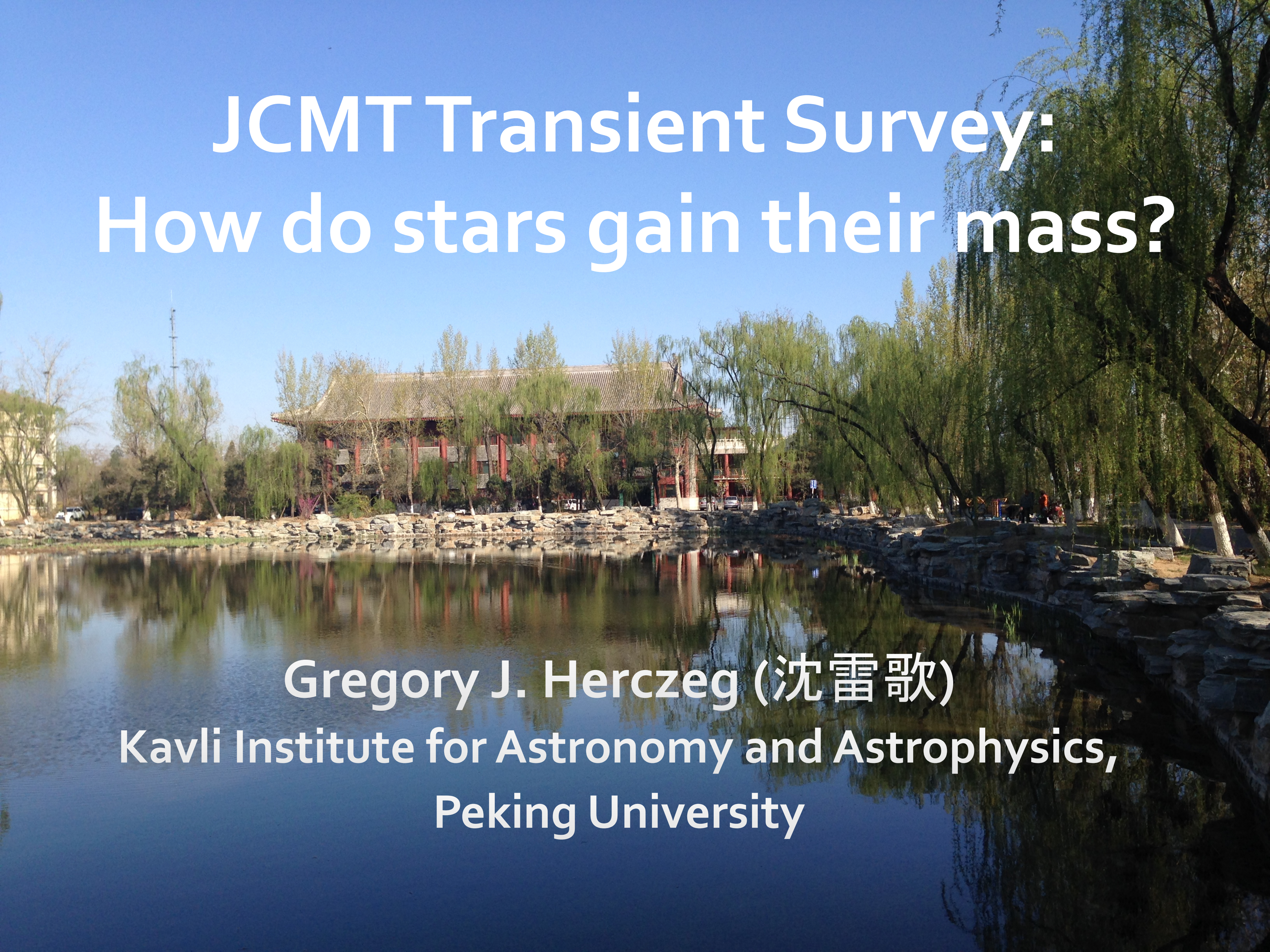


JCMT Transient Survey: How do stars gain their mass?

Gregory J. Herczeg (沈雷歌)
Kavli Institute for Astronomy and Astrophysics,
Peking University

Team of collaborators

Coordinators

Gregory Herczeg (PI; PKU/China)

Doug Johnstone (co-PI; NRC/Canada)

Yuri Aikawa (Tsukuba/Japan)

Geoff Bower (ASIAA/Taiwan)

Vivien Chen (NTU/Taiwan)

Jennifer Hatchell (Exeter/UK)

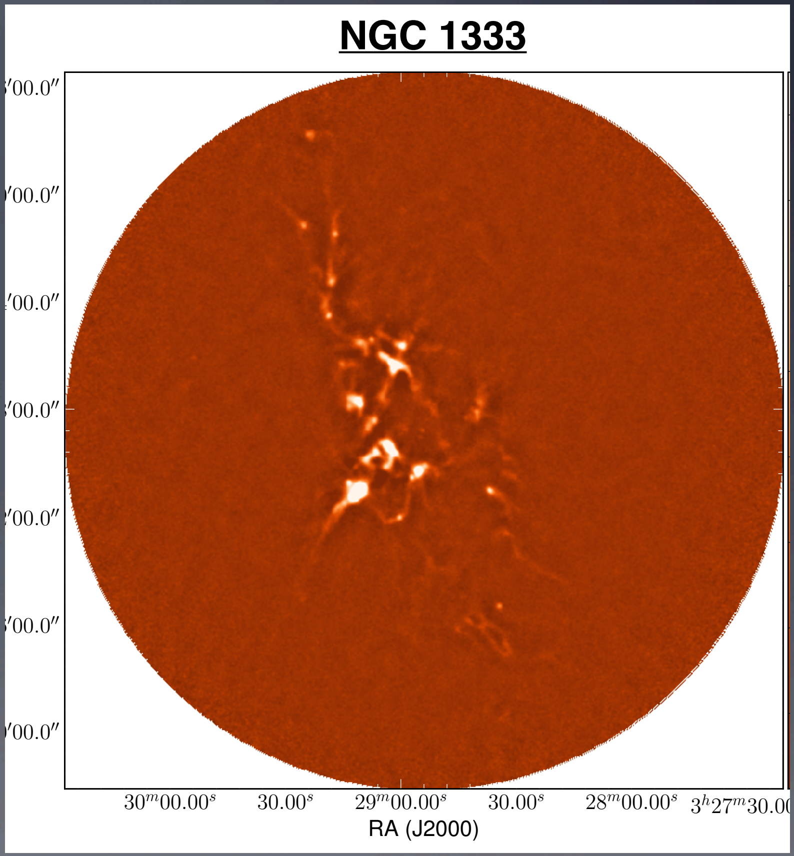
Jeong-Eun Lee (KHU/Korea)

Students (hopefully more soon)

Steve Mairs (Victoria)

James Lane (Victoria)

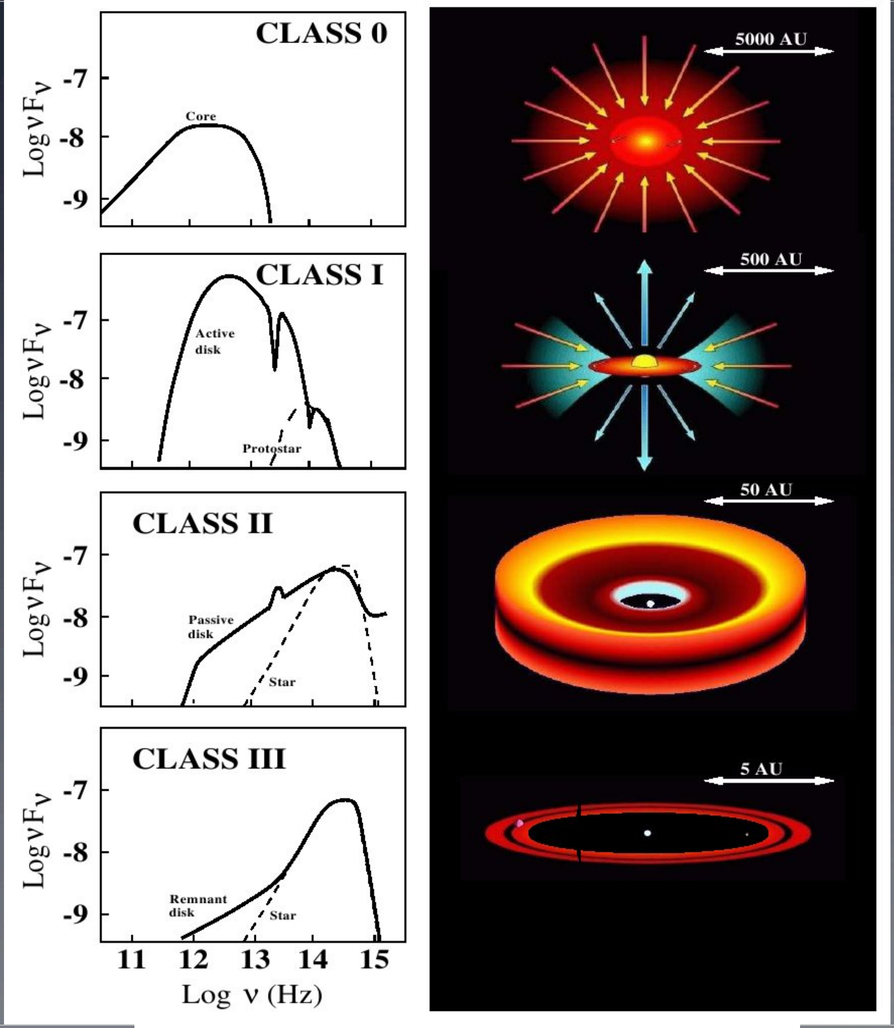
Hyunju Yoo (Kyung-Hee University)



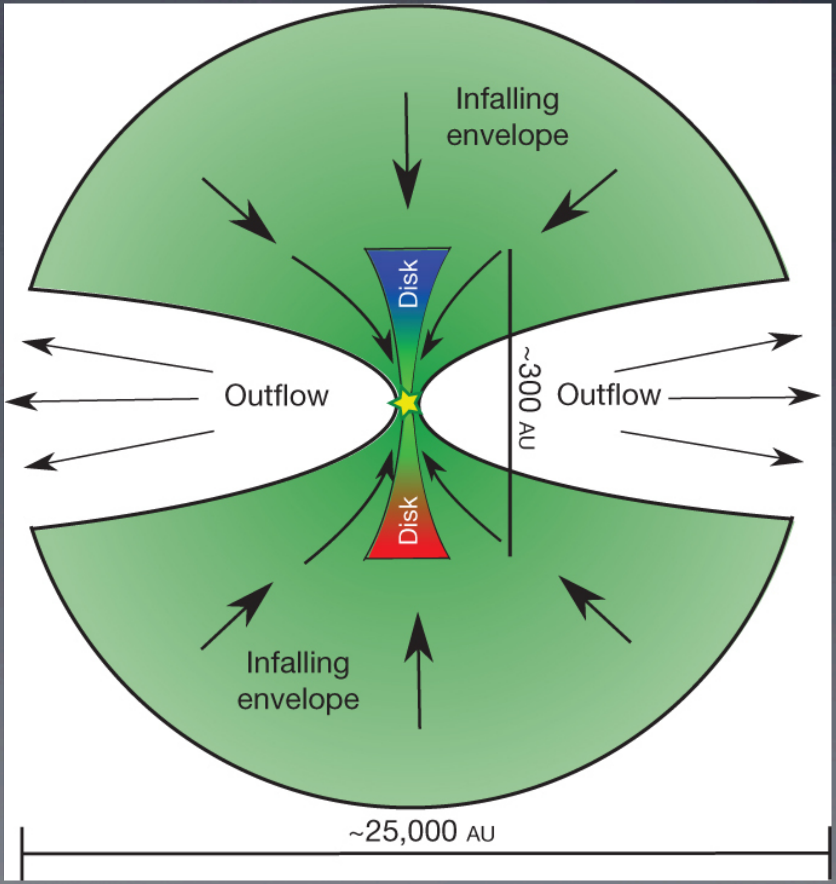
65 members (3 JPN, 10 UK, 9 CA, 13 CN, 4 EAO, 14 KR, 17 TW)

And the JCMT team who deal with our scheduling headaches to make these observations possible

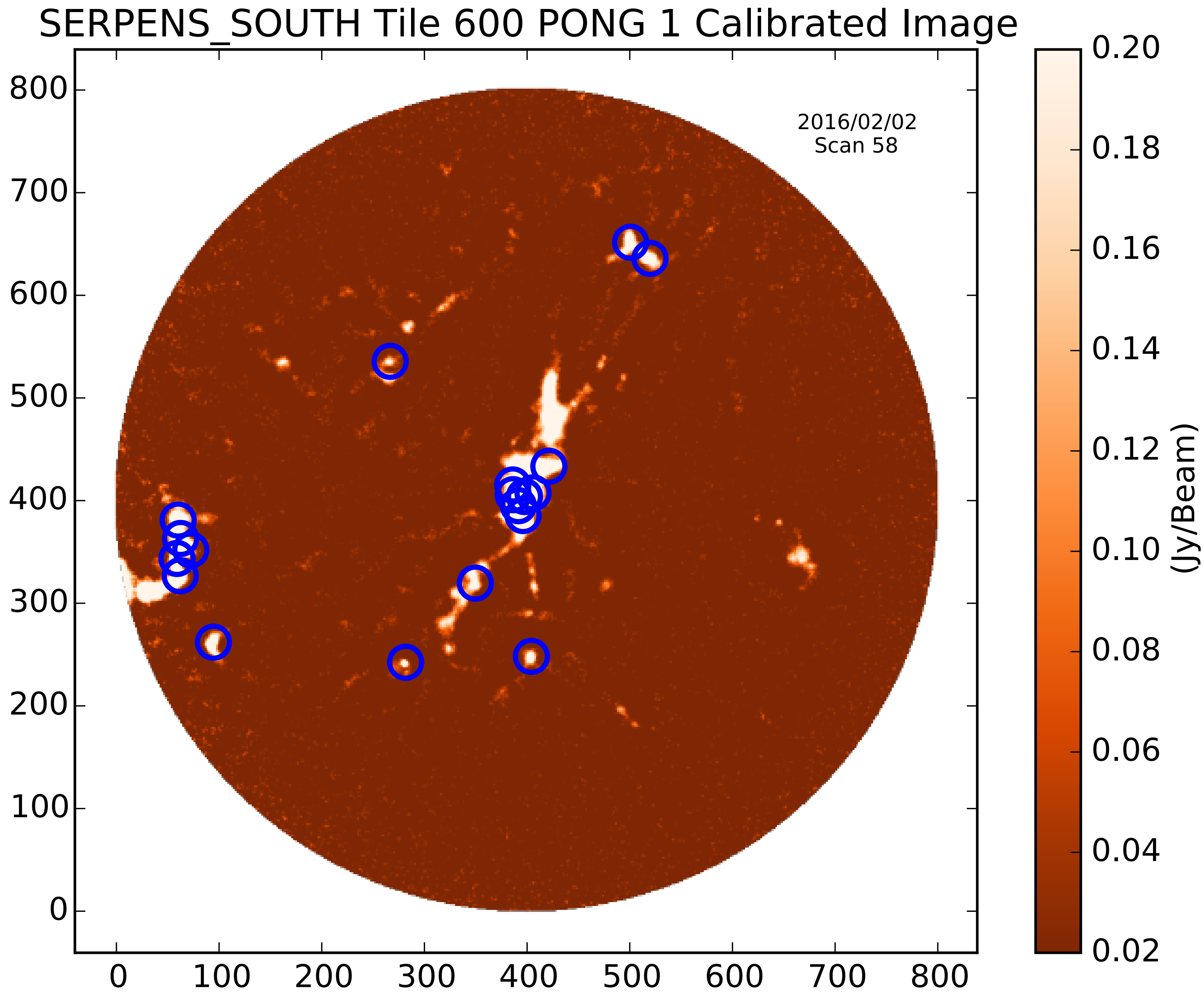
Core and initial mass function



Cartoon from Isella 2006

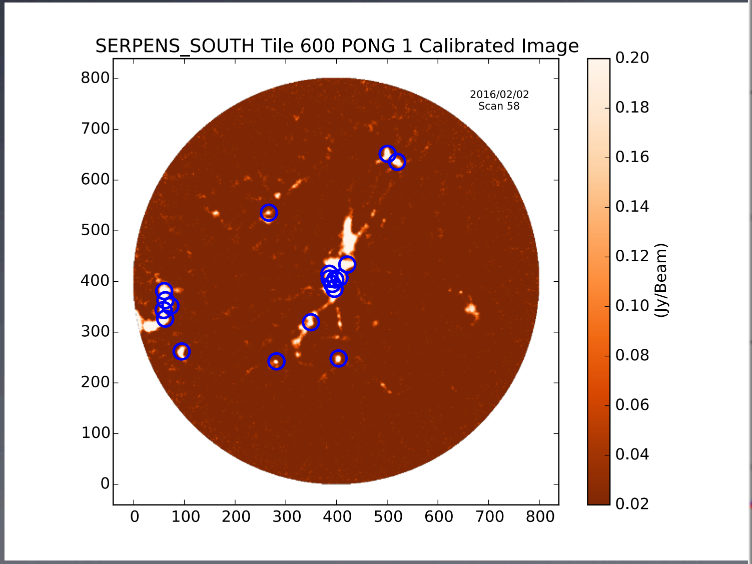


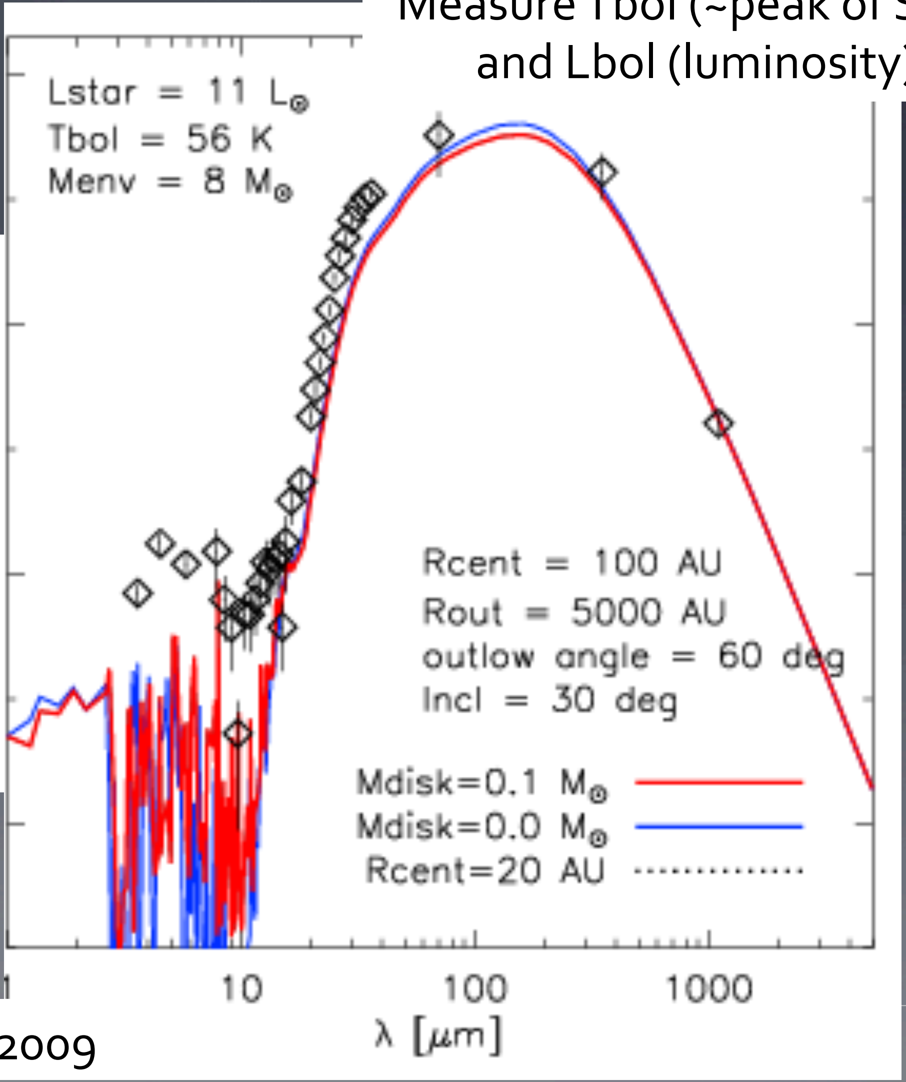
Cartoon from Tobin+2012



SERPENS_SOUTH Tile 600 PONG 1 Calibrated Image
2016/02/02
Scan 58
0
100
200
300
400
500
600
700
800
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
(Jy/Beam)

Spectral Energy Distribution



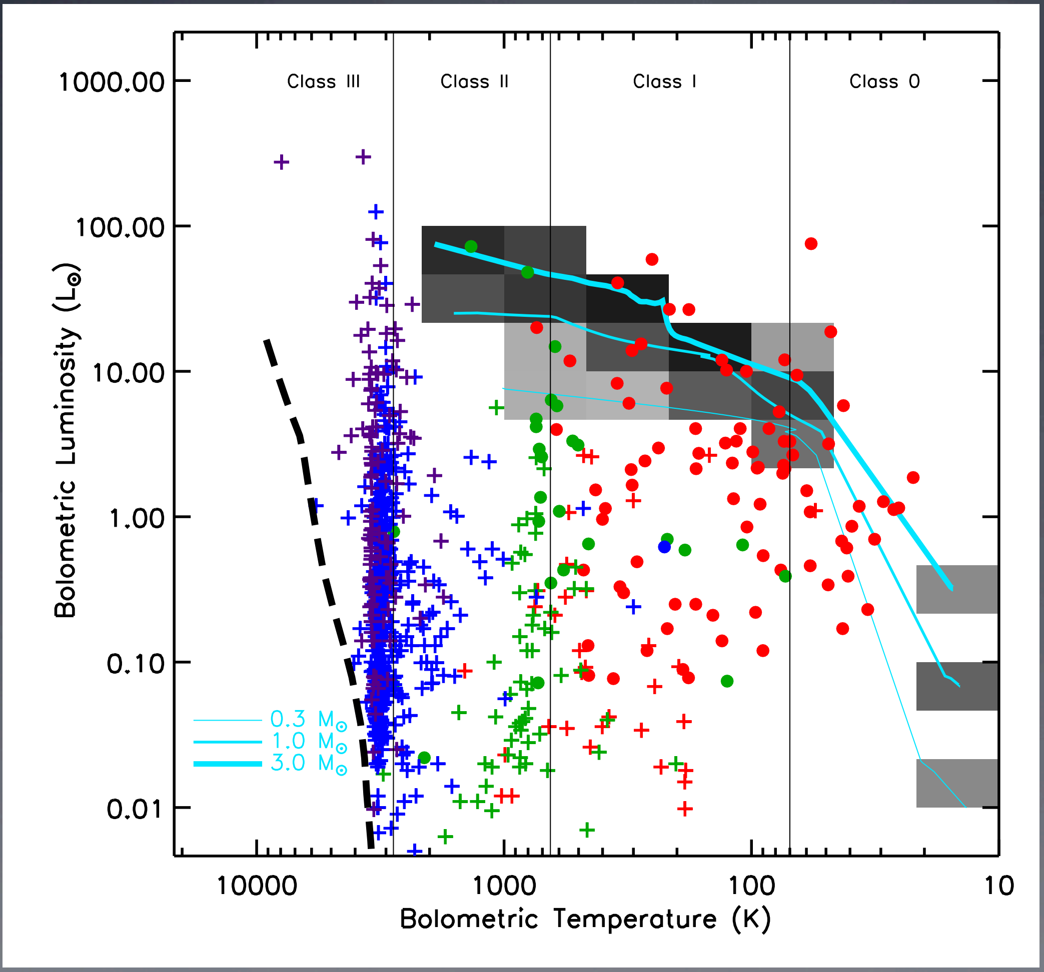


Measure Tbol (~peak of SED) and Lbol (luminosity)

Enoch+2009

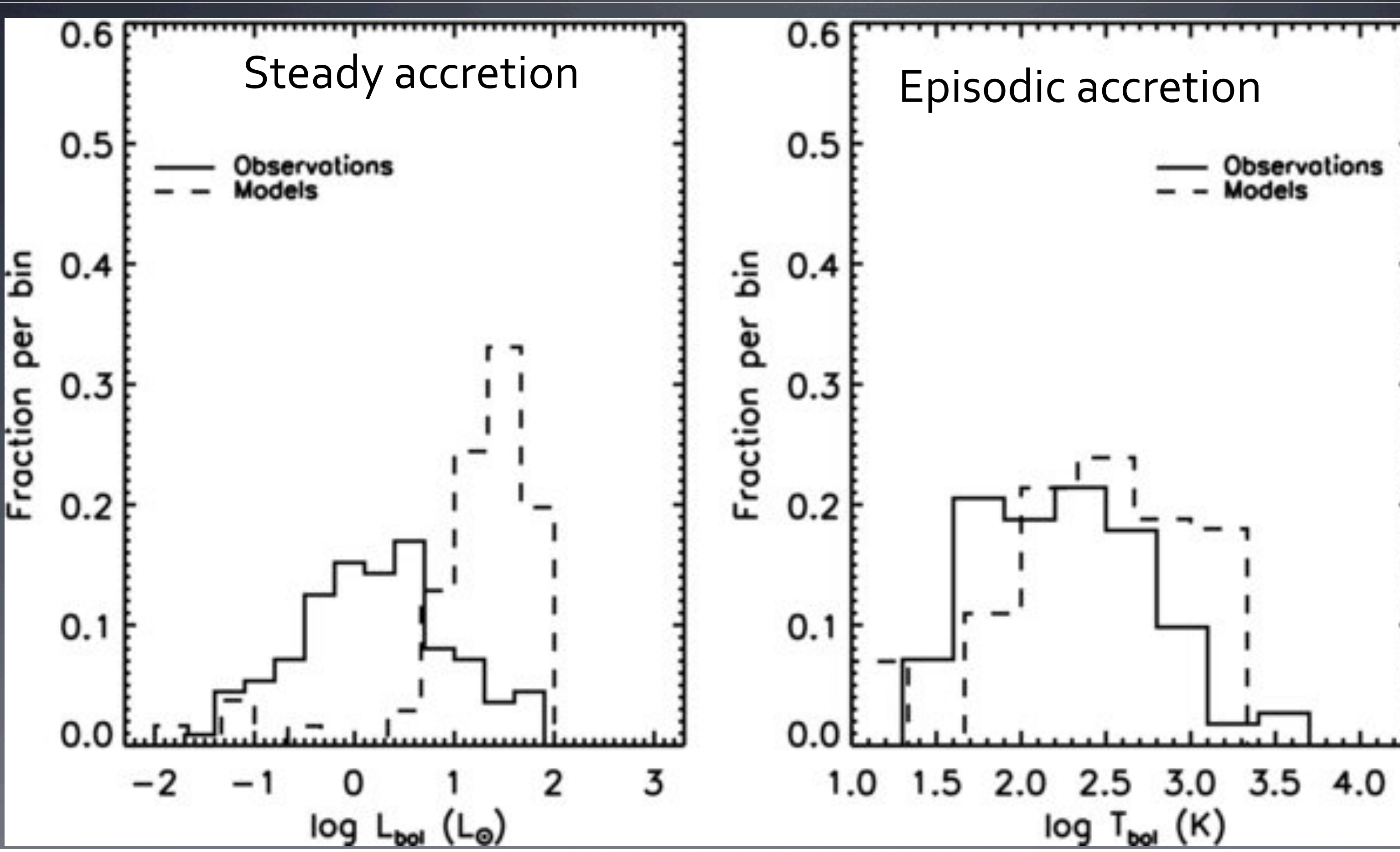
Luminosity Problem

(Kenyon et al. 1990; Dunham et al. 2010)



Episodic bursts of accretion

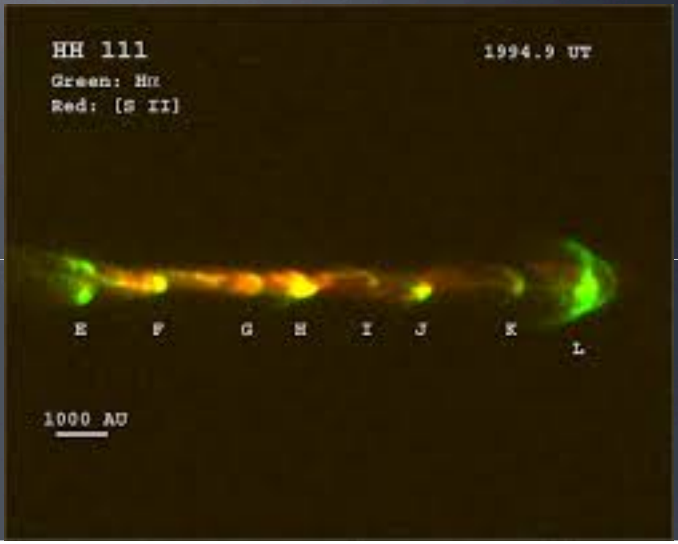
(Kenyon et al. 1990; Dunham, Evans, et al. 2009)



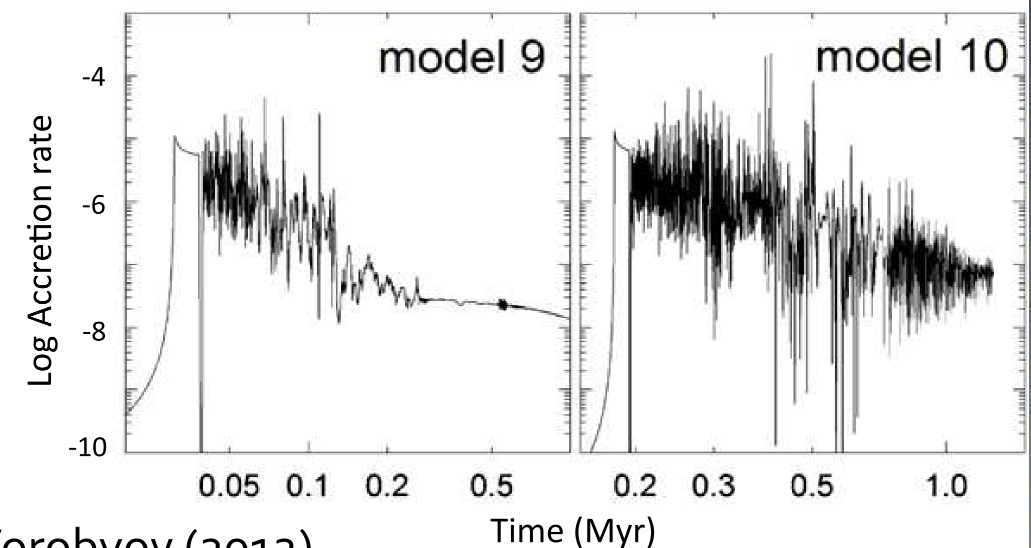
Time dependence needed; episodic accretion is likely (but not only) solution (e.g., Offner & McKee; see review by Hartmann, Herczeg, & Calvet 2016).

Evidence for episodic accretion

- Outbursts on more evolved protostars (FUors, EXors)
- Repeated jet shocks
- Chemical signatures of past epochs of high luminosity (e.g., Kim +2011; Jorgensen+2013)
- Models of disk instabilities

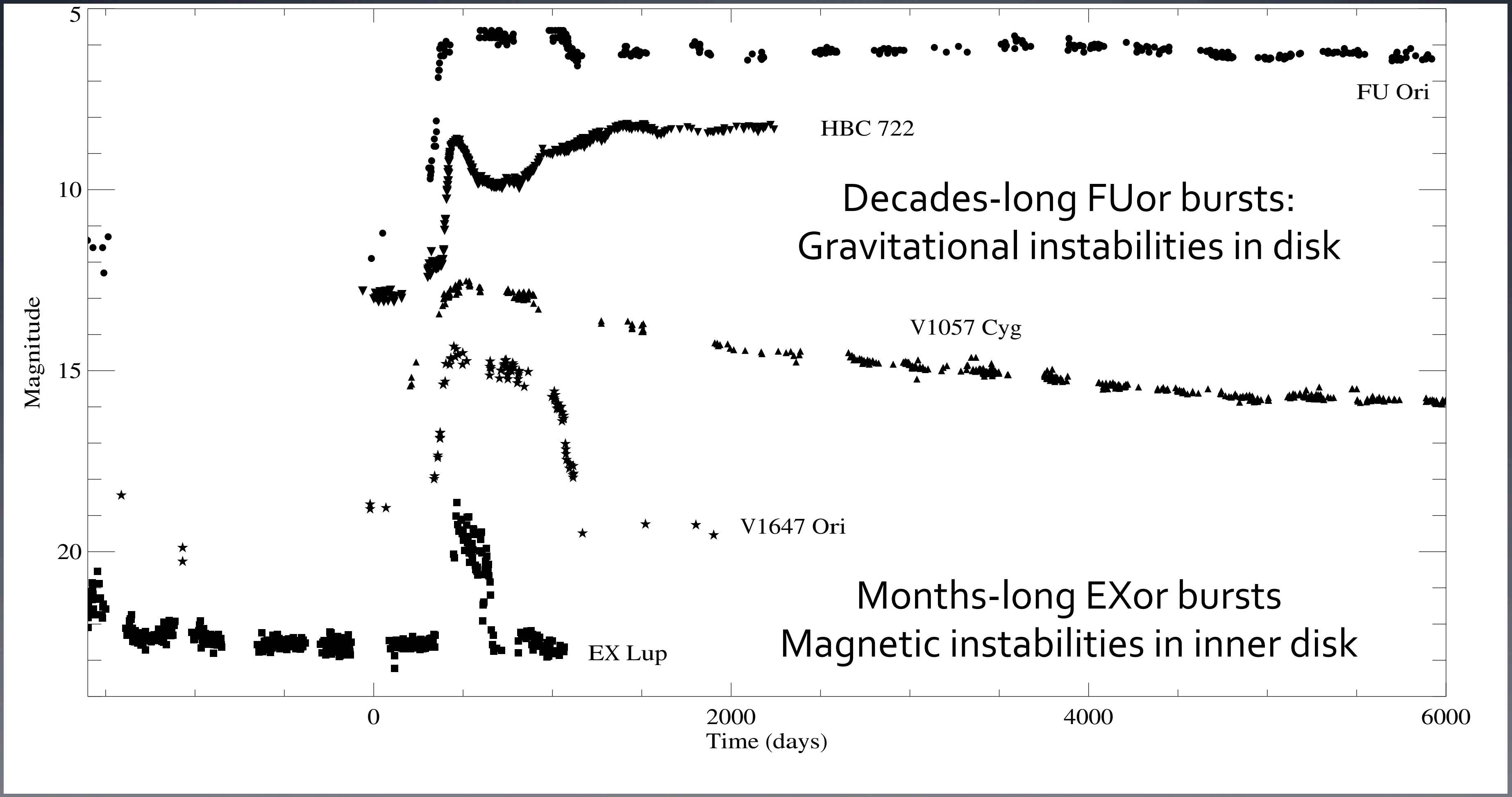


Jet shocks of HH 111
(Reipurth 1989; Hartigan et al. 2011)



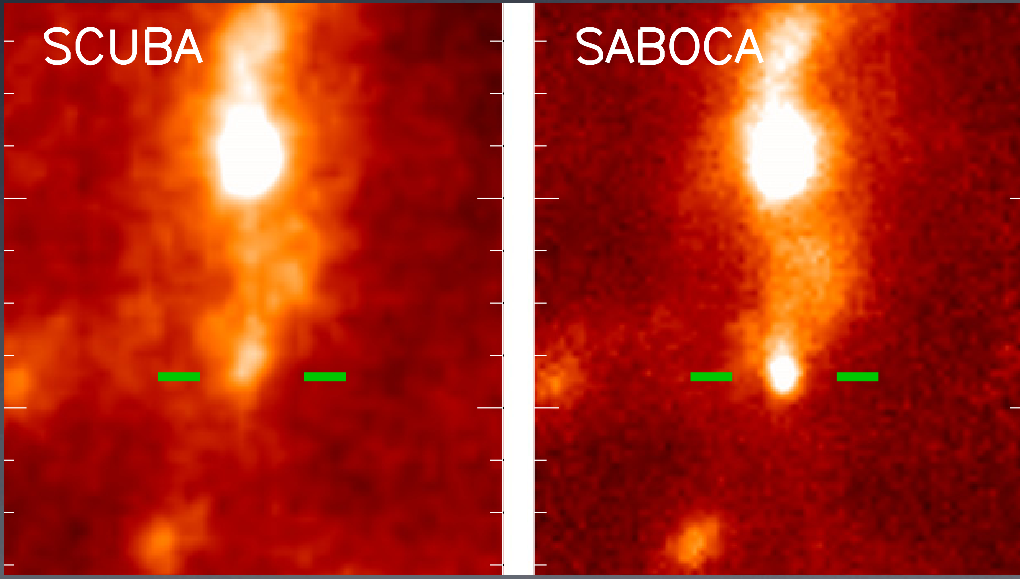
Models from Dunham & Vorobyov (2012)

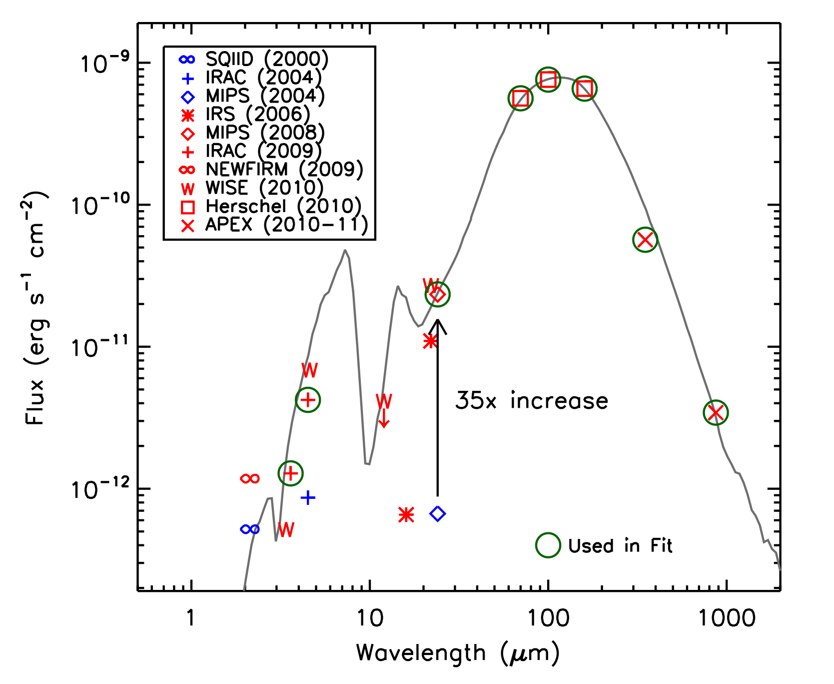
Fuor and Exor outbursts
(adapted from Kospal+2011)



Observed protostellar variability

(Safron, Fischer, et al. 2015)

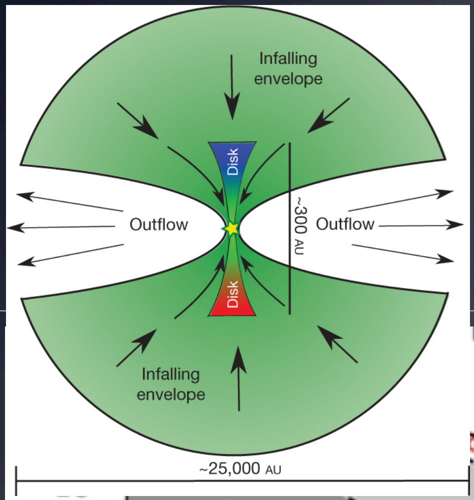


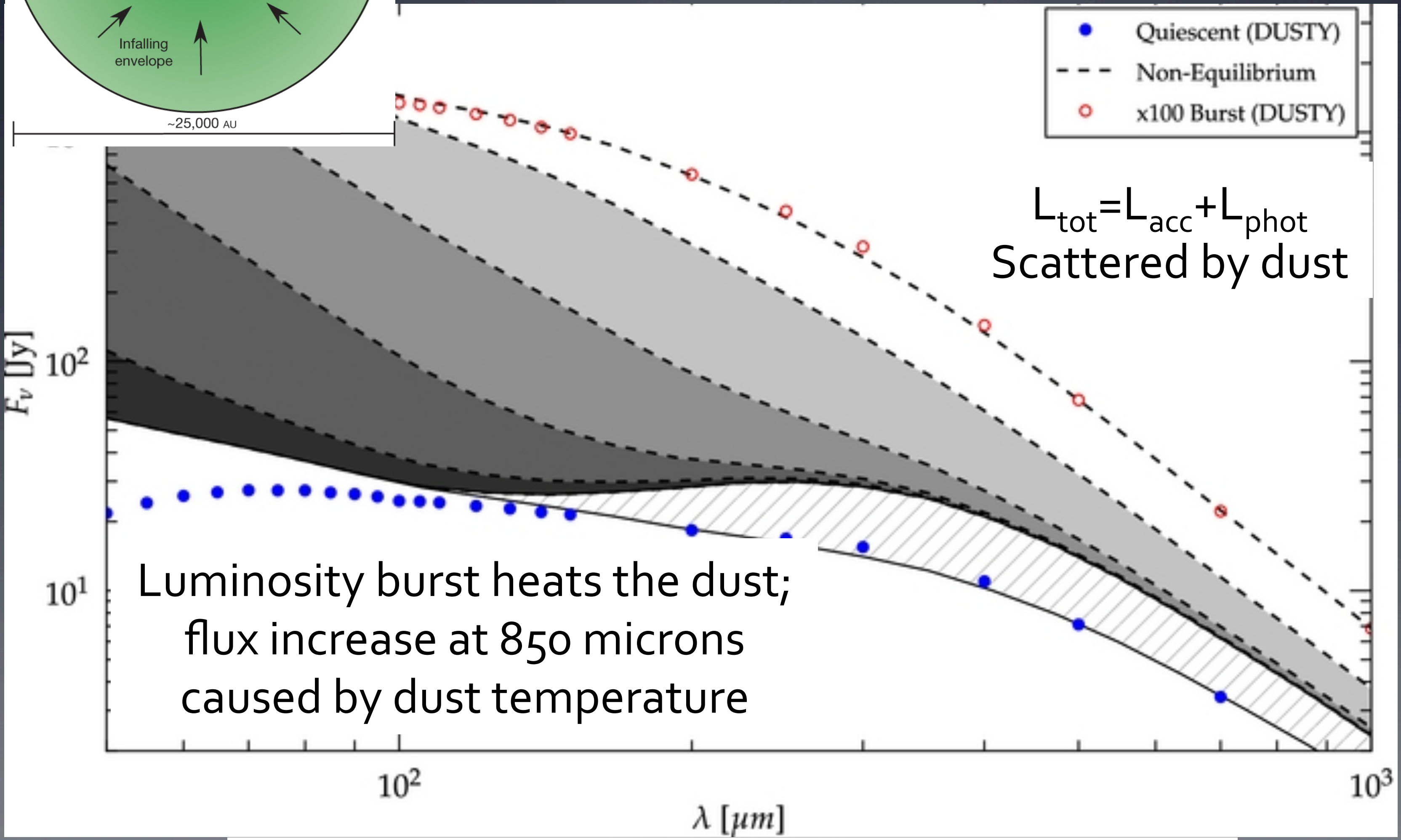


Embedded source identified in mid-IR Spitzer;
Strong sub-mm emission post-outburst

Radiative transfer: a burst through an envelope

(Johnstone et al. 2013)





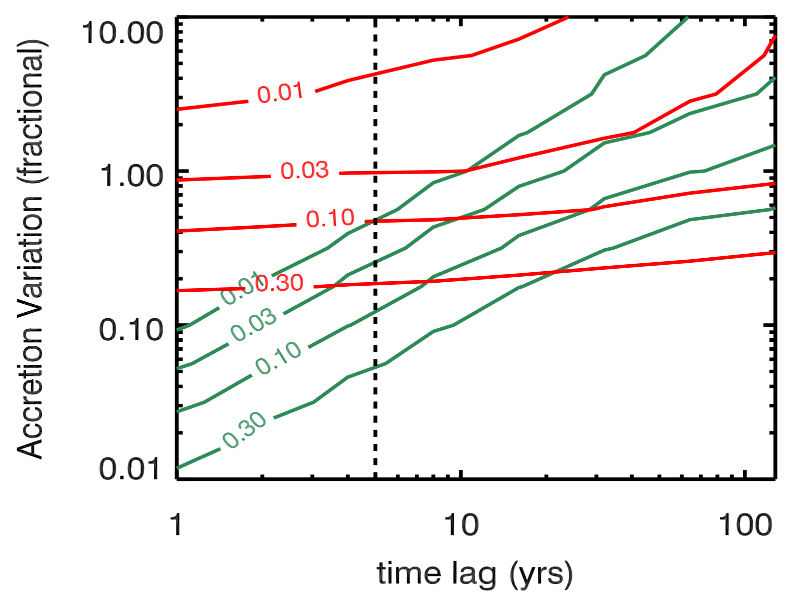
$L_{tot}=L_{acc}+L_{phot}$
Scattered by dust

Luminosity burst heats the dust;
flux increase at 850 microns
caused by dust temperature

Time delay: a few weeks (mostly light travel time)

Program description

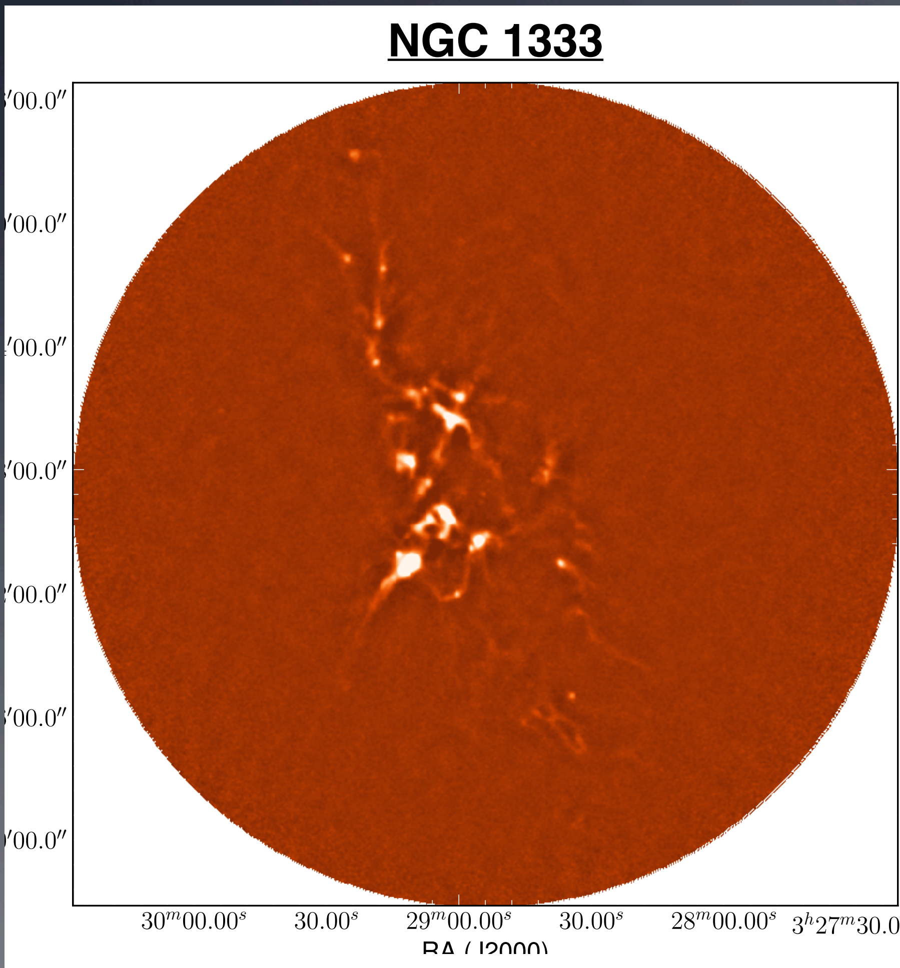
- 150 total hours spread over 8 fields of 30 arcmin
  - Perseus (2), Oph (1), Orion (3), Serpens (2)
  - Roughly monthly monitoring
  - Previous GBS epoch
- 182 Class 0/I protostars, 132 flat-spectrum srcs, 670 disks

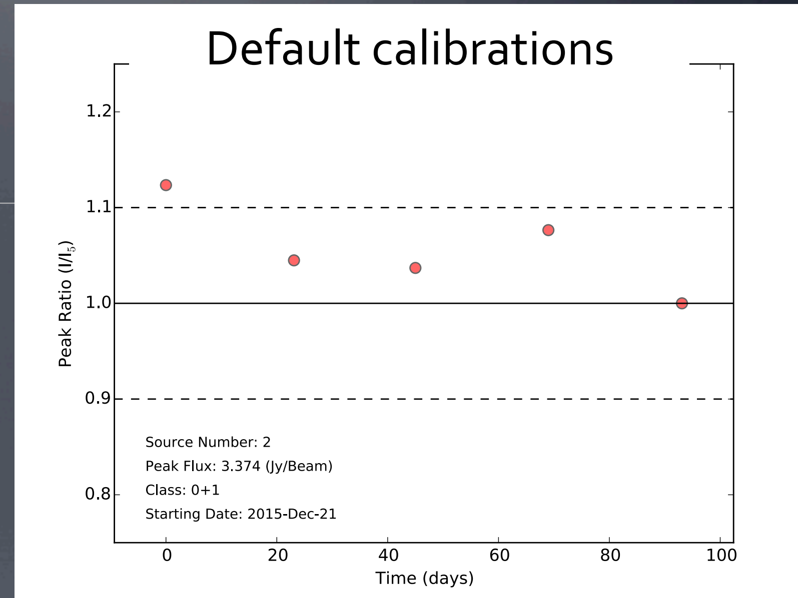


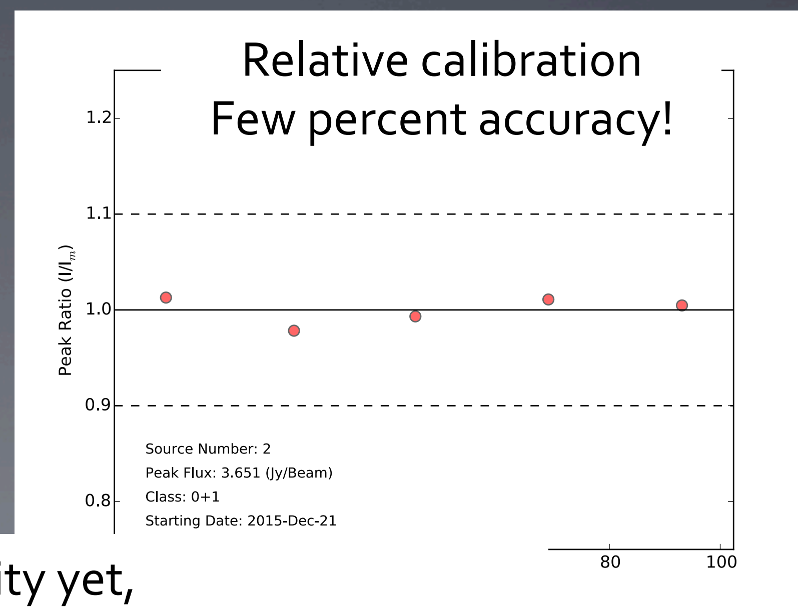
Levels of accretion variability for MRI+GI instabilities (Bae+2014, green) and GI (Vorobyov & Basu 2010, red)

First results/calibration

(Mairs, Lane, Johnstone, et al.)







No obvious variability yet,
but still improving methods and applying to fainter sources

Future of JCMT Transient Survey

- Program is running well on 8 regions rich in protostars
- No obvious variability yet, but still improving methods and applying to fainter sources
- Complementary science: disks, filaments, VeLLOs
  - 2.5 times deeper than SCUBA2 Gould Belt Survey
- Chemistry, physics modelers