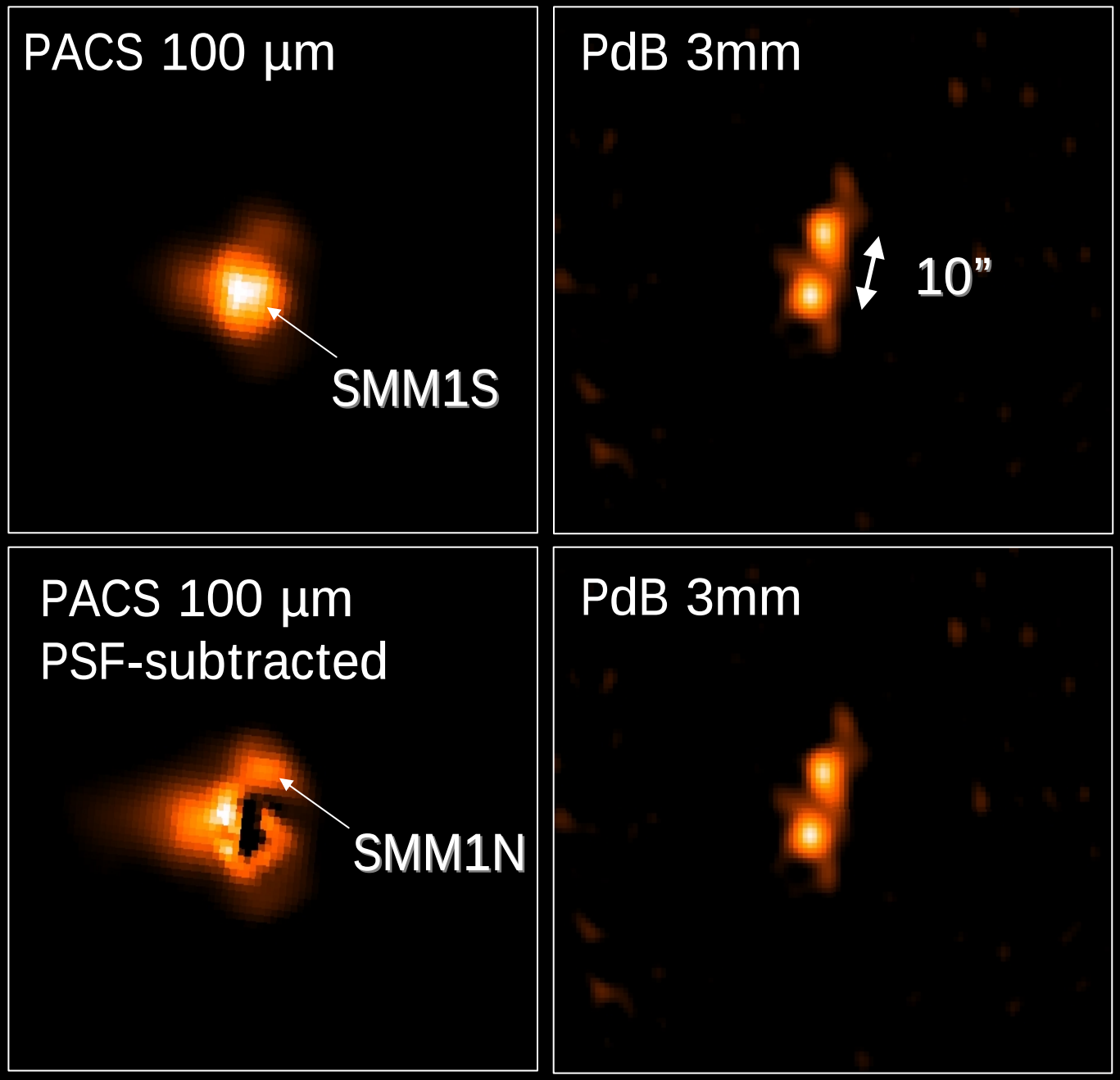


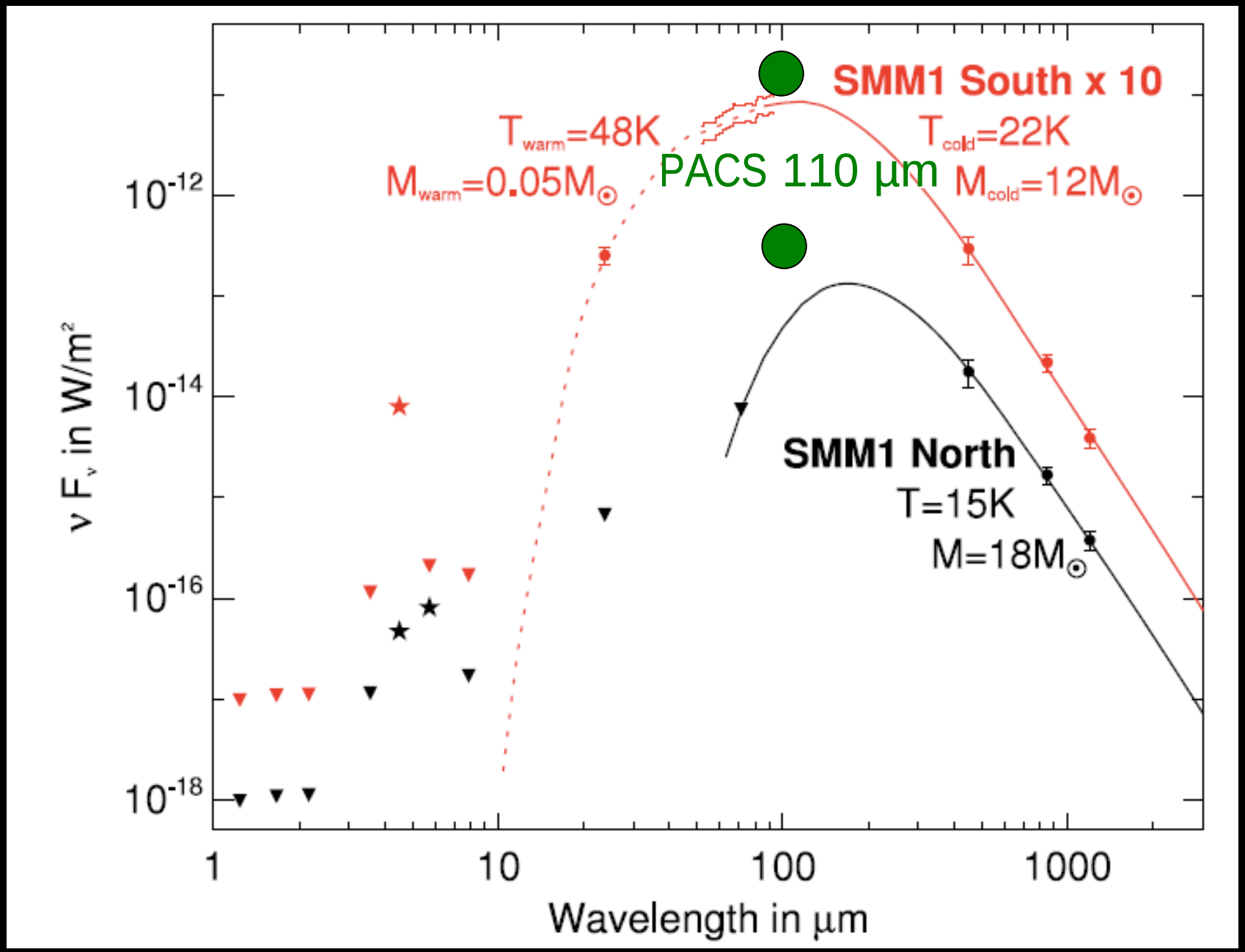
SPIRE observations



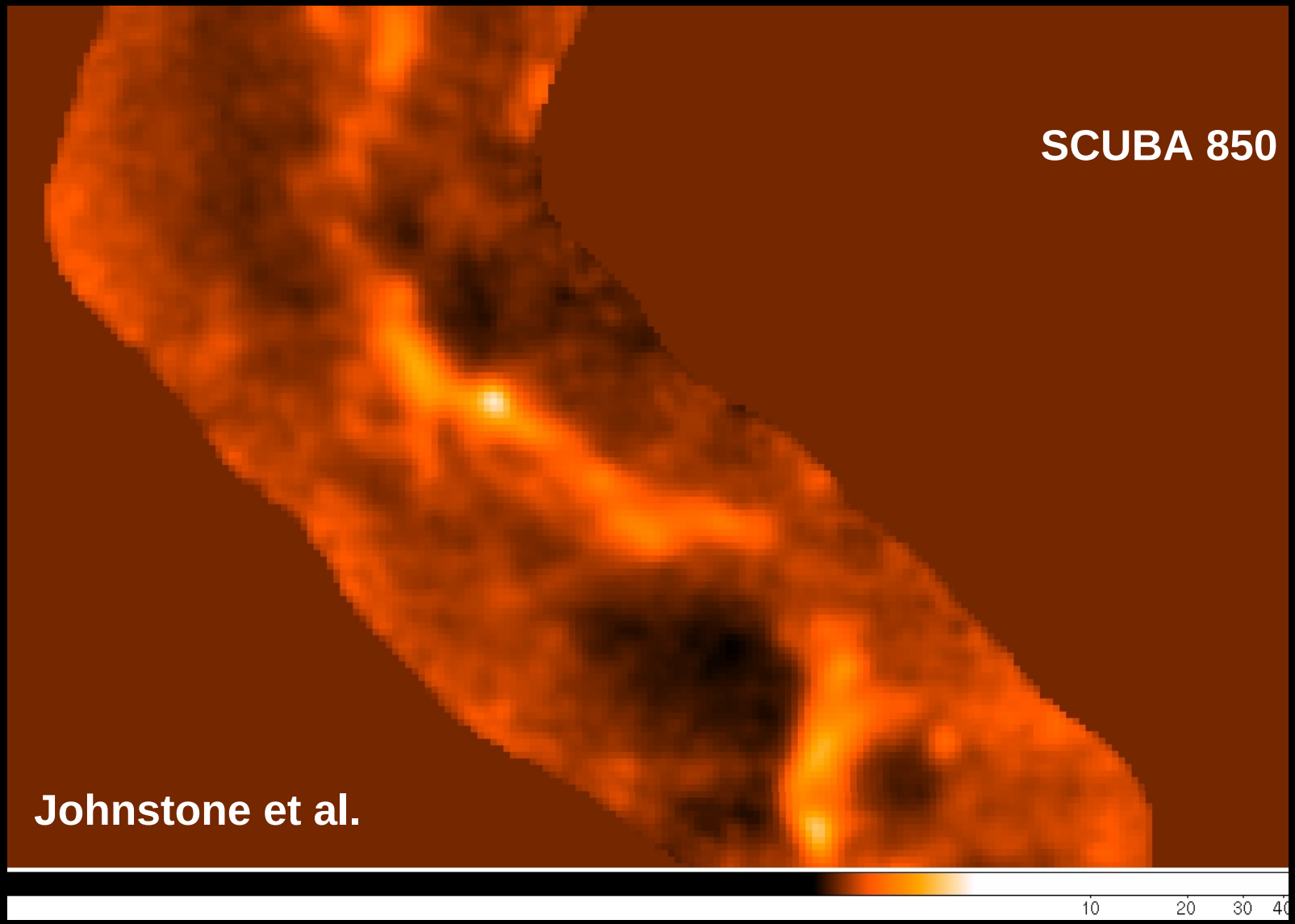
Extinction map from Calar Alto 3.5m JHK data !
Birkmann et al. 2004


PACS 70μm
SMM1
PACS 100μm
PACS 160μm
SPIRE 250μm
SPIRE 350μm
SPIRE 500μm
SCUBA 450μm
SCUBA 850μm
PdB 1.3 mm


PACS 100 µm
SMM1S
PdB 3mm
10”
PACS 100 µm
PSF-subtracted
SMM1N
PdB 3mm


SMM1 South x 10
T_warm=48K
M_warm=0.05M⊙
PACS 110 µm
T_cold=22K
M_cold=12M⊙
SMM1 North
T=15K
M=18M⊙
10^-12
10^-14
10^-16
10^-18
ν F_ν in W/m²
1
10
100
1000
Wavelength in µm

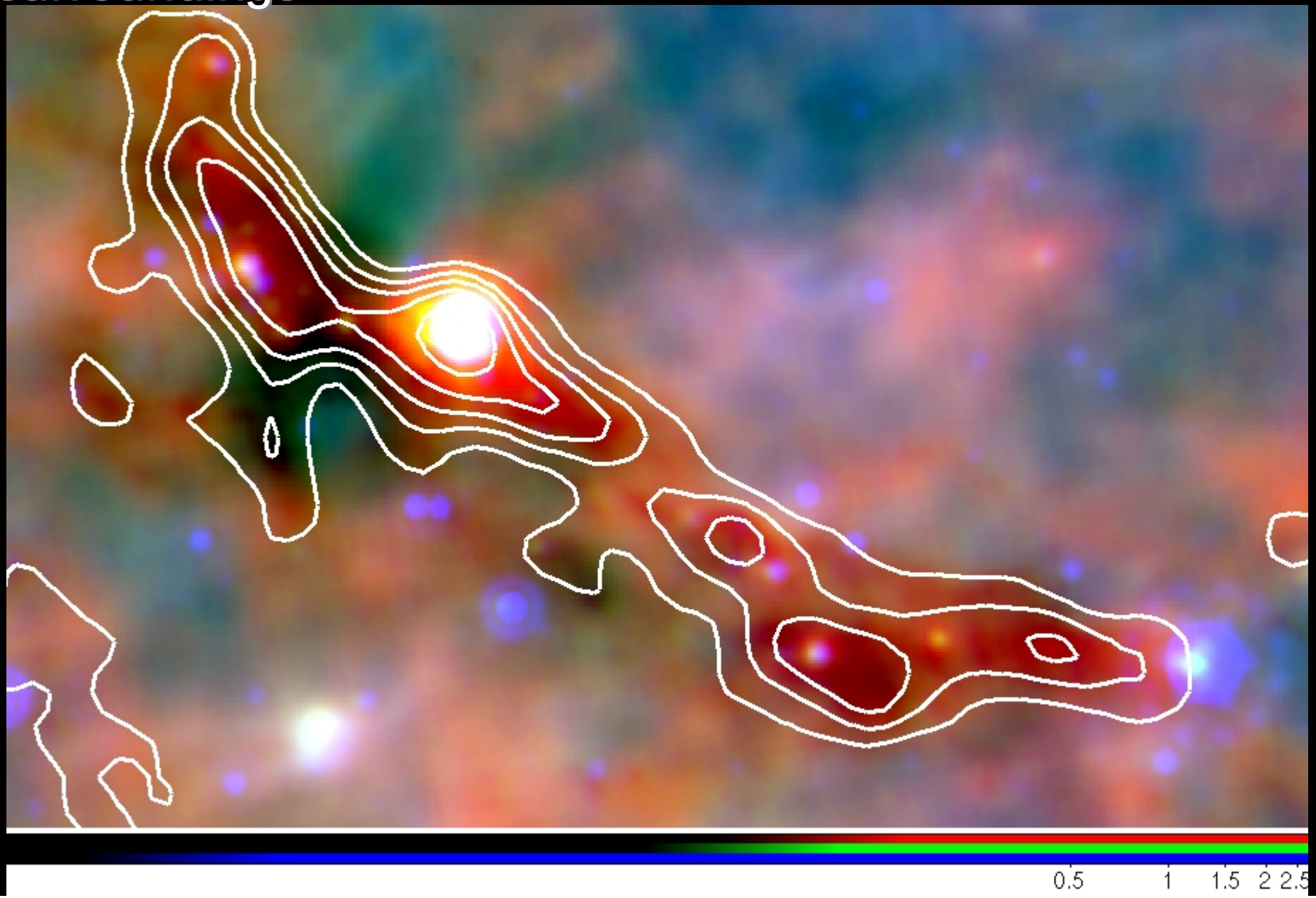
Case II: IRDC G11.11-0.12



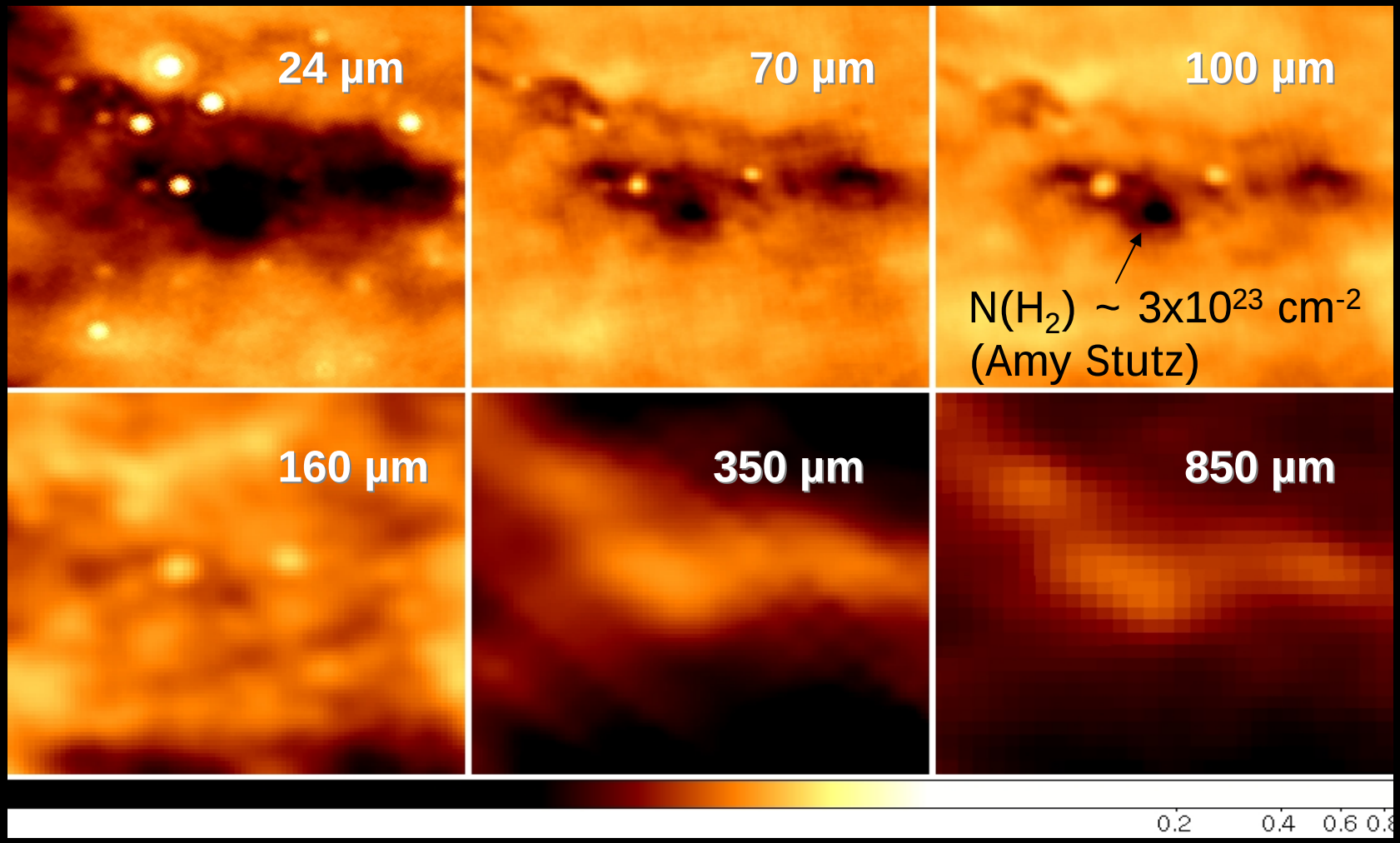
Distance 3.6 kpc

Hendrik Linz et al.

G11.11-0.12: Multicolour view on the P1 region and the surroundings

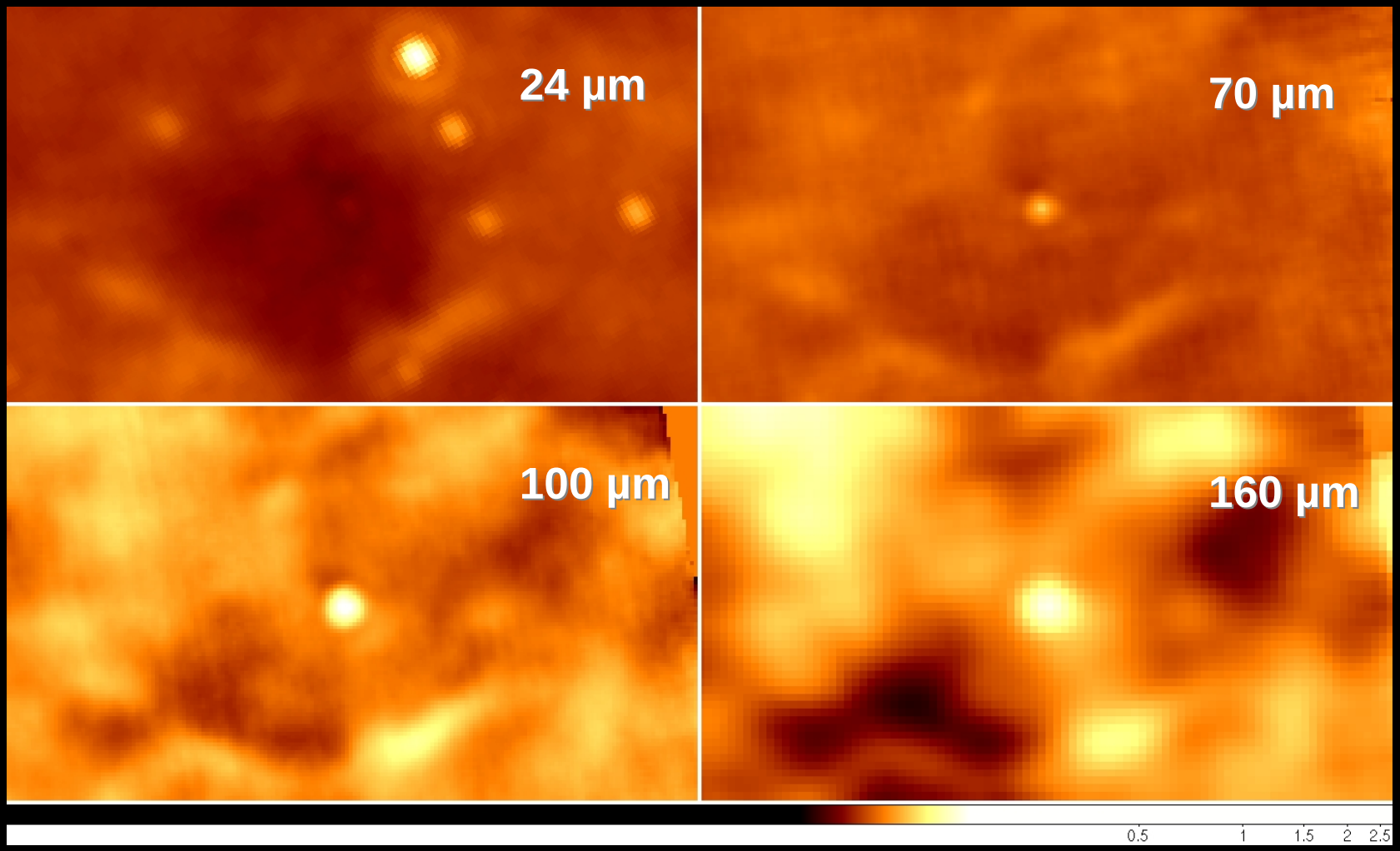


G11.11-0.12: Point sources, extinction silhouettes and cold extended emission,



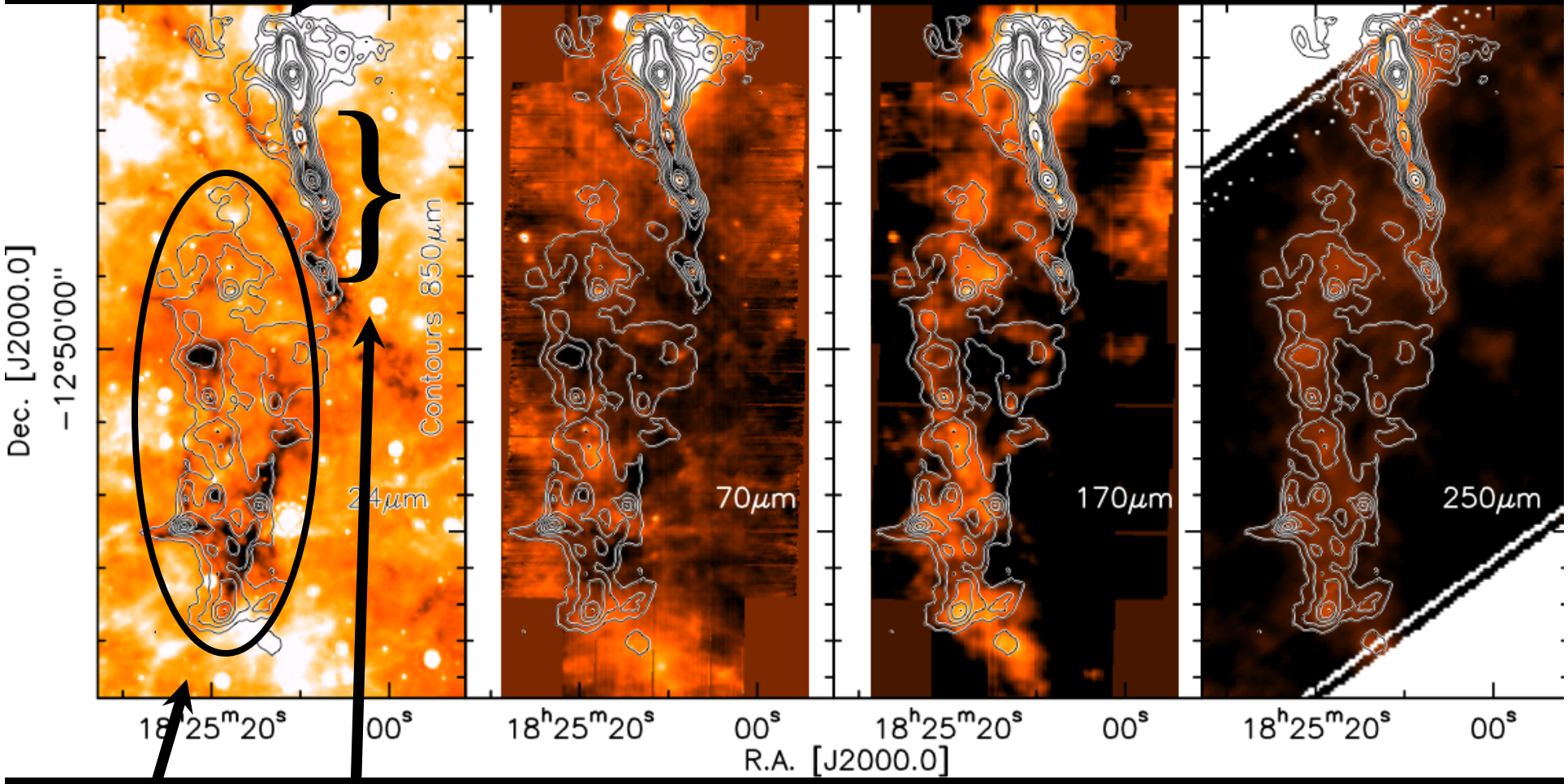
Hendrik Linz et al.

Deeply embedded point sources



Case III: High-Mass Star Formation Complex I18223

High-Mass Protostellar Object (IRAS source)



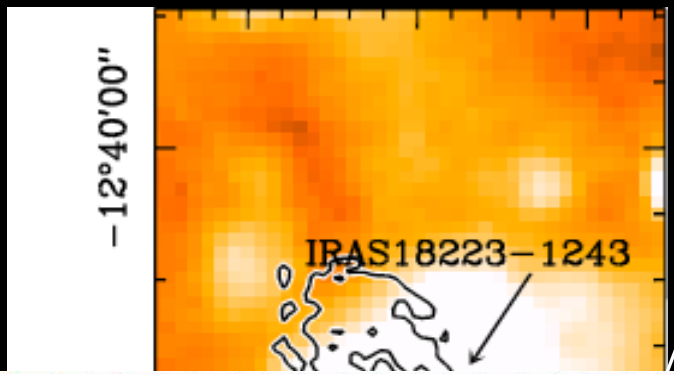
High-Mass Core with embedded low- to intermediate-mass Protostar destined to become massive at end of evolution.

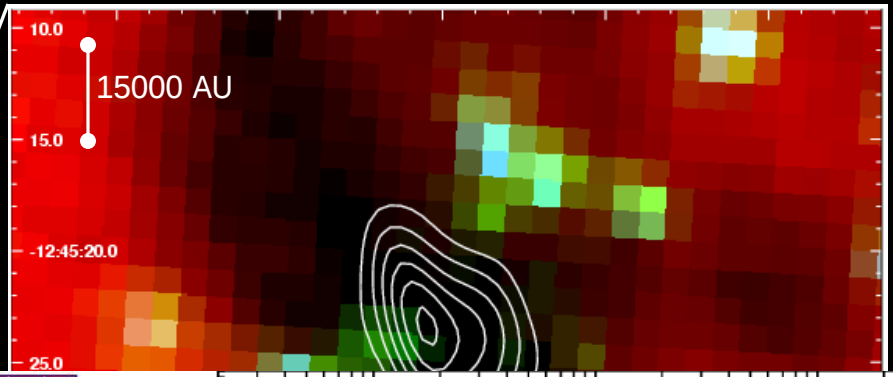
High-Mass Starless Cores

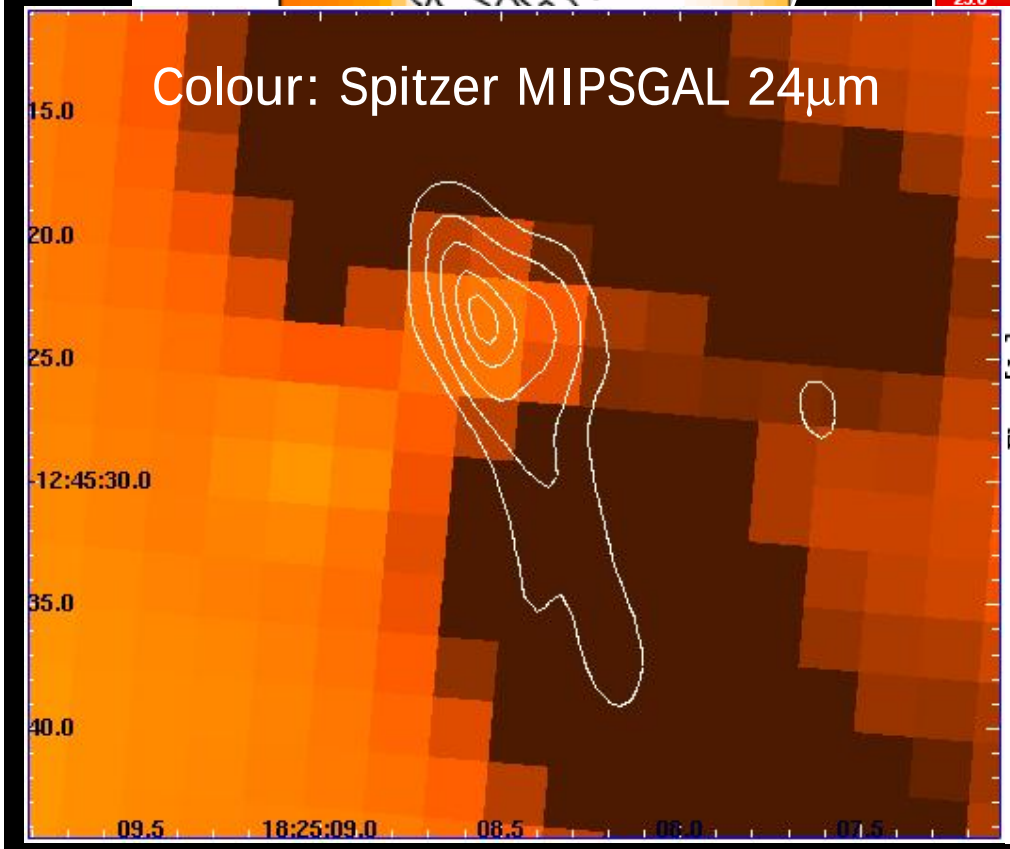
Henrik Beuther et al.

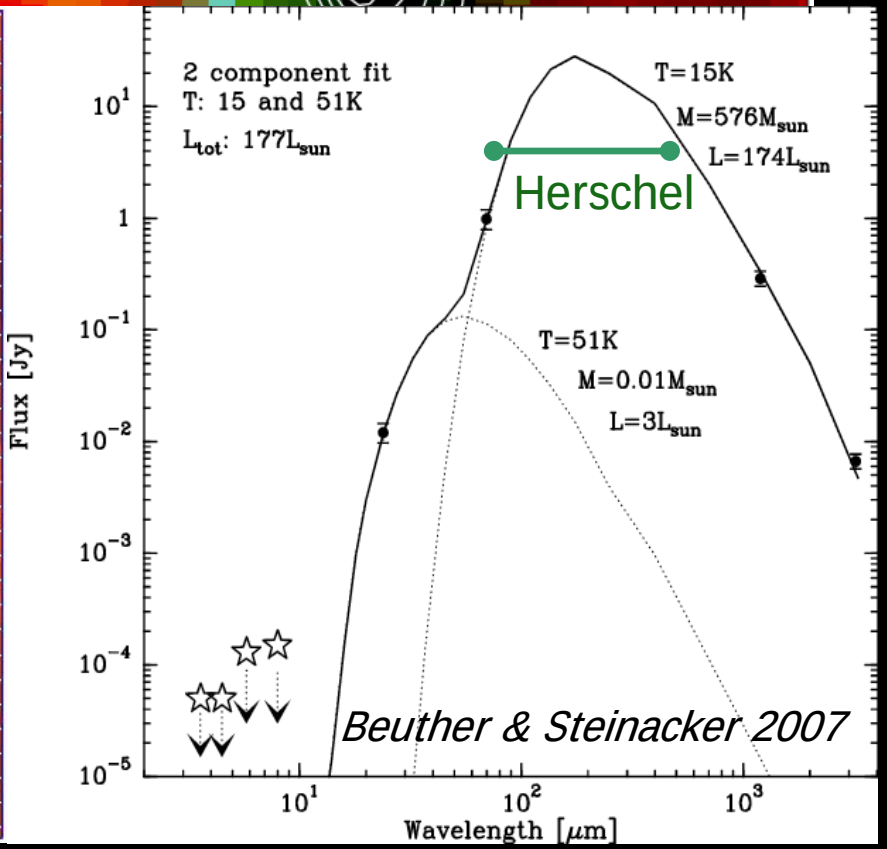
Are high-mass starless cores existing?

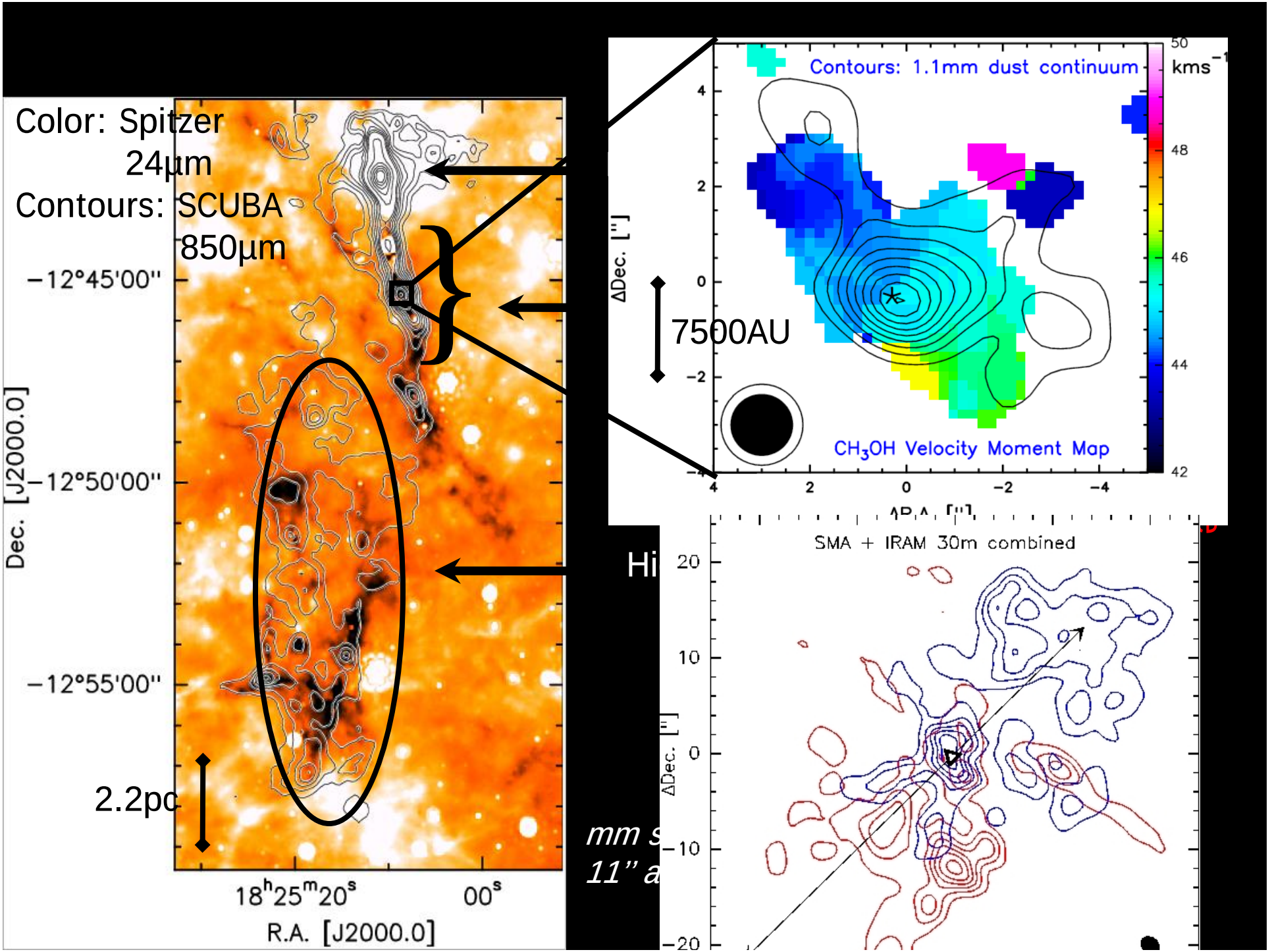
The case of IRDC 18223-3



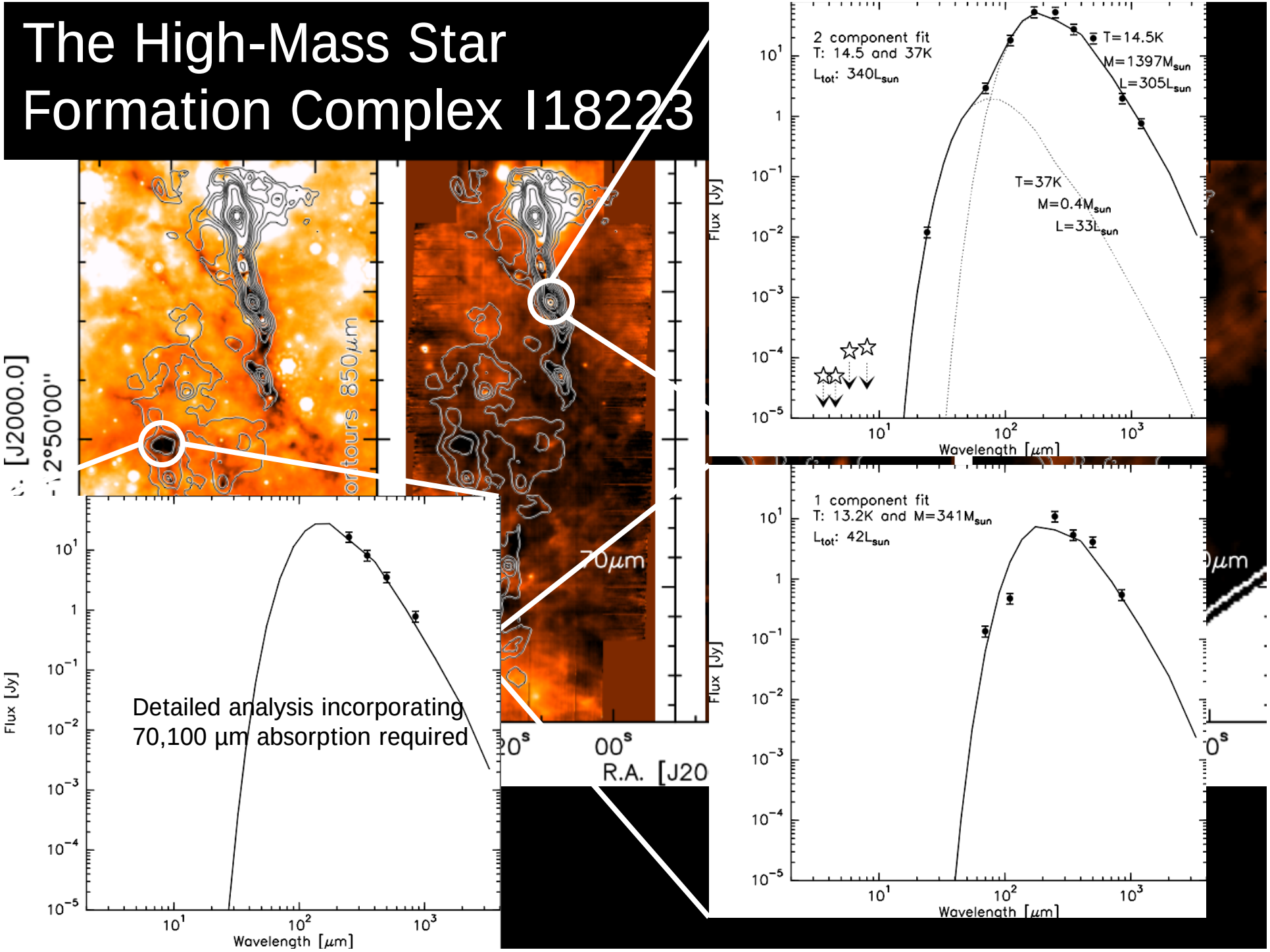


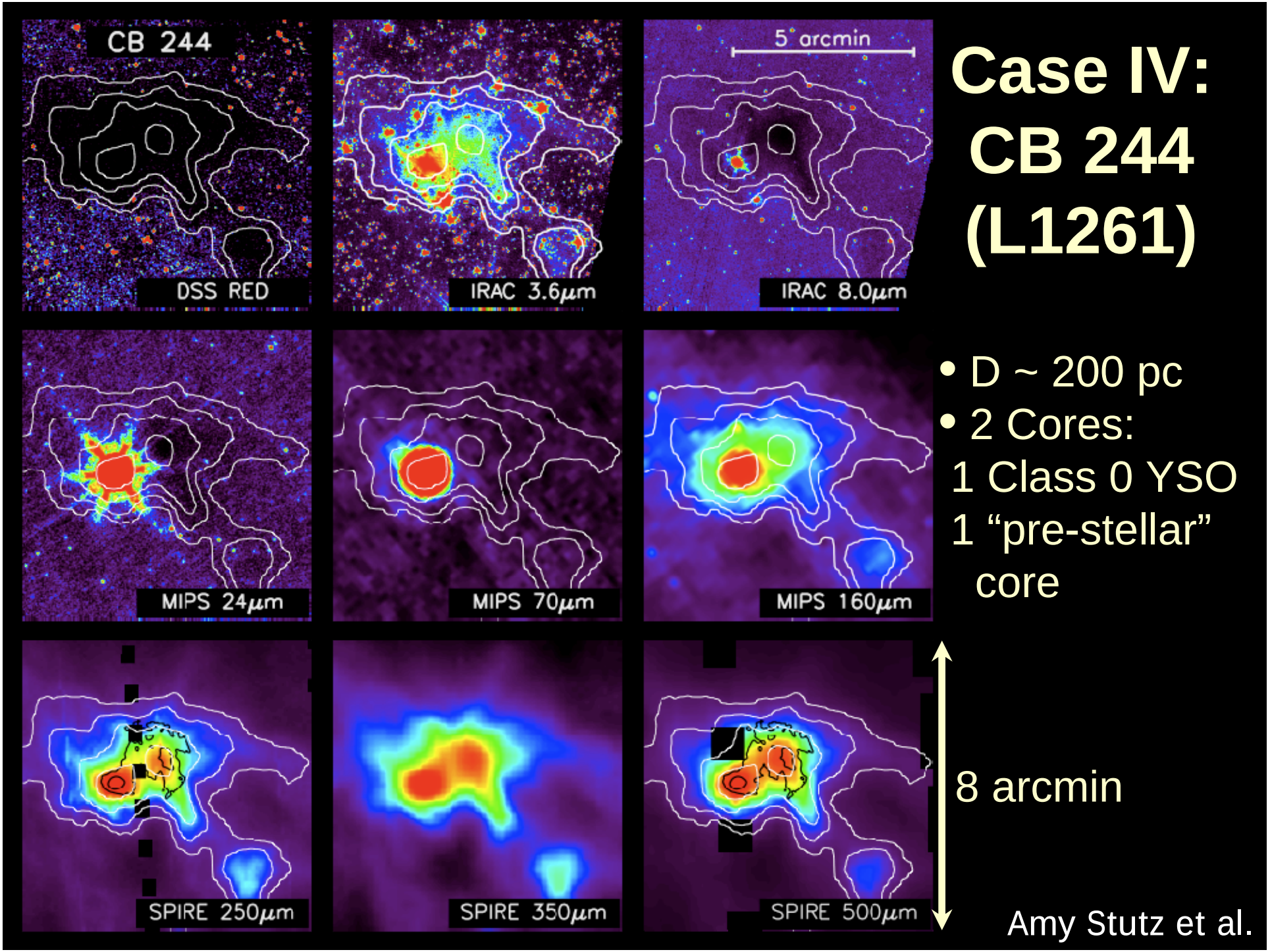





Color: Spitzer
24μm
Contours: SCUBA
850μm
−12°45'00"
−12°50'00"
−12°55'00"
Dec. [J2000.0]
2.2pc
18h25m20s
00s
R.A. [J2000.0]
Contours: 1.1mm dust continuum
CH3OH Velocity Moment Map
7500AU
ΔDec. ["]
50
48
46
44
42
kms−1
SMA + IRAM 30m combined
Hi
mm s
11" a

The High-Mass Star Formation Complex I18223



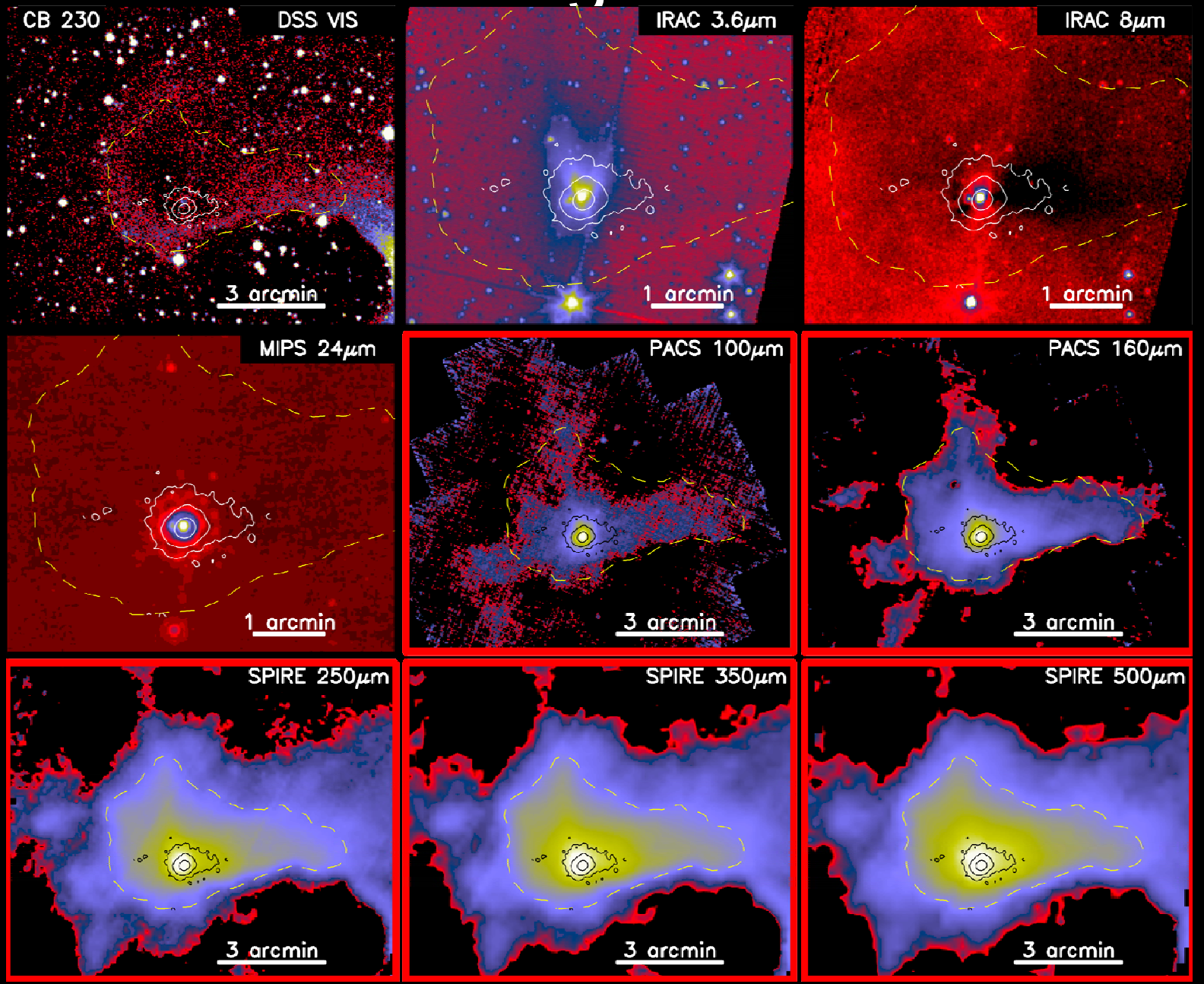


Case IV: CB 244 (L1261)

- D ~ 200 pc
- 2 Cores:
  1 Class 0 YSO
  1 "pre-stellar" core

Amy Stutz et al.

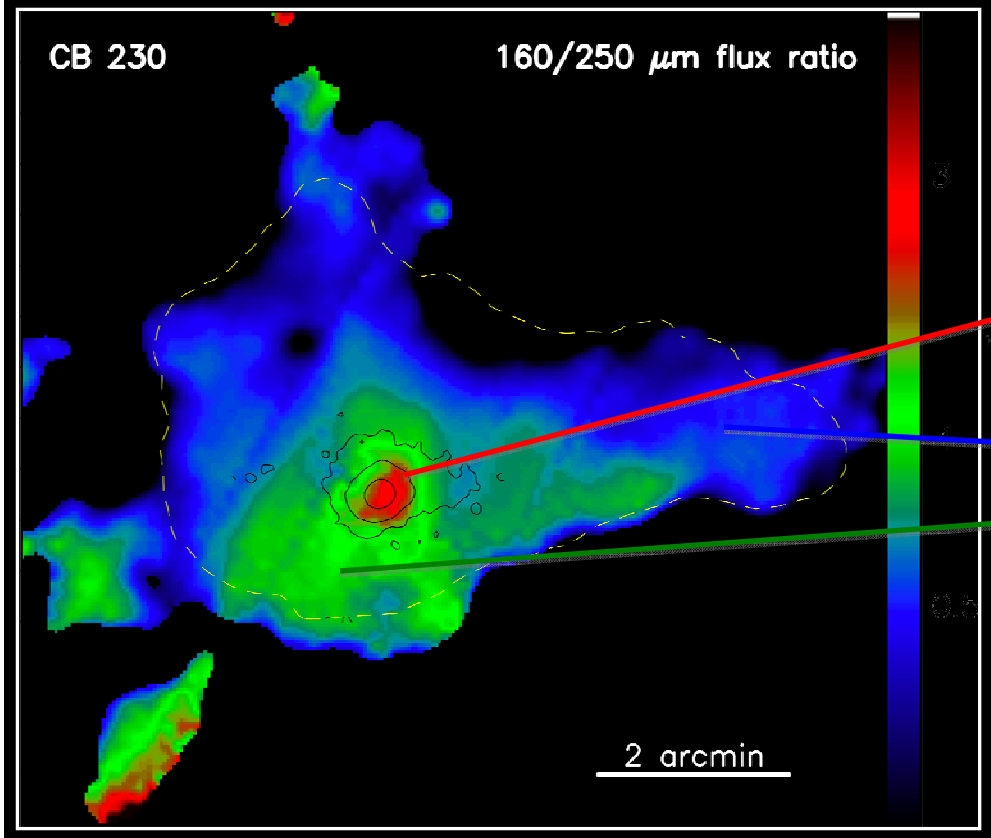
Case V: Bok globule CB230

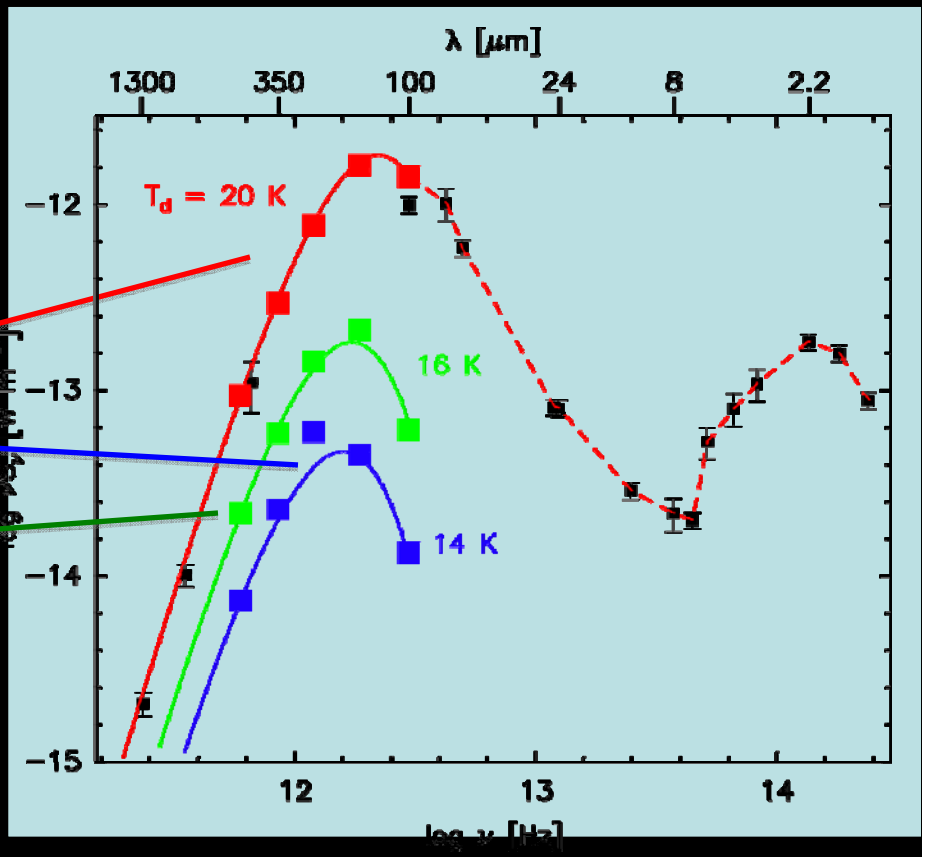


R.Launhardt et al.

Measuring dust temperatures with Herschel

Post-Herschel SED:





Preliminary !

Lessons learnt

- SDP observations successfully executed – small refinements of AORs performed
- The quality of the data is very good and detailed analysis has started
- Reduction and analysis in the complex environments with extended emission is demanding (destriping, photometry)

- We are looking forward for more HERSCHEL data to come !