Front End Technologies

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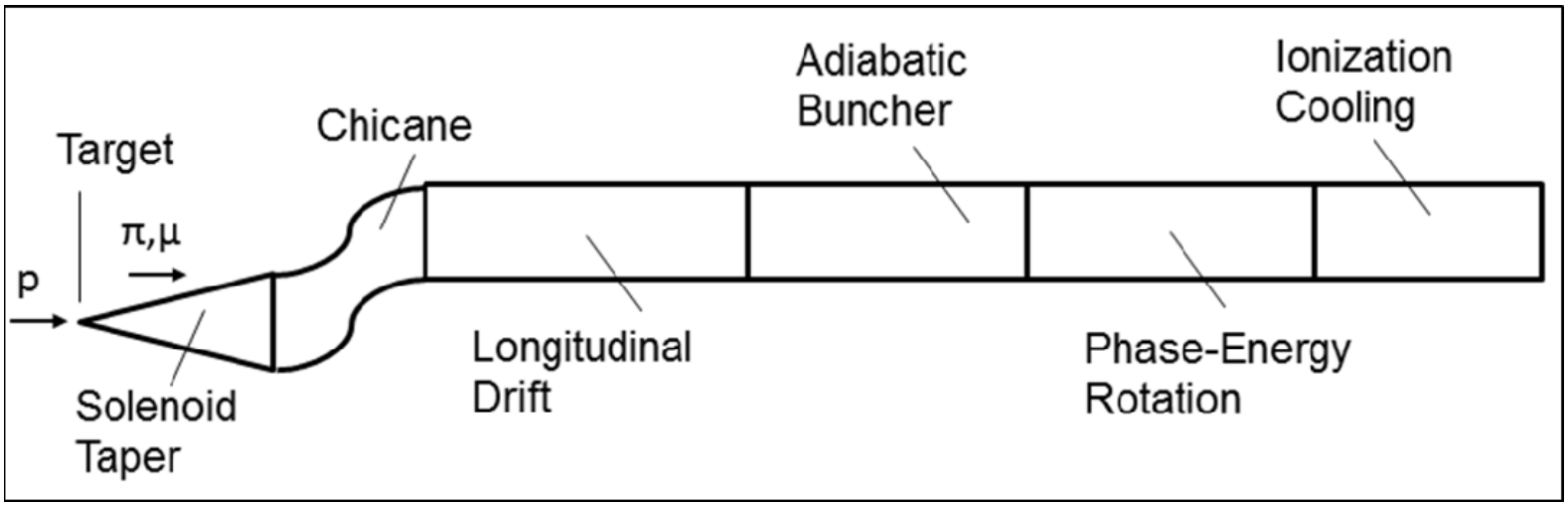
The Front End



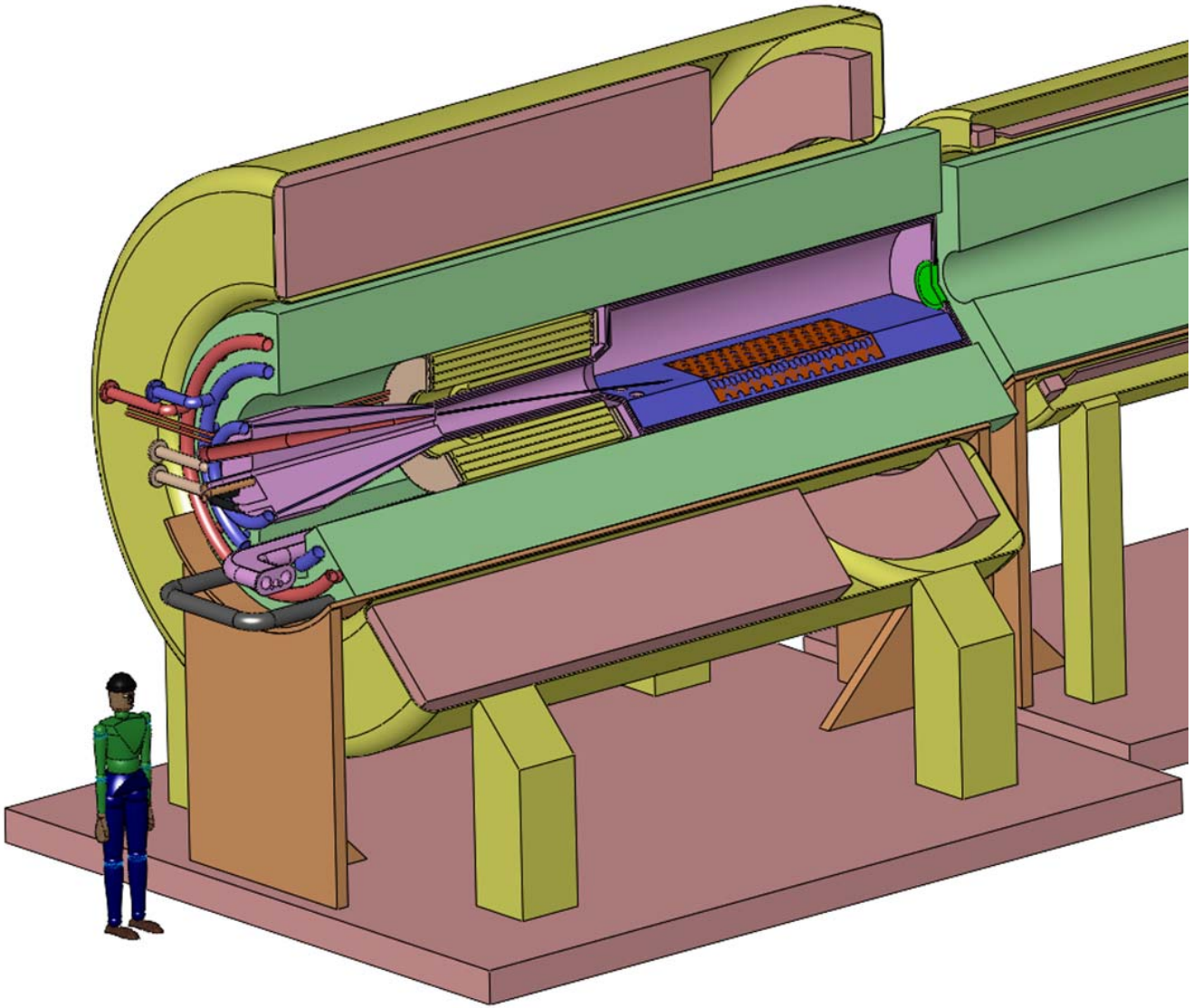
Technology Challenges

- Target
- Chicane
- RF for Buncher/Rotator
- Ionization cooling (MICE/Cooling talks to follow)

Technology Challenges

- **Target and Capture**
  - **3 GJ (15T, 2.4m ID) superconducting solenoid**
  - **Shielding for SC coils surrounding the target**
  - **Replaceable Target Module (Solid or Liquid)**
  - **Beam dump (splash mitigation if liquid target)**
- **Chicane**
  - **Field requirements (B ≥ 2T)**
  - **Shielding for SC coils**
- **RF for Buncher/Rotator**
  - **325 MHz with 20 MV/m in B ≥ 2T field**

Liquid Target System

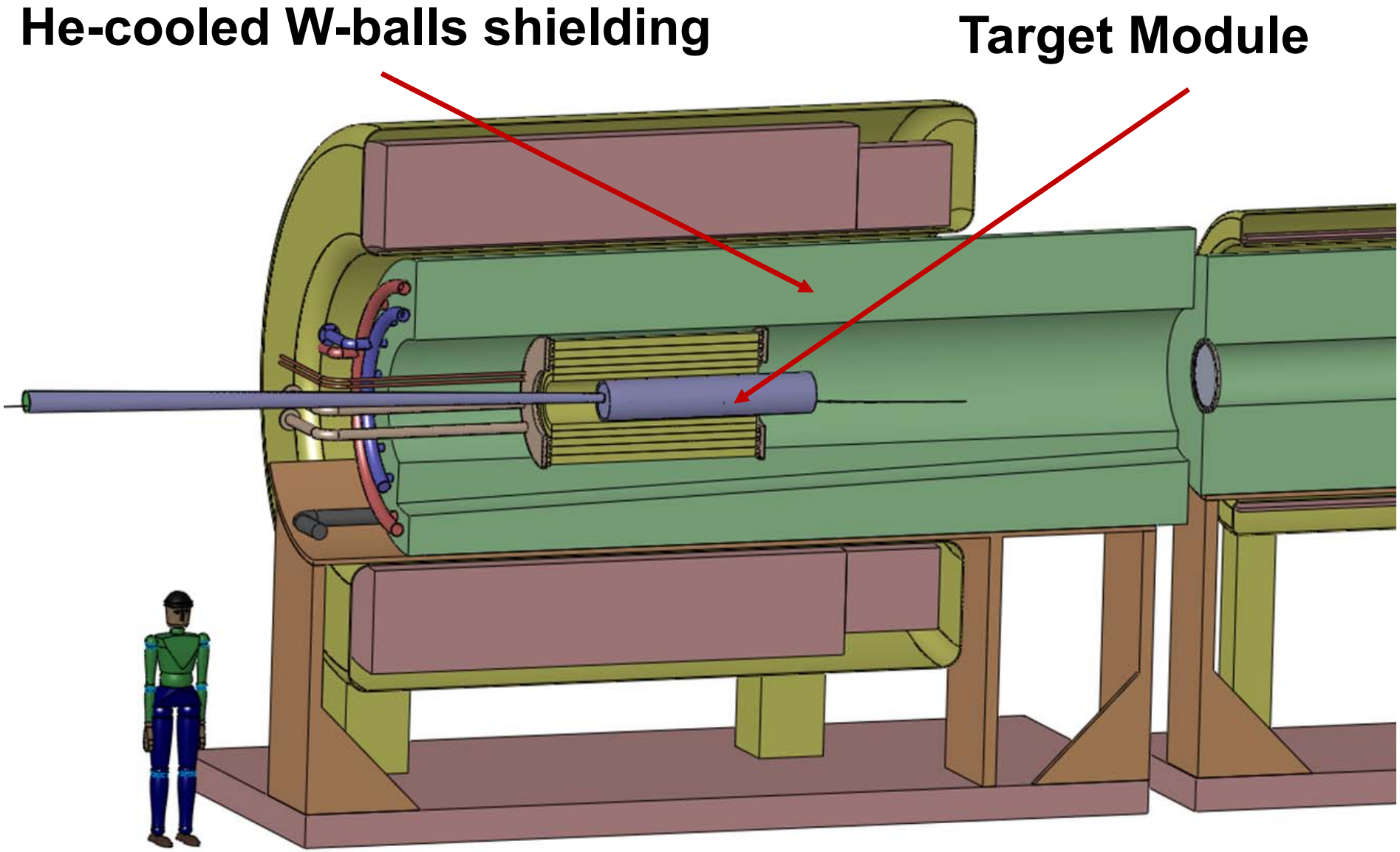


4MW

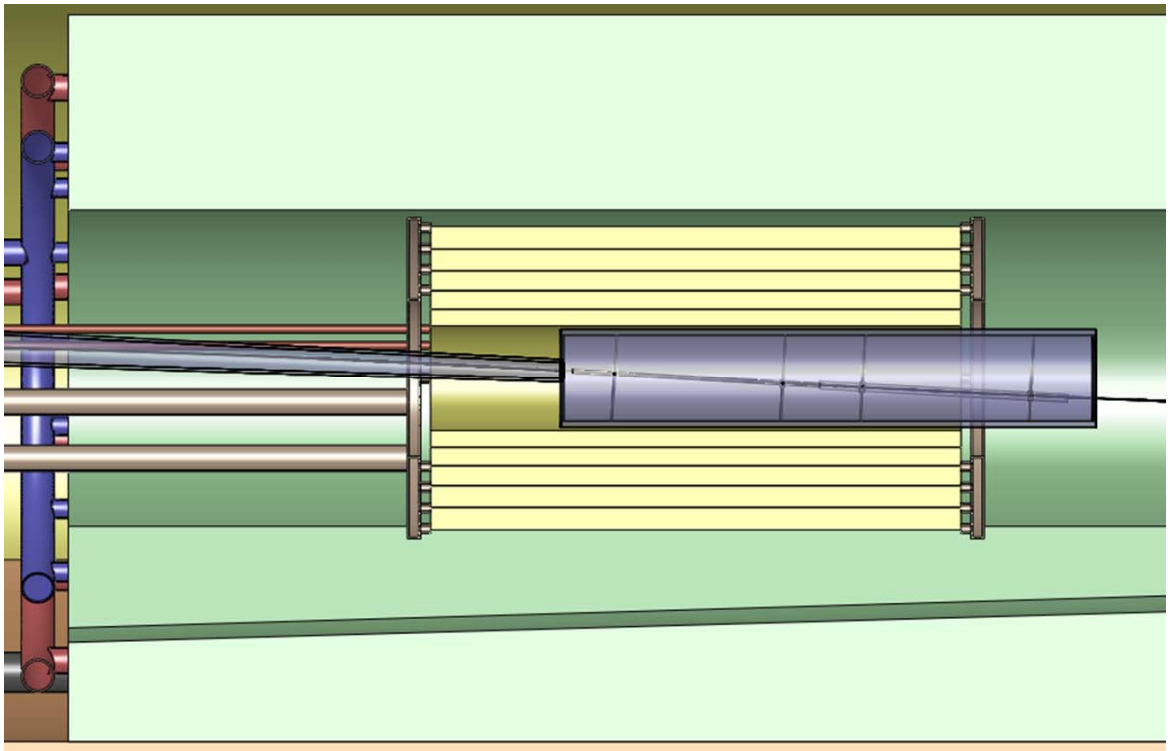
Candidate materials: Hg, Ga, PbBi

Use of Ga results in ~15% loss in muon production

A Solid Target System



Solid Target Module



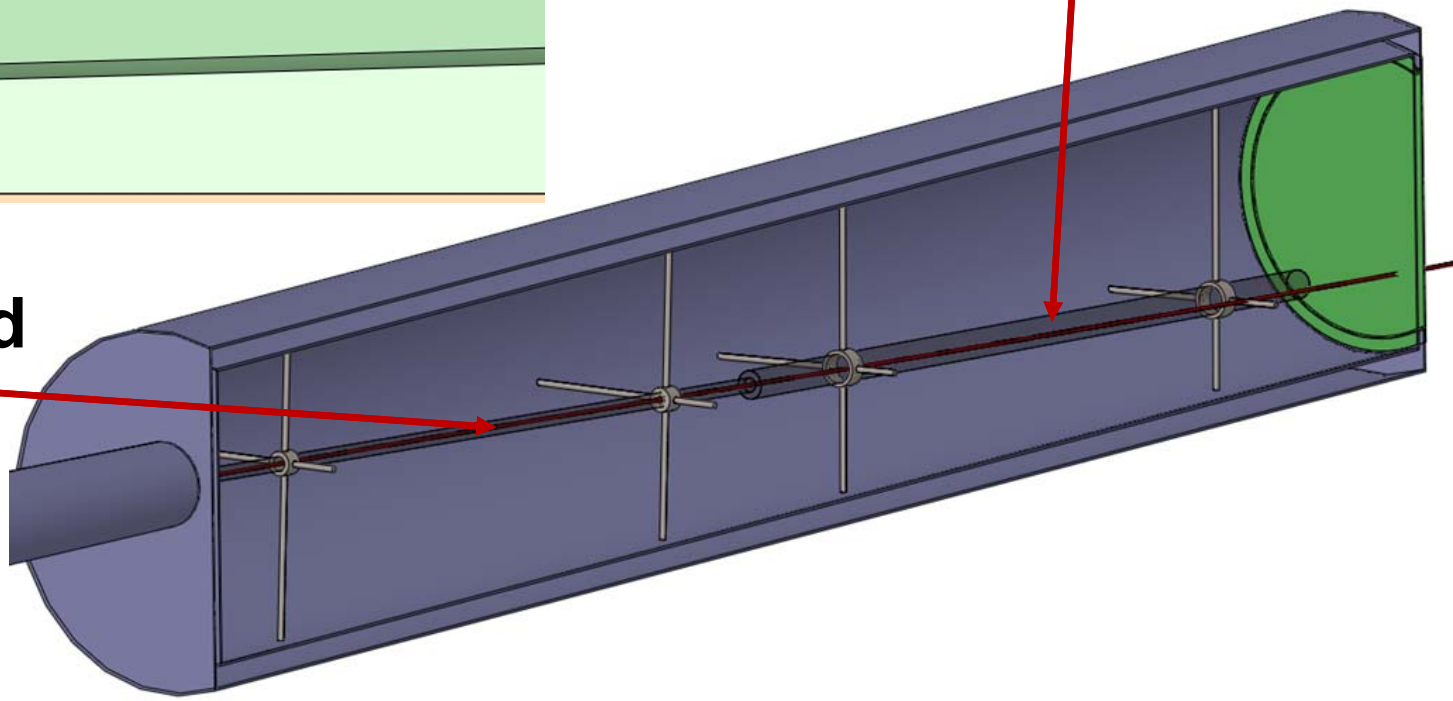
1 MW

Candidate material: Carbon

75 cm Carbon Beam Dump

75 cm Carbon Rod

4 Interaction Lengths
1% unspent primary proton beam



Drive Beam Energy Budget

The primary beam energy goes to:

~10% into the Target Module

~15% conduced downstream

~ 75 % into the volume immediately surrounding the target module

He Cooled Shielding

75% of beam power absorbed in target shield

Shielding concept:

- **97% pure Tungsten balls**
- **60% packing fraction**
- **He gas flow cooled**
  - **W and H_2O are incompatible**
  - **Reduce activation products (*e.g.*, tritium)**

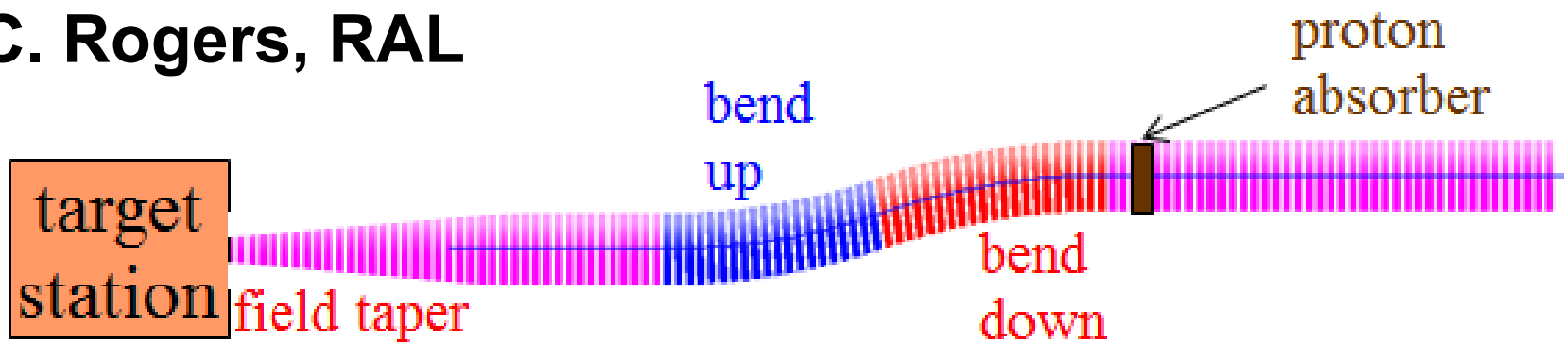
Thermal engineering required to establish feasibility

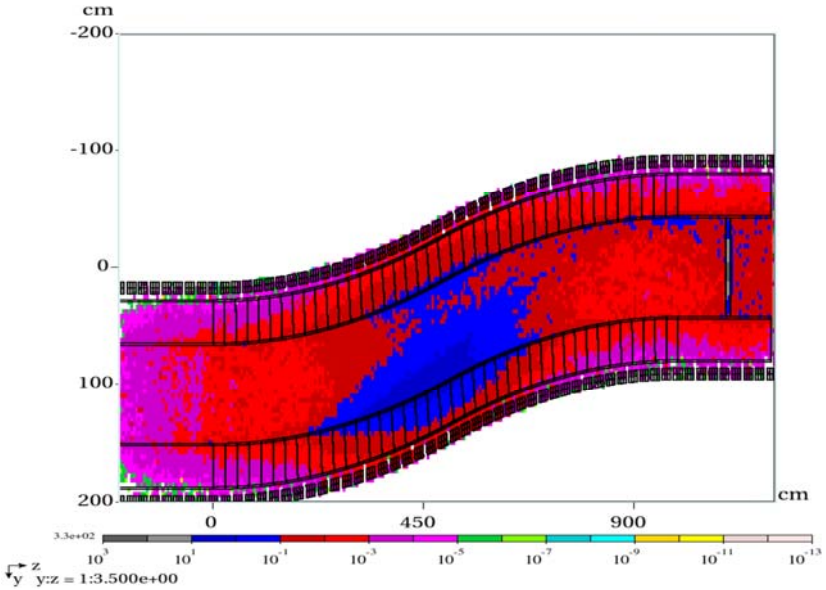
Liquid Target Issues

- **Jet delivery (Nozzle Design)**
- **Splash Mitigation**
  - **20 m/s could cause significant disruption of the liquid in the collection system**
  - **Potential to disrupt particle production**
  - **Chosen solution will need to be bench tested**

Chicane

P. Snopok, IIT,FNAL
C. Rogers, RAL





Push toward higher decay channel B fields (≥2T) will require SC coils

A credible shielding solution will be needed

Buncher/Phase Rotator

- **Require 325MHz, 20 MV/m, B ≥ 2T**
- **Gradient corresponds to:**
  - **201MHz: 16 MV/m**
  - **805 MHz : 32 MV/m**

MTA rso far: 805 MHZ, 20 MV/m, B=5T

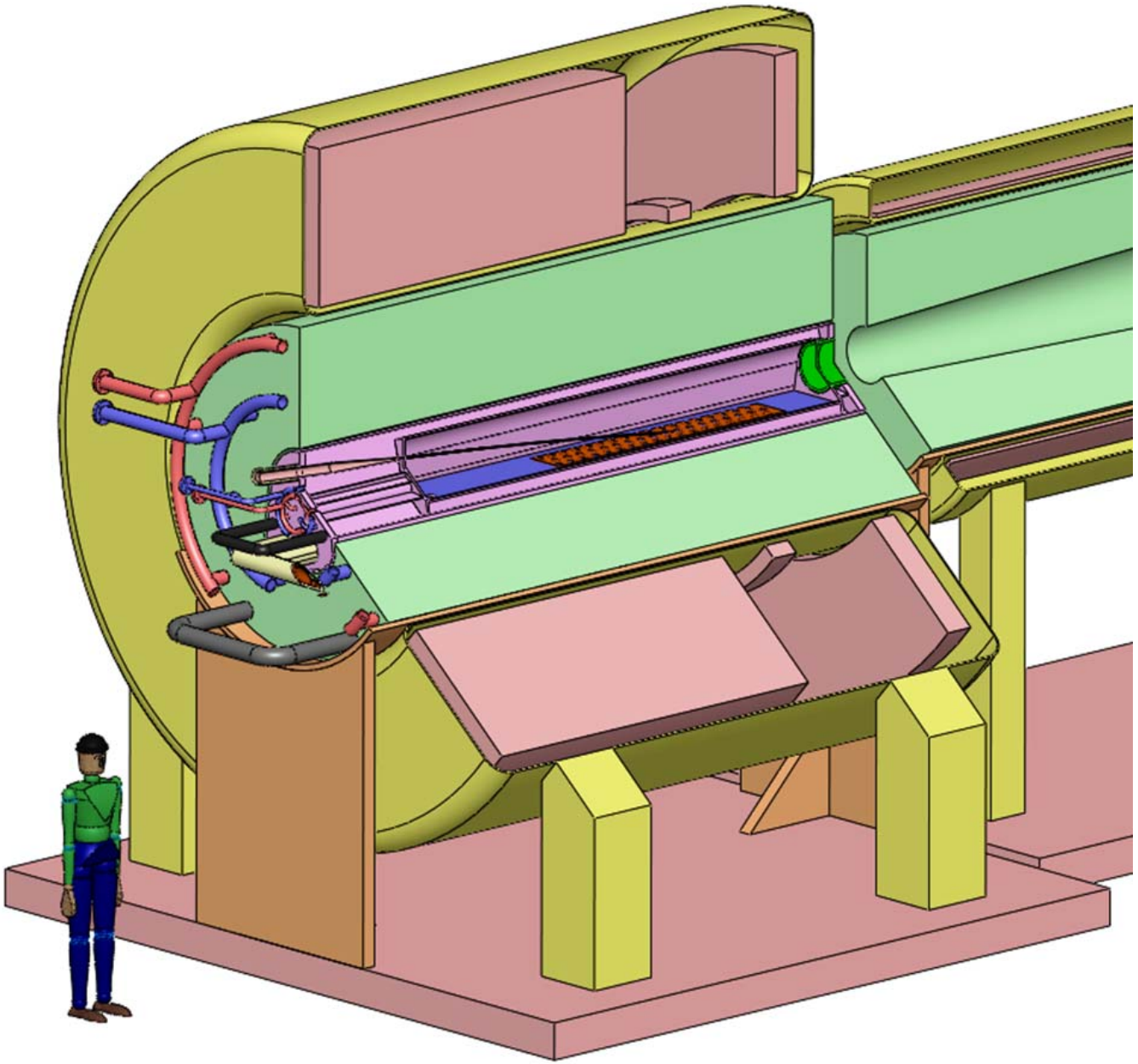
Summary

Front End technical challenges include:

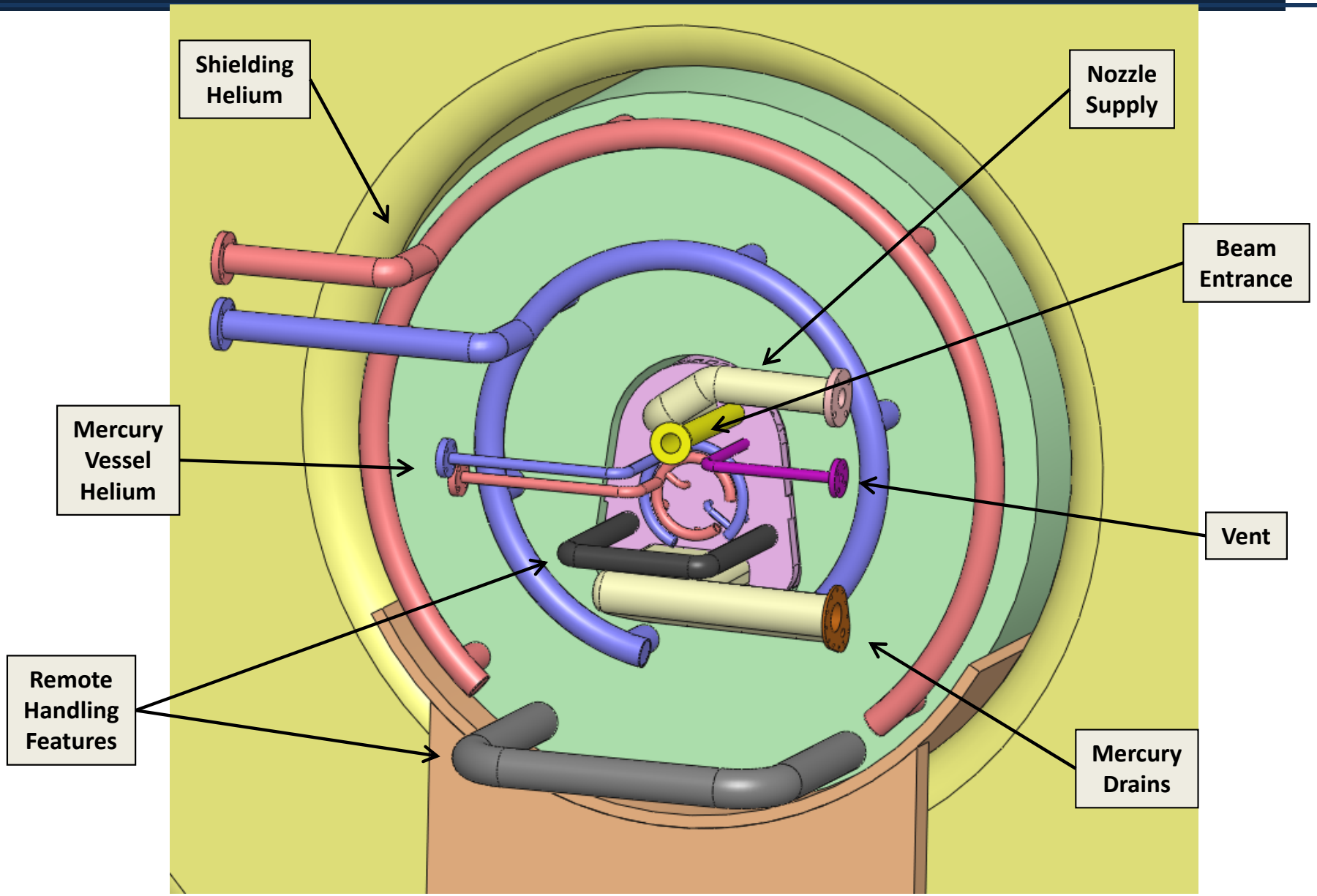
- **Shielding for the target and capture solenoids**
- **Shielding solution for the chicane.**
- **The liquid delivery system**
  - **An improved jet stream**
  - **Splash mitigation of the 20-m/s jet in the liquid collector**
- **Operation of high-gradient 325 MHz cavities in fields B ≥ 2T**

Backup Slides

15T Liquid Target Solution

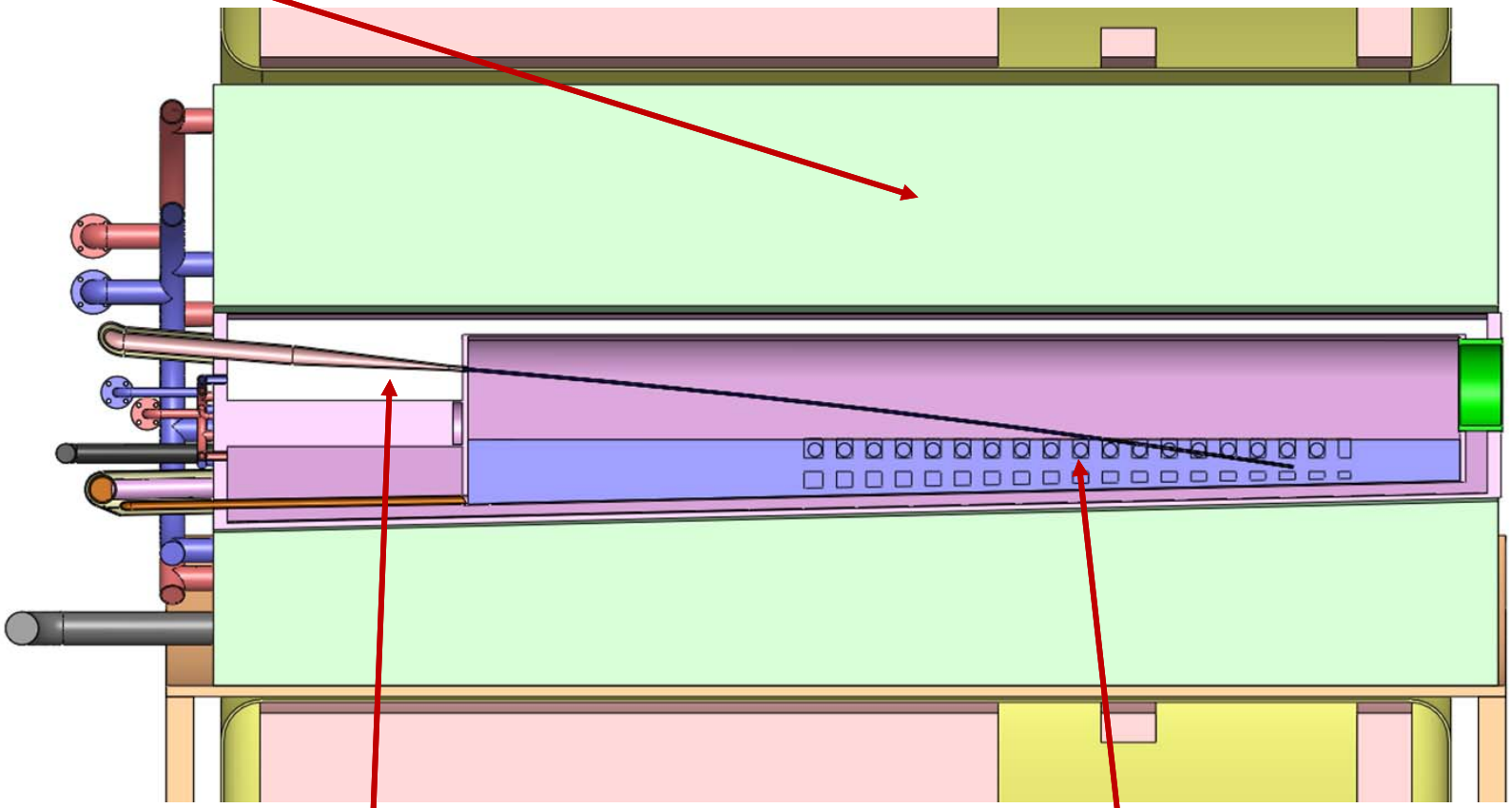


Utility Connections for 15T System



Liquid Target System Core

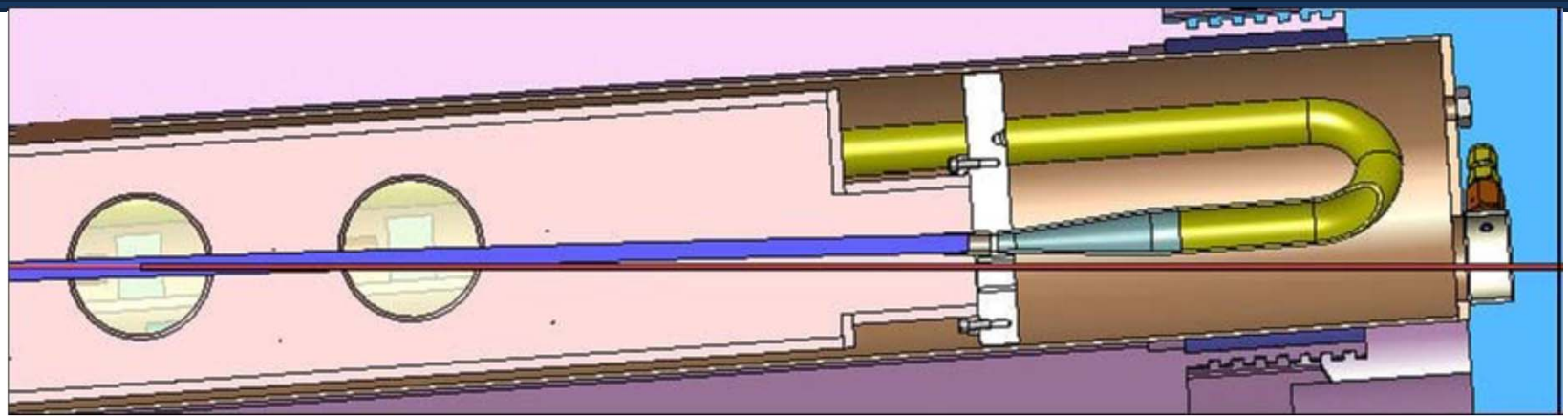
He-cooled W-balls shielding



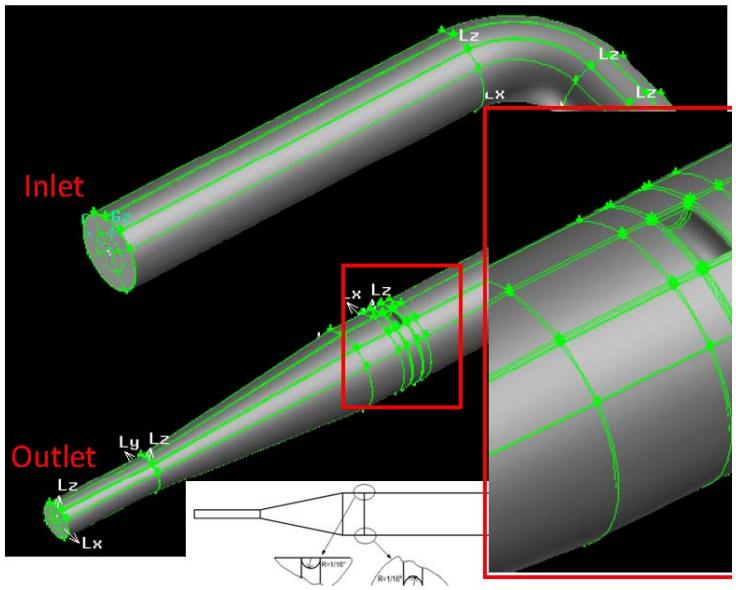
Hg delivery system

Splash mitigation

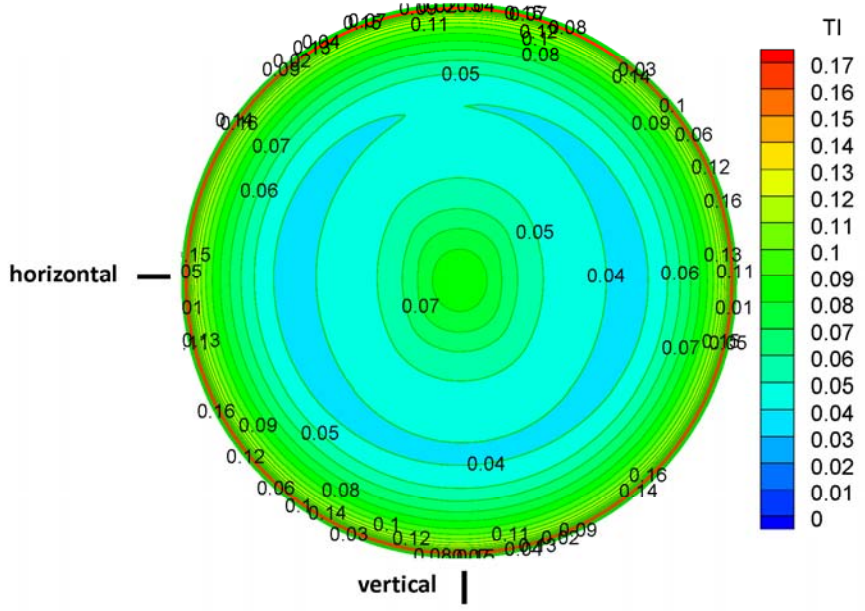
MERIT Beam Pipe Simulations
Y. Zhan, Stony Brook



Mesh For The Pipe Wi
A Partial Weld



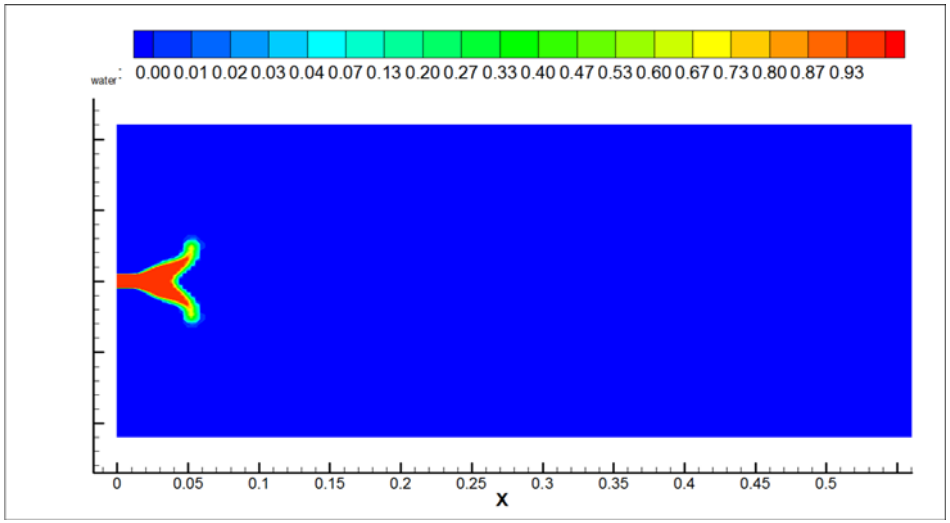
Turbulence Intensity At the Outlet



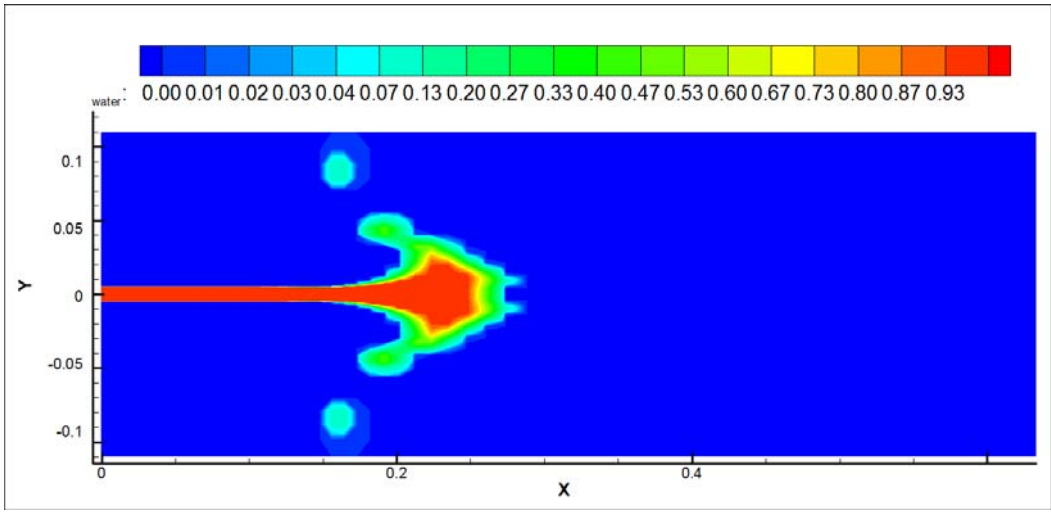
Contour of turbulence intensity at the outlet of pipe

Free Jet Simulations

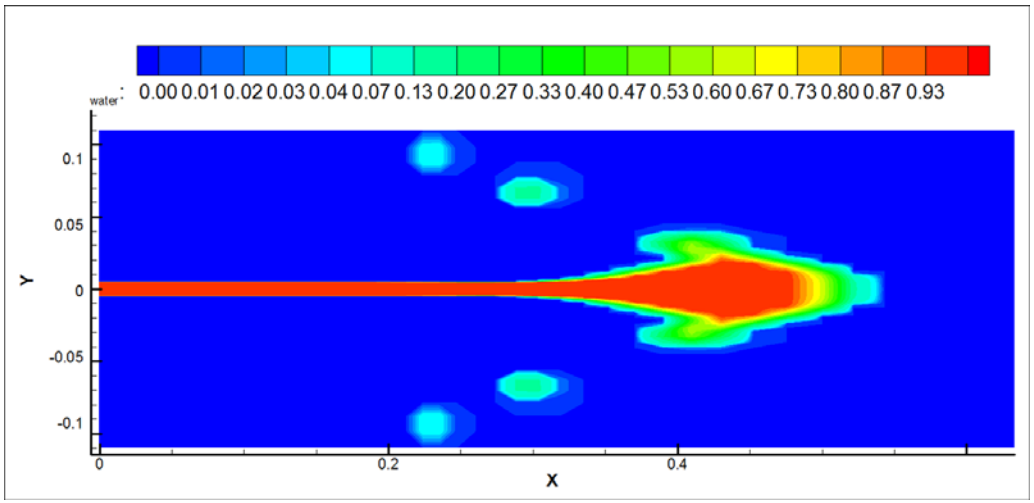
T = 16 ms



T = 111 ms



T = 180 ms



20 m/s Hg Jet in air

Results encouraging, but:
Nozzle is simple circular orifice
2D simulation—need 3D