Study of Relativistic Electron Beam Propagation in the Atmosphere- Ionosphere-Magnetosphere

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Abstract: Models for propagation physics and associated ionospheric/atmospheric modification have been developed for the space-based injection of relativistic (E(-) 1-100 MeV) electron beams. Initial evaluations of beam propagation effects in the ionosphere, magnetosphere, and atmosphere have been conducted. The overall goal of this work was to develop computational tools and use them to better assess relavistic beam launch, propagation, and interaction with the space environment and atmosphere. Computational tools developed and then applied to this problem. include models addressing: beam propagation using an envelope equation; integrated beam-atmosphere interactions (This model contains time- dependent chemistry effects necessary to compute optical emissions as a function of altitude); beam launch and propagation using particle-in-cell (PIC) techniques; and magnetospheric propagation and plasma transport (Khazanov models). It is concluded that for practical beam energies and current the beam propagation is stable This is done theoretically and using the PIC modeling. Over long distance propagation the Khazanov models were able to show that the beam particles will scatter in pitch-angle and relative location, but lifetimes are expected to be similar to those found for the radiation belts for nearly equatorial mirroring injection.

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