

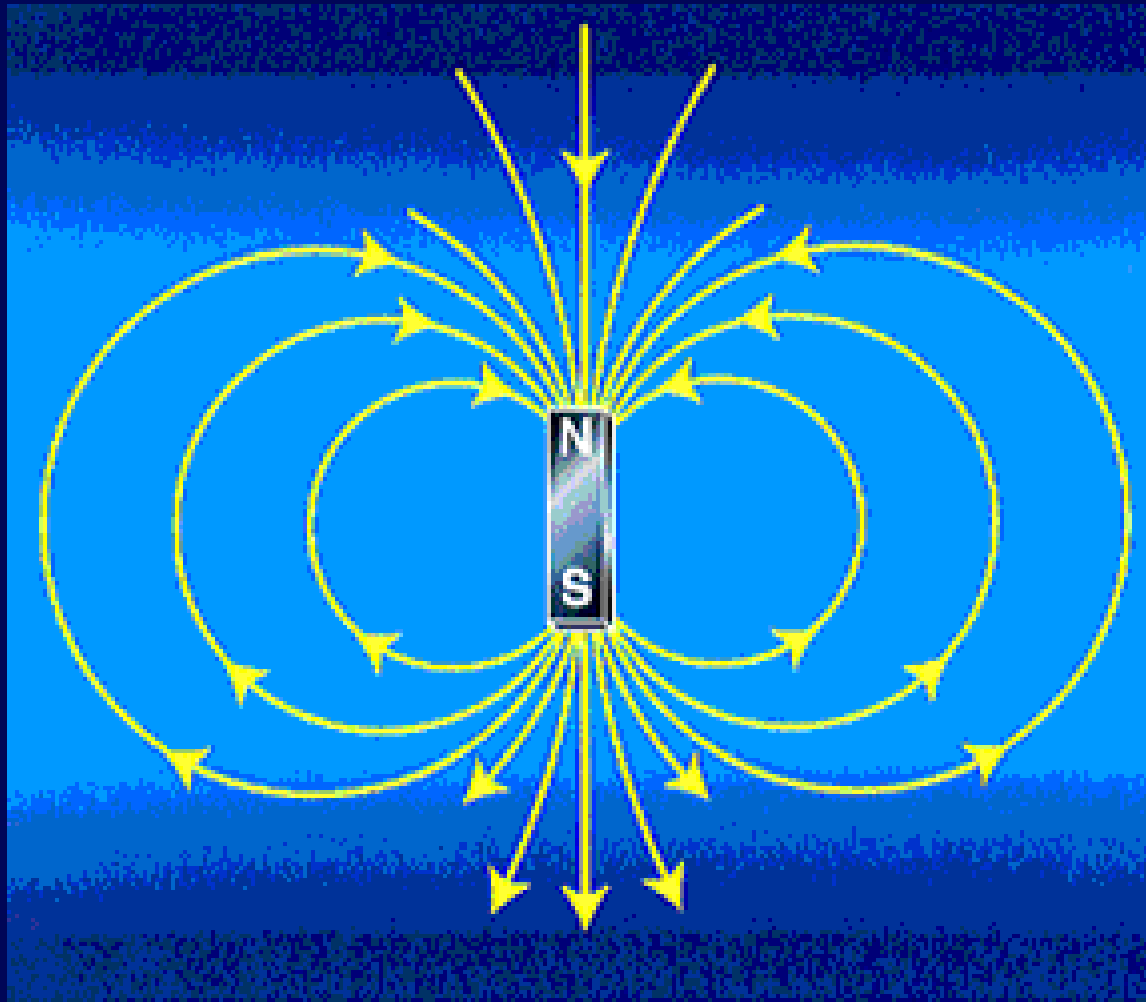
# “Magnets in Space”



*Alyssa A. Goodman*

*Harvard-Smithsonian Center for Astrophysics*

# Magnetic Field Lines



# Our Sun

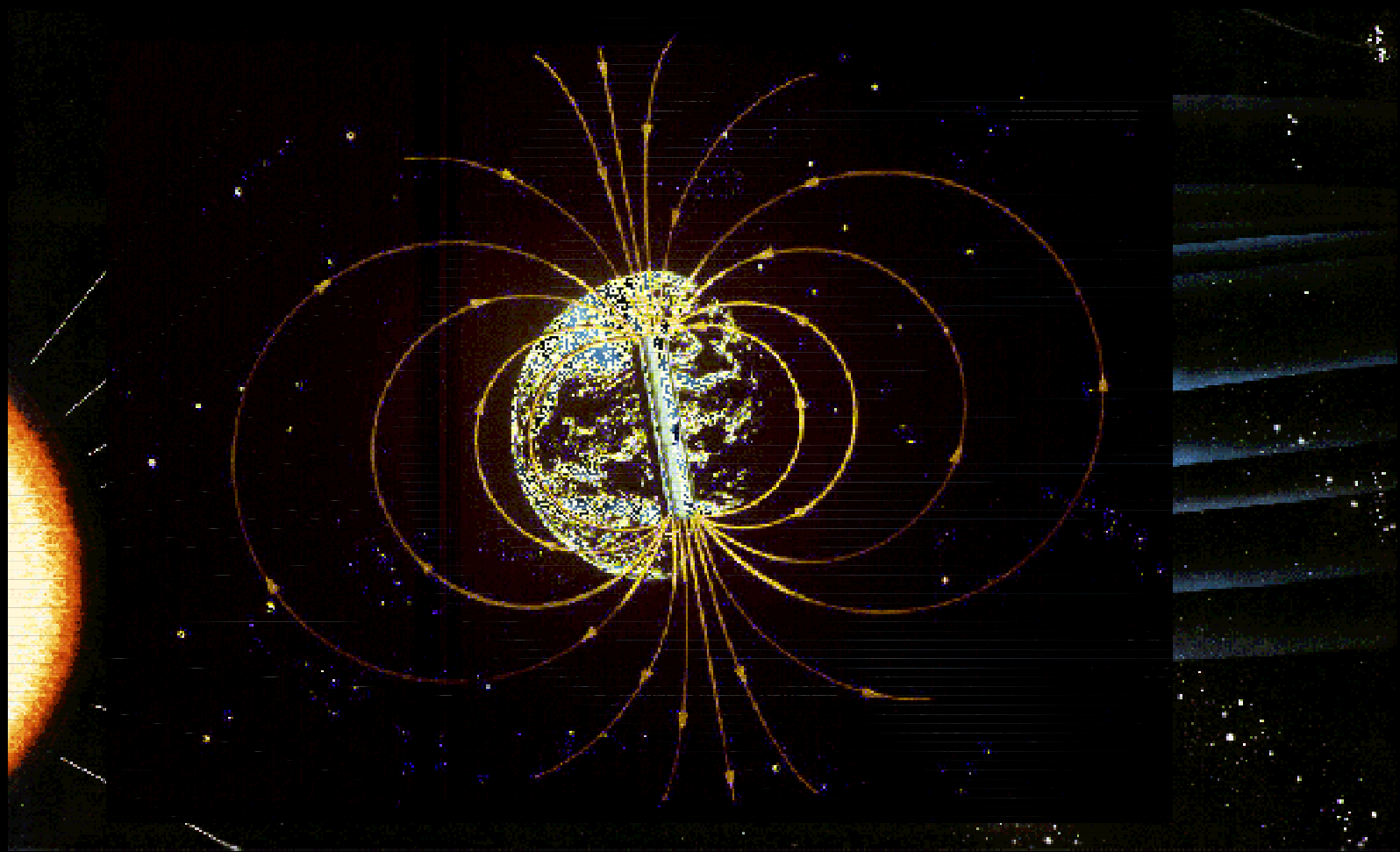


# Magnetic Fields Dancing on the Sun

<http://vestige.lmsal.com/TRACE/>

Images from NASA's "TRACE" Satellite

# Earthlings Saved by Magnetic Fields!\*



*\*but not the poor (surface) Martians, or Venusians!*

# Earthlings Saved by Magnetic Fields!\*



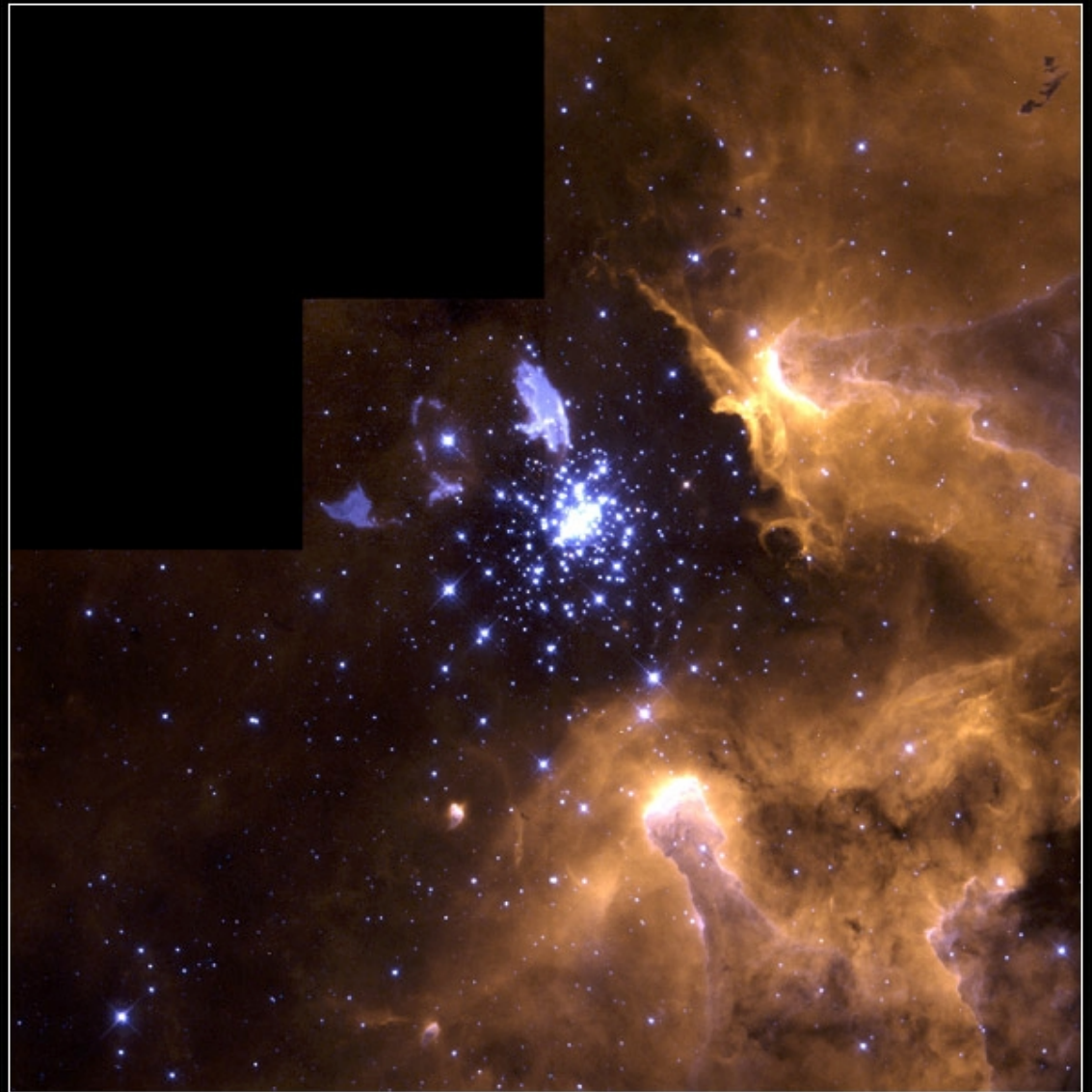
Aurora Borealis



# A Star-Forming Region



The Old(er),  
The Young  
& the  
Unborn



**NGC 3603**

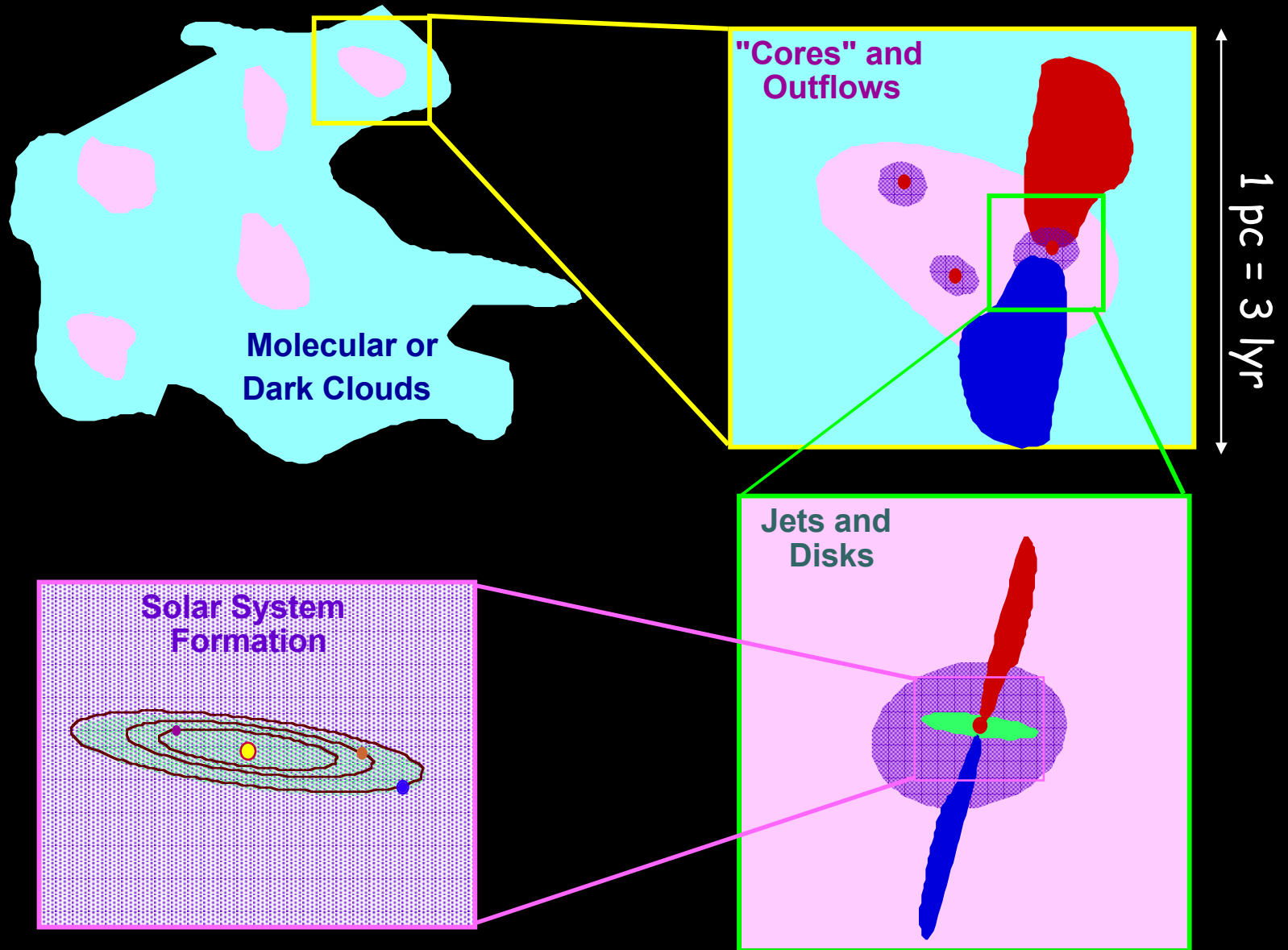
**HST • WFPC2**

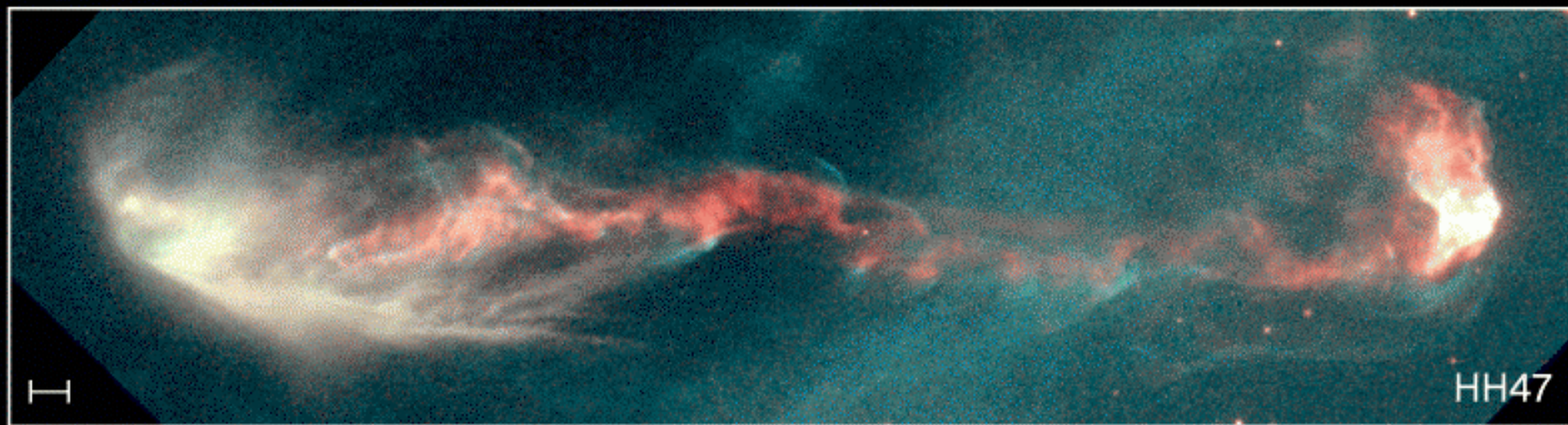
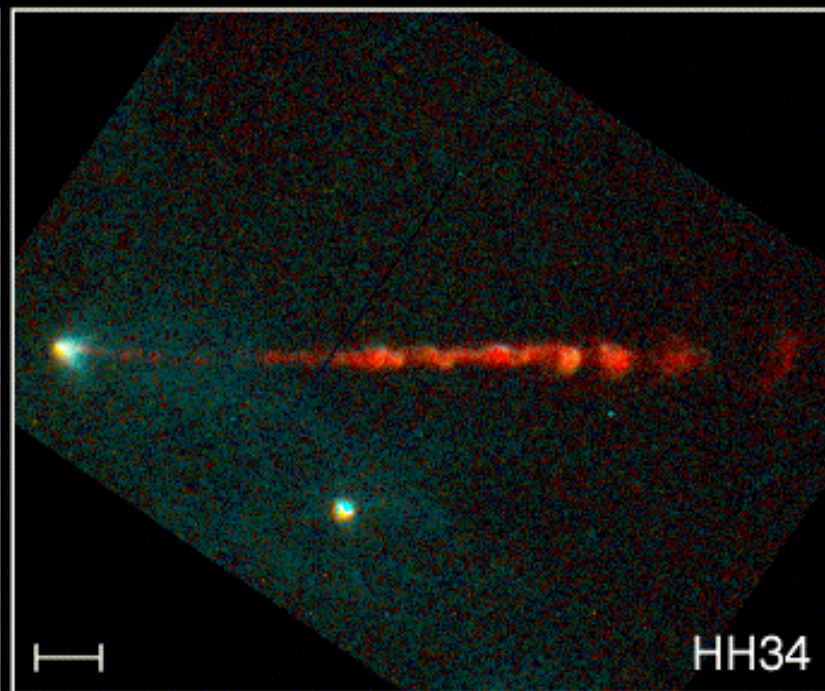
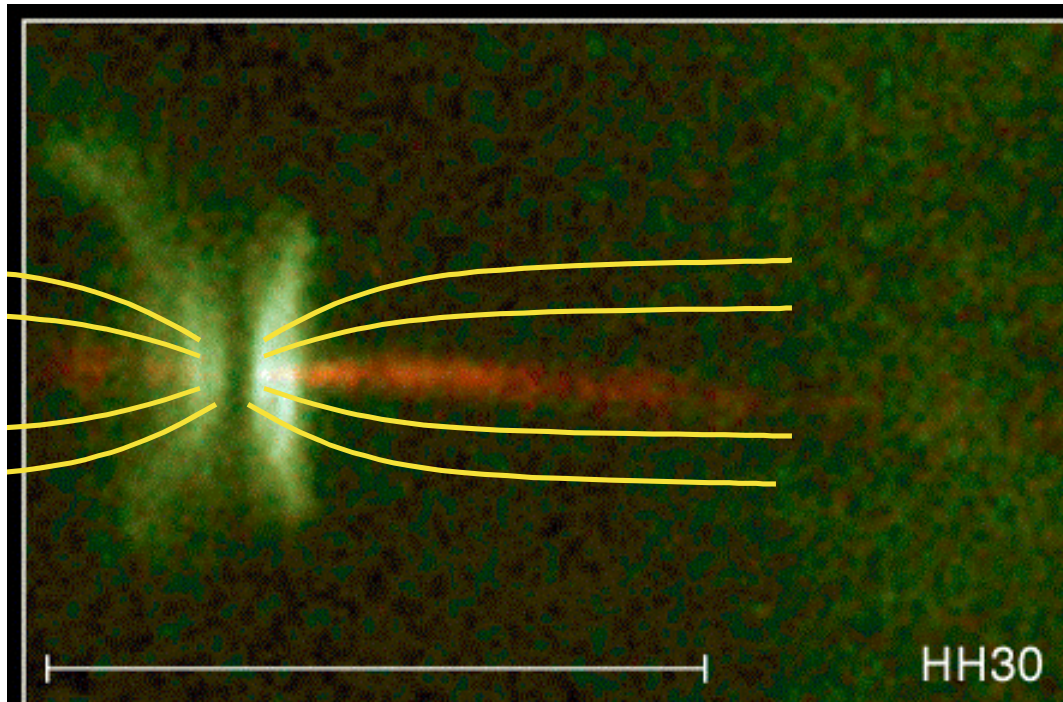
PRC99-20 • STScI OPO • June 1, 1999

Wolfgang Brandner (JPL/IPAC), Eva K. Grebel (Univ. Washington),  
You-Hua Chu (Univ. Illinois, Urbana-Champaign) and NASA



# Star and Planet Formation





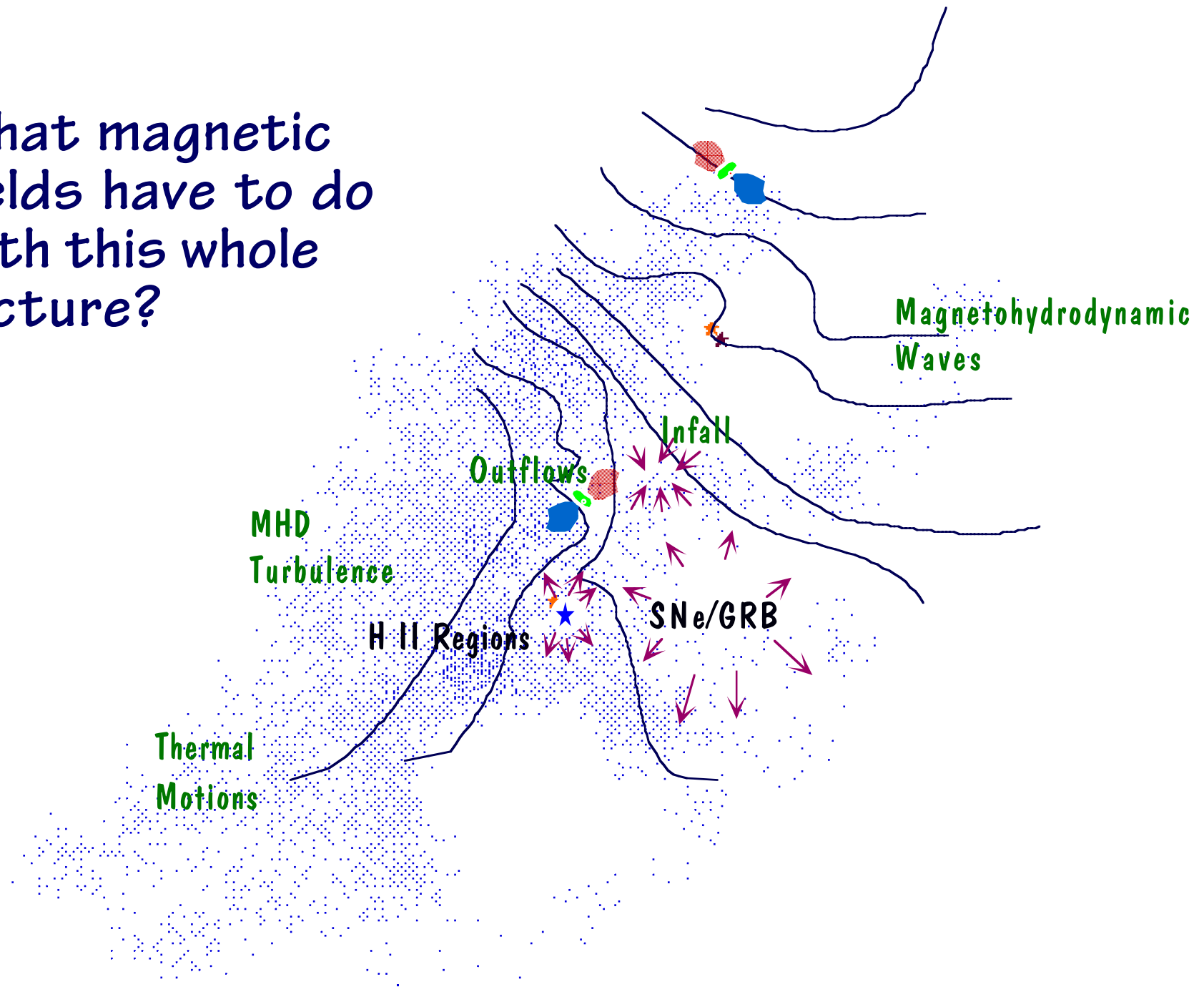
## Jets from Young Stars

PRC95-24a · ST ScI OPO · June 6, 1995

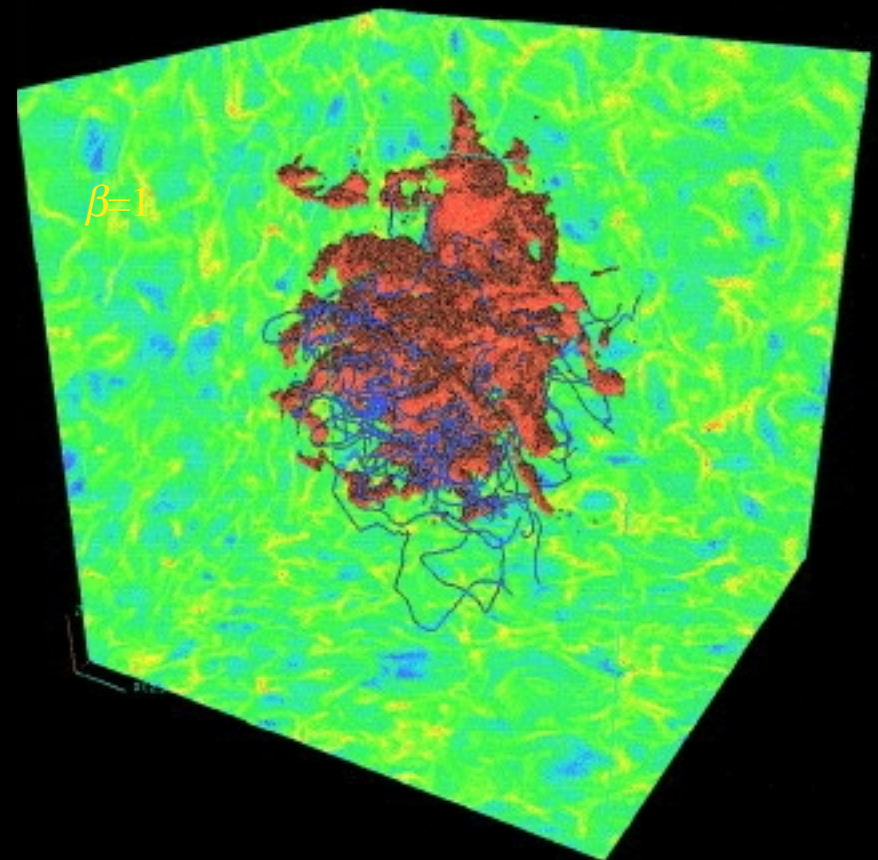
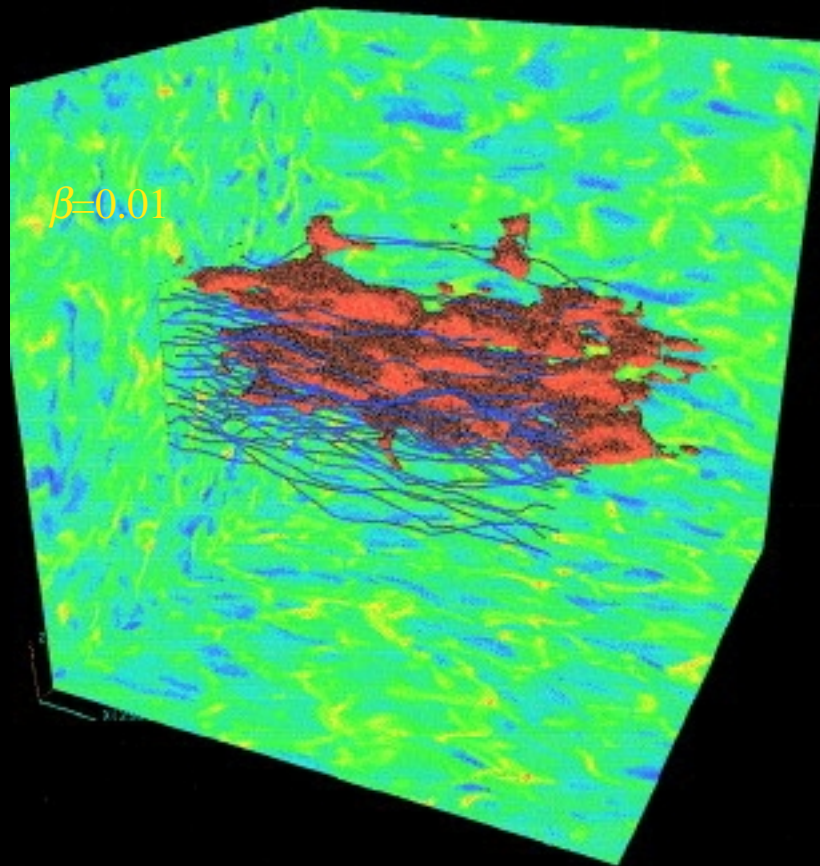
C. Burrows (ST ScI), J. Hester (AZ State U.), J. Morse (ST ScI), NASA

HST · WFPC2

What magnetic fields have to do with this whole picture?



# Magnetic Fields in Star Forming Gas



*Stone, Gammie & Ostriker 1999*

$$\beta = \frac{[T / 10 \text{ K}]}{[n_{\text{H}_2} / 100 \text{ cm}^{-3}][B / 1.4 \mu\text{G}]^2}$$

- **Driven** Turbulence; M→K; no gravity
- Colors: log density
- Computational volume:  $256^3$
- Dark blue lines: B-field
- Red : isosurface of passive contaminant after saturation

# Star Formation the Easy Way (that doesn't work)

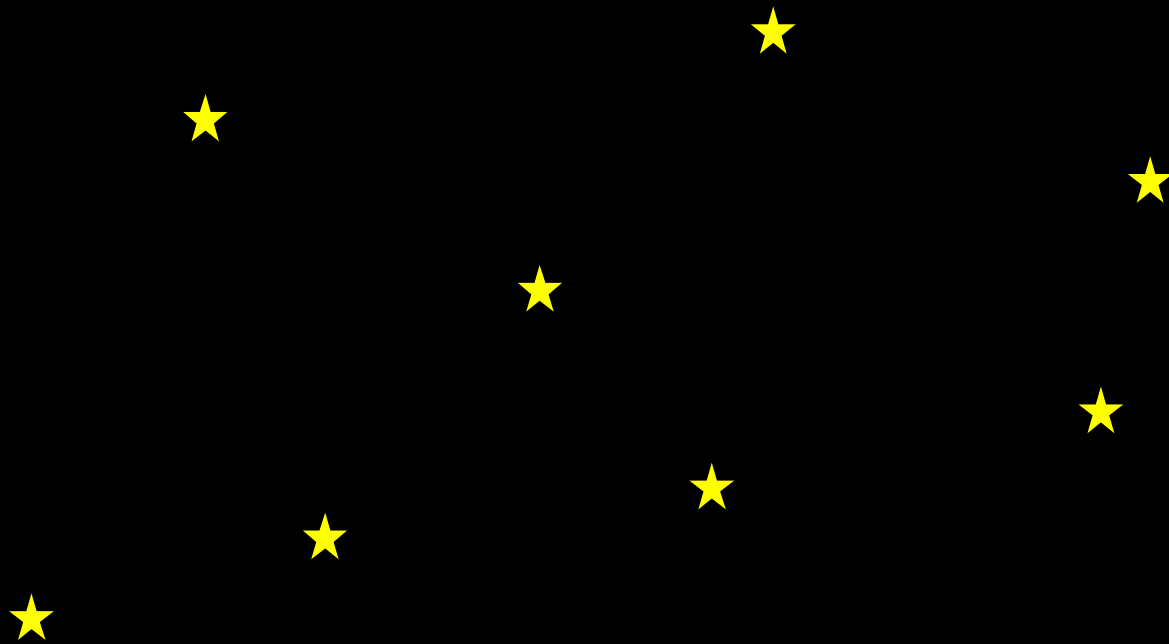


Fragments Collapse Under  
Gravity into "Protostars"  
time  $\sim 10^5$  years

Global Instability (e.g. Jeans)  
Fragments Cloud (hierarchically)  
time  $\sim 10^6$  years

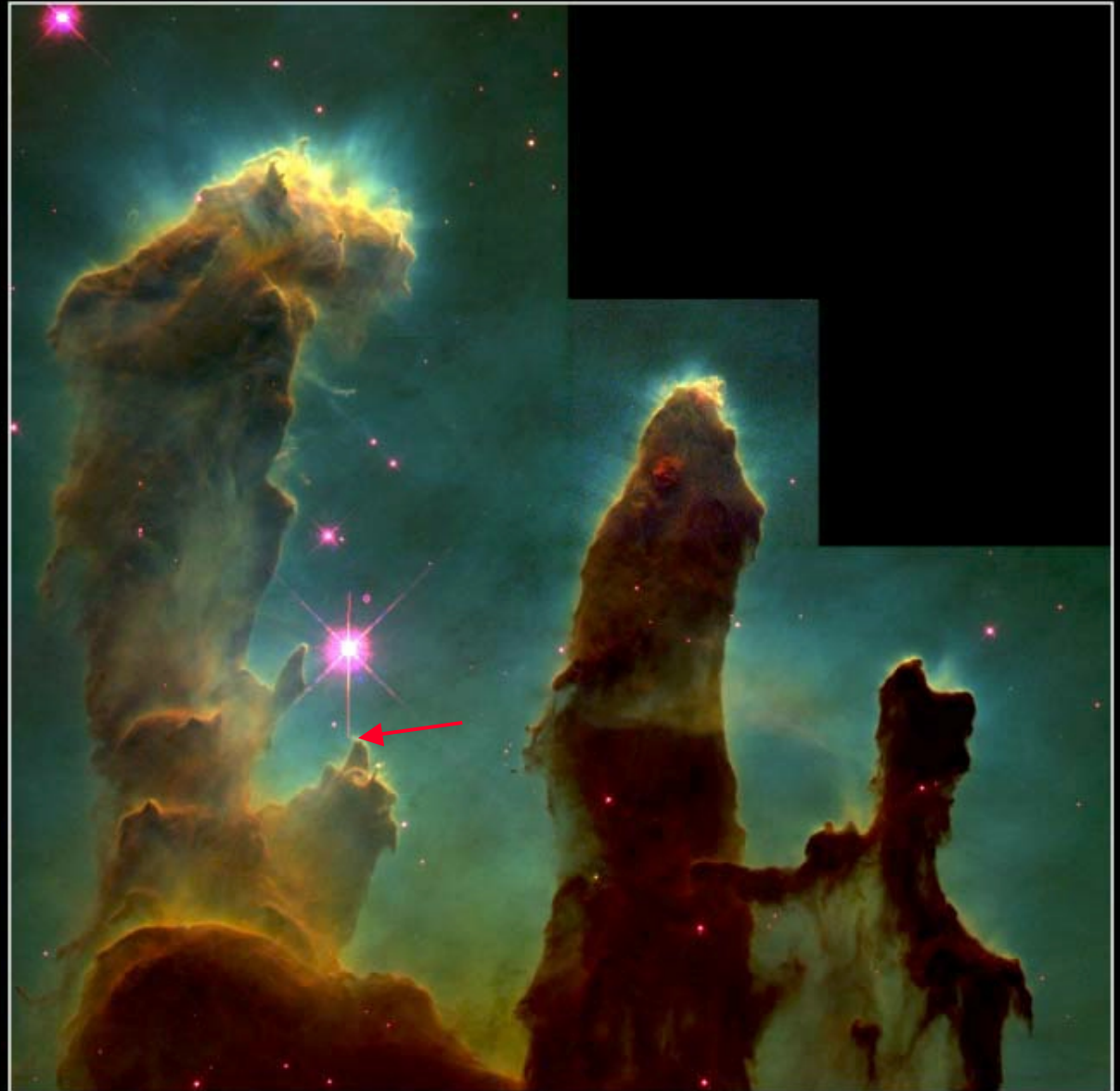
*Hoyle 1953*

Ta-Da



A Group of Young  
"Zero-Age Main Sequence"  
Stars is Born

# The (Beautiful) Ugly Truth

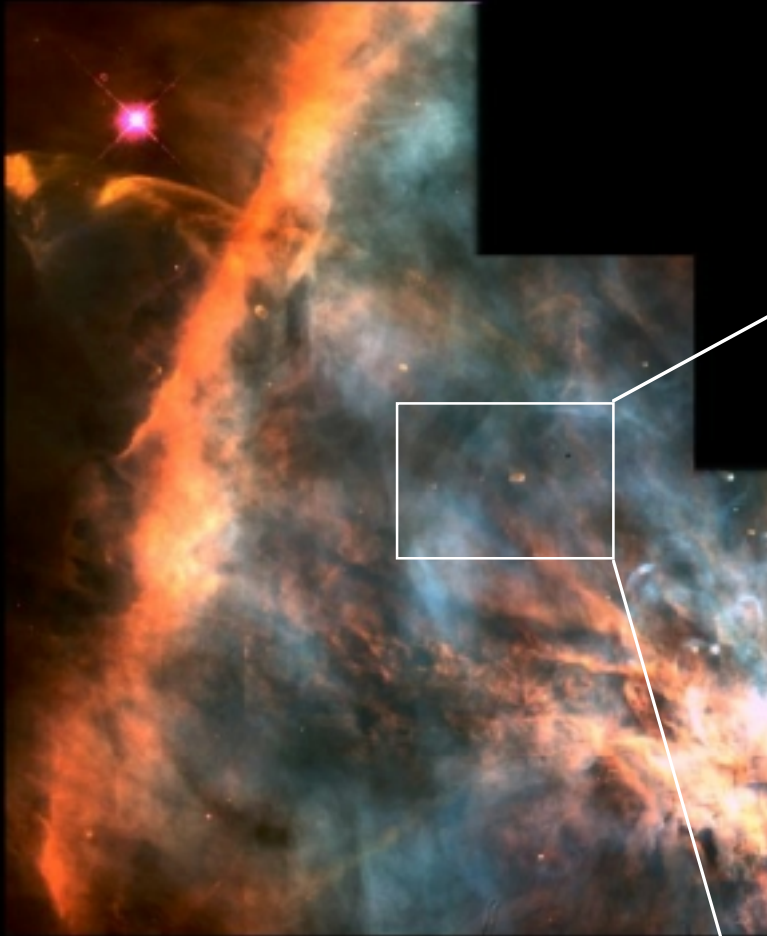


**Gaseous Pillars • M16**

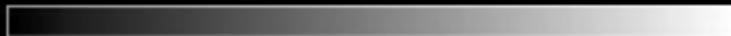
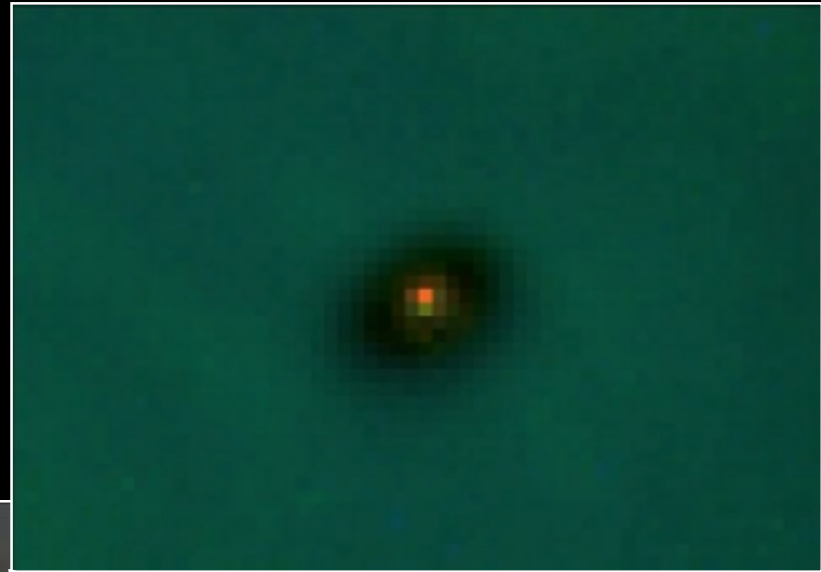
**HST • WFPC2**

PRC95-44a • ST ScI OPO • November 2, 1995  
J. Hester and P. Scowen (AZ State Univ.), NASA

# The Orion Nebula



Hubble Space Telescope  
Wide Field Planetary Camera 2





# The History of the Universe

