

# Update of Free Surface Liquid Metal Flow Experiments

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## Experimental (PPPL)

H. Ji

J. L. Peterson

J. R. Rhoads

N. Morley (UCLA)

## Theory/Simulation

D. Giannakis (Chicago)

R. Rosner (Chicago/Argonne)

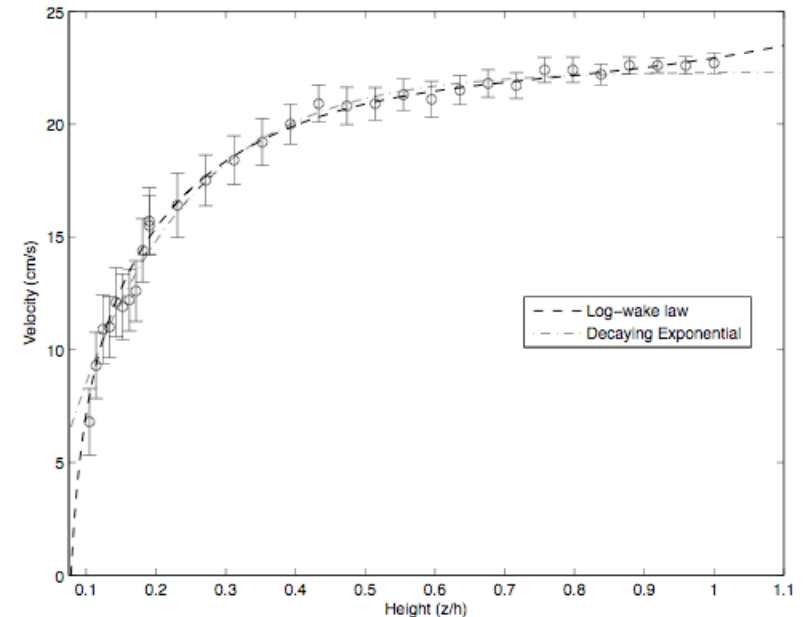
P. Fischer (Argonne)

PFC E-Meeting

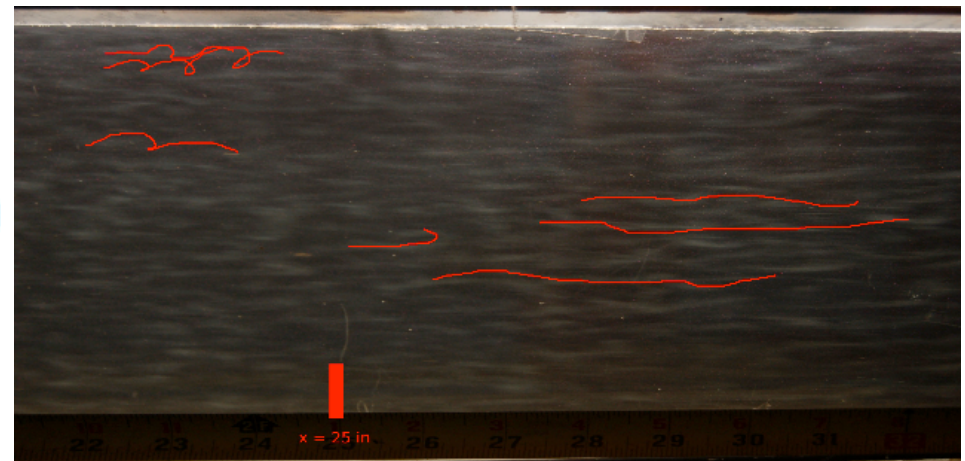
Feb 13, 2008

# Hydrodynamic Channel Flow

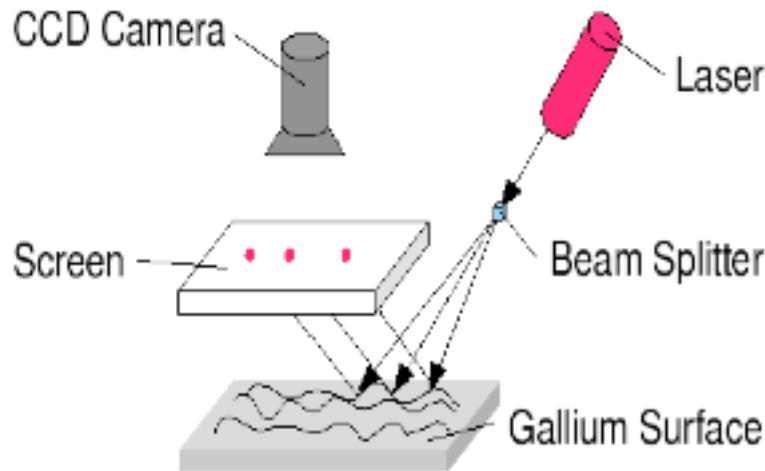
- LDV measurements show that the flow profile is well-modeled by a turbulent boundary layer using the Coles wake law (overlap region between log-layer and viscous layer)
- Flow visualization with Kalieroscope reveals eddies elongated in the downstream direction (3D structure)



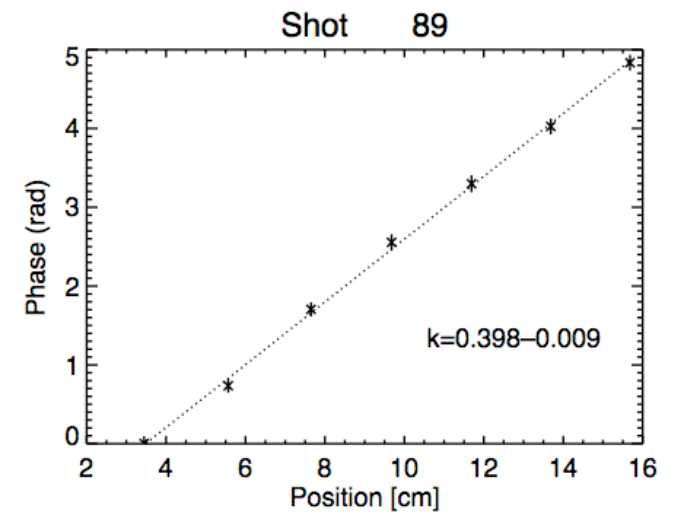
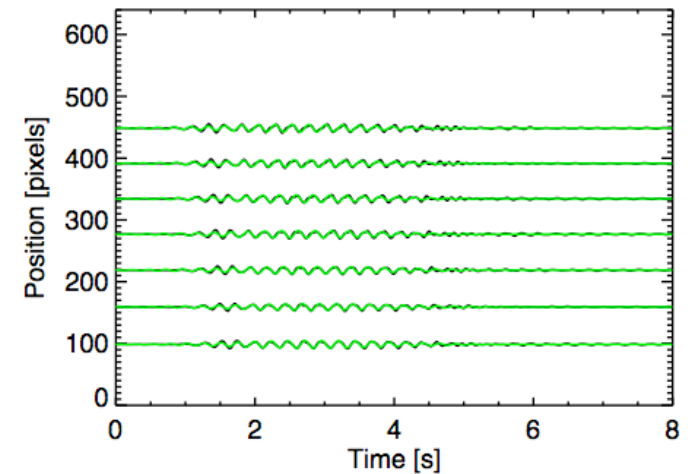
$$v^+ = \underbrace{\frac{1}{k} \ln z^+}_{\text{log law}} + \underbrace{\frac{2\Pi}{\kappa} \sin^2 \left( \frac{\pi z}{2h} \right)}_{\text{wake law}}$$



# Experiments in progress on wave propagation in a magnetic field

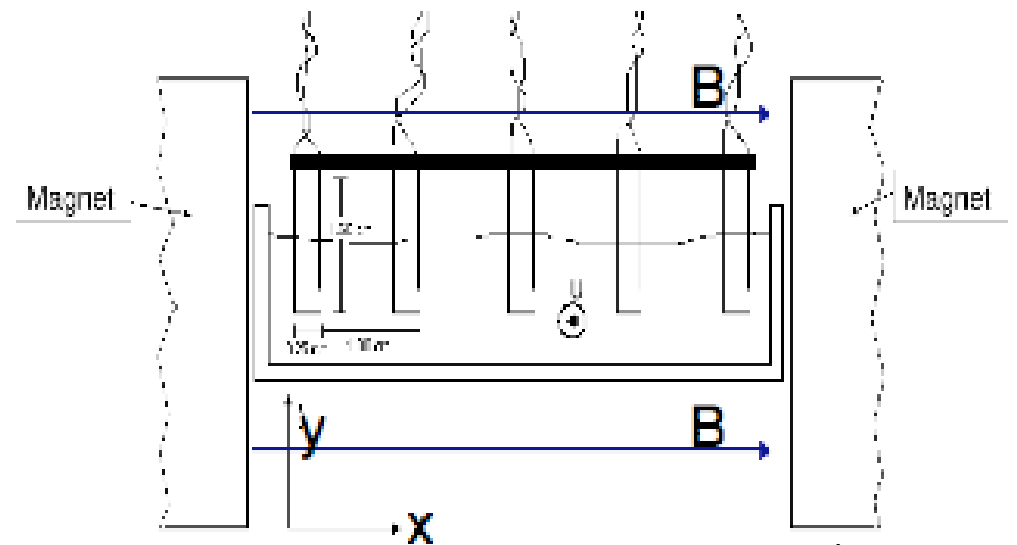
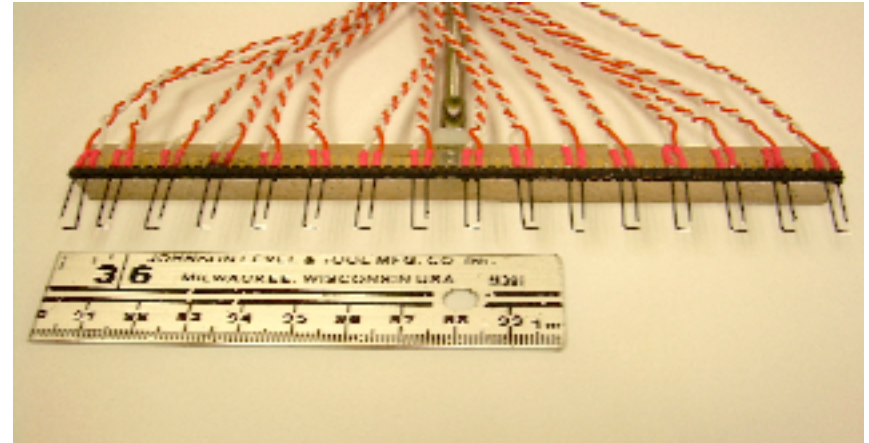


- Wave phase velocity is determined by measuring wavenumber of fixed-frequency driven wave
- Dispersion relation mapped out for flows with and without a magnetic field
- Examine effect of magnetic field on shear instabilities



# MHD Velocimetry

- Potential probe diagnostic will be used to map flow profile in liquid metal
- Study Hartmann Flow effects in wide, free surface channel flow
- Anticipate observation of velocity profile peaking in channel center due to current-free region



# Summary and Future Plans

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- **Current activity**
  - **Studying pump-driven flow of GaInSn in free surface channel**
  - **Can apply a cross-channel magnetic field of up to 3 kG**
  - **Exploring surface stability of an MHD turbulent boundary layer with laser reflection diagnostic**
  - **Potential probe velocimetry diagnostic to measure Hartmann effects in wide free surface channel flow**
- **Future plans**
  - **Explore stability and velocity profile with a vertical magnetic field**
  - **Attempt to vary shear profile by applying a voltage at discrete points in the channel**
  - **Study effects of a vertical temperature gradient and thermal transport in turbulent shear flow**