Ad hoc Workshop on Magnetized Dusty Plasmas

October 19 – 21, 2009

Auburn University, Auburn, Alabama

Supported by National Science Foundation Grant No. PHY-0936470

AUPSL
Auburn University Plasma Sciences Laboratory

AUBURN
UNIVERSITY

Agenda – Tuesday, October 20

- 8:00 am Continental Breakfast
- 8:30 am Session 3: Experiments with a magnetized dusty plasma (M. Rosenberg)
  - Development of plasma sources
  - Development of diagnostic systems
  - Safety issues
  - Operating as a user facility
- 10:30 am Coffee Break (15 min)
- 11:45 am Break for lunch (Arricia Restaurant)
- 1:30 pm Session 4: Broader plasma community / Long-term funding
  - Education and outreach plans
  - Connections to fusion and space communities
  - Securing long-term funding
- 3:30 pm Coffee Break (15 min)
- 4:45 pm End afternoon session
- 6:15 pm Gather at lobby for walk to dinner (Amsterdam Café)

Day 1 - Summary

- Update on overall project status (Thomas)
  - Status of MRI proposal path
  - Preliminary discussion of facility parameters
  - Early discussion of project goals
    - Need for community-wide effort (user facility approach)
    - What is the National/international impact (Hyde)
    - Connections to regional universities (Robertson)

- Conditions for dust magnetization (Merlino)
  - Particle size, pressure, charging effects
  - General discussion of conditions for magnetization – is it limited by dust-neutral collisions or dust-dust interaction?
  - Experience from other experiments
    - Neutrals may play a modifying role
    - E x B effects may be more significant (MPE, Sato experiments)
    - Outstanding question – magnetic field affect on charge

Day 1 - Summary

- Experimental questions (Robertson)
  - Types of plasma sources
    - Filaments (no), Q-machine(?), RF plates (MPE), DC plates (?), inductive RF (no)
    - May be a critical issues (Merlino, Robertson)
  - Diagnostics
    - PMT approach – sensitive to density fluctuations, not individual particles
    - Metallic nanoparticles – using surface plasmon resonance (Rosenberg)
    - UV laser / camera system – down to ~200 nm (Thomas)
    - Visible lasers – for particles down to 1 μm (Konopka)
  - Cloud size
    - Gas flow to fill a volume with dusty plasma? (Robertson)
    - 10's of layers of strongly coupled system (Konopka)
    - Dropping particles into volume (Merlino)
  - Safety
    - Similar to a NMR facility – concern about loose metallic objects
    - Interlocks with metal detectors
    - Bring in PPPL/MIT/NHMFL safety experts before operation (Zwicker)
    - Review relevant OSHA/EU guidance (Konopka)

Day 1 - Summary

- MPE experiences (Konopka)
  - Hardware/construction
    - More time that was expected – delay in superconductor fabrication
    - More personnel needed (wanted 5 FTE's – had 1.5)
    - Minimize use of ferrous materials anywhere near device – fringe fields may disturb magnetic field homogeneity.
    - Use piezo-electric manipulators
  - Initial experiments
    - Confirmed cloud rotation in response to ion E x B flows (Sato)
    - Noted initial linear increased followed by saturation => E(B)
    - Issues with filamentation – possibly related to close electrode spacing?
  - MPE focus going forward
    - Single particle forces
    - Confinement and deflection of grains in magnetic fields
    - Strongly-coupled effects
    - Charging

Day 1 - Summary

- Project physics goals
  - Build on single particle results and extend to large clouds?
  - Focus on large dust clouds vs. 10's on monolayers – 3D effects?
  - Emphasize collective effects?
  - Emphasize wave and instabilities?
  - Have a specific focus on para- and ferro-magnetic materials and mixtures with "regular" particles – possibility to another type of phase transition using magnetic effects?

Day 1 - Summary

- Initial experiments (w/o magnetic field)
  - Experiments to map magnetic field?
  - If using thermophoresis, experiments on cloud size (w/o B)
  - Probably on larger particles – for ease in imaging
  - Confirm E x B flow effects

- Building on past experiments
  - Larger experimental volume – can it be filled with a dusty plasma?
  - 4 coil system with independent current control – extends B and allows controllable grad B – structural forces?
  - Ability to rotate magnets and chamber – experimental restrictions?
  - What type of plasma source - ??
  - Is there a configuration that will allow uniform field region in the extension region?
  - Should we have the ability to heat/cool electrodes (w/ water lines?) to use thermophoresis to extend dust cloud extent?