A_RD_16

MAGNETIC FIELD MONITORING AND MANAGEMENT FOR SUPERCONDUCTING RF CAVITIES

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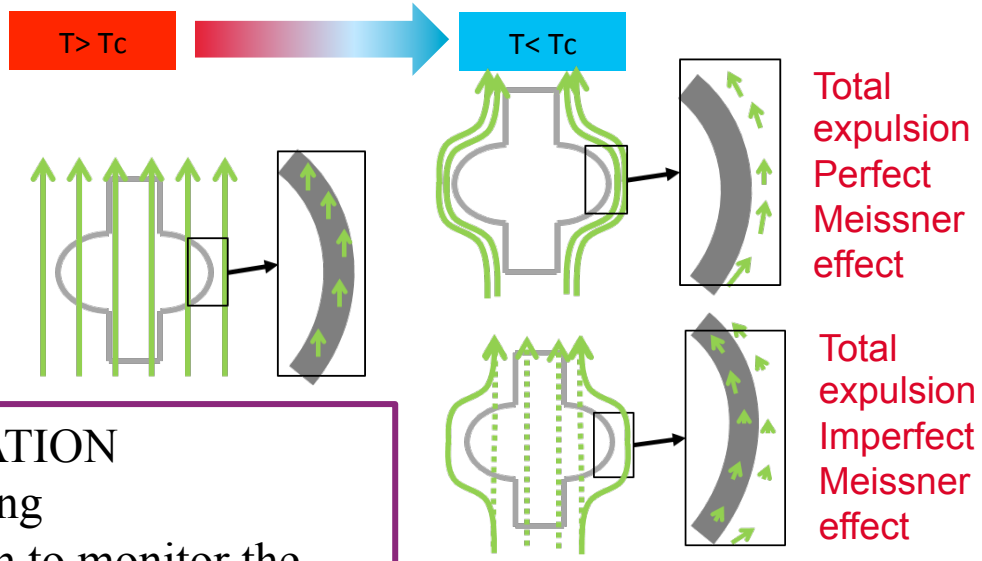
MOTIVATION AND COLLABORATION OVERVIEW

Various studies progress around the world for achieving the high-Q operation of superconducting radio frequency (SRF) cavity.

⇨ **Necessity of reducing the surface resistance.**

When a cavity is cooled down to a superconducting state, some part of the ambient magnetic field is trapped into the cavity.



MAIN R&D AXIS OF THIS COLLABORATION

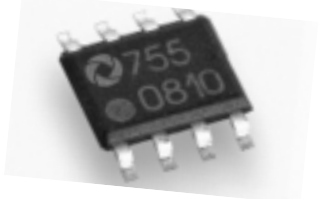
- Understand the mechanism of flux trapping
- Develop a magnetic field mapping system to monitor the magnetic flux trapping and expulsion around the cavity during its cool down and warm up process

CEA *Requested funding*	J. Plouin, E. Cenni, C. Marchand, T. Proslier *3 k€ (1 travel)*
KEK *Requested funding*	*M. Masuzawa, K. Umemori, K. Tsuchiya, R. Ueki, T. Okada* *100 k¥ (3 travels)*

MAGNETIC FIELD SENSORS

Magnetic sensors AFF755 from Sensitec, based on Anistropic Magneto Resistance (AMR)

- Cheap (~10 $).Work at low temperature
- Needs calibration procedure.



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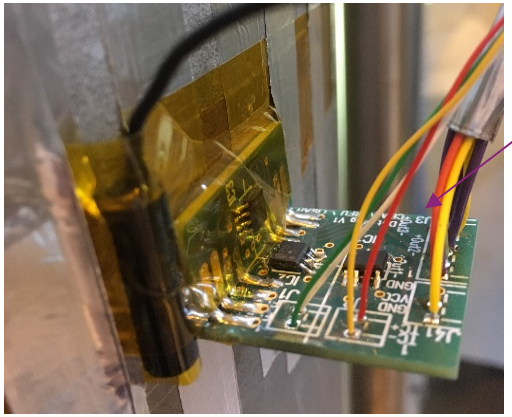
CAVITY



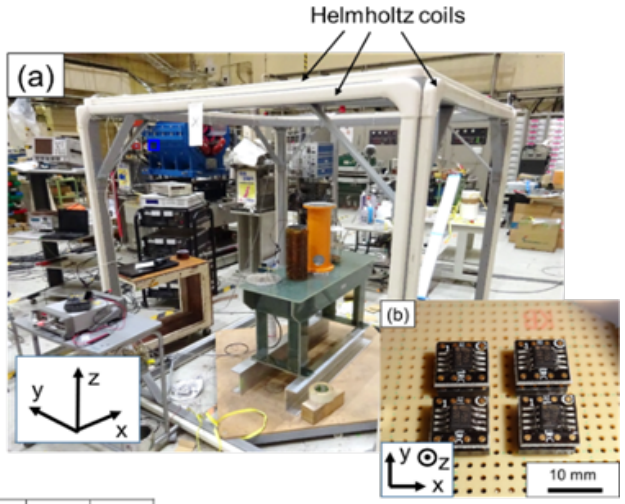
3 AMR sensors (X, Y, Z)

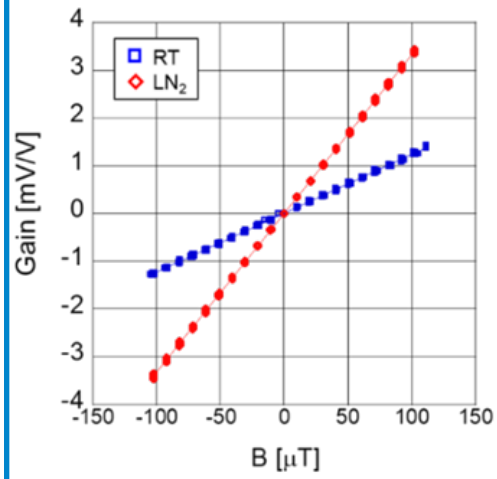
1 fluxgate (~1000 $)

calibration procedure, work at RT and 77 K. still to be improved at 4 K

KEK

Helmholtz coil fabricated for calibration at 77 K and 4 K





Output voltage vs B

FLUX TRAPPING

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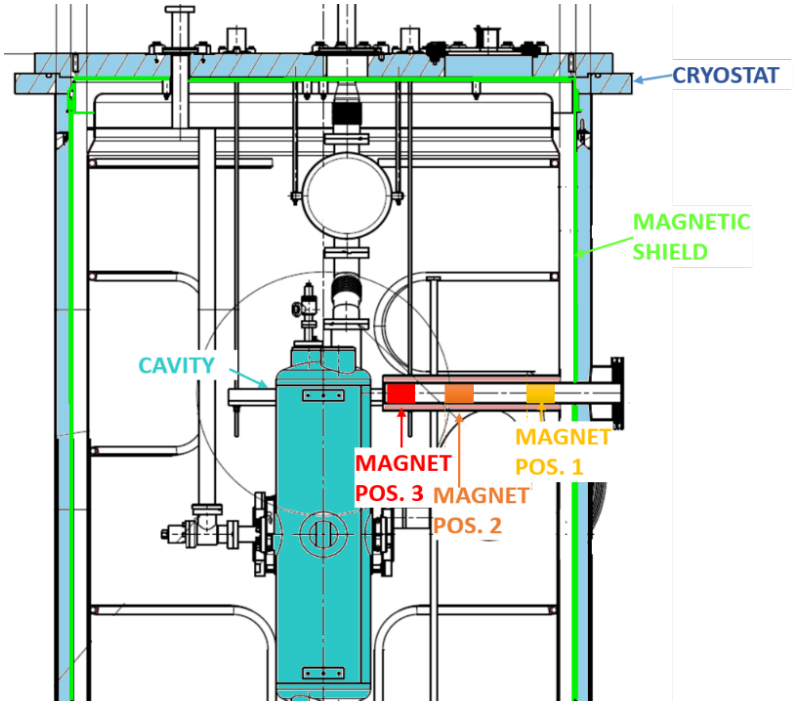
Q_0/E_{acc} measurements on a 175 GHz cavity in presence of a magnet



- Magnet placed when cavity is already supra : no effect on Q_0/E_{acc}
- Cavity cooled down to 4.2 K in presence of the magnet : Q_0 dropped up to of a factor 10 for the closest magnet position

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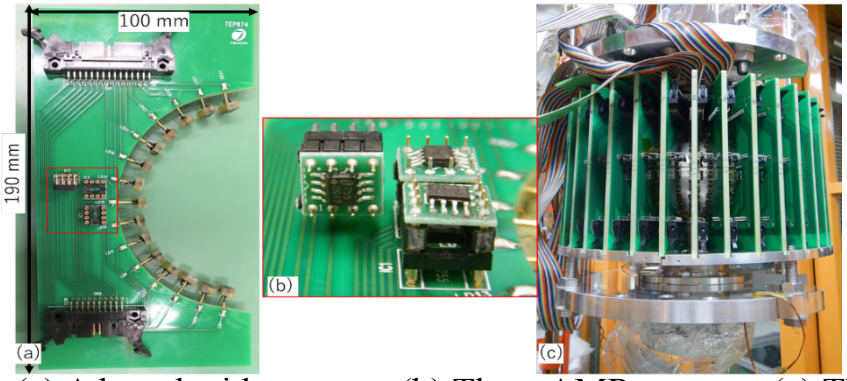
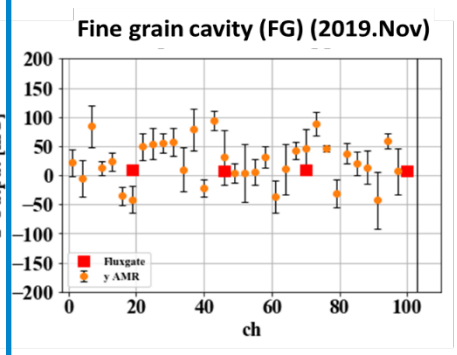
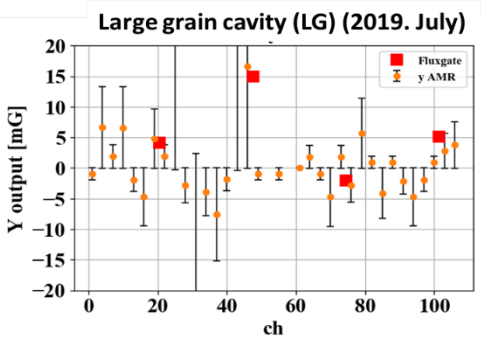


(a) A board with sensors. (b) Three AMR sensors. (c) The set up of cavity with the mapping system.





Flux expulsion measurement

- Develop a device able to move a set of 10 x 3 (for X,Y,Z) sensors around a cavity during tests at liquid helium temperature. 3D cartography of the magnetic field
- Make new experiments with a permanent magnet, in order to measure the effect of a static magnetic field on the cavity performance.
- Master student arrived in February 2020

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- Test about 40 AMR sensors at the liquid Helium temperature
- Map the magnetic field around the cavity during the cool down and warm up process to see if there is any flux trapping and/or expulsion process taking place.
- Examine a correlation between the trapping/expulsion and the performance of the cavity (Q-value) .

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2019 publications/conferences

SARAF Equipped Cavity Test Stand (ECTS) at CEA, LINAC 2019
Study of magneto-resistance for low magnetic field measurement, 26th International Conference on Magnet Technology, 2019
Study on Magneto-Resistance Sensors for Low Magnetic Field Measurement, submitted to IEEE Trans. Appl. Supercond

2020 envisaged conferences

Next TTC (TESLA Technology Collaboration) meetings in Aomori, Japan

Expected outcomes from the collaboration
Share experience on magnetic sensors
Participation flux expulsion operation
Data analysis