| FAIR – Minutes | **Writer: Hanno Leibrock** |
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| Minutes of Multiplet design meeting 11.03.2009 | |
| **Participants:** | Mélanie Bruchon, CEA; ; Antoine Dael, CEA; Eric Floch, GSI; Luis García-Tabarés, CIEMAT; Marion Kauschke, GSI; Hans-Dieter Krämer, GSI; Bernhard Launé; Hanno Leibrock, GSI; Jan Patrick Meier, GSI; Eduardo Molina, CIEMAT; Carsten Mühle, GSI; Gilles Olivier, IN2P3; Jean-Michel Rifflet; Fernando Toral Fernandez, CIEMAT; Helmut Weick, GSI; Horst Welker, GSI; John Winfield, GSI; Martin Winkler, GSI; Yu Xiang, GSI |

# Minutes of "Super-FRS: Multiplet Design Meeting", 11nd March 2009

## Welcome (Hans-Dieter Krämer, GSI)

Dieter Krämer stated that an advisory committee (for example a Machine Advisory Committee, MAC) will make the decision about the final magnet design.

## Short Review of Technical Conditions (Hanno Leibrock, GSI)

Hanno Leibrock presented the different configuration of the Super-FRS multiplets. Frame conditions for interfaces of cryogenics, vacuum connections, and alignment have been shown.

## Design review of Super-FRS type3 superferric quadrupole (Fernando Toral Fernandez, CIEMAT)

Two similar superferric design options with 300 A and 450 A have been presented.
Modified Kalimov/Toshiba design with less iron but more maximum ampere turns than in the Kalimov/Toshiba design.
Good field quality reached with big holes. All field quality requirements reached up to 8 T/m also in 3d.
Reducing the maximum gradient from 10 T/m to 9.5 T/m or 9.0 T/m would reduce the required ampere turns and mainly the iron weight significantly.
Ordered wound layered coil is necessary to reduce layer to layer voltage in case of a quench is low.
Pancake coil (race track coil) like in the quadrupole triplets at RIKEN.
The yoke is laminated.
Similar working magnets exist at RIKEN and MSU.
Tolerance of coil position and coil dimensions must be checked.
Leakage flux should be checked.

## Design ideas for a cos(2theta) magnets (Mélanie Bruchon, CEA, Saclay)

A new conceptual design with cold iron and a maximum current of 950 A has been made. The coil has now 4 layers.

Cosine(theta) magnets have long fringe fields. To avoid space problem the length of the straight section is reduced to 845mm. But to achieve the same focusing power, the maximum gradient is increased to 14.2 T/m.
It is planned to consider some innovative design ideas made by Pavel Vobly (BINP, Novosibirsk Russia), but additional R&D time is required
A better field quality could be reached if the inner wall of the yoke is has a distance of 50 mm to the outer coil. But the reduction of the yoke contribution leads to a raise of the maximum current to 1055 A if the thickness of the yoke is 200 mm and 1105 A if the thickness of the yoke is only 150 mm.
Only a 2d design exists but no 3d design up to now.
The new design uses an indirect cooling scheme. Additional cooling pipes are needed for cooling down. Bath cooling is in principle also possible.
Coils shape the field in a cosine(theta) magnet, so persistent current in the conductor could be a problem for the field quality at low field (must be checked).

**Local Cryogenics and Cryogenic Interfaces (Yu Xiang, GSI)**

Forced flow as well as bath cooling could be possible without changing the local cryogenic design. The partners should check if their design requires modifications on the current design of the local cryogenic.

**Quench Calculations on Super-FRS Quadrupoles (Eric Floch, GSI)**

Eric Floch made some detailed quench calculations with the Spanish 450 Ampere design version. Most probably the quadrupole is not self protecting. But acceptable maximum coil to ground voltages and acceptable maximum hot spot temperatures could be achieved with dump resistors.

**Super-FRS Lattice with Cos $\theta$ multipoles (John Winfield, GSI)**

John Winfield presented a proposal of another Super-FRS lattice in case of cosine theta solution with combined quadrupoles/sextupoles. In this case the number of stand alone sextupoles is decreased. But the total number of sextupoles is still the same. All Quadrupoles would have an effective length of 1 meter

**Short comparison of the influence of the different designs on current leads, power converter and cabling (Hanno Leibrock, GSI)**

A comparison of the influence of the different designs on current leads, power converter, cabling and space requirements has been shown.
Result of the comparison: a low current option is in favour

**Discussion about advantages and disadvantages of the different design proposals. (All participants)**

Hanno Leibrock, GSI has to modify the table of advantages and disadvantages of the different magnet designs.

**Next steps**

- There will be video conferences with both partners planned mid of May.
- There will be a meeting of an advisory committee (for example a Machine Advisory Committee, MAC) which will make the decision about the final magnet design.