Detector solenoids for the MICE experiment

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Basic design of the solenoids

Considering the following assumptions:

- **operating current = 1000 A**
- **maximum quench temperature = 100 K**
- **maximum quench tension = 1000 V**

the following solenoids can be build:

			V3	V4
Axial field	T	3	3.6	5
Inner radius	cm	33	35	35
Stored energy	MJ	2.4	4	7.7
Time constant	s	4.8	7.9	15.3
SC section	mm≤	0.37	0.48	0.58
cu/SC		14	16.1	15.6

Basic design of the solenoids

Influence of the operating current:

- **maximum quench temperature = 100 K**
- **maximum quench tension = 1000 V**

the following solenoids can be build:

Axial field	T	3.6	3.6
Operating current	A	1000	2000
Inner radius	cm	35	35
Stored energy	MJ	4	4
Time constant	s	7.9	4
SC section	mm≤	0.45	0.9
Cu/SC		16.1	11.5
Mass of winding	kg	1230	900

Field coming from the cooling cells

In the 1 m usefull length of the detector solenoid the fringe field from the experiment varies from 0.1 T to -0.005 T.

Solutions to compensate this:

- **vary the winding compaction (not easy to control during winding).**
- **ad compensation coils at the end.**
- **ad an other SC coil to locally adjust the field (I = 100A). This solution allows the field to be tuned.**

Question: will the experiment be running with different field?

Conductor development

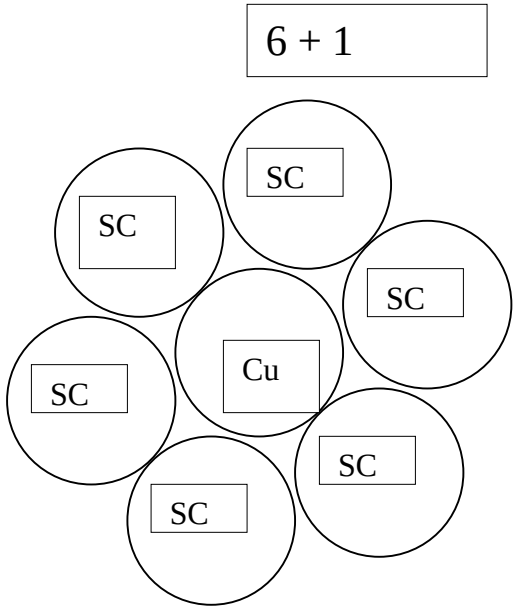
- **There is no existing conductor for these magnets.**
- **There is no strands having the right Cu/SC ratio.**

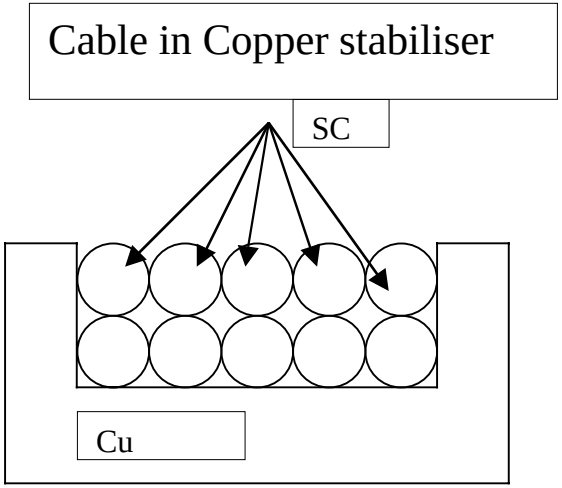
Conductor development will be needed

		V3	V5
Axial field	T	3.6	3.6
Operating current	A	1000	2000
Cu/SC conductor		16.1	11.5
Nb of SC wires		6	10
Cu/SC on the SC wires		4	1.3
complementary Cu section	mm≤	5.91	28.6

Conductor development

How could the conductor look like?





Stored energy and Inductance

For a given stored energy the inductance decreases when the operating current increases:

For the 3.6T magnets

		V3	V5
Axial field	T	3.6	3.6
Operating current	A	1000	2000
Stored energy in the experiment	MJ	27.6	27.6
Stored energy in the detectors	MJ	5	5
Inductance in the experiment	H	62.9	15.7
Inductance in the detectors	H	9.8	2.5

One power supply is sufficient for both detectors

Forces

Forces between the experiment and the detector solenoids around 500 kN (or 50 tons).

A section of 1000 mm2 (or 1.55 square inches) of titanium alloy will support it.

Conclusion and Input needed to progress

- Detector magnets can be made without major problems.
- A conductor need to be developed.
- The different ways to run the experiment should be defined to determine the fringe field coming from the experiment, and the way to compensate it!