New cavity options at 805 MHz

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Fermilab MCTF
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High Gradient Limits are not well understood.

- Although all accelerators designs are limited by the maximum gradient that can be obtained, there is little scientific interest in the mechanisms responsible.

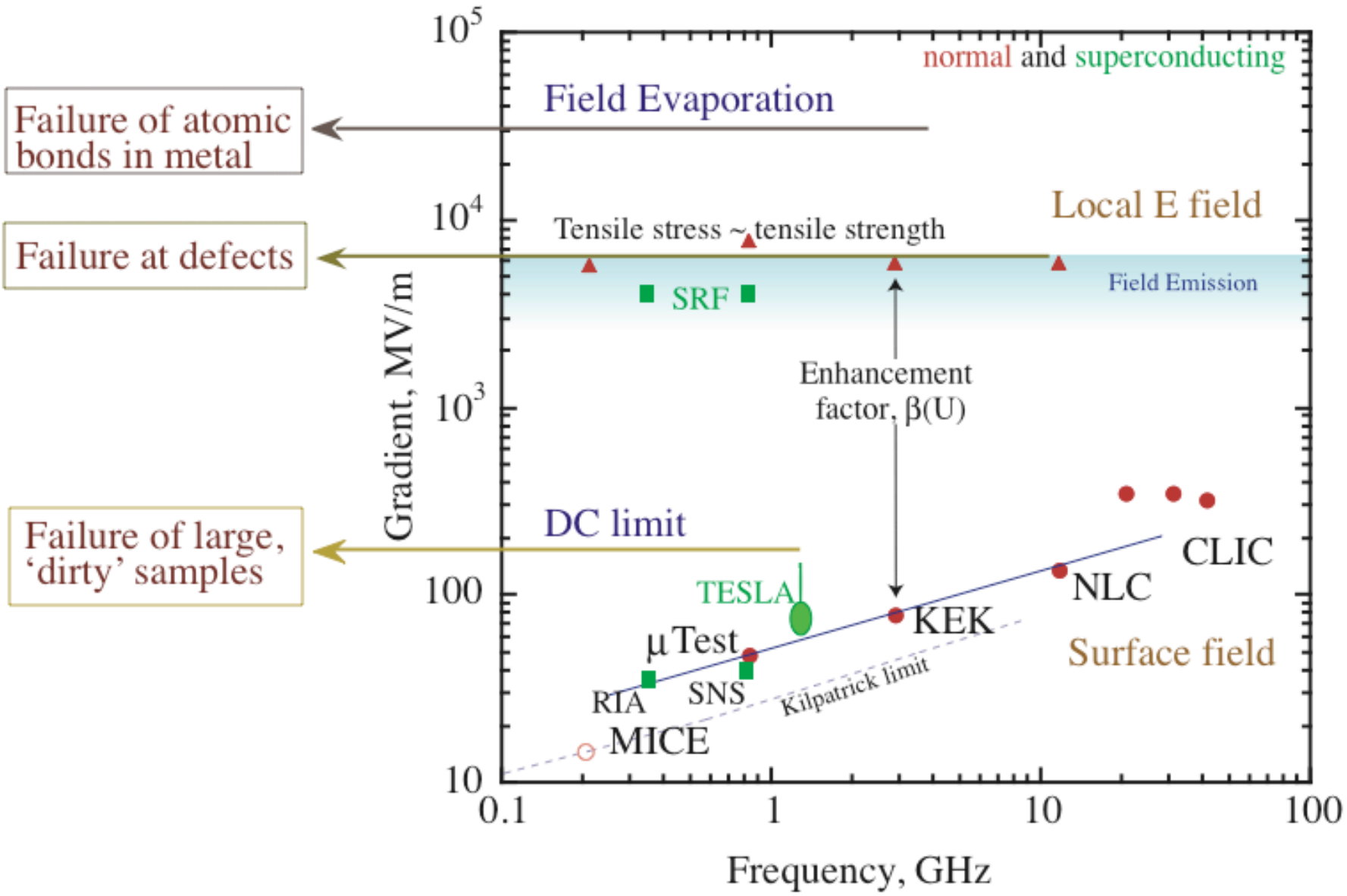
- What effort there is, is divided up in three non-communicating groups, that are separately funded, and located at different laboratories.

CERN?SLAC	High frequencies
Fermilab/Cornell/JLab	SCRF
Muon Collab	Low frequencies

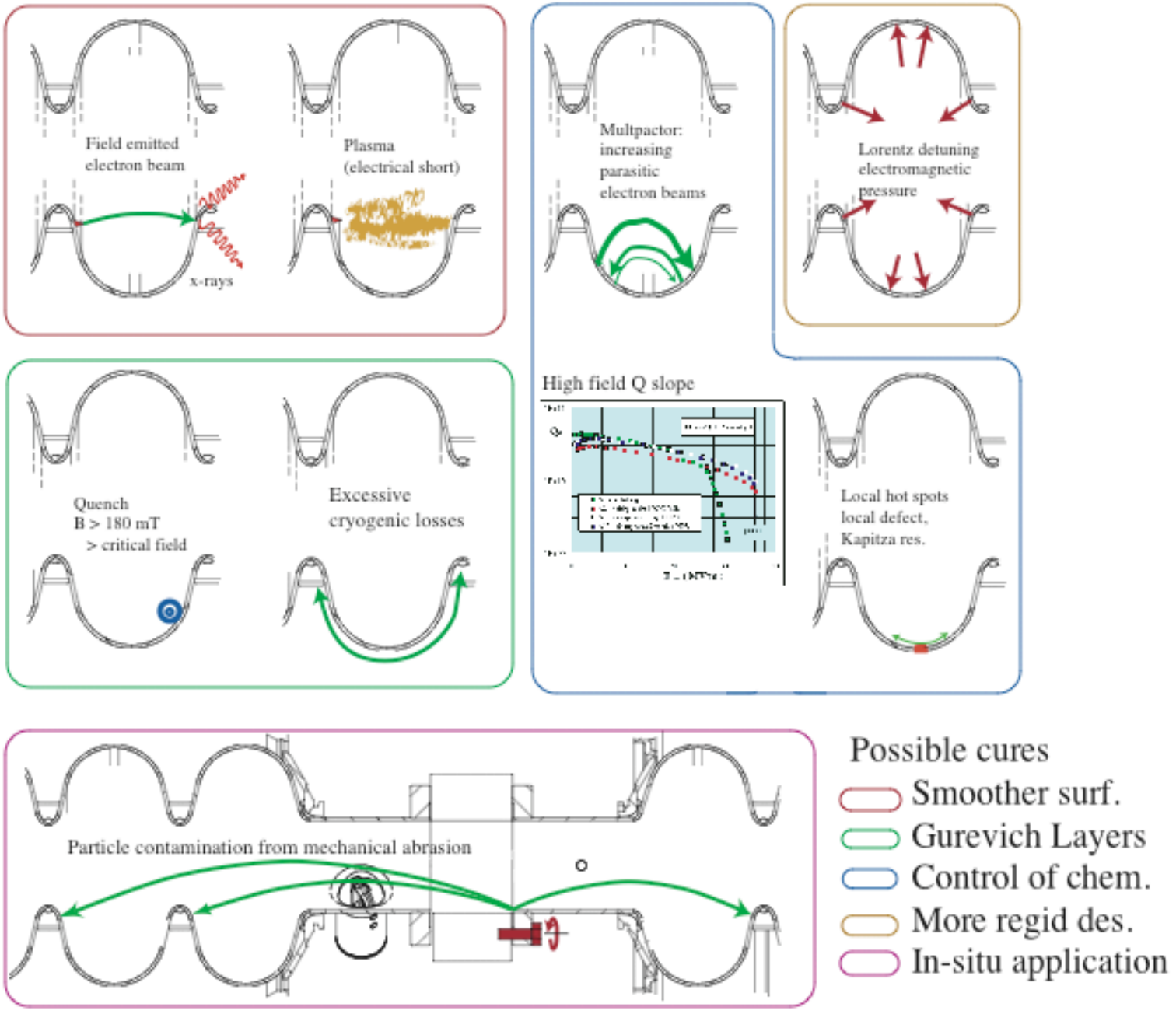
- Everyone is studying the same physics.

- It is vital to the future of High Energy Physics that this work is done productively and systematically.

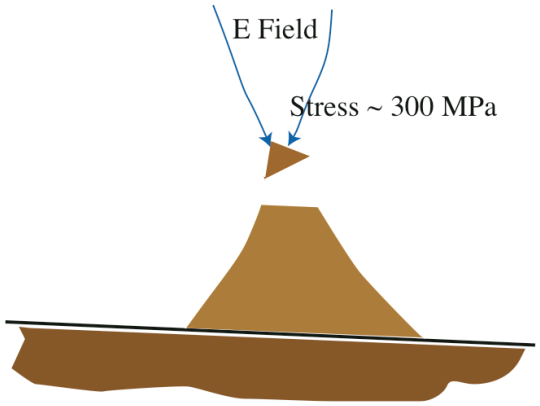
Everyone works in the same High Gradient Universe.



Superconducting cavities are more fragile and have many limits.

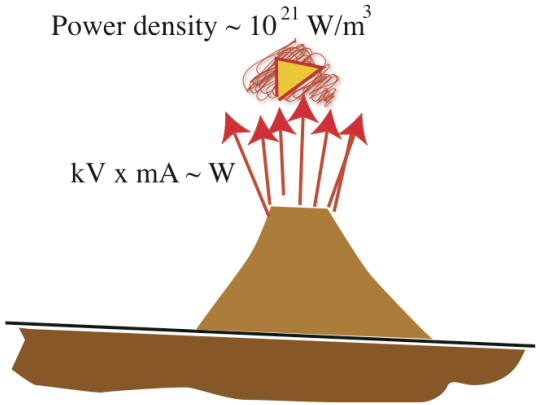


Tensile stress at high local fields explains normal breakdown.



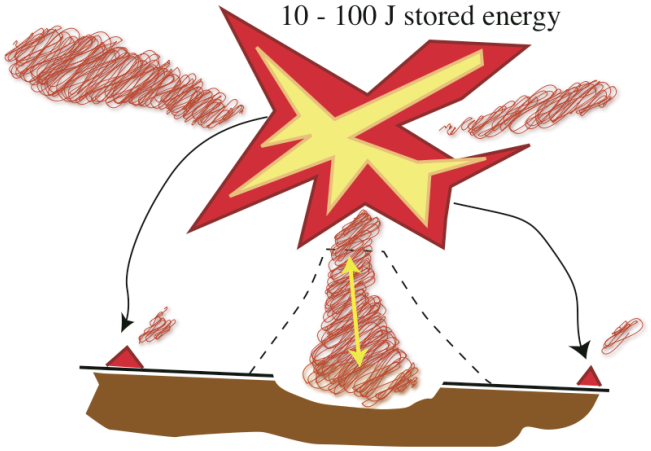
Fracture is the trigger

$\varepsilon_0 E^2/2 = T$



Field emission produces plasma

$dE/dx = \{\ \}/\beta^2$



Lossy plasma absorbs energy

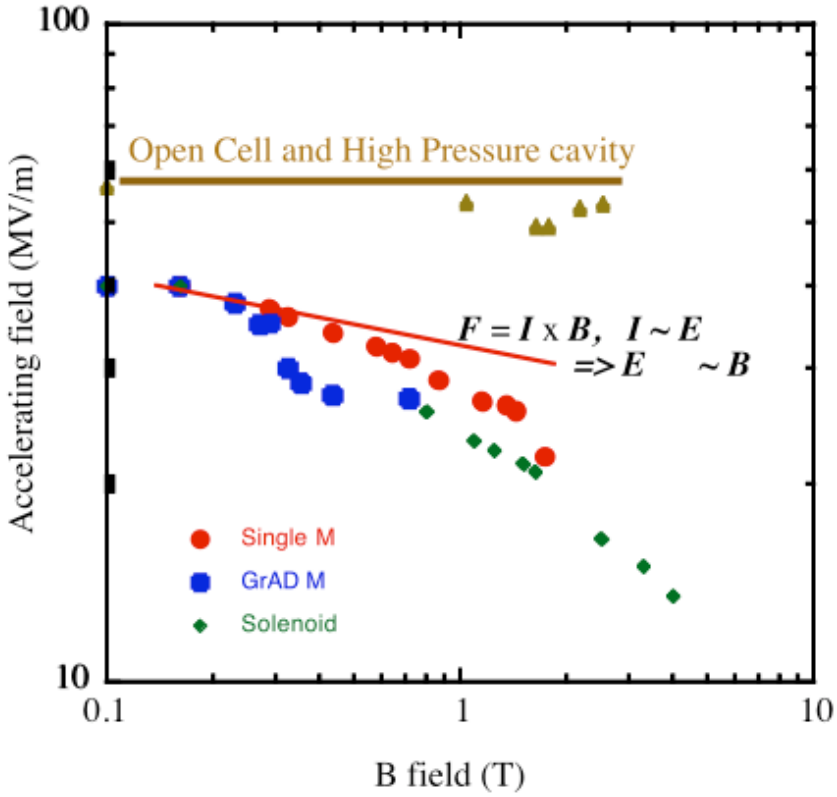
$s_2(\beta) = \exp(-b\beta)$

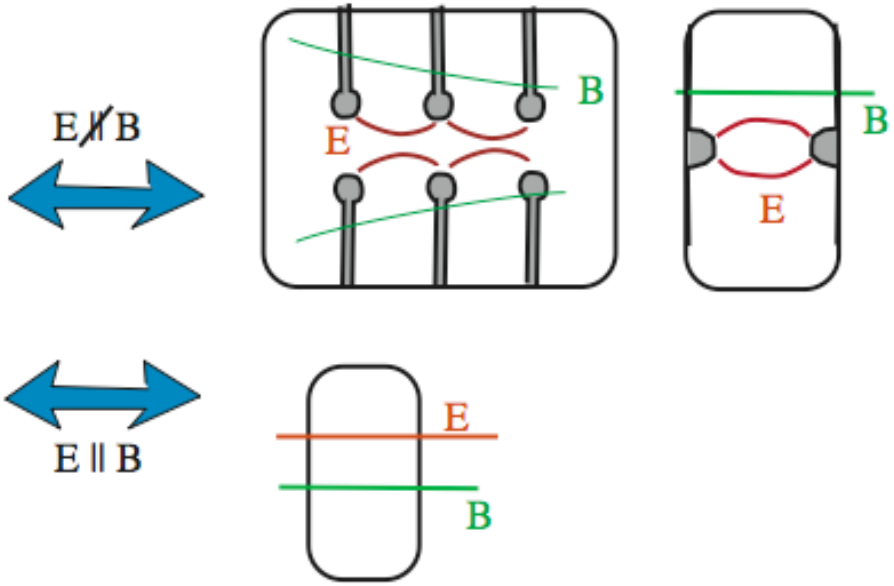
The effects of magnetic fields are a more complex problem.

- Will the unevenness of the ***B*** field in the MICE (MUCOOL) cooling line be enough?
- If the wall is uneven (rippled) will it raise the allowed field gradients?,

High Solenoidal fields

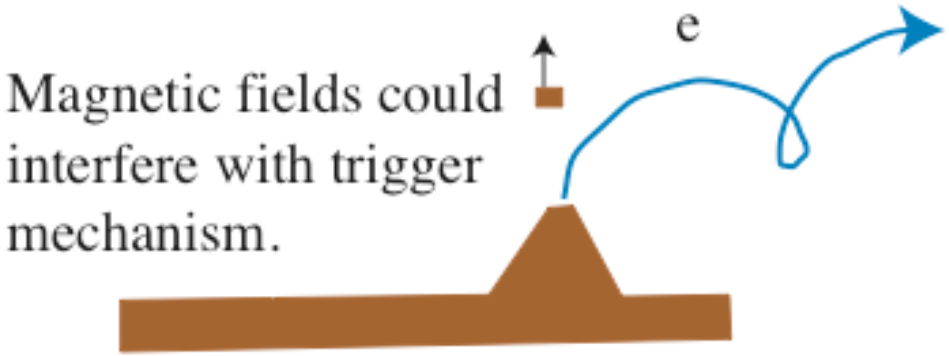
- This behavior is consistent with mechanical stress causing breakdown
- The geometry of the cavity seems to matter.
- Other effects (magnetic confinement of damage) may contribute.





The plasma physics is very complex.

- The magnitude and orientation of the B field must matter.

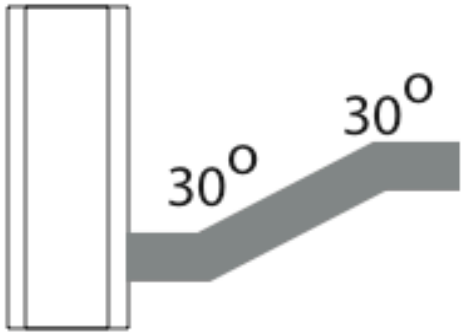


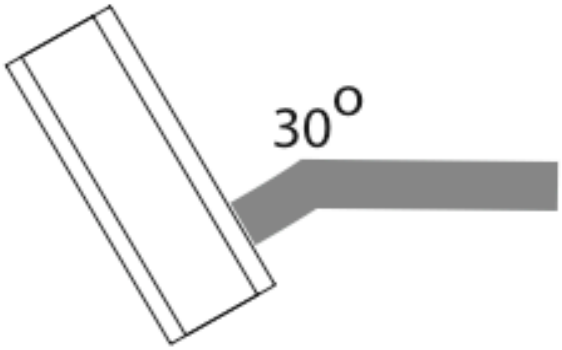
We need to understand the effects of magnetic fields.

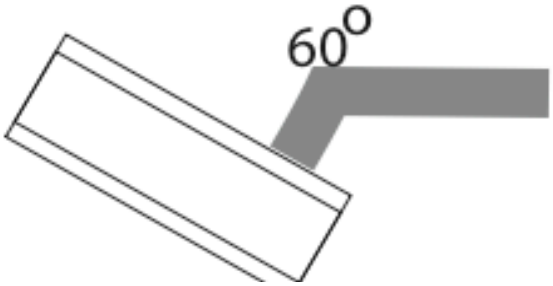
- Magnetic fields will:
  Perturb electron orbits to change the trigger mechanism,
  Change the temperature and sheath potential of the plasma,
  Make the discharge sensitive to the orientation of the solid surface,
  Cause the plasma to drift perpendicular to the fields.

- It would be desirable to have a simple geometry, i.e. a pillbox..

Cavity used to test
E x B effects with
custom bends.
$0^o 30^o 60^o$ or 0^o n^o $2n^o$.



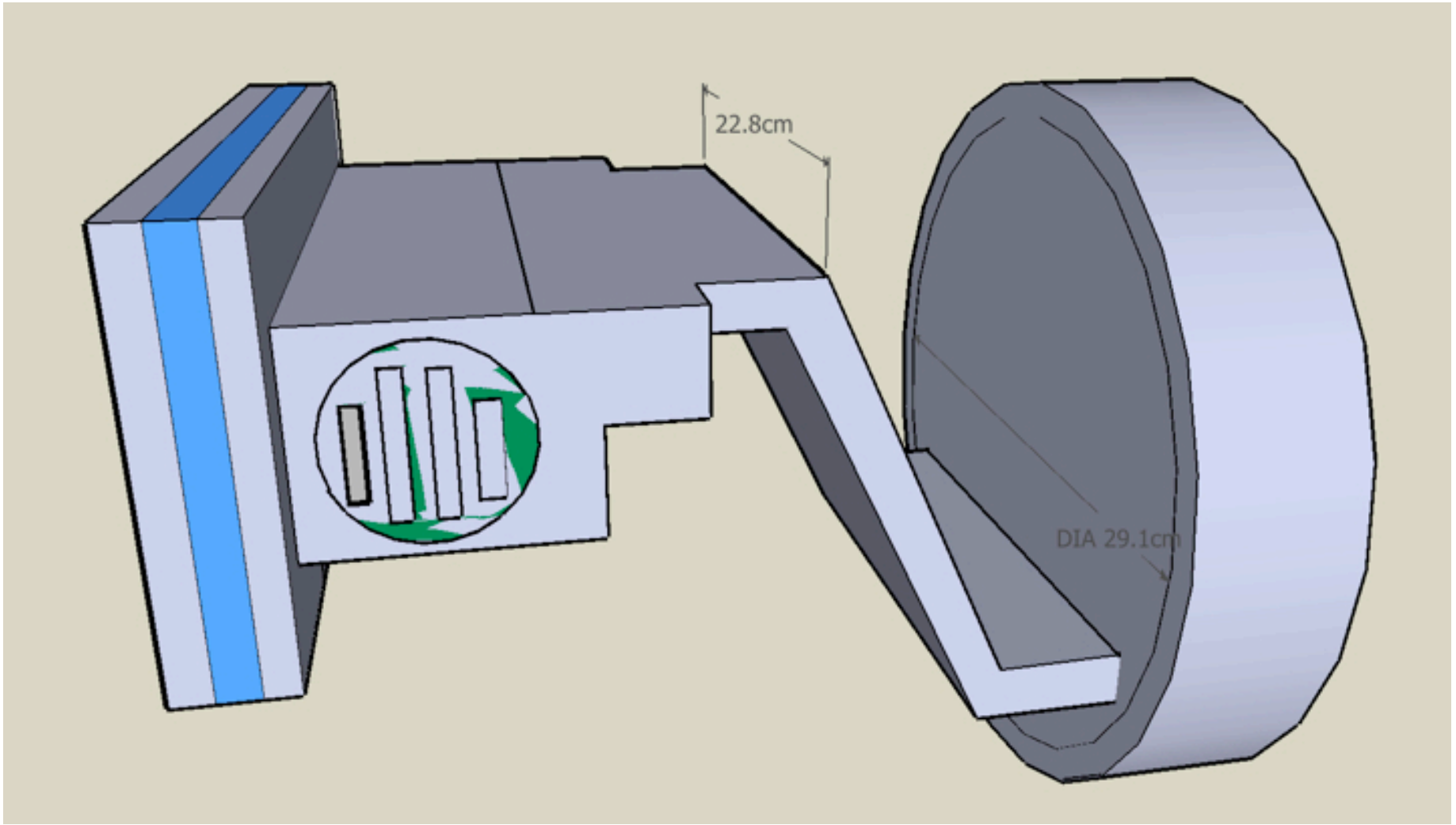




There are a few numbers that define how this can look.

The pillbox has to have a certain diameter

The waveguide has a minimum width.



The detailed design remains to be done – need decisions.

- What angles do we want to measure?
- Can button measurements be done in the same cavity?
  Do we want to make a longer version
- How much will this cost?
- What sort of schedule can we maintain?
- Can we coordinate this with other measurements, ideas and models?
- Detailed design
  Ports for: pumping, field probes, cleaning, disassembly
  Materials: copper with SS for strength at flanges
  Support for magnet quenches

Tech-X is interested in theoretical aspects of this problem.

- Plasma theory is a separate discipline – done by Tech-X
- Modeling should be helpful in determining how the variables change the results.
- This could be an interesting experiment.