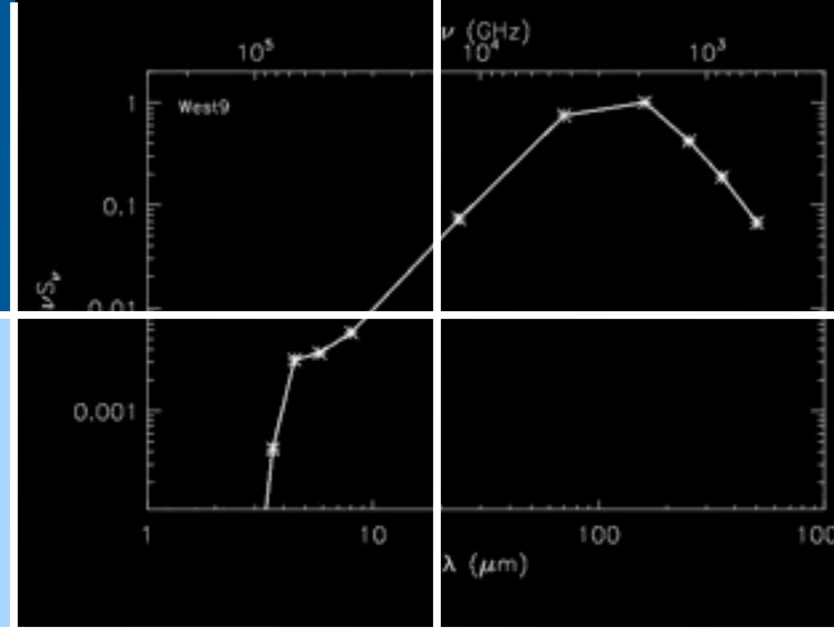
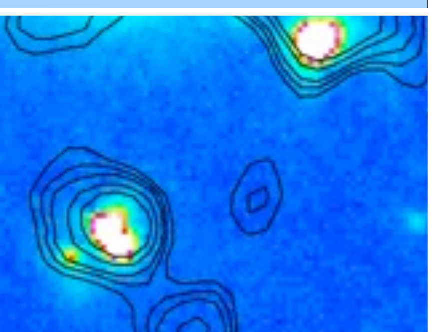


Evidence of Feedback?

Class 0 Protostellar Fraction and Environment in the Perseus Molecular Cloud

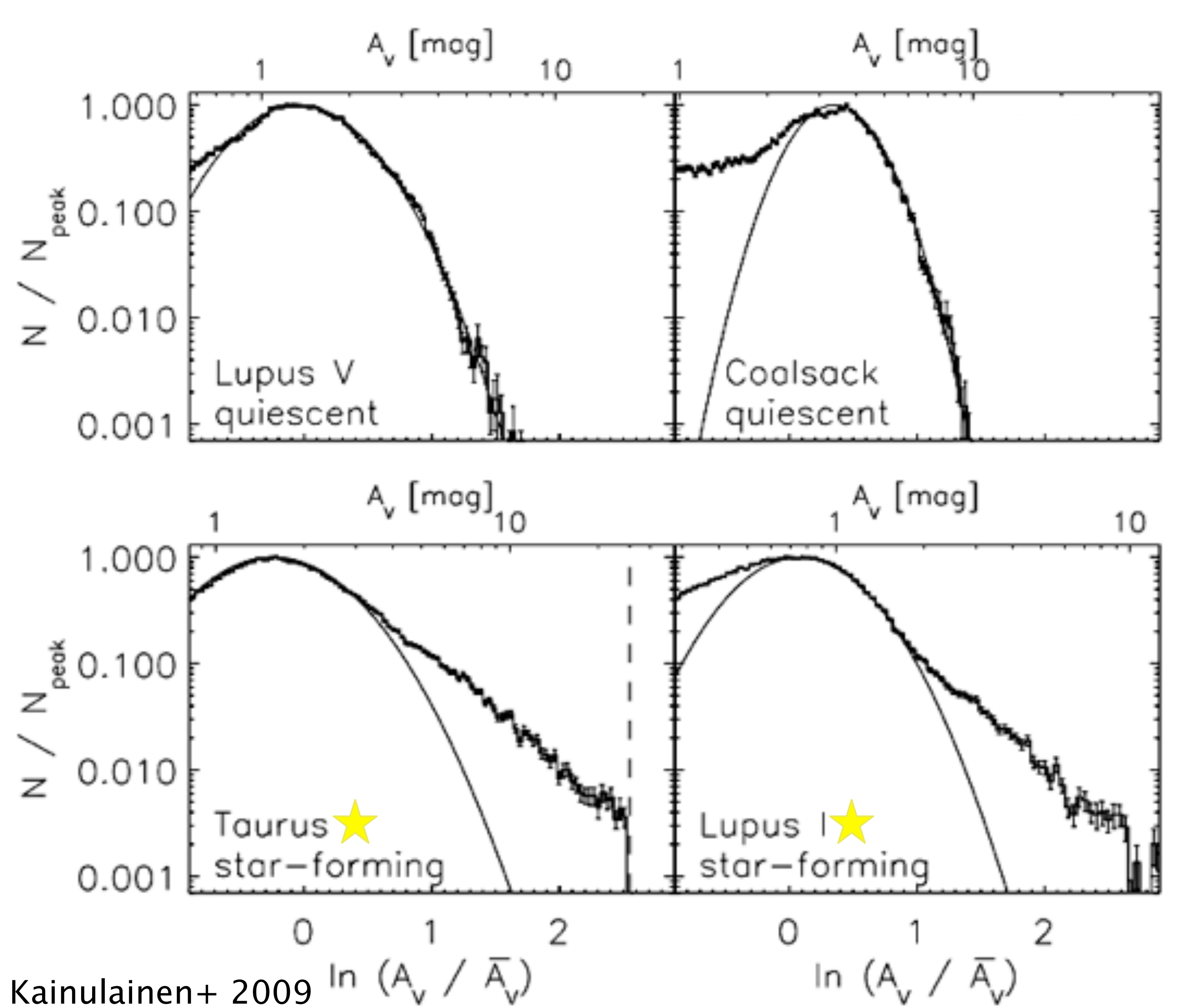
Sarah Sadavoy (MPIA)
sadavoy@mpia.de

EPoS 2014



Star Formation and Environment:

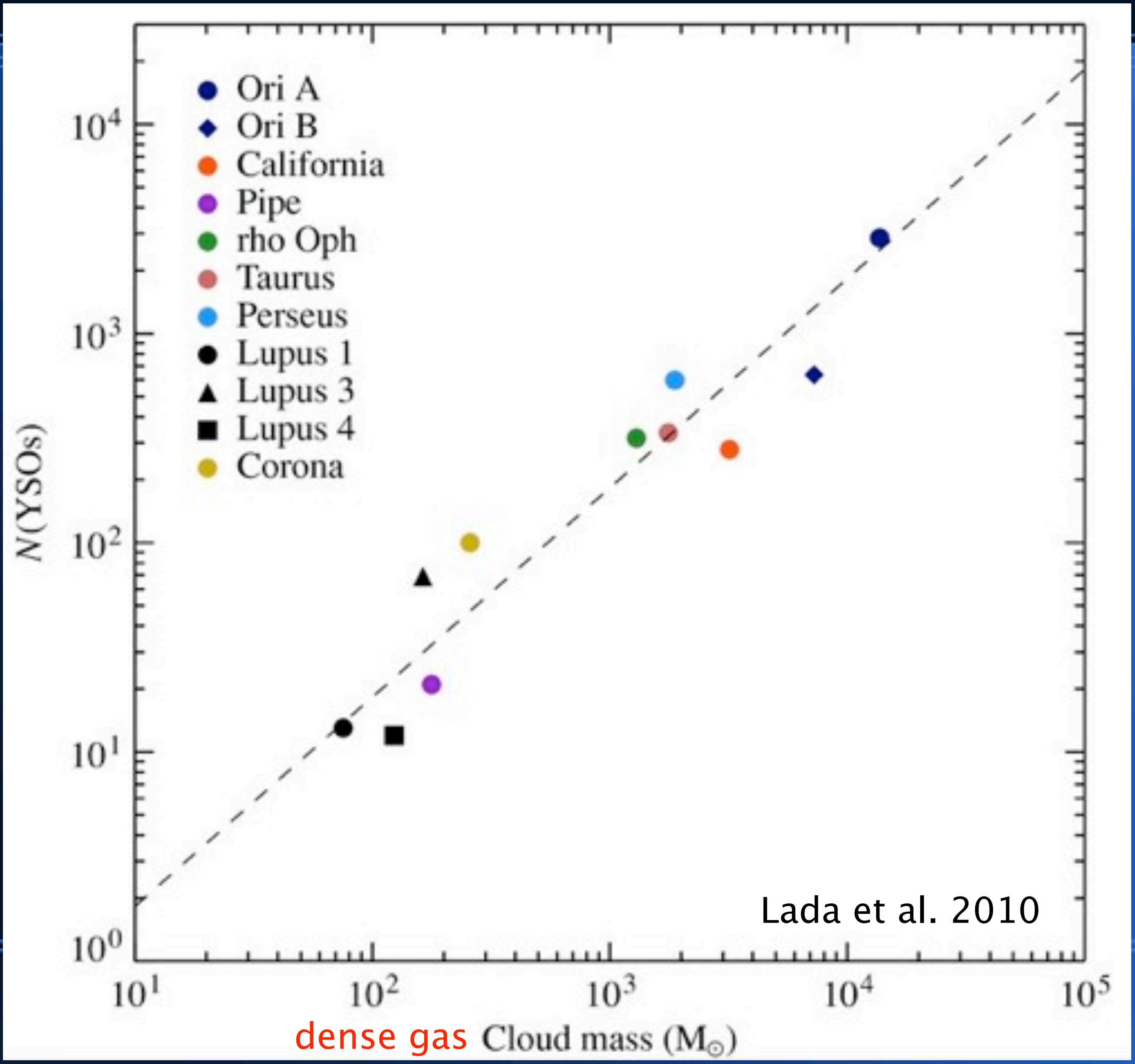
Clouds with broad column density distributions are more active



Kainulainen+ 2009

Star Formation and Environment:

Clouds with more dense (high extinction) material form more stars



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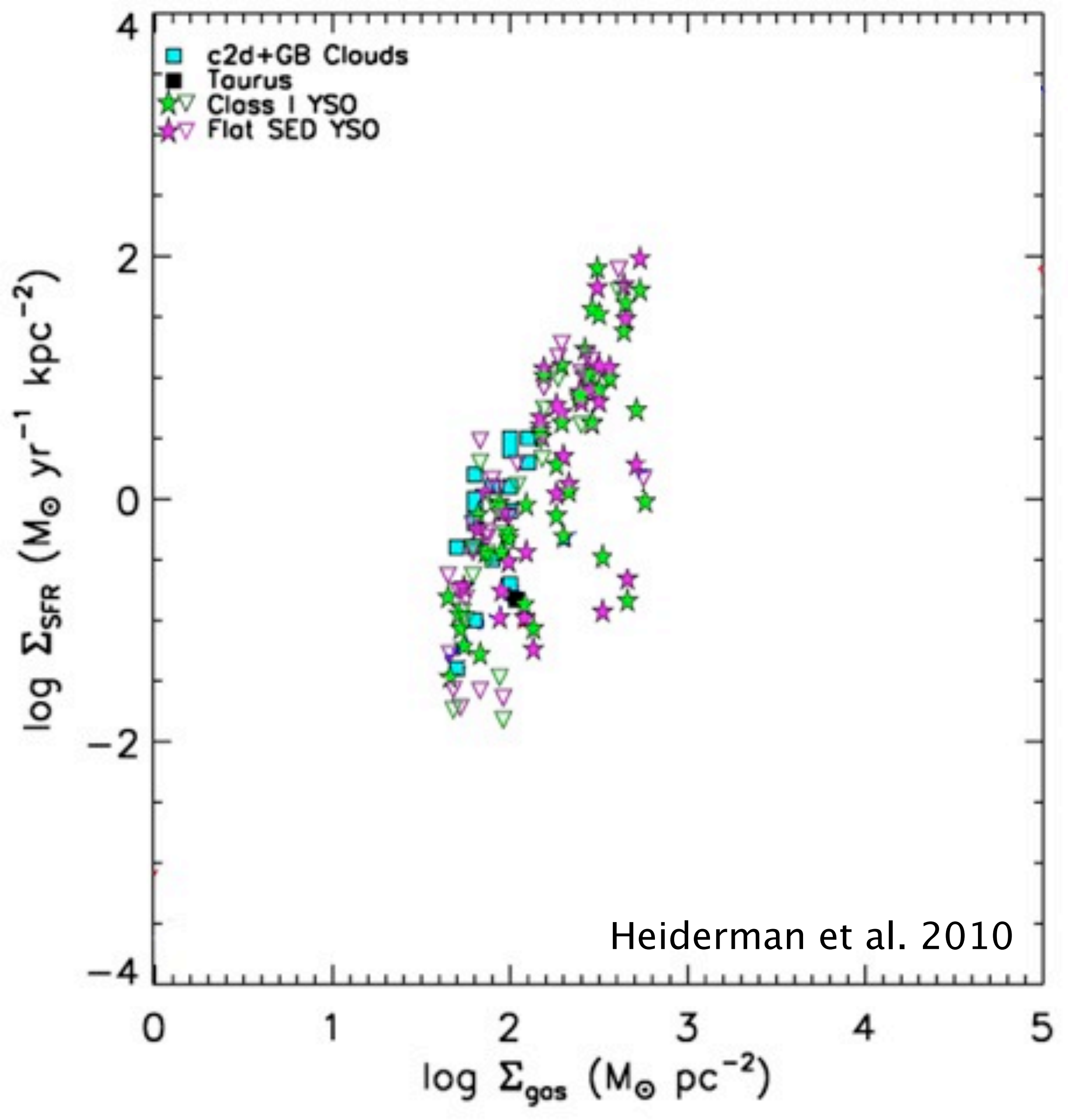
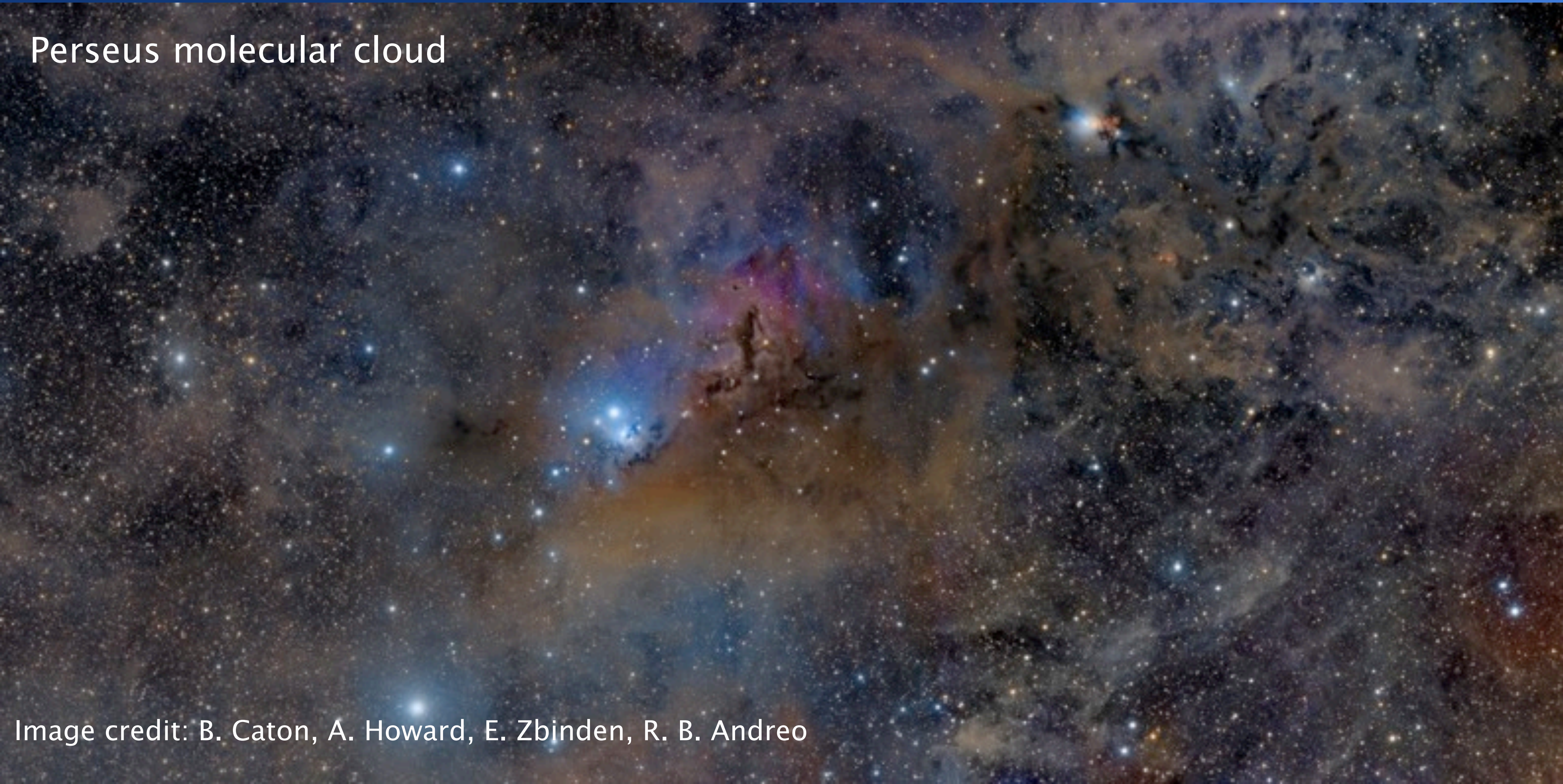


Aims

Compare star formation and environment in the clumps of one cloud



Clumps in the Perseus Cloud

Clumps: moderately dense subregions of clouds

Molecular Cloud: ~ 10 pc, ~ 10^{4-5} $M_\odot$

Perseus image credit: G. Bachmayer

Clumps in the Perseus Cloud

Clumps: moderately dense subregions of clouds

Molecular Cloud: ~ 10 pc, ~ 10^{4-5} $M_\odot$

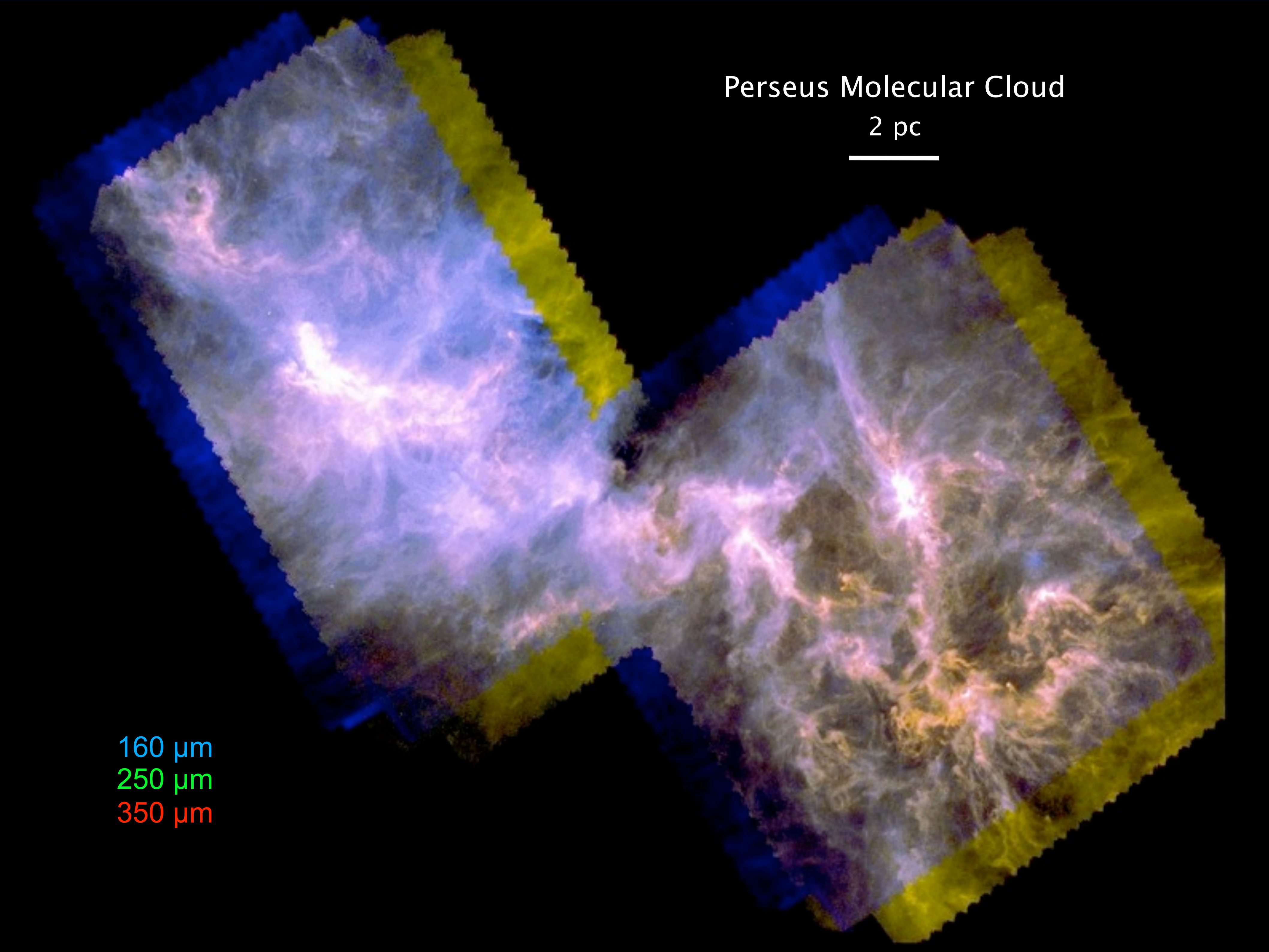
Molecular Clump:
~1 pc, ~10^{2-3} $M_\odot$

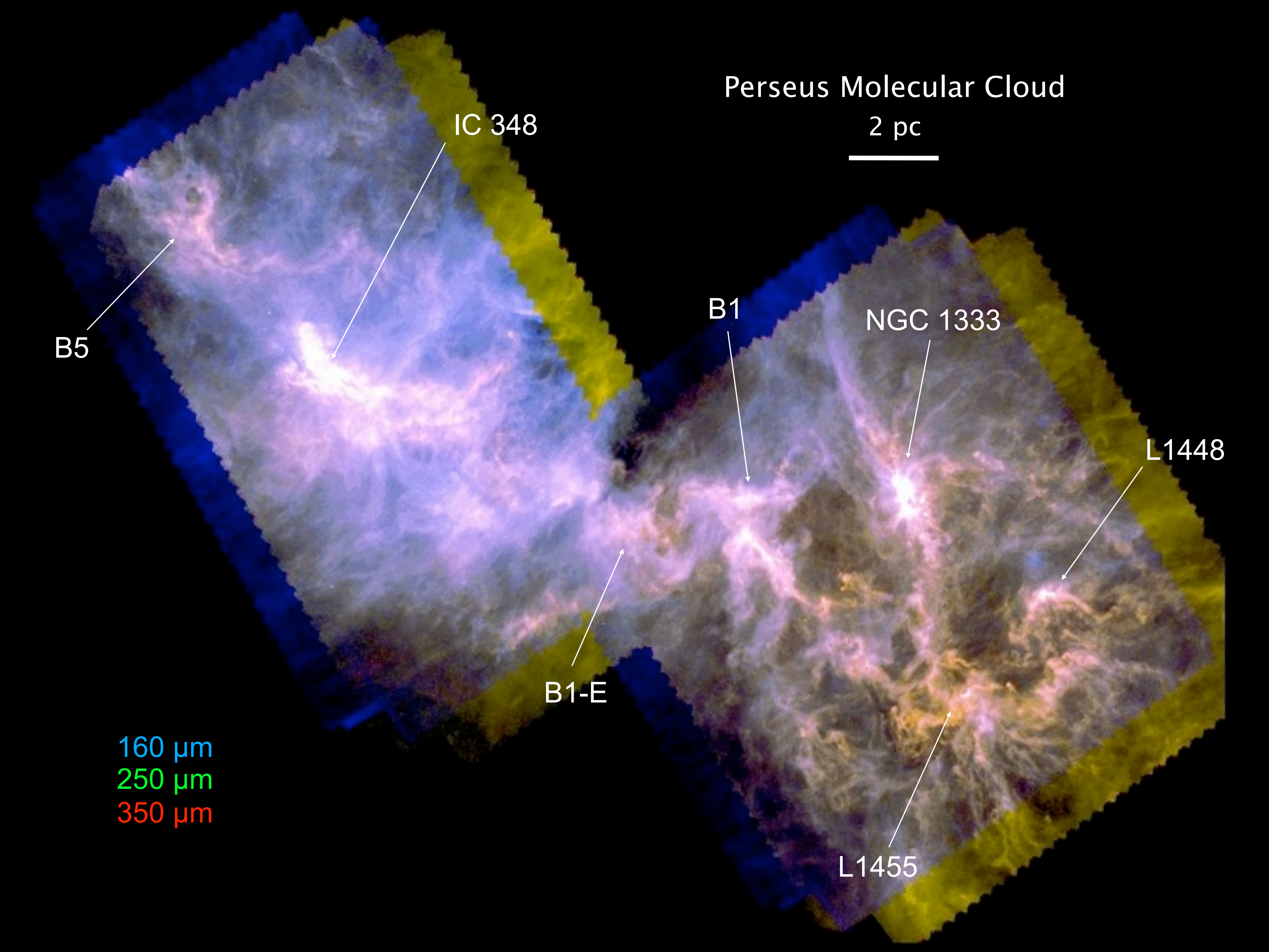
Perseus image credit: G. Bachmayer

NGC1333 image credit: T.A. Rector, H. Schweiker, NOAO, AURA, NSF

Cloud "Environment"

Environment characterized by GBS Herschel data: 160 – 500 μm


Perseus Molecular Cloud
2 pc
160 μm
250 μm
350 μm


Perseus Molecular Cloud
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B5
B1
NGC 1333
L1448
B1-E
L1455
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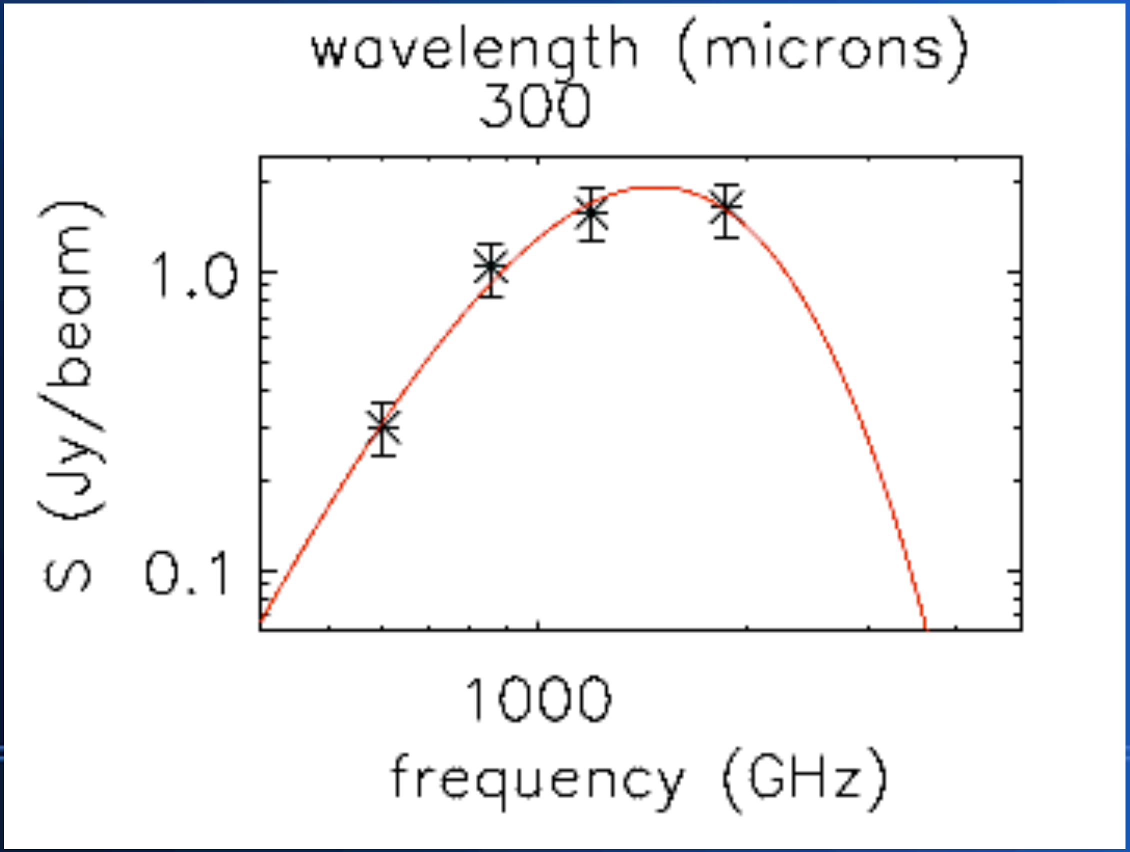
350 μm

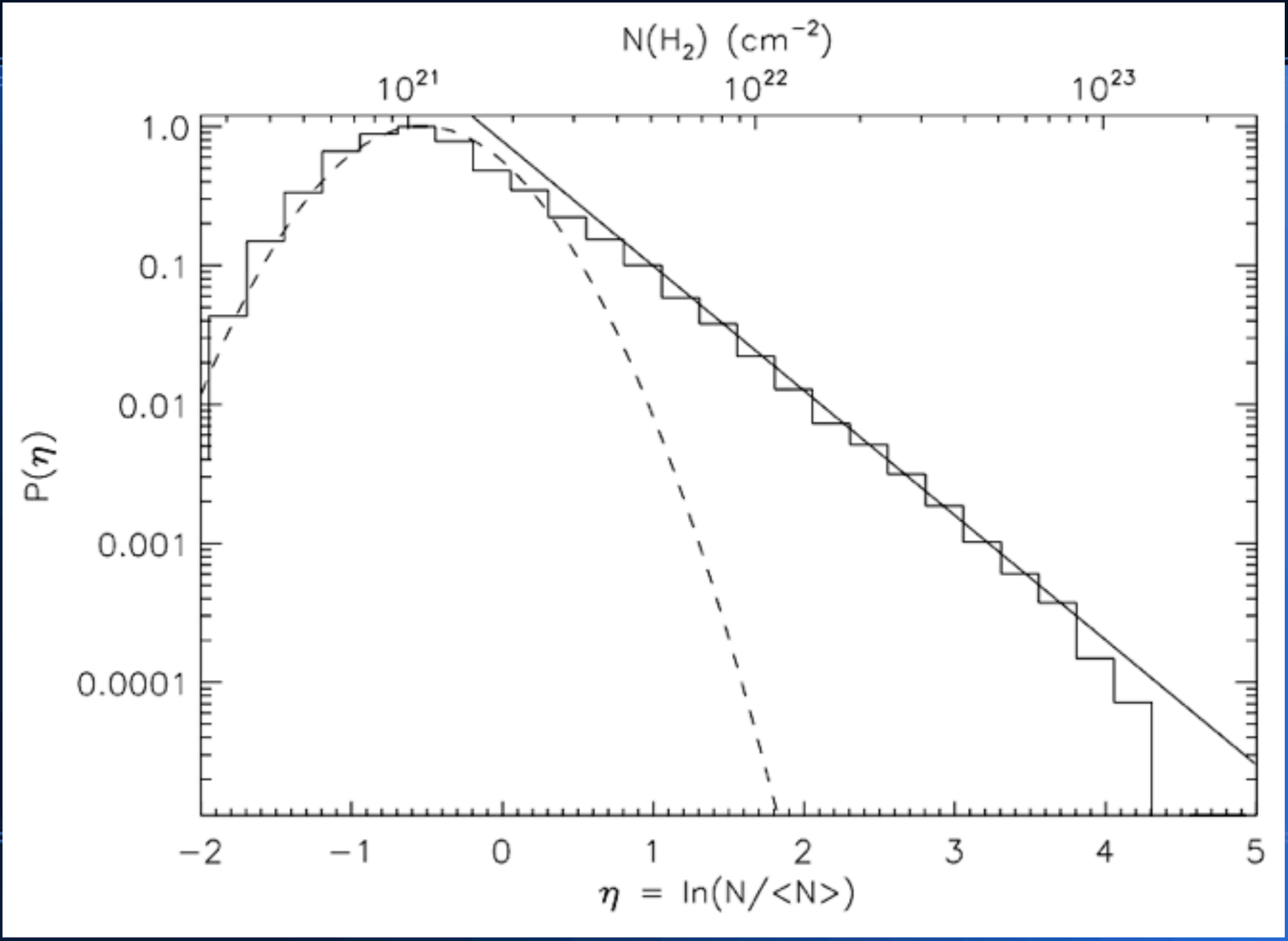
Cloud “Environment”

Environment characterized by GBS Herschel data: 160 – 500 μm

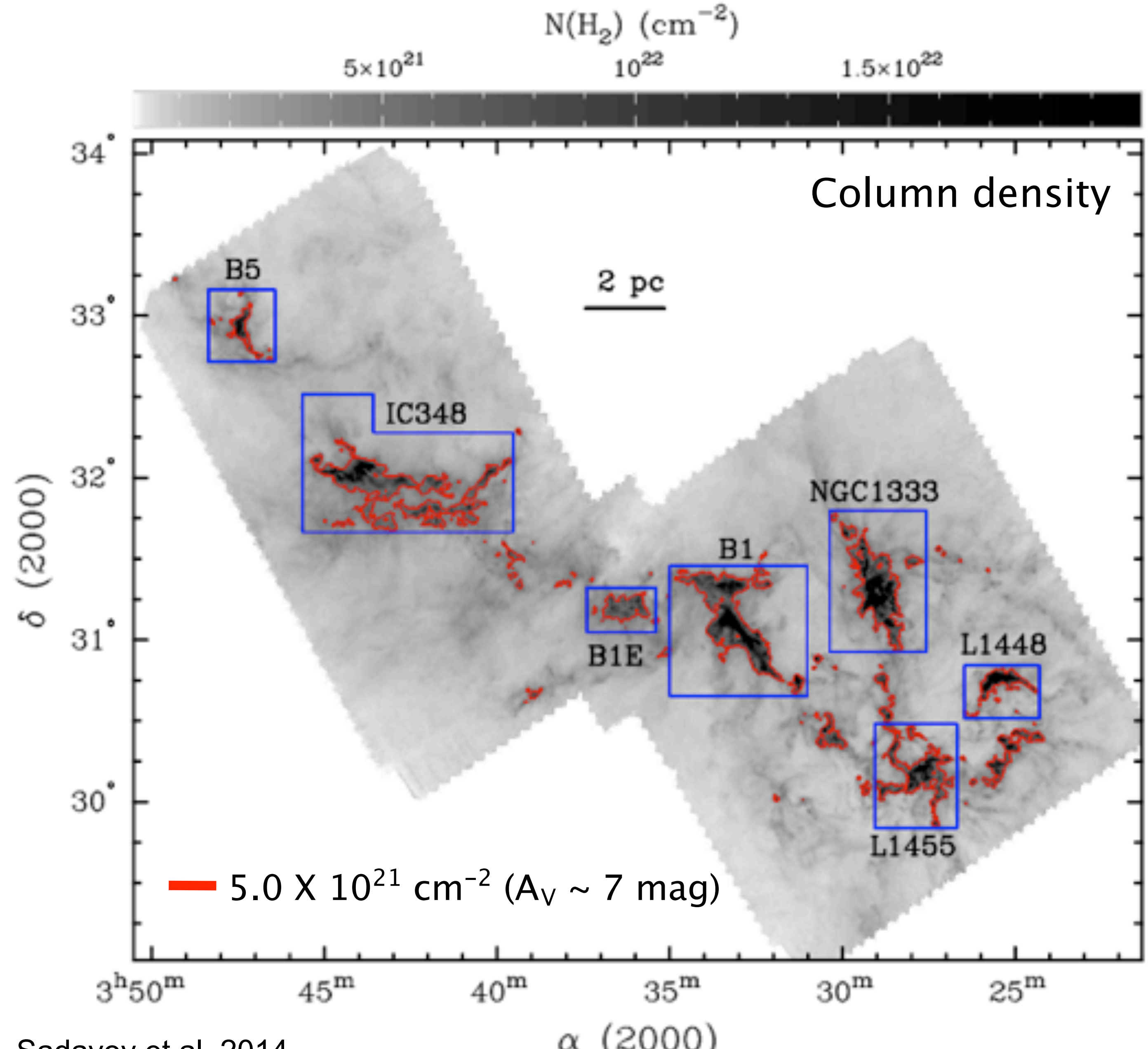
Greybody fitting at 36″ resolution → T, $N(H_2)$



Perseus Column Density Distribution

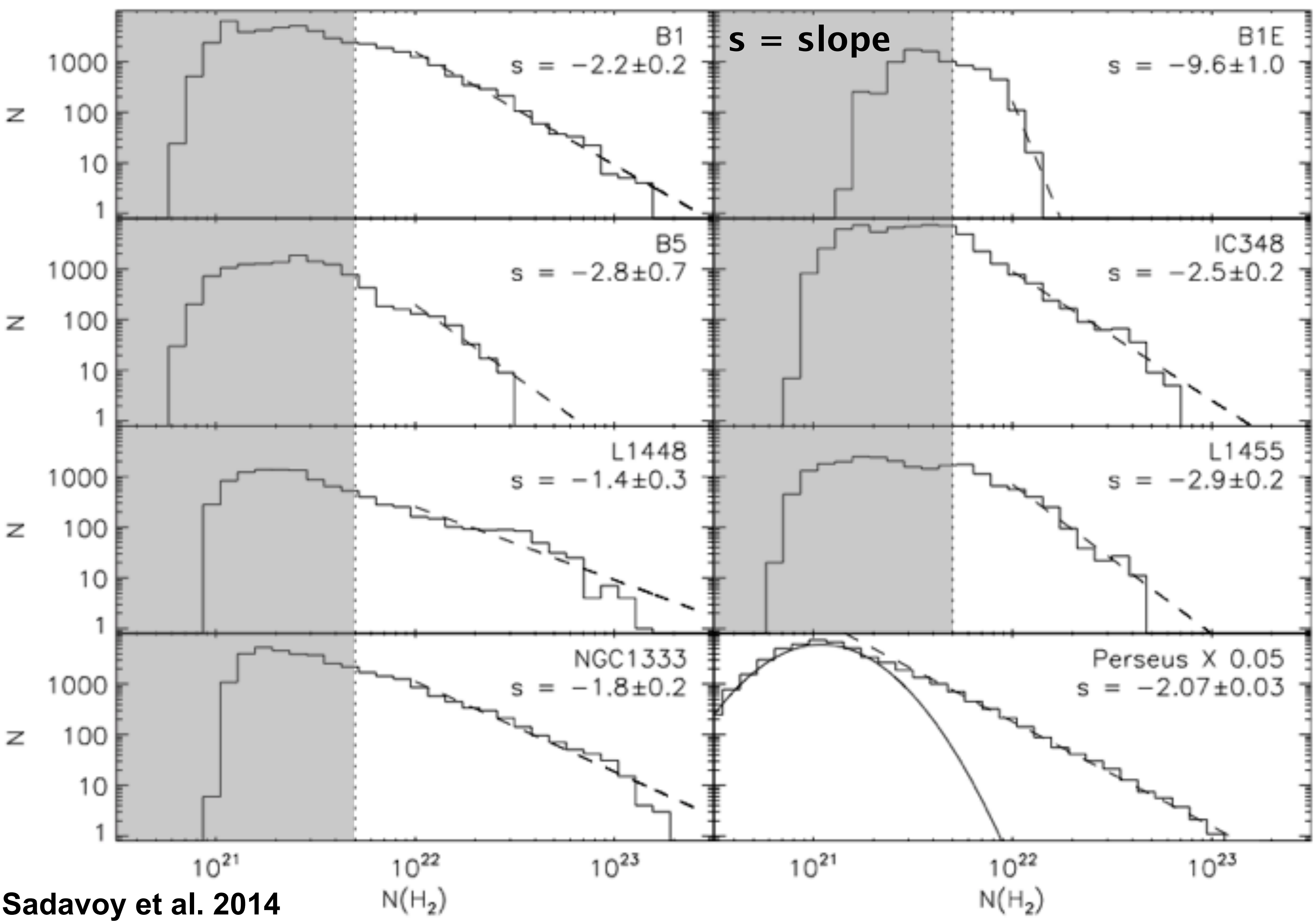


Defining the Perseus Clumps



Sadavoy et al. 2014

Clump Column Density Distributions



Sadavoy et al. 2014

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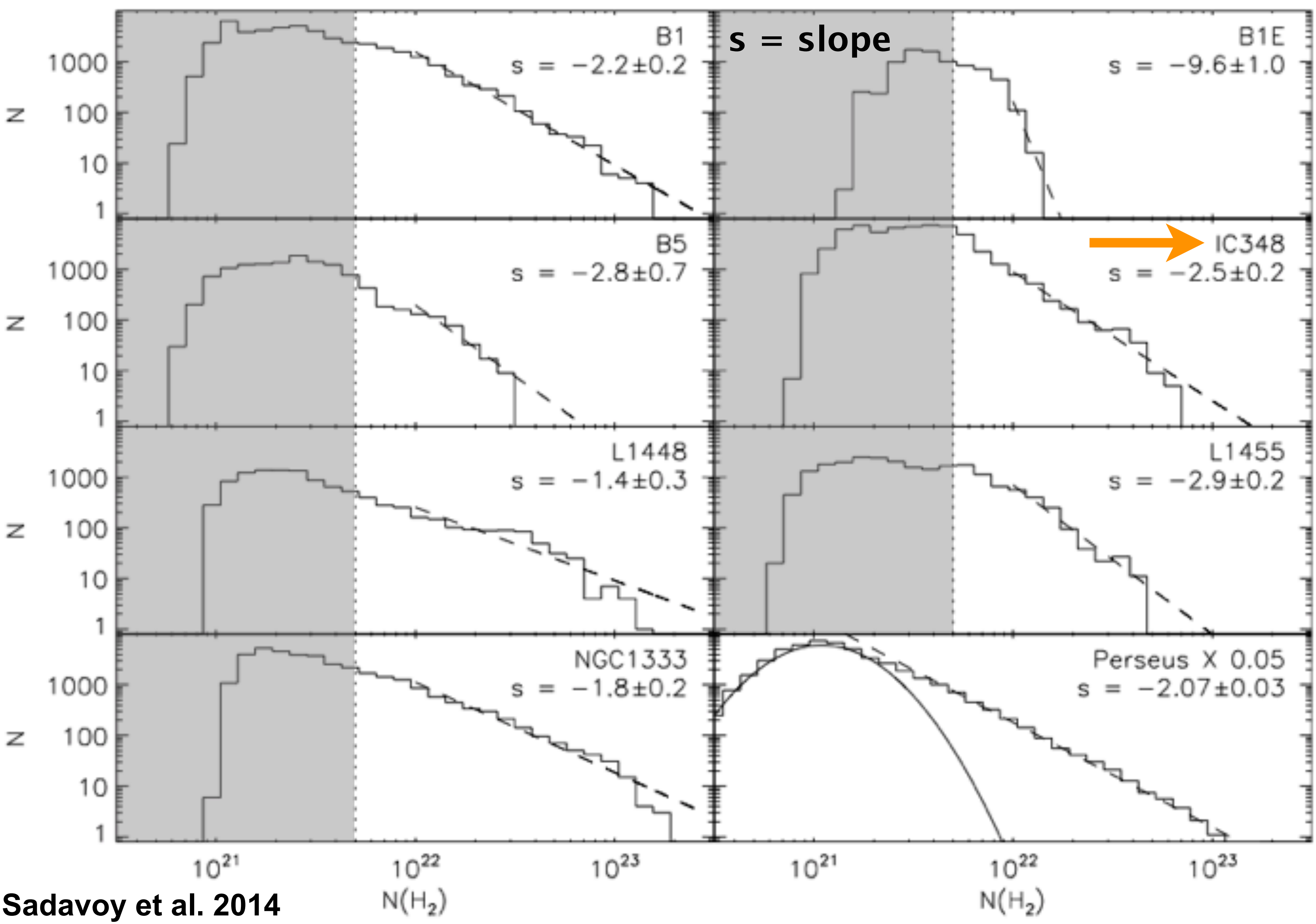

Sadavoy et al. 2014

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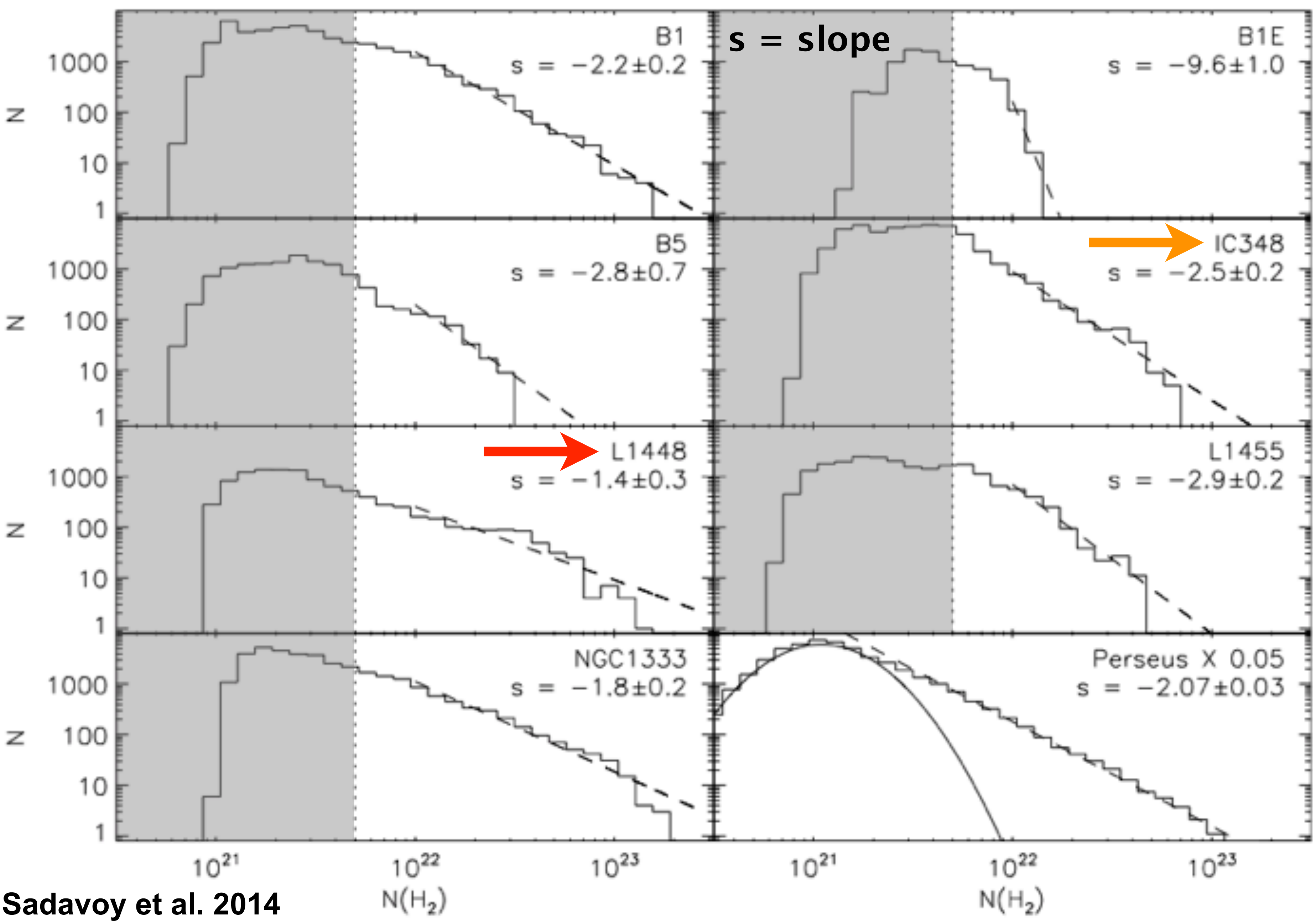

Sadavoy et al. 2014

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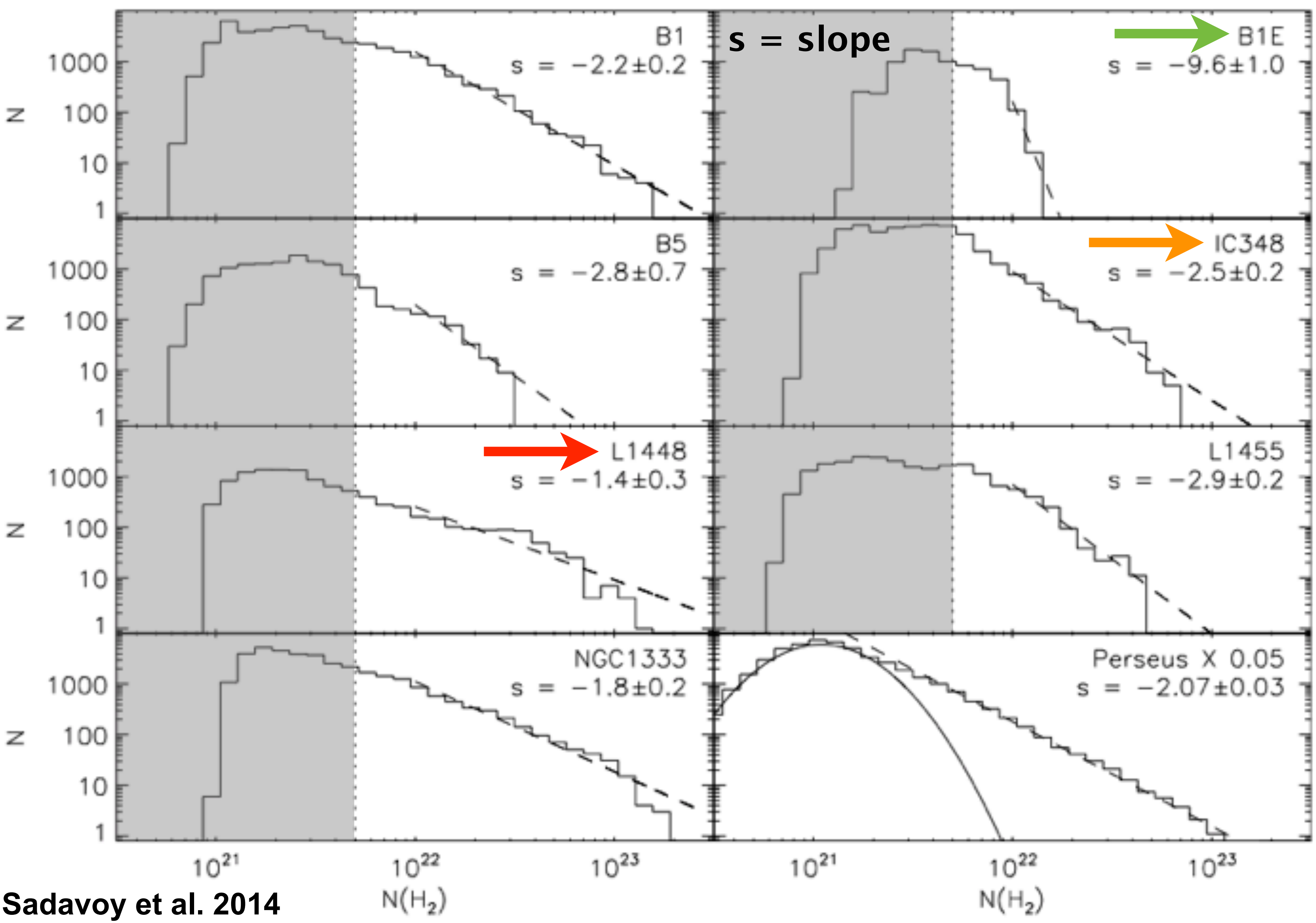

Sadavoy et al. 2014

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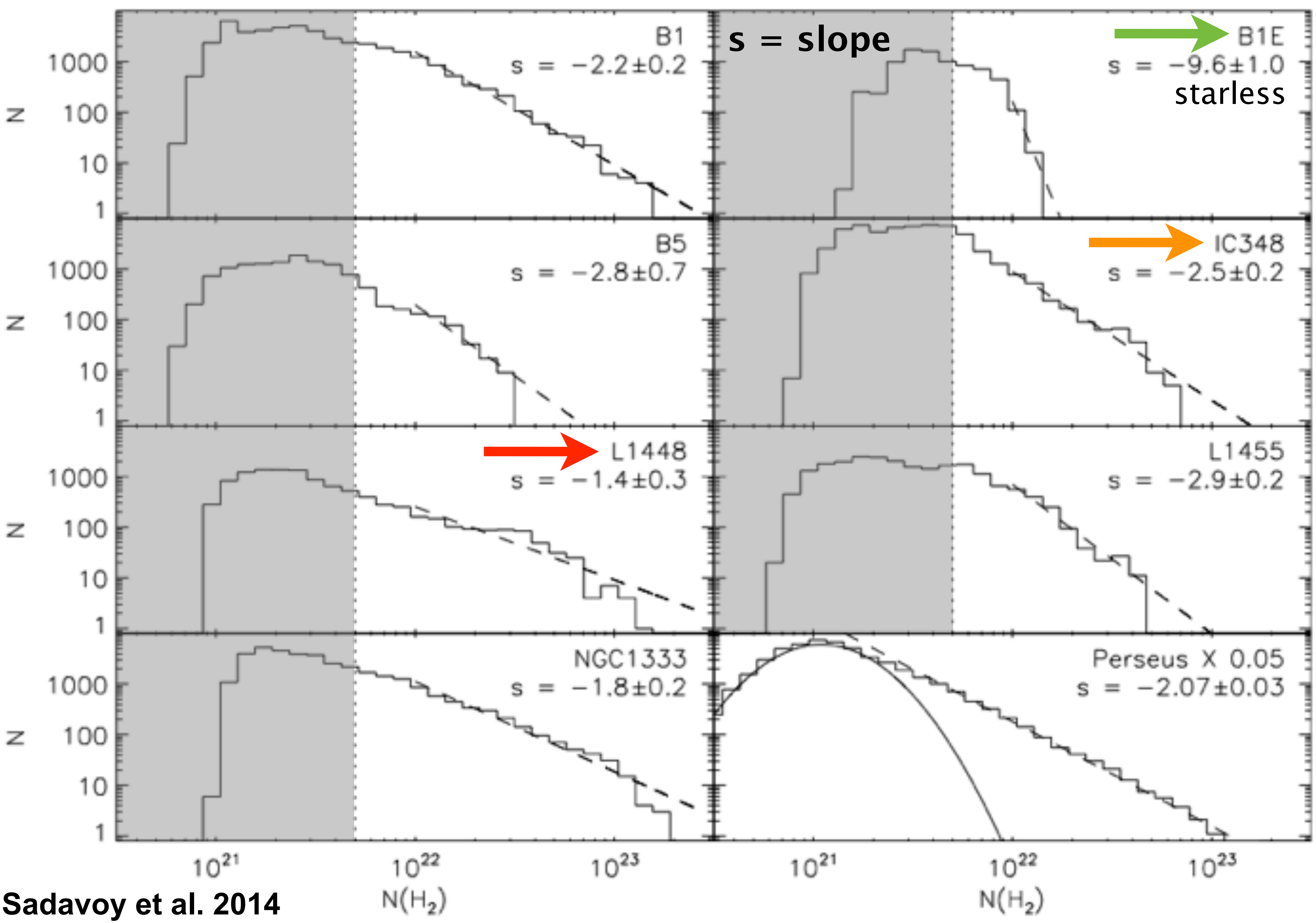

Sadavoy et al. 2014

Clump "Environment"

Clump	s	M ($M_\odot$)	A (pc^2)	Star Formation
L1448	−1.4 ± 0.3	118	0.21	
NGC1333	−1.8 ± 0.2	365	0.73	
B1	−2.2 ± 0.2	342	0.84	
IC348	−2.5 ± 0.2	156	0.44	
B5	−2.8 ± 0.7	28	0.09	
L1455	−2.9 ± 0.2	101	0.31	
B1-E	−9.6 ± 1.0	5	0.02	
Perseus	−2.07 ± 0.03	1171	2.8	

for $N(H_2) > 10^{22}$ cm^{-2}

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Characterizing Star Formation

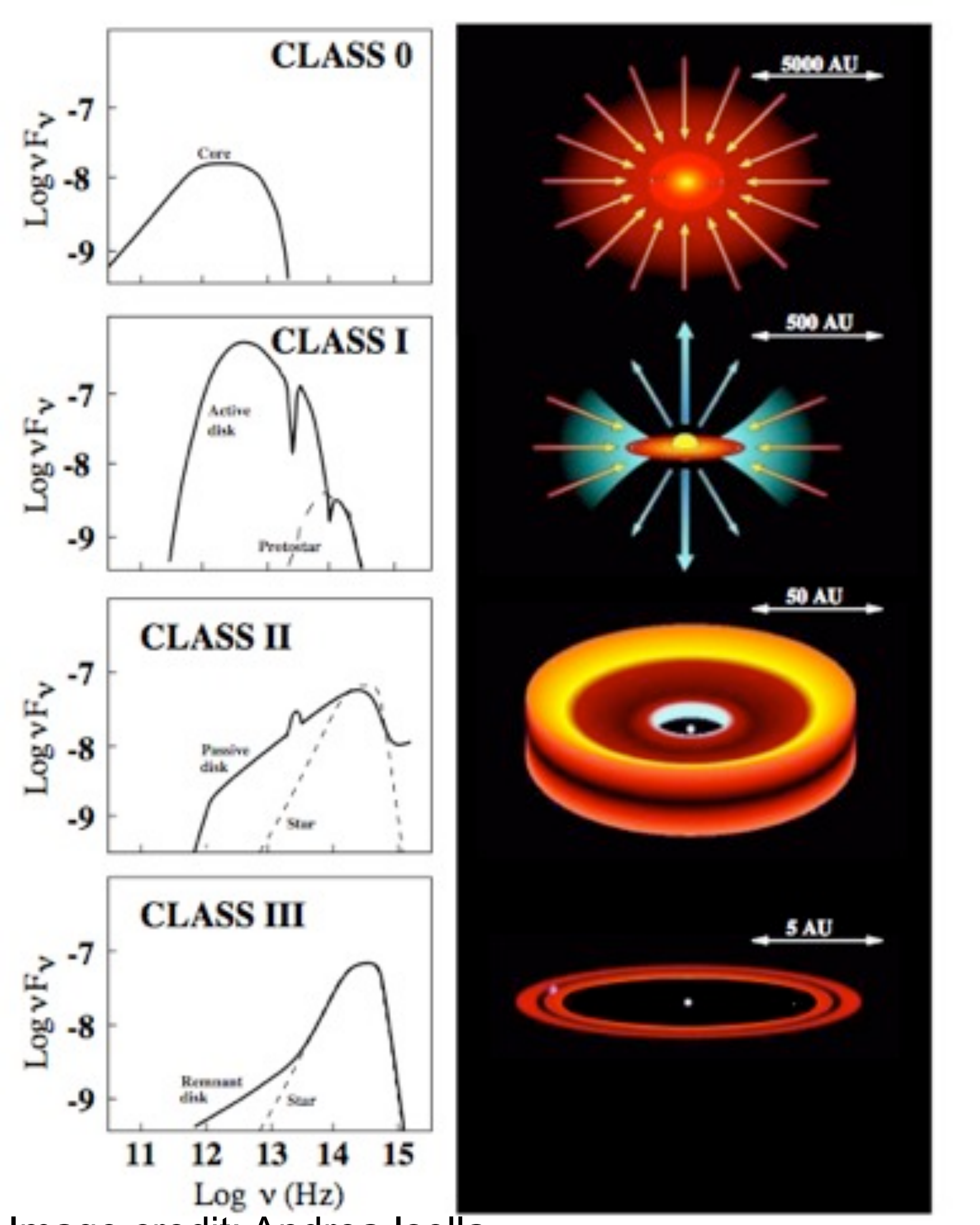


Image credit: Andrea Isella

Characterizing Star Formation

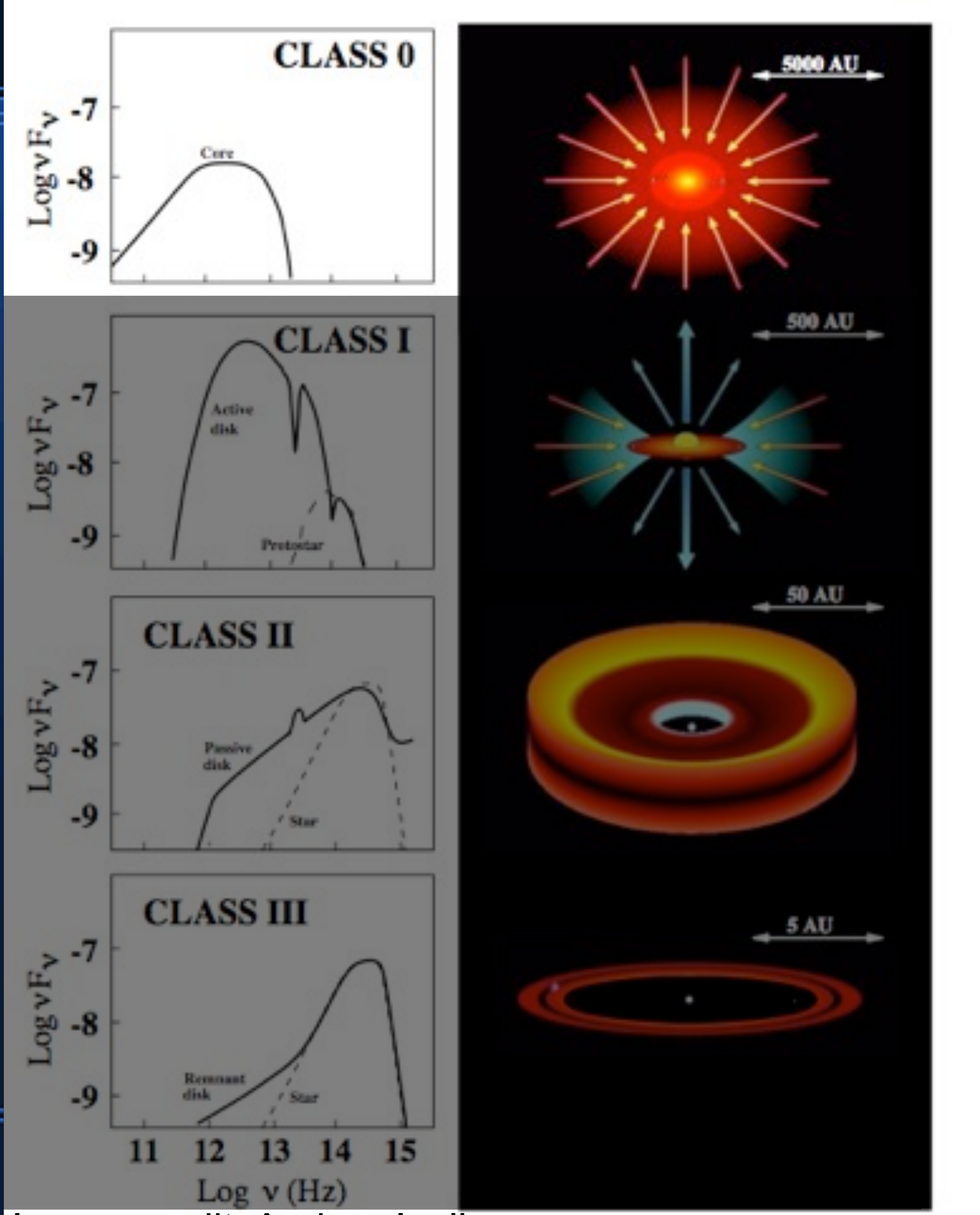


Image credit: Andrea Isella

Characterizing Class 0 Protostars

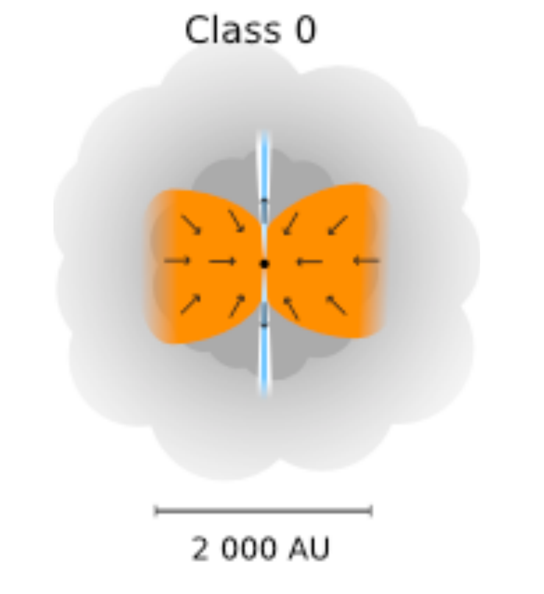


Image credit: M. V. Persson

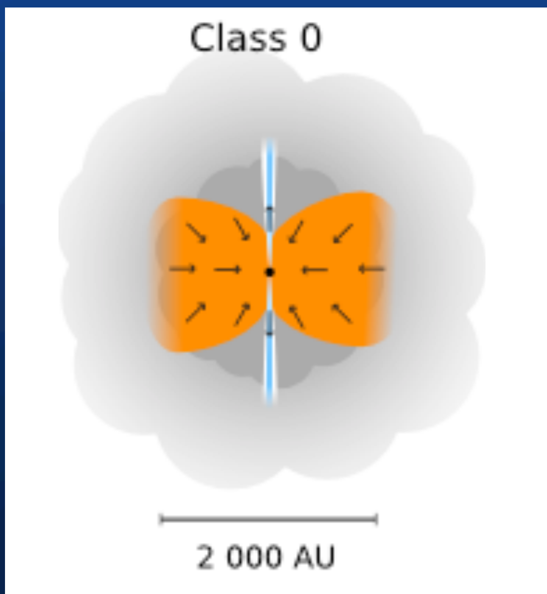
Class 0 protostars are difficult to observe

~ need infrared-to-millimeter data

~ protostellar signatures can be faint

~ source inclination can affect classification

Characterizing Class 0 Protostars



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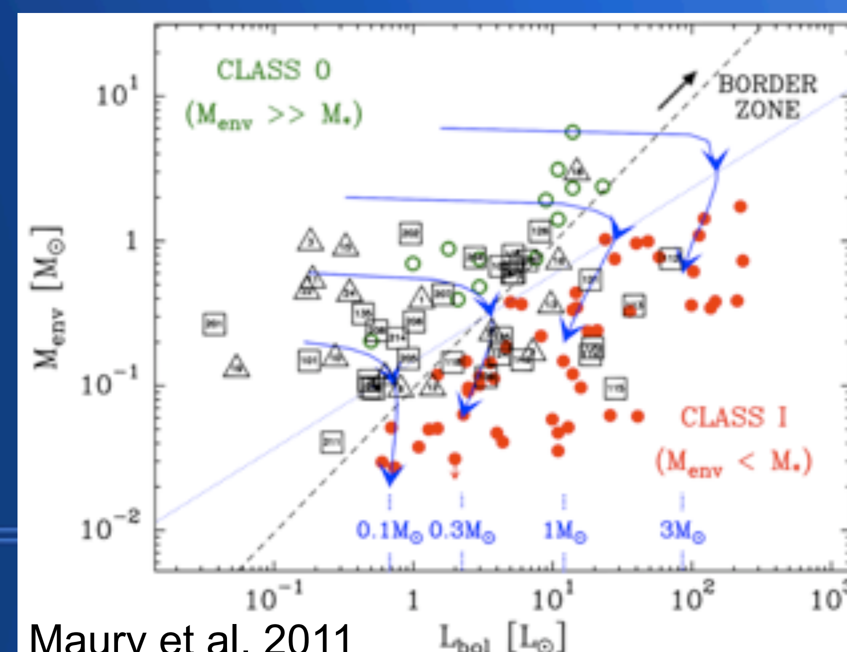
Herschel + Spitzer YSOs + SCUBA 850 μm

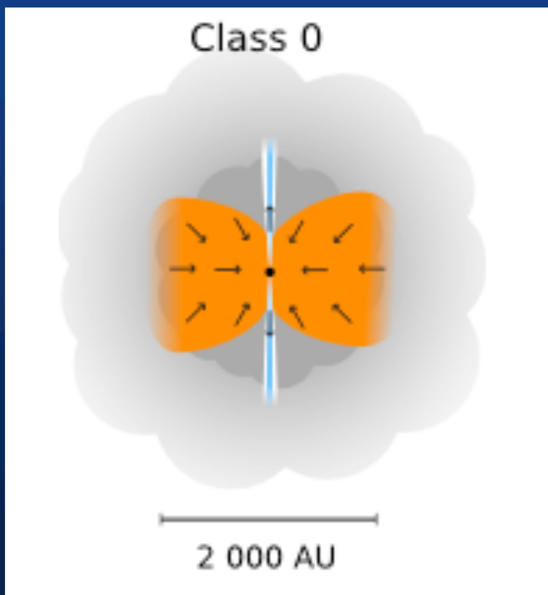
Observational criteria (70 μm, T_{bol}, L_{smm}/L_{bol})

Evolutionary criteria (accretion models)



Maury et al. 2011

Characterizing Class 0 Protostars



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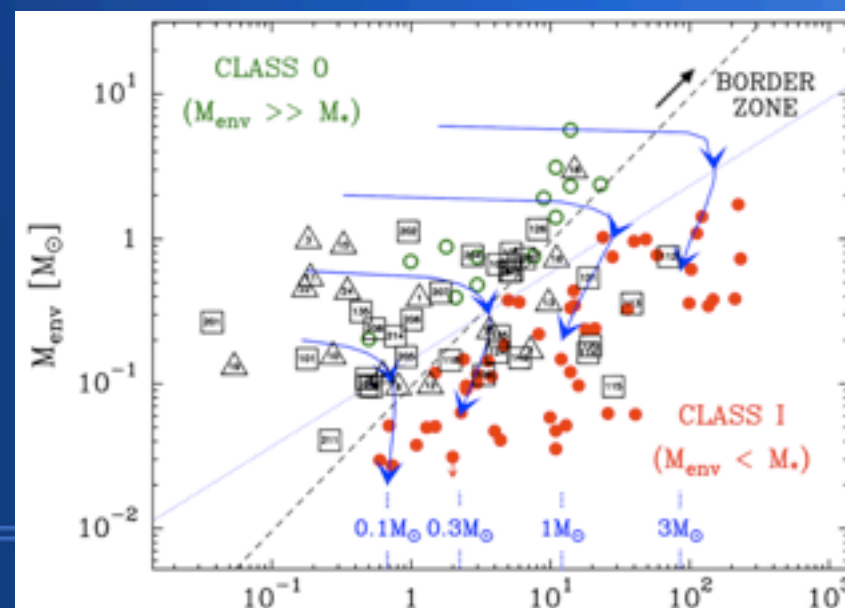
➔ 28 Class 0 protostars



Maury et al. 2011

Star Formation and Environment

Clump	s	M ($M_\odot$)	A (pc^2)	N(Class 0)
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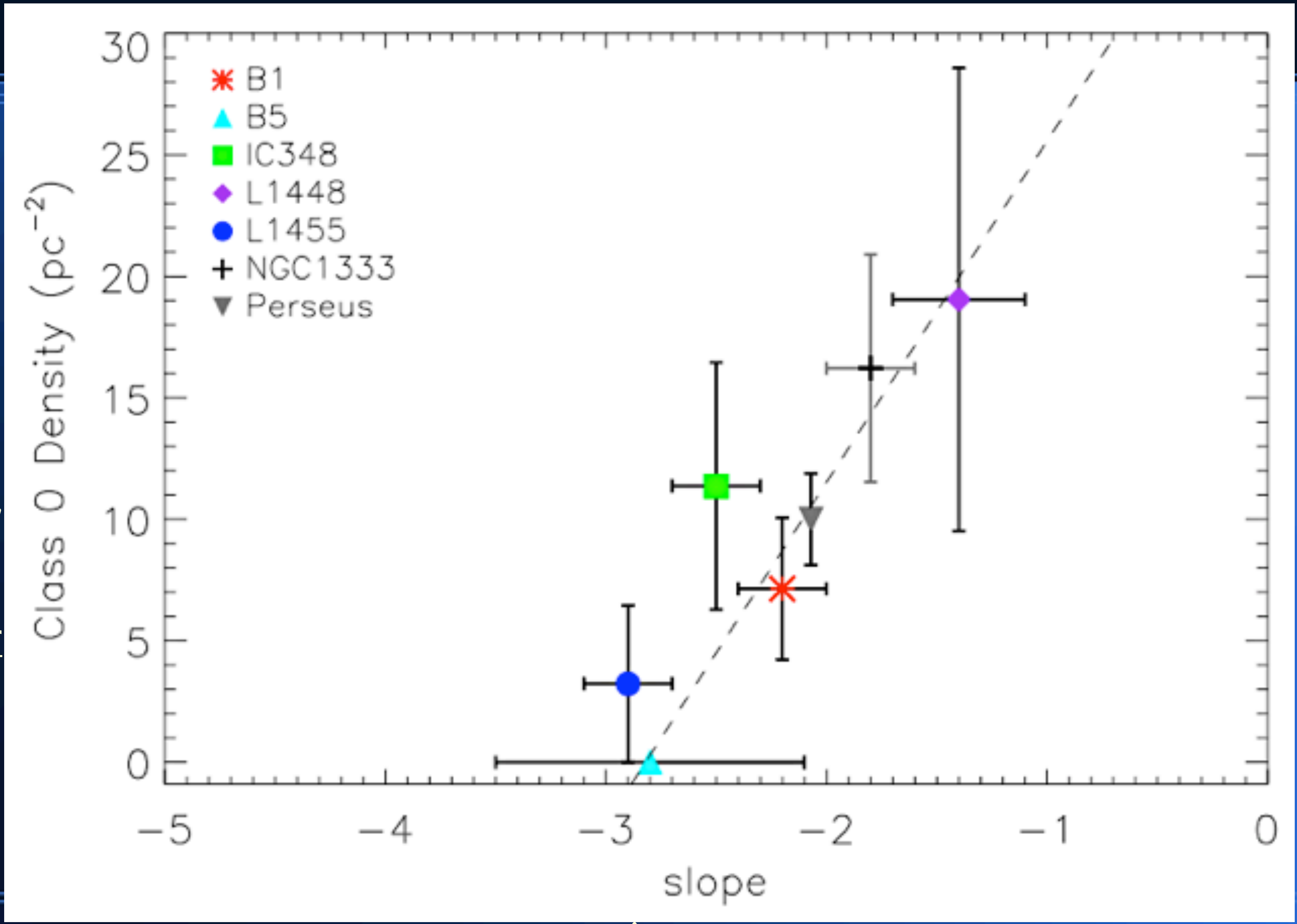
Perseus	−2.07 ± 0.03	1171	2.8	28

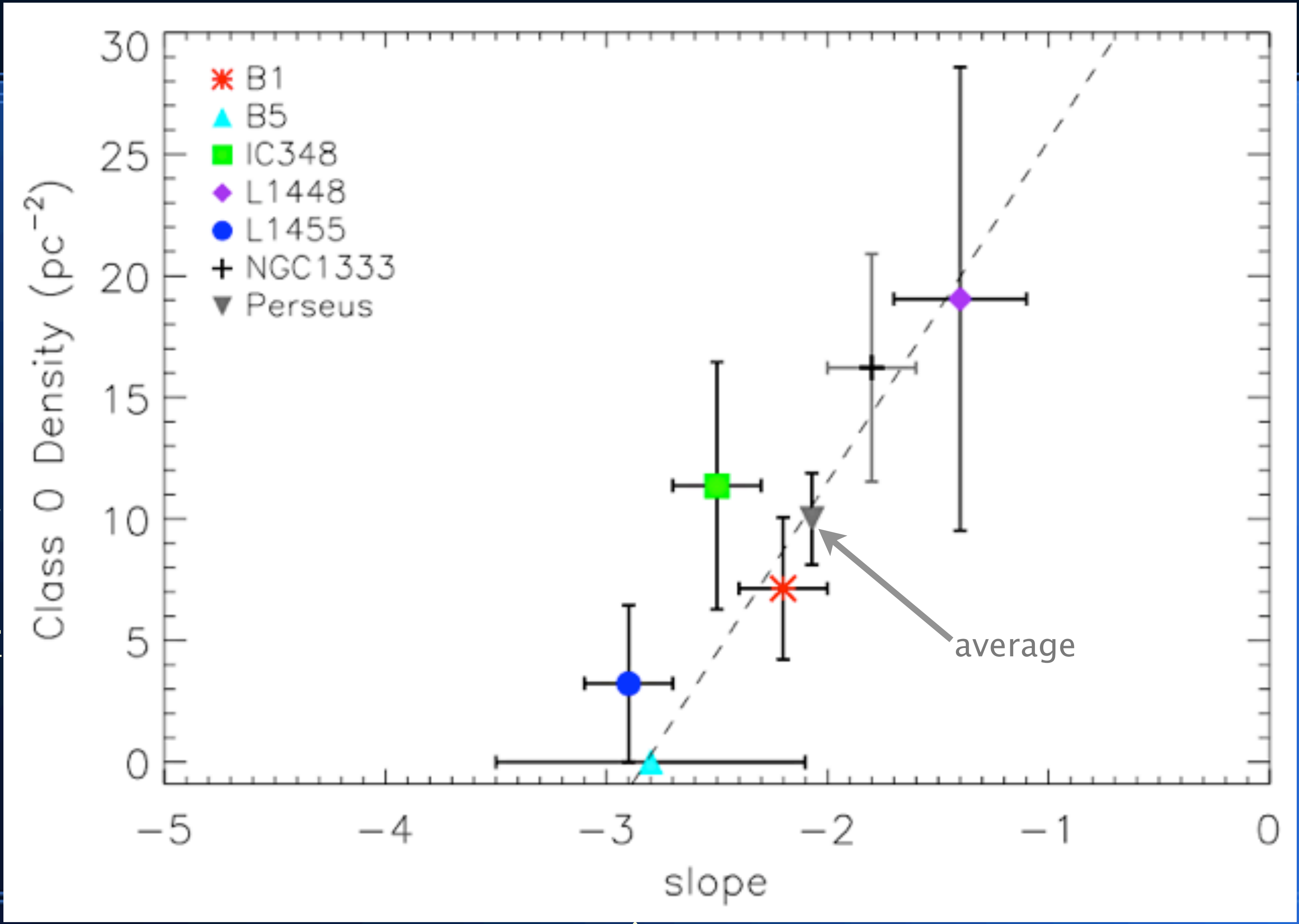
Class 0 Surface Density



Number / Area

power-law index at high column densities

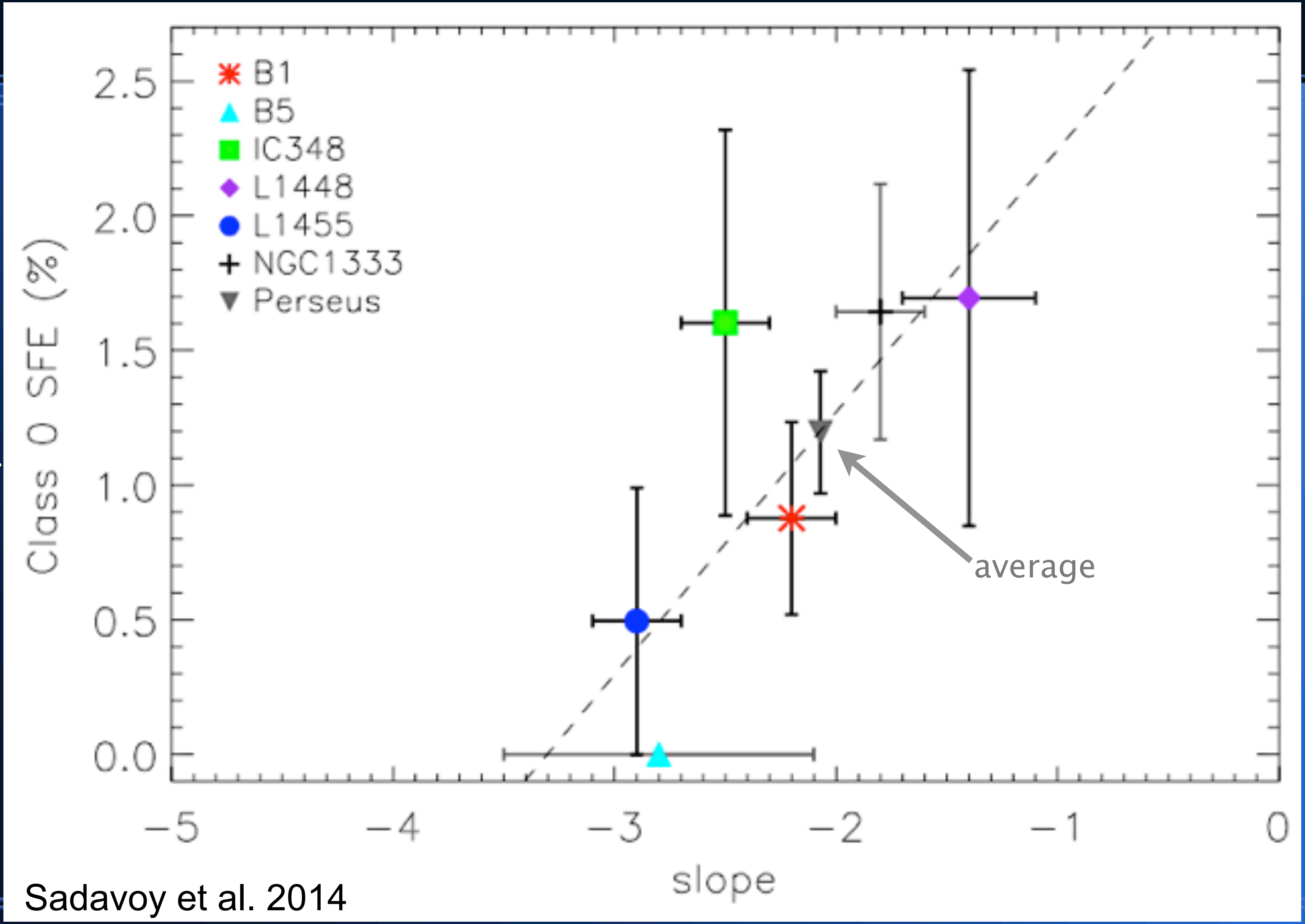
Class 0 Surface Density



Number / Area

power-law index at high column densities

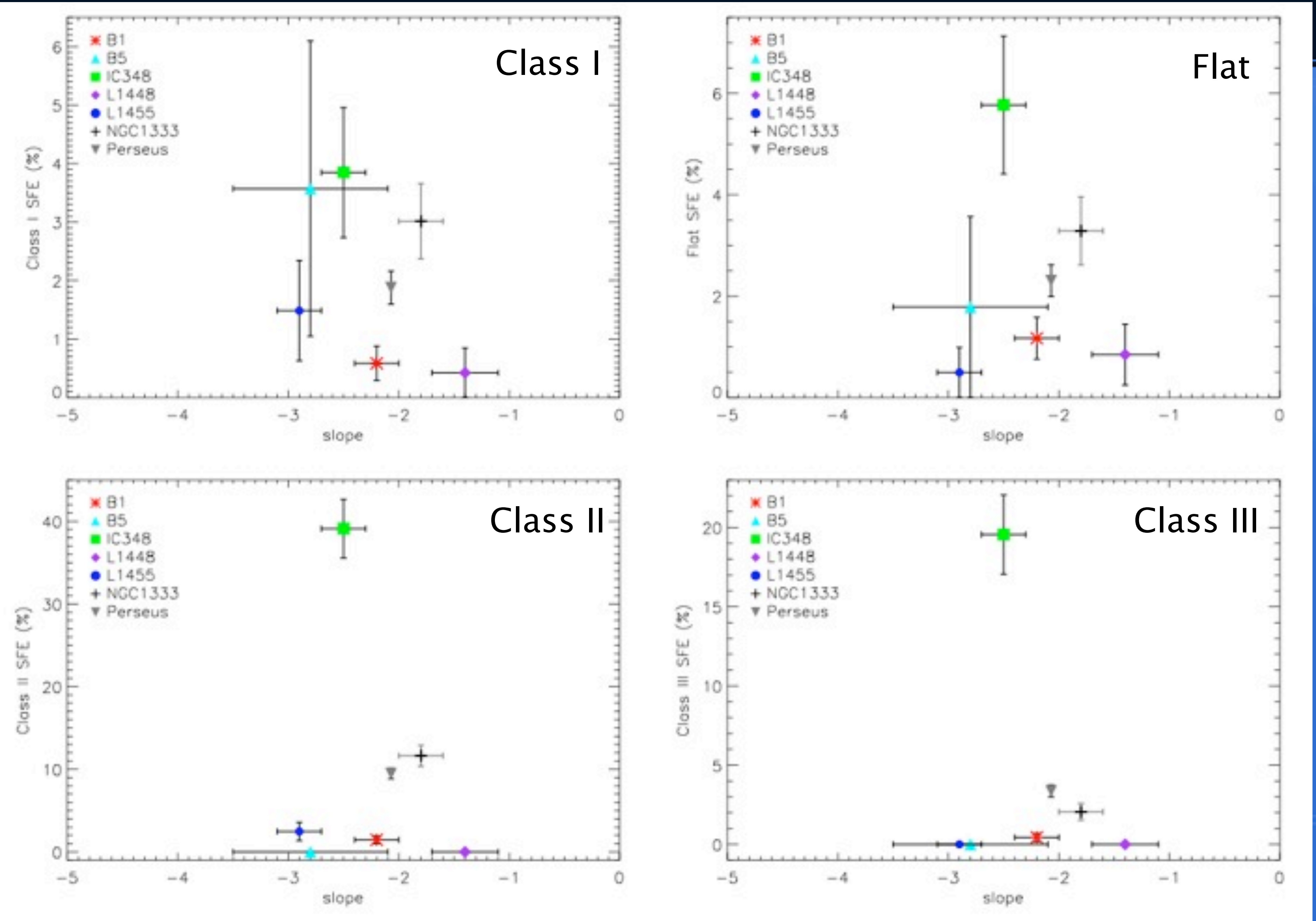
Class 0 Star Formation Efficiency (SFE)



$\frac{\text{Number X } 0.5M_\odot}{\text{Clump Mass}}$

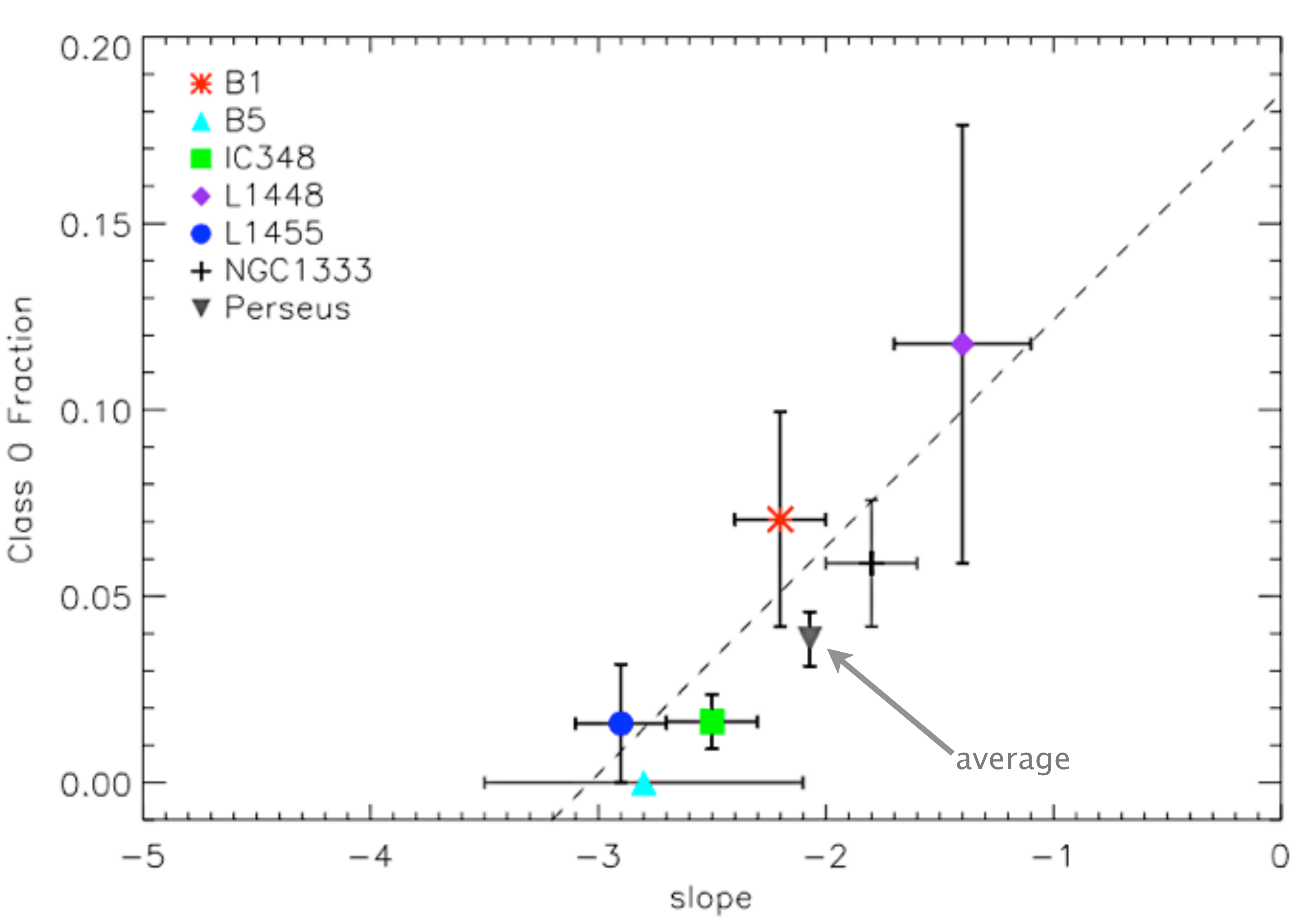
power-law index at high column densities

Later-Stage YSOs



Class 0 Fraction

Number Class 0 / Number all



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☆ As clump population ages, power-law slope steepens

1) YSO Feedback Disrupts Clumps

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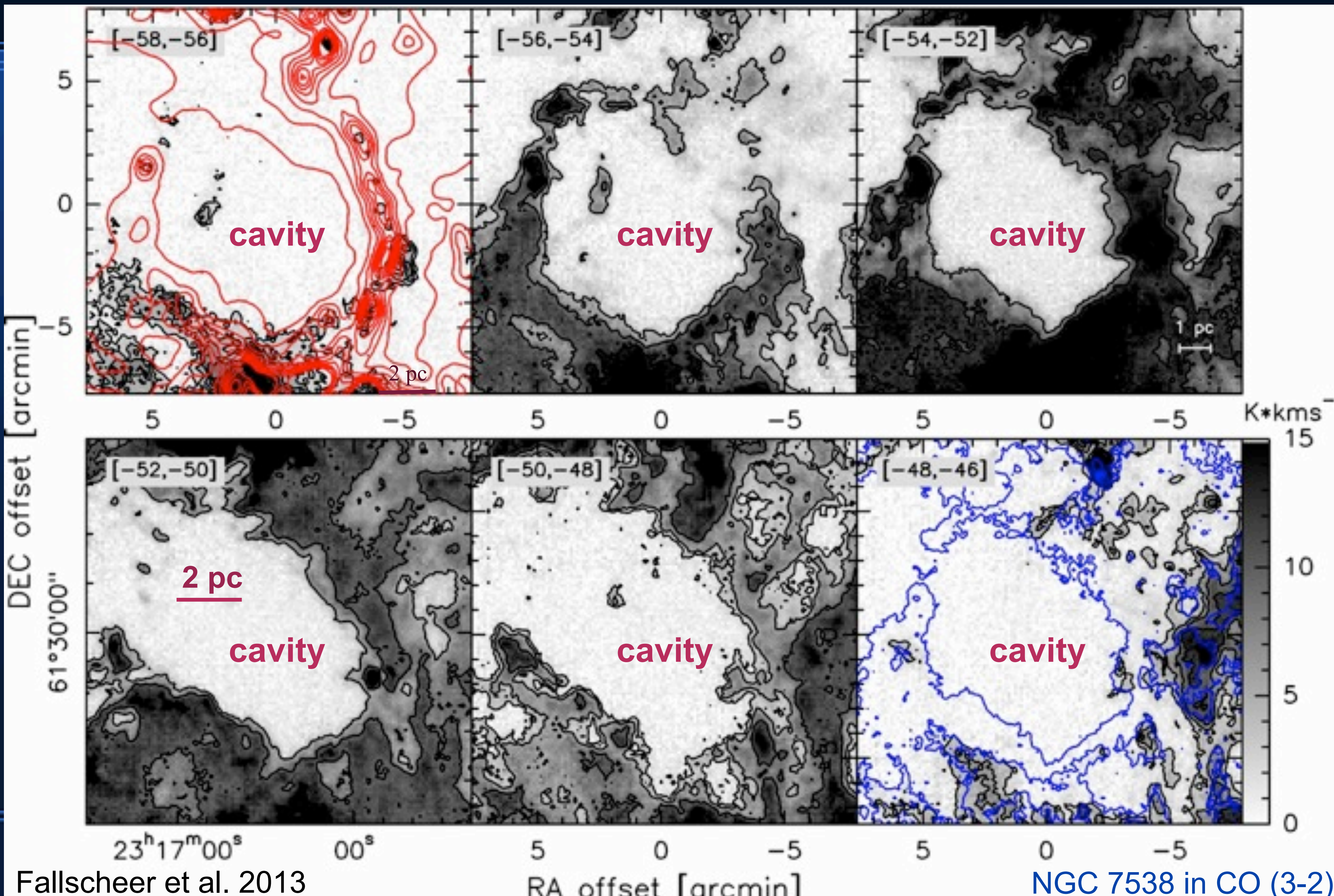

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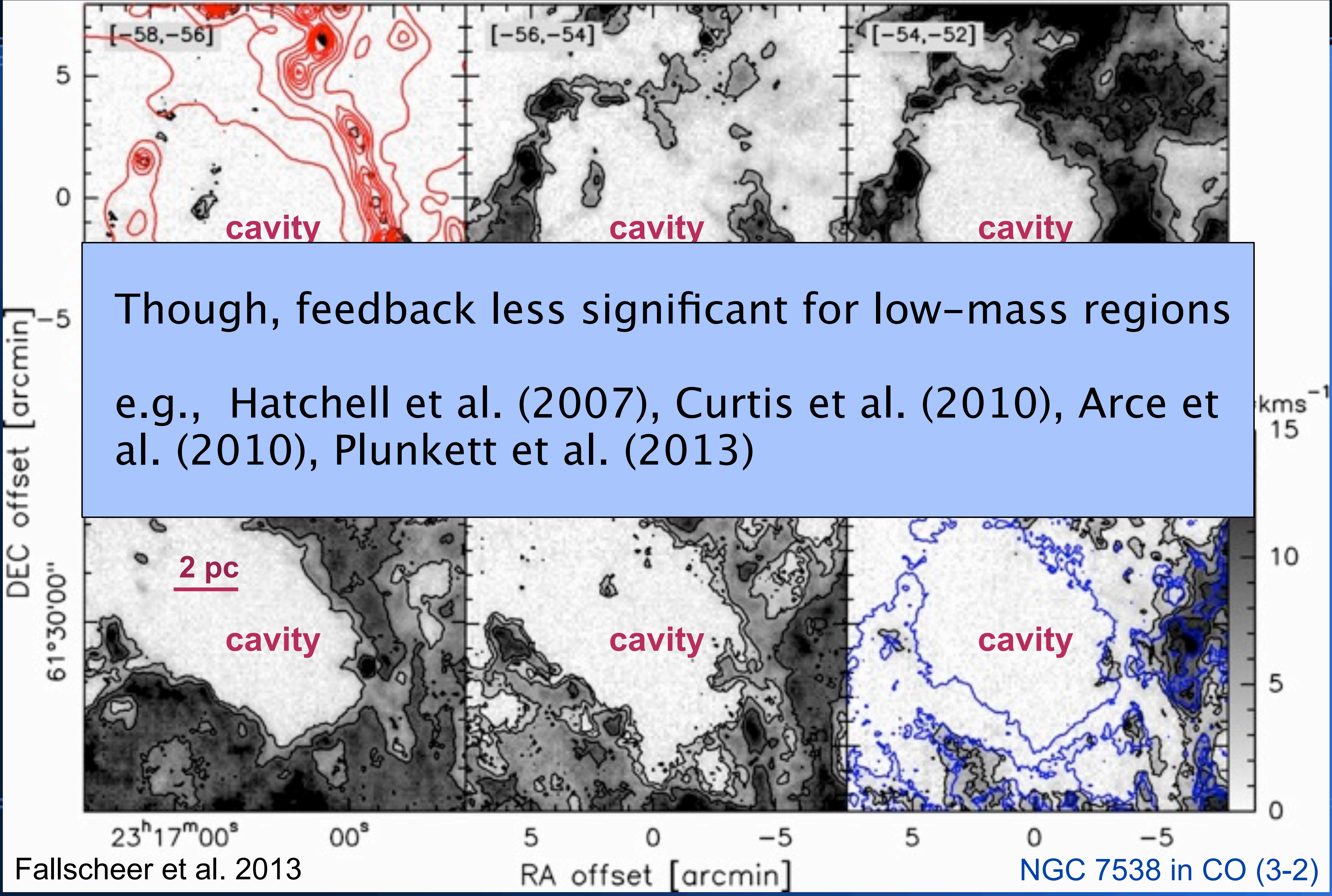

Though, feedback less significant for low-mass regions

e.g., Hatchell et al. (2007), Curtis et al. (2010), Arce et al. (2010), Plunkett et al. (2013)

Fallscheer et al. 2013

2) Class 0 Feedback Enhances Tails

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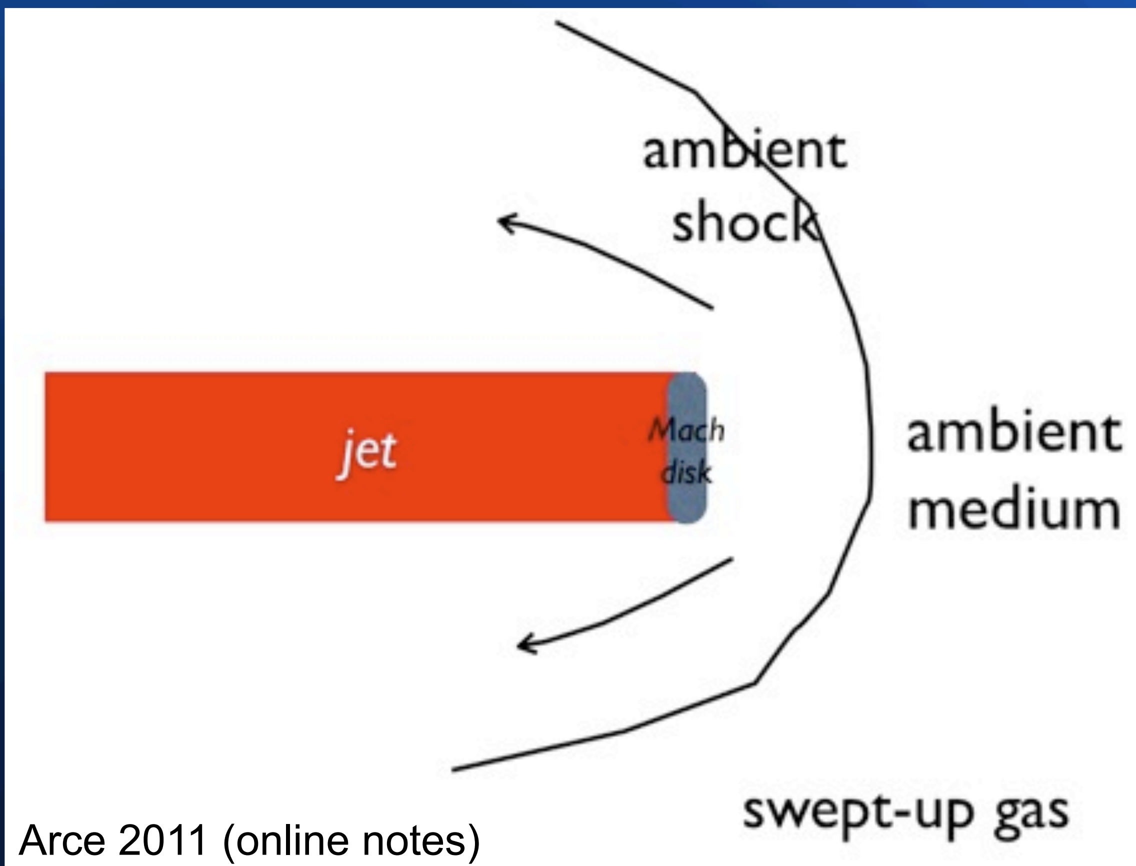
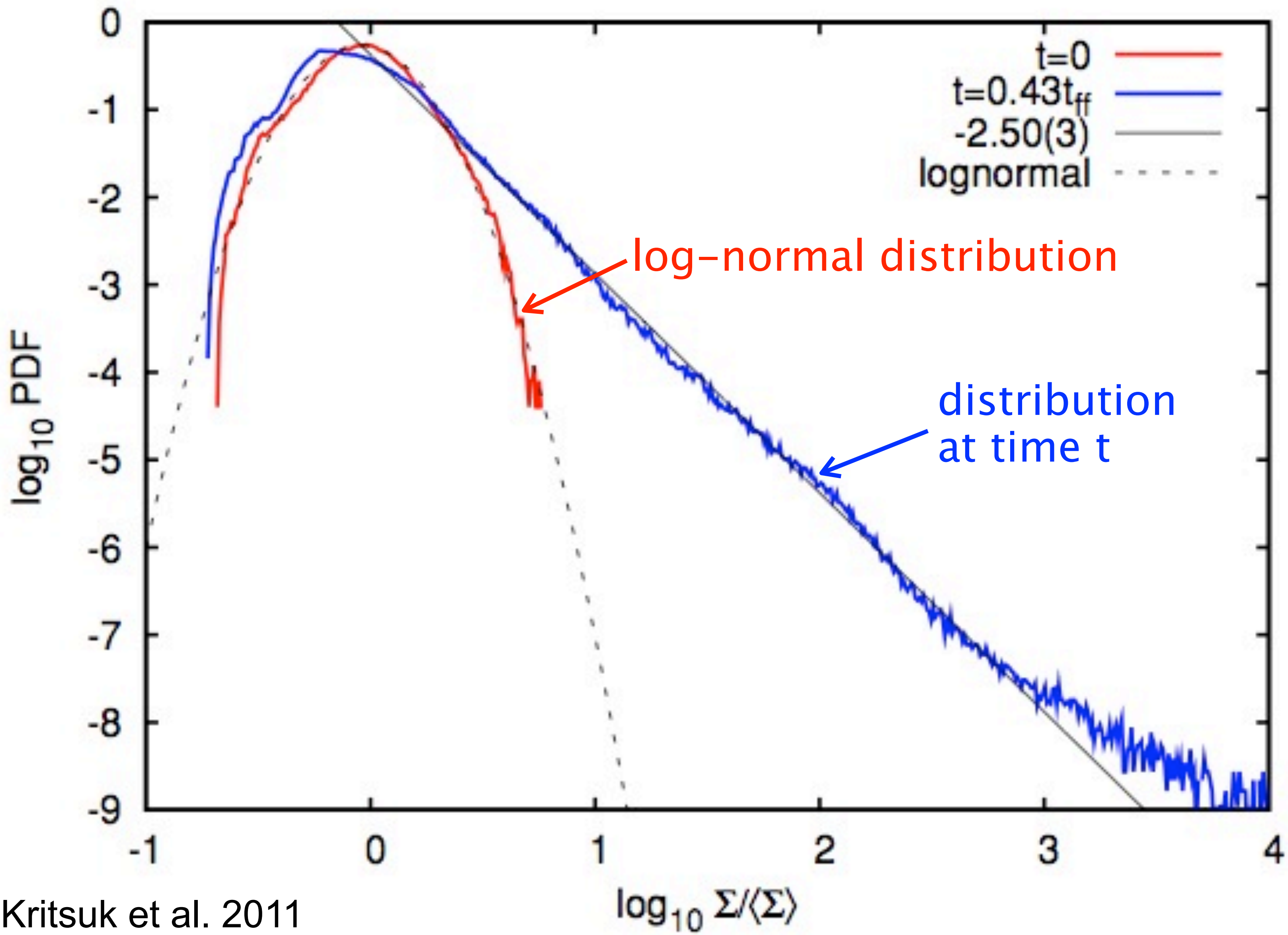


Arce 2011 (online notes)

Image credit: J. Morse/STScI/NASA/ESA

Implications: Simulations

We need to test the impact of YSO feedback



Kritsuk et al. 2011

Summary and Acknowledgements

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Collaborators: J. Di Francesco, Ph. André, S. Pezzuto, A. Men'shchikov, and the HGBS

Special thanks: EPoS LOC and SOC

Sarah Sadavoy: sadavoy@mpia.de