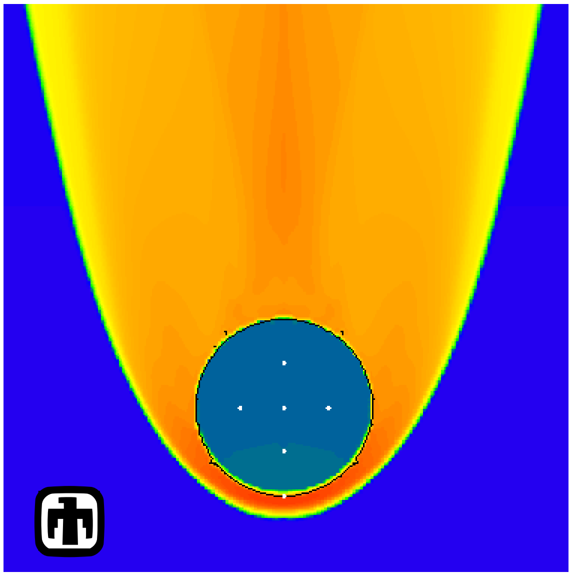
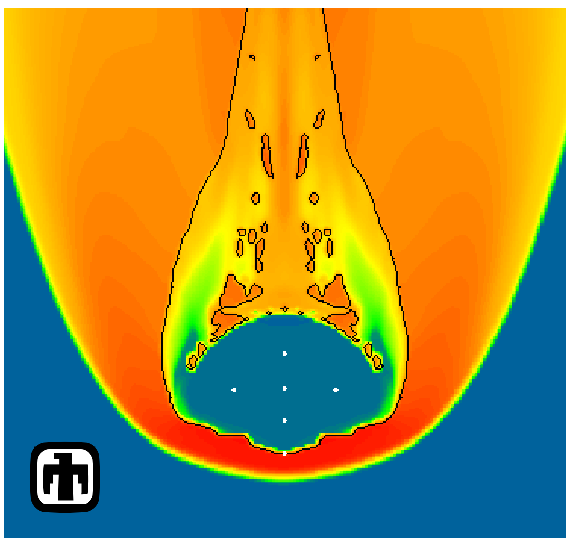


1) **Entry (t=1 sec.):** A cometary fragment penetrates Jupiter's atmosphere at 60 km/s (traveling downward in this figure) as a rigid object, creating a bow shock ahead of it. Inside the bow shock region, the atmospheric gases are heated to temperatures as high as 35,000 degrees Centigrade. Here we model the cometary fragment as a 3-km sphere of water ice - consistent with predictions made by Hubble in Jan., 1994. If the fragments are smaller, their behavior at this and subsequent times will be similar although the final penetration depths will be smaller (**see Note near Fig. 6**).

Scale Bar

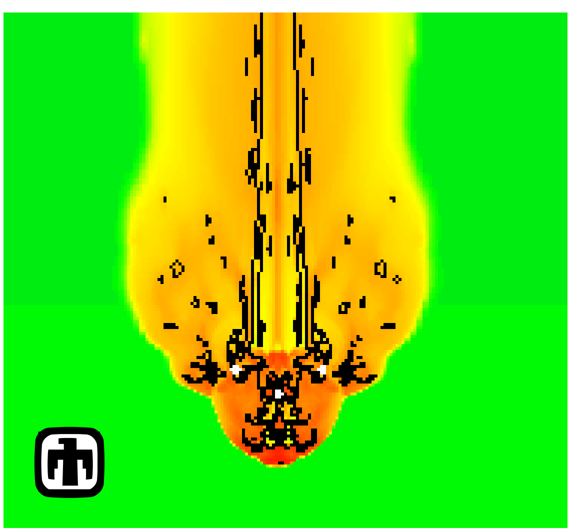
3 km



2) **Deformation (t=3 sec.):** As the cometary fragment penetrates deeper into the planet's atmosphere, the pressure at the front of the body increases. The body begins to flatten (the white dots inside the figure are indicators of the amount of flattening) and hydrodynamic instabilities (undulations at the front of the body) begin to develop.

Scale Bar

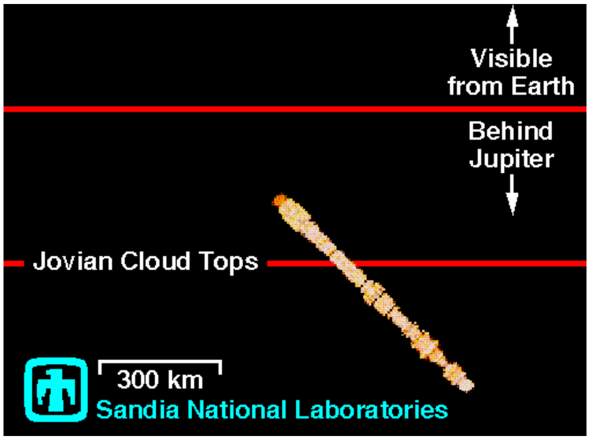
3 km



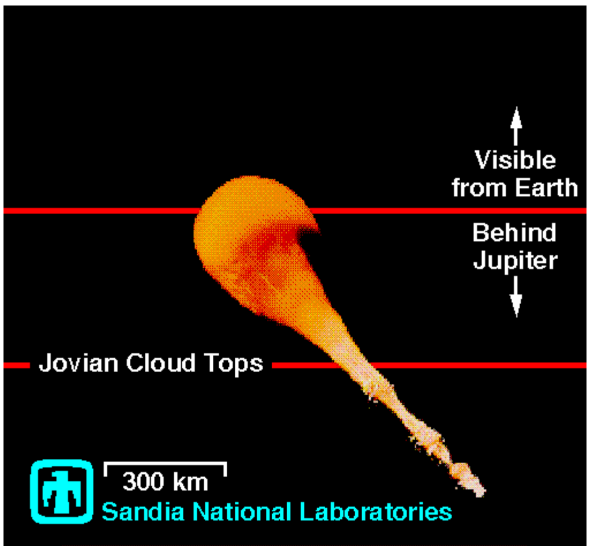
3) **Breakup (t=8 sec.):** When the instablilties grow beyond a certain point, they cause the body to break up catastrophically. The resulting cloud of debris continues to penetrate (at reduced velocity) until most of the comet's original kinetic energy is given up to the atmosphere. (Some of the original kinetic energy is retained by the greatly heated cometary material.)

Scale Bar

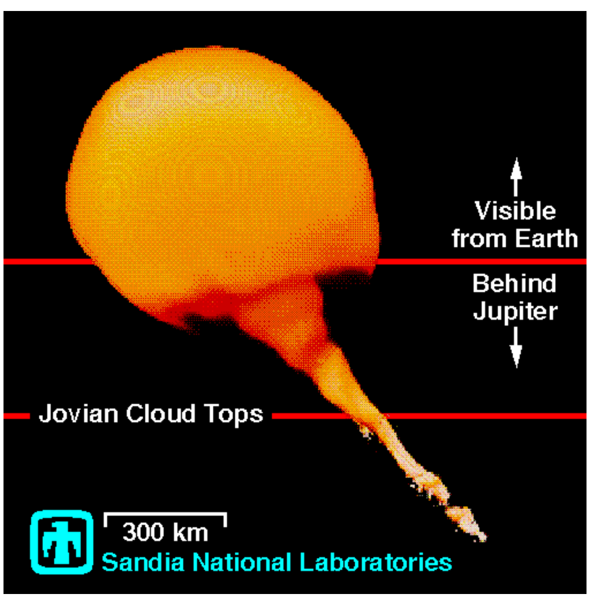
10 km



4) Beginning of the fireball (t=15 sec.): By this time, the comet has penetrated to a depth 340 km below the outermost visible cloud tops of Jupiter's atmosphere. The fragment has left a trail of hot, high-pressure air and cometary debris behind it which expands explosively into the surrounding atmosphere, creating a fireball that grows upwards supersonically as shown in Figures (5) and (6). These calculations were performed on Sandia's 1840-processor Intel Paragon, presently the world's fastest supercomputer.

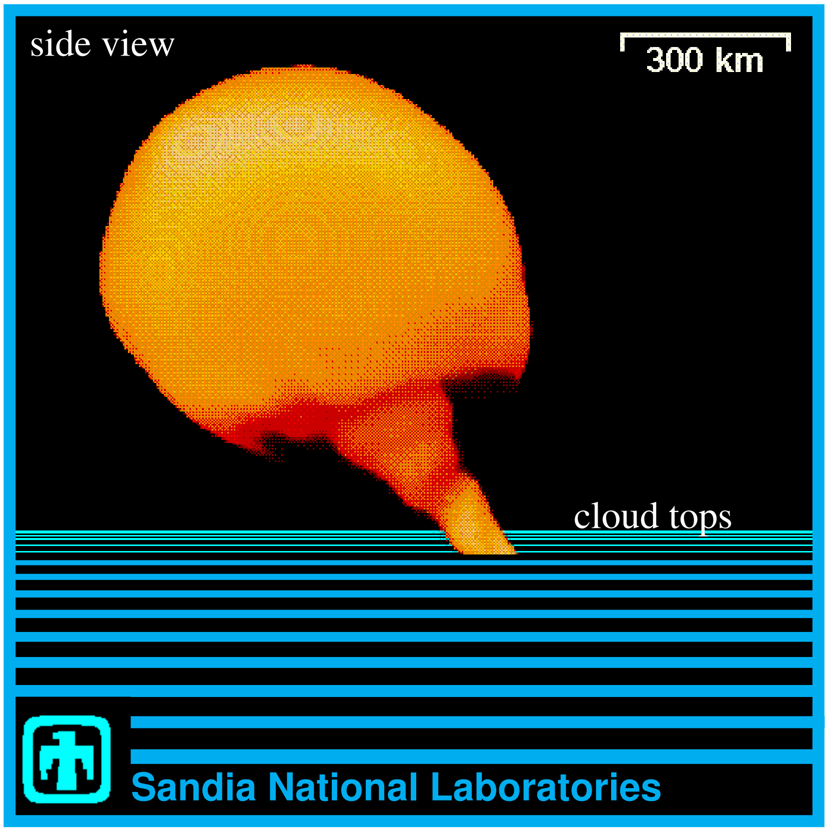


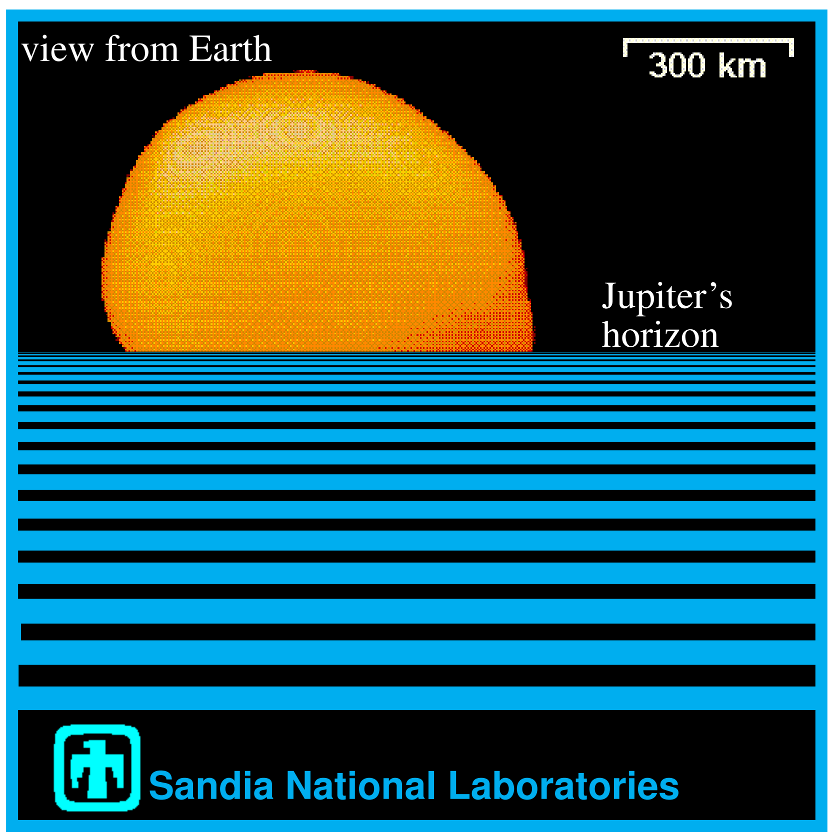
5) Growing Fireball (t=50 sec.): The fireball is growing upward at a rate of 10 km/s and has reached a diameter of 300 km and an altitude 450 km above the cloud tops. At this point, the top of the fireball is in line-of-sight for Earth- (or Earth-orbit)-based observers.



6) Growing Fireball (t=70 sec.): The fireball is growing upward at a rate of 25 km/s and has reached a diameter of 700 km and an altitude 900 km above the cloud tops.

Note: A similar calculation that we have performed shows that a 1-km fragment of the comet with 3% of the mass and kinetic energy penetrates only 200 kilometers beneath the cloud tops. The resulting fireball grows more slowly and is substantially reduced in size from that shown here. We will periodically update these figures as we refine our calculations.


side view
300 km
cloud tops
Sandia National Laboratories


view from Earth
300 km
Jupiter's
horizon
Sandia National Laboratories