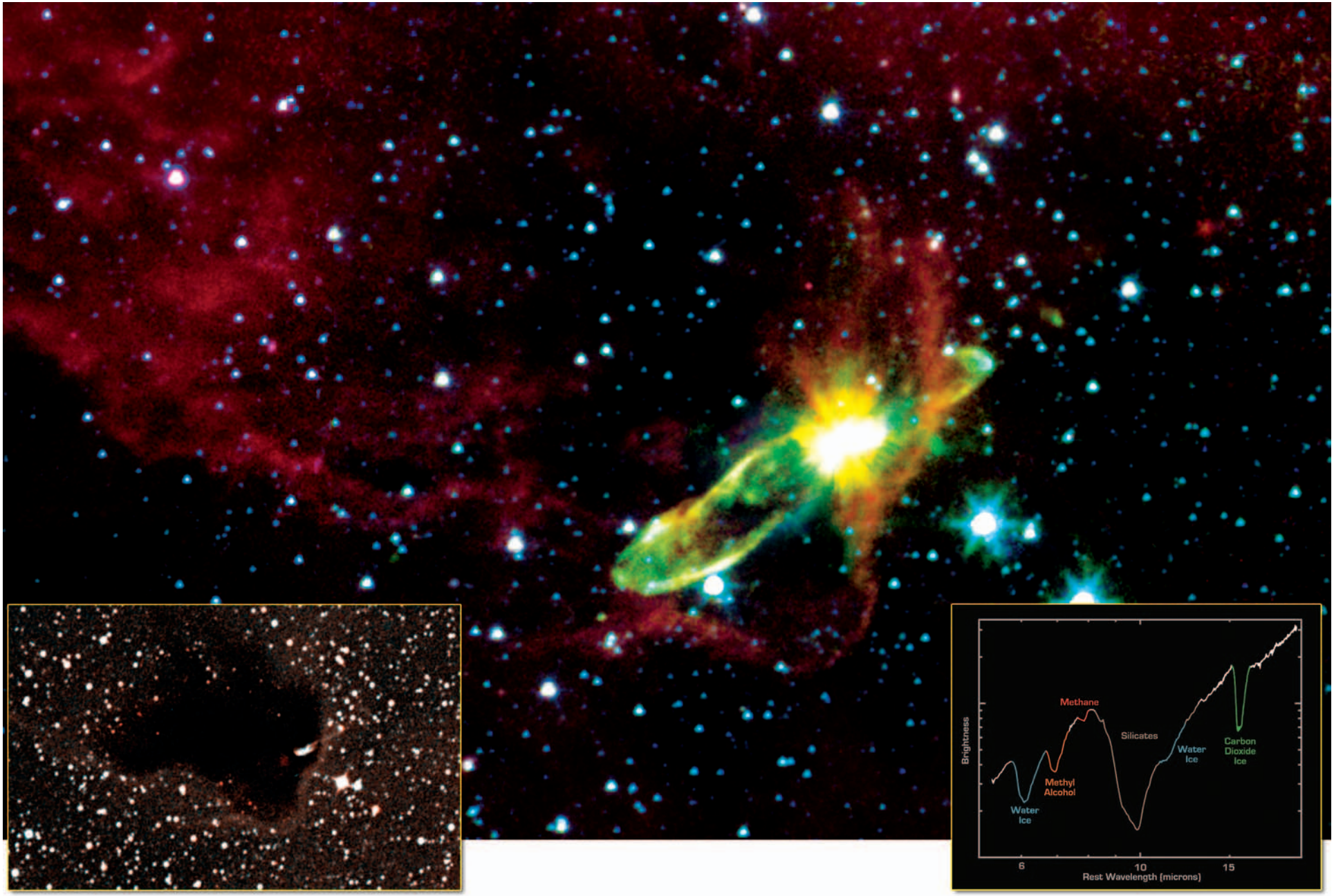

National Aeronautics and Space Administration

Jet Propulsion Laboratory
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The Young Star HH 46/47

SPITZER SPACE TELESCOPE

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This image from NASA's Spitzer Space Telescope transforms a dark cloud into a silky translucent veil, revealing the energetic outflow of a newborn, Sun-like star that is hidden from view to optical telescopes. Spitzer, using its sensitive infrared detectors, pierces through the dark cloud to reveal the Herbig-Haro object known as HH 46/47. The glowing curved line of gas in this image is the front of a huge shock wave that is traveling through space.

Herbig-Haro objects are bright regions of gas and dust that are usually buried within dark clouds. They appear bright because they are heated by the shockwaves generated by supersonic flows of gas from a nearby, developing star which has not yet stabilized. The young star, called a protostar, is usually still buried deep within the gas and dust cloud from which it formed and can often only be detected in the infrared.

In this image, the central protostar lies inside a dark cloud which is illuminated by the nearby Gum Nebula. Located at a distance of 1,140 light-years and found in the constellation Vela, the protostar is hidden from view in the visible-light image (left inset, Digitized Sky Survey/Caltech), buried deep within a dark dust cloud. Spitzer, using longer wavelengths of light, can see through this obscuring dust to the star and its dazzling jets of molecular gas. The reddish cloud shown in this image is the glow from organic molecules called polycyclic aromatic hydrocarbons. These molecules, made up of carbon and hydrogen, are excited by the surrounding radiation field and become luminescent.

HH 46/47 is a striking example of outflow from a developing star. Outflows characterize one of the most energetic phases of the formation of stars like our Sun. The jets arising from these protostars can reach sizes of trillions of miles and velocities of hundreds of thousands miles per hour. The twin jets of HH 46/47 are very powerful, speeding outward in opposite directions across a distance of over 9 light-years!

Most stars produce powerful jets while they are forming, in a process that is not yet completely understood. It is thought that the jets may help slow the young star's spin, in the same process that causes a spinning skater to slow down when extending arms outwards. By preventing the star from spinning too fast, the jets may help the star continue its growth by allowing it to continue gathering infalling material. The jets are associated with the presence of a circum-stellar disk that surrounds the young star. Such disks contain the material from which planets and moons could eventually form. Our Sun probably underwent a similar process some 4.5 billion years ago.

This Spitzer Space Telescope image was obtained with an infrared array camera that is sensitive to invisible infrared light at wavelengths about ten times longer than visible light. Emission at a wavelength of 3.6 microns is shown as blue, emission from 4.5 and 5.8 microns has been combined as green, and 8.0 micron emission is depicted as red. A micron is one millionth of a meter.

Spectrum

The spectrum of HH 46/47 (right inset) was obtained with Spitzer's infrared spectrograph. A spectrograph is a tool used by astronomers to split the light collected by a telescope into its colors (or wavelengths). This allows astronomers to study the details in the light from space and collect information about an object's composition, temperature, velocity, and much more.

The broad dip in the center of the spectrum shows the presence of silicates, which are chemically similar to beach sand. The depth of the silicate feature indicates that the dusty cocoon surrounding the embedded young star is extremely thick. Other dips are produced by water ice and carbon dioxide ice. The fact that water and carbon dioxide appear in solid form suggests that the material immediately surrounding the star is cold. In addition, the Spitzer spectrum includes the chemical signatures of methane and methyl alcohol.