The Fate of Star Formation in Chamaeleon I and III

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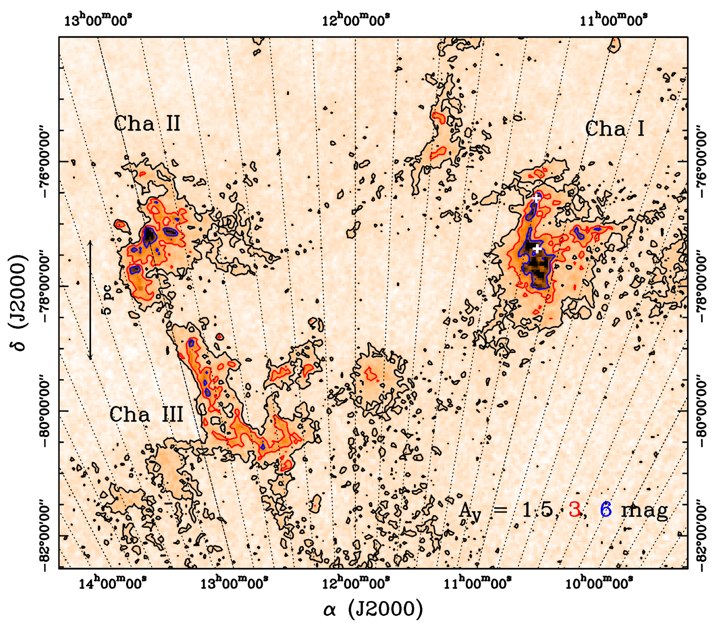
Star formation in Chamaeleon:

- nearby cloud complex (150–180 pc)
- 3 molecular clouds: Cha I, II, and III
- similar masses traced with ^{13}CO but larger fraction of dense gas in Cha I (traced with C^{18}O)
- no sign of star formation in Cha III while Cha I has produced $>$ 200 young stellar objects (YSOs) already and Cha II a few dozens

→ clouds in different evolutionary stages OR conditions for star formation not fulfilled in Cha III?

⇒ Chamaeleon = excellent laboratory for understanding conditions promoting/inhibiting star formation



Observation strategy:

- 2MASS extinction map used to select areas with $A_V > 3$ mag (left fig.)
- mapping of Cha I and III in dust continuum emission at 870 μm with LABOCA at APEX (HPBW: 19″) (figs. below)
- sensitivity $\sim$ 12 mJy/beam ($\sigma(N_{H_2}) = 1.1 \times 10^{21}$ cm^{-2} at 12 K)

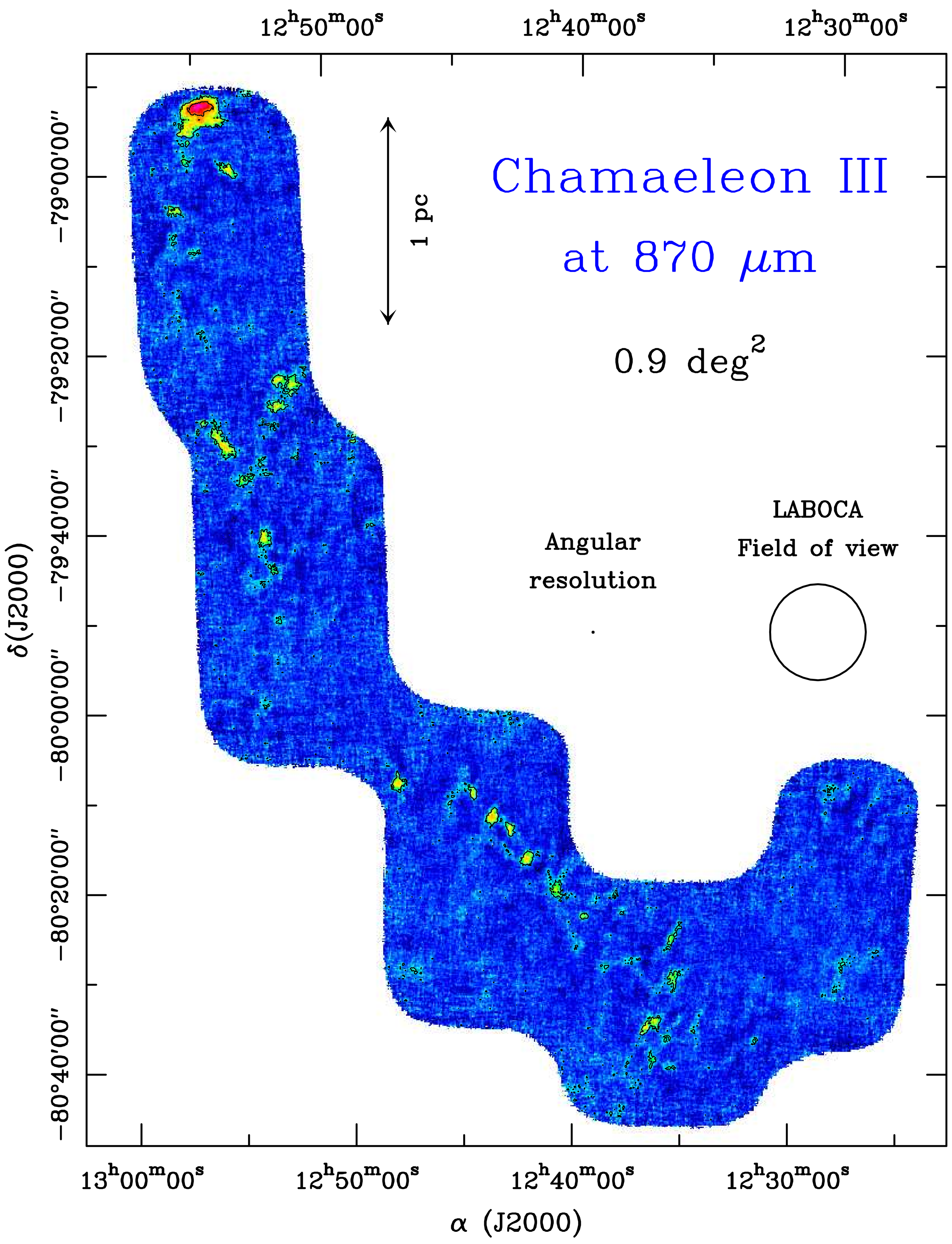
Analysis method:

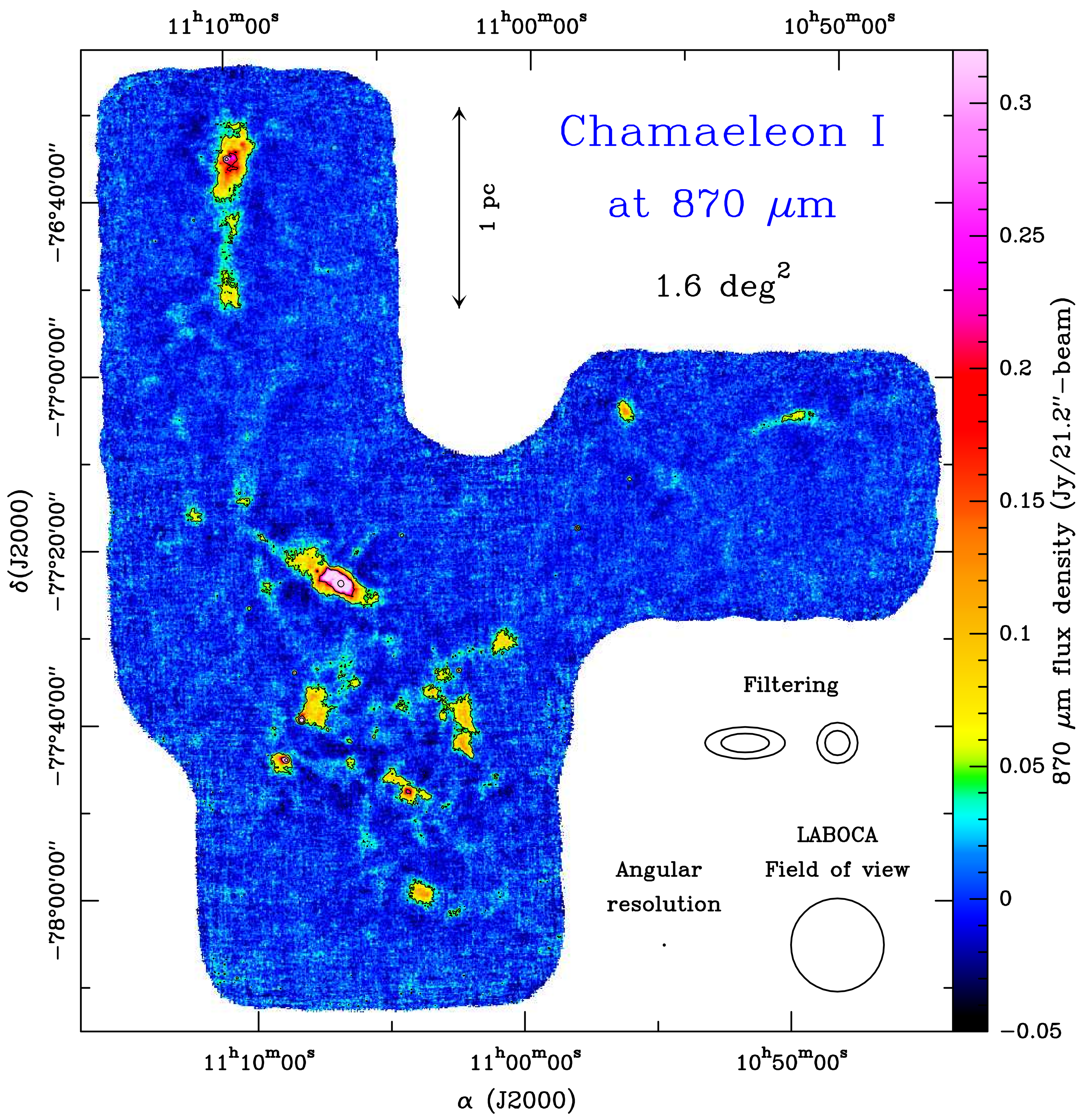
- Monte Carlo simulations performed to characterize the spatial filtering inherent in the data reduction process
- multiresolution map decomposition based on median transform to separate small scale emission from faint, large scale emission
- source extraction performed with GAUSSCLUMPS

Results:

(Belloche et al. 2011, A&A, 527, A145 and Belloche et al. 2011, A&A, 535, A2)

- 59 starless cores detected in Cha I above 5σ, 29 in Cha III, all new! (90% completeness limit $\sim$ 0.22 $M_\odot$)
- 1 candidate first hydrostatic core in Cha I: Cha-MMS1 (Belloche et al. 2006, Tsitali et al. 2013)
- 21 sources associated with more evolved YSOs in Cha I, none in Cha III





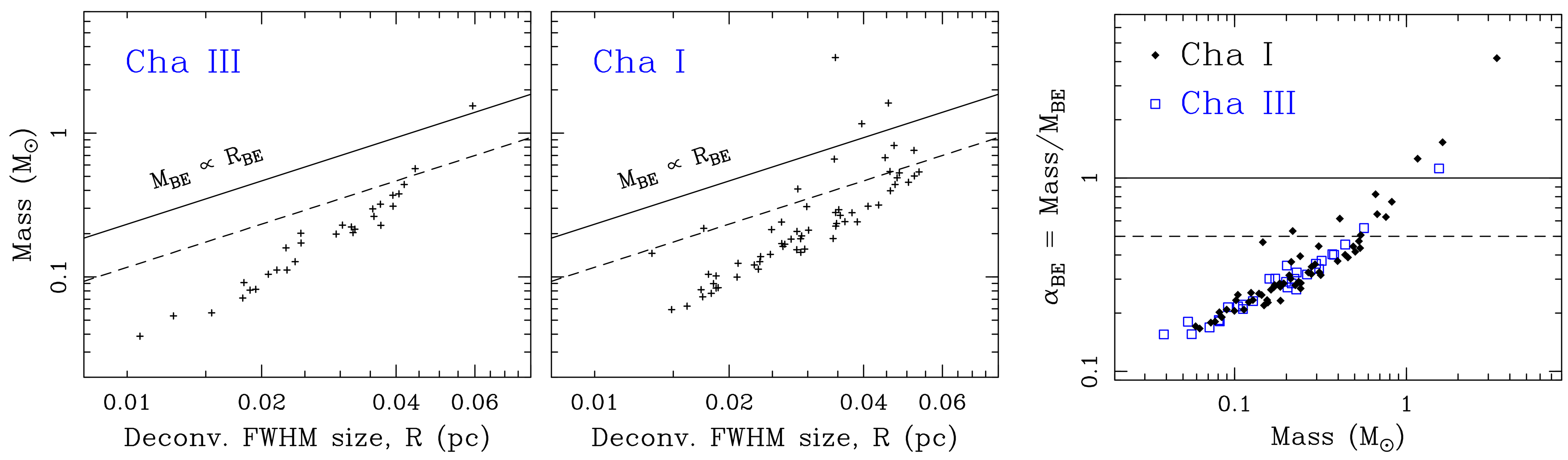
A new population of starless cores in Cha I and III:

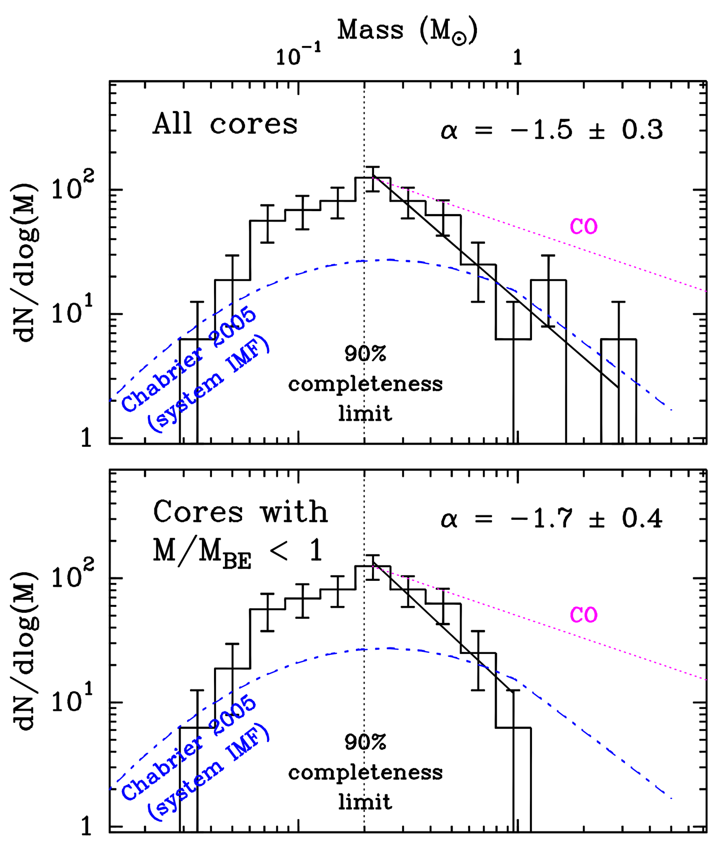
- similar properties in both clouds in terms of median mass, size, aspect ratio
- but starless cores found down to 5 mag in Cha I vs. 1.9 in Cha III (median A_V: 9 vs. 5 mag)

Stability:

- small fraction of sources with mass above critical Bonnor-Ebert mass limit ($<$ 17% in Cha I, $<$ 7% in Cha III) (left and middle panels)
- only most massive sources above BE mass limit (right panel)

⇒ most starless cores stable or even unbound, i.e. not prestellar?





Core mass function:

- CMF slope at high mass end similar to IMF (top left panel)
- same conclusion for cores with $M/M_{BE} < 1$! (bottom left panel)
- but overpopulation at low-mass end
- no break in CMF down to completeness limit

⇒ starless cores may become prestellar? still accumulating mass?

Numerical simulations of mass growth of unbound cores:

(e.g. Clark & Bonnel 2005, Gómez et al. 2007, Gong & Ostriker 2009, 2011)

- filaments formed in post-shock regions at same time as cores condense within filaments
- *observable* core-building phase 1–2 times longer than collapse phase

⇒ at most 50% (20%) of starless cores in Cha I (III) may turn prestellar

CONCLUSIONS

Star formation in Cha I and III:

- starless cores have similar properties in both clouds
- Cha I: star formation rate has decreased with time (by at least a factor 2–4)
- Cha III: prime target to study *formation* of prestellar cores

→ observational constraints on core-building phase needed!

Prospects:

- ongoing analysis of APEX + Mopra molecular line survey to investigate kinematics and dynamical state of starless cores (Tsitali et al.)
- *Herschel* Gould Belt continuum survey between 70 and 500 μm (PI: P. André): will bring wealth of new information about starless cores in Chamaeleon (completeness, temperature, filamentary structure, low-density gas...)