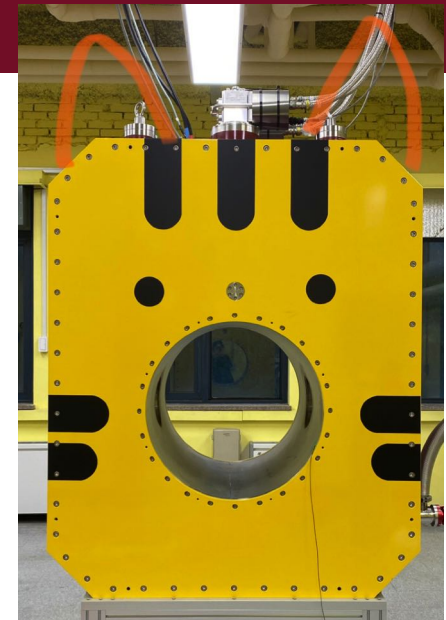


CENuM Workshop, Online, July 3-4, 2020



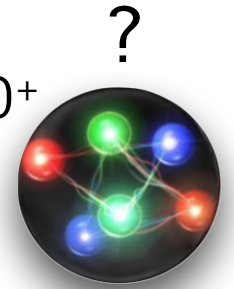
Superconducting Magnet at KU

Shin Hyung Kim
(Korea University)

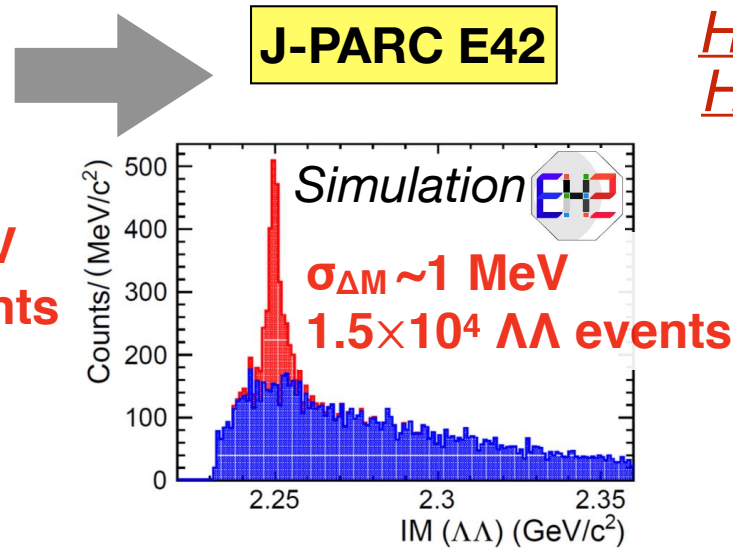
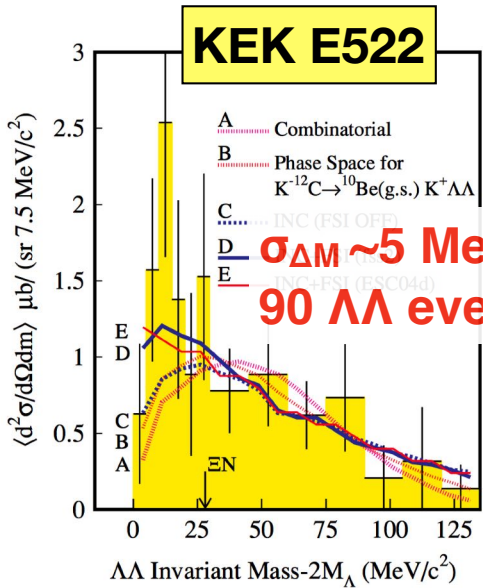


J-PARC E42 Experiment

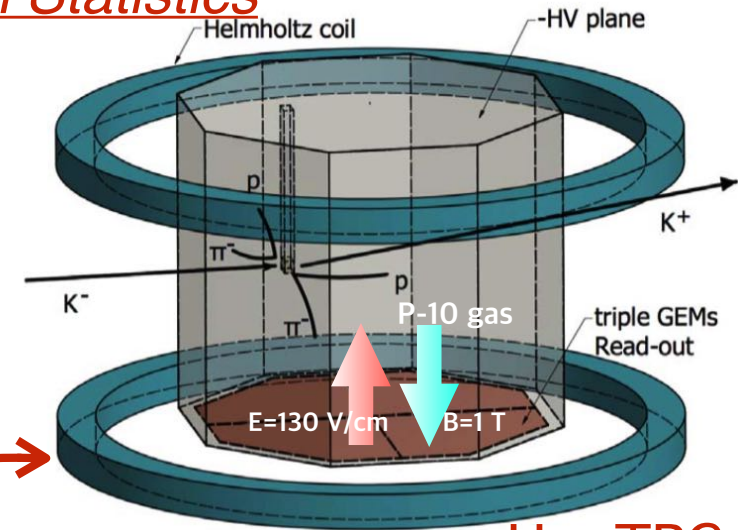
$uuddss$
 $I=0, J^\pi=0^+$



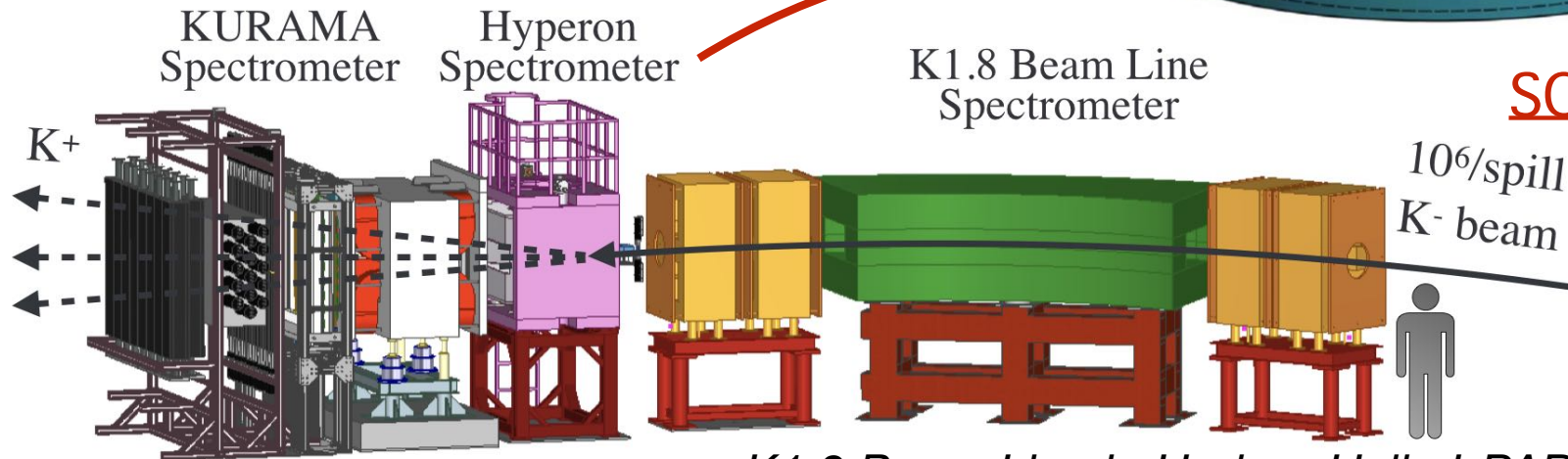
- Search for H-dibaryon via $^{12}\text{C}(K^-, K^+)$ reactions



High Resolution
High Statistics

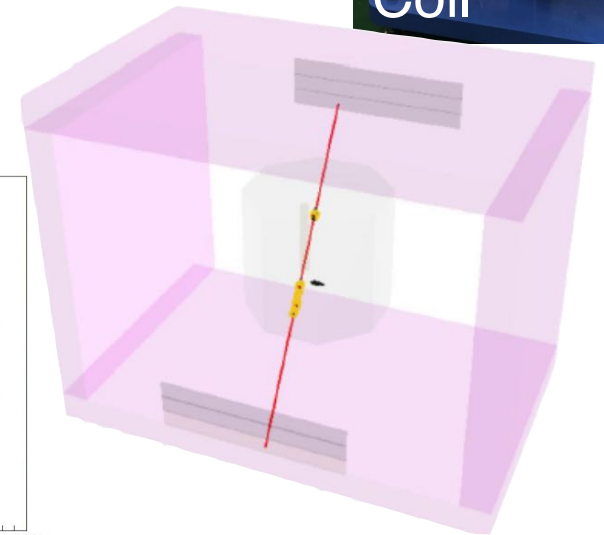
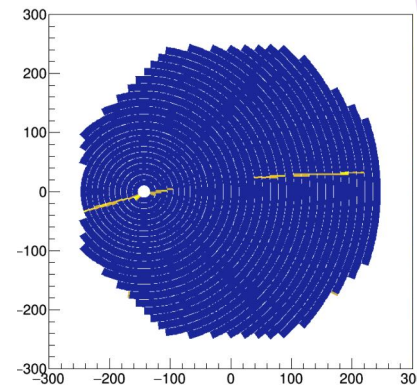
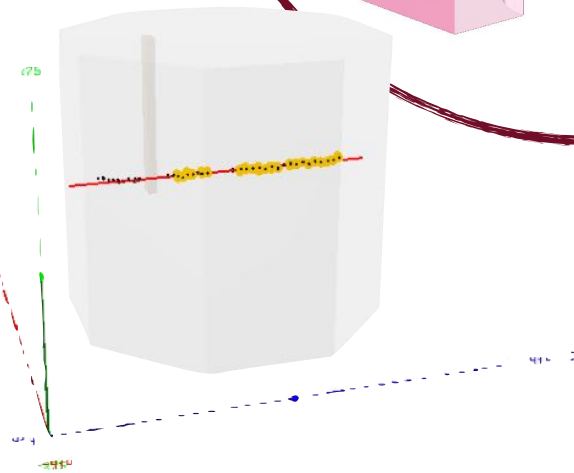
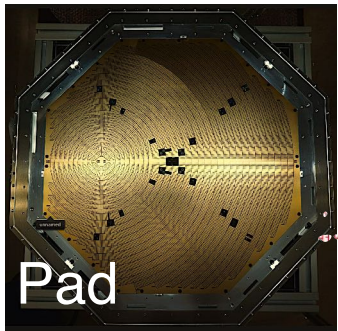
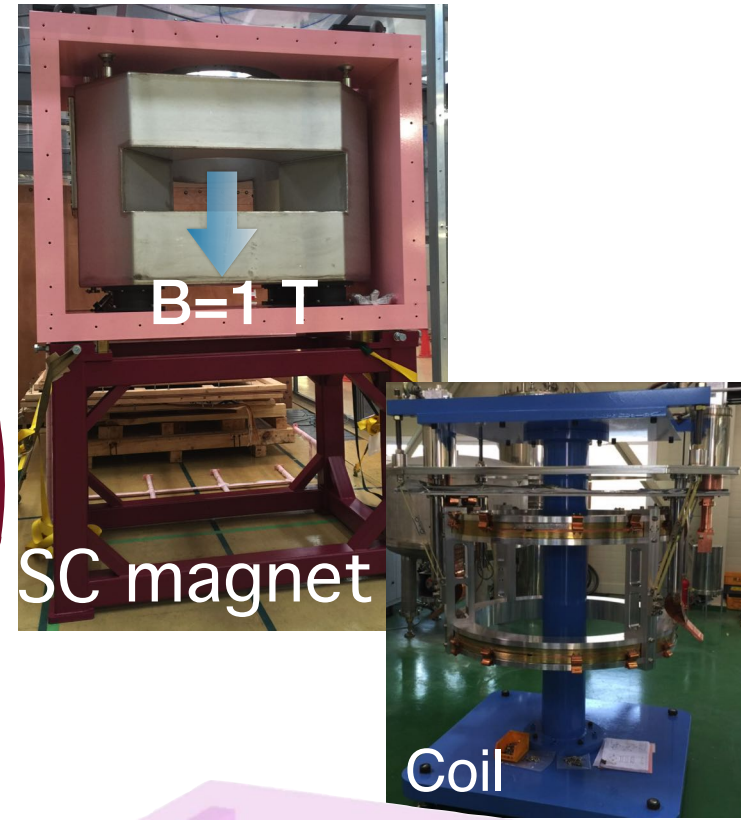
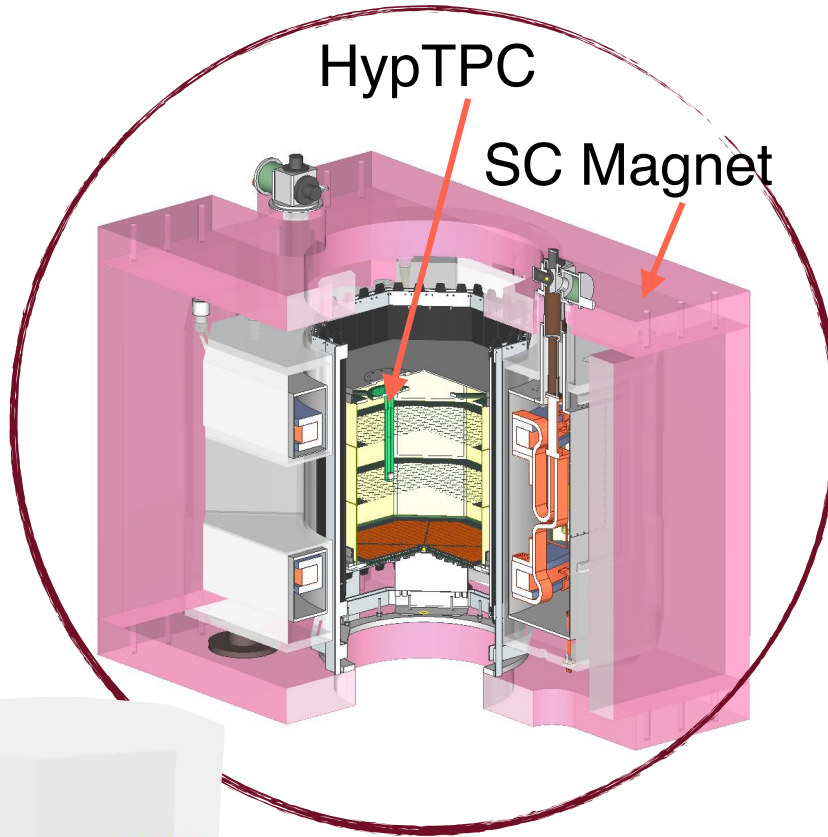


HypTPC
SC Magnet



K1.8 Beam Line in Hadron Hall, J-PARC

Hyperon Spectrometer



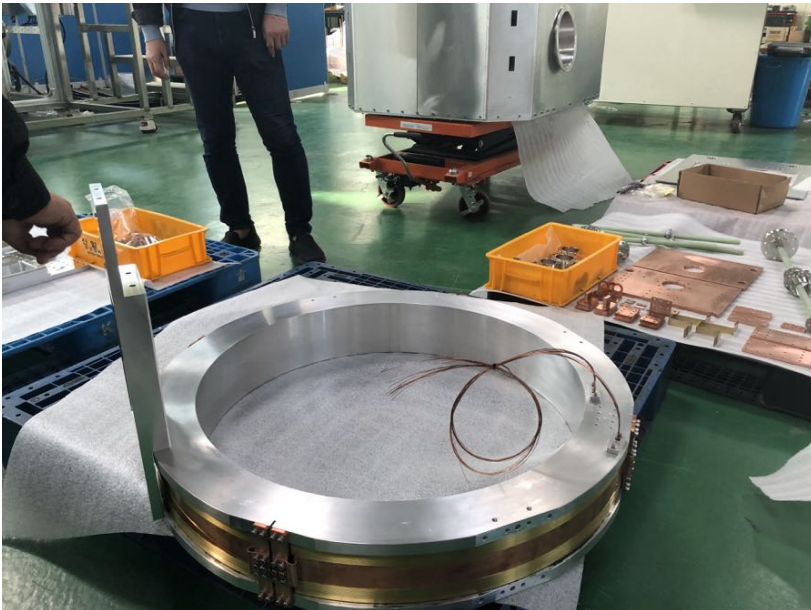
S.H. Kim *et al.* NIMA 940 (2019) 359-370

Superconducting Magnet @KU

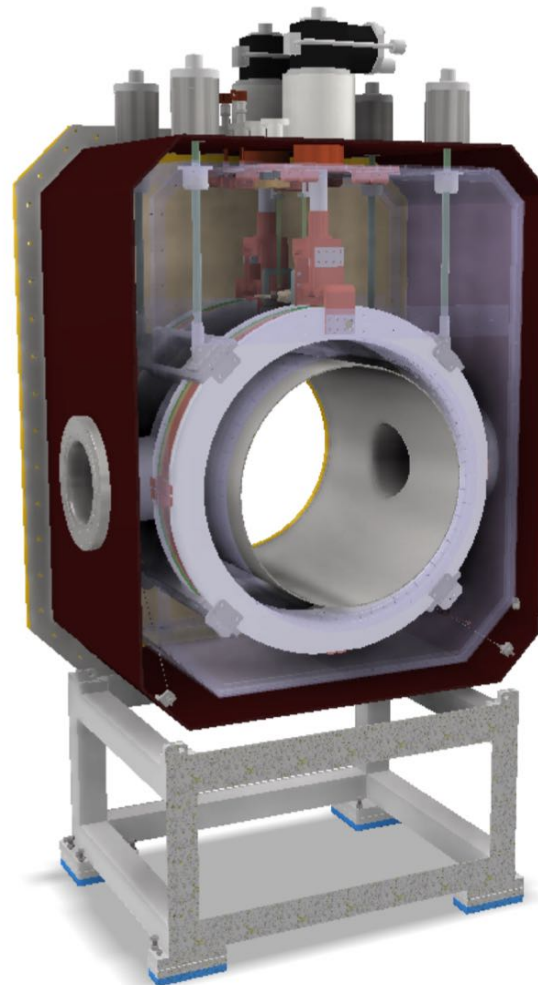


Superconducting Magnet @KU

- Helmholtz coils w/ $R \approx 40$ cm
- ~ 9440 turns/coil
- 1.5 T Max. @ 70.13 A
- NbTi ($T_c = 9$ K), Cu/SC = 2.4
- Conduction cooling
- 2 beam windows ($\phi 600$, $\phi 204$)



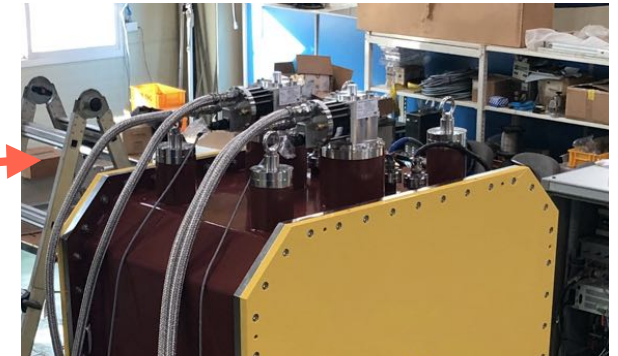
Nov 2019 @KR-tech



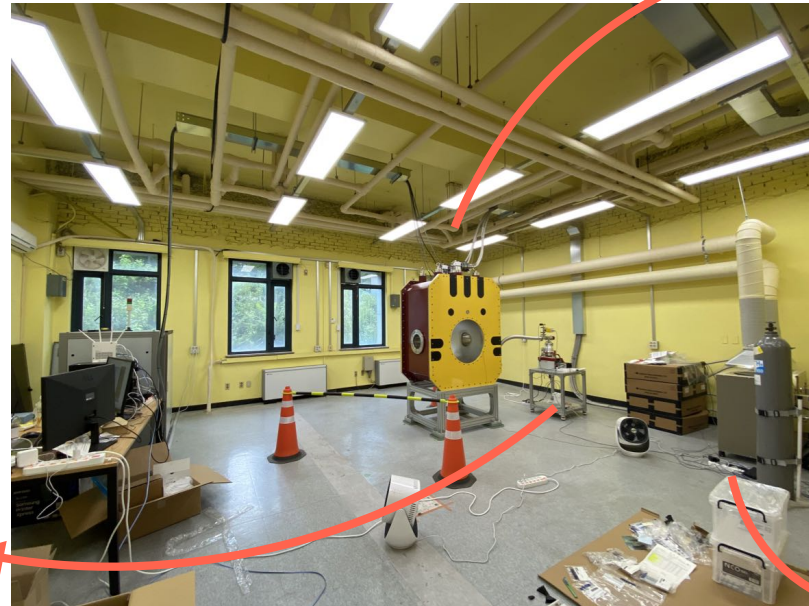
Jan 2020 @KU

Cooling System

GM Coolers



Vacuum chamber



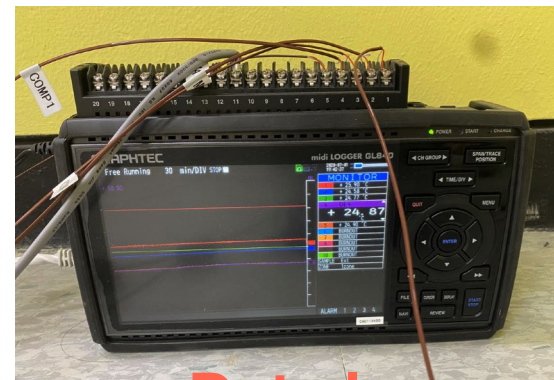
Compressors



Vacuum pump

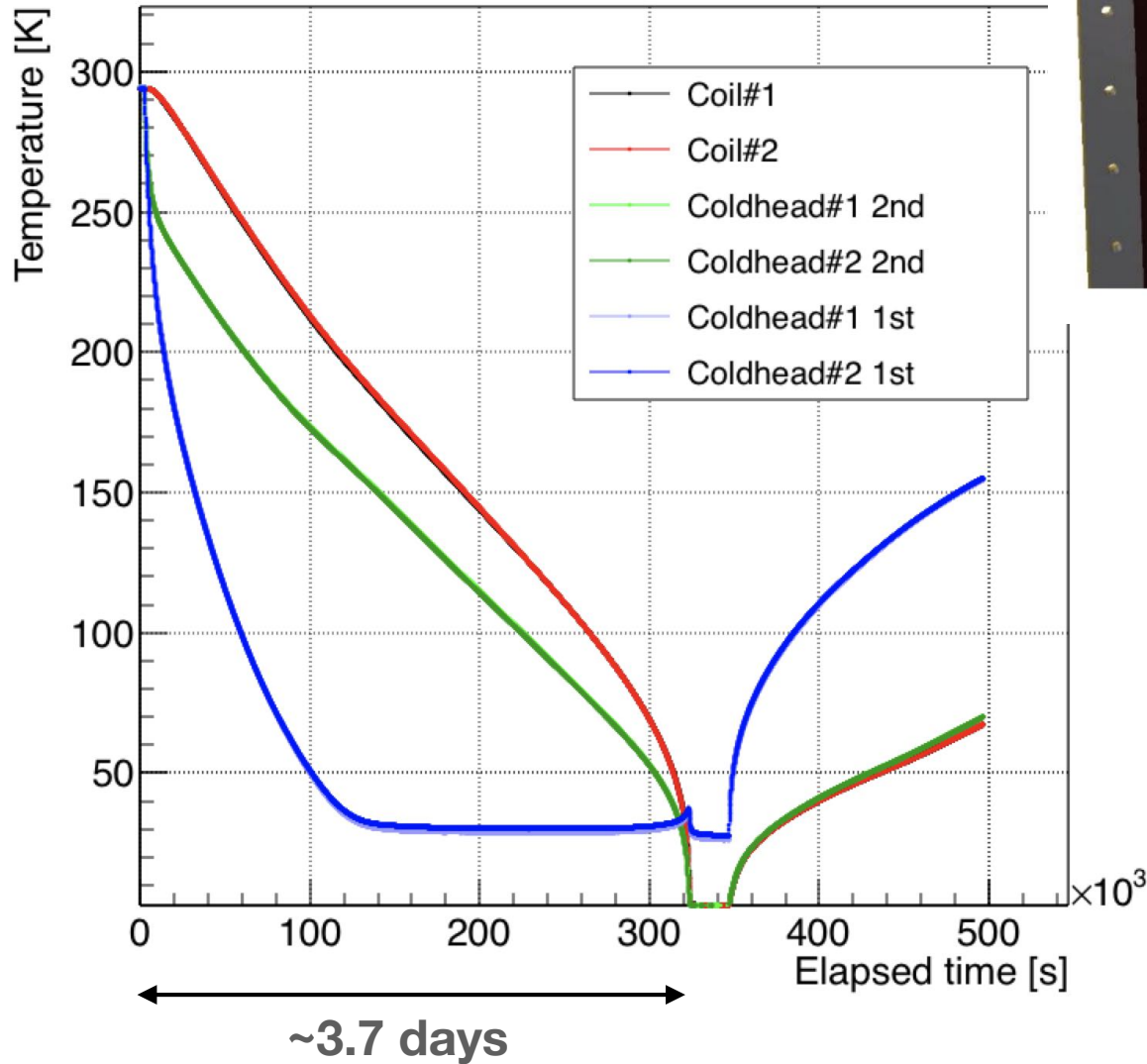
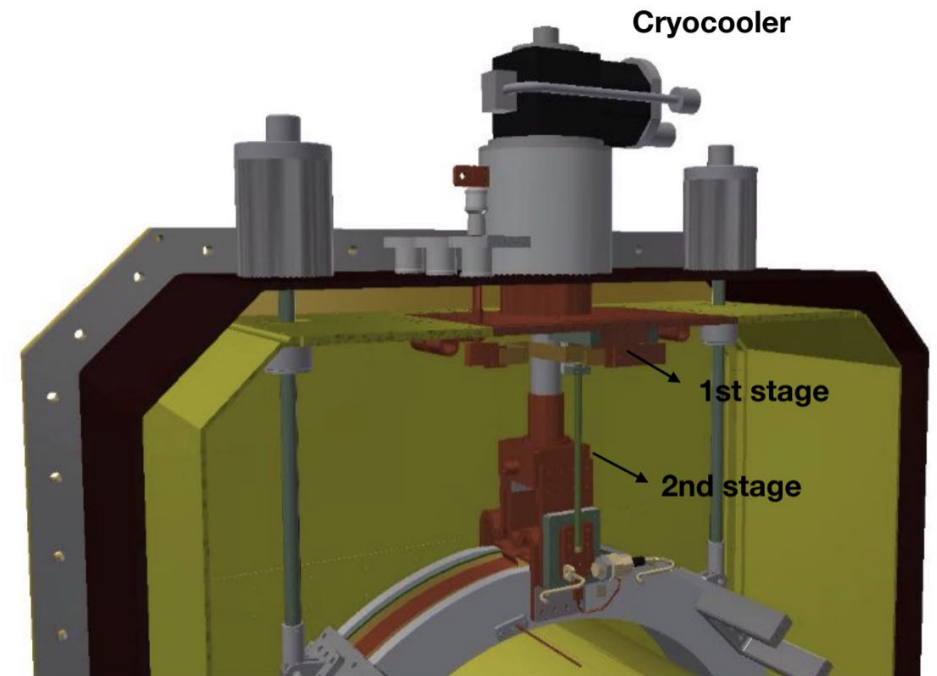


Vacuum gauge

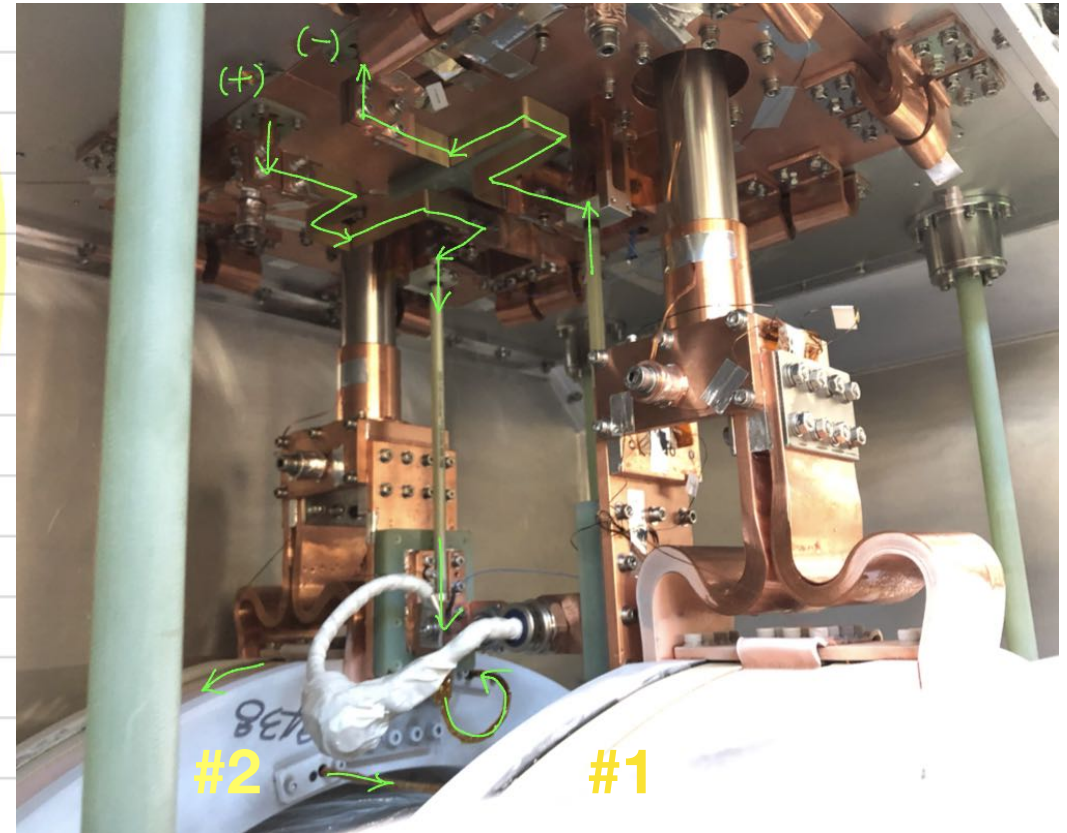
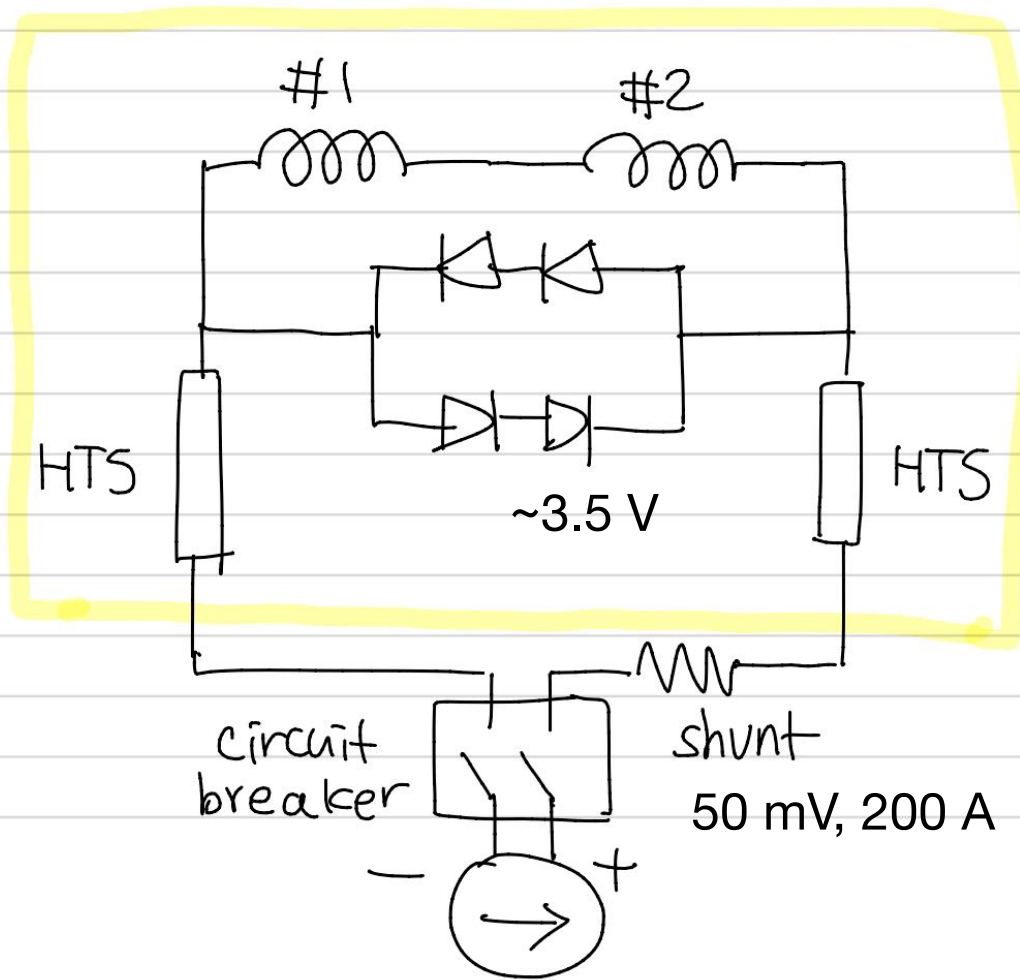


Data logger

Cooling System

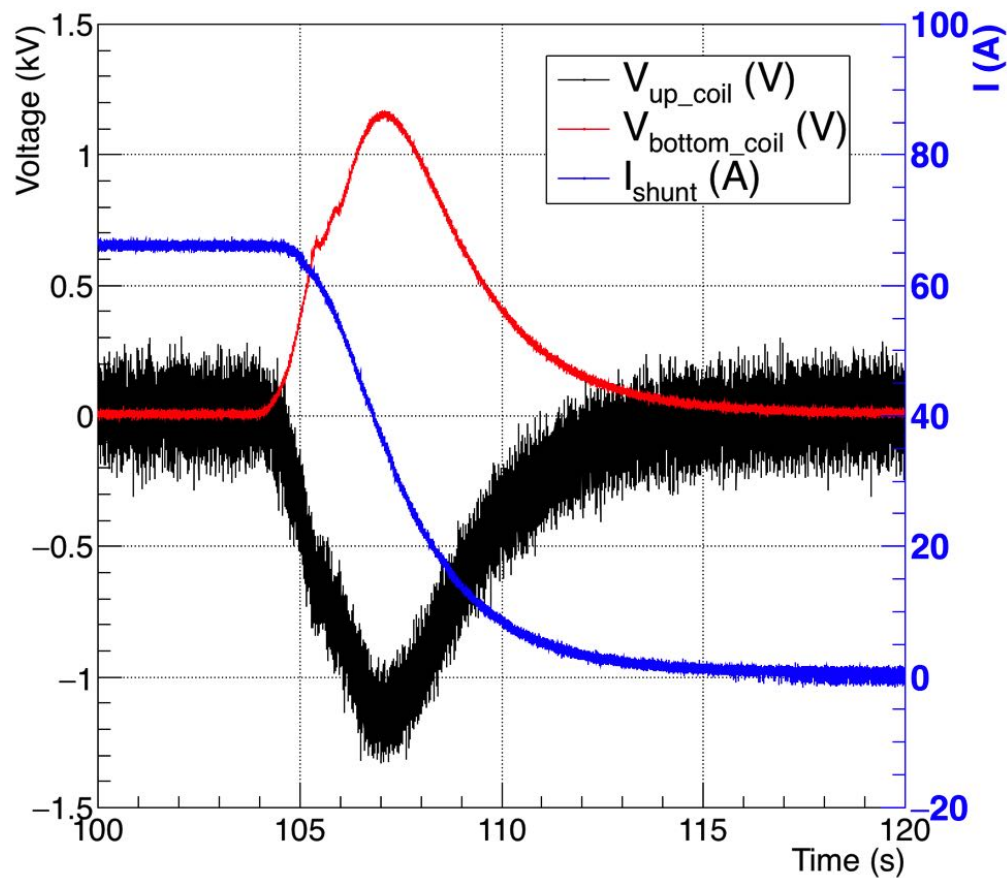


Circuit Diagram

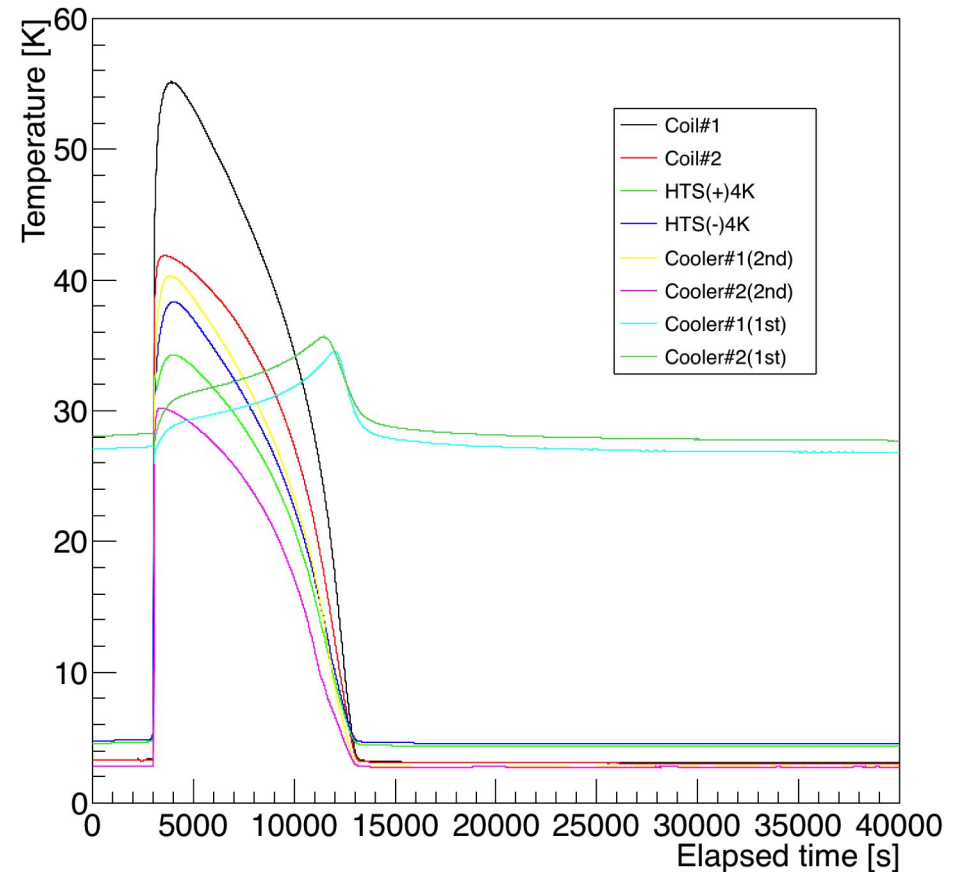


Magnet Quench

● Voltage & Current



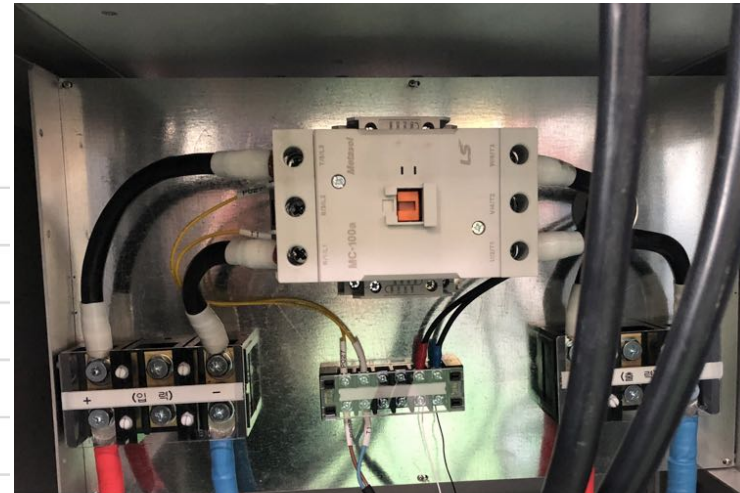
● Temperature



(J-PARC E42 Magnet)

Quench Protection System

Circuit breaker



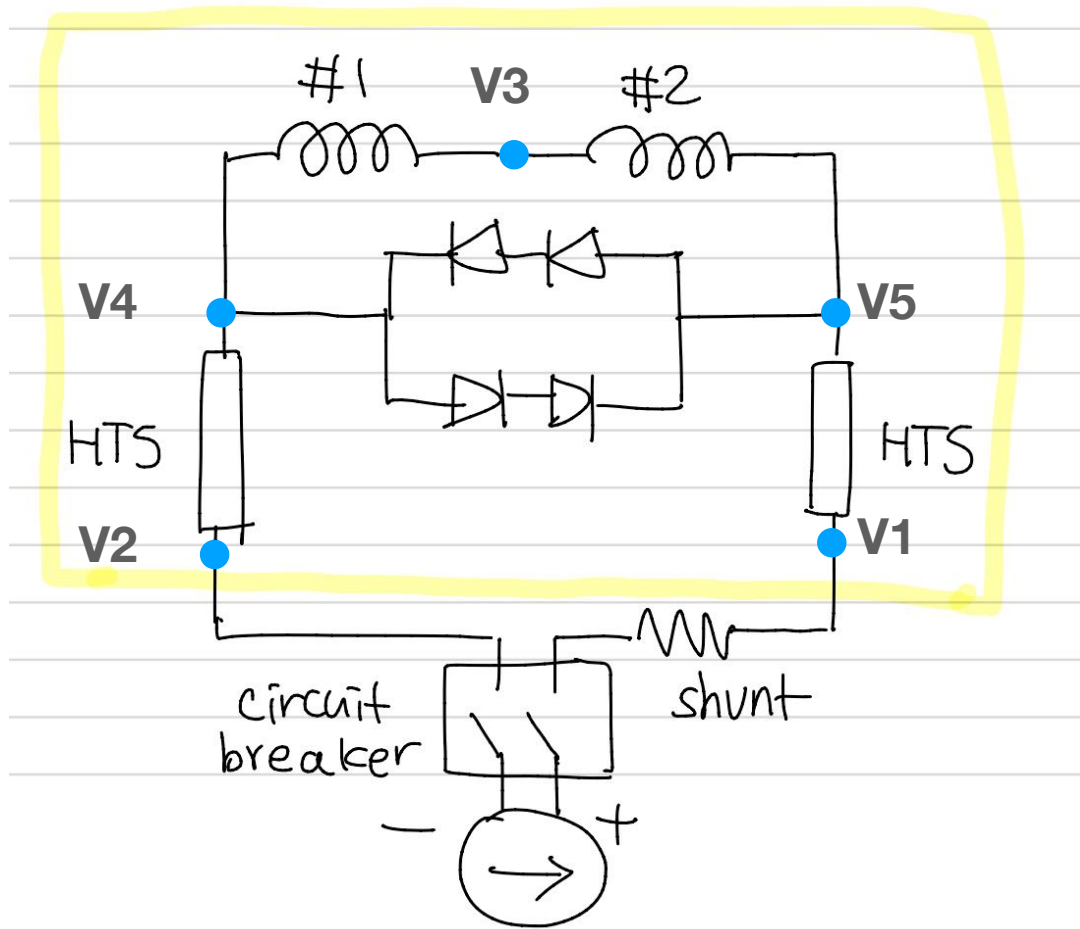
if >0.2 V for 0.3 s



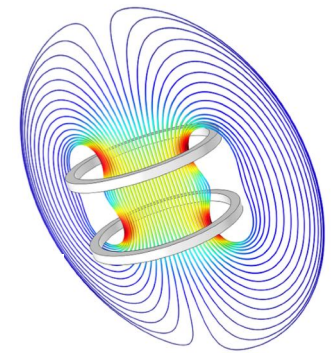
V31-V32

Quench Controller

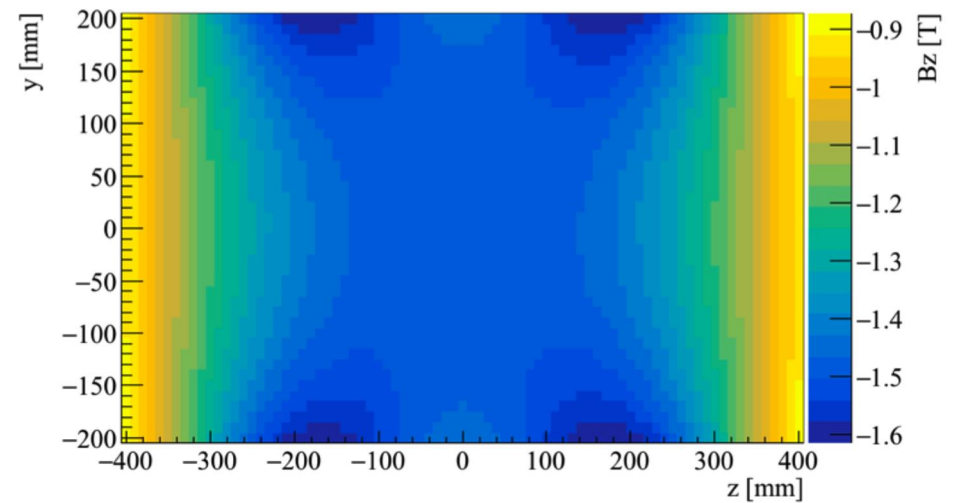
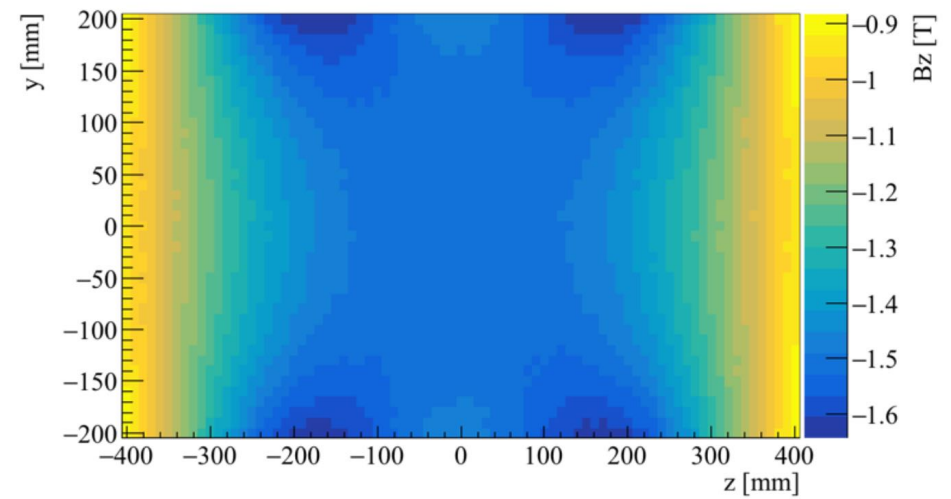
V1,2,3



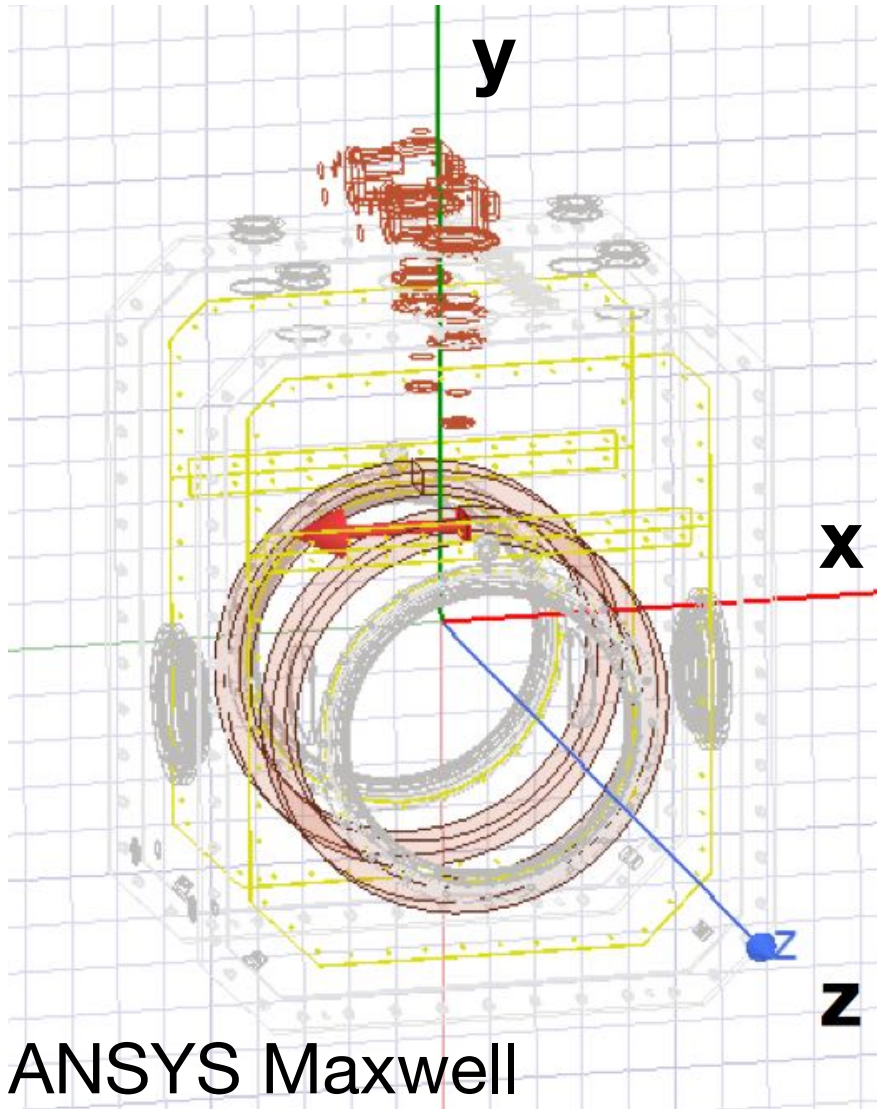
B Field Calculation



Measurement

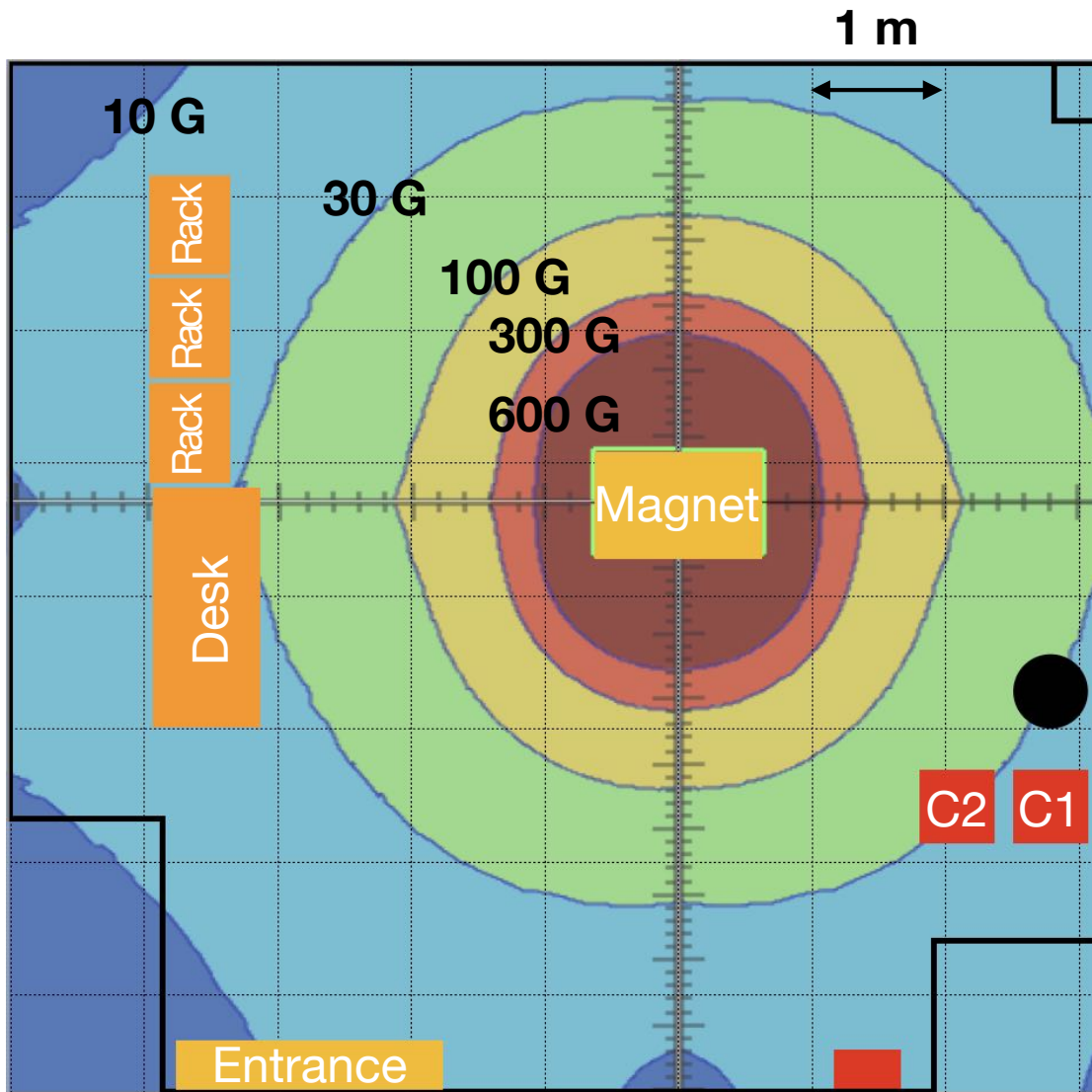


Calculation



ANSYS Maxwell

Fringe Field in the Lab



● Magnet Safety Guidelines

10 G	Damage to watches, credit cards, magnetic tape, and computer disks
30 G	Kinetic energy hazard from small ferrous objects
600 G	Allowed TWA for routine exposure (whole body) (8-hour TWA*)


*TWA – time weighted average

<https://blink.ucsd.edu/safety/radiation/magnet/limits.html>

At $y=0$ (magnet center), 1.5 T (Max.)

Test Log @KU

<https://www.youtube.com/watch?v=7KvxrCWFYIQ>

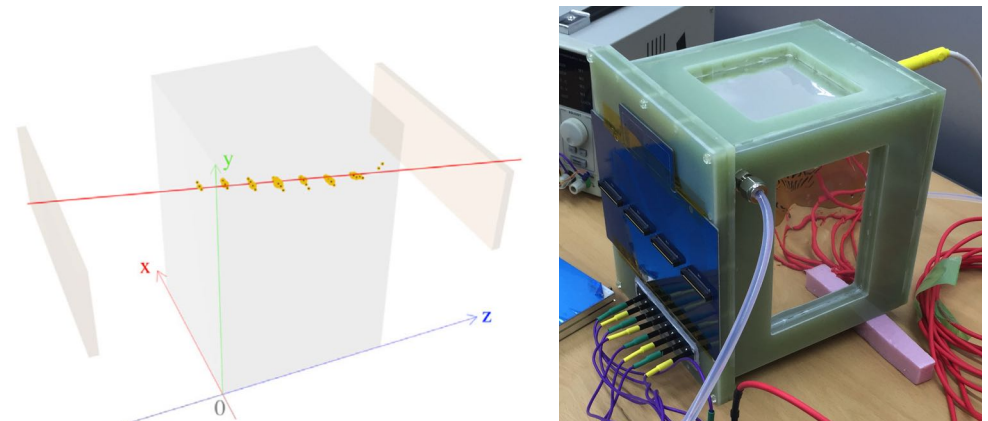
- 1/3 Magnet installed @KU 
- 1/3-10 Test #1 (1.5 T) -> Noise, Exhaust problem
- 2/18 Soundproof wall installed, Exhaust system modified
- 3/2-6 Test #2 -> Exhaust problem
- 3/14 Exhaust system modified
- 3/16-23 Test #3 -> Minor problems
- 5/22 Vacuum pump replaced, air circulators added
- 5/25-31 Test #4 -> Lower cooling efficiency



Plan & Summary

- Prepare voltage monitor system
- Hall probe -> Excitation test
- Equip detector test system
NIM, VME, GET, ...

- Beam window $\phi 600$
- **Max. 1.5 T @ 70.13 A**
(ramping : ~1 hour)
- Prep. Time : **~1 week**
(vacuum + cooling)
- **Safety comes first!!**



S.H. Kim *et al.* NIMA 962 (2020) 163687

Backup