Task II general status and progress on task II experiments

Neil Morley

on behalf of Task II drones

APEX Electronic Meeting

February 27, 2001

Experimental damping of flow separation by a magnetic field:
Dresden University of Technology

Task II Agenda

Focused on studying phenomena and model/experiment development

Here

Overview of experimental status - Morley

Overview of modeling status - Smolentsev

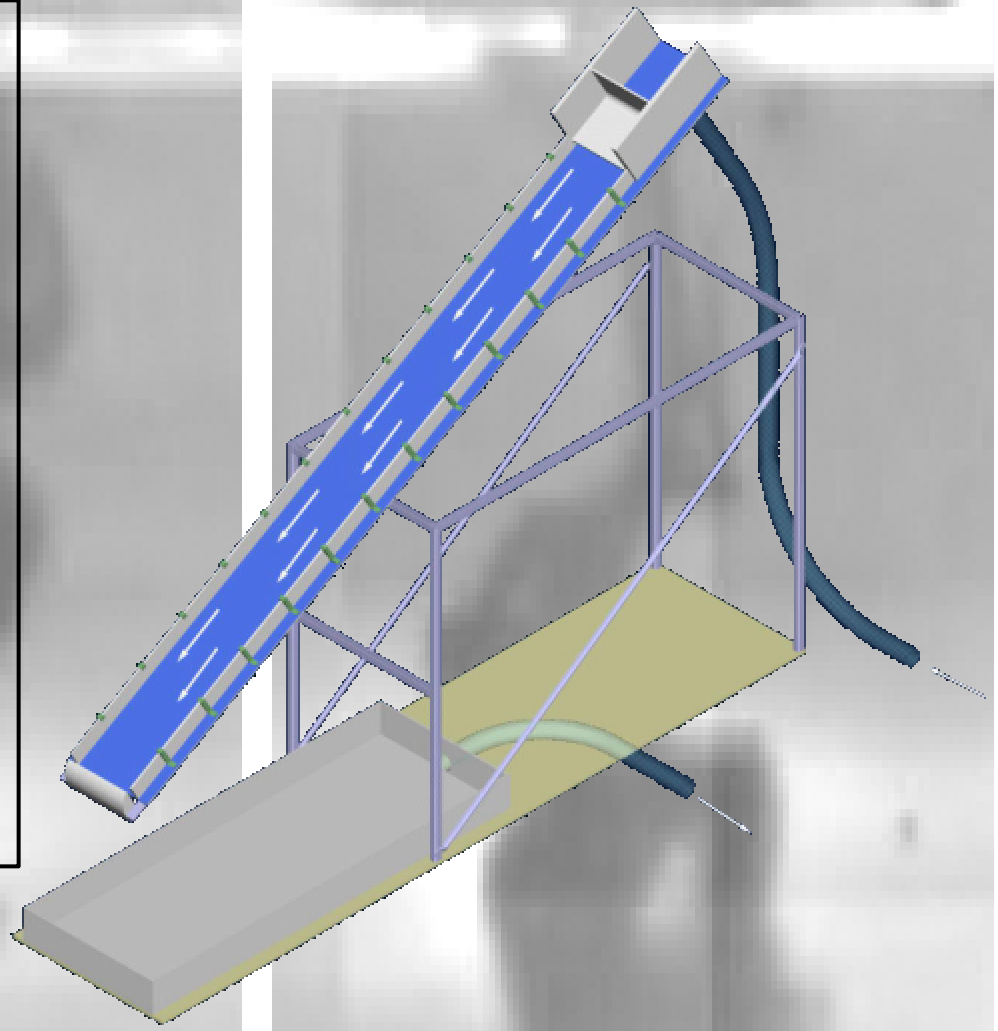
Elsewhere

Applications of models to NSTX and ARIES
(covered in Task I and III sessions)

Bulk plasma interactions
(covered in Task B session)

Interfacial Transport Experiments in FLIHY

- **Large scale test section with water/electrolyte flow will generate LW relevant flow**
- **Tracer dye and IR camera techniques will be used to measure interfacial transport at free surface**
- **PIV and LDA systems for quantitative turbulence comparison to DNS**



Visualization of sinking and dispersing milk drop in water

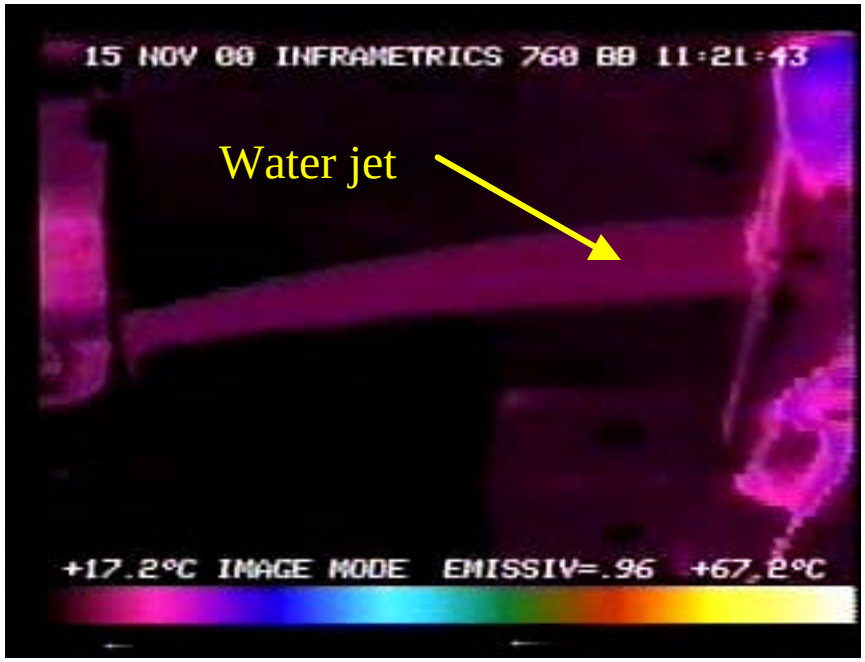
2 cm

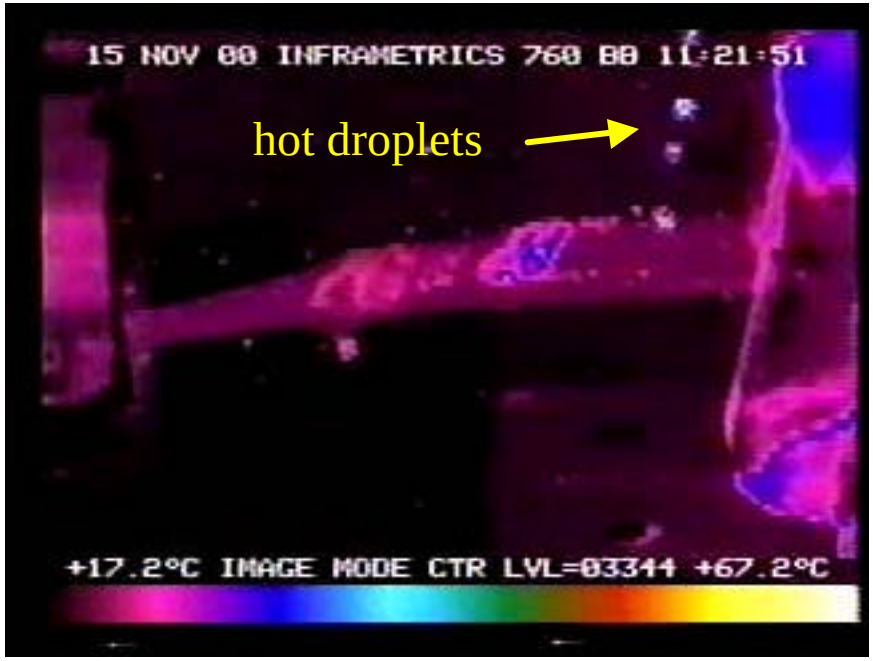
FLIHY Equipment Status

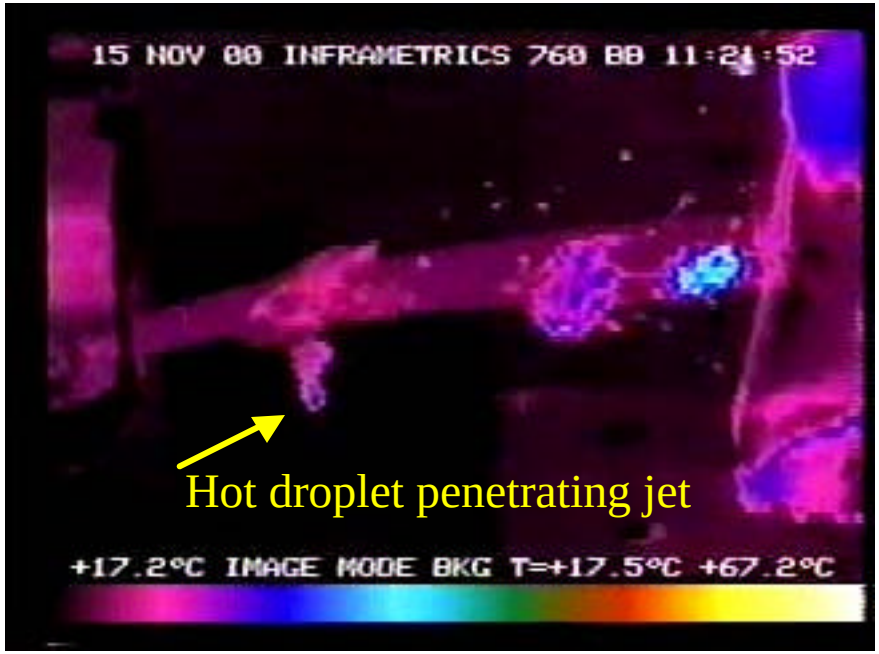
COMPONENT	VENDOR	STATUS
Pump Module	Evans Hydro.	Late February
Frame Module and Catch Basin	FYZ Welding	Late February
Turbine Flow Meter	S.C. Controls	Arrived
4” hoses cam-locks	Evans Hydro.	Not Yet Ordered
4m Lexan Sheeting	Cadillac Plastic	Arrived
Planar Test Channel	Acratech Corp	Mid February
Straight Pipe Test Module (J-II)		**Under Design**
Curved Test Module		Under Design
IR Heater	Casso-Solar	Arrived

Dynamic Infrared measurements of jet surface temperature

Impact of hot droplets on cold water jet (~8 m/s) thermally imaged in SNL/UCLA test



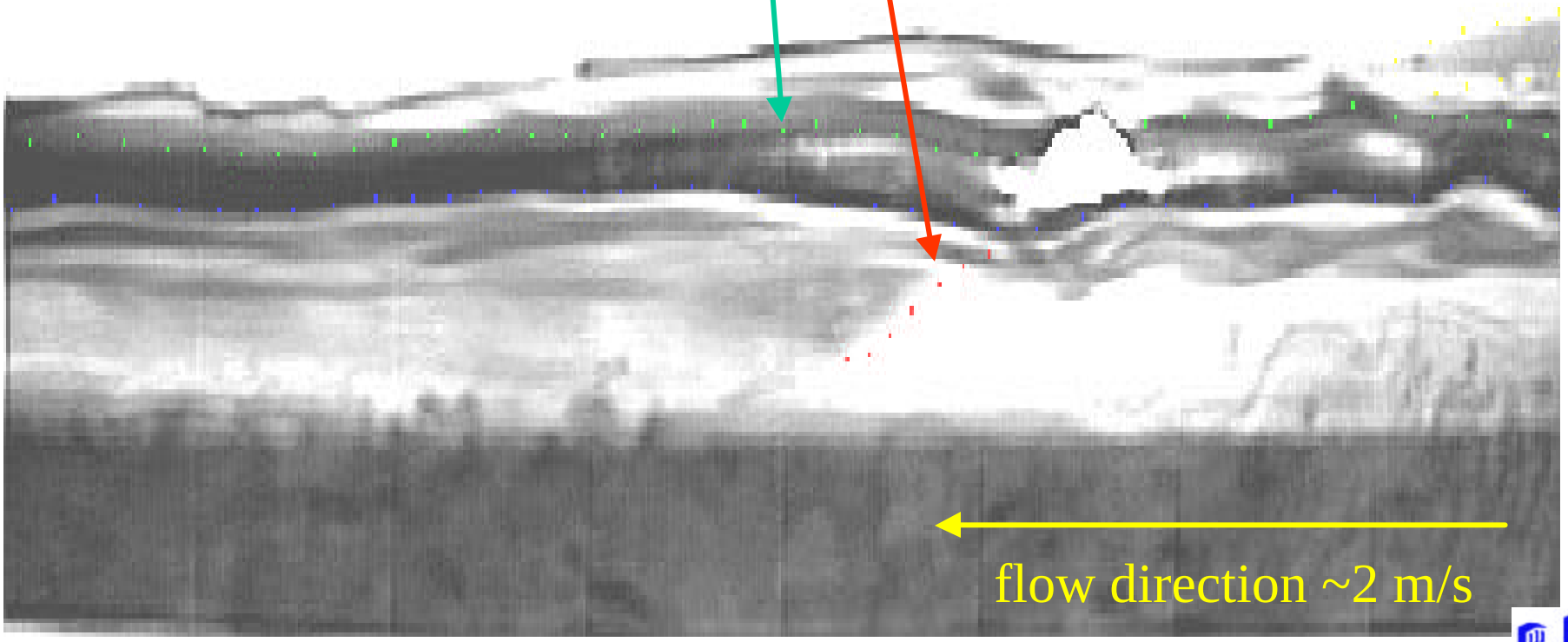




Dye Technique Testing for FLIHY

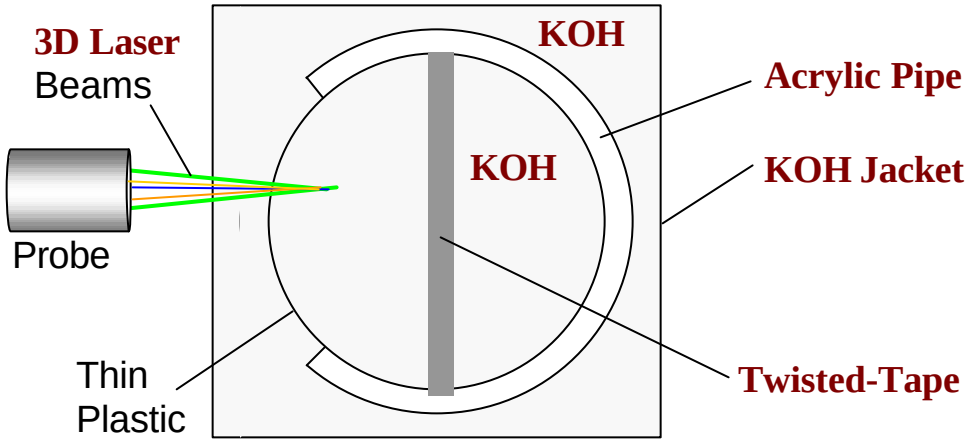
Profile of dye penetration (**red dots**)

Local free surface (**green dots**)



JUPITER-2 Collaboration:
Complex pipe shape effects on turbulence and high Pr heat transfer

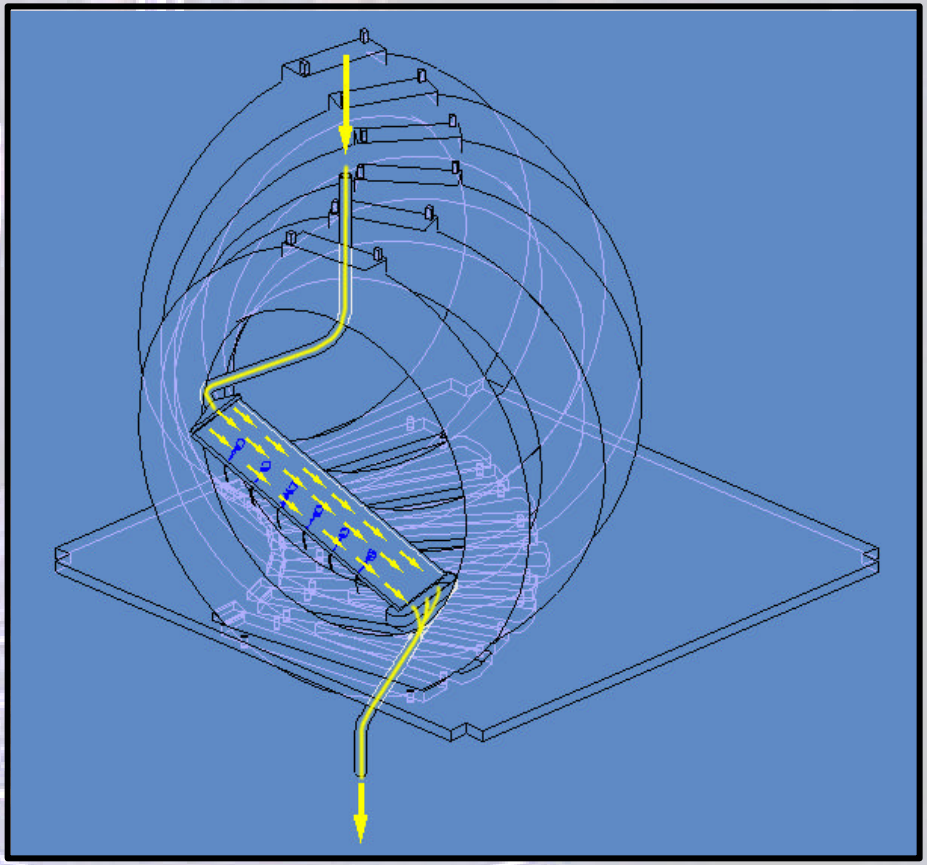
Purpose: Pipe flow experiments with complex inner wall surface like fins are performed to develop an understanding of high heat flux removal applied for the High-Pr. fluid system.



Diagnostics: Pipe and free surface test section on improved FLIHY with transparent structure and windows, and with functions of inclination or rotatory movement and magnetic field, LDV/PIV and hot-film anemometers

Exploring Free Surface LM-MHD in MTOR Experiment

- **Study toroidal field and gradient effects:** Free surface flows are very sensitive to drag from toroidal field 1/R gradient, and surface-normal fields
- **3-component field effects on drag and stability**: Complex stability issues arise with field gradients, 3-component magnetic fields, and applied electric currents
- **Effect of applied electric currents**: Magnetic Propulsion and other active electromagnetic restraint and pumping ideas
- **Geometric Effects**: axisymmetry, expanding / contacting flow areas, inverted flows, penetrations
- **NSTX Environment simulation:** module testing and design

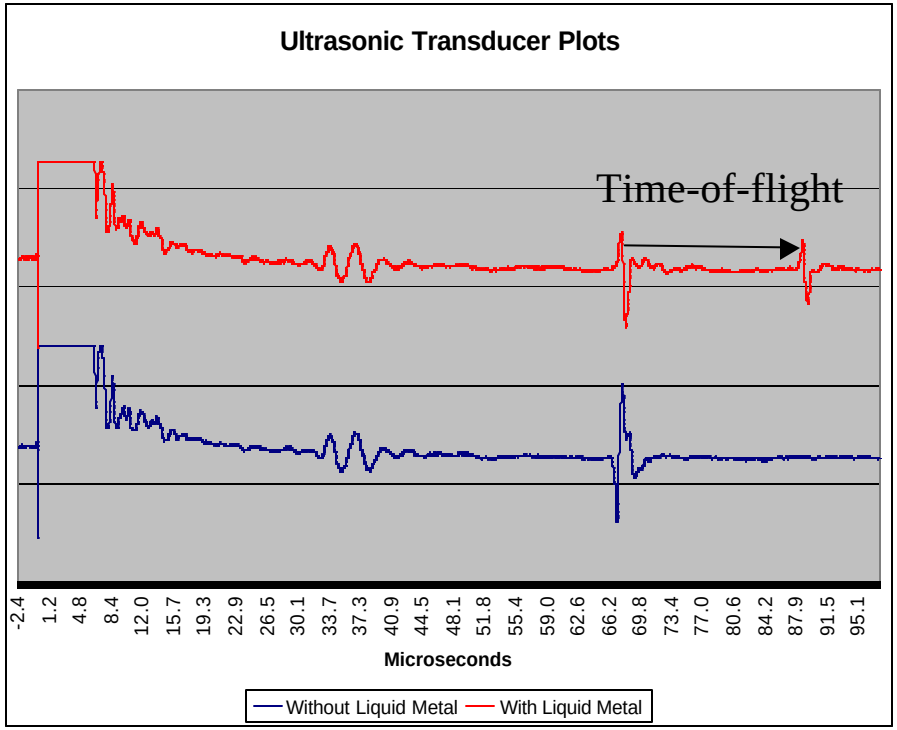


APEX

MTOR Magnetic Torus and LM Flowloop: Designed in collaboration between UCLA, PPPL and ORNL

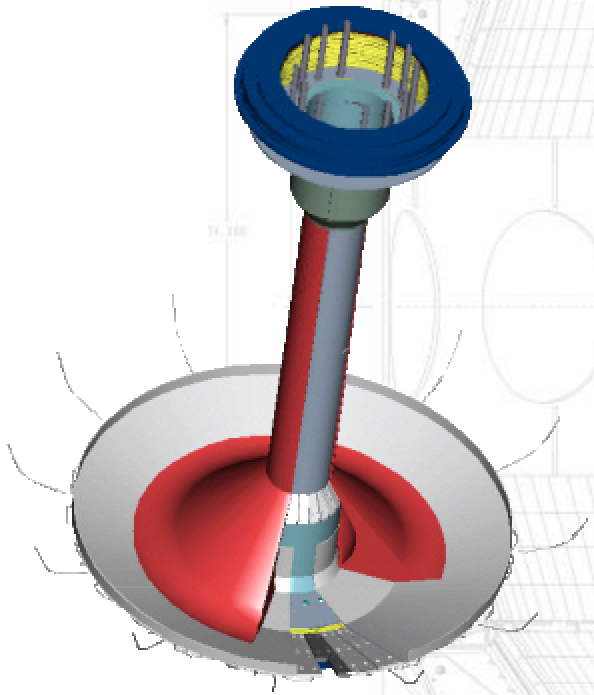
Current Status MTOR Facility

- PPPL DC power supply wired, debugged, “meggared”, and tested with no load.
- Water coolant loop installed
- Small Ga loop (1L) operating
- 16 L Ga alloy on order from Russia
- Ultrasound diagnostics working, automatic data acquisition still under development
- Safety consultation with GA completed

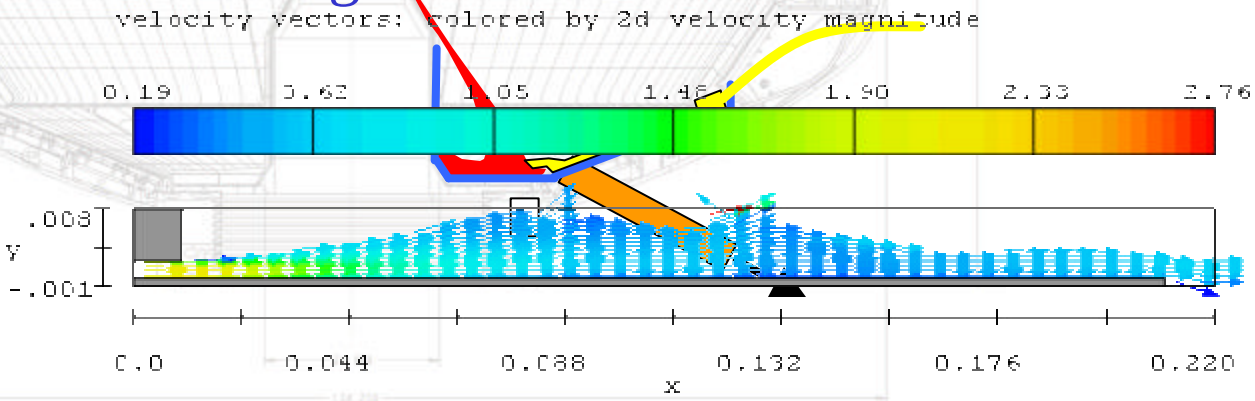


Typical ultrasound plot with and without liquid metal present

Flowing Lithium in NSTX



- Centerstack and inboard divertor options were explored first - most impact on heat removal.
- MHD forces were strong but manageable. Start-up and shut-down effects still need to be analyzed
- More conservative outboard mid-plane and lower divertor modules now under investigation.



MHD film flow instability from vertical field on inboard divertor - UCLA simulation