

# Shielding the Earth Magnetic Field using Spherical Coils

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The Jiangmen Underground Neutrino Observatory (JUNO) is a neutrino experiment consisting of 2 systems; central detector (CD) and veto system. The CD is composed of thousands of photomultiplier tubes (PMTs) used to detect light signals from neutrino induced interactions with liquid scintillator inside the CD. Another set of PMTs is used as water Cherenkov detector, together with muon top tracker forming the veto system for background rejection. However, the PMTs' efficiency decreases when they are used in magnetic field. At JUNO's construction site, the Earth Magnetic Field (EMF) is approximately 0.45 G. Therefore, the PMTs of JUNO detector are necessary to be shielded from the EMF.

This work aims to design current-carrying coils that generate magnetic field in the opposite direction to the EMF, thus, the two fields tend to cancel each other. We found that the magnetic field generated by the 32 circular coils forming a sphere of diameter 43.5 m can reduce the residual magnetic field to be lower than 10% of the EMF at the CD region and less than 20% at the veto region. Moreover, considering the secular change of the EMF's inclination angle of approximately  $2.87^\circ$  over the 20 years of its operation, the coils can maintain the residual magnetic field both in the CD and the veto regions to be less than 10% and 20%, respectively.

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