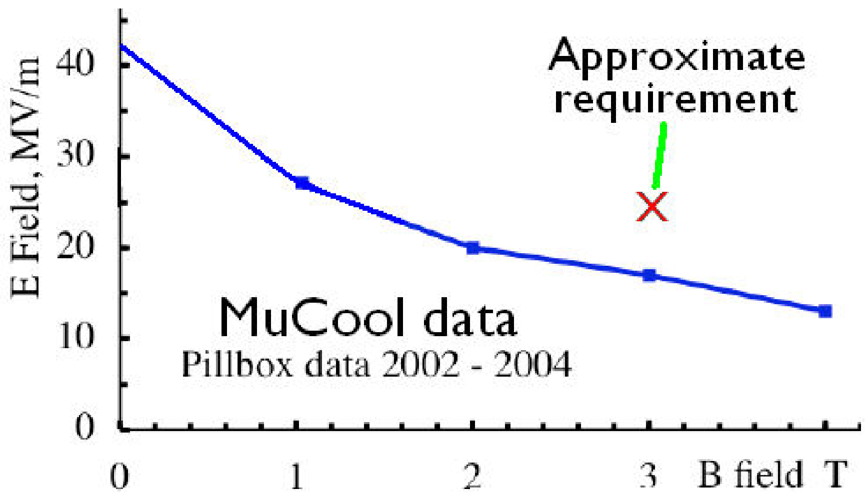
Fermilab

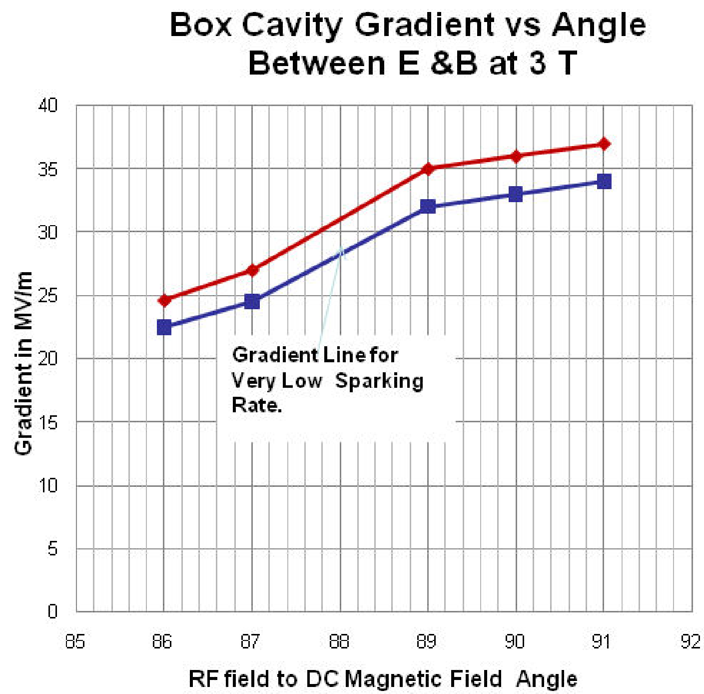
WG2 Summary

Muon Accelerator Program

RF

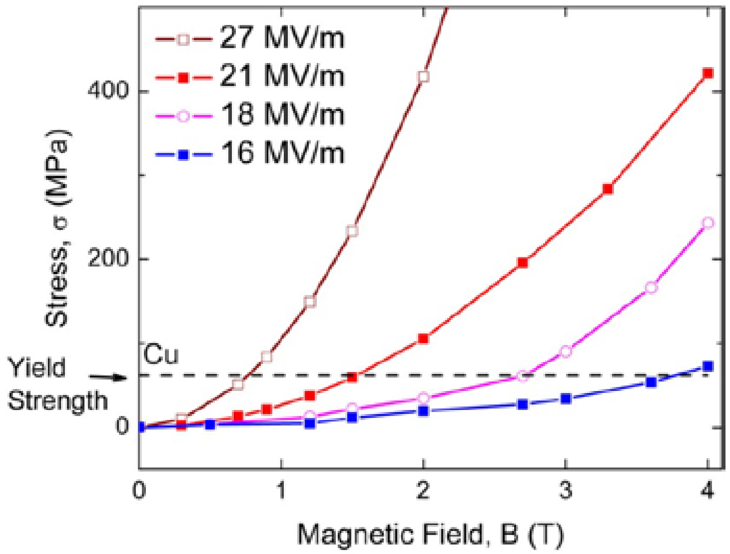
RF Problem

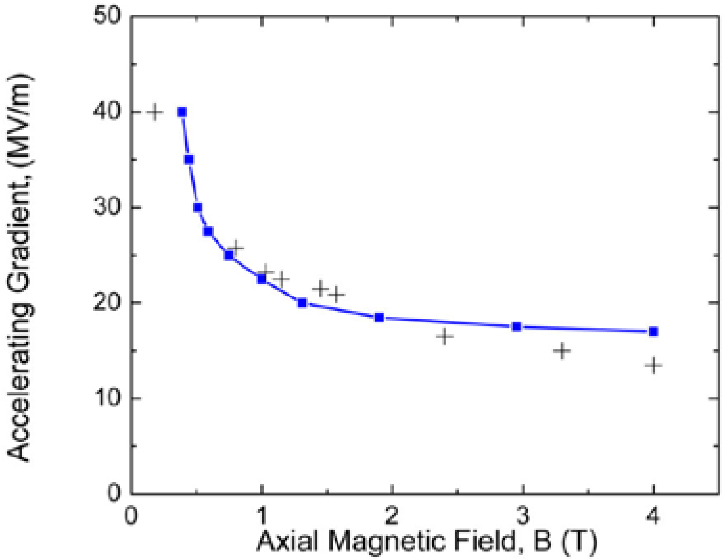




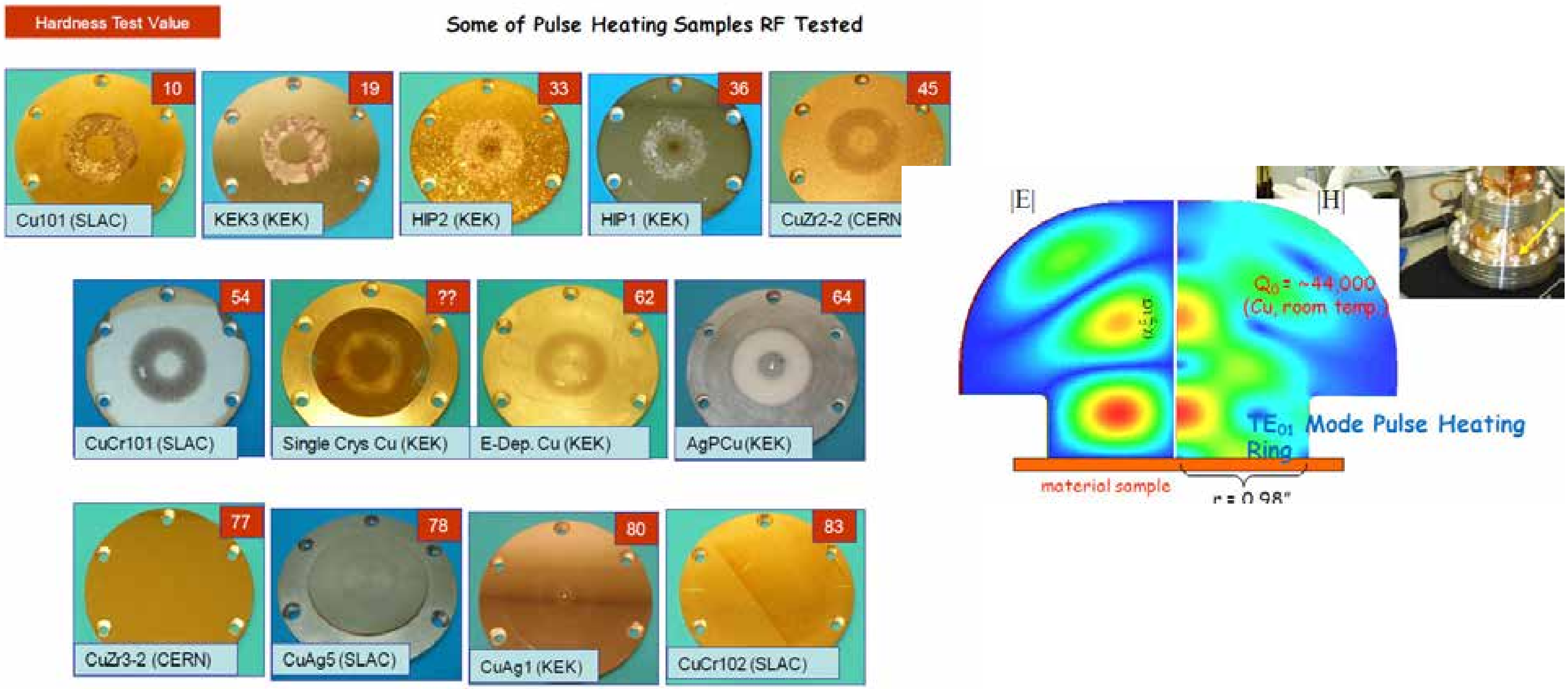
- So far, vacuum cavities tested so far indicated inability to reach required gradient in magnetic field.
  - Left: Summary of problem see in 805 MHz pillbox
    - Also saw "issues" with the 201 MHz MICE prototype cavity (but it reached 21MV/m, B=0
- Solutions
  - SCRF processing (& ALD), Materials (Be + others), Magnetic Insulation, HPRF
    - Right: Disappointing results from magnetic insulation

Pulse Heating Model



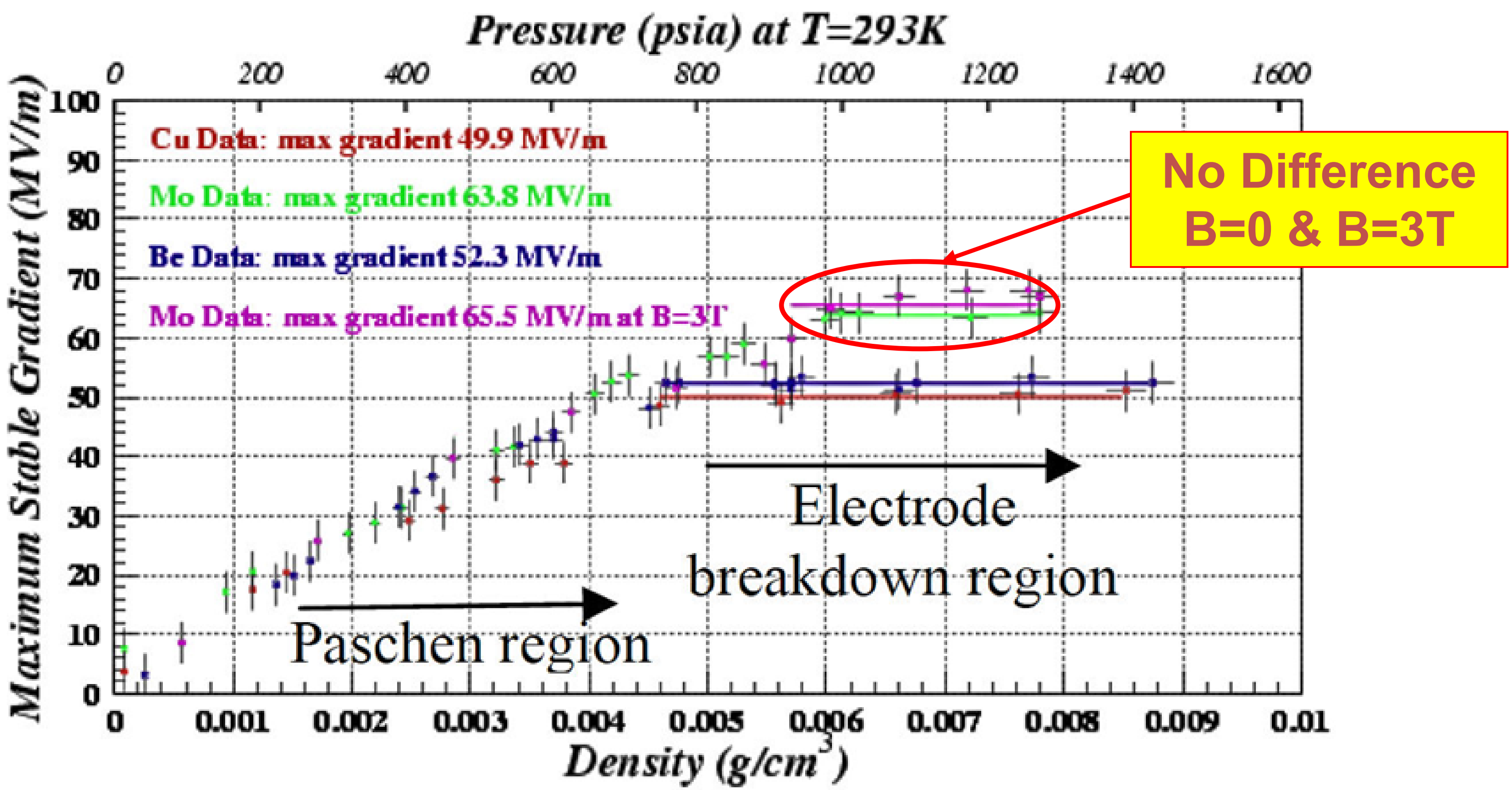


- Pulse heating model by Ditkys Stratakis
  - Lighter/harder (Be) materials better
  - Predicts damage
    - Fits well 805 pillbox data
    - Not so well with the box cavity data w/r angle effect
      - More data needed



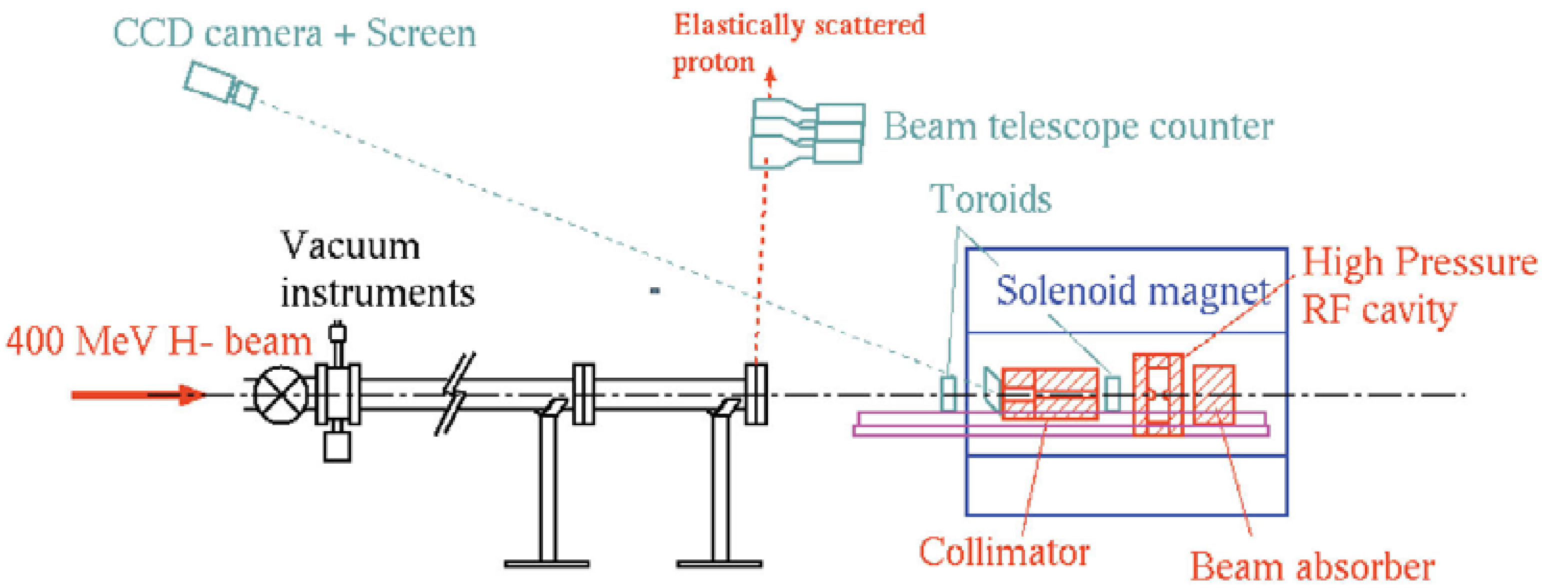
- Pulse-heating studies at 11 GHz
  - Harder materials do better

Gas-filled Cavities



High-pressure H_2 filled cavities may offer a solution
Need Beam Test!

HPRF Beam Test



- We are almost ready
- Results in July 2011, yes... 2011

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RF R&D Plan

- trying to demonstrate a working solution to RF cavity operation in high external magnetic field for muon cooling
- major MAP milestone
- big impact on cooling channel design and future system tests
- multipronged approach to cover maximum ground with available resources

Cavity		Outstanding issues	Proposed resolution	Experimental tests
Vacuum	pillbox	Breakdown and damage	Better materials	Mo, W, Be buttons Be-walled 805-MHz cavity
			Surface processing	Electropolished buttons 201-MHz pillbox in B-field
			Coatings	ALD-coated buttons ALD-coated cavity
	rectangular open-iris		Magnetic insulation	E⊥B box cavity E∥B box cavity Modified cavity-coil geometry
Pressurized		B-field/pressure effects	Materials tests	805-MHz 4-season cavity
		Beam-induced ionization	Measure ionization lifetime	805-MHz cavity in beam
		Frequency dependence	Test at different frequency	Pressurized 201-MHz cavity

RF Experiments

- HPRF cavity in beam
- 805 MHz pillbox cavity with Be and other button
  - Be wall cavity utilizing 4 Seasons cavity (?)
- 201 MHz cavity coupler repair and operation in large B
- further HPRF beam tests as needed
- rectangular box cavity with B parallel to E
- more ⊥ E rectangular box cavity tests
- ALD cavity

Ring Magnets

Brief Overview of the Collider Ring Magnets Mini-Workshop

J. Tompkins, Fermilab

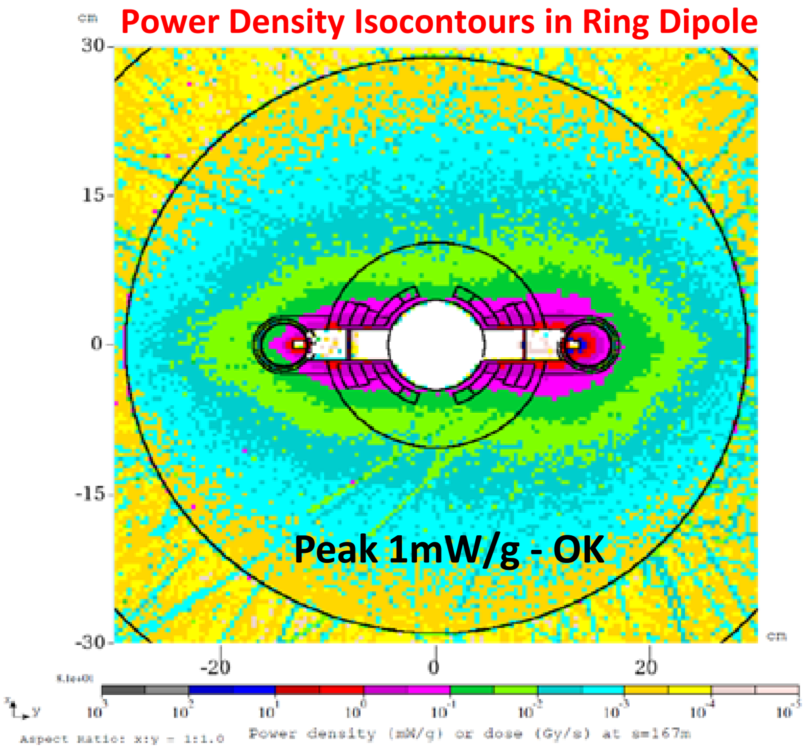
Requirements

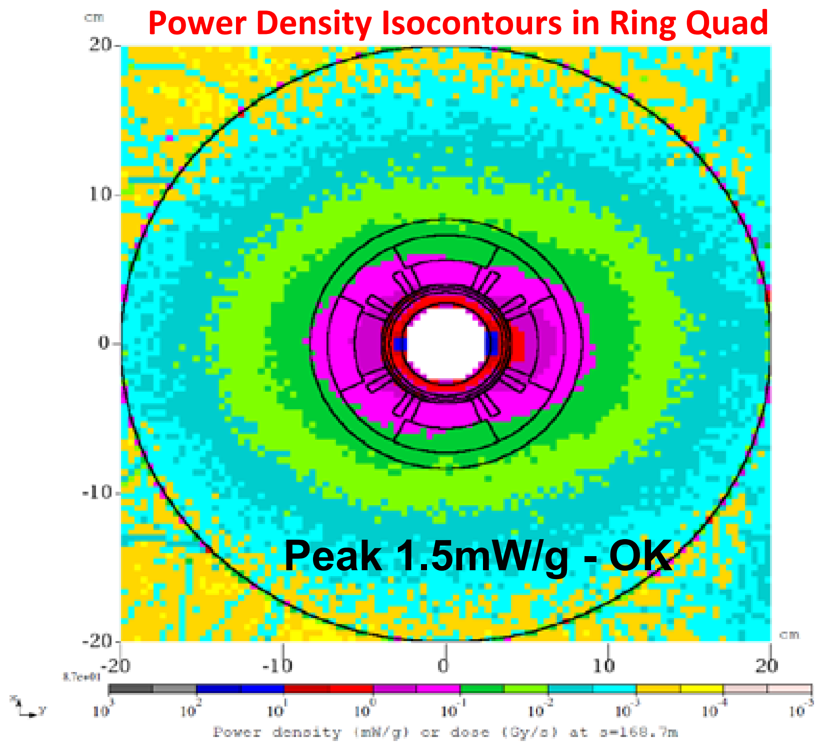
Y. Alexahin

- We need large aperture (up to 20 cm for 3 TeV) strong quadrupoles G~10T/IR
- For closest to IP dipoles the open-midplane C-configuration looks preferable
- The large nonlinearities in the open-midplane dipole do not appear prohibitive
- The required aperture in the arc magnets is much smaller ($10\sigma_y$ = 7mm)
- We are working on a significant modification of the IR optics, hopefully the aperture requirements will be the same for 3 TeV β^*=5mm

OMD Study

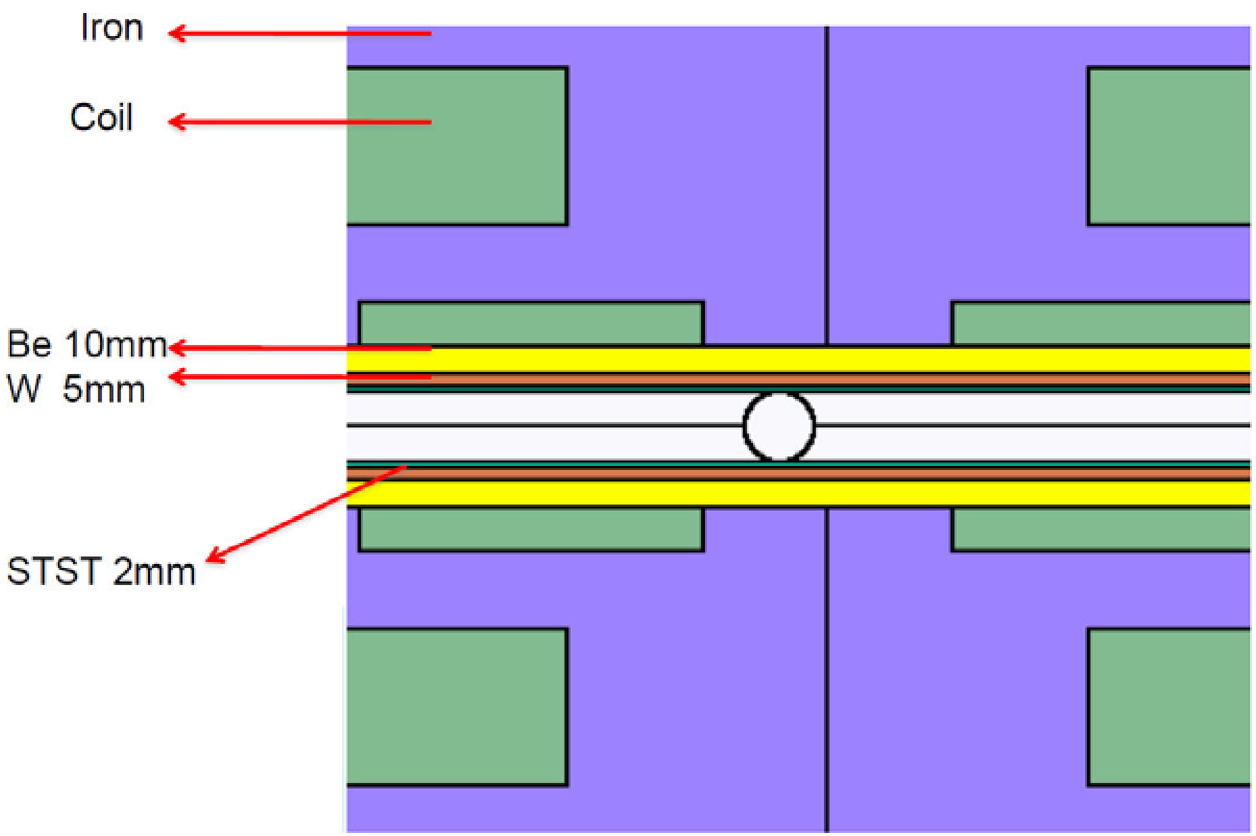
N. Mokhov

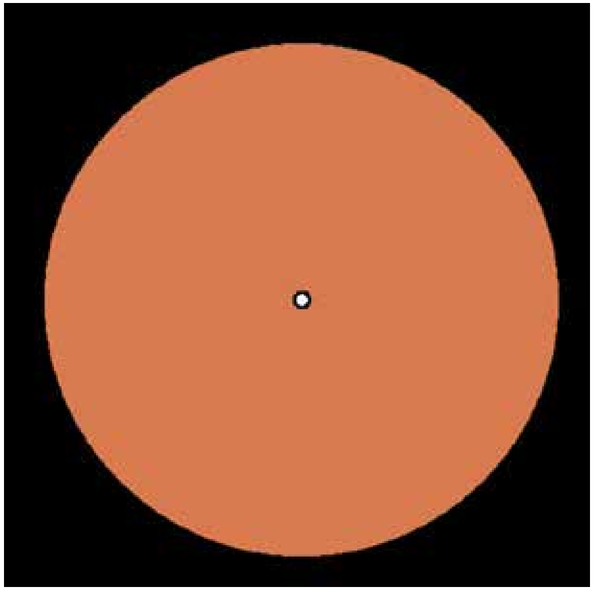




- Quench stability (peak power density, heat transfer): manageable with appropriate design and protection
- Dynamic heat loads: challenging with 0.5-1 kW/m
- Radiation damage – Component lifetime: R&D needed
- Residual dose rates - Hands-on maintenance: OK

OMD Study
X. Ding et. al



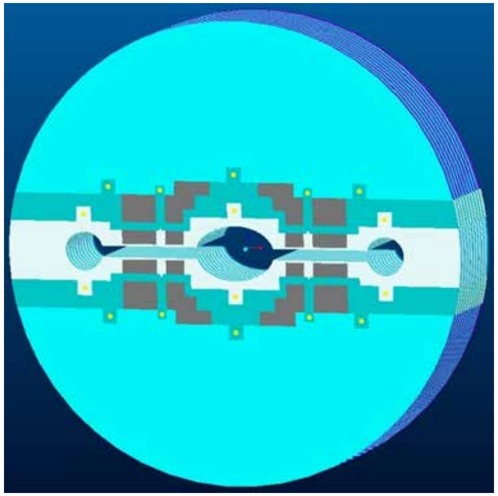


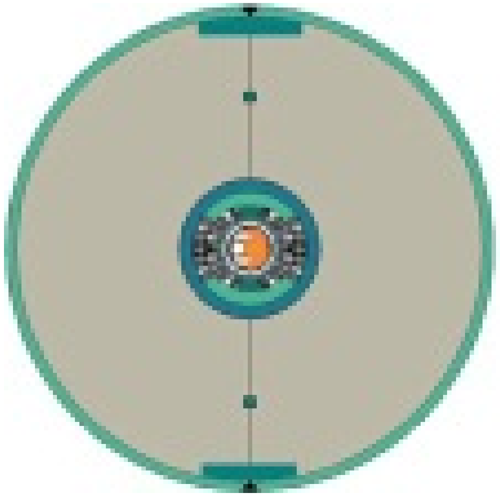
Liner + W collimator (2.6 cm aperture)

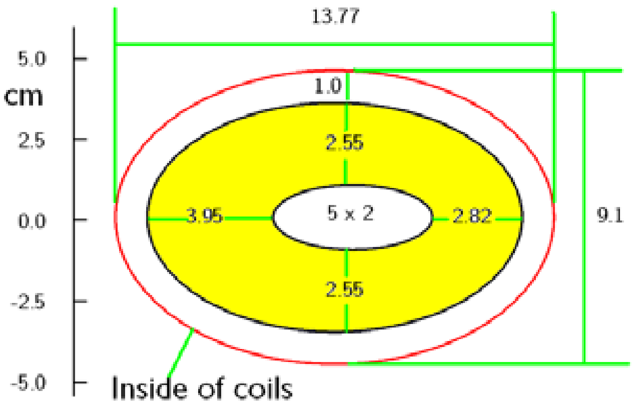
Ding *et al.*

		Power (W)	Percent of total (%)
Dipole (Coil+Iron)	1st	1.168	
	2nd	3.689	
	3rd	0.047	
	sum	4.904	0.43
Collimator	1st	828.9	72.25
	2nd	244.73	21.33
	3rd	5.04	0.44
	sum	1073.63	94.0
STST vacuum chamber		48.63	4.2
Liner (Be+W)		9.82	0.9
Total "Visible"		1147.29	

Magnet Conceptual Designs







Gupta

Partial "open midplane design" although there is "no conductor" at the midplane, there could be some "other structure" between the upper and lower halves of the coil to help deal with Lorentz forces. Moving ahead to Due Proof-of- principible Proto.

Zlobin

Two double-layer cos-theta coils, vertically split iron yoke, and thick stainless steel skin with two alignment keys and two control spacers.

Palmer

Tungsten beam-pipe option: For beam pipe 5 x 2 cm and 1 cm gap, then: Elliptical coil inside 13.8 x 9.1 cm. Can certainly meet shielding requirements, but requires large coils

Summary

Well, Summary of a summary of a summary of a summary

- Challenges include:
  - Heat load
  - Efficient shielding/absorber
  - Magnet mechanics for open mid-plane structures
- Magnet solutions presented
  - Field quality requirements achievable
  - Conceptual designs look promising - further development to reduce heat load to 4K
  - Mechanics/stress management details to follow…
  - Elliptical coil design to be investigated
  - Material properties/radiation sensitivity need continued study