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Plasma in Europa's near space environment.

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Europa orbits Jupiter outside the worst of Jupiter's intense radiation belts but still immersed in an almost fully ionized gas composed of mostly Sulphur and Oxygen products redistributed via transport and charge exchange from the volcanic moon Io, along with a smaller proportion from Europa itself. We are motivated by recent inferences of plume activity observed in situ at Europa by the Galileo spacecraft [Jia et al., 2018] as well as relatively well documented association of surface darkening with incident radiation [Paterson et al., 2012] to explore the effect on Europa and its plumes of electron-impact and thermal plasma in general. Plasma, thermal and radiation (very energetic particle) processes affect the production of near-surface ambient gas and plasma at Europa – as has been observed both remotely and in situ and may eventually be directly measured by instruments on the Europa Clipper. Plasma distributions near Europa are often assumed to be well-represented by a Maxwellian distribution with electron temperature a few 100 eV, ions a few keV and density a few 10s per cc. As we know from studies with Cassini at Saturn [e.g. Rymer et al., 2008] and inferences at Jupiter [Scudder et al., 1981] the observed plasma distributions are not Maxwellian and instead are usually comprised of a bi-modal hot/cold component – a surprising situation for space plasmas, as waves and other instabilities tend to rapidly isotropize any bi-modality. In this presentation we will use re-analysis of Galileo plasma data by Heuer et al., 2018 along with magnetic field data in order to discuss where thermal to supra-thermal plasma has access to the Europa surface and implications for plasma observations at Europa with the Europa Clipper Spacecraft.