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Origins of Europa Na Cloud and Torus

FRANCOIS LEBLANC[1], A. E. POTTER[2], R. M. KILLEN[3], R. E. JOHNSON[4]

[1] *Service d'Aéronomie du CNRS/IPSL, Verrières-le-Buisson, France.*

[2] *National Solar Observatory, Tucson, Az., USA.*

[3] *University of Maryland, College Park, Md., USA.*

[4] *University of Virginia, Charlottesville, Va. USA.*

Following the discovery observations by Brown et al. (1996), only few new observations of Europa Na cloud and torus have been reported (Brown 2001, 2004). Previous works (Johnson et al.2002, Leblanc et al.2002) have reproduced some of these observations and concluded that the origin of Europa's Na cloud is primarily sputtering of Europa's surface by Jovian magnetospheric energetic particles. Leblanc et al. (2002) suggested there was a correlation of the rapid variation of the total content of Europa's Na cloud with the variation of Europa's Jovian centrifugal latitude. The contribution to the observed signal due to Na atoms ejected from Io and energetic Na ejected from Europa by atmospheric sputtering were also considered. In this work, we present improved results using a more accurate description of the variation of the magnetospheric incident flux, electron impact ionization and Io background with respect to Europa's and Io's positions in Jupiter's magnetosphere. We also describe the energetic component due to atmospheric sputtering. This model of the sodium cloud is constrained by new observations of Europa's sodium cloud close to Europa's surface by Potter and co-workers also presented here. Their high spectral resolution provides unprecedented detail of the velocity distribution of the Na atoms at different positions aroundEuropa and for various Europa positions around Jupiter. This analysis confirms a number of earlier conclusions and highlights observed variations of Europa Na cloud with respect to Europa's local time within the Jovian magnetosphere. These large observed variations require that the ballistic transport across Europa's surface must be taken into account. Brown, M. E. and R. E. Hill, Nature, 380, 229, 1996. Brown, M. E., 2001, 151, 190, 2001. Brown, M. E., Submitted to Icarus, 2004. Johnson R. E., Leblanc F., B. V. Yakshinskiy and Madey T. E., Icarus, 156, 136-142, 2002. Leblanc F., Johnson R. E. and Brown M., Icarus, 159, 132-144, 2002.