The Earliest Phases of Star Formation (EPoS): Resolving the Precursors to High-Mass Stars and Clusters

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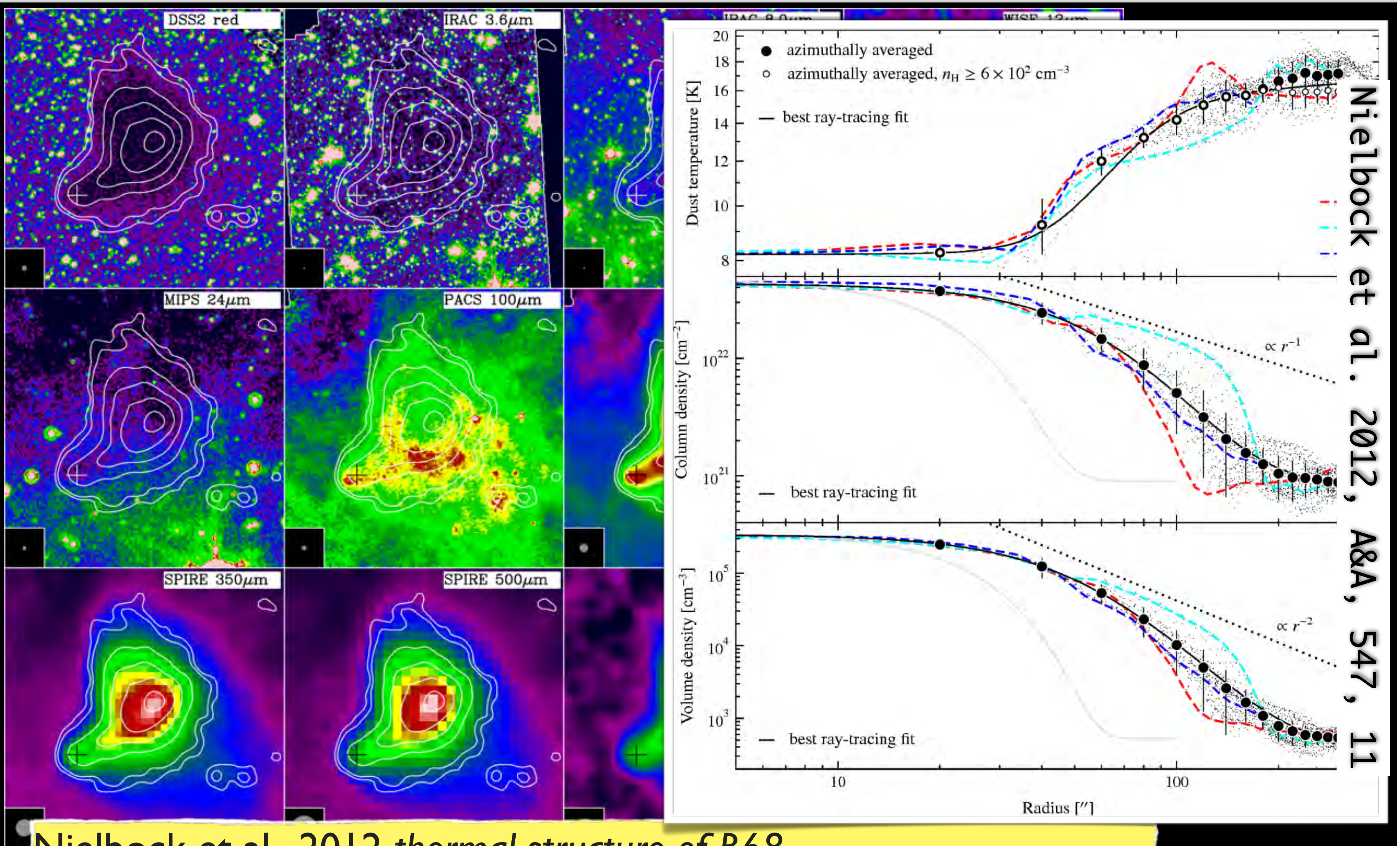
What I will <u>not</u> speak about... globules

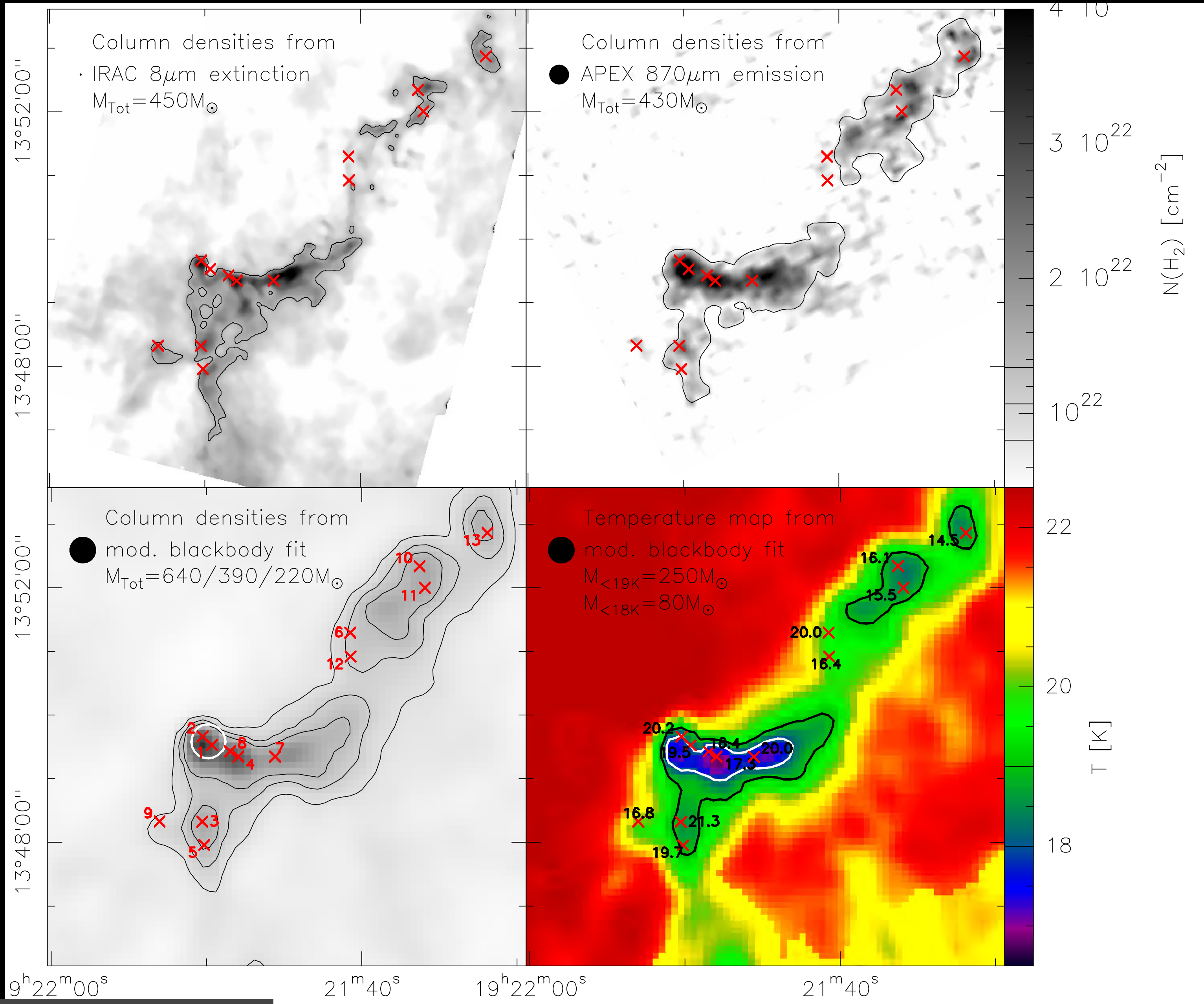


Nielbock et al. 2012 *thermal structure of B68*

Launhardt et al. 2013 *modeling EPoS globule sample (talk Thurs., 12b)*

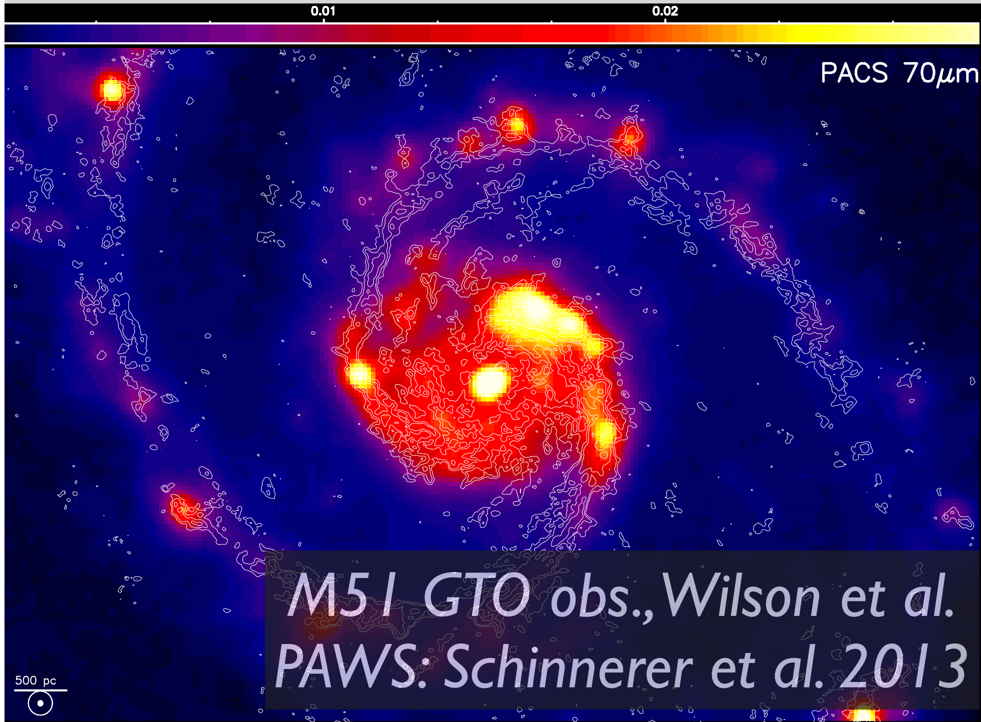
Lippok et al. 2013 - *gas phase CO depletion in starless cores*

G48.66: a detailed study of an isolated IRDC

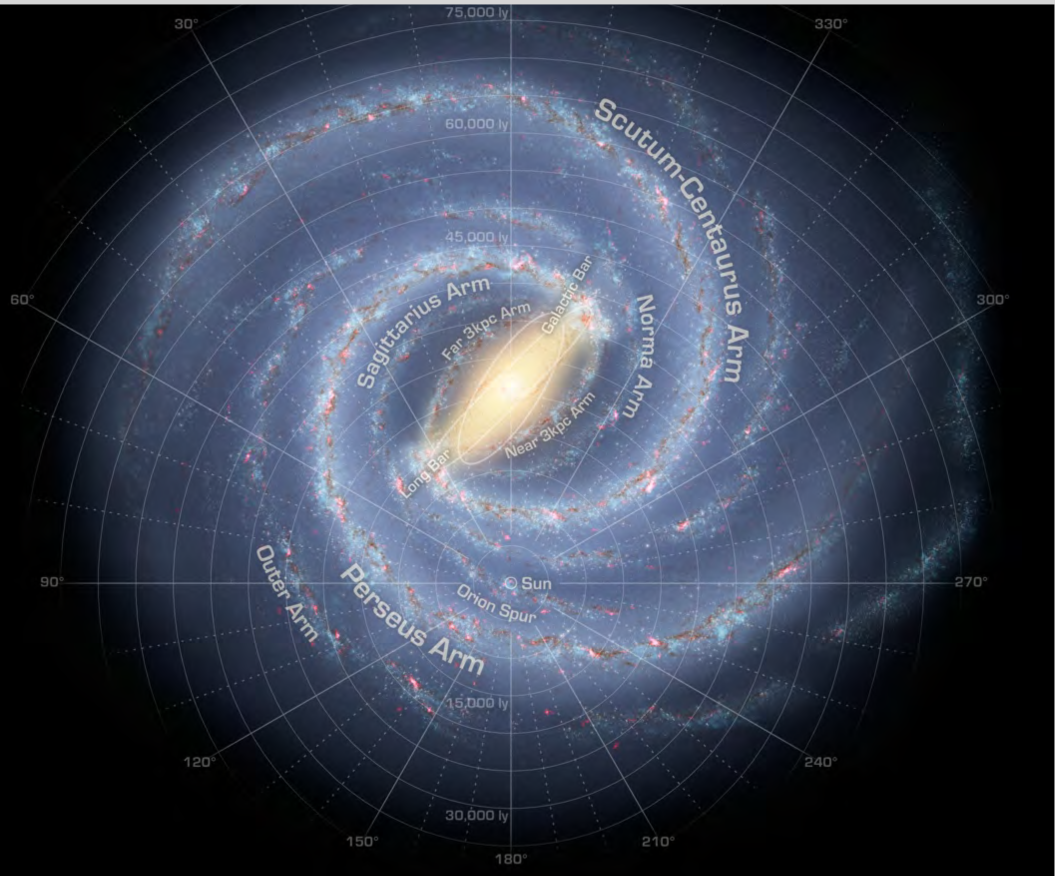


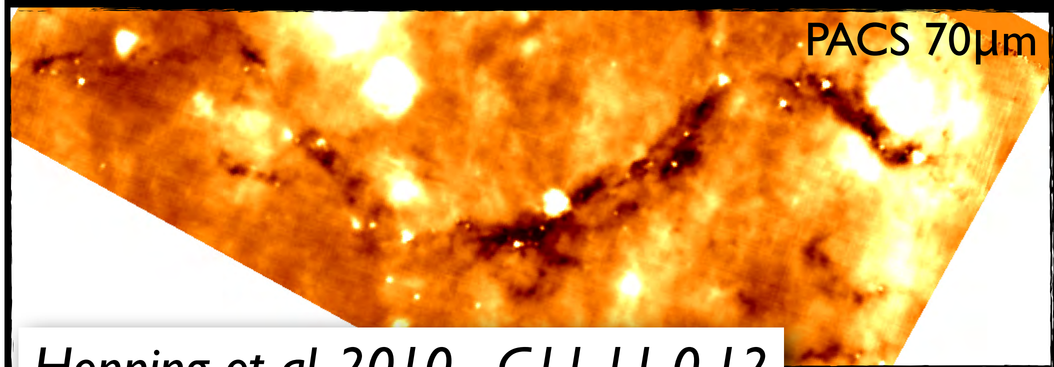
Pitann et al. 2013

Early Phases of Star formation ... in IRDCs



M51 GTO obs., Wilson et al.
PAWS: Schinnerer et al. 2013

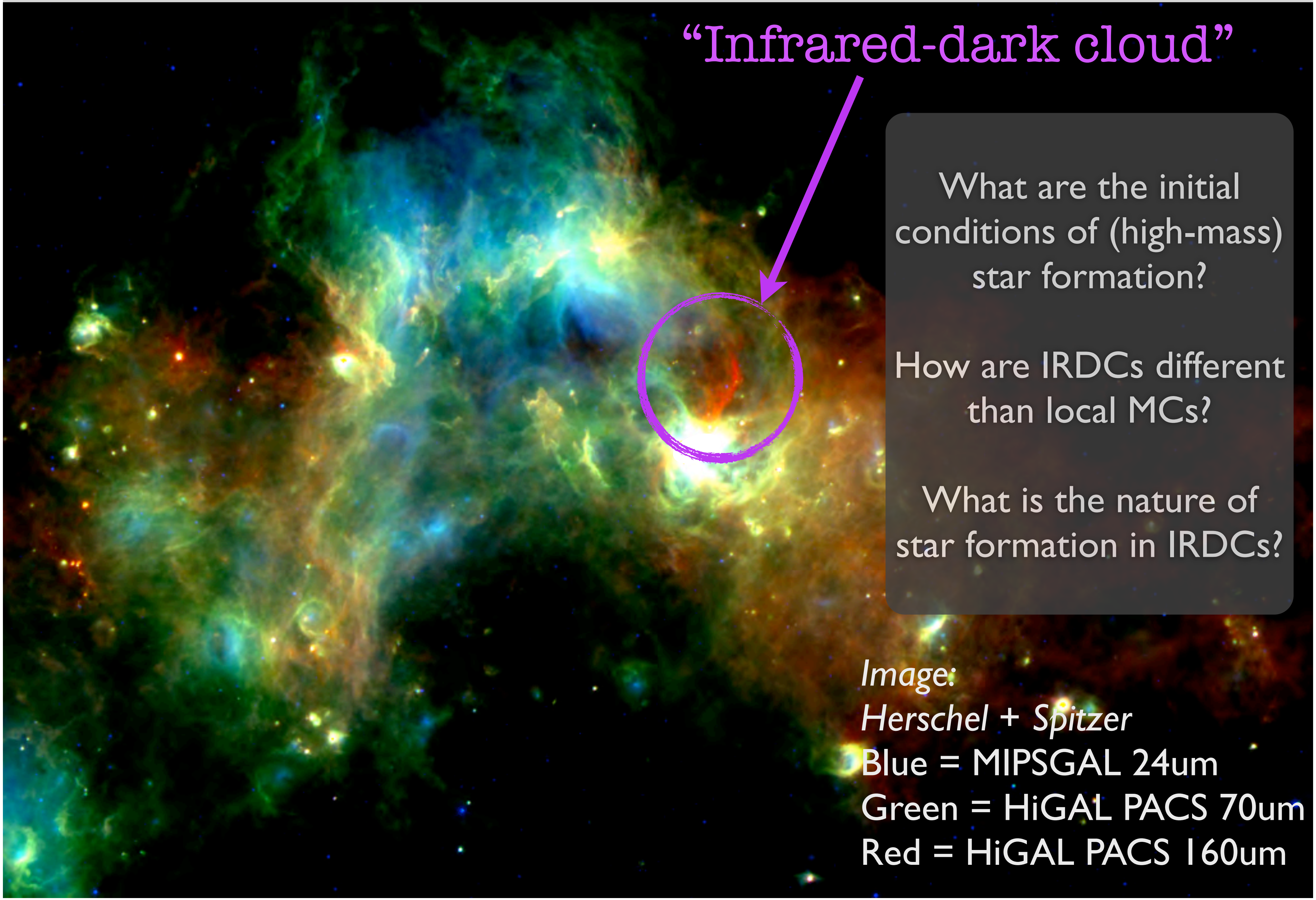




Henning et al. 2010 - G11.11-0.12

Infrared-dark cloud (IRDC): Cold ($T < 20K$), dense ($n \sim 10^{4-5}$ cm^{-3}) molecular cloud complex containing an ensemble of objects in the early stages of clusters and (sometimes) massive stars.

Context and motivation



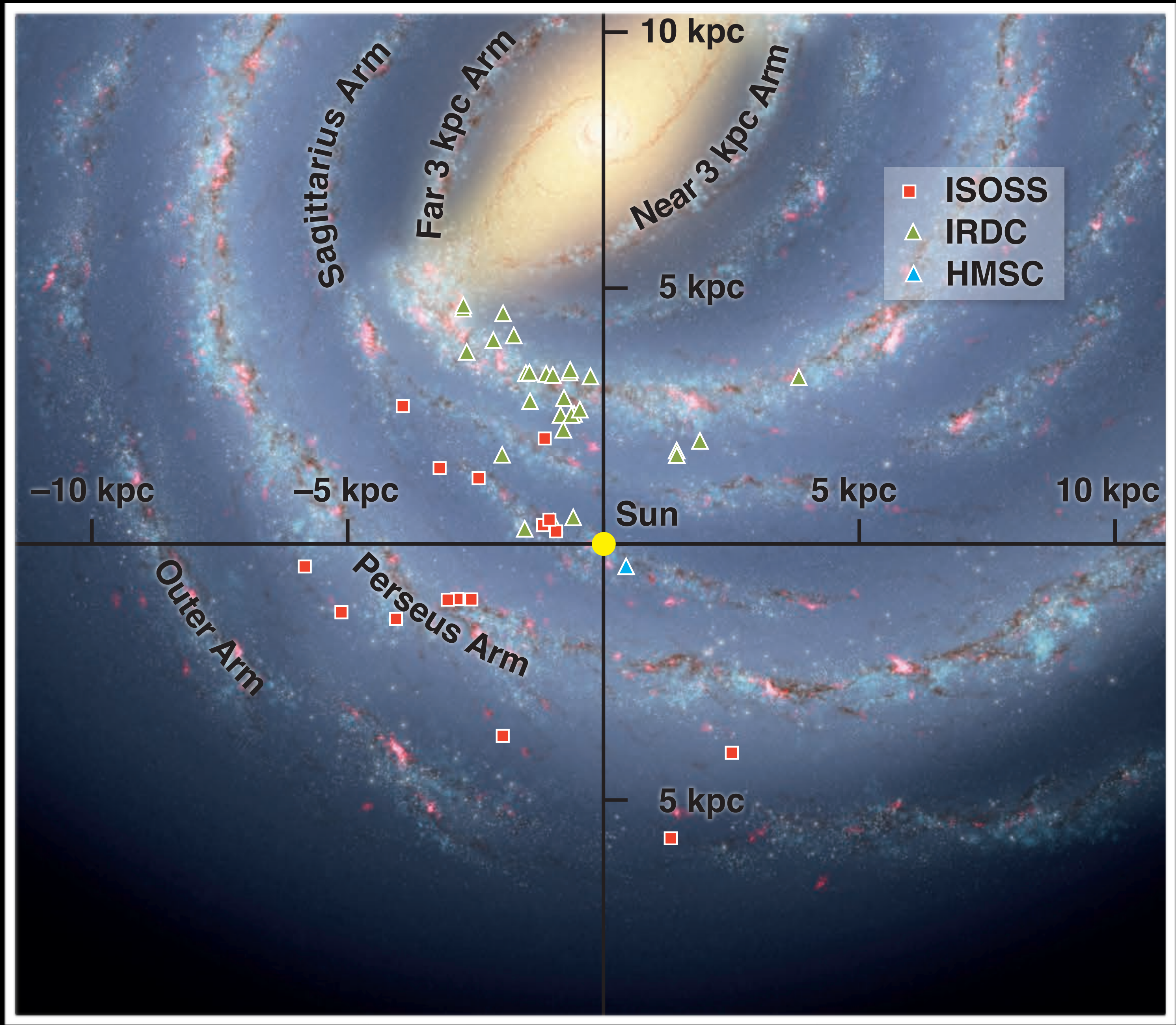
What are the initial conditions of (high-mass) star formation?

How are IRDCs different than local MCs?

What is the nature of star formation in IRDCs?

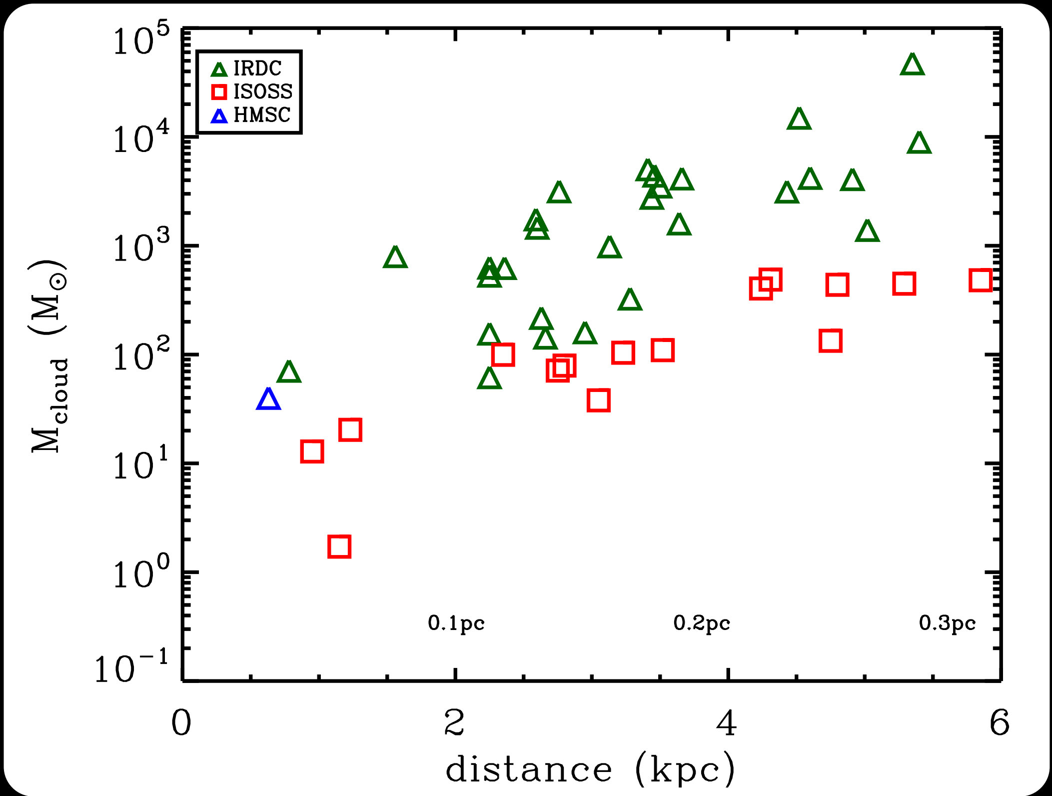
Image:
Herschel + Spitzer
Blue = MIPSGAL 24um
Green = HiGAL PACS 70um
Red = HiGAL PACS 160um

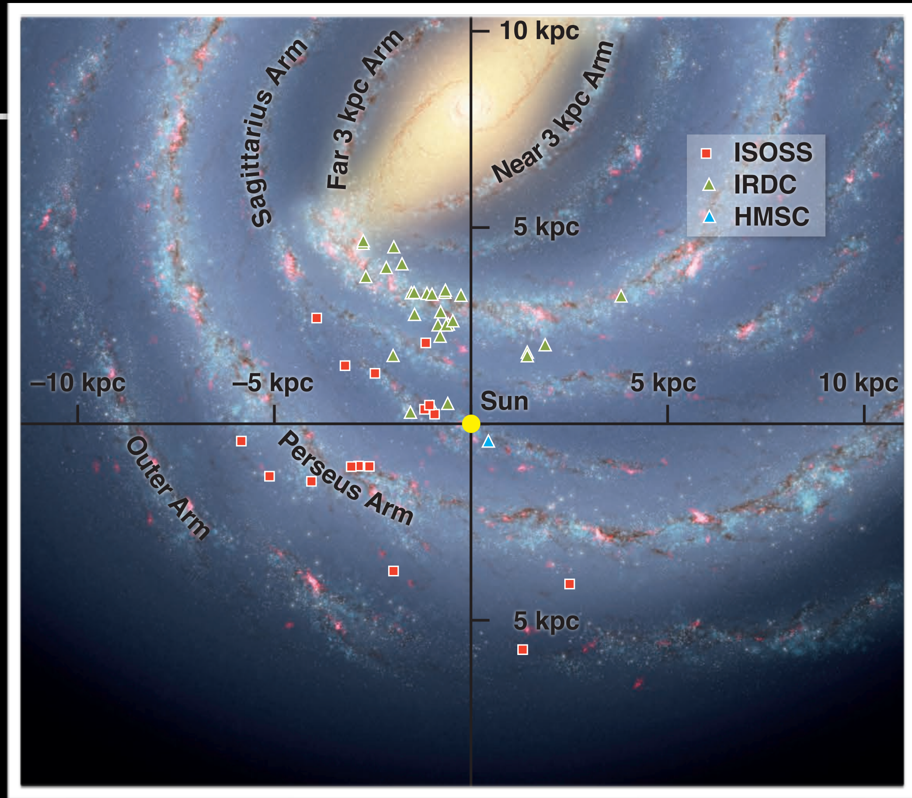
EPoS survey design



EPoS survey design

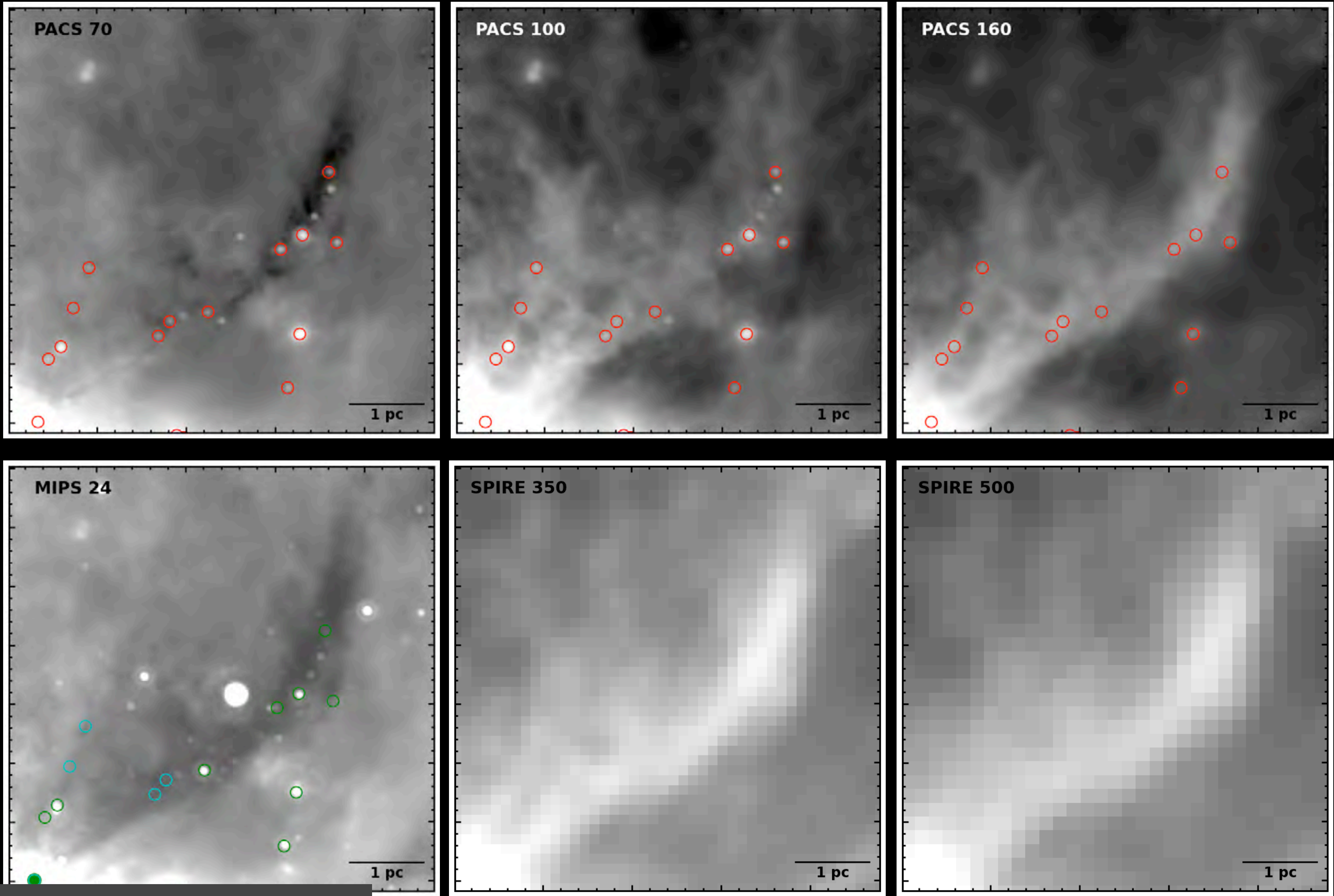
- PACS 70, 100, 160µm
- SPIRE 250, 350, 500µm
- Targets: IRDCs, ISOSS sources





Ragan et al. 2012b

Protostars in IRDCs



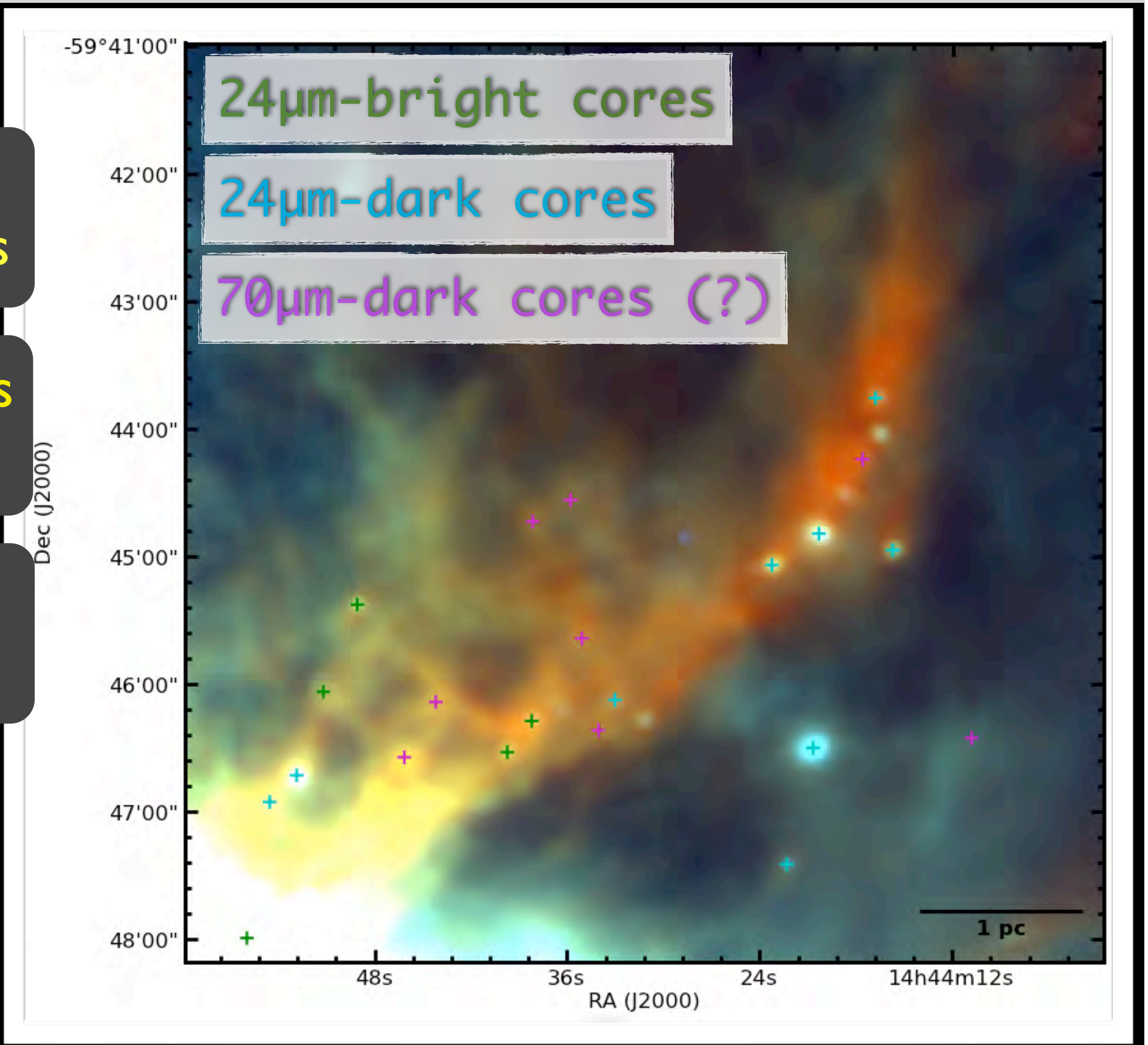
Ragan et al. 2012b

Protostars in IRDCs

496 cores in sample of 45 clouds

PSF-fit point sources
Size 0.05 - 0.3pc

65% have 24μm counterparts

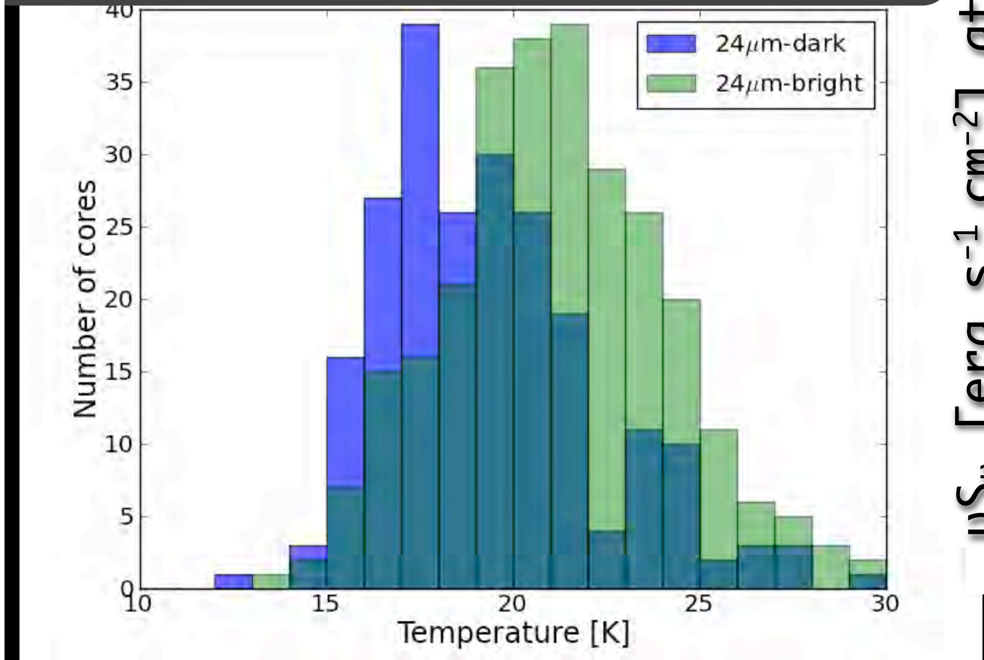


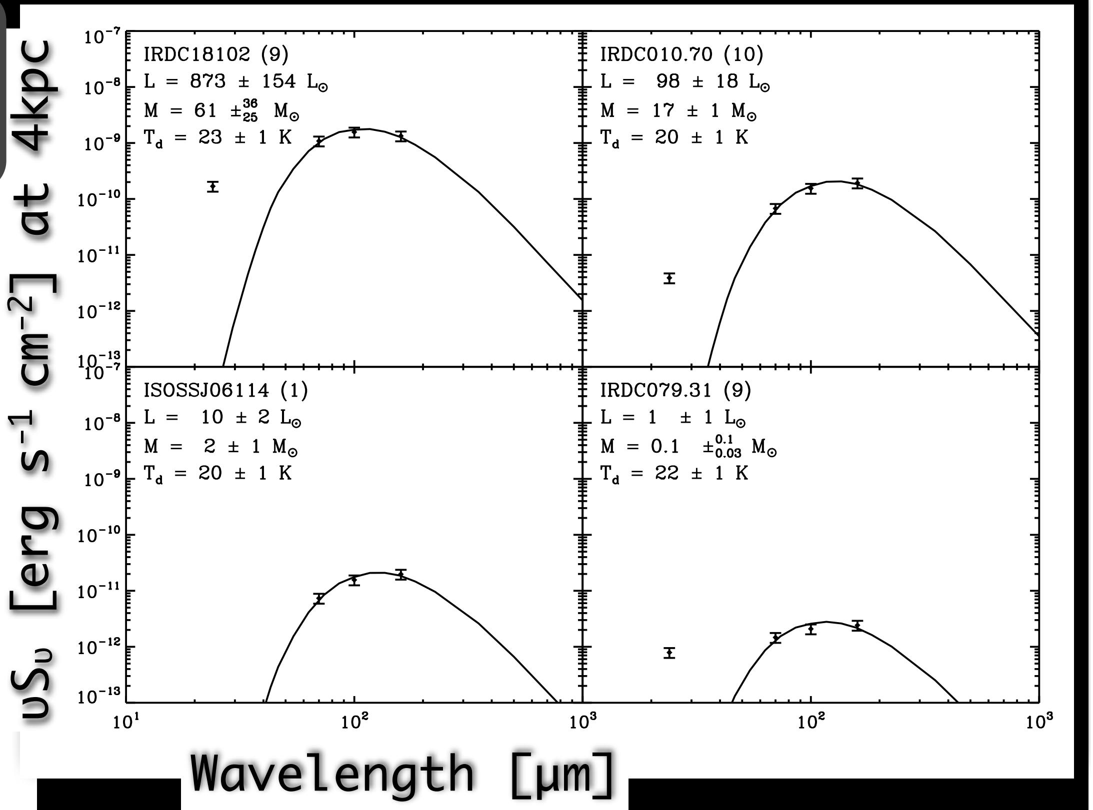
Ragan et al. 2012b

Nature of cores: distributions

Ragan et al. 2012b

24µm-bright cores appear warmer than 24µm-dark cores





Require internal heating source

Enhanced ISRF cannot reproduce short-wavelength SED

24µm counterpart

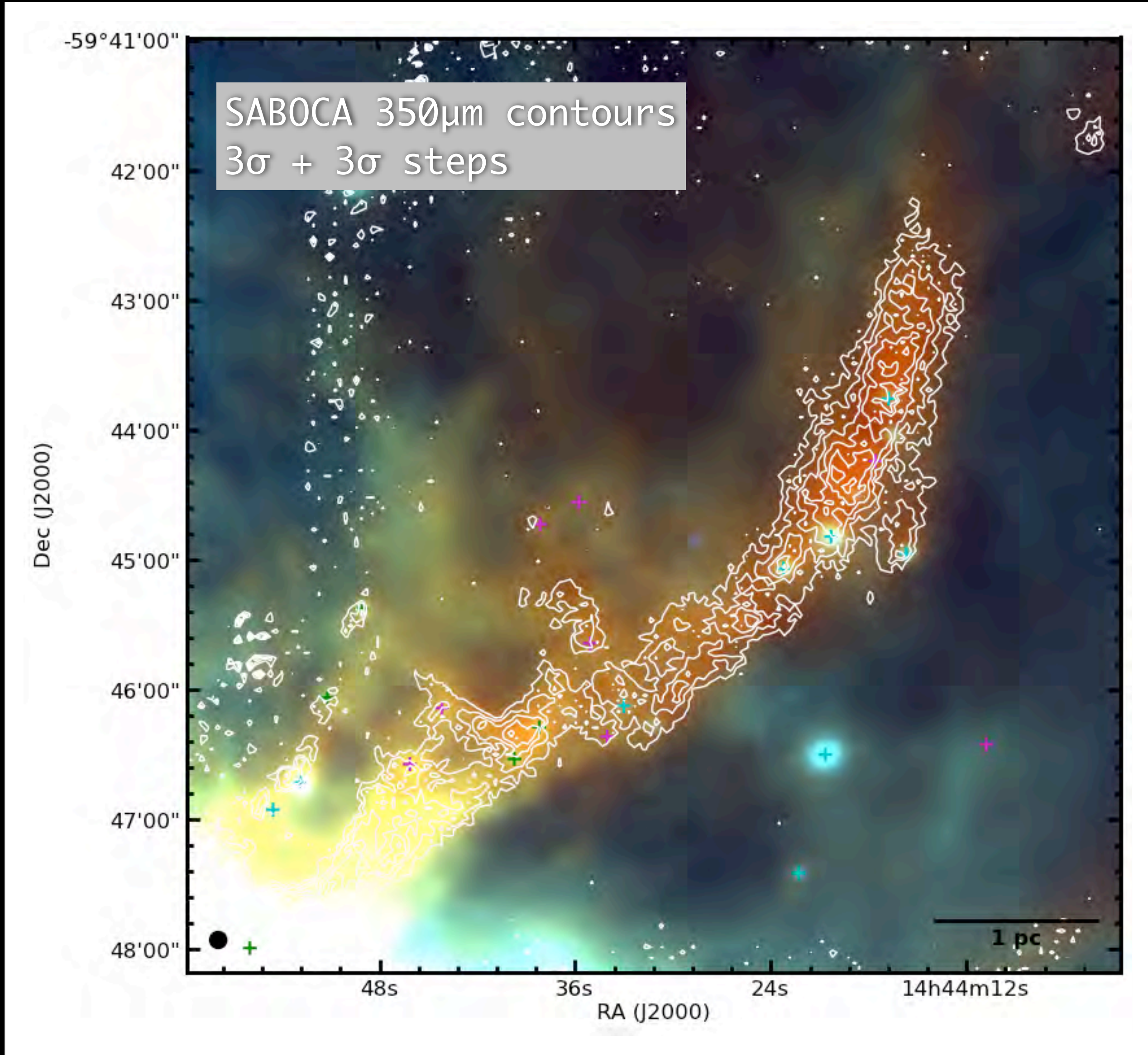
May signify more evolved core or a geometrical effect

70µm dark objects

are good candidates for elusive 'starless cores'

see also complementary results from Stamatellos+2010, Wilcock+2011

Anchoring the SED



Ragan et al. 2013

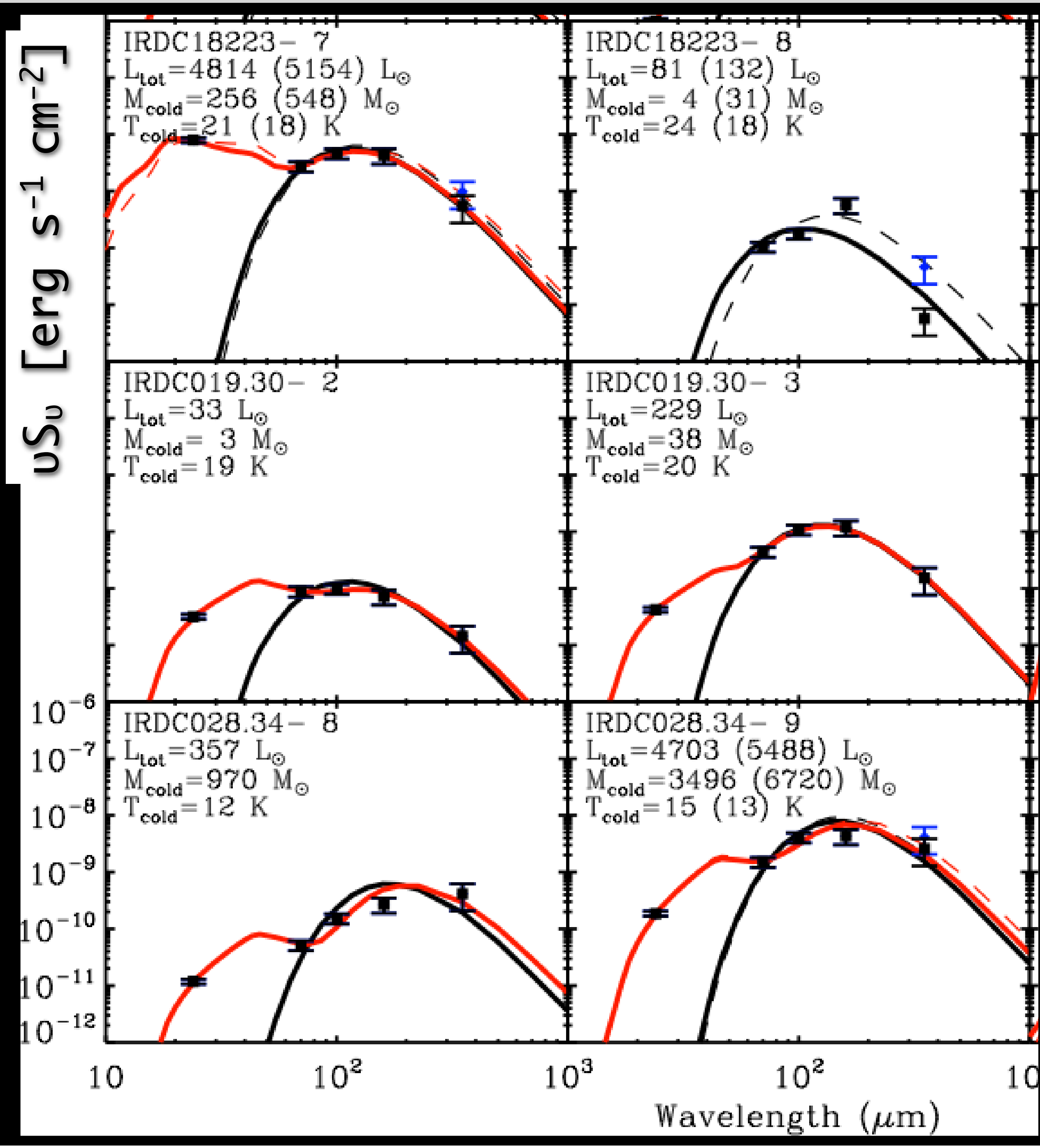
PACS cores, revisited

Recover 40 (45%) Ragan+2012b cores

Biased toward most luminous

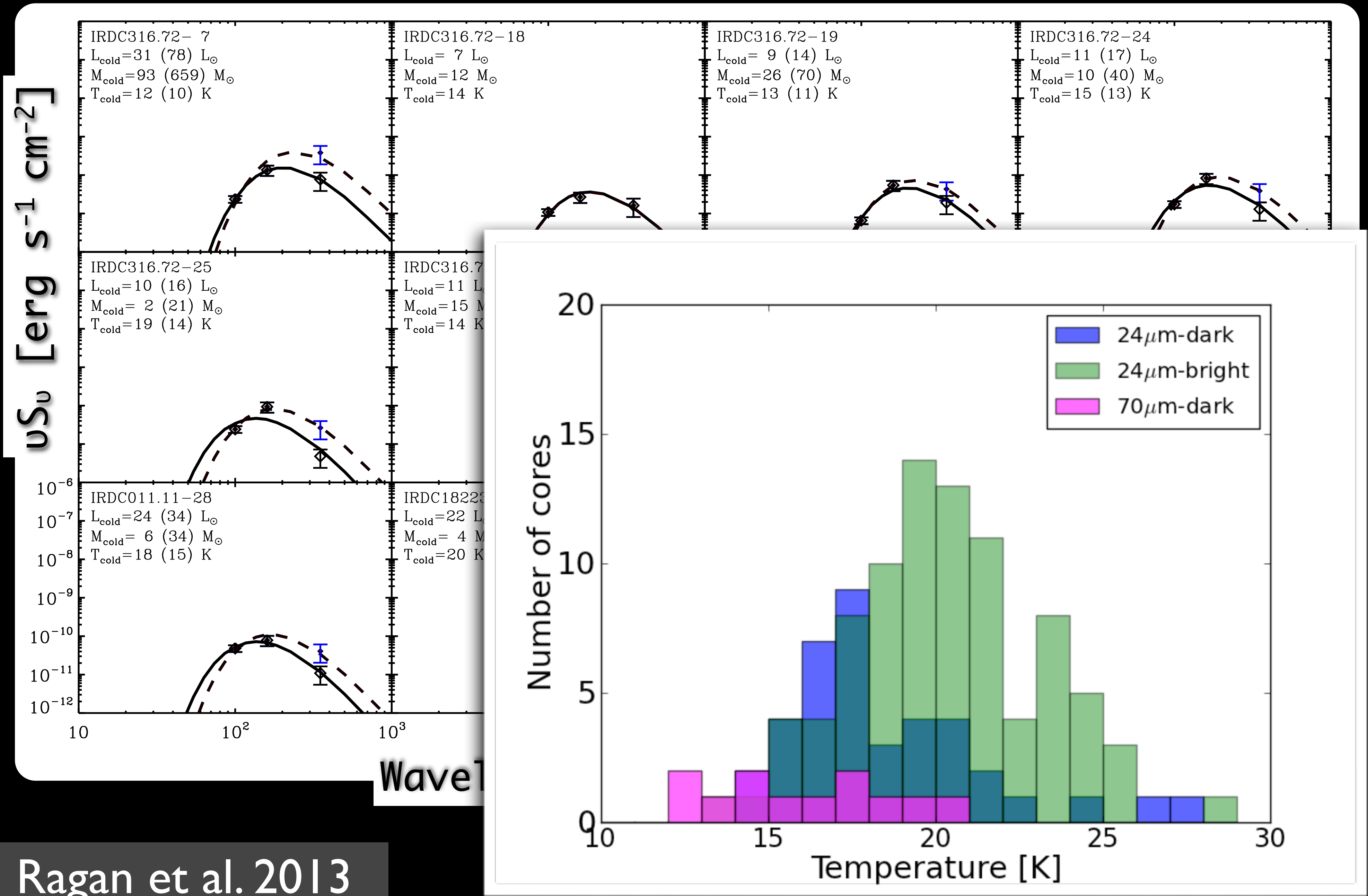
Re-fit SEDs with SABOCA data

Enabling us to characterize 'warm' dust component



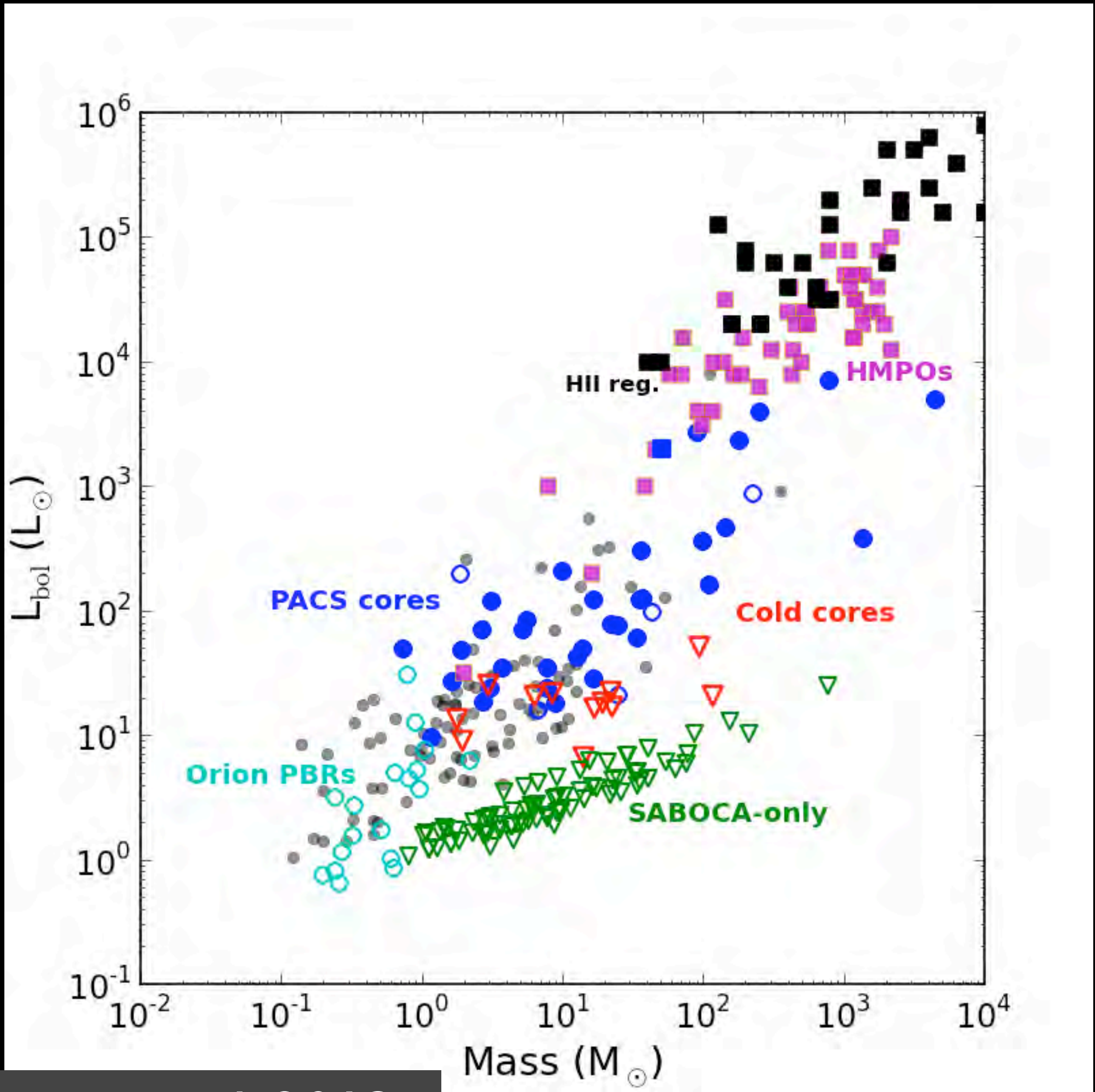
Ragan et al. 2013

Younger cores revealed by SABOCA



Ragan et al. 2013

Core evolution



Ragan et al. 2013

EPoS sample
Ragan+2012b

PACS cores
Ragan+2013

Orion PBRs
Stutz+2013

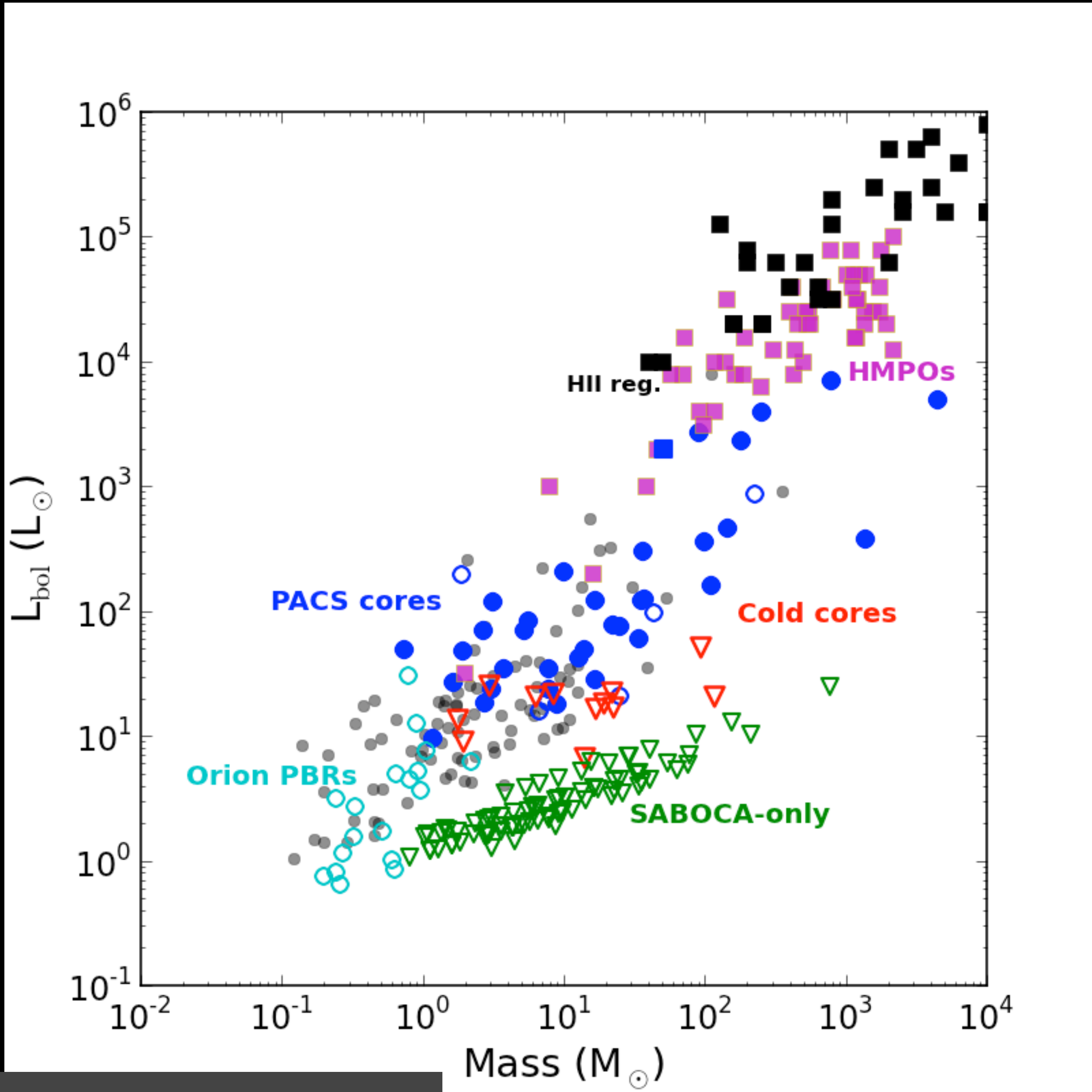
70μm-dark cores
Ragan+2013

HMPOs
Beuther+2002

UCHII regions
Hunter+2000

SABOCA only
Ragan+2013

Core evolution



Ragan et al. 2013

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Ragan+2013

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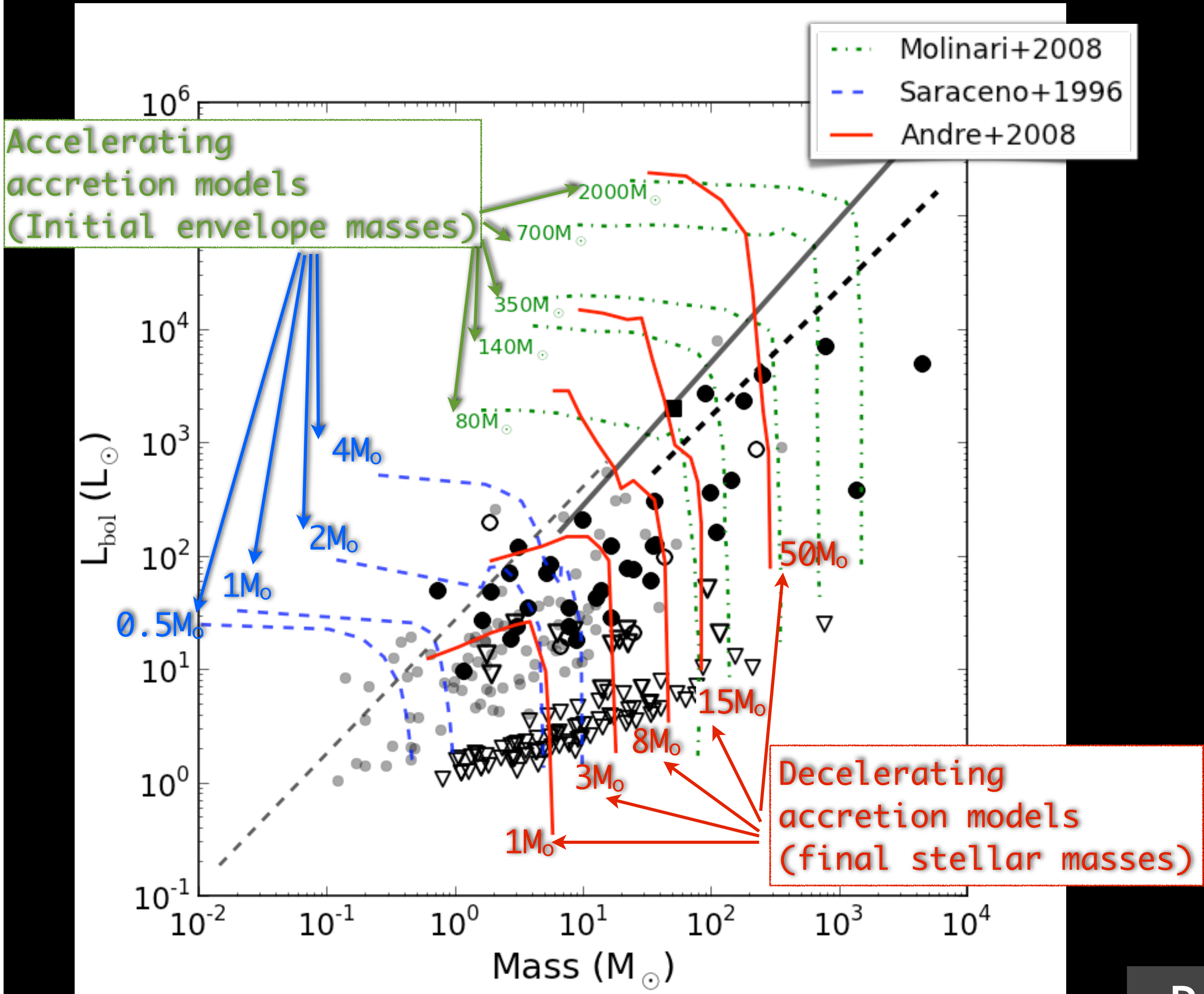

Ragan et al. 2013

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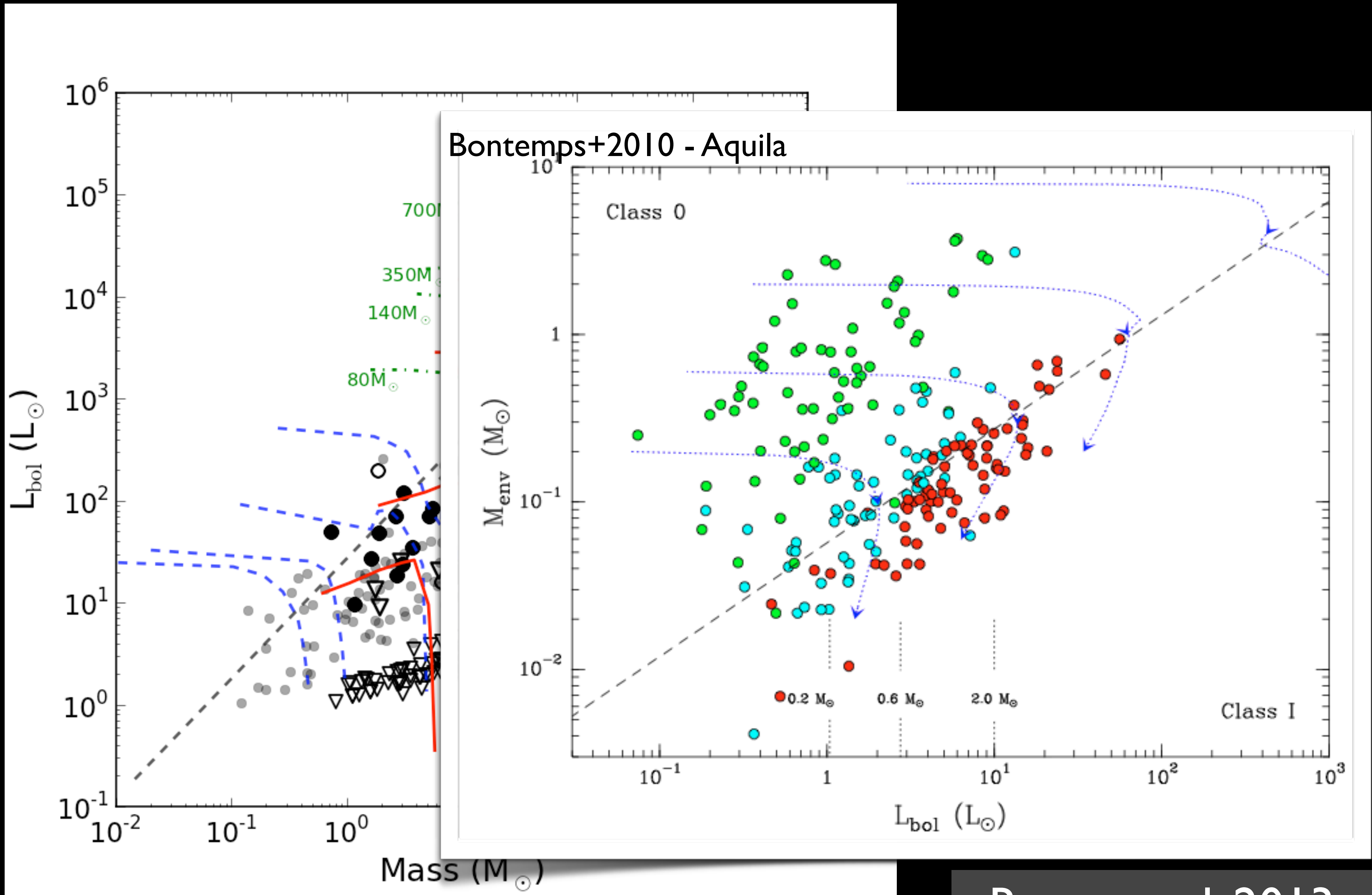

Ragan et al. 2013

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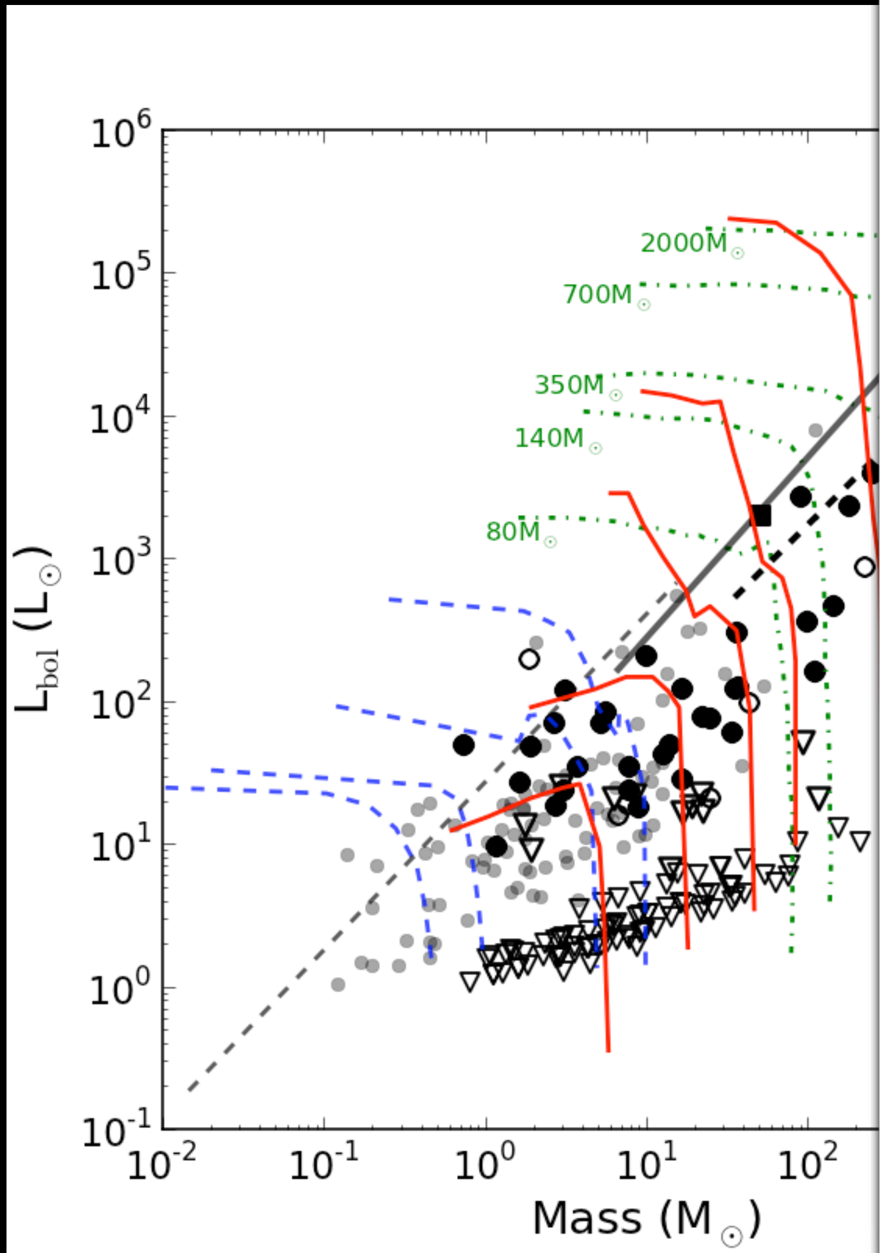
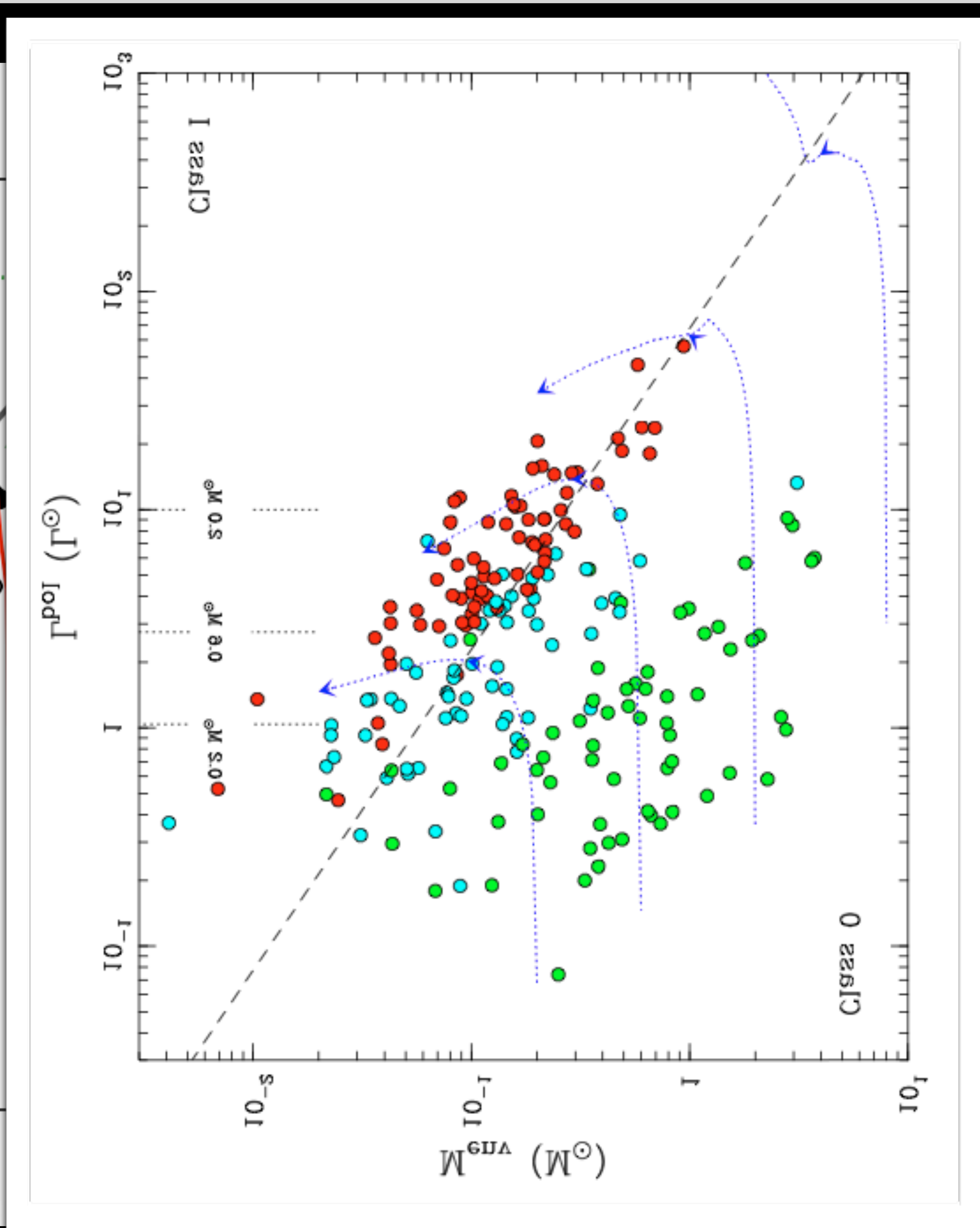
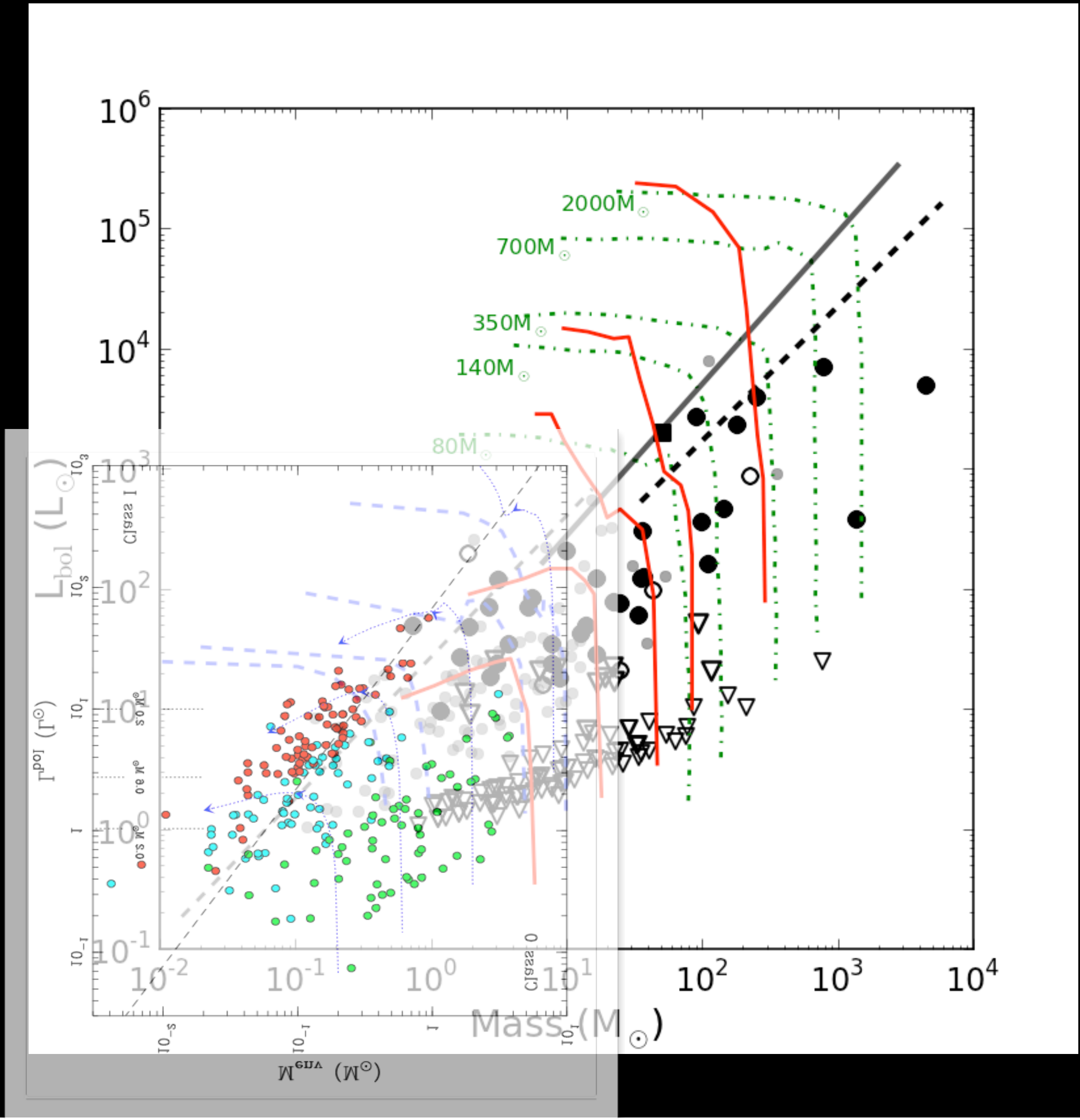




Ragan et al. 2013

Core evolution



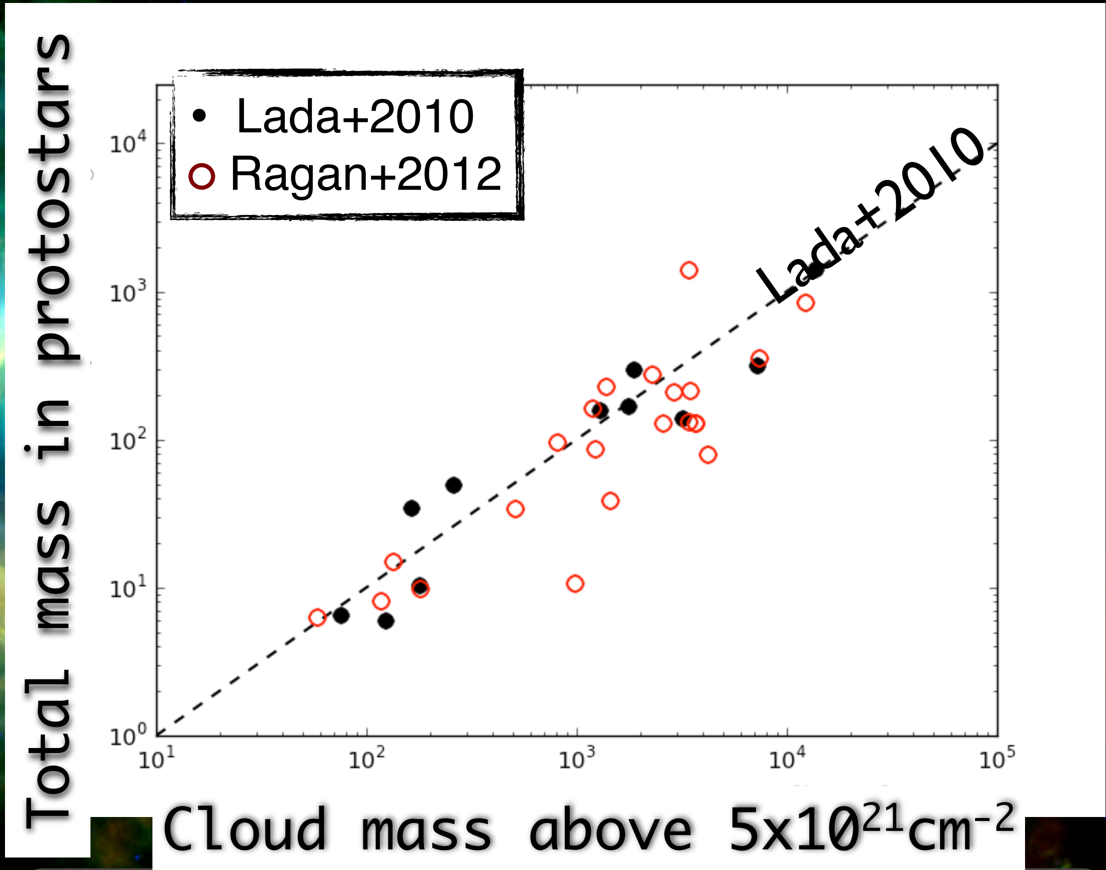
Ragan et al. 2013

Summary

We have isolated the earliest ``core`` stages in IRDCs

SED-fitting provides estimate of core mass, temperature, luminosity

Star formation rate in IRDCs appears comparable to that in local molecular clouds



Next steps...

1. *Follow-up starless candidates*
2. *Characterize surface relations*
3. *Improve modeling of protstellar cores*