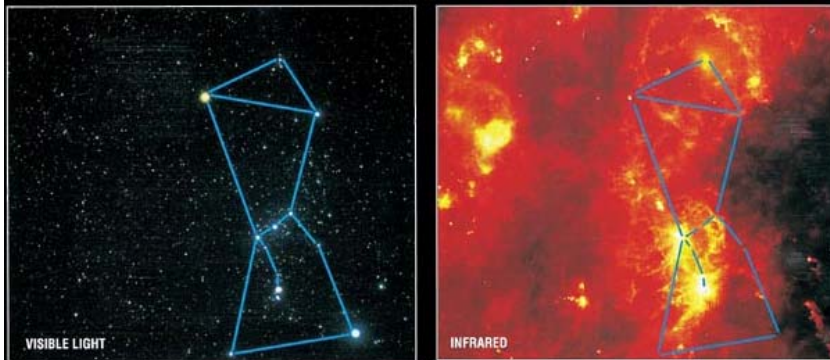


Orion Molecular Cloud



- 100 pc across
- 200,000 M_{\odot}
- Only a few of its stars close to the near edge can be seen in visible light.
 - But infrared images penetrate the dust and show many more stars.

The Orion-Monoceros Molecular Clouds

Orion A	$1.0 \times 10^5 M_{\odot}$
Orion B	0.8
Mon R2	0.9
Total complex	$4 \times 10^5 M_{\odot}$

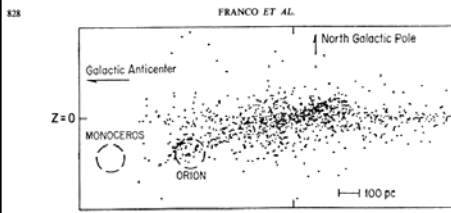


FIG. 2.—Projected positions of O-B stars within 100 pc from the Sun, which is located at $r = z = 0$ (adapted from Smecher and Flegal 1976). The r projections of the main bodies of Orion and Monoceros are also indicated.

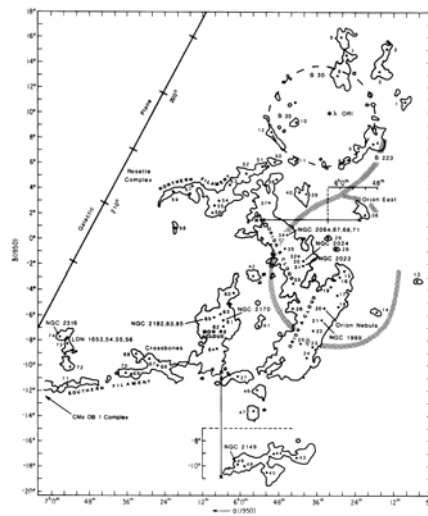
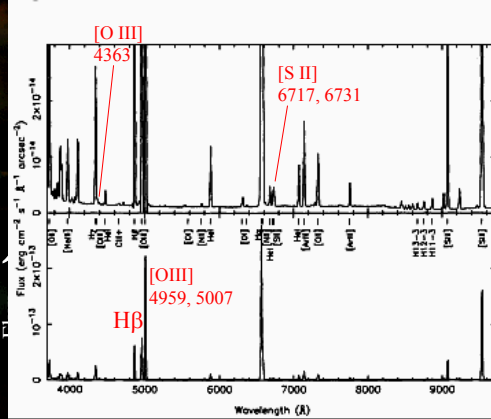
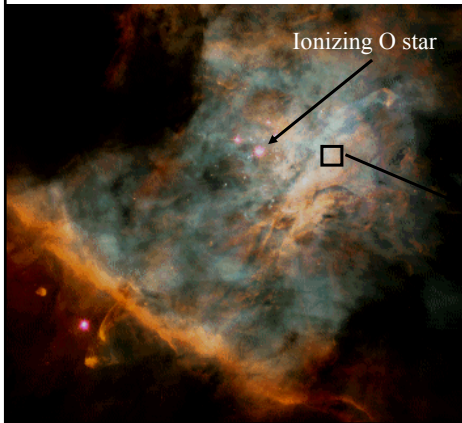
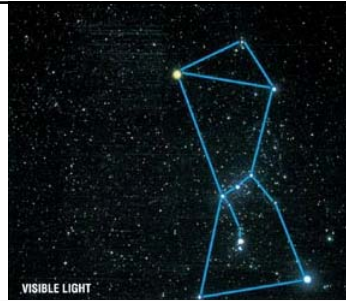


FIG. 3.—Schematic diagram of the molecular clouds: the lower contour from Fig. 2. Stars with numbers, corresponding to those in Table 1, indicate locations of O-B massive stars. Some NGC numbers indicate the centrally prominent objects coincident with O-B stars. The extent of UV emission from Herbig's loop is indicated by the shaded arc (from O'Dell, York, and Herbig 1967; Smith 1973). The dashed line roughly indicates the extent of the α Ori ring of clouds.

The Orion Nebula

- 440 pc away from us
- The central “star” in Orion’s sword.
- ~ 0.6 pc across



HII region is small cavity at edge of much bigger molecular cloud

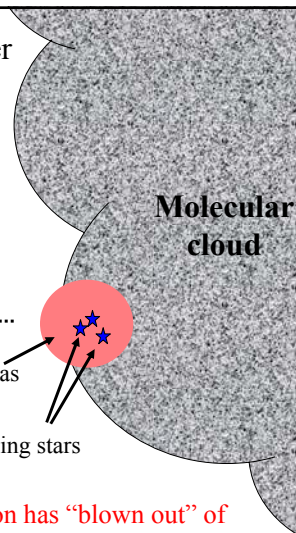


Earth



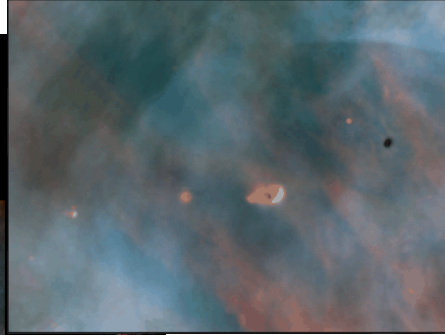
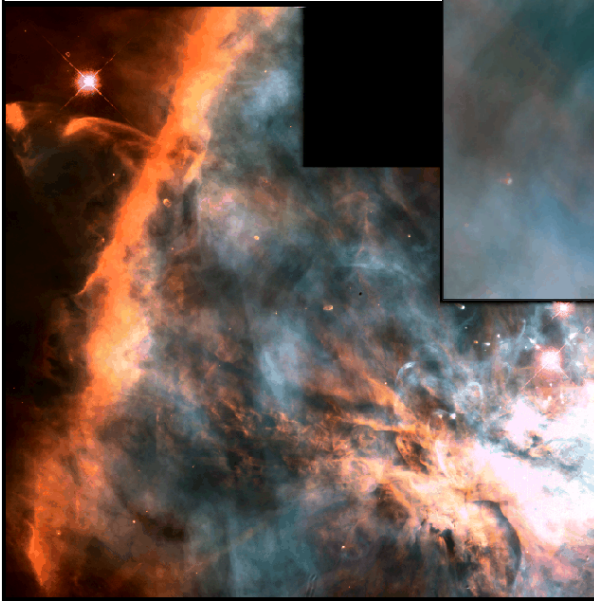
Ionized gas

Ionizing stars



- Ionized region has “blown out” of near side of dense cloud.
 - “Blister” HII Region
- Many more similar star-formation regions buried deep inside cloud.

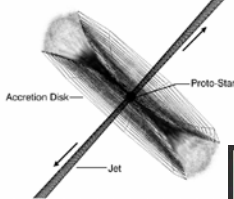
“Proplyds” in Orion



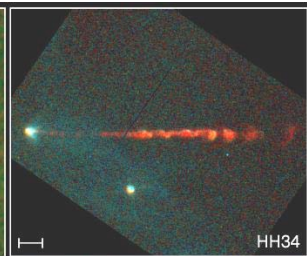
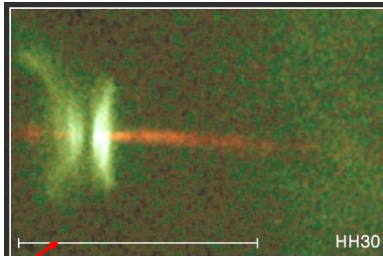
- Dusty disks around new-born stars.
- Scattered throughout Orion Nebula.

Herbig-Haro Objects

Diagram of HH 30 Circumstellar Disk & Jet



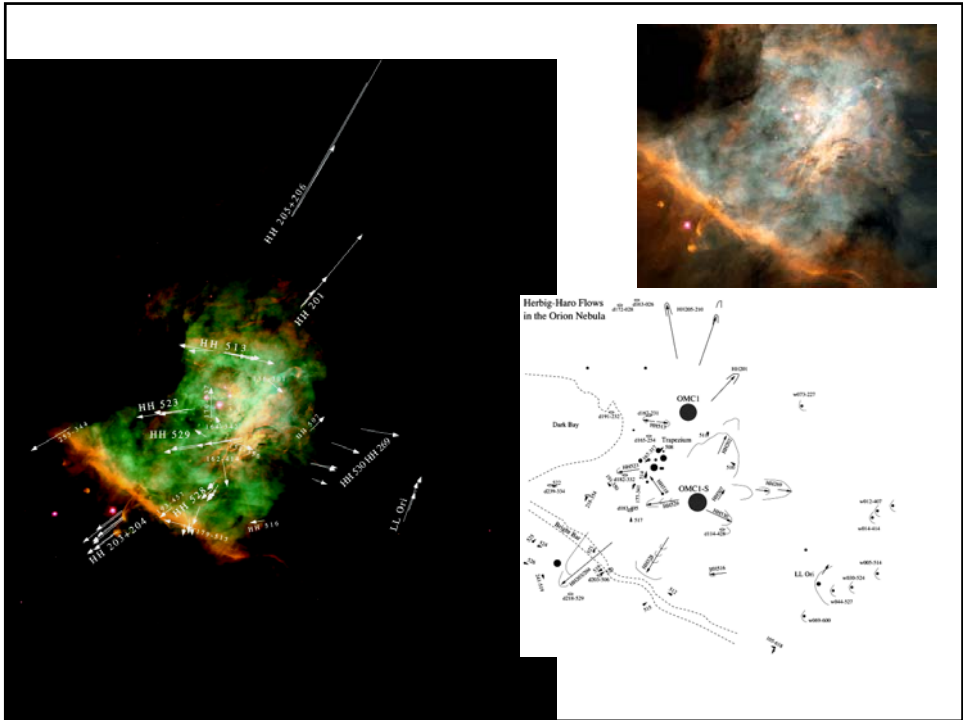
- “Accretion disk” around proto-star channels outflow along opposed jets.
- Star is continuing its gravitational contraction
- Still not burning H \rightarrow He.



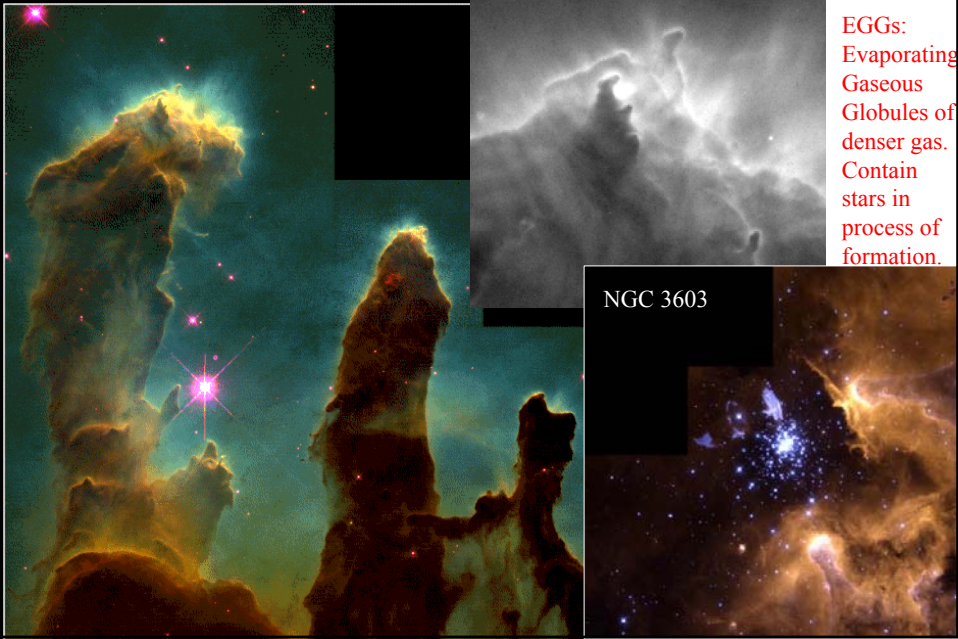
1000 AU
scale bars

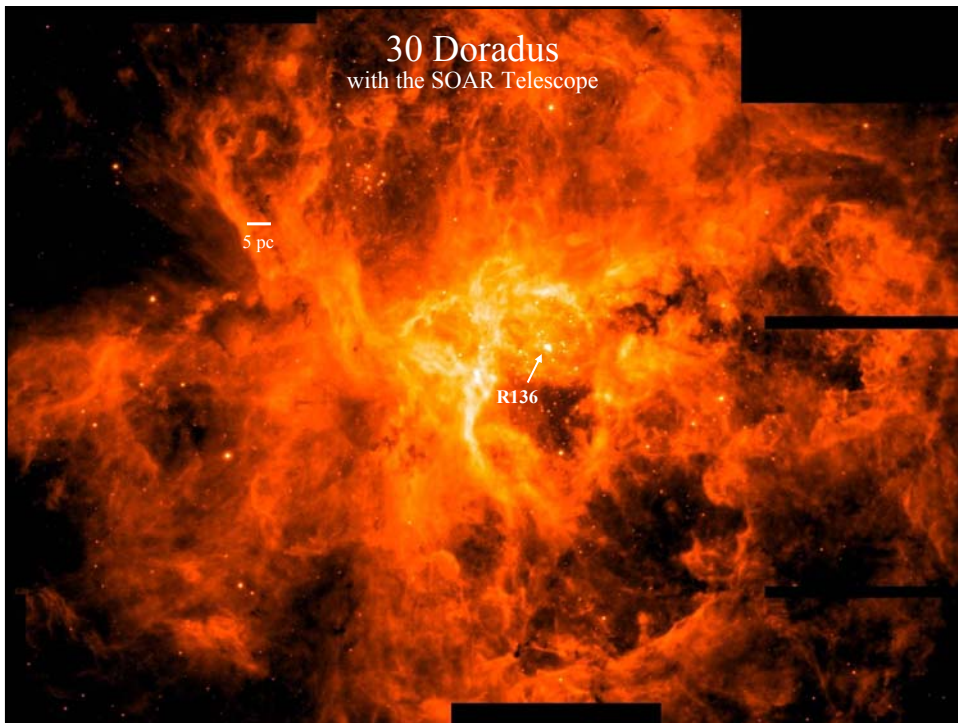
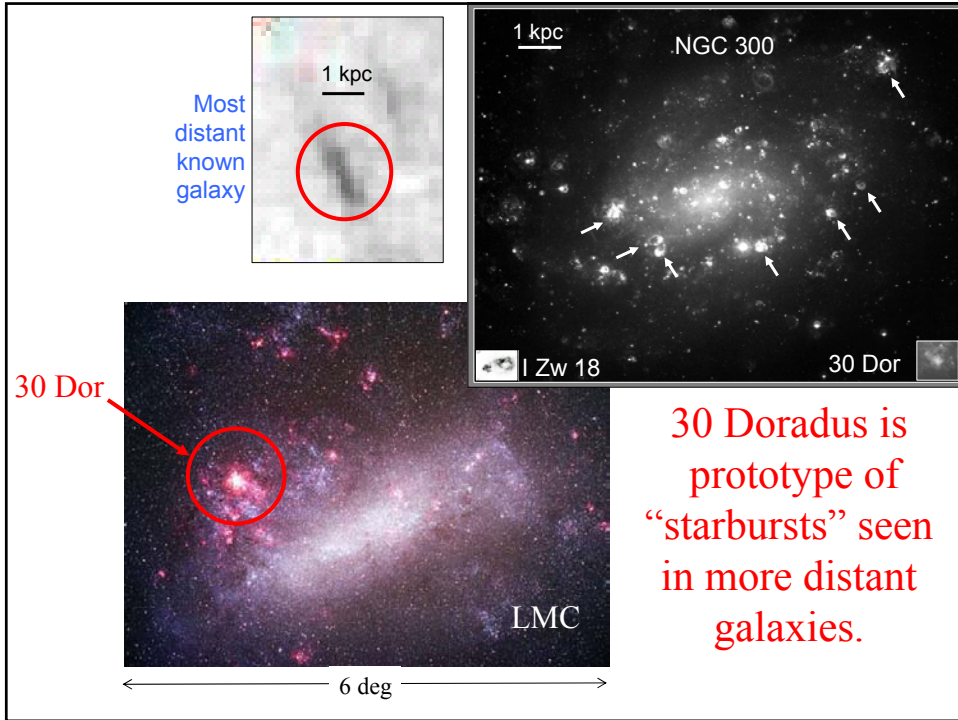
Jets from Young Stars

HST · WFPC2

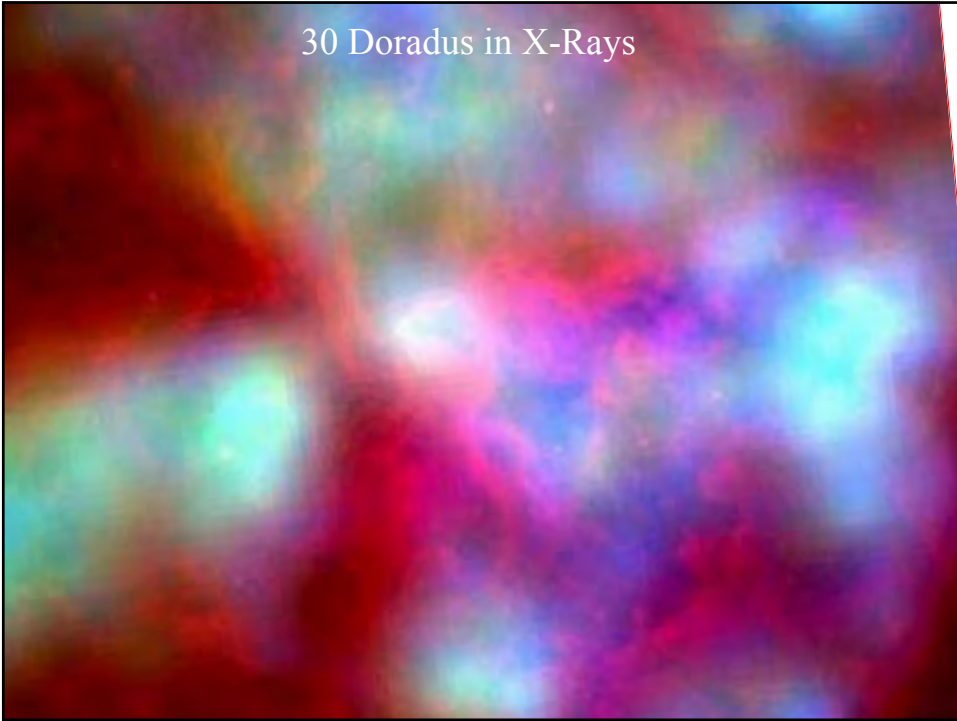


M16 “Pillars of Creation”



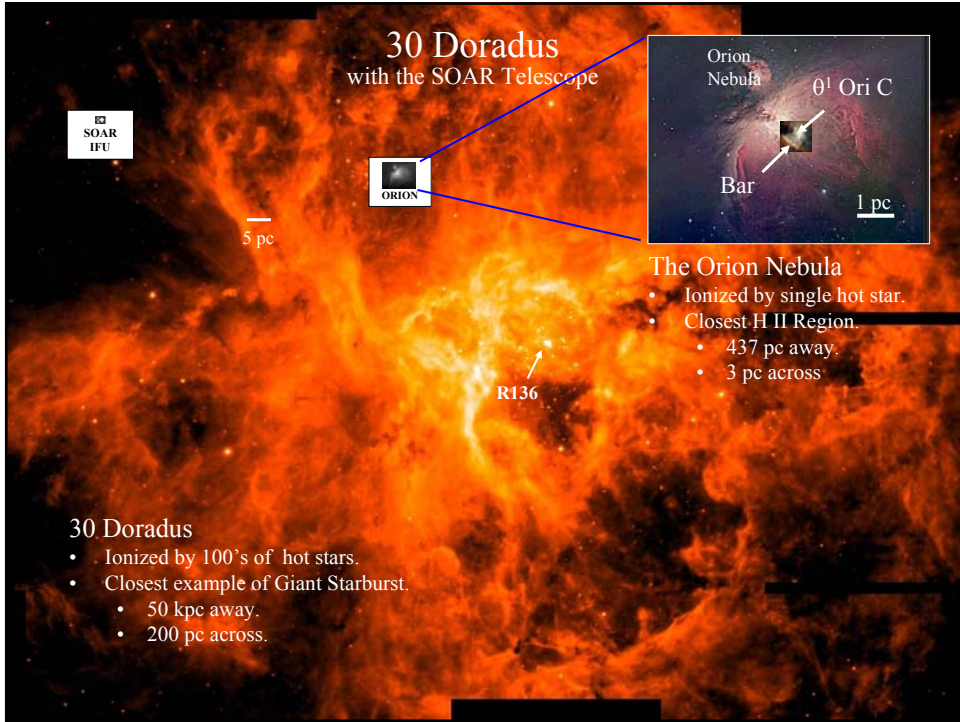


30 Doradus in X-Rays



30 Doradus in the Infrared





Galactic Fountains

- **M101 superbubble**
 - 1.5 kpc diameter
 - $3 \times 10^7 M_{\odot}$
 - 50 km/s expansion velocity
 - $KE = 10^{53}$ ergs (1000 supernovae)
- **Milky Way**
 - Heiles (1984) lists 44 superbubbles
 - Diameter 0.2-2.4 kpc
- **W4 superbubble in Milky Way**
 - Reaches 250 pc above plane
 - HI disk scale height is only 25 pc
 - Width = 110 pc
 - 2.35 kpc from Sun
 - 2.5 Myr old
 - Driven by young cluster associated with W3/W4/W5 HII region complex.
 - 9 O stars
 - At base of cavity.

M101
5 kpc

Dec(1950)
R.A.(1950)

HI

Galactocentric Radial Velocity (km/sec)
Distance from centre

HI intensity contours

Galactic Latitude
Galactic Longitude

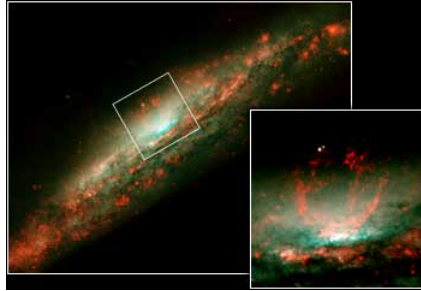
HI

Galactic Latitude
Galactic Longitude

H α

Bubble in NGC 3079

HST



- These NASA Hubble Space Telescope snapshots reveal dramatic activities within the core of the galaxy NGC 3079, where a lumpy bubble of hot gas is rising from a cauldron of glowing matter. The picture at left shows the bubble in the center of the galaxy's disk. The structure is more than 3,000 light-years wide and rises 3,500 light-years above the galaxy's disk. The smaller photo at right is a close-up view of the bubble. Astronomers suspect that the bubble is being blown by "winds" (high-speed streams of particles) released during a burst of star formation. Gaseous filaments at the top of the bubble are whirling around in a vortex and are being expelled into space. Eventually, this gas will rain down upon the galaxy's disk where it may collide with gas clouds, compress them, and form a new generation of stars. The two white dots just above the bubble are probably stars in the galaxy.