THE PROBLEMATICALLY SHORT SUPERWINDS OF OH/IR STARS

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LAST TALK OF THE DAY

★ KU Leuven, Belgium
Onsala Space Observatory, Sweden

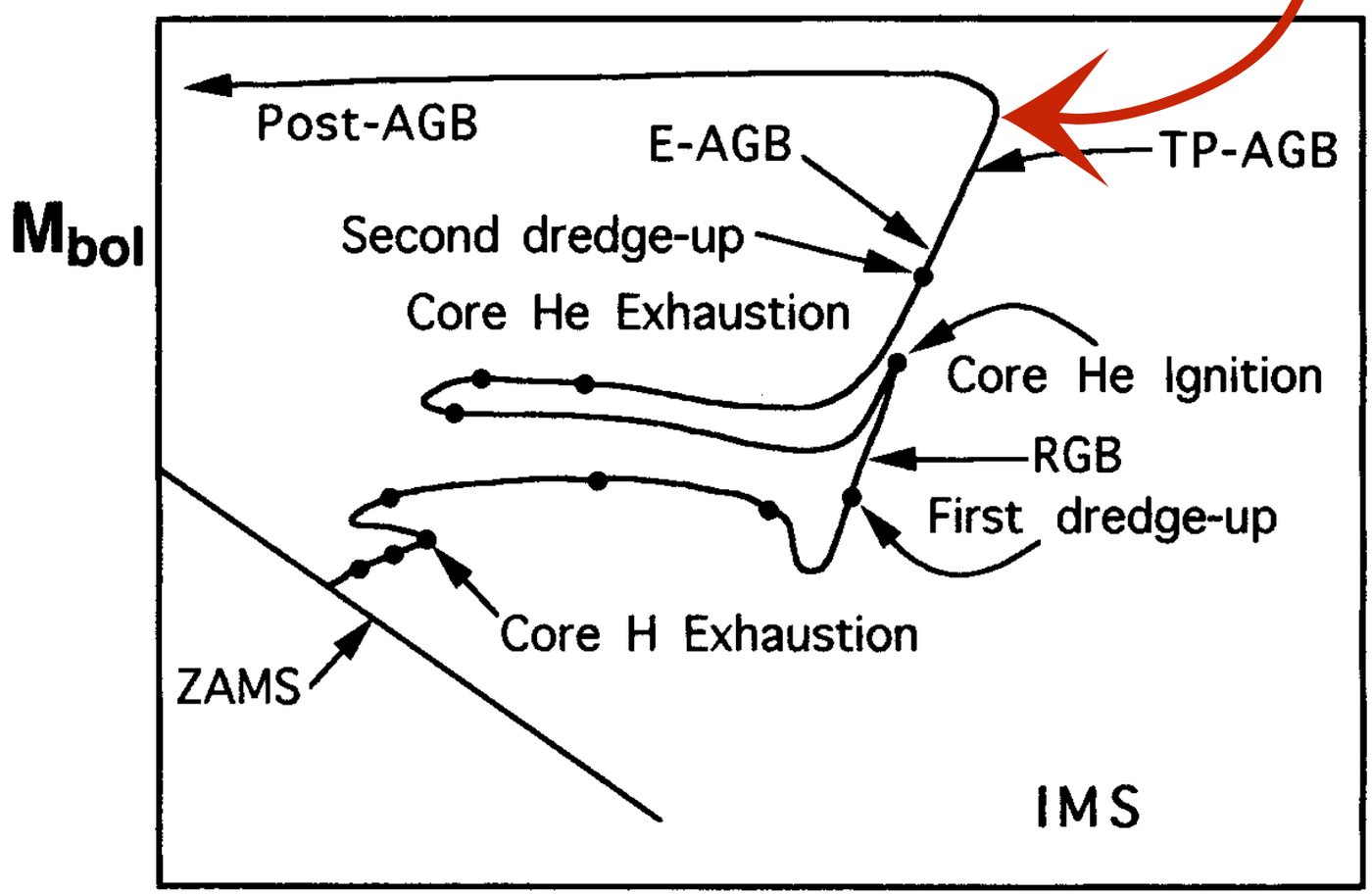
The Physics of Evolved Stars - Nice, June 2015

INTERMEDIATE INITIAL-MASS STARS

(ACTUALLY PRETTY MASSIVE RELATIVE TO WHITE DWARFS...)

YOU ARE HERE

$5\ M_{sol} \lesssim$ MS mass $\lesssim 8\ M_{sol}$

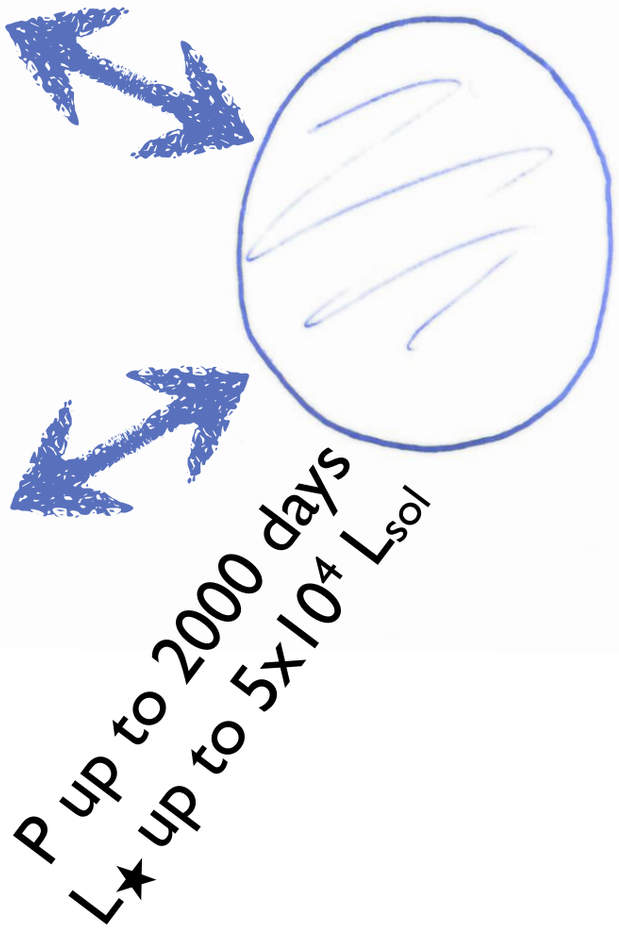


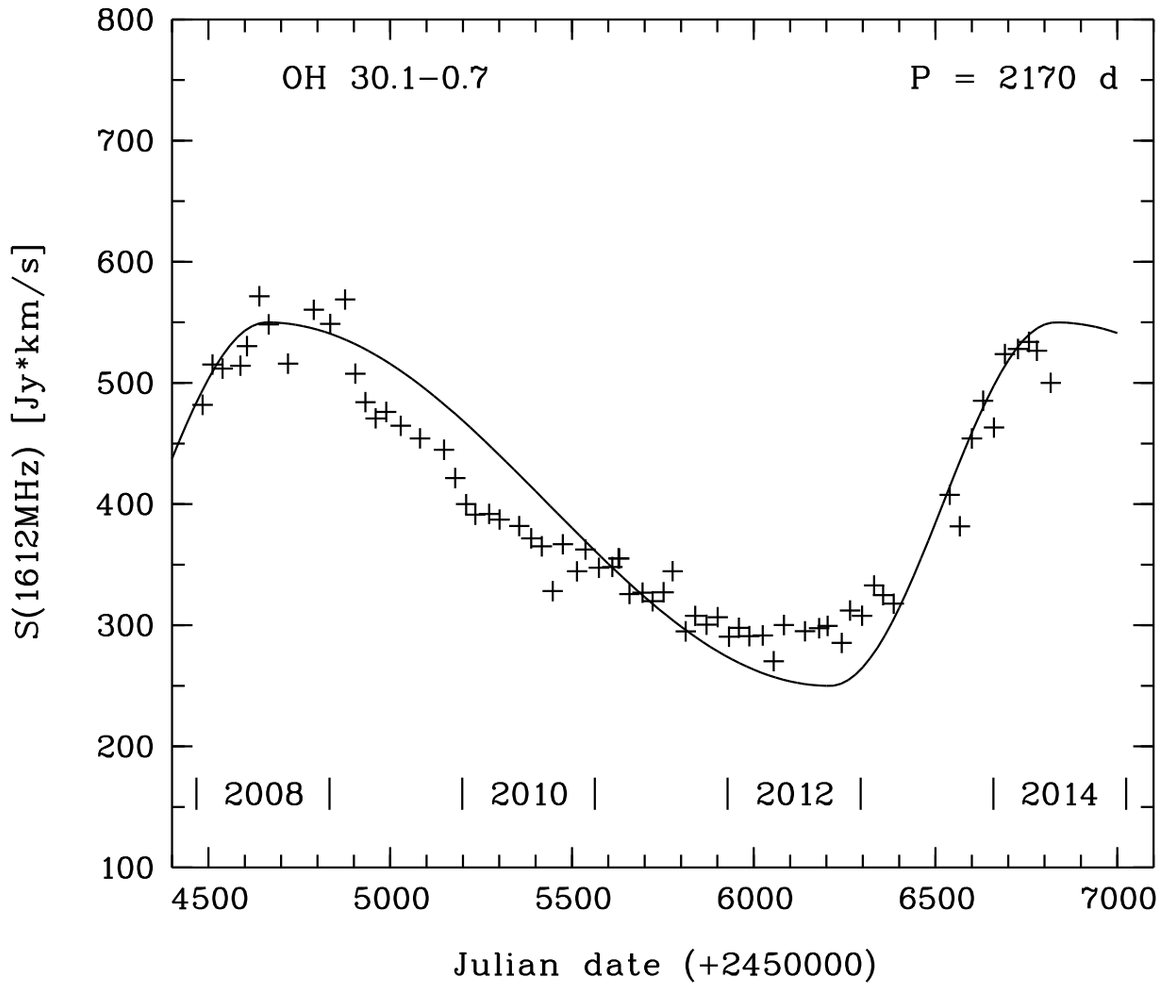
BUSSO ET AL. 1999

MIRA & LONG-P PULSATIONS

(NON-PULSATING OH/IR STARS EXIST!)

$5\ M_{sol} \lesssim$ MS mass $\lesssim 8\ M_{sol}$



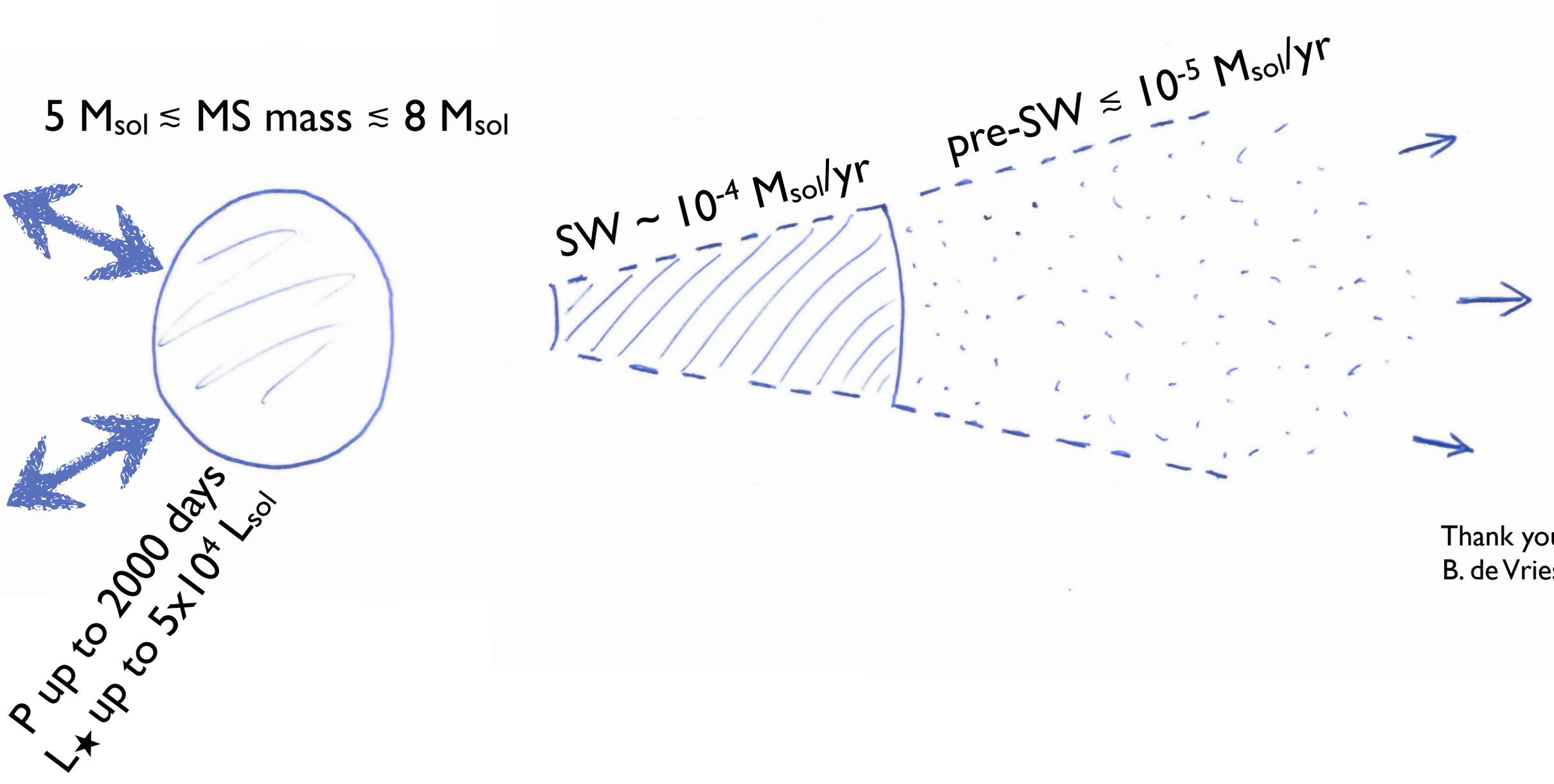


ENGELS ET AL. 2015

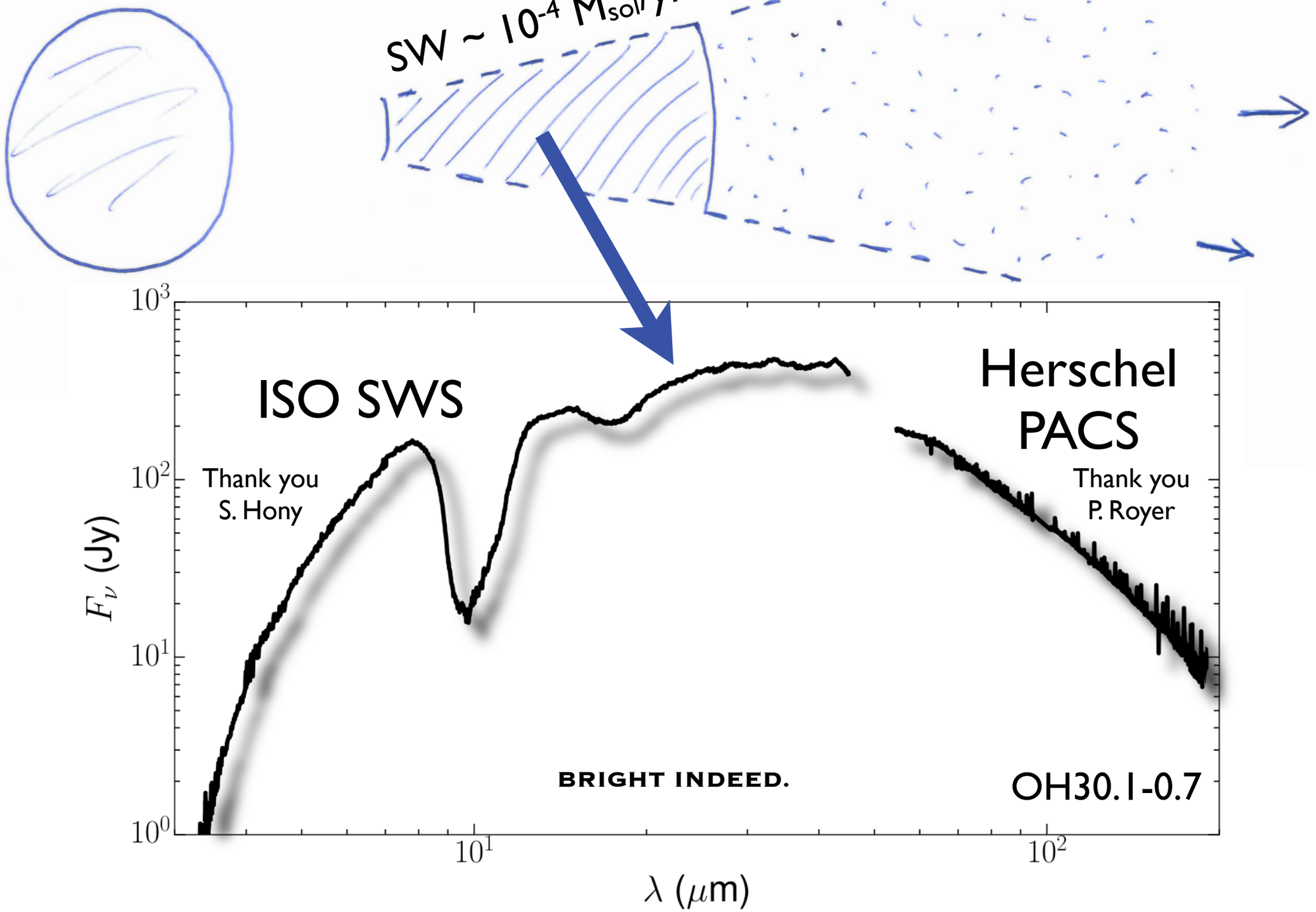
DUST-DRIVEN (SUPER)WIND: IR COMPONENT

(CAN'T MISS 'EM, THEY'RE THAT BRIGHT!)

$5\ M_{sol} \lesssim$ MS mass $\lesssim 8\ M_{sol}$

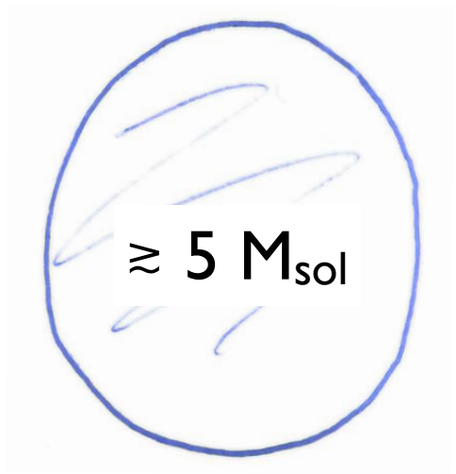


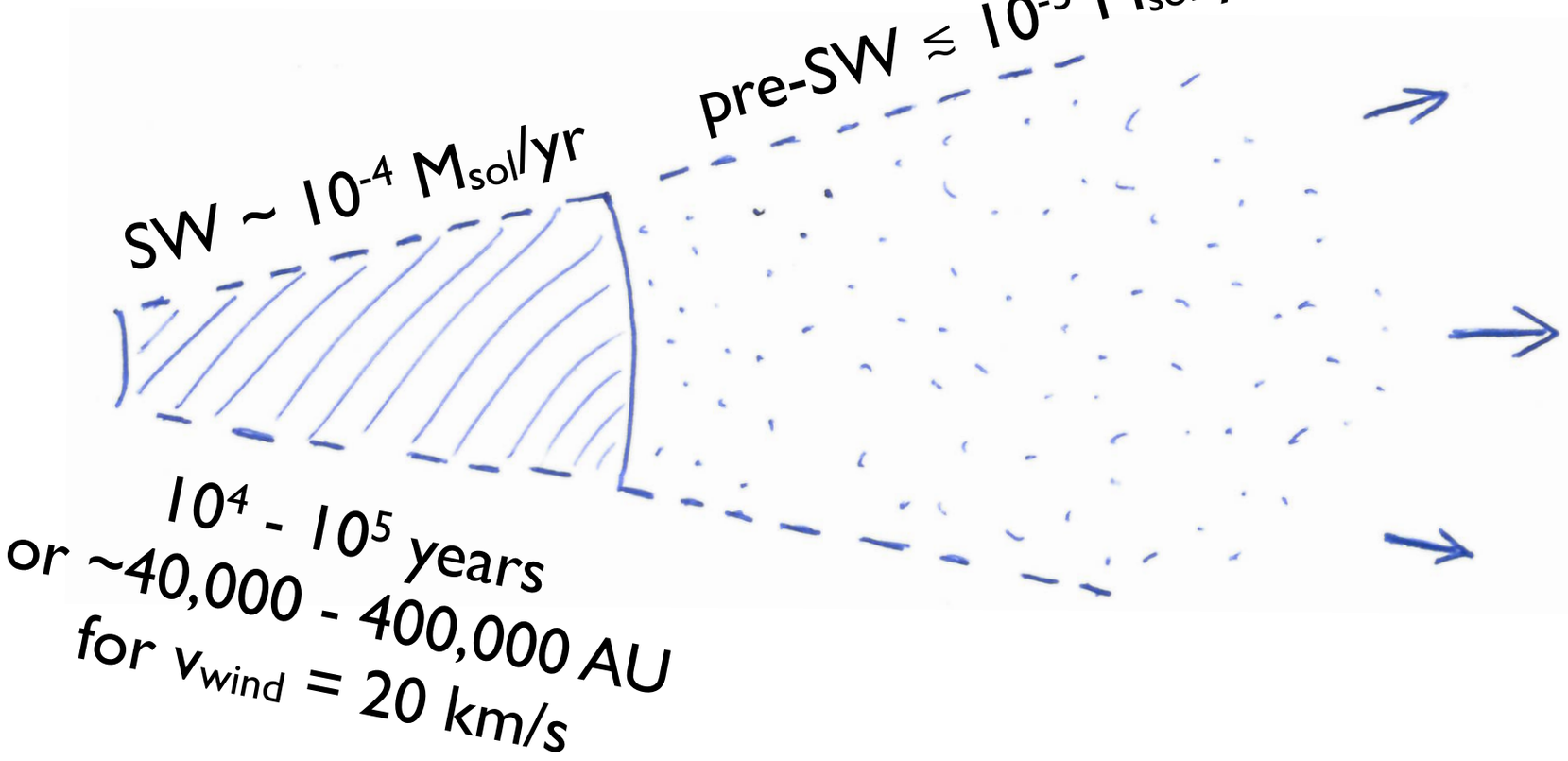
Thank you
B. de Vries


SW ~ 10-4 Msol/yr
pre-SW ≲ 10-5 Msol/yr
ISO SWS
Thank you
S. Hony
Herschel
PACS
Thank you
P. Royer
BRIGHT INDEED.
OH30.1-0.7
F_ν (Jy)
λ (μm)
10^3
10^2
10^1
10^0
10^1
10^2

DURATION OF THE SUPERWIND

(HAVE TO LOSE THOSE M_{SOL} OF STUFF!)





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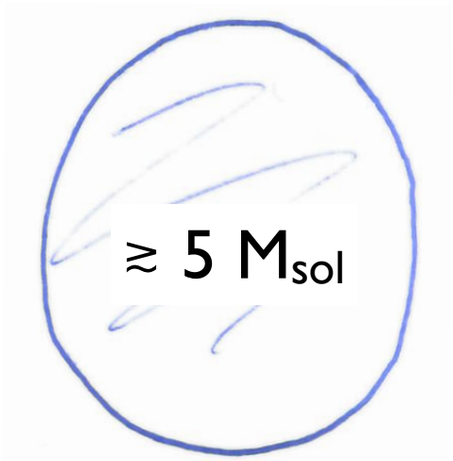
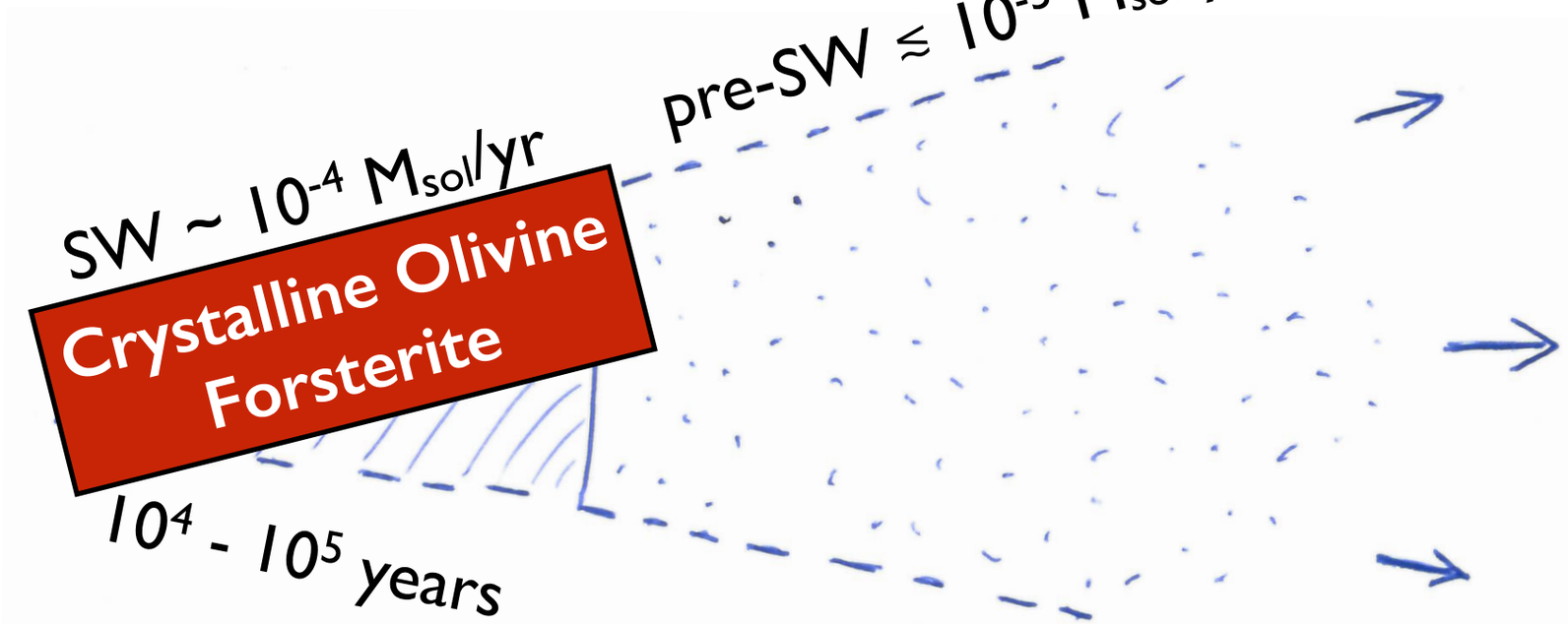
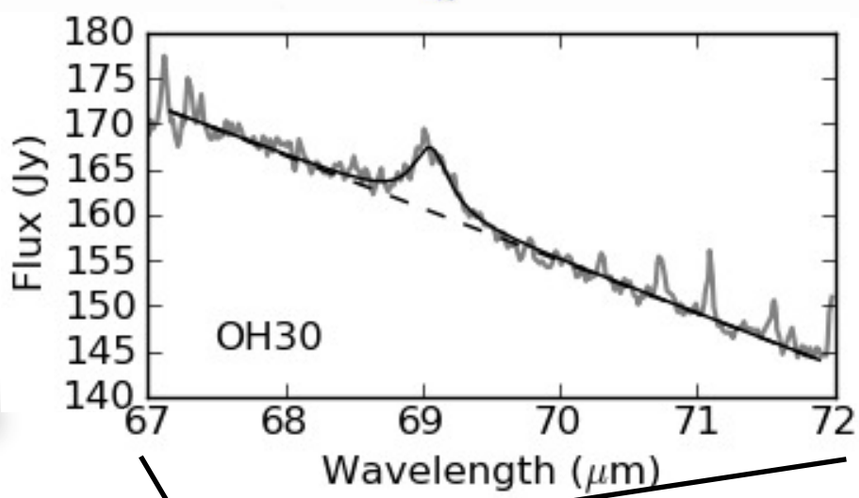


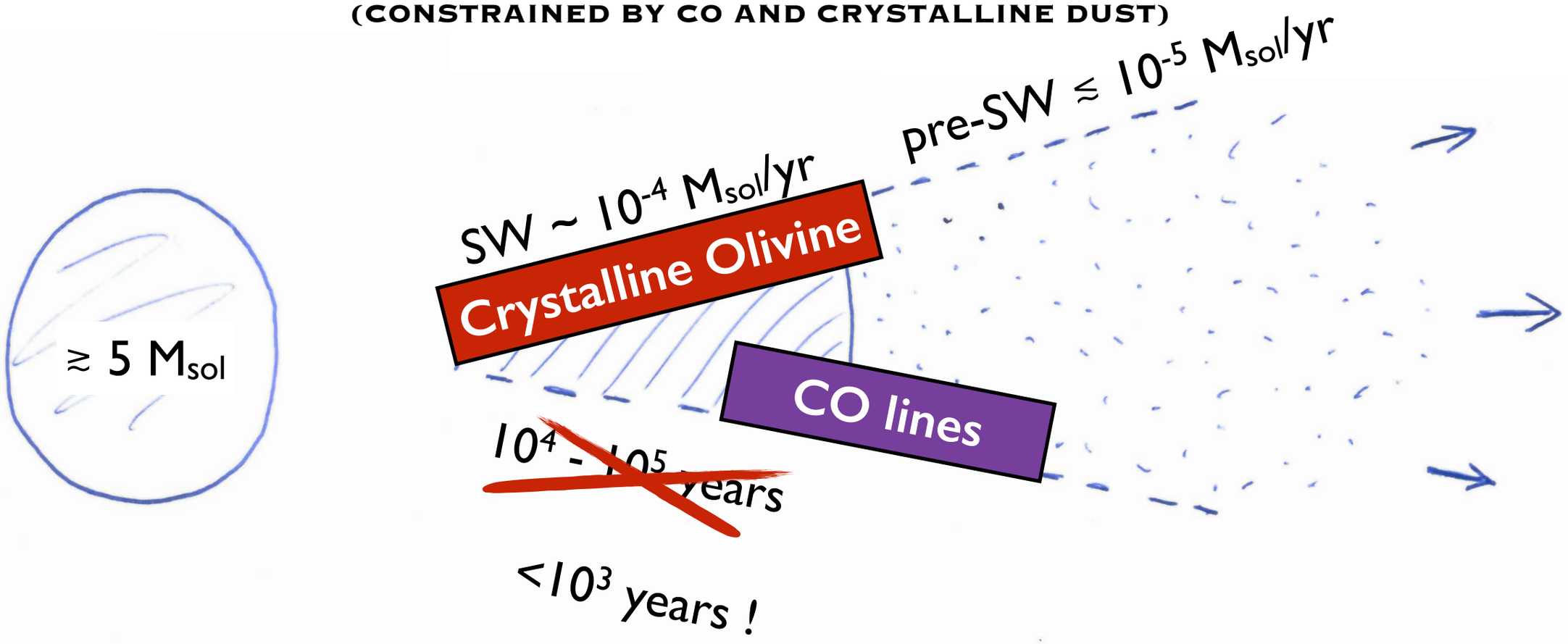


Amorphous Silicate
(Olivines and Pyroxenes)



SUPERWIND IS PROBLEMATICALLY SHORT

(CONSTRAINED BY CO AND CRYSTALLINE DUST)



According to:

de Vries et al. 2014

Justtanont et al. 2013

SUPERWIND IS PROBLEMATICALLY SHORT

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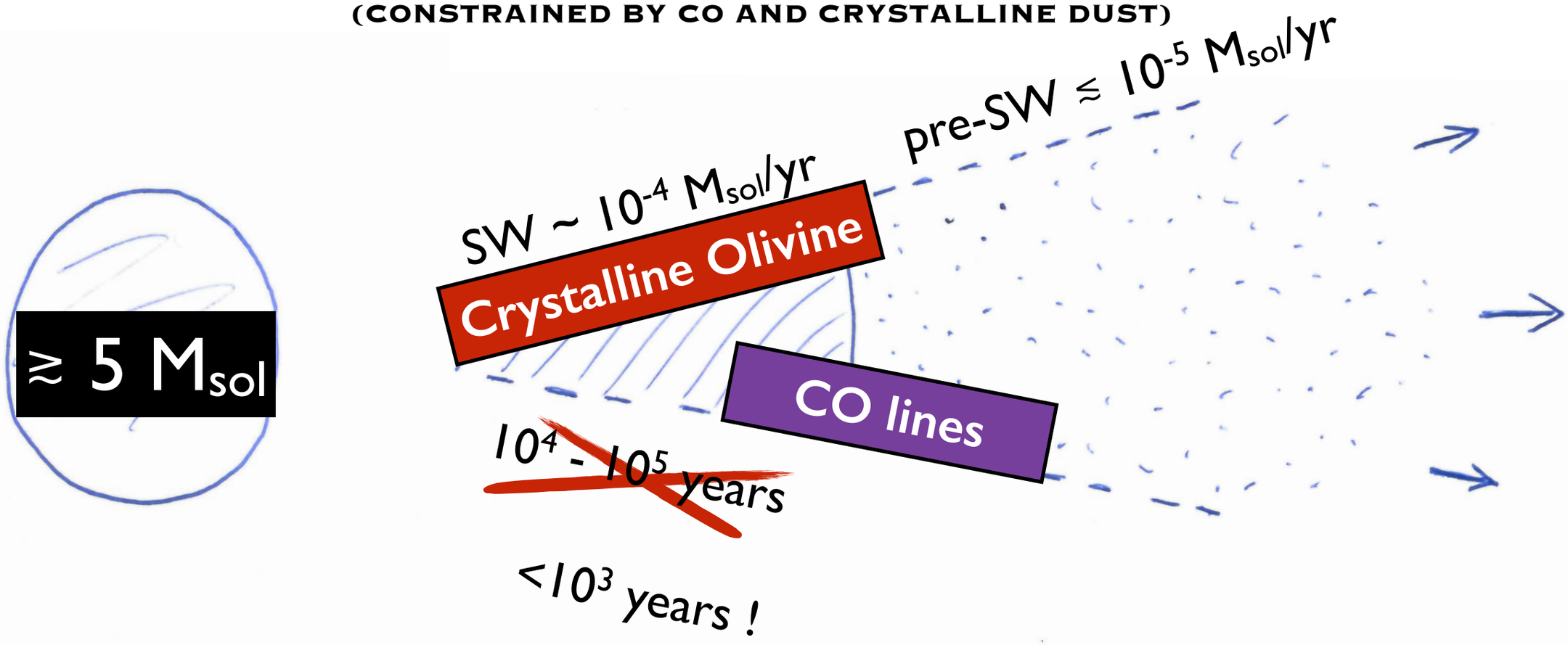
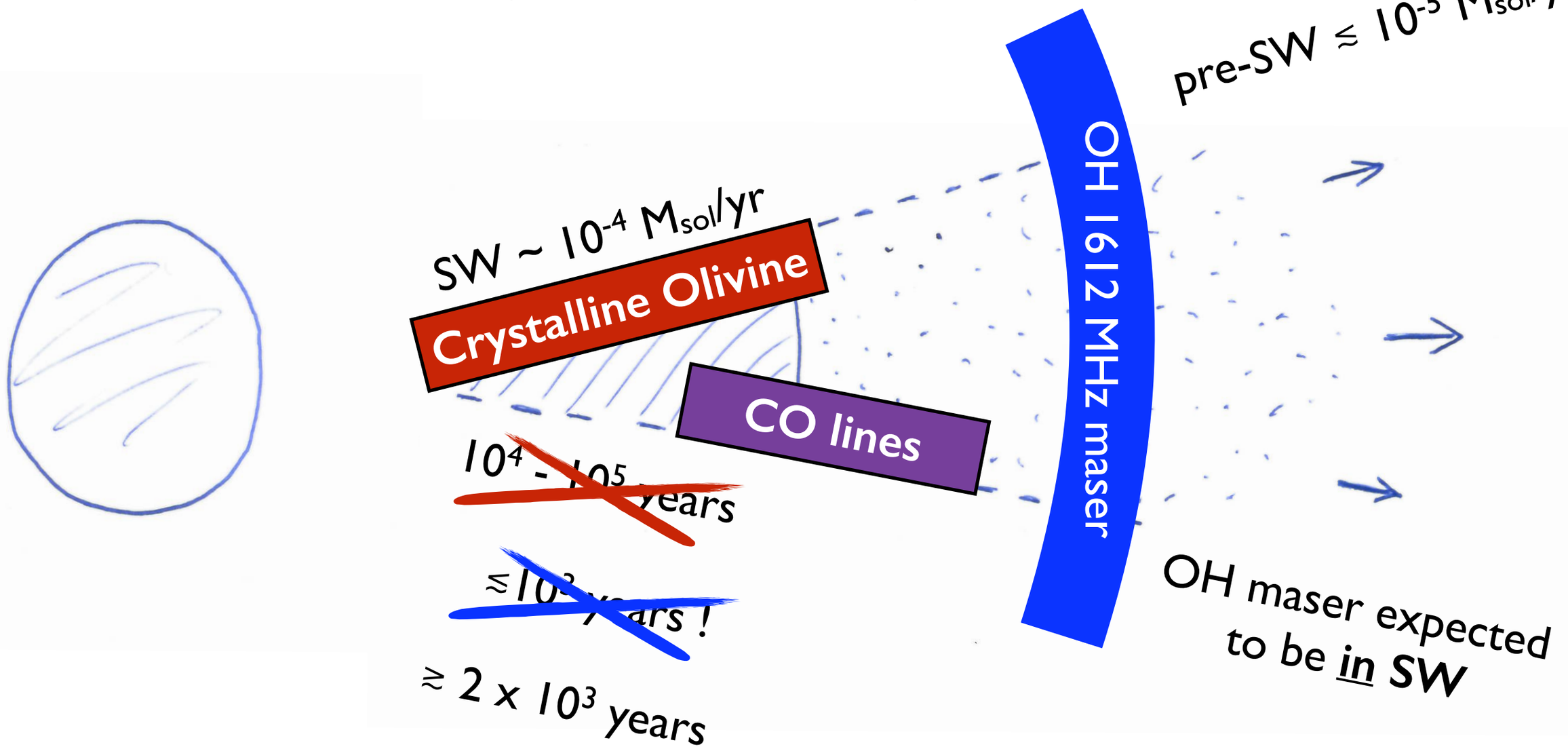


How do these stars lose at least 3 M_{sol} in one SW?

TOO SHORT A TIME!

OH MASERS: SUPERWIND CANNOT BE THAT SHORT

(CONTRADICTION MUCH?!)



According to:

Engels et al. 2015

CHOOSE NOW!

Camp Short: $\lesssim 10^3$ years

According to:

de Vries et al. 2014

Justtanont et al. 2006, 2013

Camp Long: $\gtrsim 2 \times 10^3$ years

According to:

Engels et al. 2015

Camp Short: $\lesssim 10^3$ years

According to:

de Vries et al. 2014

Justtanont et al. 2013

Problems:

OH maser outside SW?

Camp Long: $\gtrsim 2 \times 10^3$ years

According to:

Engels et al. 2015

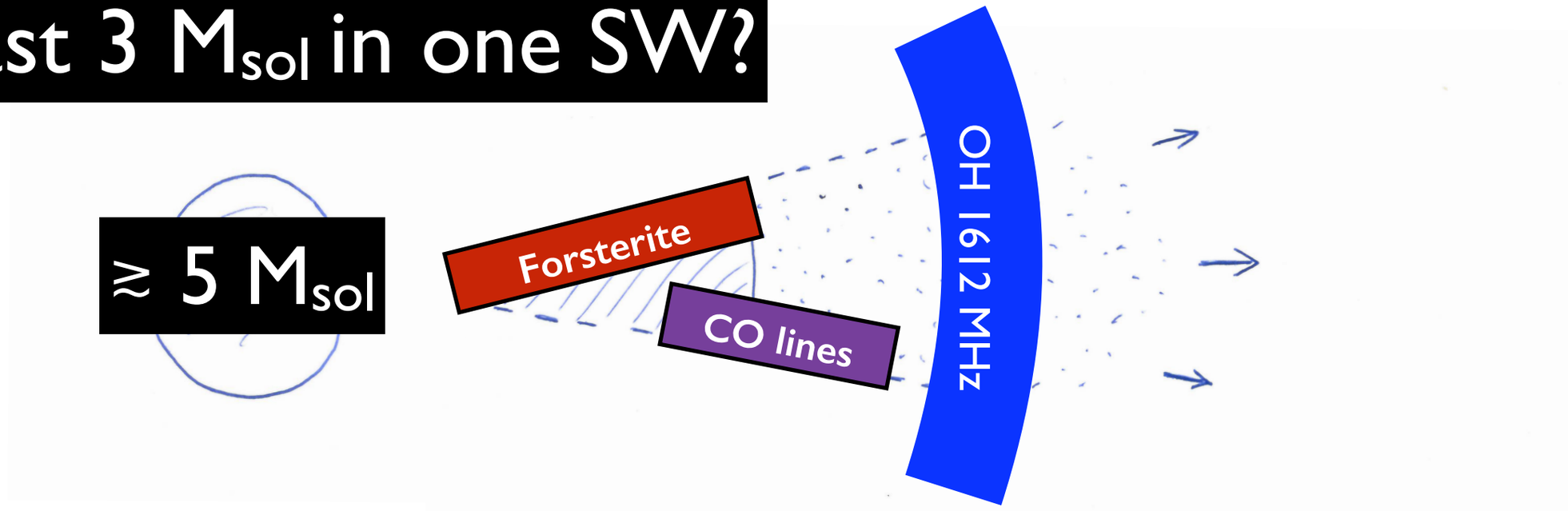
Problems:

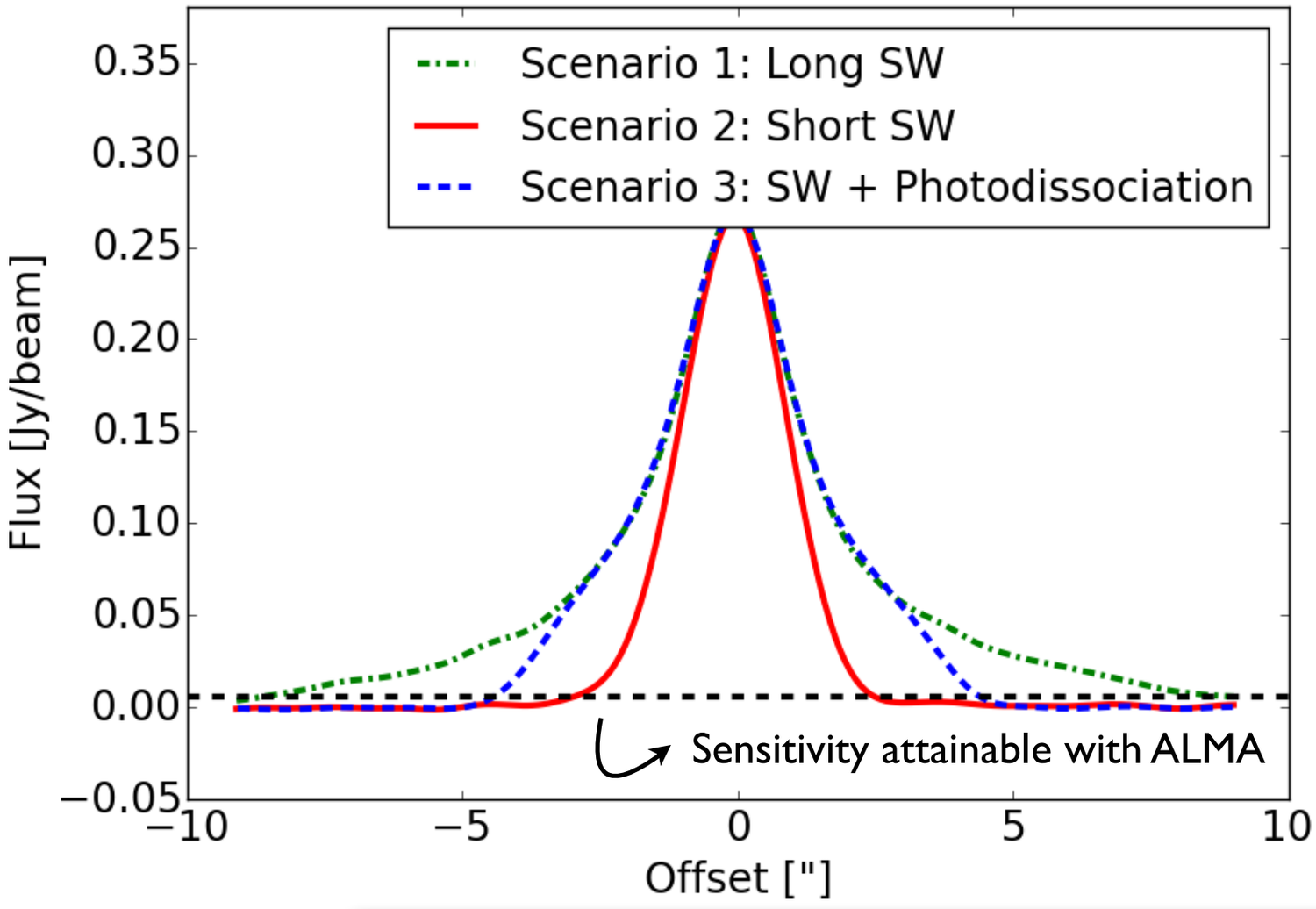
Forsterite destruction?

CO destruction?

(enhanced photodissociation?)

How do these stars lose at least 3 M_{sol} in one SW?



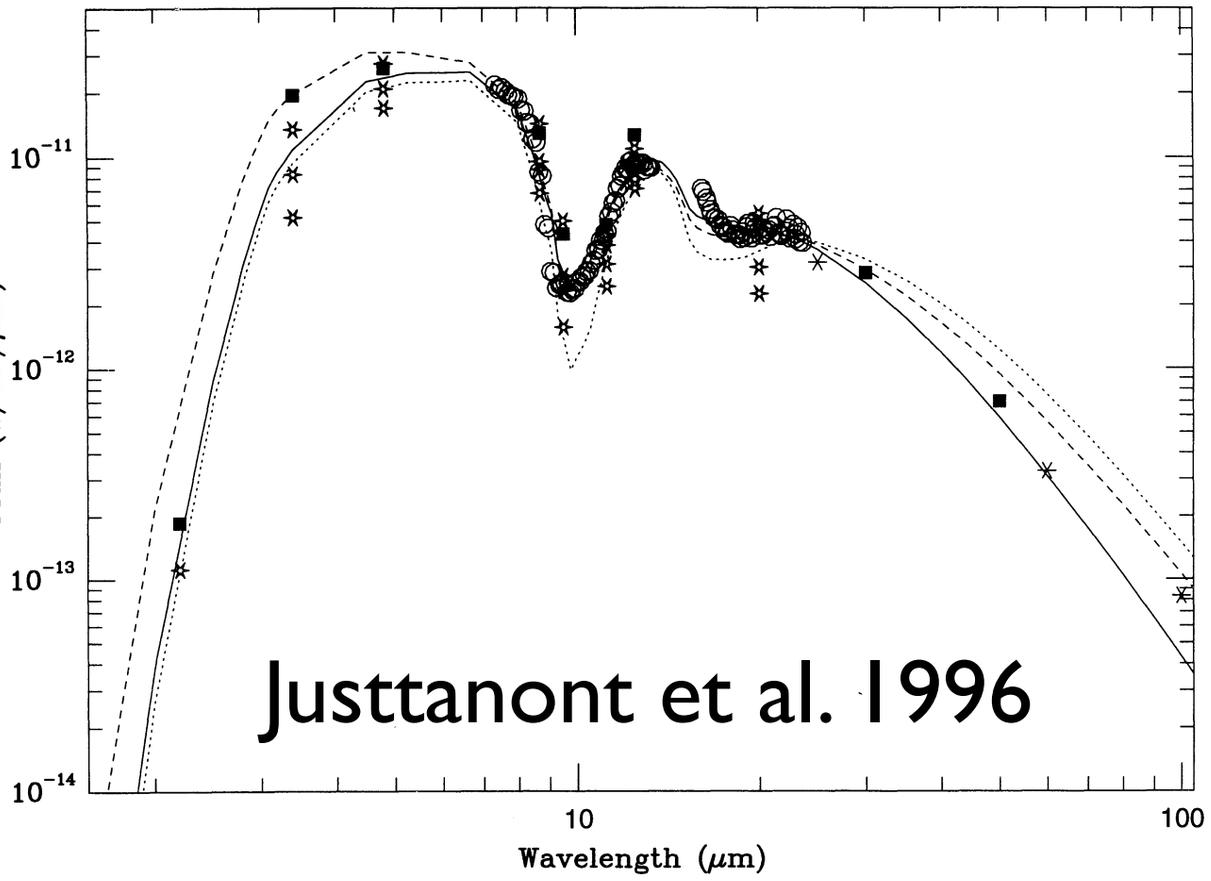


Cuts through
CO J=1-0
ALMA
simulations
for OH30.1-0.7

SUCH DEADLINE, WOW!

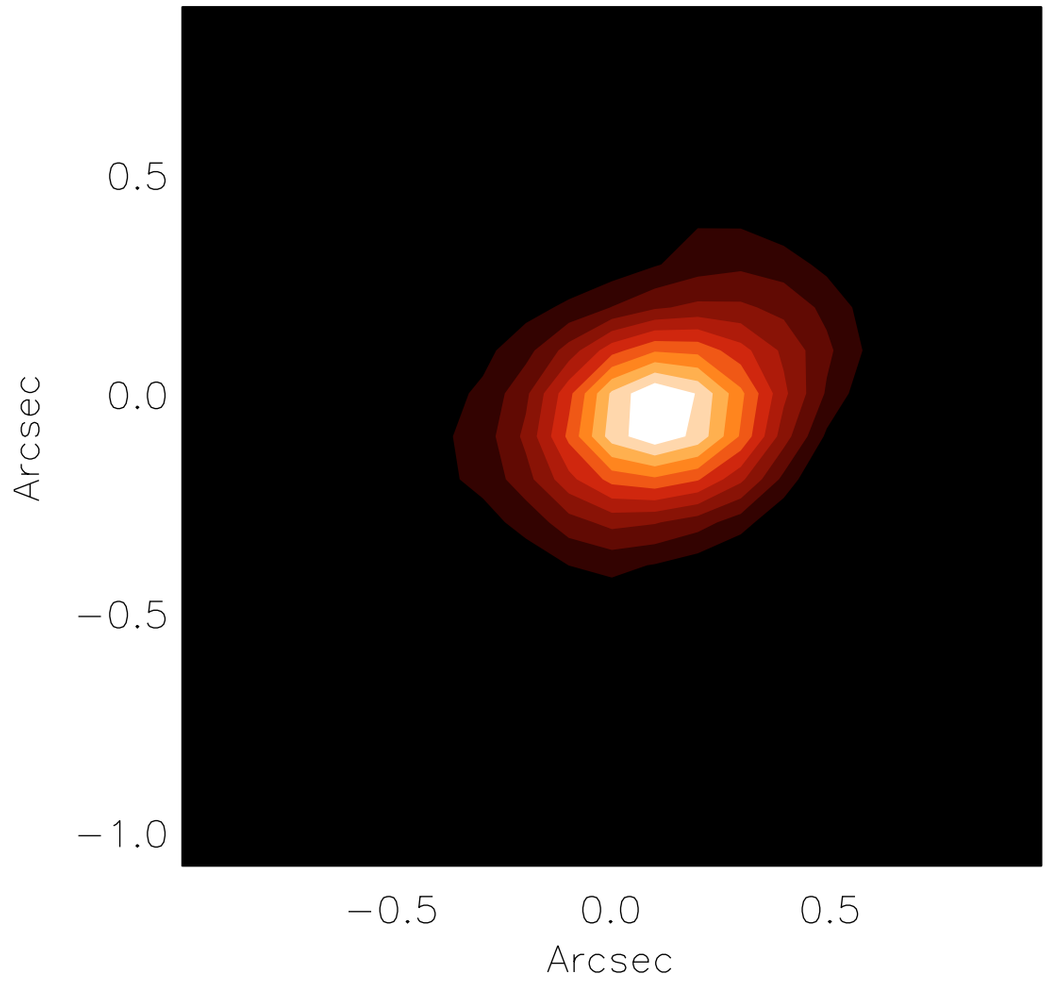
ADDITIONAL CONSTRAINTS: DUST EMISSION

(POPULAR GUY IN SCHOOL: OH26.5+0.6 ...)



Justtanont et al. 1996

Superwind duration: 150 years



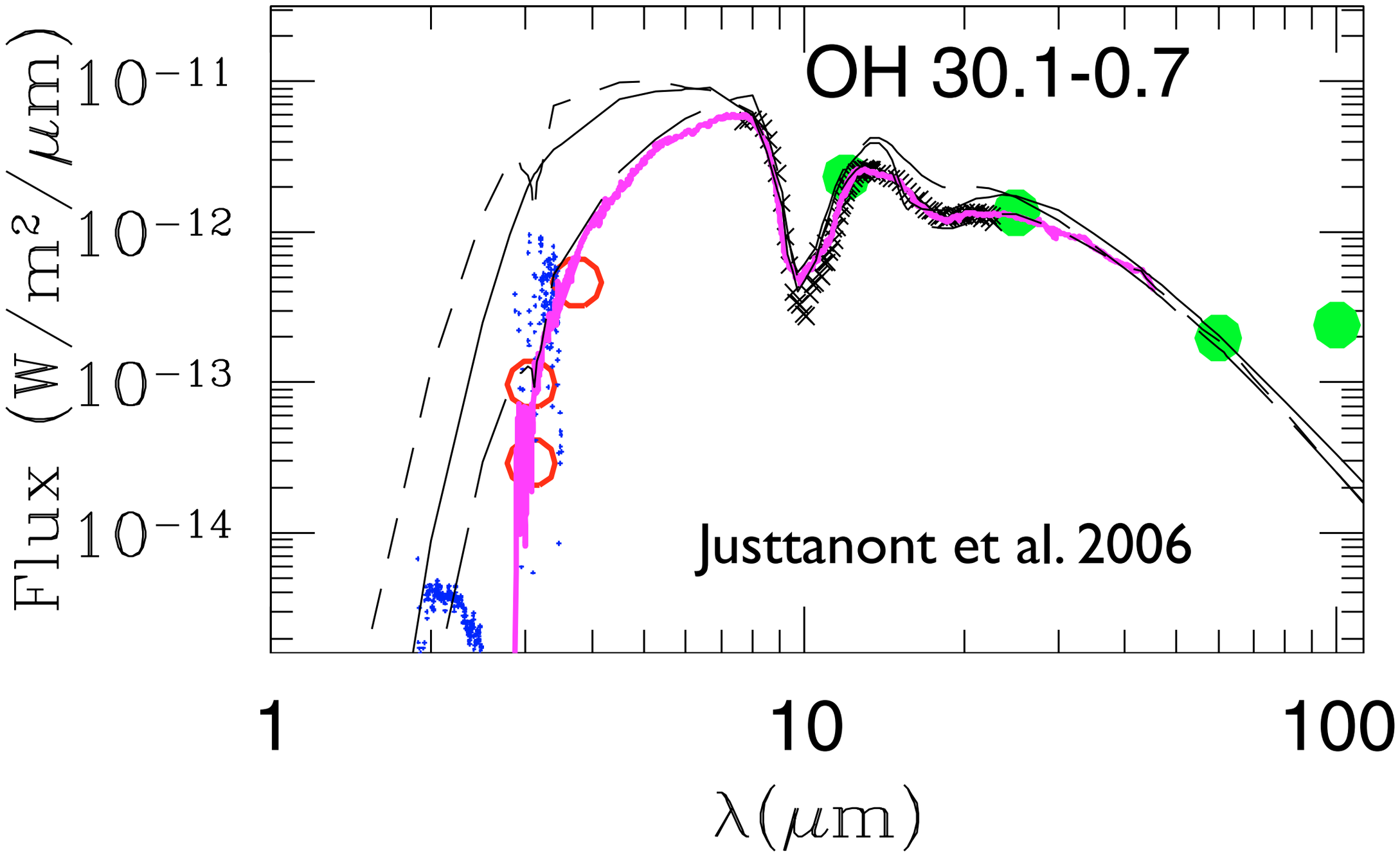
Chesneau et al. 2005

MIDI (UT - VLTI) images:
1) Short SW works!
2) Asymmetries

WAITING TO GET ALMA TIME... MEANWHILE!

THE SED OF OH30.1-0.7 — AS OF 2006

(MOVE OVER, OH26.5+0.6, NEW KID IN TOWN!)

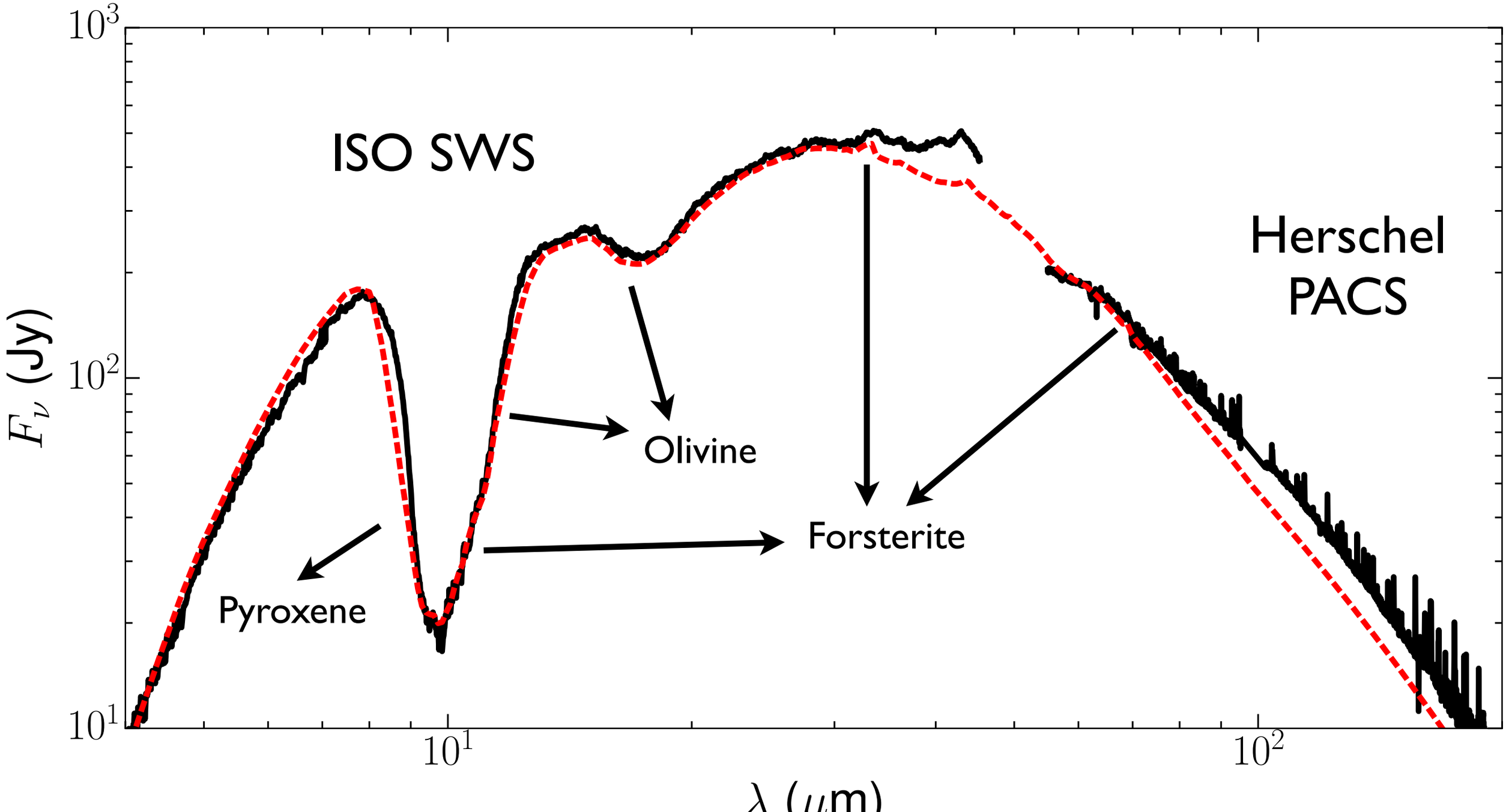


DUST RADIATIVE TRANSFER

(WE CAN DO MUCH BETTER NOW)

WORK-IN-PROGRESS WARNING

Mineralogy must be understood to constrain the superwind duration **reliably** from SEDs

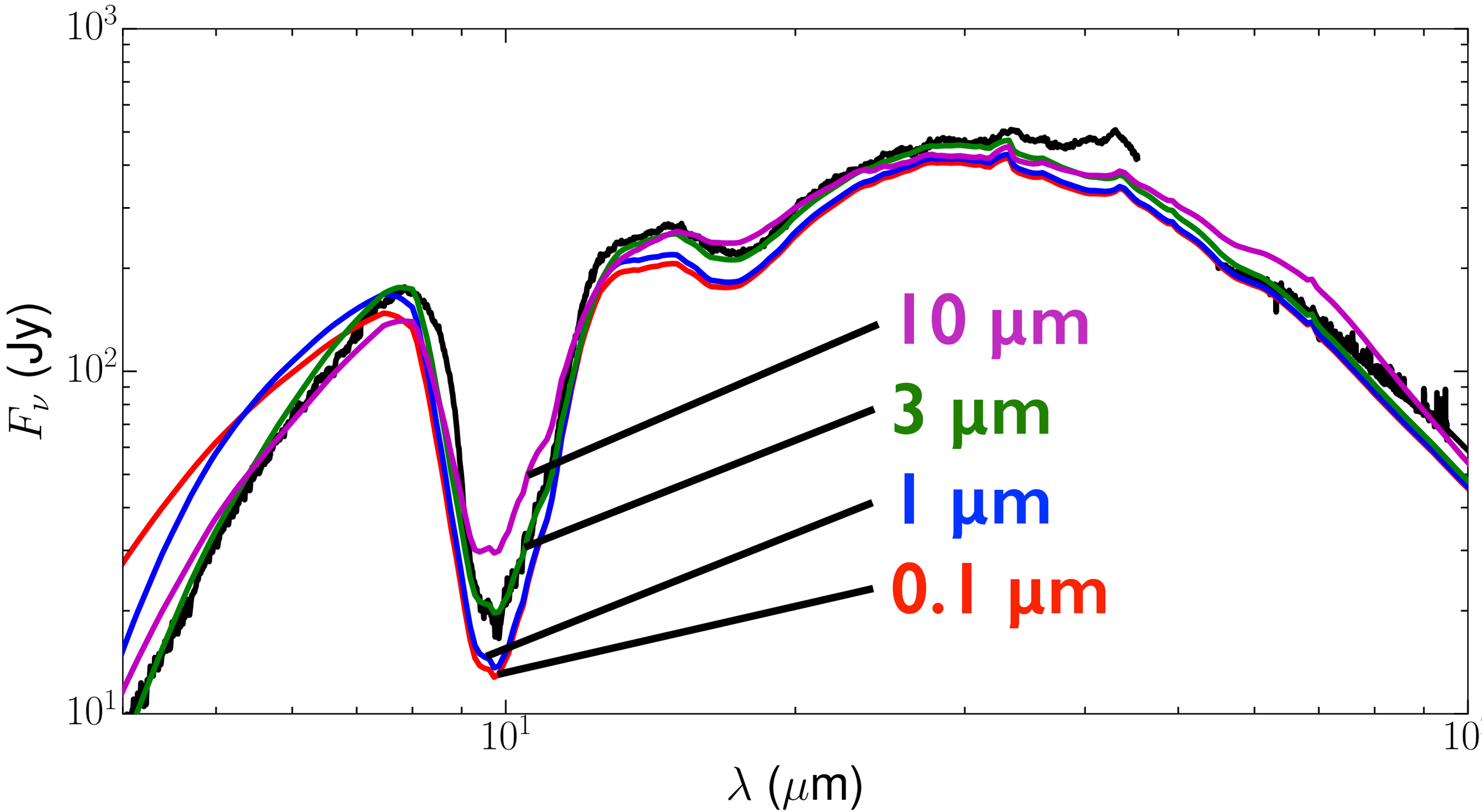


MINERALOGY: GRAIN SIZE

(DOWN THE RABBIT HOLE)

Grain size distribution: MRN,

with minimum grain size: 0.01 μm



MINERALOGY: METALLIC IRON

(DOWN THE RABBIT HOLE)

Metallic Fe contribution to dust composition

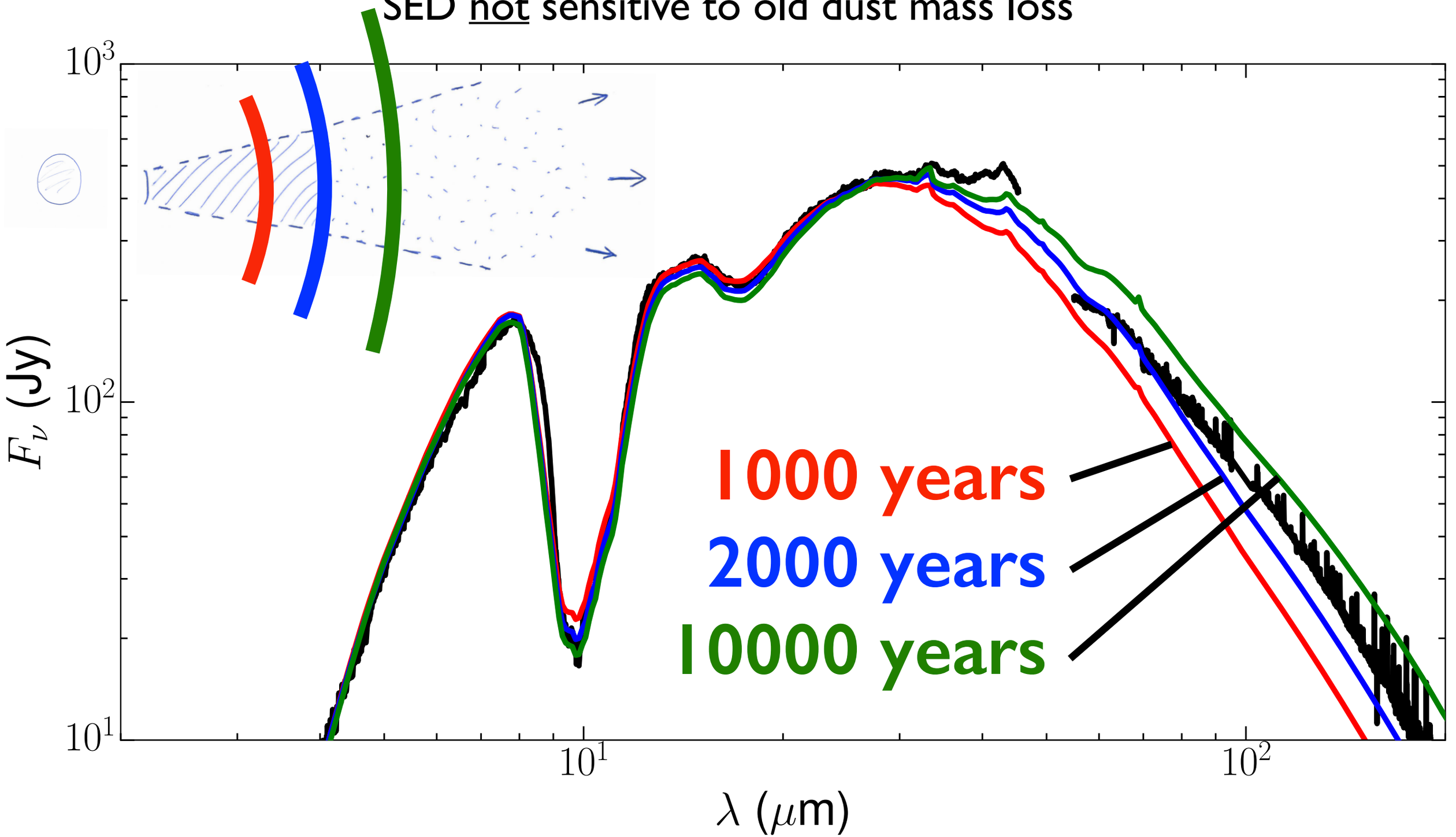
"Continuum opacity source"

FAR-INFRARED FLUX VS. SW DURATION

(SED MODELLING ON STEROIDS)

10 μm absorption sensitive to SW duration

SED <u>not</u> sensitive to old dust mass loss



(There is no such thing as good or bad)

SED

OH26.5+0.6 — 150 years

OH30.1-0.7 — 2000 years

Studies do not necessarily disagree.
Range in SW durations: ≲ 2 x 10^3 years?
Require SED sample study!

CO lines

Forsterite

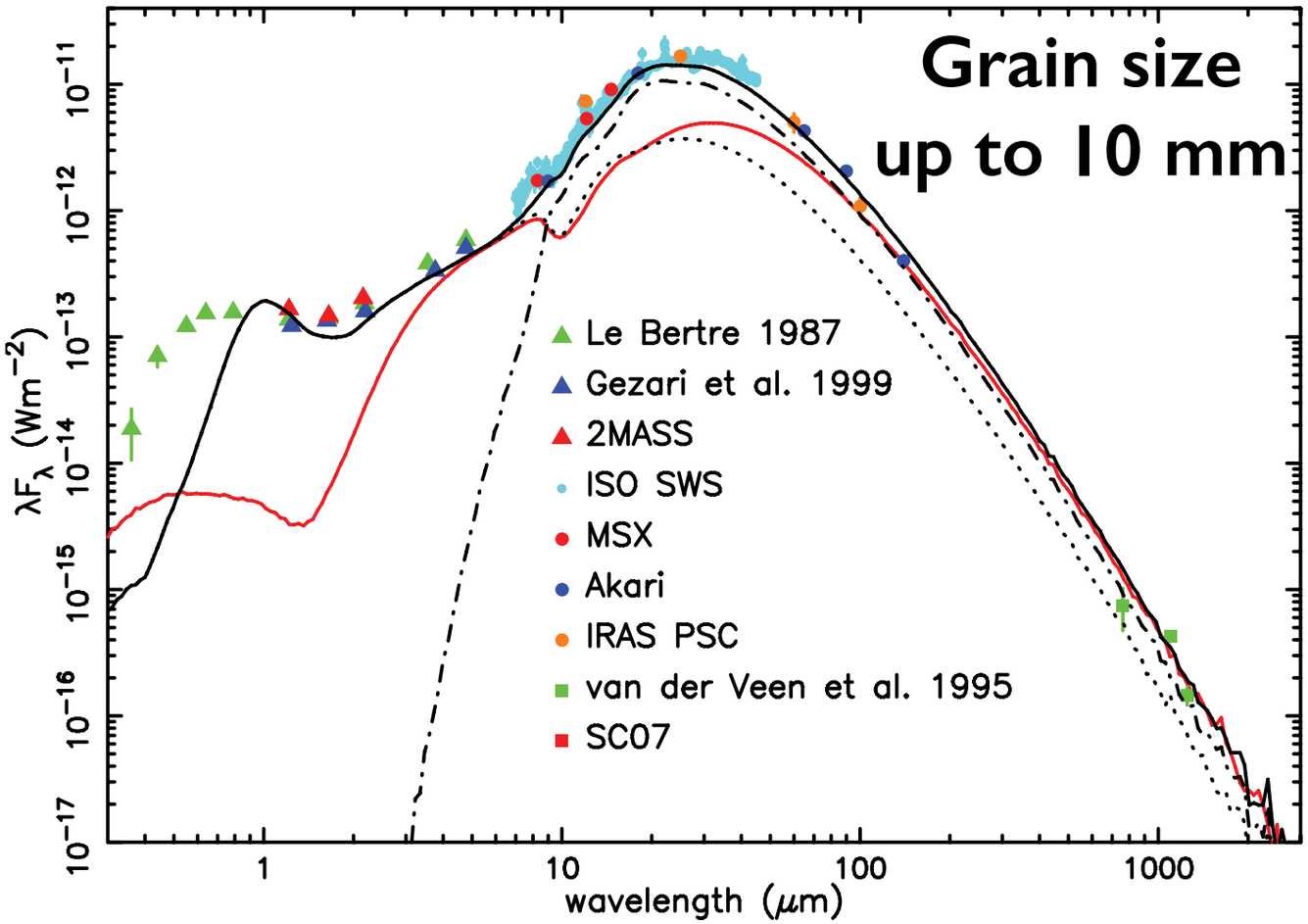
OH 1612 MHz

Superwinds remain… problematically short

LINK TO EXTREME POST-AGB SHELLS

(THESE ARE ACTUALLY REAL)

IRAS 18276-1431:
high-density torus,
equivalent with
10^{-2} M_{sol}/yr for 300 years



MURAKAWA ET AL. 2013

THANK YOU

QUESTIONS?

16h05: ***Shazrene Mohamed*** 3D models of stellar wind interaction symbiotic

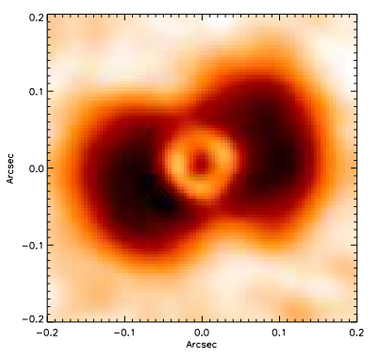
16h30: ***José Groh*** Probing mass loss at the end stages of massive s evolution

16h55: ***Robin Lombaert*** The problematically short superwind of OH/IR s

❖ 17h30: Welcoming Cocktail (wine & cheese)

↳ **IT'S TIME!**

(BUT IN FACT A NOD TO OLIVIER'S WORK)



Chesneau et al. 2012