Design of magnetic shielding and field coils for a TES X-ray microcalorimeter test platform

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Comsol Modelling - Coil

The residual magnetic fields trapped in the Nb shield are compensated with a coil near the TES to get the best field uniformity along the focal plane. The best design of this field offset setup is a trade-off between the number of coils, their positions, their sensitivity to tilt or displacement and the value of the field which reaches the SQJID readout devices surrounding (lowest value is the goal). We modeled three types of coil: Helmholts, JAX and Single. For each type, we calculated the position of the coil(s) to get the best uniformity of the field along the TES array and the impact of a 1 deg tilt of the coil(s) on it. The coils are set under the TES to reduce the interaction between the Nb shield and the generated magnetic field.

SQUID shielding implementation and final results

For one design (or position) of the Nb and/or SQUID shield there exists multiple positions of a single coil that meets the field uniformity requirements (ratio above 10). Designs iterations between the best coil position and the 3D CAD model gives us the best final results. We took into account that (1) The shield has a CuO on the Nb SQUID, which is placed away from the TES and is 1 mm thick. (2) Space between the coil and the shield has to be greater than 4 mm. (3) A longer shield has less impact on the uniformity along TES plane. The following conclusions show the results obtained for the best position of the coil.

Conclusions

- We have modeled the magnetic shielding of the Mumetal, A4K and Nb shields as well as the coil using Comsol. The resulting design will be used to test the IRA at Athena/IFU.
- The theoretical results meet the requirements and phase as reference to build this setup.
- The CAD designs of the Nb, A4K and 300 K shields as well as the coil and SQUID shield sub-assembly are done.
- The fixation system of the Nb and A4K shield to the 50 mK and 3 steps, respectively, is still under construction.
- A shielding/coil prototype will be machined within the next few months.

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