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Low-Energy Energetic Neutral Atom Imaging of Io Plasma and Neutral Tori

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Io's plasma neutral tori play significant roles in the Jovian magnetosphere. We present a feasibility study of measuring low-energy energetic neutral atoms (LENAs) generated from the tori. We calculate the LENA flux between 10 eV and 3 keV, which covers the energy range of the corotational plasma flow. The differential flux is typically 10^3–$10^5 \mathrm{cm}^{-2}\mathrm{sr}^{-1}\mathrm{s}^{-1}\mathrm{eV}^{-1}$ near the energy of the corotation measured from the Ganymede orbit. It is above the detection level of the planned LENA sensor that is to be flown to the Jupiter system with a time integral of 0.01–1 seconds. The flux is typically observed from the dawn side of Jupiter. The observed flux will exhibit periodicities though the assumed ENA generation is time independent, which can be attributed to the Jovian magnetosphere rotation and the rotation of Io around Jupiter. The energy spectra will exhibit dispersion signatures, because of the non-negligible flight time of the LENAs from Io to the satellite. In 2030, the Jupiter exploration mission JUICE will conduct a LENA measurement with a LENA instrument, the Jovian Neutrals Analyzer (JNA). From the LENA observations collected by JNA, we will be able to derive characteristic quantities, such as the density, velocity, velocity distribution function, and composition of plasma-torus particles. We also discuss the possible physics to be explored by JNA in addition to the constraints for operating the sensor and analyzing the obtained dataset.