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Testing Measurements of Star-formation Rates Using Realistic Synthetic Observations

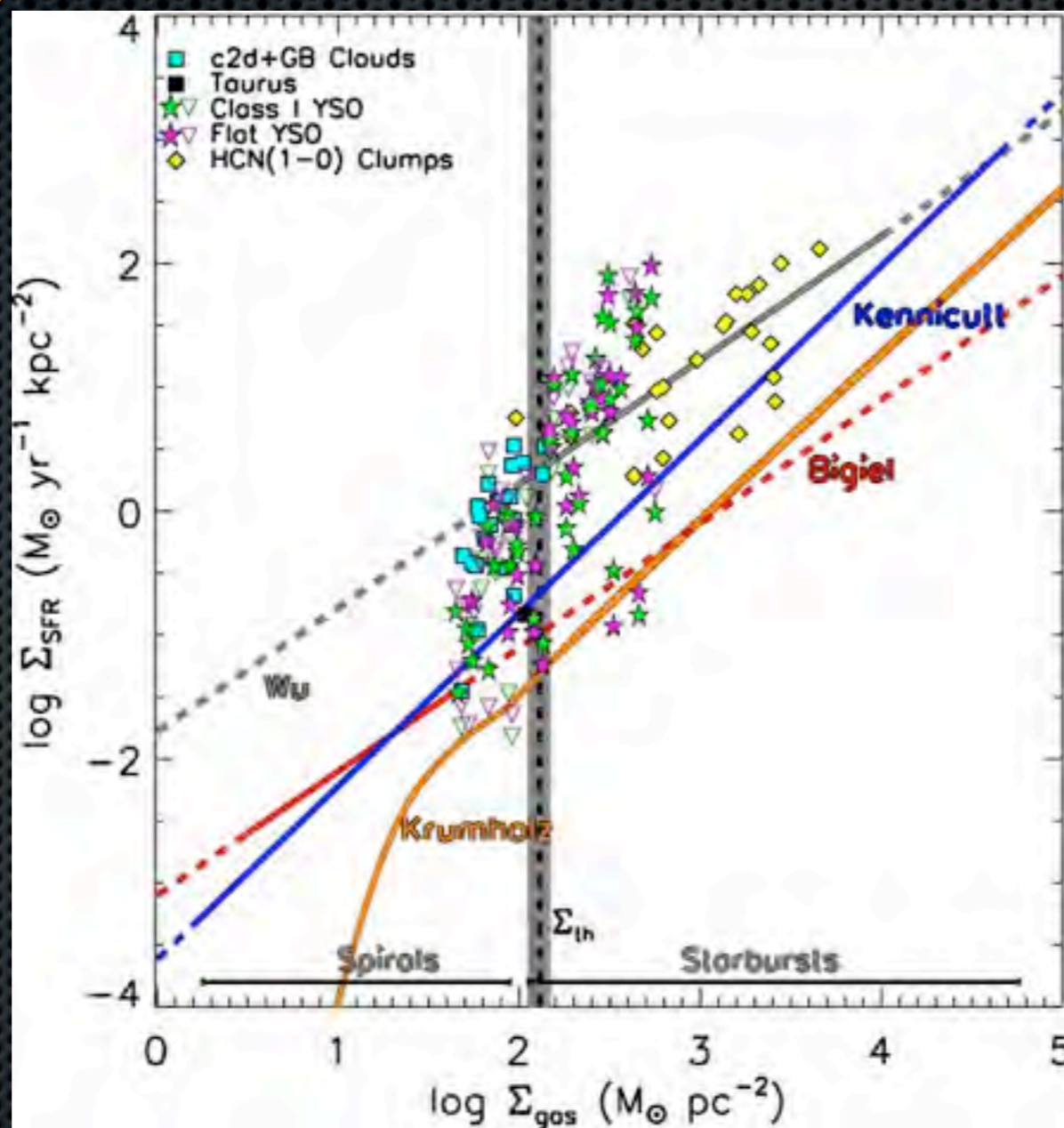
Christine
Koepferl
MPIA



GLIMPSE

Star-formation relations?

SF of yesterday



Heiderman et al. 2010

SF of tomorrow

Synthetic Observations | overview

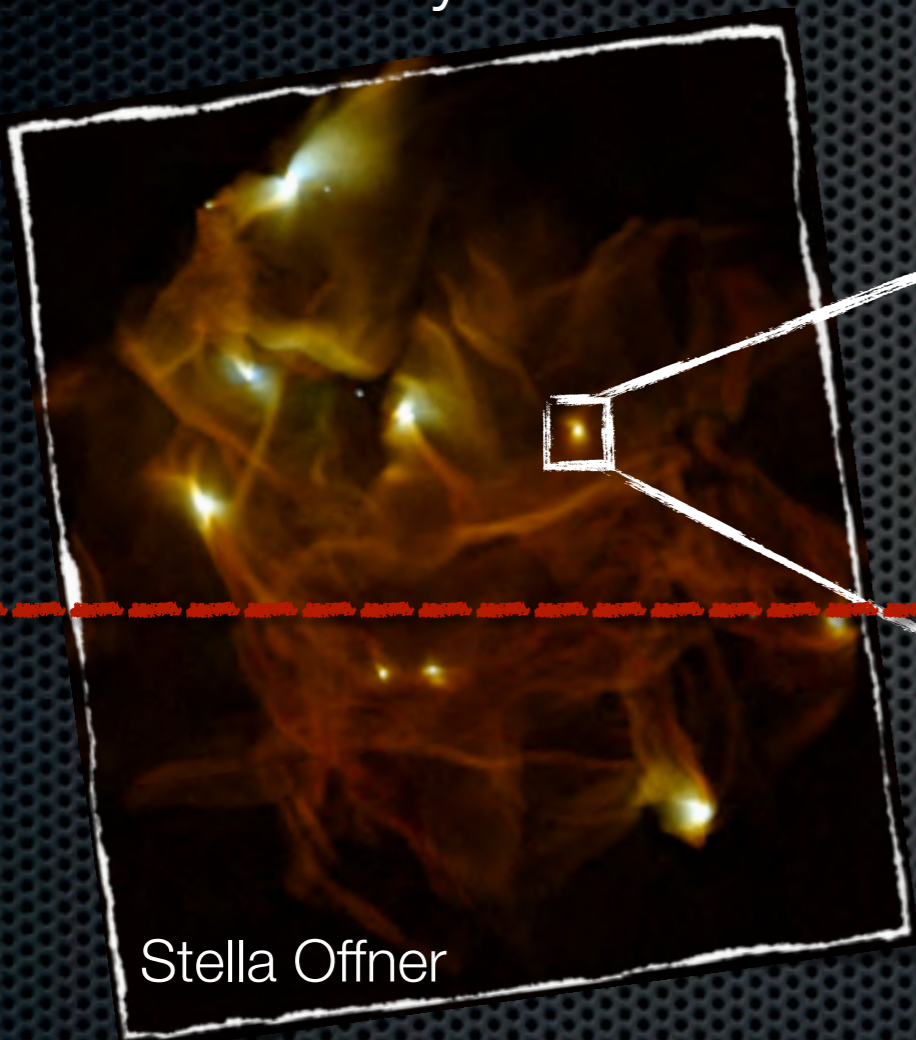
density & dust

photons

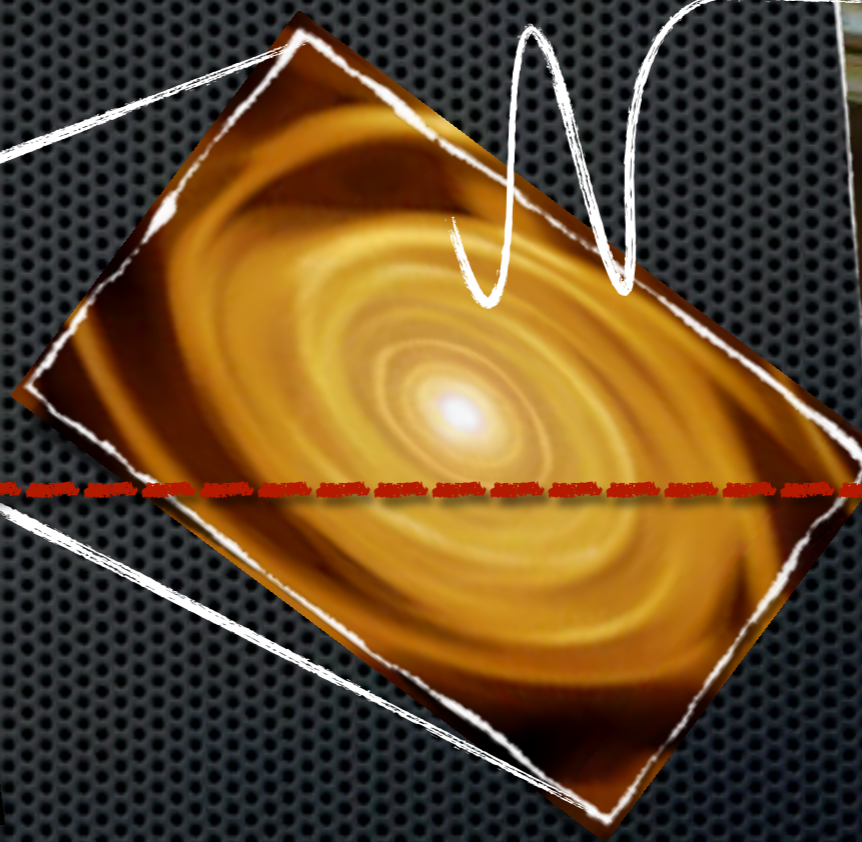
telescope & detector

REALITY

VIRTUAL



Stella Offner



density grid
hydro-simulations

radiative transfer
HYPERION

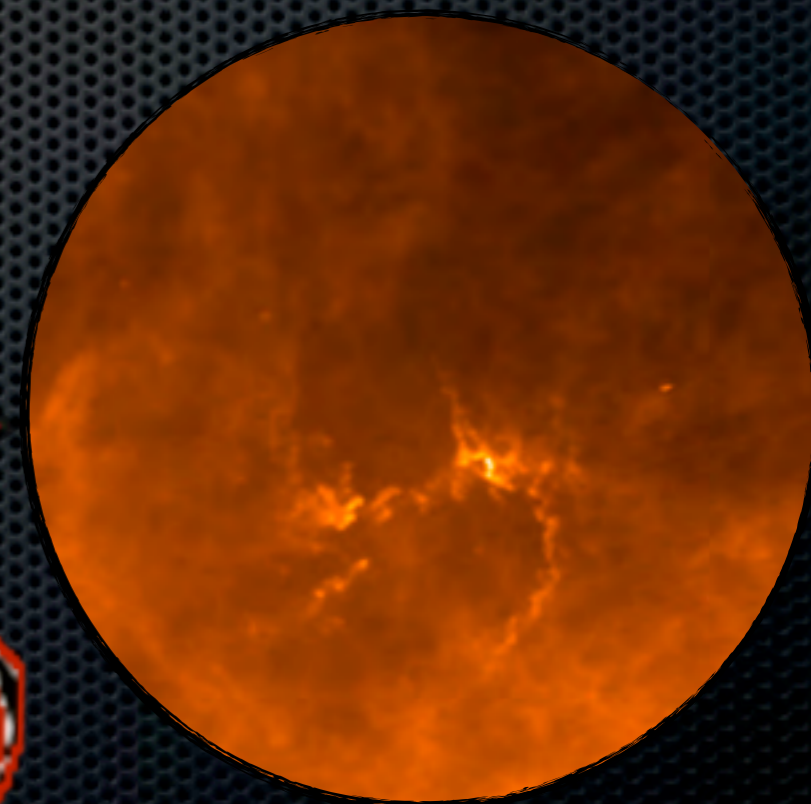
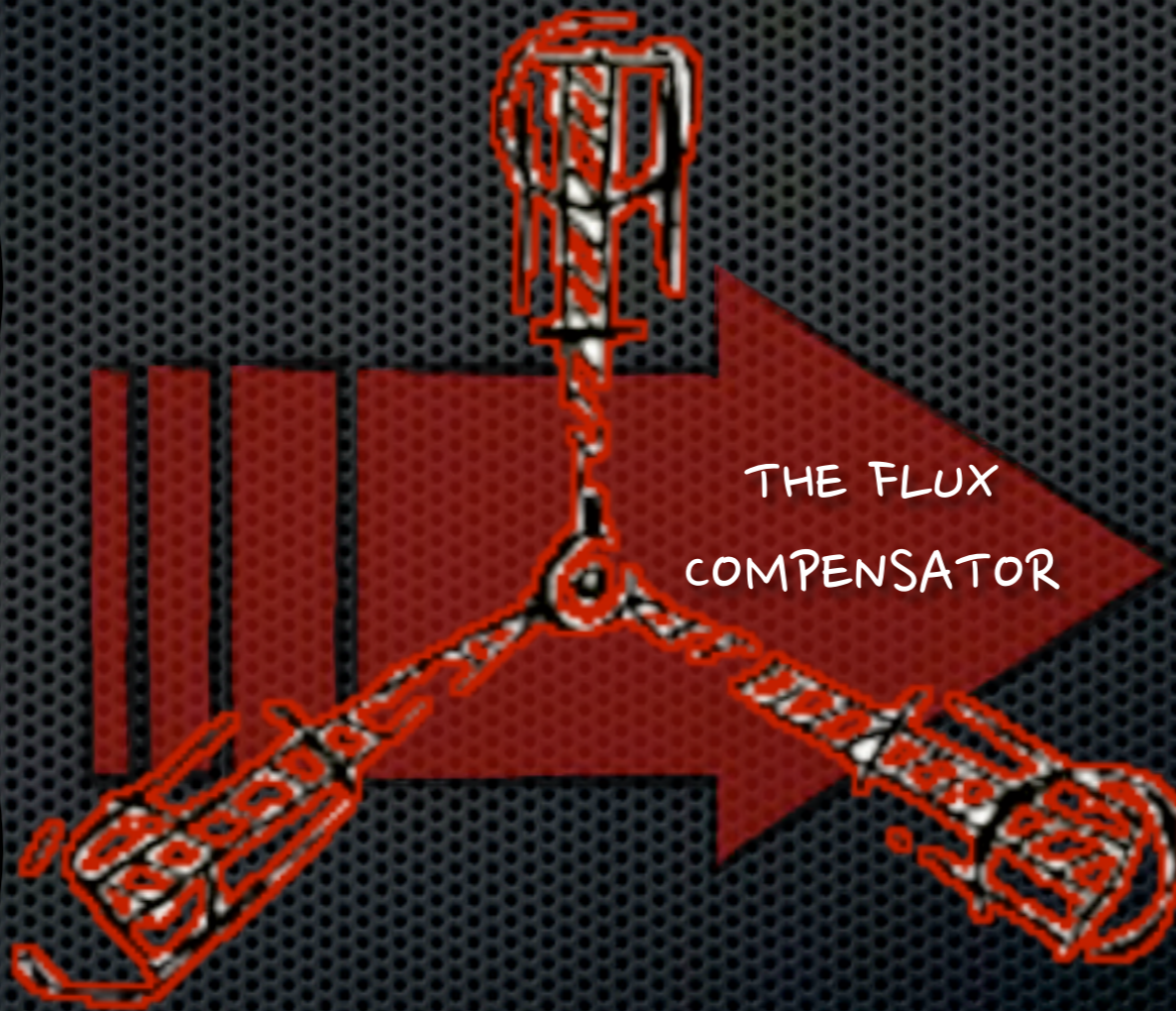
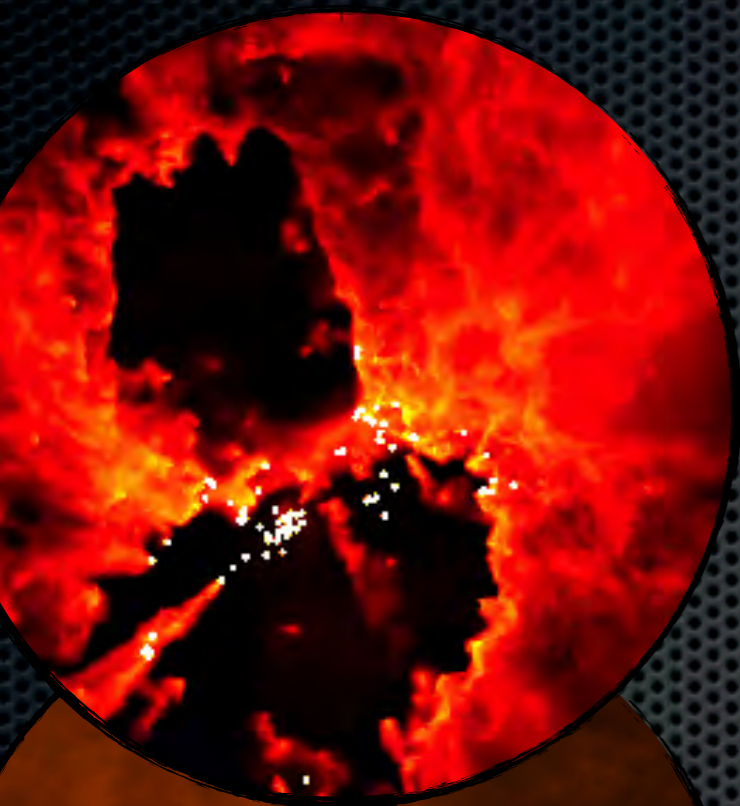
convolution within
THE FLUXCOMPENSATOR



hyperion

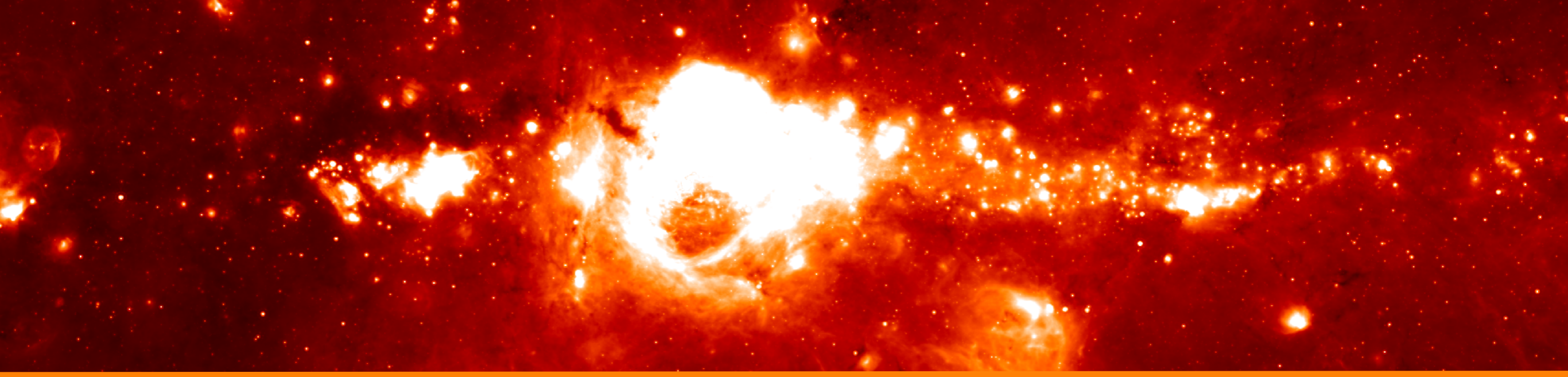


RADIATIVE
TRANSFER MODELS



REAL OBSERVATION (FITS)
VS. HYDRO SIMULATION

REALISTIC SYNTHETIC
OBSERVATIONS



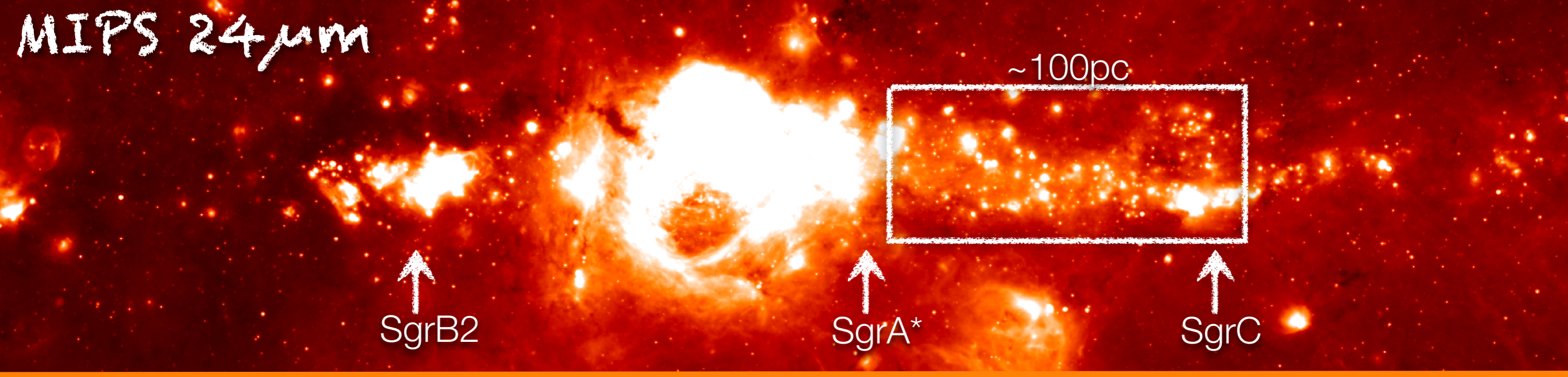
Main-sequence stars masquerading as Young Stellar Objects in the central molecular zone

C. Koepferl, T. Robitaille, E. Morales, K. Johnston



2015, ApJ, 799, 53

<http://arxiv.org/abs/1411.4646>



indirect

- total ionizing flux using free-free emission
- e. g. Longmore et al. 2013

SFR

$\sim 0.01 \text{ M}_\odot/\text{yr}$
0.06

direct

- calculations from observed YSOs at MIPS[24]
- Yusef-Zadeh et al. 2009

$\sim 0.1 \text{ M}_\odot/\text{yr}$

- ~ 600 objects
- age $< 1\text{Myr}$
- IMF extrapolation

Modelling | YSOs vs. MS stars

660 radiative transfer models

- YSOs (9 infall rates)

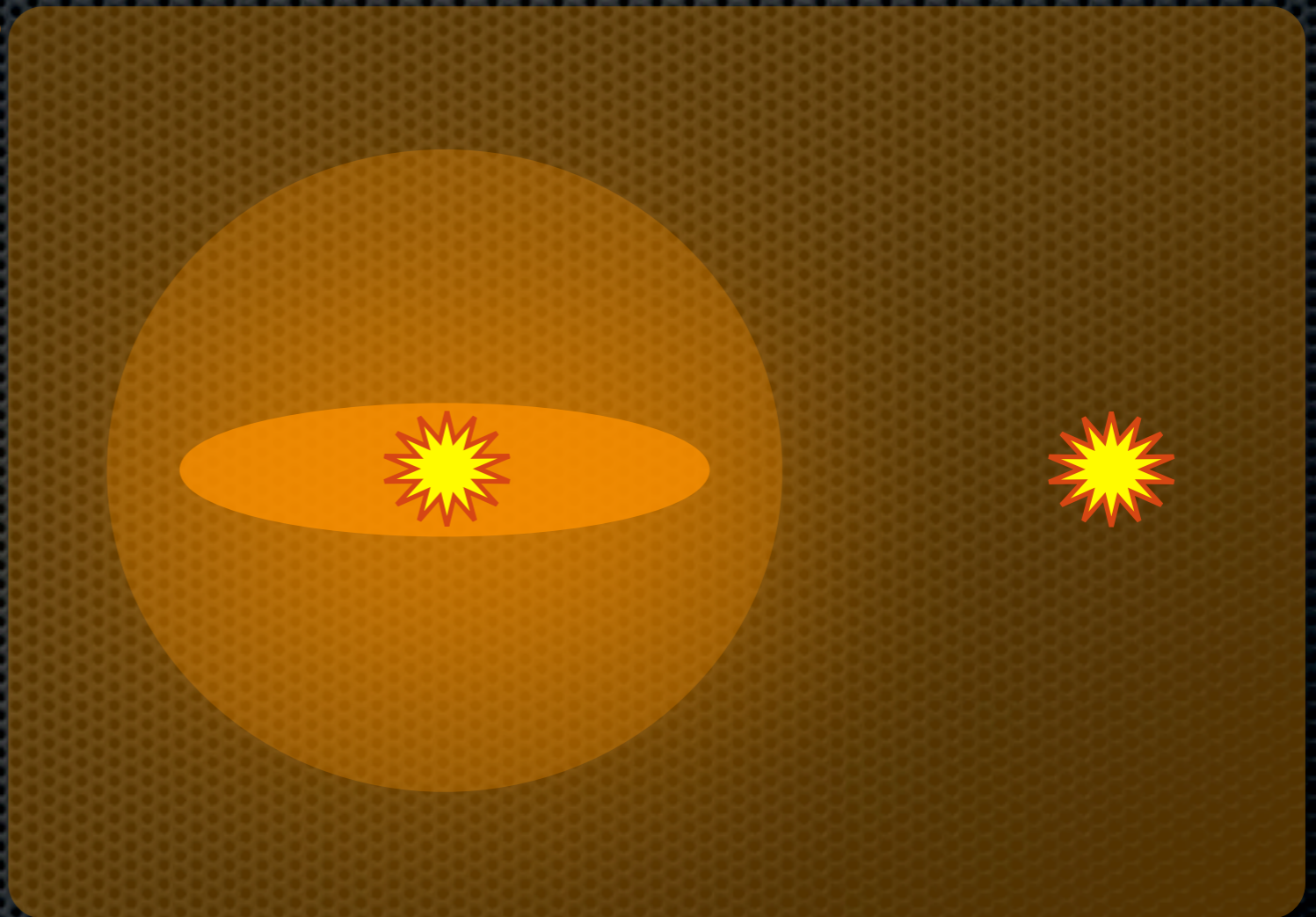
- MS stars

in an ambient medium

- 3 ambient densities

- 2 dust types

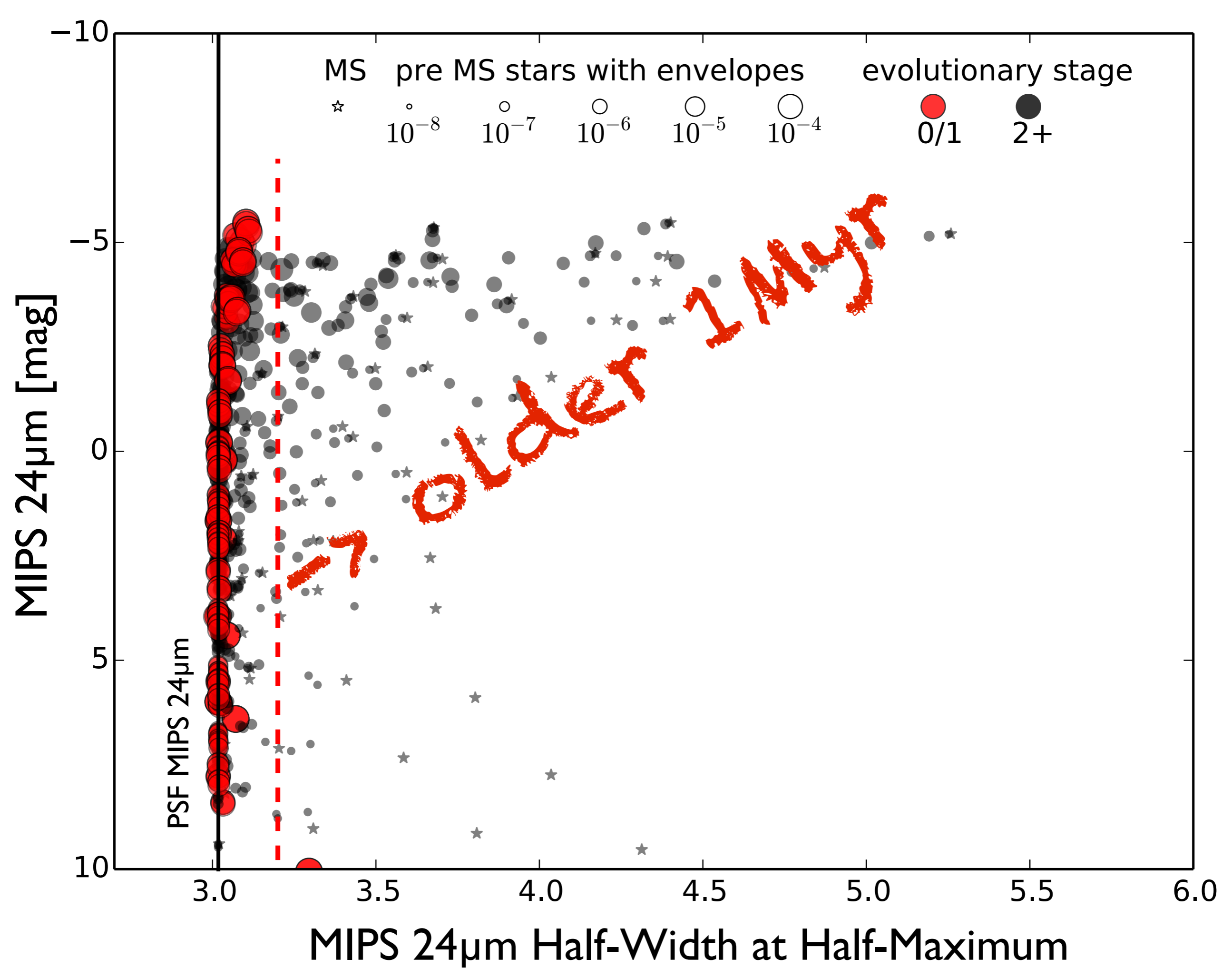
- 11 spectral types (O to A)



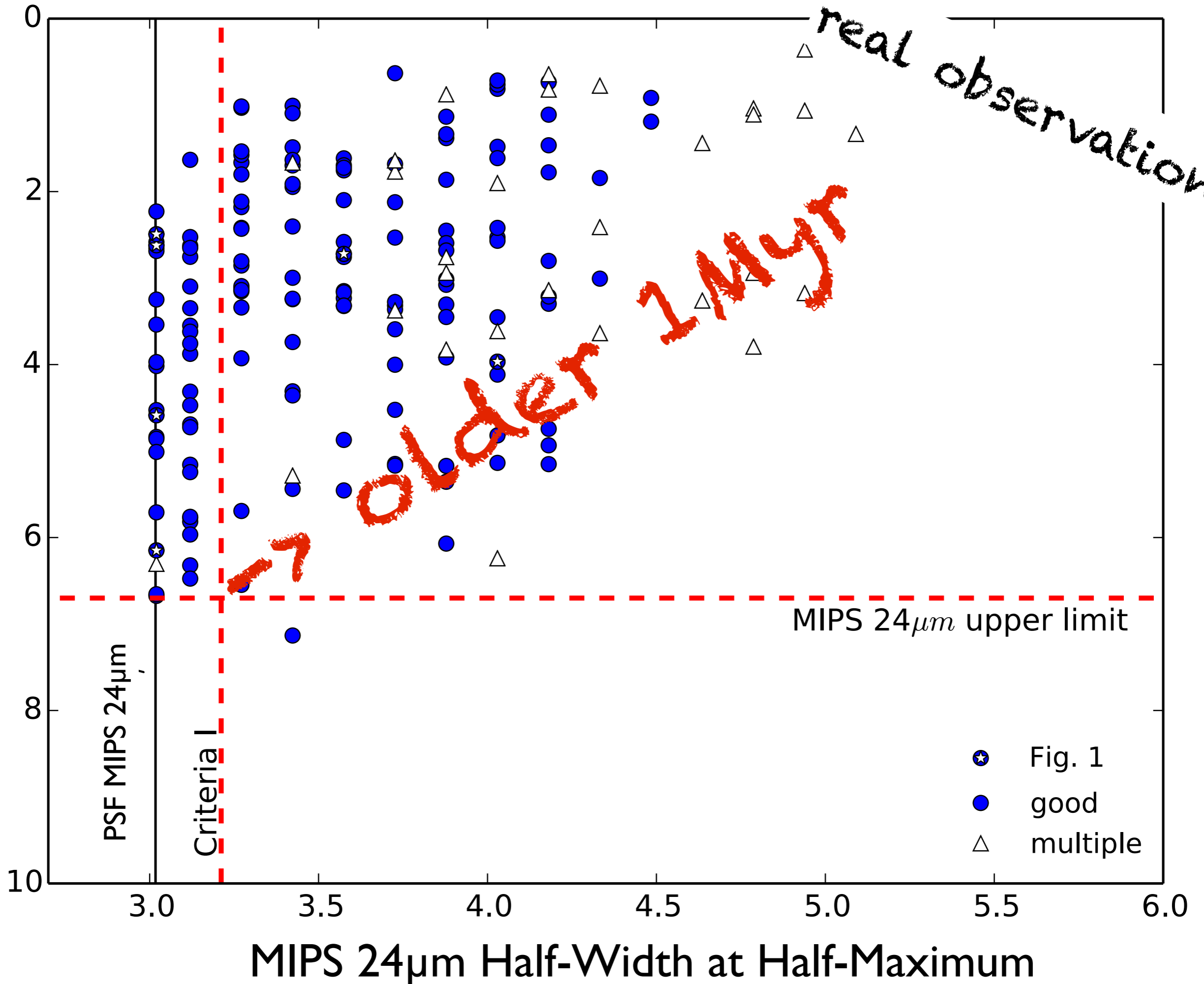
realistic synthetic observations

~ radiative transfer **HYPERION**
~ PSF & filter convolution
~ extinction

~ background
~ pixel-size



MIPS 24 μ m [mag]



In the CMZ ...

published

Criteria show...

some classified YSOs
are **not young** (~63%)

[http://arxiv.org/
abs/1411.4646](http://arxiv.org/abs/1411.4646)

2015, ApJ, 799, 53

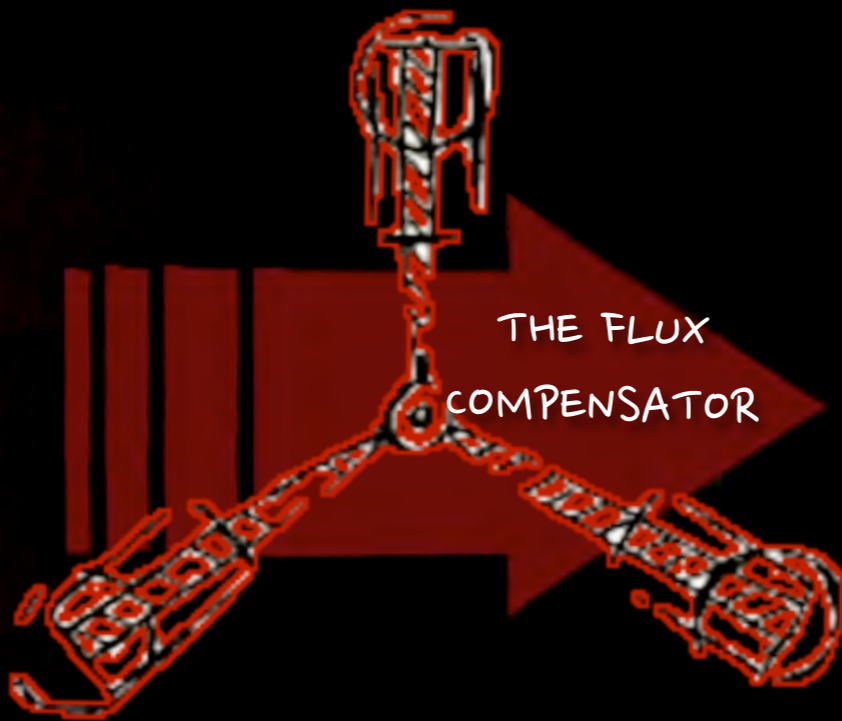
Star-formation rate

lower SFR in CMZ

Star-formation rate

better **agreement** with
the **free-free** estimate

hyperion



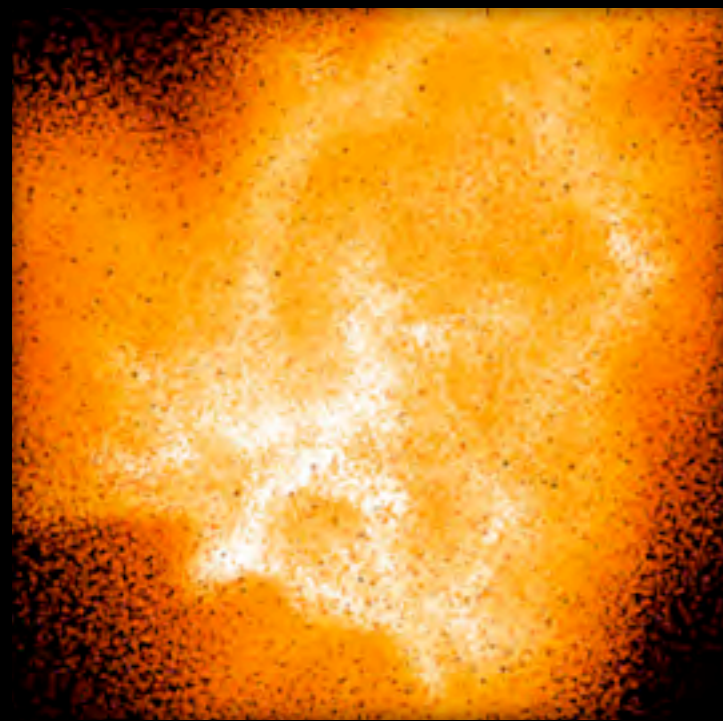
Star-formation Rate in synthetic star-forming regions

C. Koepferl, J. Dale, T. Robitaille

in prep.

Simulations | RUN I by Jim Dale

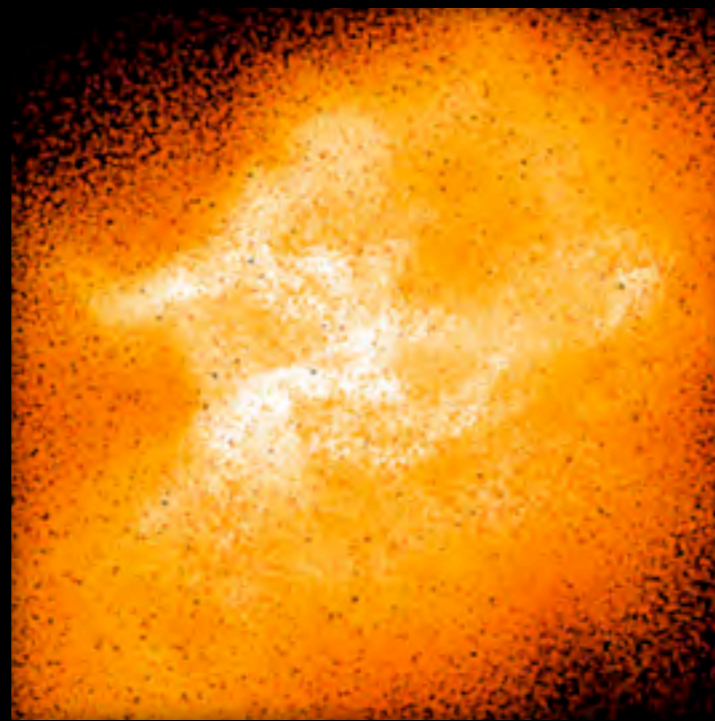
down z



30 pc

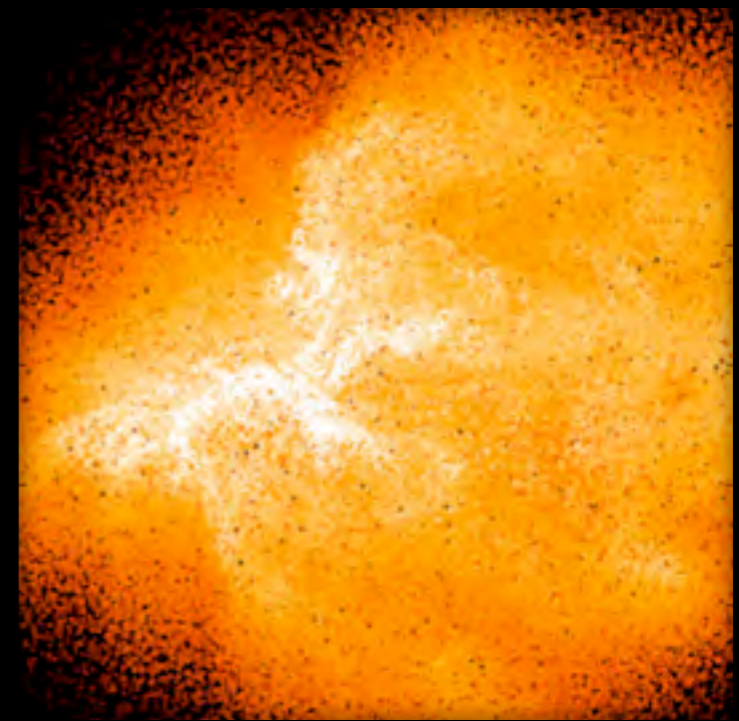
- 10^4 Msun
- 7 Myr
- 180 timesteps

down y



- feedback
- winds
- ionization

down x



- control runs without feedback

g/cm^3

$1\text{e-}21$

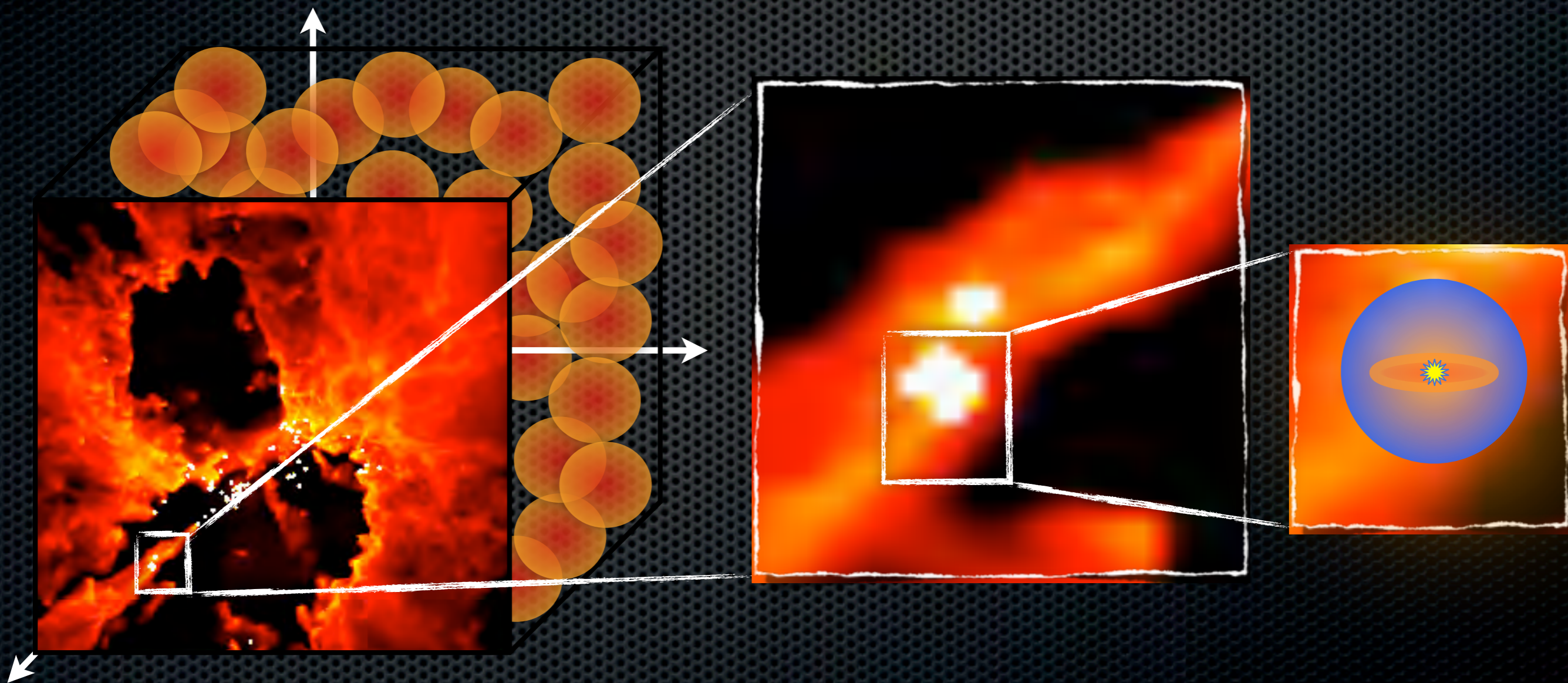
$1\text{e-}22$

$1\text{e-}23$

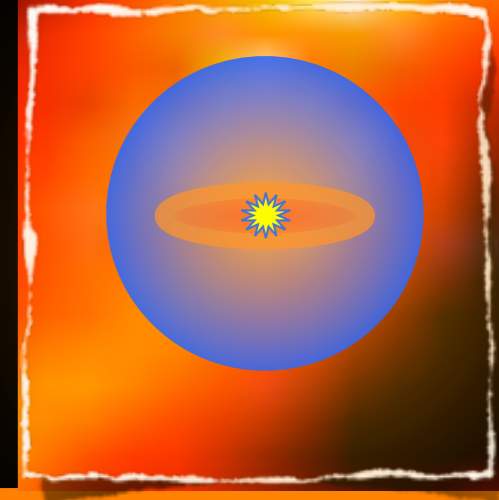
$1\text{e-}24$

$1\text{e-}25$

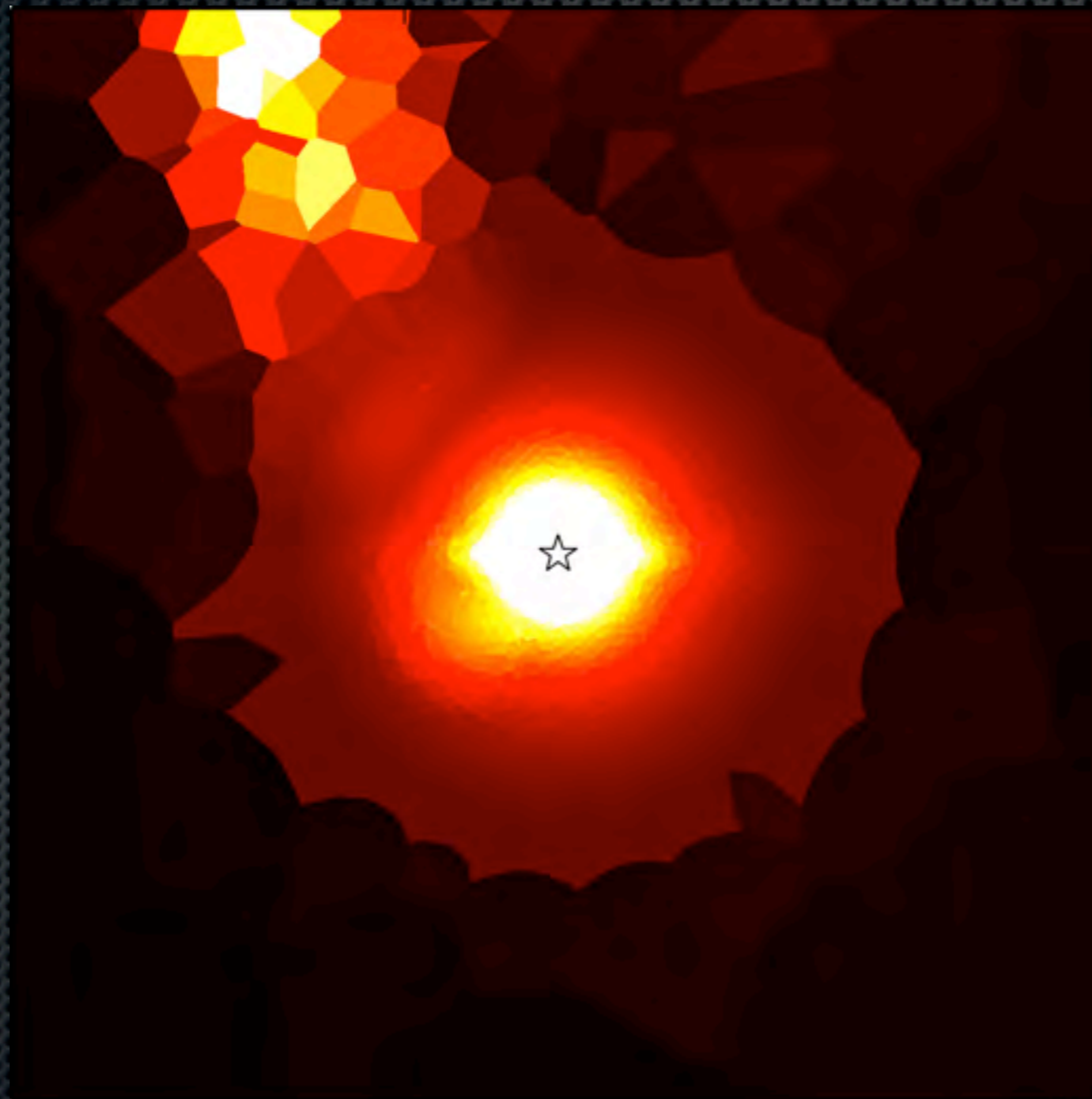
Refinement | envelopes ...



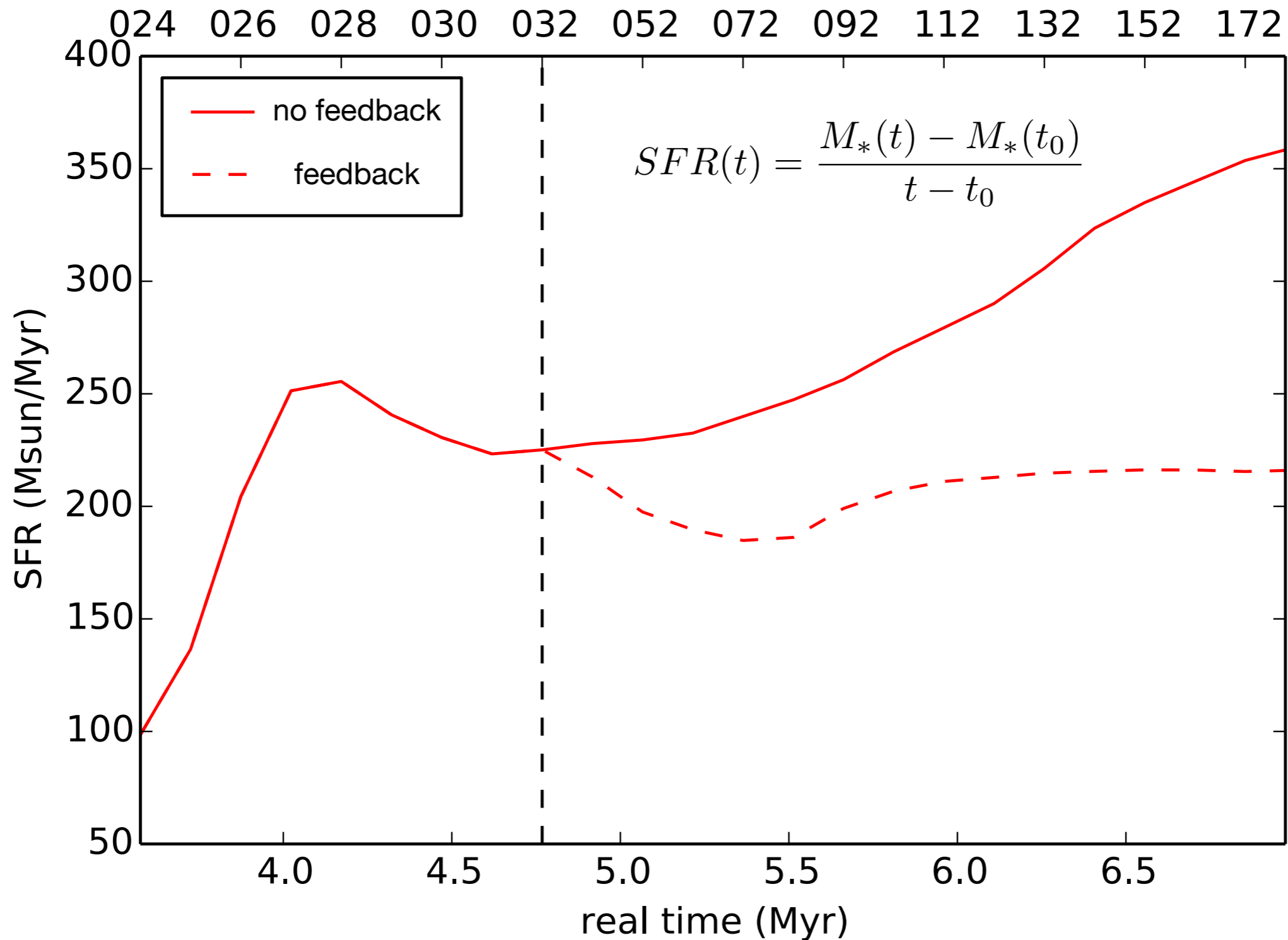
Refinement | transitions



1.2 pc



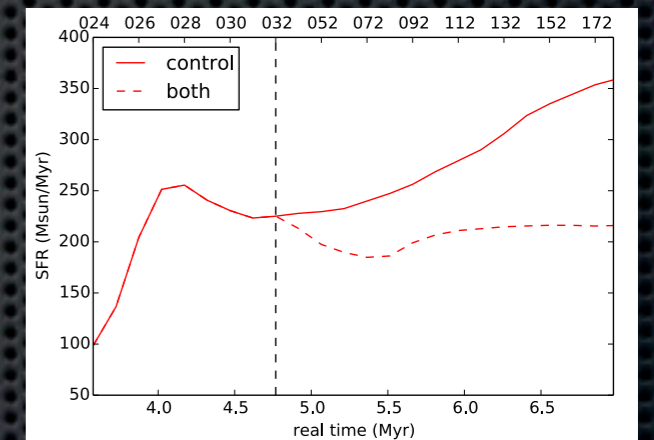
Properties | extracted from simulations



Questions | Selection Biases?

Is the SFR different ...

- ✦ for synthetic observations of dust tracers?
- ✦ for different views?
- ✦ for different distances?



after my PhD

tracer dependence

- ✦ gas, dust tracers
- ✦ SFR tracers, gas reservoir tracers



variation in the
star-formation relation

Summary

published

THANK
You 😊

FLUXCOMPENSATOR

- realistic synthetic observations
- directly comparable



code
available
soon

direct 24 μ m tracer

YSO | unresolved in [24]
most MS | resolved

↓
some classified YSOs
are not young

↓
lower SF rate in CMZ

↓
better agreement with
the free-free estimate

technique gauge

Is there a global
underlying SF relation?

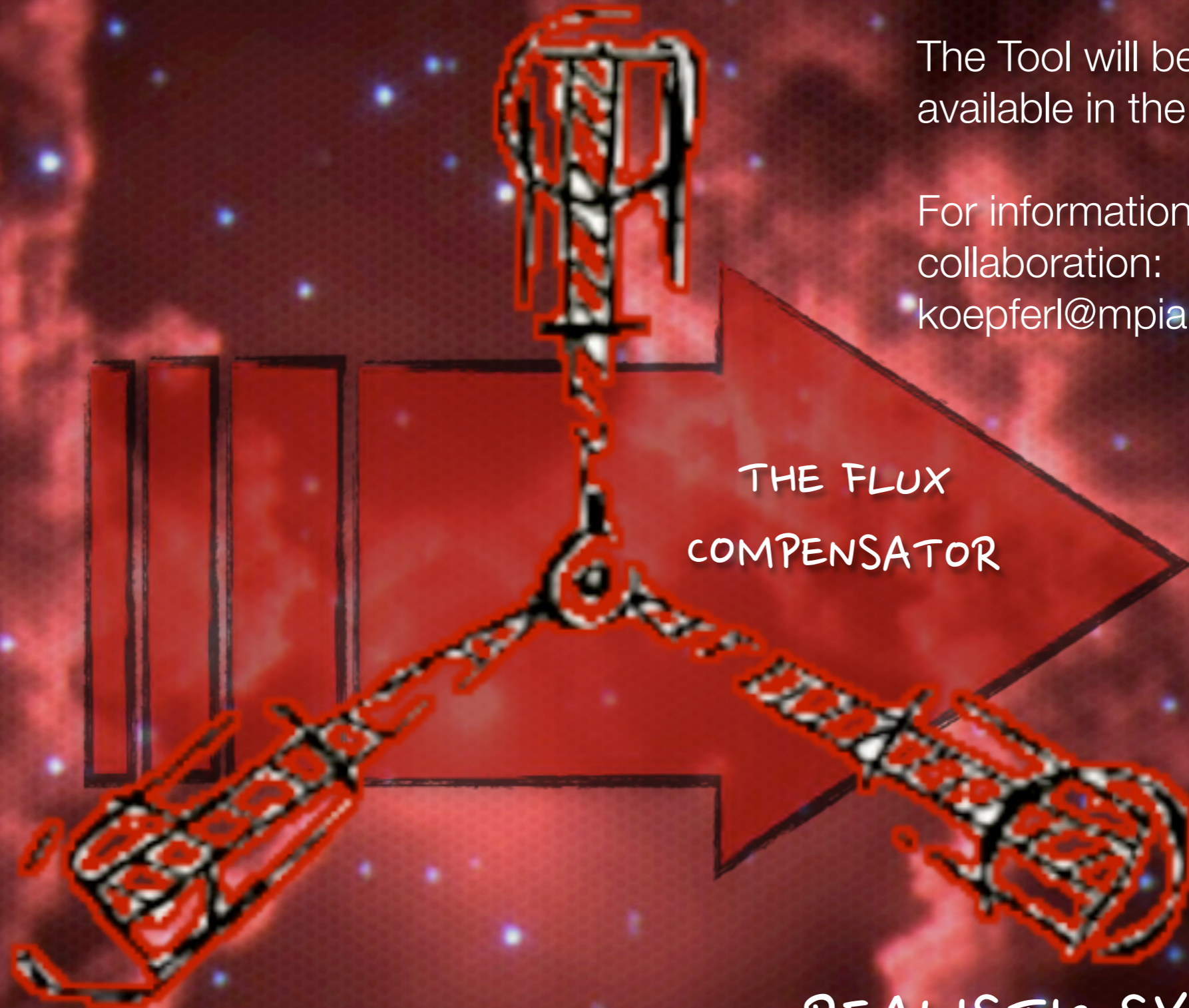
Different SF relation for
different tracers?

IMF universal?

RADIATIVE TRANSFER MODELS

The Tool will be publicly
available in the future.

For information or
collaboration:
koepferl@mpia.de



REAL OBSERVATION
VS. SIMULATIONS

REALISTIC SYNTHETIC
OBSERVATIONS