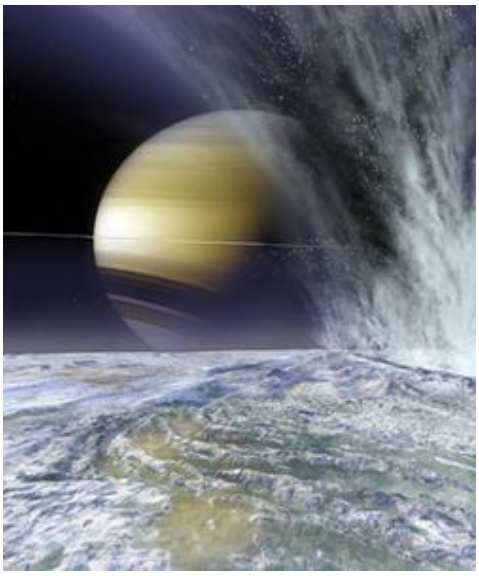
Scientists explain intriguing phenomenon on Saturn's moon



Geyser on Enceladus. Credit: Michael Carroll, www.stock-space-images.com

An enormous plume of dust and water spurts violently into space from the south pole of Enceladus, Saturn's sixth-largest moon. This raging eruption has intrigued scientists ever since the Cassini spacecraft provided dramatic images of the phenomenon.

Now, physicist Nikolai Brilliantov, at the University of Leicester, and colleagues in Germany, have revealed why the dust particles in the plume emerge more slowly than the water vapour escaping from the moon's icy crust.

Enceladus orbits in Saturn's outermost "E" ring. It is one of only three outer solar system bodies that produce active eruptions of dust and water vapour. Moreover, aside from the Earth, Mars, and Jupiter's moon Europa, it is one of the only places in the solar system for which astronomers have direct evidence of the presence of water.

The erupting plume on Enceladus is ejected by geyser-like volcanic eruptions from deep, "tiger-stripe" cracks within the moon's south pole. Some astronomers have suggested that the myriad tiny grains of dust from these eruptions could be the actual source of Saturn's E-ring. However, the dynamics and the origin of the plume itself have remained a mystery.

Now, Brilliantov, who is also on the faculty at the University of Potsdam, Germany and Moscow State University, working with Juergen Schmidt and Frank Spahn of Potsdam and Sascha Kempf of the Max Planck Institute for Nuclear Physics in Heidelberg, and the Technical University of Braunschweig, Germany have developed a new theory to explain the formation of these dust particles and to explain why they are ejected into space.

The researchers point out that once ejected the dust particles, which are in fact icy grains, and water vapour are too dilute to interact with each other and so the water vapour cannot be the cause of the dusty slowdown. Instead, the team suggests that the shift in speed must occur below the moon's surface before ejection.

The numerous cracks through which the plume material escapes from the moon's icy surface, and which can be hundreds of metres deep, are narrower at some points along their length. At these points temperature

and pressure of vapour drop drastically down, causing condensation of vapour into icy grains and hence to formation of the dust-vapour mixture. The required vapour density to accelerate the grains to the observed speeds implies temperatures where liquid water can exist in equilibrium with solid ice and water vapour within the moon's frozen crust.

These peculiar conditions allow the water vapour to erupt rapidly carrying with it the dust particles. However, these particles undergo countless frequent collisions with the inside of the channel walls which causes friction that slows them down before final ejection. The larger the particle the slower the ejection speed. This effect, quantified by the new theory, explains the structure of the plume and eventually the particle size distribution of the E-ring of Saturn.

The existence of liquid water is a prerequisite for life and, while not suggesting there is life on Enceladus, offers another extraterrestrial place that might be searched.

The scientists published details of their findings in the journal *Nature*.

Source: University of Leicester