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Magnetic field simulations and measurements on mini-ICAL

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The proposed ICAL detector is designed to detect muons generated from interaction of ν_μ and anti-ν_μ with Iron. It is designed with a maximum Magnetic field of about 1.5 Tesla (with 90% of the its volume having > 1 Tesla magnetic field). The purpose of using magnetic field is charge identification and momentum reconstruction of the muons. The mini-ICAL is a fully functional 85-ton prototype detector. It consists of 11 layers of iron and 10 layers of RPCs placed in the air gap between the iron layers. Each iron layer is made up of 7 plates of soft iron. There are two sets of copper coils through which the current is passed to produce magnetic field in the detector. One of the main challenges of the mini-ICAL detector is to produce the required B-field and to measure it as accurately as possible to study muons. A comparison between the measured B-field with 3-D finite element electromagnetic simulations is done to find the correlation between the two B-field values.

For the purpose of measurement of B-field in the detector, Hall sensor PCBs and search coils are used. Hall sensor provide real time measurement of B-field and search coil provides B-field values during the ramp up and down of the current through the copper coils. Calibration and systematic study of characteristics of the Hall sensors which are used for measurement are carried out. Out of 11 layers of iron, 3 layers (1, 6 and 11) have provision for measurement of B-field using Hall sensor and search coils. In the mentioned layers, the gap between the adjacent plates is kept 3-4 mm for the purpose of inserting of the Hall sensor PCBs. A set of 5 search coils are wound around the iron plates at suitable locations in the same layers. In the rest of the layers, the gap between the plates is kept 2 mm.

The static 3-D simulation is done using MAGNET 7.7 software for the 11-layer model and single-layer model of mini-ICAL. Optimization of various parameters (mesh size, etc) is done for the iron as well as for the air. Full geometry is simulated for different values of the coil current. A detailed comparison between the measured B-field and simulated B-field will be presented in this paper. This will help in completing the study on the final magnetic field configuration of ICAL.

In-person participation

Yes

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