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Europa's Interaction with the Magnetosphere of Jupiter

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Galileo's observations of magnetic field in the vicinity of Europa have shown that Europa does not possess an appreciable internal magnetic field. However, Europa strongly modifies its plasma and magnetic field environment by directly interacting with the magnetosphere of Jupiter. The plasma interactions cause the absorption of Jovian plasma by the moon, pick-up of newly formed ions from the exospheres of the moon, plasma diversion by electrodynamic (Alfvén wing) interaction and the formation of a long wake in the downstream region. In addition to the electrodynamic interactions, Europa also displays electromagnetic induction response to the rotating field of Jupiter presumably from the conducting presence of global salty liquid oceans inside the moon.

Galileo successfully encountered Europa 10 times during its mission. We are developing quantitative 3-D MHD models of plasma interactions of Europa with Jupiter's magnetosphere. In these models we include the effects of plasma pick-up and plasma interaction with a realistic exosphere as well as the contribution of the electromagnetic induction. We will present results of these quantitative models and show that the plasma interaction is strongest when Europa is located at the center of Jupiter's current sheet. We find that plasma mass loading rates are extremely variable over time. We will investigate various mechanisms by which such variability in mass-loading could be produced including episodically enhanced sputtering from trapped gaseous molecules in ice and enhanced plasma interaction with a vent(s) generated dense exosphere. The new model will aid researchers in planning observations from future missions such as JUICE and Europa flagship mission.