Plume profile studies of Nanosecond laser induced desorption of water ice –*amorphous versus crystalline* -

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Introduction: Recently, macromolecular organic compounds have been detected from the depths of Saturn's Moon Enceladus by NASA's Cassini.[1] The Jovian Moon Europa is soon to be subject to close investigation by both NASA's upcoming Europa Clipper and ESA's JUputer ICy moons Explorer (JUICE). The ocean worlds are of particular interest for the search of extraterrestrial life within our solar system.

Both Enceladus and Europa are covered with a presumably active ocean underneath the thick ice shell. Enceladus has cryo-volcanic plumes that actively expel material from its subsurface ocean. Active plumes are also present on Europa,[2] as has been unveiled by re-examining the data from the Galileo mission. It is likely that in the future *in situ* investigation of these highly active locations, with fresh material from the ocean is required to determine if molecules associated with life are present. However, getting detailed insights of the composition of ice is challenging. One of the possible instruments for investigation of these ices is combining laser induced desorption with time-of-flight mass spectrometry.[3,4,5]

At NASA's Jet Propulsion Laboratory, we have used the two-color Laser Ablation Ionization Mass Spectrometer system to study such ice-surface analogous.[3] The system has the capabilities to simulate relevant conditions, encountered on the ocean worlds. The structure of the ice, depends on the temperature at which this ice is deposited. IR laser desorption combined with multiphoton ionization mass spectrometry, provides insights into the desorption dynamics of amorphous and crystalline ices and their propagation in the plume. By introducing different species in low abundances into the ice structure, we can study if these molecules follow the same trend in extraction time as the water molecules. These fundamental investigations are essential for understanding the processes at play.

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