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Water cluster chemistry and photoelectrons in the Enceladus plume

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Abstract

The plume of Enceladus is a remarkable plasma environment containing several charged particle species. These include cold magnetospheric electrons, negative and positive water clusters, charged nanograins and 'magnetospheric photoelectrons' produced from ionisation of neutrals throughout the magnetosphere near Enceladus. Here we review the various populations, including the water cluster ions and the relevant chemistry. We also discuss observations of a newly observed population by the CAPS ELS instrument – photoelectrons produced in the plume ionosphere itself. These were found during the E19 encounter, in the energetic particle shadow where penetrating particles are absent. Throughout E19, CAPS was oriented away from the ram direction where the clusters and nanograins are observed during other encounters. Plume photoelectrons are also clearly observed during the E9 encounter, and are also seen at all other Enceladus encounters where electron spectra are available. This new population, warmer than the ambient plasma population, is distinct from, but adds to, the magnetospheric photoelectrons. Here we discuss the observations and examine the implications, including the ionization source these electrons provide.