

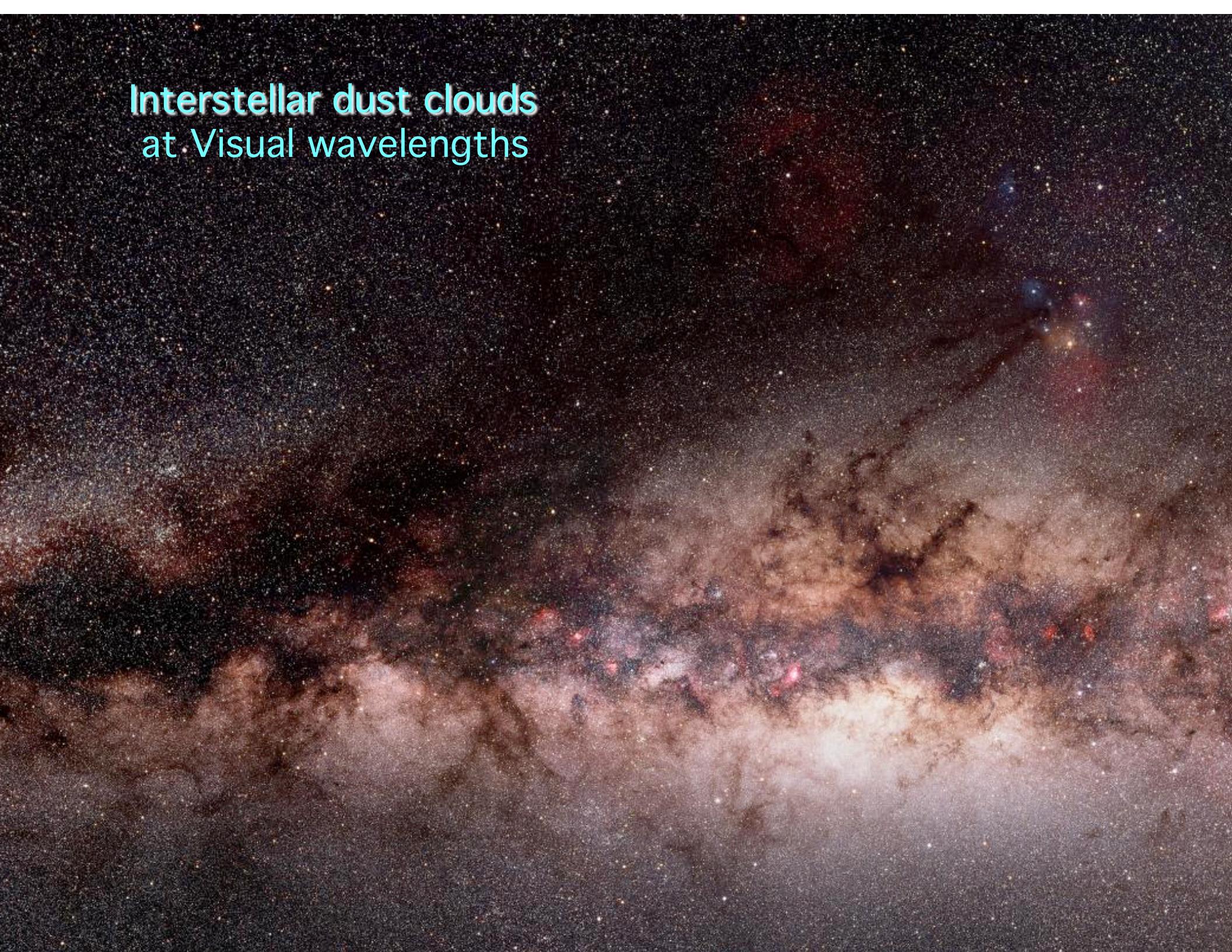
Studies of Star Formation At Apache Point Observatory

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Interstellar dust clouds at Visual wavelengths



Interstellar dust clouds (Planck satellite)
far-infrared & sub-mm



Star Formation

Shrink size by 10^7 ; increase density by $\times 10^{21}$!

- Giant Molecular Cloud Core

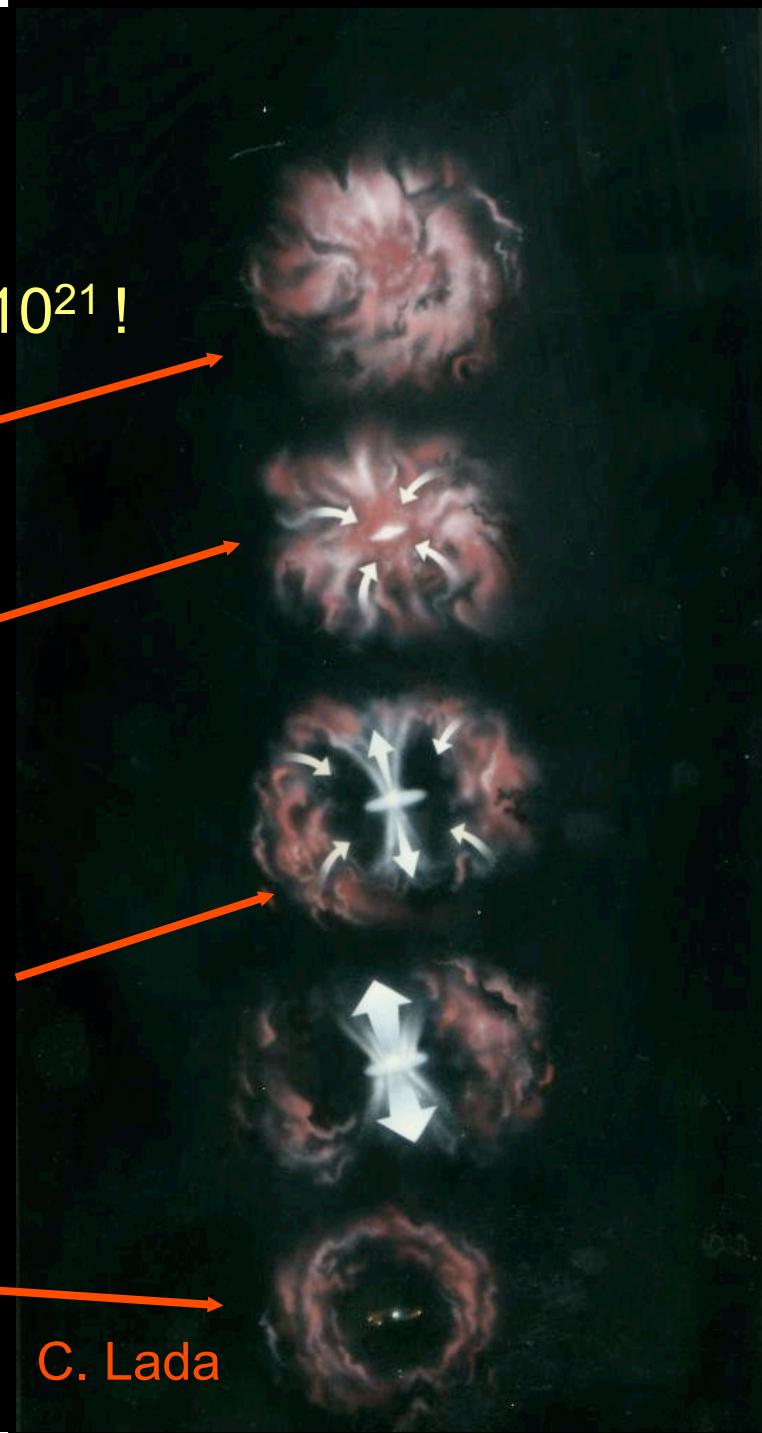
Raw material for star birth

- Gravitational Collapse

- Rotating disks & Magnetic Fields

Outflows

- Planets



C. Lada

Young, Massive Star: Cepheus A

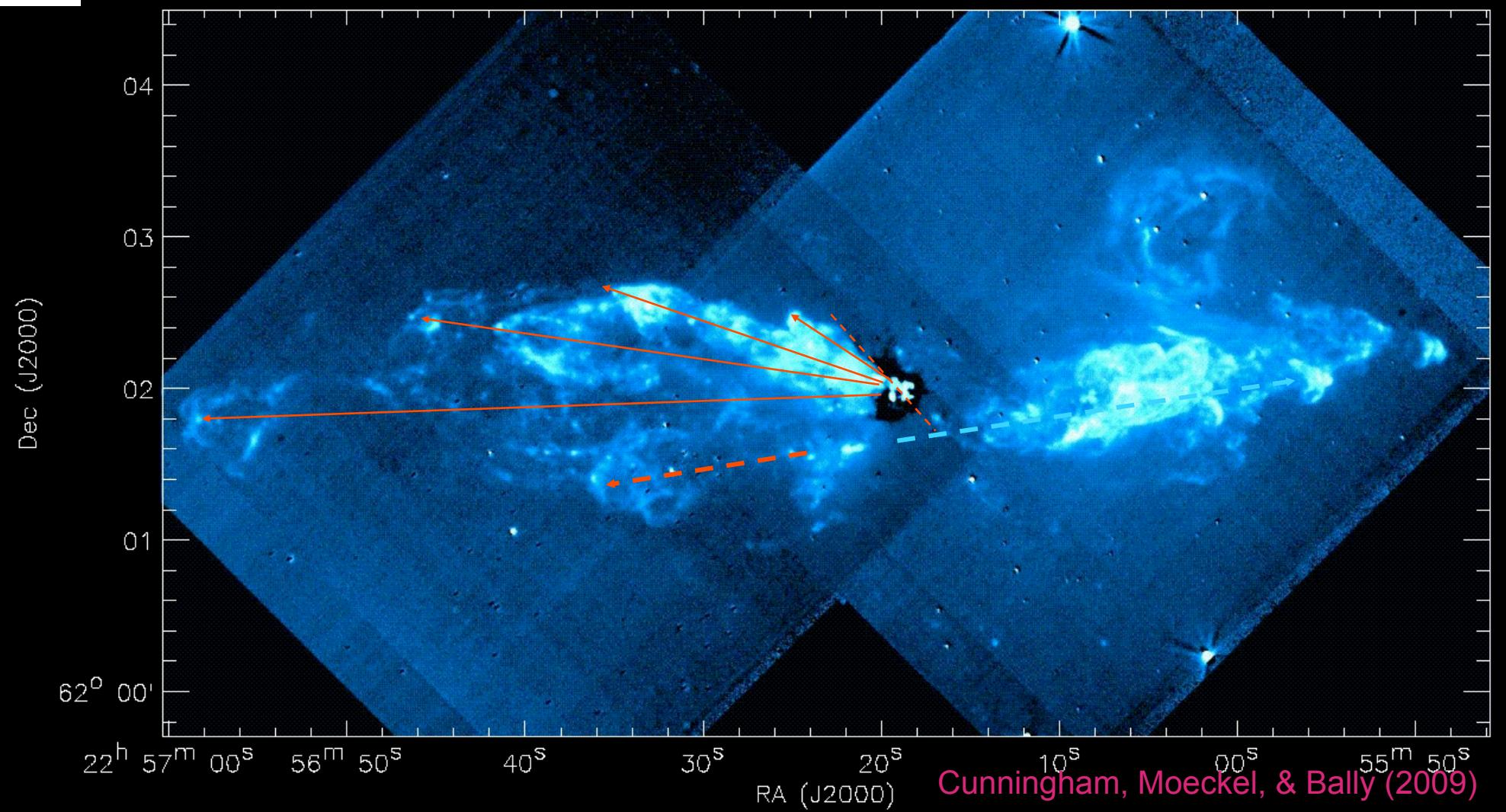
Near infrared: (1.2, 1.6, 2.2 micro-meters)

shock-waves seen in molecular hydrogen

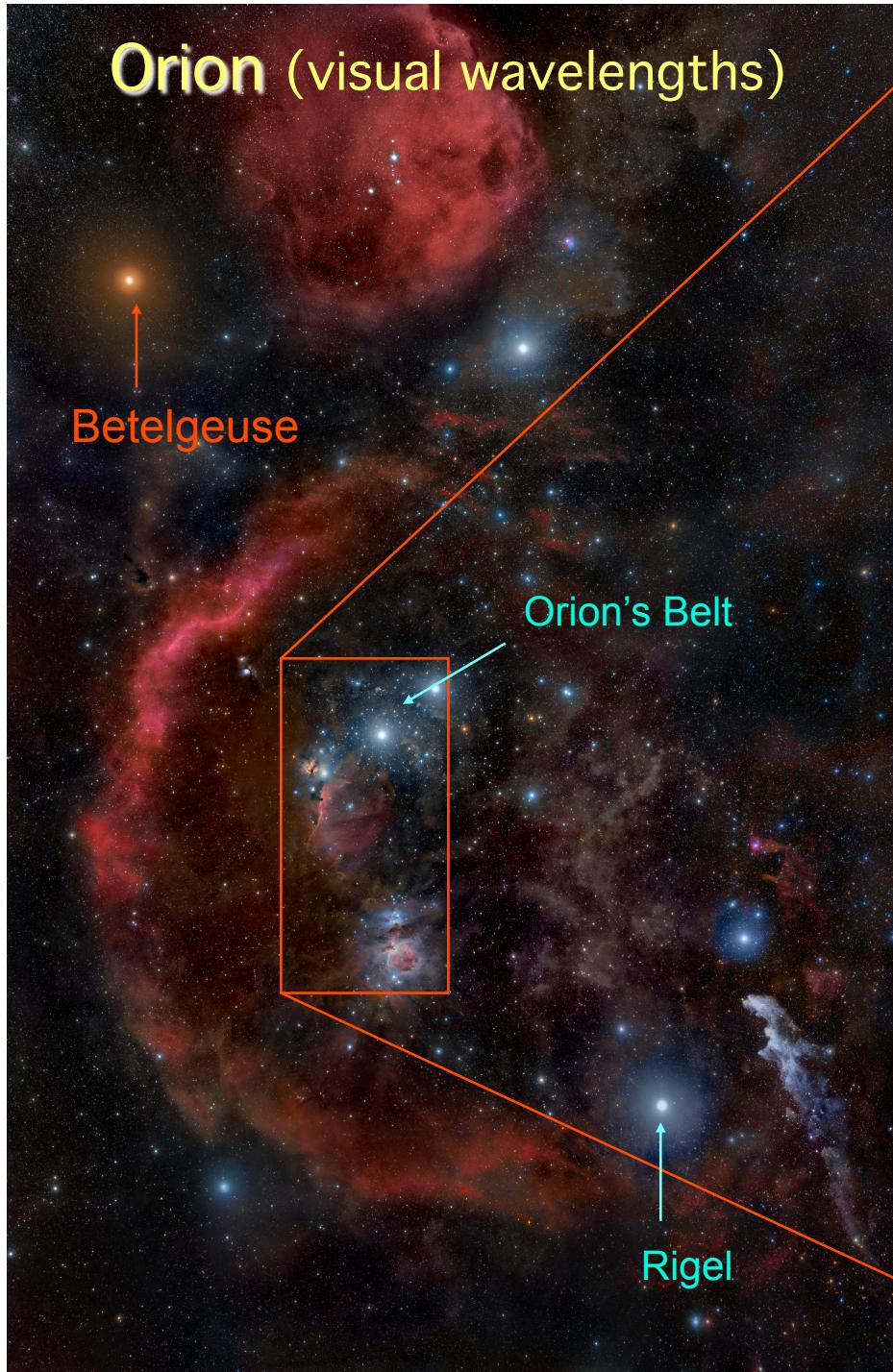


Cunningham, Moeckel, & Bally (2009)

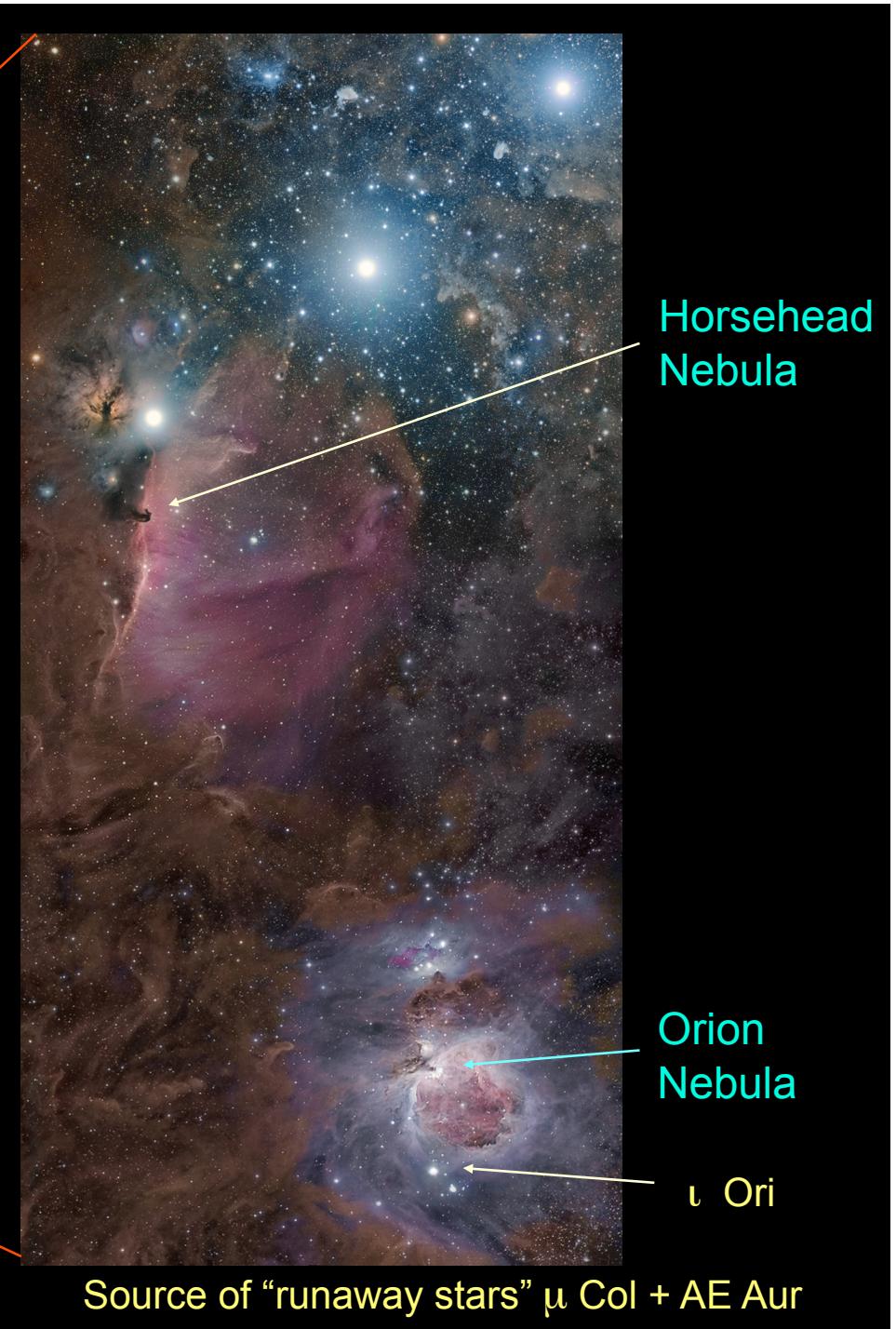
**Cepheus A: A pulsed, precessing jet:
15 Solar mass star's disk captured a 5 Solar mass star ...
... forming a multiple star**



Orion (visual wavelengths)

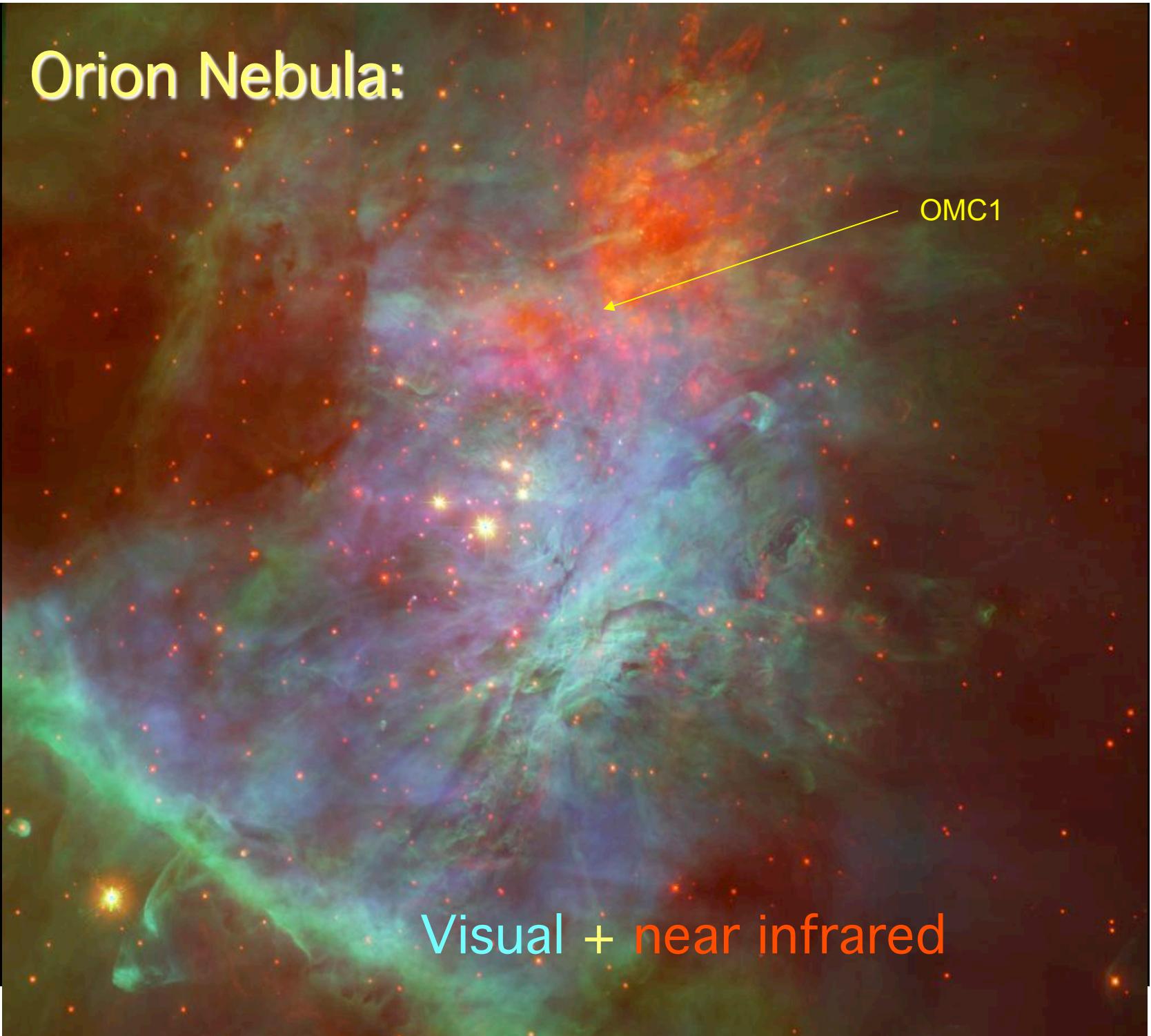


Horsehead Nebula



Source of “runaway stars” μ Col + AE Aur

Orion Nebula:



Visual + near infrared

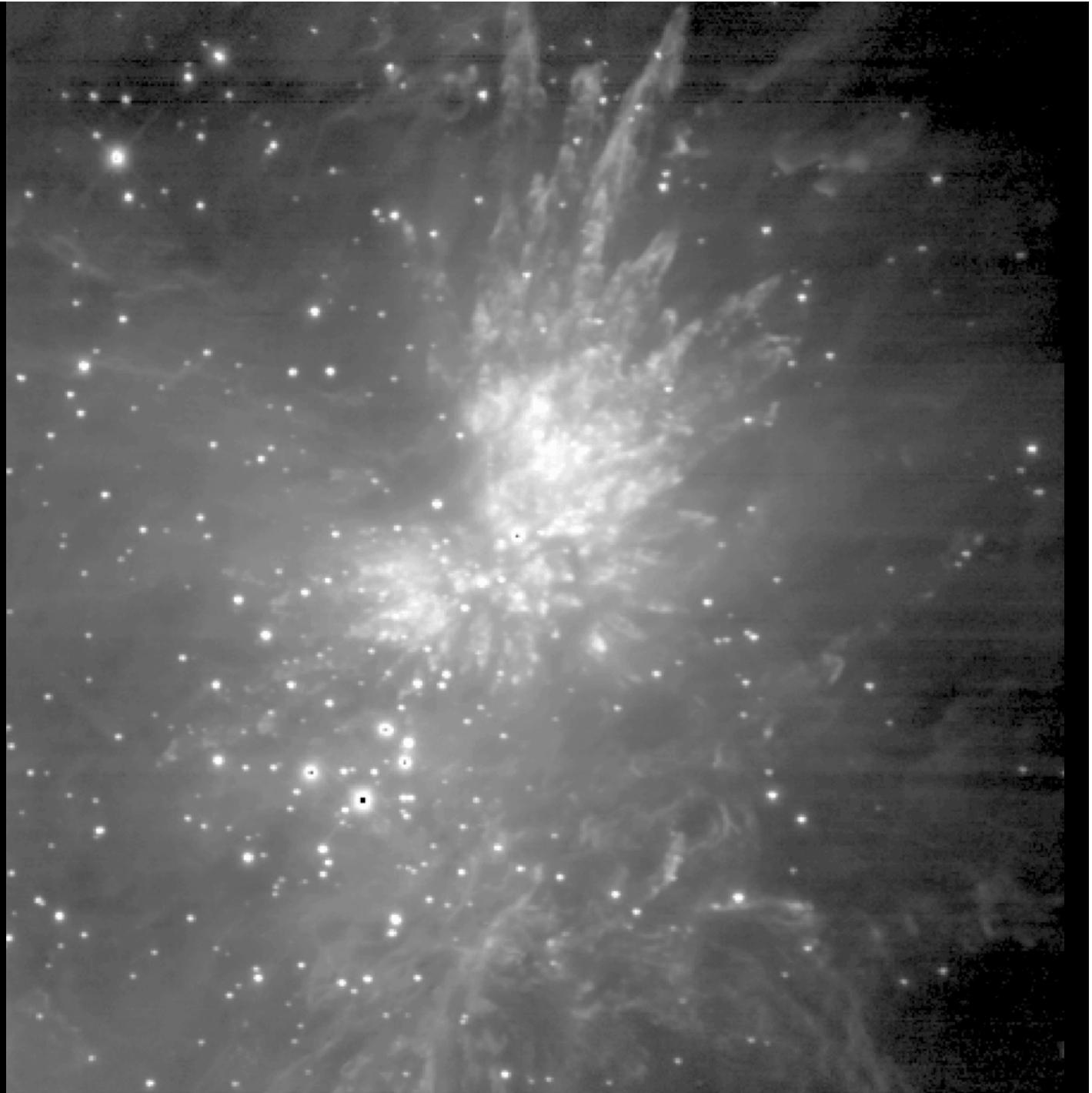
The Orion “fingers” ...

Explosion in the
OMC1 cloud core:

500 ~ years ago

Liberated more
energy than the
Sun generates in
10 million years
(10^{48} erg)!!!

(N. Cunningham
2006 PhD thesis;
Bally et al
2011)

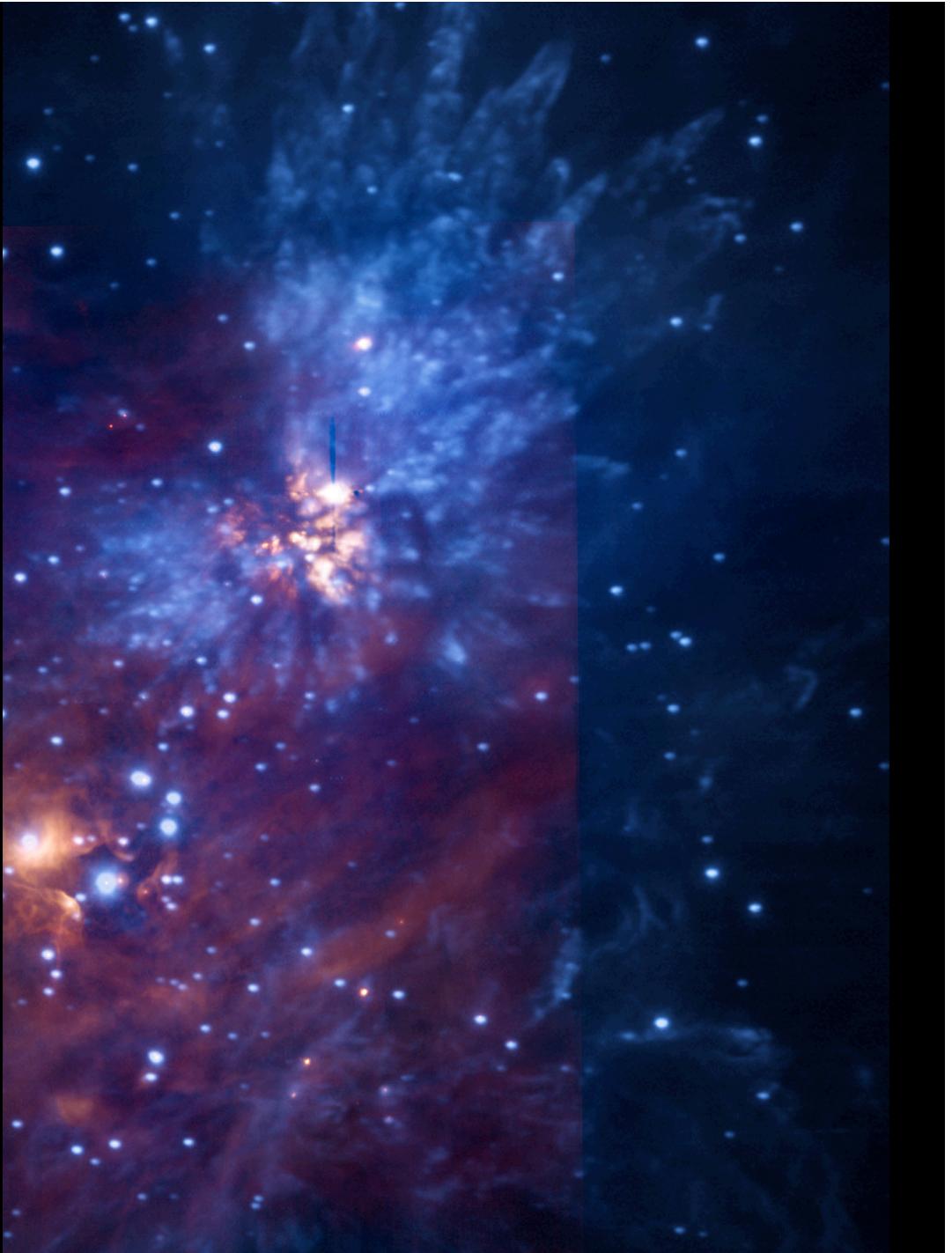


Orion H_2 fingers

Decay of a
cluster of
massive stars
~ 500 years ago

(Bally et al. 2011;
Goddi et al. 2011)

2.12 μm H_2 (blue)
11.7 μm (orange)

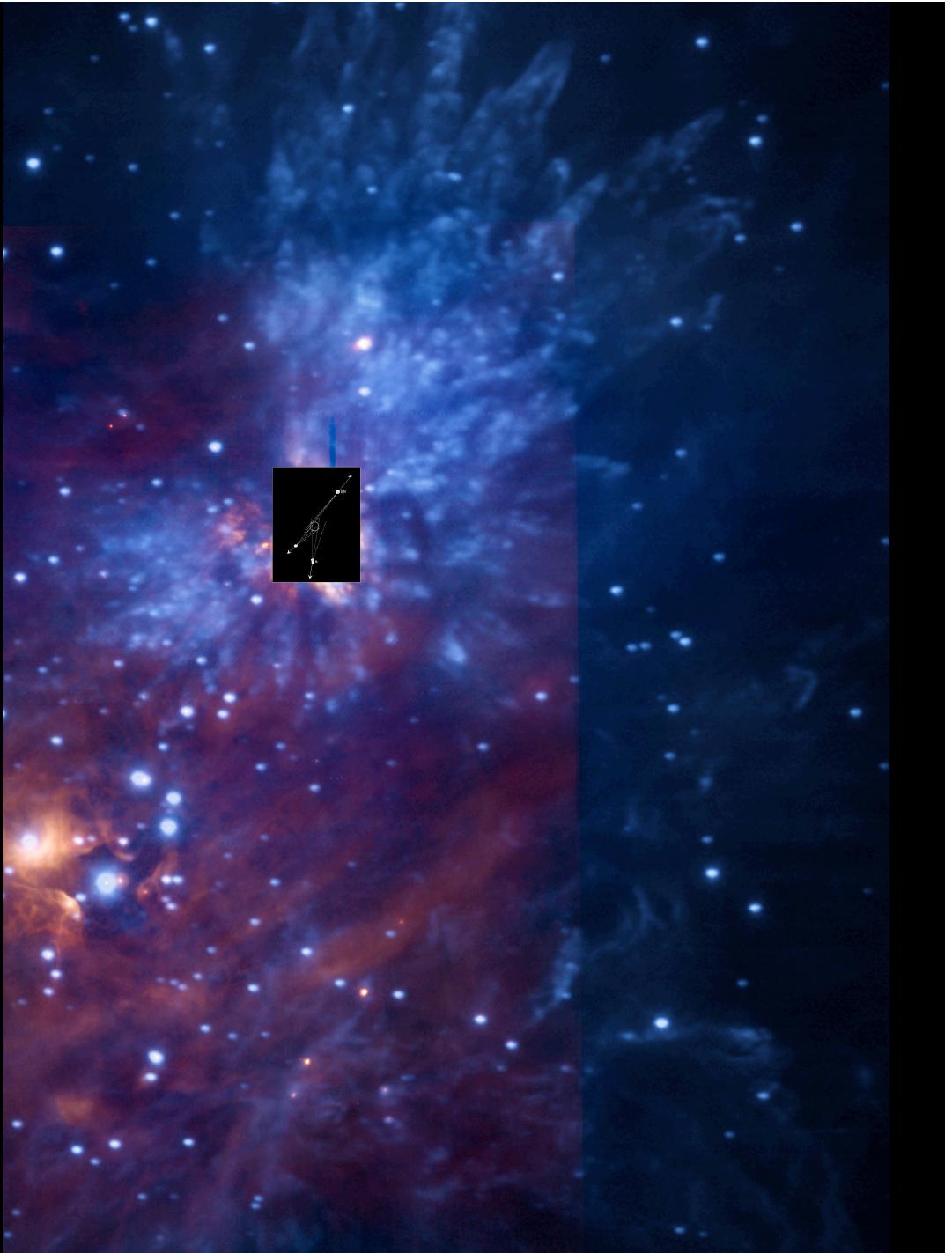


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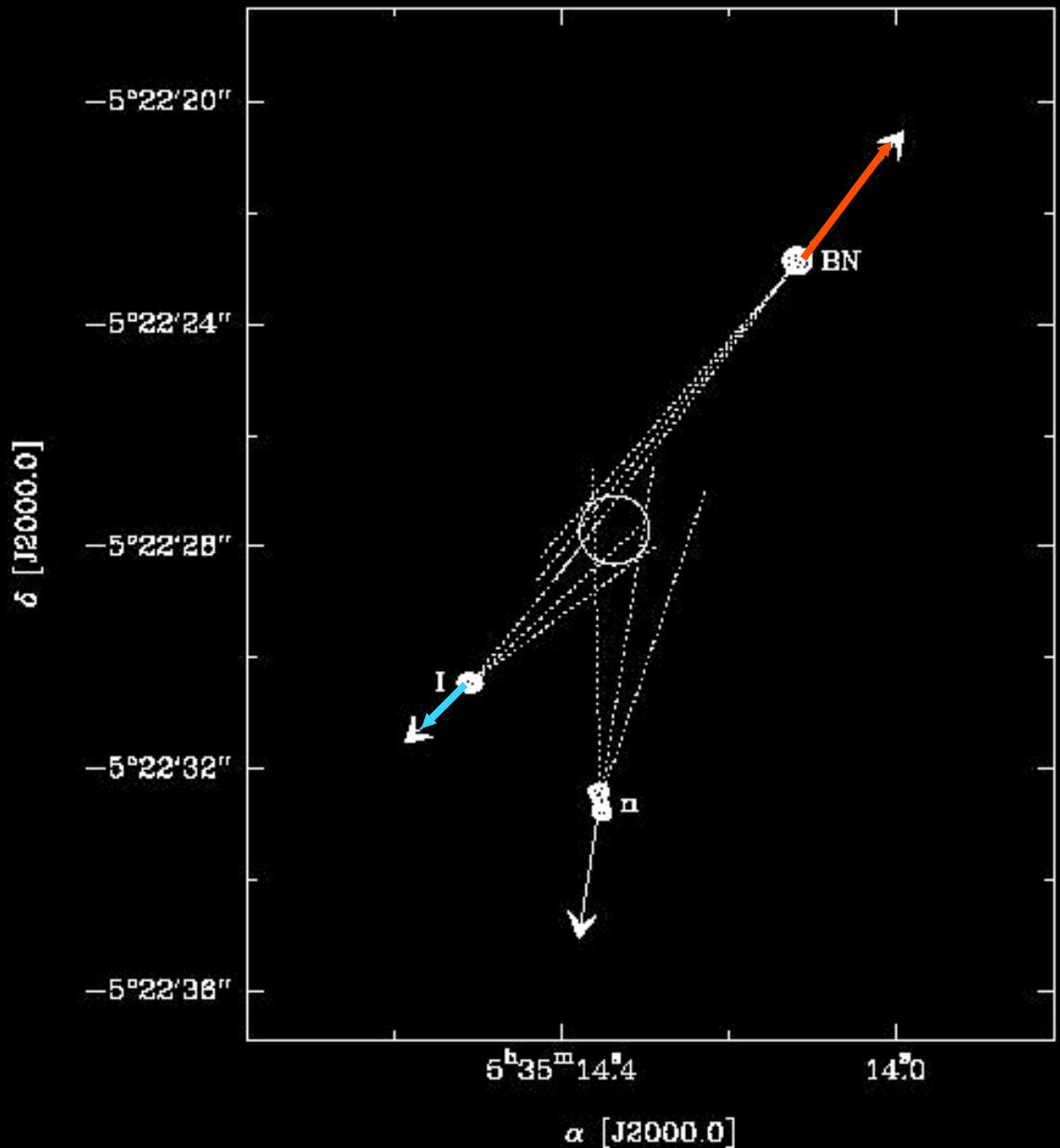


Three ejected stars: I, BN, n (Gomez et al. 2005)

BN: $\sim 30 \text{ km s}^{-1}$

I: $\sim 13 \text{ km s}^{-1}$

n: $\sim 20 \text{ km s}^{-1}$

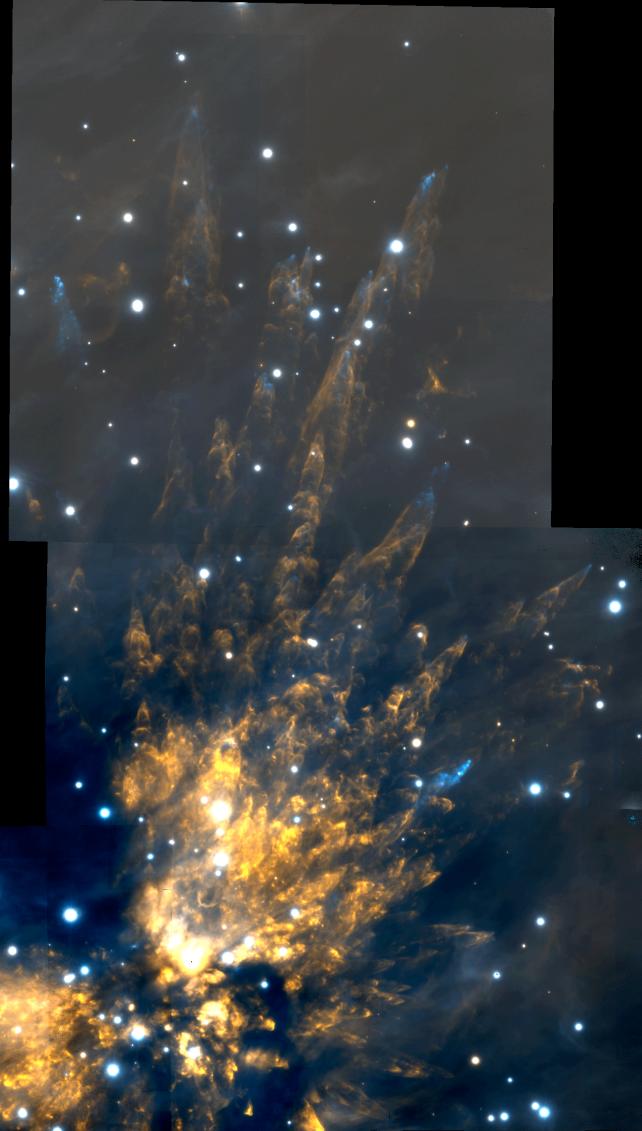
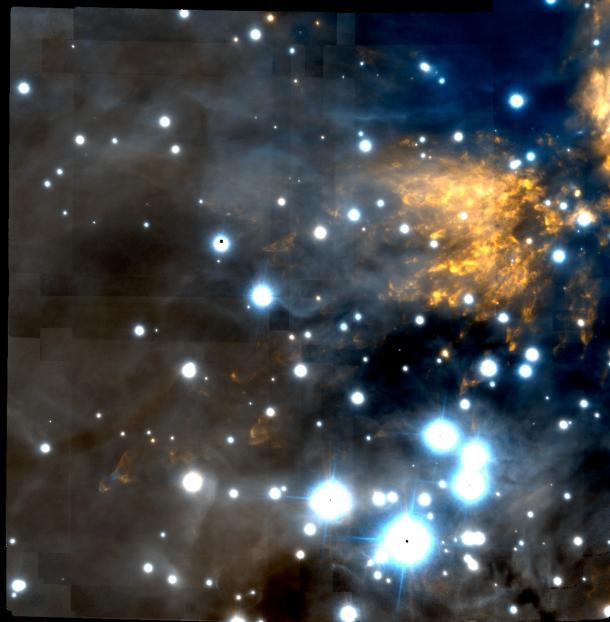


- Ejected massive stars
in Orion => Explosion

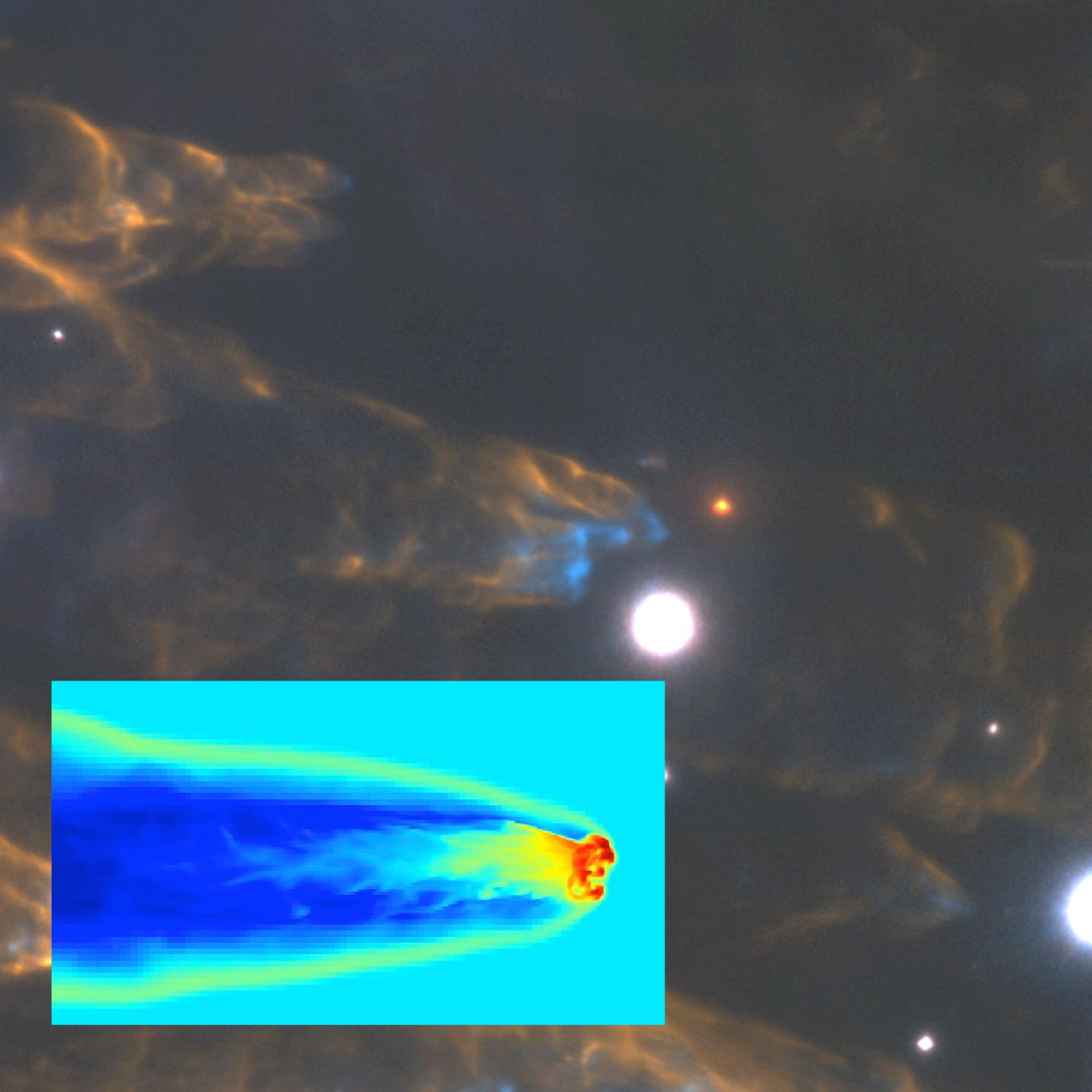
Gemini
South
Adaptive
Optics
Imager

John Bally,
Adam Ginsburg,
Rodrigo Carrasco,
Peter Michaud,
Benoit Neichel, ...

(in prep)







Dense Bullet
running into
medium:
 10^3 density
contrast

Devin Silvia
3D simulations

