Hypervelocity Dust Beam to measure profiles of the magnetic field direction in NSTX

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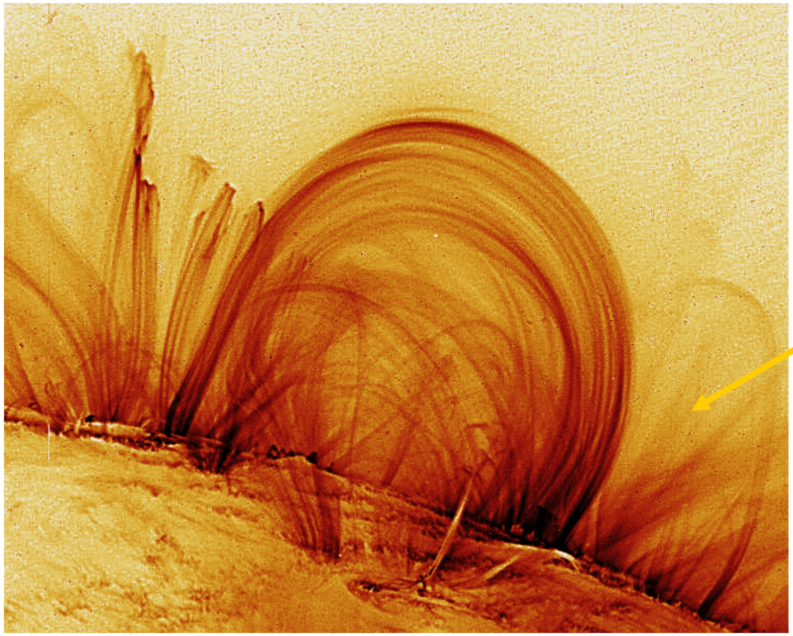
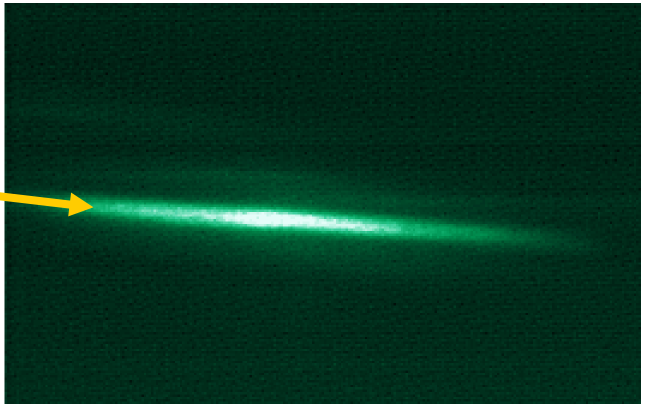
Dust injection is a new way to visualize magnetic field in multiple dimensions when neutrals are otherwise absent

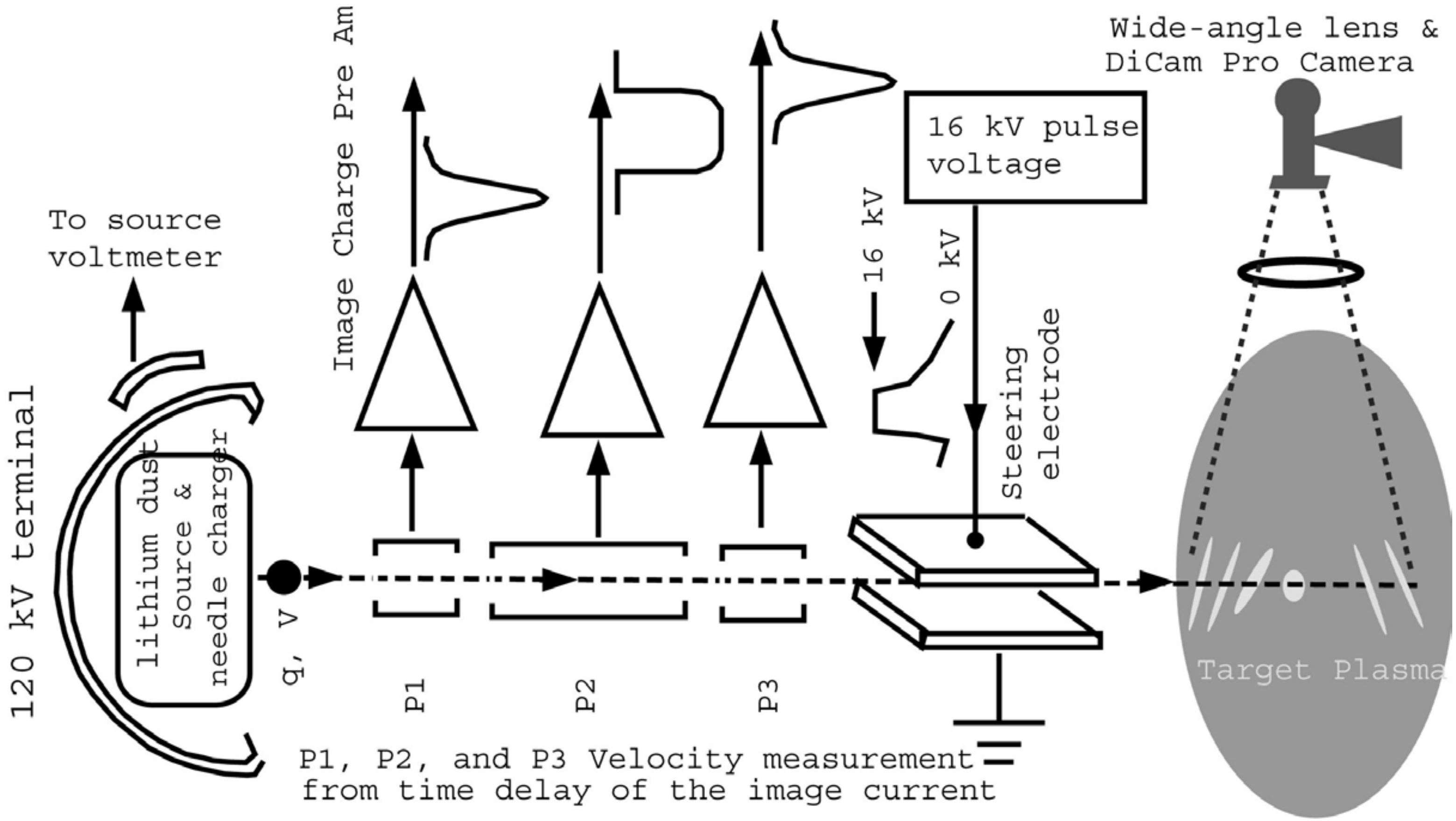


Imaging of magnetic field structures is possible (TRACE satellite photo in Fe IX 171 Å light, Nov. 6, 1999)

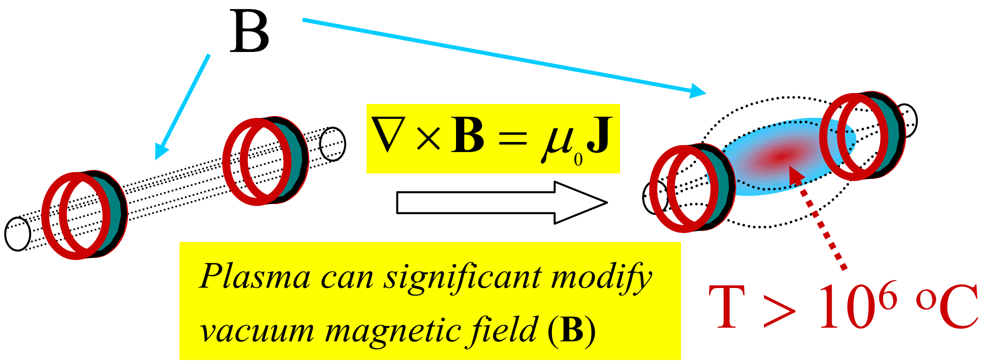


Large pellets have been used previously to visualize the local magnetic field angle in high temperature plasmas (the tilt of the Lithium pellet cloud holds this information in Li^{+} 460 nm green light).

We will image the tilt of the micro-pellet plasma tail, which contains the local magnetic field direction information. High velocity dust is the key to penetrating a hot plasma.



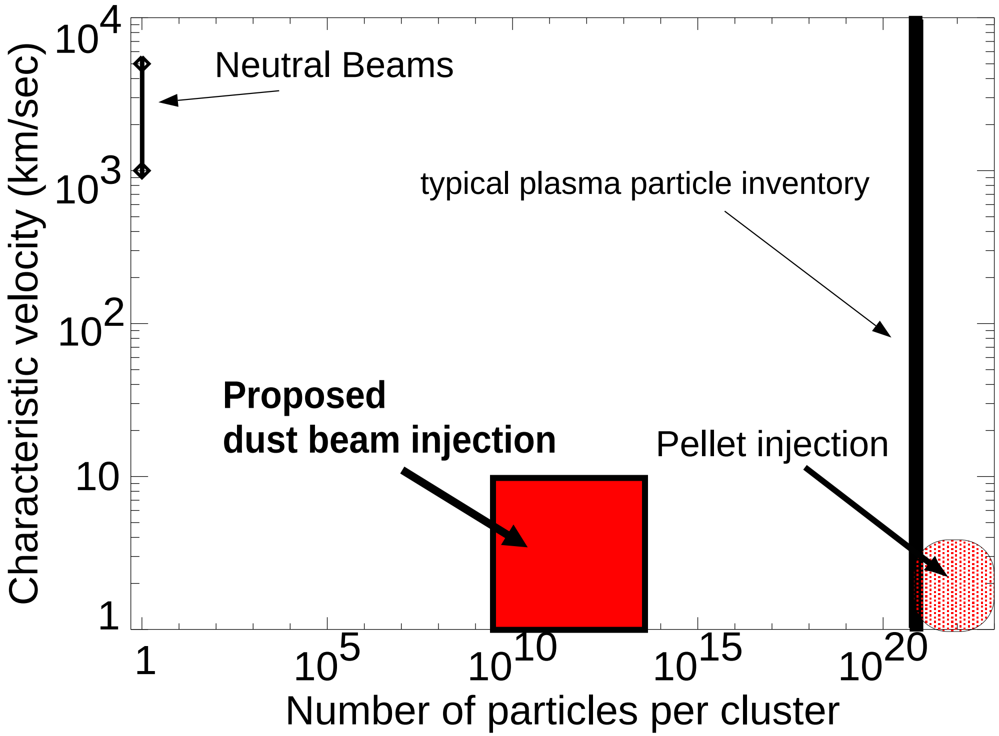
Measurement of internal magnetic field is critical to the high temperature plasmas research



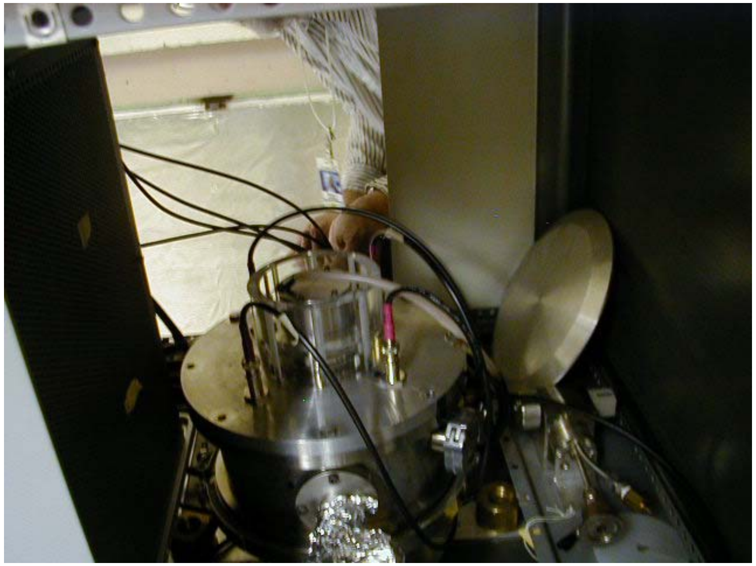
We are the first to propose the concept of dust beam injection for <u>internal</u> magnetic field mapping; [RSI, 2003]

Our technology (diagnostic) will enable measurements of magnetic fields in a hostile plasma environment in a routine way previously not possible

Our dust beam will be a *non-perturbing **B**-field mapping tool* in plasma regimes hotter and denser than previously accessible



- μsec time resolution
- Large S/N ratios (>100)
- Direction of magnetic field at multiple points in space and time
- Electrostatic dust acceleration to these velocities is a proven technology.



Our proposal begins with using some existing electrostatic dust accelerator hardware presently at the old tandem Van de Graaff at LANL

Point design: 5 micron lithium dust, 2×10^{13} atoms per dust particle, dust velocity = 6 km/s; peak photon emissivity = 1×10^{19} s^{-1} cm^{-3} for a 200 eV, 10^{20} m^{-3} plasma in a 1 kG magnetic field

Scientific and technical goals

FY04

- To resurrect an existing dust accelerator system and modify to accommodate dust injection needs;
- To characterize and measure various dust properties, including dust charge, and achieved velocity;

FY05

- To accelerate lithium-deuteride/carbon dust to hypervelocity in 1-10 km/s range using existing 120 kV electrostatic method, with a delivery system consistent with the dust particle density as described;
- To obtain optical images of the injected dusts into a plasma, such as that of the P-24 Flowing Magnetized Plasmas facility, or Reconnection Scaling eXperiment; and

FY06

To demonstrate internal 2-D magnetic field visualization and mapping by injecting the dust beam into NSTX. Goal is to image ~100 dusts at a time, strung out across the NSTX midplane, with high resolution visible imaging camera. The direction of the ablation plumes will be along the local magnetic field lines.