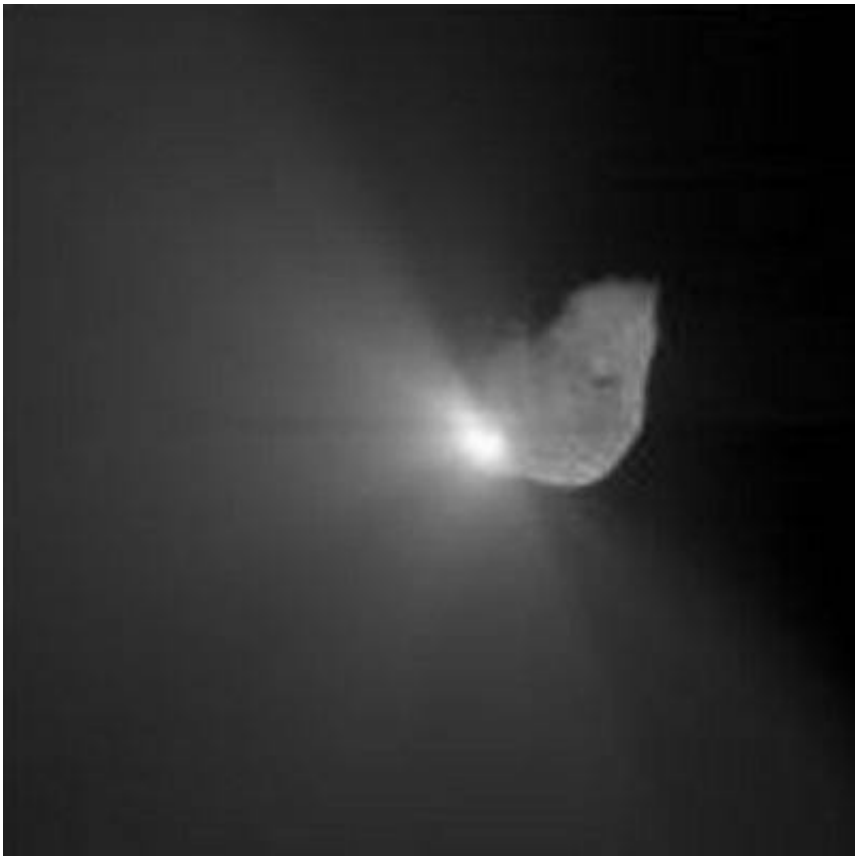
Daughters of Deep Impact: UM Proposed Missions Could Clear Clouded Comet Picture

April 24 2006



Over the past five years, three space missions -- Deep Impact, Deep Space 1 and Stardust -- have provided unprecedented information about comets. However, rather than clearing up the true nature of comets, the sometimes conflicting data from these missions have scientists

questioning almost everything they thought they knew about these fascinating, and potentially dangerous, objects.

Now, the University of Maryland-led team that produced the spectacular Deep Impact mission is proposing two new missions that they think can help coalesce the cloud of cometary information into solid ideas about the nature of comets, how they formed, how they have evolved and what role, if any, they may have played in the emergence of life on Earth. Both missions would build on the highly successful Deep Impact mission that on July 4th 2005 smashed a probe into Tempel 1 to reveal that comet's interior, its fluffy structure and weak materials. Deep Impact was the first large scale experiment ever conducted on a comet.

The proposed new missions are called DeepR and DIXI. DeepR (Deep-Rosetta) would clone the Deep Impact mission, building identical flyby and impactor spacecraft and targeting comet 67P/Churyumov-Gerasimenko (C-G), the destination of the European Space Agency's currently-in-route Rosetta mission. DIXI, which stands for Deep Impact eXtended Investigation, would use the surviving Deep Impact spacecraft and its three working instruments (two color cameras and an IR spectrometer) for a flyby of Comet Boethin in December 2008.

Like Deep Impact, DeepR and DIXI would be a partnership between the the University of Maryland, NASA's Jet Propulsion Laboratory (JPL), and Ball Aerospace & Technologies Corporation.

"One of the great surprises of comet explorations has been the wide diversity among the different cometary surfaces imaged to date," said Deep Impact leader and University of Maryland astronomer Michael A'Hearn, who would be principle investigator (PI) for DIXI and deputy PI for DeepR. Even on Tempel 1, the comet we've imaged the best, there is shocking variability in its surface. The comet's different surface types clearly have undergone different histories.

"These proposed missions are very cost effective ways to provide new results that can be directly compared to the landmark Deep Impact findings as well as with the results of Deep Space 1 and Stardust," said A'Hearn.

Jessica Sunshine, a scientist at Maryland who would be the principle investigator for the DeepR mission and deputy PI for DIXI, said, "By giving us high quality comparable data on two additional Jupiter class comets, these missions will help us figure out which characteristics of structure and composition are common among comets and which are more individual or distinctive characteristics."

A'Hearn, Sunshine and the other University of Maryland scientists who would be part of the missions say the data that would be obtained from these two missions would also will help scientists determine which characteristics of comet structure and composition are primordial, reflecting conditions and processes that existed 4.5 billion years ago when the solar system formed, and which are the result of evolutionary forces (heating and cooling, impacts, etc.) that have acted on comets since that time.

"Data from comets can help us to better understand the origin of the solar system, as well as what role, if any, comets may have played in the emergence of life on Earth," said Sunshine, who is a member of the Deep Impact science team. "However, we first must know which cometary characteristics are due to evolution and which are primordial."

Making a Deep-R Impact

Results from Deep Space 1, Stardust, and the Deep Impact experiment at comet 9P/Tempel 1 fundamentally challenge the existing paradigms on cometary formation, composition, and evolution. The DeepR (Deep Rosetta) mission will fly a build-to-print clone of the highly successful

Deep Impact mission to an encounter with comet 67P/Churyumov-Gerasimenko, which is the current destination of Rosetta, a mission of the European Space Agency (ESA).

Employing the experimental approach defined by Deep Impact mission, the DeepR mission would deliver to comet 67P/Churyumov-Gerasimenko an impactor that would collide with the comet at some 22,000 miles an hour (10 km/s) on July 29, 2015. The collision will expose the interior of 67P/ Churyumov-Gerasimenko to examination by a comprehensive set of instruments from both the DeepR flyby spacecraft and ESA's flagship-class Rosetta mission. These instruments will monitor the impact from two complementary viewing directions at high temporal and spatial resolution, -- including the formation of the crater and its subsequent evolution -- and provide unprecedented analyses of the components in the interior comet's nucleus.

"The DeepR experiment will leverage ESA's more than $1 billion Rosetta mission, which includes 11 orbiter and 10 lander experiments, to create the most complete knowledge set to date for any comet," said Sunshine.

She explained that the focus of DeepR is to determine if the variability seen on Tempel 1 extends to the chemistry and physical properties of other cometary interiors and to understand if findings from the material excavated from the interior of Tempel 1 are representative of comets in general. DeepR would employ the same experimental approach that we pioneered at Tempel 1," she said. "Since the only variable will be the cometary target, we will be able to directly compare the results of both experiments."

For, DeepR competing for selection by NASA is a two-step process. The first round is expected in September, 2006. If selected in that round, the DeepR team will write another larger proposal called a "concept study

report" that NASA will evaluate in the final selection process.

DIXI: Deep Impact eXtended Investigation

The Deep Impact flyby spacecraft made many surprising discoveries on approach to comet Tempel 1. These include an extremely fluffy composition that largely insulates the interior from heat experienced by the surface; frequent, natural outbursts; major differences in the distribution of carbon dioxide and water; craters and other surprising geological features; demonstration that the ice below the surface must be evaporating (subliming) to water vapor, and the first detection of ice (a very small amount) on a cometary nucleus.

"There are clearly large differences between Tempel 1 and the much younger Wild 2 [pronounced Vild 2], visited by the Stardust mission," said A'Hearn. Deep Impact's flyby spacecraft and payload are still healthy. We propose to direct the spacecraft for a flyby of Comet Boethin in December 2008 in order to investigate whether the results found at comet Tempel 1 are unique or are found on other comets. Obtaining data of the same type on a second, similarly evolved comet is crucial to our understanding.

"Since half the discoveries at Tempel 1 were from the flyby data taken before impact, DIXI can return half the science of Deep Impact for much less than 10 percent of the cost of Deep Impact," he said. "From the point of view of cost effective science, an extended mission such as DIXI is unbeatable"

NASA's decision to select DIXI or a competing mission proposal is expected in September, 2006.

Source: University of Maryland