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Detailed reconstruction of the magnetic-field profile penetrating into a nearly-collisionless plasma RAMY DORON, BOAZ RUBINSTEIN, JONATAN CITRIN, RON ARAD, YITZHAK MARON, Weizmann Institute of Science, AMNON FRUCHTMAN, Holon Academic Institute of Technology — Observations of nearly-collisionless plasmas interacting with pulsed magnetic fields reveal rich physics and intriguing, unexplained phenomena. Among these are the mechanism of rapid (non-diffusive) magnetic-field penetration, the structure of the propagating magnetic front, the fate of the dissipated magnetic energy, and the particle dynamics. We utilize highly-resolved spectroscopy to study the penetration of a ∼1 T magnetic field into a low resistivity plasma ($n_e \sim 10^{14}$ cm^{-3}, $T_e \sim 6$ eV). The magnetic-field profile is determined from Doppler-shifted line-emission of ions at the *edge* of a trace-element column that are pushed by the magnetic field. This technique allows for achieving submilimeter spatial resolution, approaching the electron skin-depth scale. Reliable Doppler-shift measurements allow for determining field magnitudes as low as 0.2 T, which are extremely difficult to measure via Zeeman spectroscopy under the present conditions. Moreover, the measured ion velocities enable to calculate self-consistently the plasma compression. These calculations predict the build up of a density shock that may induce instabilities behind the penetrating magnetic front.

Ramy Doron
Weizmann Institute of Science

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