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Grid-based Solenoid-free Start-up Modeling of 2nd Harmonic Electron Cyclotron Heating and Current Drive[1] MASAYUKI ONO, NICOLA BERTELLI, Princeton Plasma Physics Laboratory, HROSHI IDEI, KAZUAKI HANADA, SHINICHIRO KOJIMA, TAKUMI ONCHI, HATEM ELSERAFY, Kyushu University — The QUEST ECH solenoid-free start-up experiment utilizing the 28 GHz gyrotron at 2nd harmonic frequency has demonstrated remarkable efficiency and record start-up current values. A grid-based modeling code where the plasma parameters, generated plasma currents, and resulting changing poloidal magnetic fields are evolved from the vacuum fields. A new feature of this model is the inclusion of the neutral collisions and ionization terms in the model. Formation of hot trapped particles, which then generates processional current, provides improved confinement limited only by collisions even in the open field line configuration. The ECH heated grad-B drift driven current together with the processional currents can then create a closed flux surface configuration where the bootstrap current can further enhance the plasma current. Once plasma temperature is sufficiently high >1 keV, a single-pass absorption can rise sufficiently for ECCD to become dominant. This entire start-up process is a self-amplifying "explosive" nonlinear problem, where a very rapid plasma current rise can be expected.

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Masayuki Ono
Princeton Plasma Physics Laboratory

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