Two-dimensional modeling of massive binary interaction in Eta Car

(Groh et al. 2010a, ApJL 716, 223)
(Groh et al. 2010b, A&A 517, 9)
(Groh et al. 2011, in preparation)

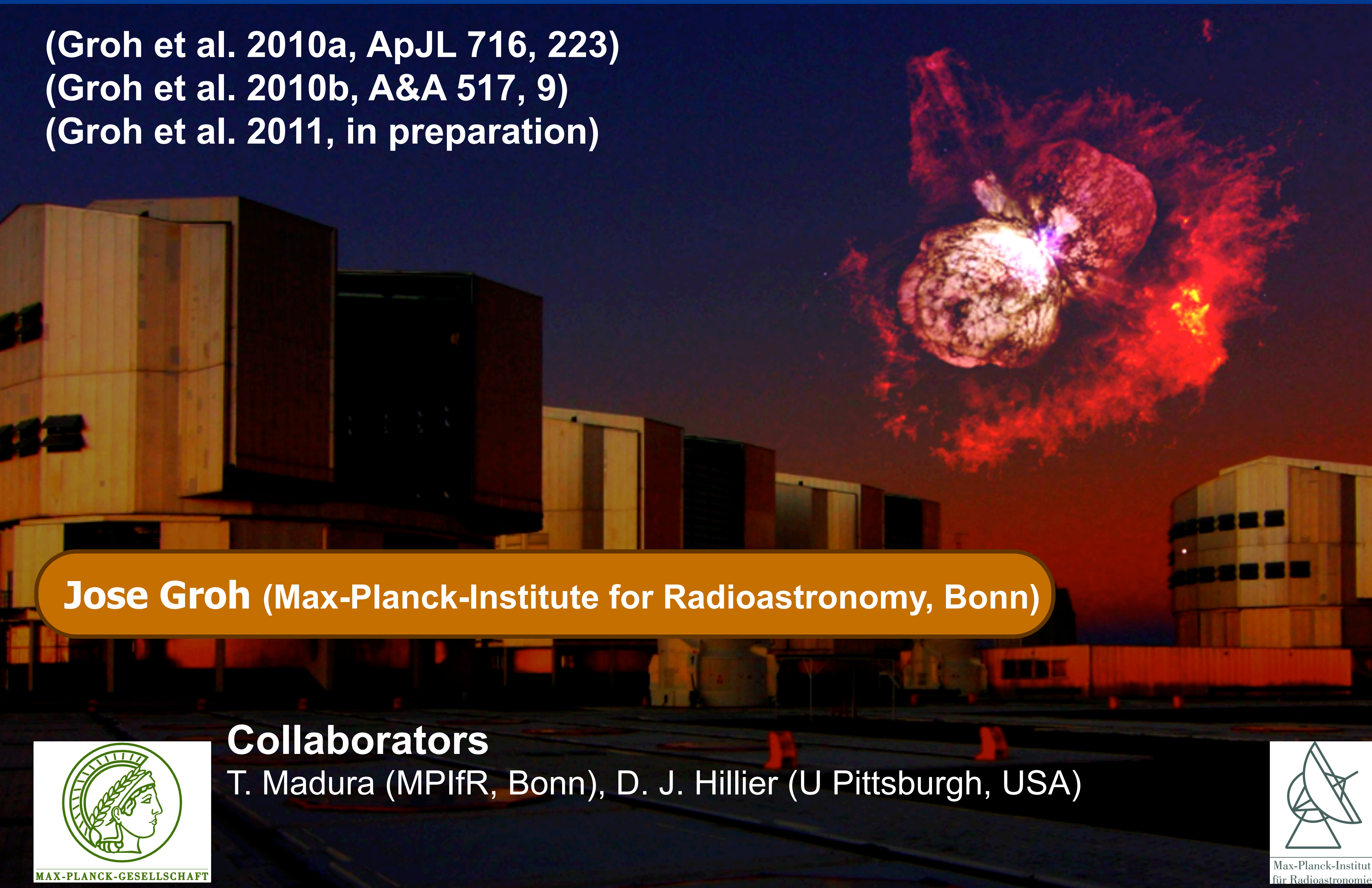

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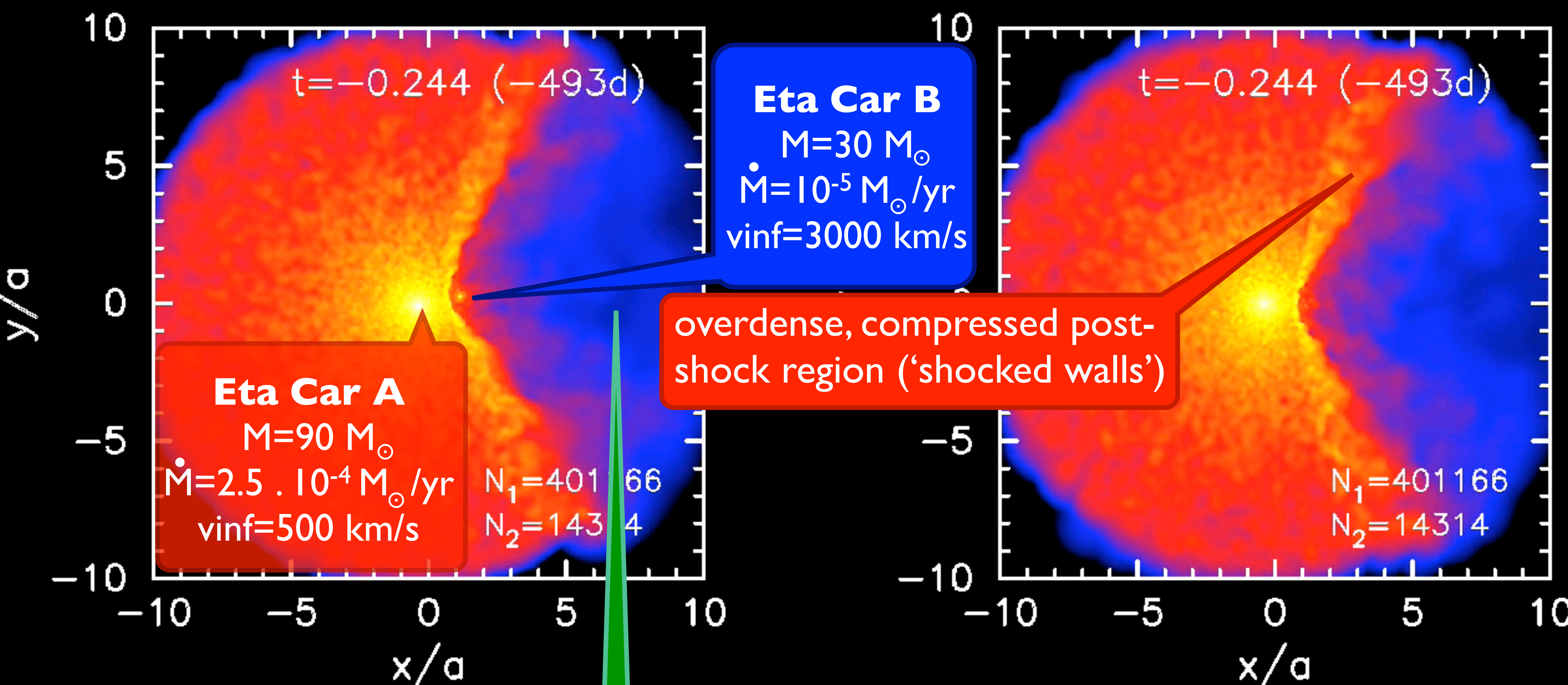
Image credits: VLTI (ESO), Eta Car (N. Smith, NASA)

I.) Effects of binarity in Eta Car

Changes in the density structure of the primary wind

Density cuts from 3D hydrodynamical SPH simulations of the Eta Car binary system (Okazaki et al. 2008): orbital period P=5.54 yr, eccentricity e=0.9.



Eta Car B
M=30 $M_\odot$
$\dot{M}=10^{-5}$ $M_\odot$/yr
vinf=3000 km/s

Eta Car A
M=90 $M_\odot$
$\dot{M}=2.5 \cdot 10^{-4}$ $M_\odot$/yr
vinf=500 km/s

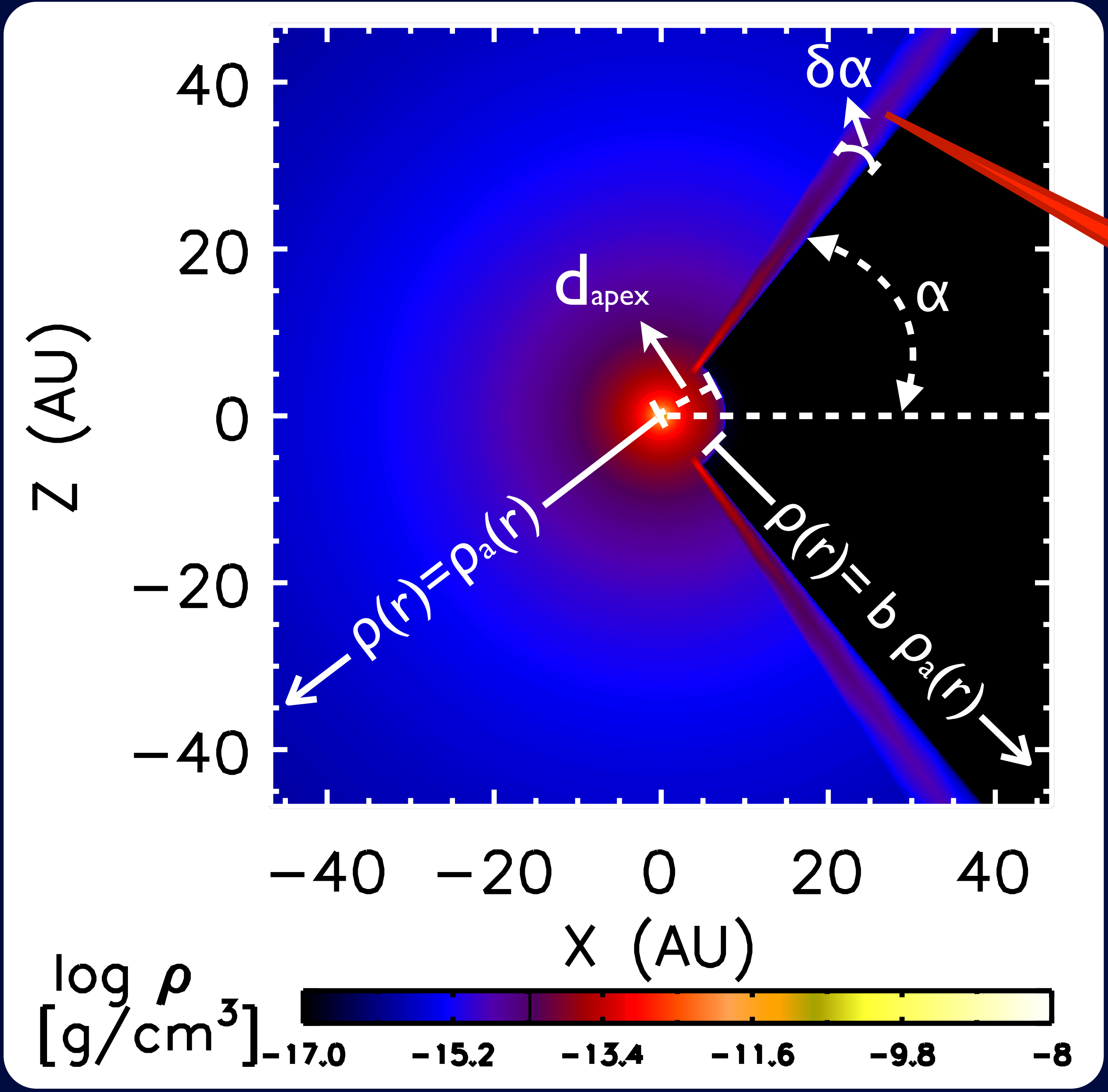
overdense, compressed post-shock region ('shocked walls')

Fast, thin wind of the companion produces a **cavity** in the slow, dense wind of the primary star (Pittard & Corcoran 2002, Okazaki et al. 2008, Parkin & Pittard 2009).

Movie: courtesy of Atsuo Okazaki (Hokkai-Gakuen University, Japan)

2.) An extension of the 2D radiative transfer code of Busche & Hillier (2005) to analyze massive binary systems

- We modify the 1-D density structure of the wind of the primary star to create a cavity and dense interacting-region walls, according to the orbital and wind parameters (following Canto et al. 1996 or your favorite hydro simulation).

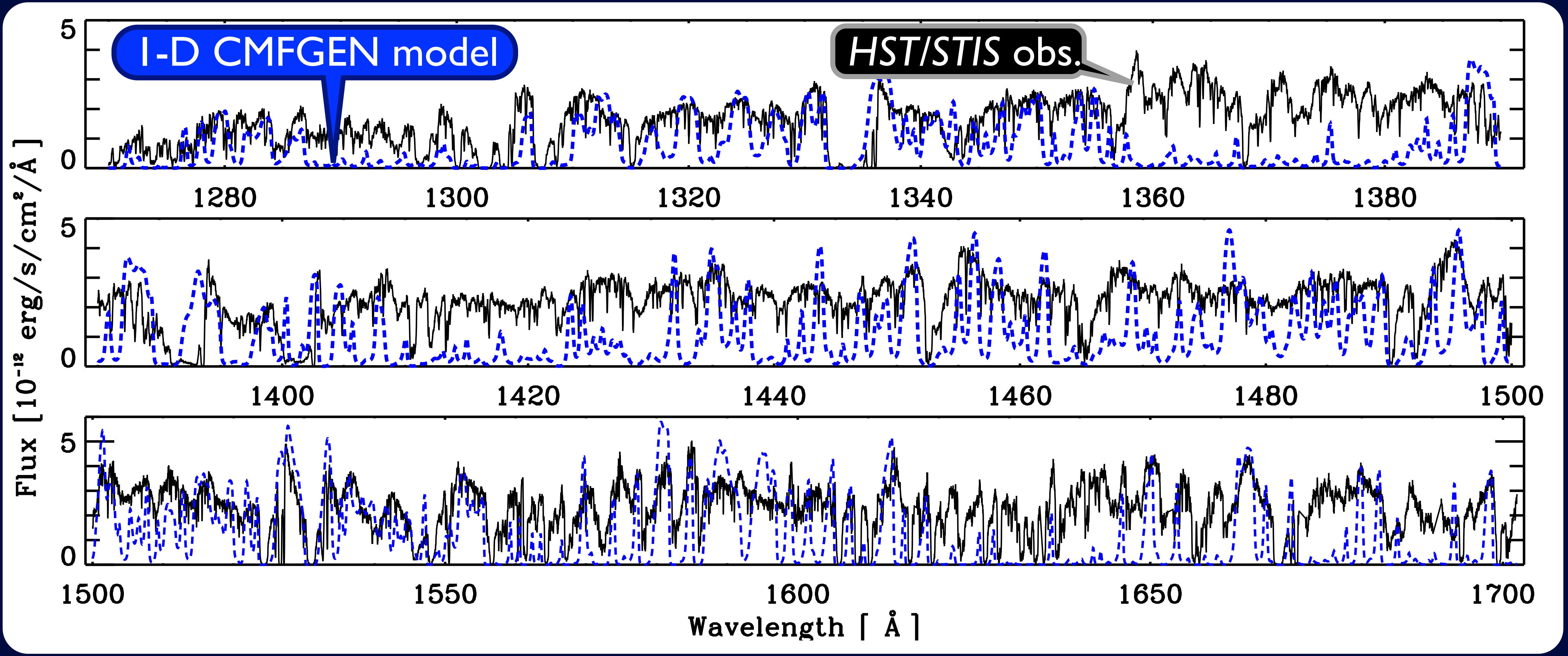


from mass conservation:
$f\alpha = [1 - \cos(\alpha)]/[\sin(\alpha)\delta\alpha]$

3.) Effects of the companion star on the spectrum of Eta Car

Ultraviolet spectrum around apastron (ϕ= 0.6)

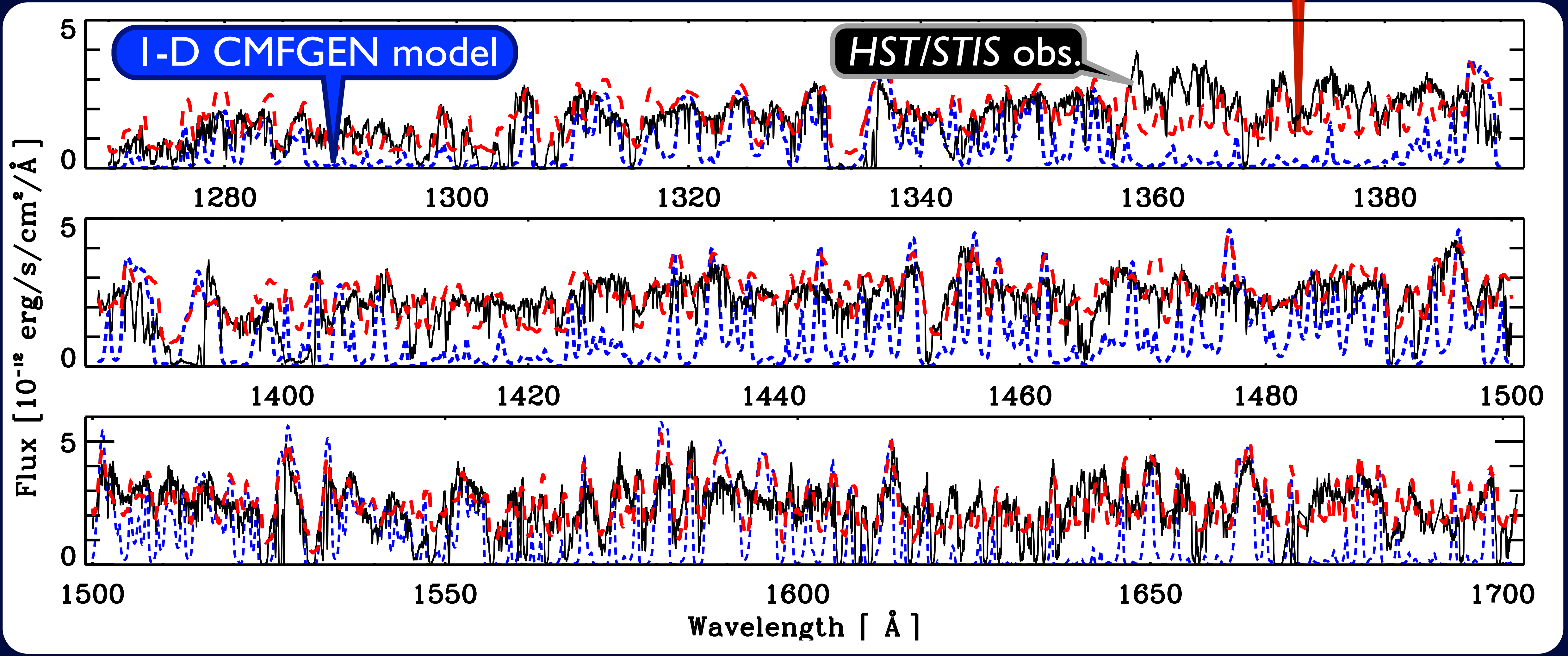
Most of the ultraviolet spectrum of Eta Car is dominated by Fe II transitions.



3.) Effects of the companion star on the spectrum of Eta Car

Ultraviolet spectrum around apastron (ϕ= 0.6)

2D model with i=41° and ω=270° provides a much better fit to the ultraviolet spectrum because it yields a much weaker Fe II absorption spectrum



3.) Effects of the companion star on the spectrum of Eta Car

Fe II absorption formation region

Without a cavity:

1-D model overestimates the amount of Fe II absorption

Including a cavity:

may cause reduced Fe II absorption depending on the viewing angle