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Space Plasma Generator for Controlled Enhancement of the Ionosphere

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We are presenting an innovative space plasma generator, using explosive-driven flux compression generators to convert explosive chemical energy to electromagnetic energy. We will then use a Joule heating to heat up light metallic load in a sub millisecond time scale to transform the load from a solid metallic state to a first ionization plasma state going through multi-phase transitions to generate an artificial man-made plasma cloud in the ionosphere. The target plasma cloud will be composed of 1025 ion-electron pairs of fully-ionized plasma with a few eV temperature propagating initially as a plasma disk jet, cylindrical jet, or linear jet depending on the choice of load material and geometry. This is the required amount of plasma to control enhancement of the ionosphere over the wide area of application zone. We also present analytical/computational studies of the generated plasma and plasma cloud interacting with the ionosphere and the geomagnetic field. Major mechanisms of plasma generation and initial plasma disk jet formation have been identified during parametric studies of plasma liner simulations. We used the ALEGRA-MHD code with the multi-phase equation of state and conductivity models to study multi-phase transition, plasma formation, and initial plasma evolution. Many interesting plasma physics phenomena in later time scales will be discussed, including ambient geomagnetic flux compression dynamics, high kinetic beta plasma evolution, and dense plasma recombination. We studied the dispersal of the injected artificial plasma clouds, their interaction with the ambient particles and magnetic field as a function of the injection altitude, ambient ionospheric parameters and energy and mass of the injected artificial plasma over several hours. A sounding rocket can be utilized to demonstrate the device performance in ionospheric test environments.

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