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Global morphology of ENA emissions from the atmosphere-magnetosphere interactions at Europa and Callisto

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We analyze the emission of energetic neutral atom (ENA) flux from charge exchange between Jovian magnetospheric ions and the atmospheres of Callisto and Europa. For this purpose, we combine the draped electromagnetic fields from a hybrid plasma model with a particle tracing tool for the energetic ions. We determine the ENA flux through a spherical detector that encompasses the entirety of each moon's atmosphere, thereby capturing the complete physics imprinted in these emission patterns. In order to constrain the modifications to the ENA emissions that arise from the periodic change of the ambient plasma conditions, we calculate the emission morphology at multiple positions during a Jovian synodic rotation. To isolate the influence of field line draping, we compare to the emission patterns in uniform fields. Our major results are:
(a) At Europa and Callisto, the majority of detectable ENA emissions are concentrated into a band normal to the Jovian magnetospheric field. (b) The fraction of observable ENA flux that contributes to this band depends on the number of complete gyrations that the parent ions can complete within the moon's atmosphere. (c) Field line draping partially deflects impinging parent ions around both moons, thereby attenuating the ENA flux and driving significant morphological changes to the emission patterns. (d) The band of elevated ENA flux contains a local maximum and a local minimum in intensity, on opposite sides of each moon. At Europa, detectable ENA emissions are maximized slightly west of the ramside apex. At Callisto, they maximize near the Jupiter-facing apex.