The Magnetosphere-Ionosphere Observatory (MIO): An Ongoing Heliophysics Mission Concept Study.

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Introduction: Insufficiently accurate magnetic-field-line mapping between the ionosphere and the equatorial magnetosphere has prevented us from determining the causes of many types of ionosphere/atmosphere phenomena. A specific example is the longstanding question of how the magnetosphere drives quiescent auroral arcs: a large number of diverse generator mechanisms have been hypothesized but equatorial magnetospheric measurements cannot be unambiguously connected to arcs in the ionosphere, preventing the community from identifying the correct generator and energy-conversion mechanisms..

The MIO Mission: The MIO mission concept is a swarm of 5 spacecraft designed to measure critical gradients in the equatorial magnetosphere and near-Earth magnetotail. One spacecraft carries a 1-MeV electron accelerator that is fired along the magnetic field from the magnetosphere into the atmospheric loss cone where the electron beam optically excites the upper atmosphere, unambiguously illuminating the magnetic footpoint of the magnetospheric swarm. Optically locating the beamspot using an array of ground cameras (the TREx array extended into Alaska), magnetospheric measurements can be unambiguously connected to ionospheric phenomena. Orbits will be chosen such that the atmospheric magnetic footpoint of the swarm passes near HAARP and PFISR one time every 24 hours. Multiple technical challenges that must be overcome for this mission concept include spacecraft charging, beam dynamics, beam stability, and detection of the beam spot in the presence of aurora [cf. Borovsky et al., J. Atmos. Solar-Terr. Phys., 206, 105310, 2020].

Decadal White Papers: The MIO team welcomes concepts for scientific collaborations with ground-based science. As part of the NASA Mission-Concept-Study process the MIO team will submit two white papers to the Decadal Survey, one describing the science justification for MIO and one describing the mission engineering study. The MIO team is interested in collaborating with other ground-based-research white papers.

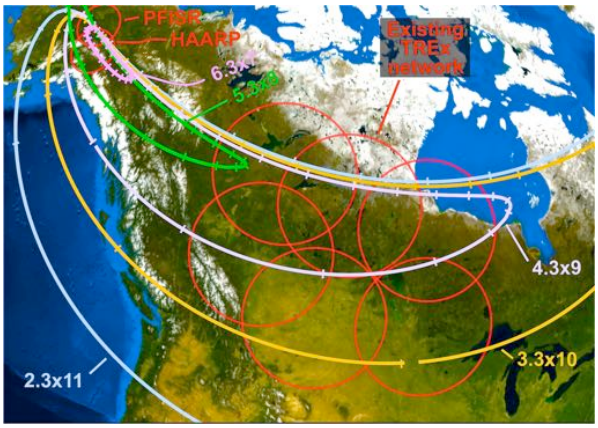

Figure. Approximate magnetic footpoints of the MIO swarm for various orbit choices. The pink 4.3 R_E by 9 R_E 24-hr equatorial orbit is the most favorable.