

Technical details of DIMAG

Chamber

Main experimental chamber will be aluminum 18" tall with an 18" diameter.

Chamber will be octagonal and each face will accept a 6" square flange

Top will be 0.5" thick aluminum plate that will accept an ISO150 nipple (6" diameter, 18" long)

Also be extensions that are approximately the same size as the experimental chamber that can be stacked on the main experimental chamber.

Will be capable of rotating inside the magnet coils (?)

Magnets

Preliminary design by Joe Minervini and the Magnet Design Group at the MIT Plasma Science and Fusion Center

Set of four superconducting solenoid magnets in two stacks of two.

Coils will have a bore of 50 cm bore and separated by 23 cm to allow diagnostic access.

This configuration allows for a 100 cm wide x 100 cm tall uniform region (<1% variation) in the center of the chamber with a maximum field strength of 4.7 T in this region. Stronger fields will be observed outside this region (as large as 6.9 T near the coils). This region is larger than what is observed in the magnetic facility at MPE.

Each magnet can be controlled separately to produce uniform fields and a field gradient (latter would be unique)

Coils will have the capability of rotating about the chamber (?)

Superstructure must be aluminum and strong enough to counter magnetic forces

Source

Initial design will be based on what is currently used at the MPE facility – an rf discharge between parallel plates.

As the facility is developed other sources will be tried, including an inductively coupled source (possibly at 100s MHz), dc discharge (very smooth plates will be needed), UV source (could make dust-electron plasma)

Sources that are not expected to work include filaments (magnetic forces on filament) and heated cathode (thermophoretic forces on particles)

Diagnostics

Standard diagnostics can be used with larger (>1 μm) particles (video imaging, PIV, etc.)

Other diagnostics will be needed for smaller particles. These include using a UV laser and camera (190 nm) to directly visualize particles down to ~200 nm, optical extinction measurements (multiple pass, use polarization to reduce intensity), surface plasmon resonance (see nm particles) in gold or silver particles, CCD detector to observe density fluctuations (similar to what is used with smoky plasmas), harmonics with the rf source/rf coupling and probes, etc.

Control System

System will be automated (LabVIEW?) and will have the capability to be run remotely.
Need large storage array

Other

Particles over a wide range of sizes (nm to μm scale) and materials (paramagnetic, superparamagnetic, metal, etc.) will be used. Can be grown in-situ or injected.
Safety systems are important – similar to what is seen at NMR systems (metal detectors, alarms, etc.)
No motors can be in regions of high magnetic field (no turbo pumps, use pneumatic/piezoelectrics).
No stainless steel should be used.