ON THE NEAR-SURFACE HABITABILITY OF EUROPA'S TRAILING HEMISPHERE. Murthy S. Gudipati[1], Bryana L. Henderson[1], Fred Bateman[2], Shawn Kang[1], and Henry B. Garrett[1]; [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109; [2]Dosimetry Group, National Institute of Standards and Technology (NIST), 100 Bureau Drive, Gaithersburg, MD 20899.

Abstract: Radiation could be both a giver and a taker of life, particularly in Europa's environment. While energy that is stored in oxidants could be useful for life, radiation itself could be lethal. In order to assess near-surface habitability of Europa, we need to conduct studies that simulate realistic Europaean conditions. Our study presented here is first steps towards this overarching goal.

Introduction: The Jovian magnetosphere consists of ions such as H^+, O^+, S^+, and electrons at MeV energies. In addition, solar photons also accompany the local radiation to bombard on Europa's atmosphereless surface. Electrons penetrate by far the deepest with estimates of a few centimeters to tens of centimeters on the trailing hemisphere of Europa, where electron energies up to 25 MeV are expected to reach the surface. Electrons with higher energy than 25 MeV would land on the leading hemisphere, though their flux drops exponentially [1]. As a consequence, this radiation environment is on one hand a source for energetic oxidants that can support life's energy/oxidant needs, but on the other hand, could be harmful for the potential life or tracers of life such as organic biomolecules. With Europa orbiter and lander mission concepts on the horizon, it is critical to understand and quantify the role of Europa's radiation environment on potential life, if it exists close to the surface.

Motivation: As mentioned earlier, electrons penetrate through ice by far the deepest at any given energy compared to protons and ions, making the role of electrons very important to understand. In addition, secondary radiation – Bremsstrahlung in X-ray wavelengths – is generated during high-energy particle penetration through solids. Secondary X-rays are equally lethal to life and penetrate even deeper than electrons, making the cumulative effect of radiation on damaging organic matter (and on life) on the near surface of Europa a complex process that could have effects several meters below Europa's surface [2].

Methods: In order to quantify this effect under realistic Europa trailing hemisphere conditions, we devised, built, tested, and obtained preliminary results using our ICE-HEART instrument. Our Ice Chamber for Europa High-Energy Electron And Radiation-Environment Testing (ICE-HEART) operates at ~100 K. The telescopic chamber can accommodate ice cores up to 110 cm in length and diameters of ~ 6 cm. We use a novel Halbach cylindrical magnet to remove electrons allowing only X-rays to pass through, giving us unique opportunity to determine the role of secondary X-rays on Europa's near-surface habitability.

Results: With the Halbach magnet, we have collected photon and electron-penetration data for several different lengths and compositions of ice cores, and are in the process of comparing our results with current models. Our preliminary results show that NaCl and $MgSO_4$-containing ices that are thought to be relevant to Europa [3] (and which have higher Z values than pure ice) produce more secondary electrons and less Bremsstrahlung. Preliminary results from these studies will be presented and the relevance to the Europa lander mission concept will be discussed.

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