Magnetic Shielding
(from the BICEP Array experience)

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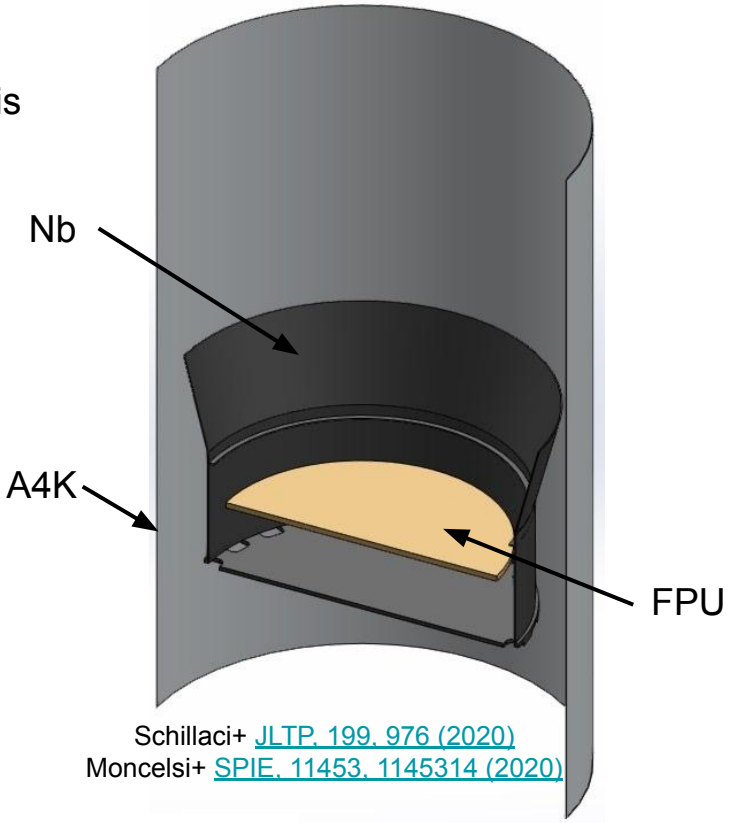
Readout parallel session
CMB-S4 remote meeting March 2021

CMB-S4

General considerations & lessons learned

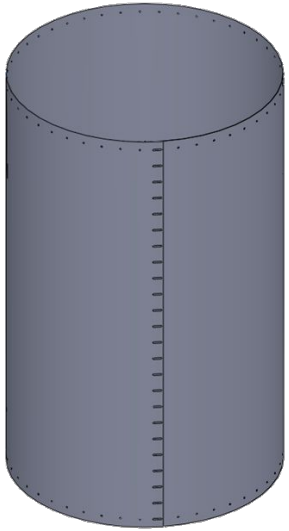
- Magnetic shielding strategy traditionally focuses on minimizing flux density at the location of the SQUIDs – this works really well
- However, TES can be susceptible too, and less easy to shield directly.
- In general, shielding should be progressive going from 300K to the sub-K stages, interleaving high-mu materials and superconductors
- COMSOL Simulation reproduces measured shielding but model should include primary and secondary shielding.
- Aspect ratio for SAT not favorable for efficient shielding compared with CMB-stage 2 receivers.

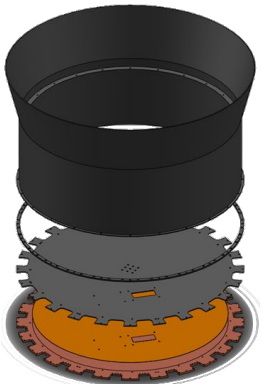


Schillaci+ JLTP, 199, 976 (2020)
Moncelsi+ SPIE, 11453, 1145314 (2020)

BICEP Array shielding

Receiver shielding

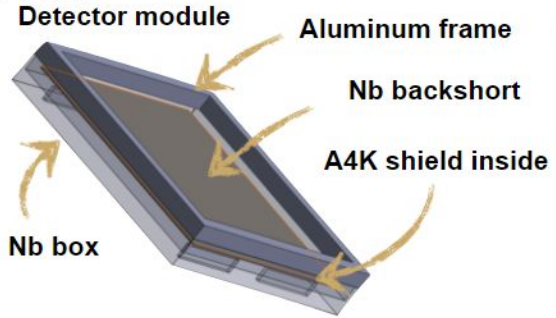


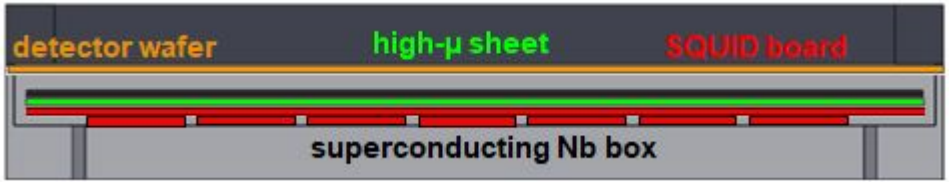


A4K Cylinder @ 50K Nb Cup @ 300mK

In BA this gives a COMSOL Shielding factors:
Axial ~ 400, Transverse ~ 200

Module shielding



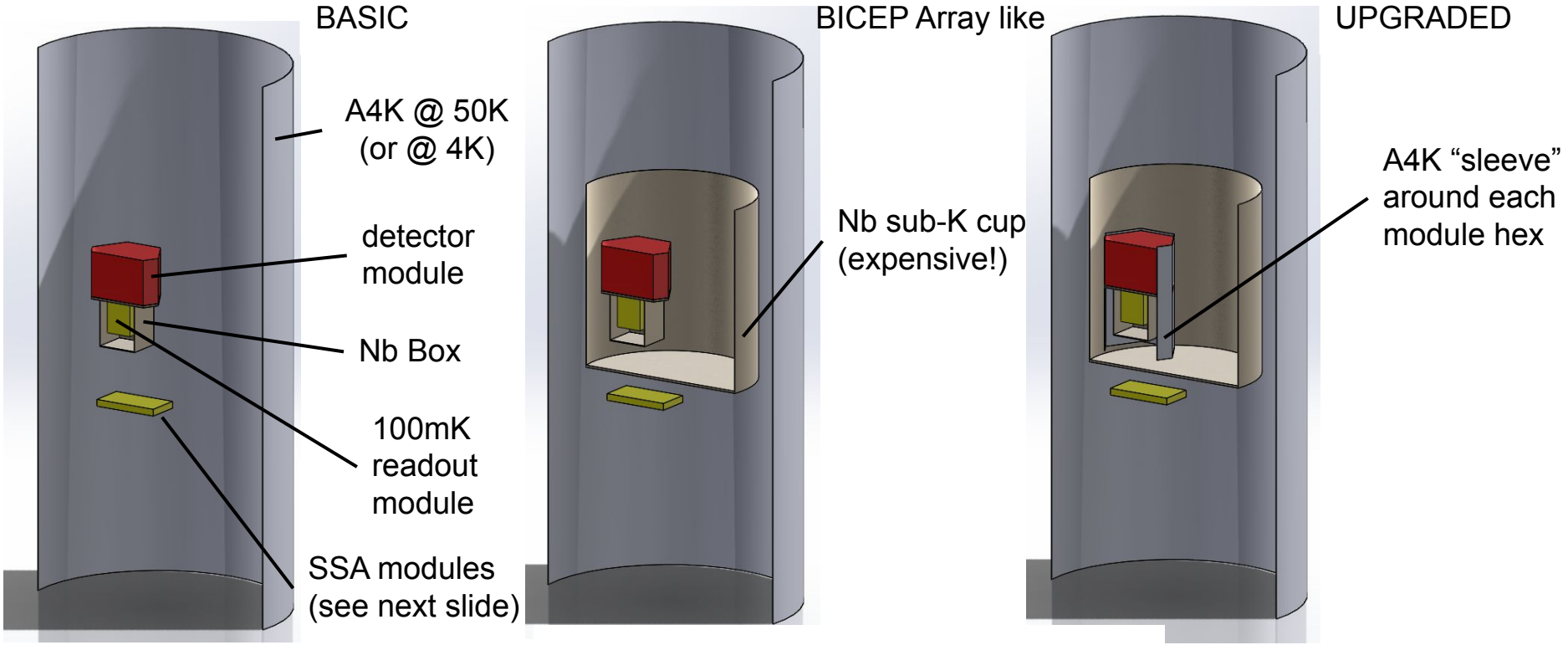


SQUIDs encased in Nb box plus A4K layer

In BA this gives a COMSOL Shielding factors:
Axial ~ 800, Transverse ~ 500

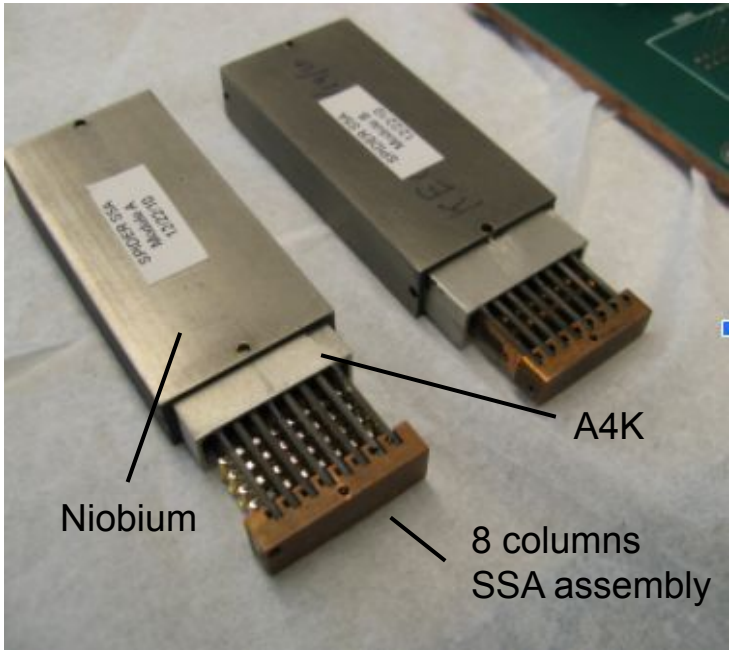
SAT magnetic shielding

(Cartoon-like, approximate dimensions, proposal not yet validated nor agreed upon)

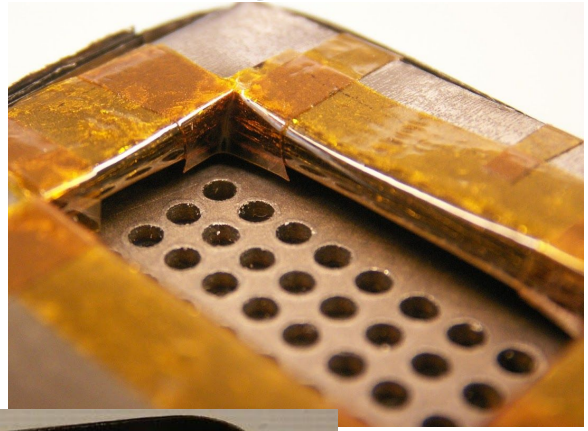


For the record: SSA module shielding

The 8-column SSA modules come from NIST already with a A4K sleeve and a Nb sleeve



Additionally shielded with 10x layers Metglas wrap (high μ)

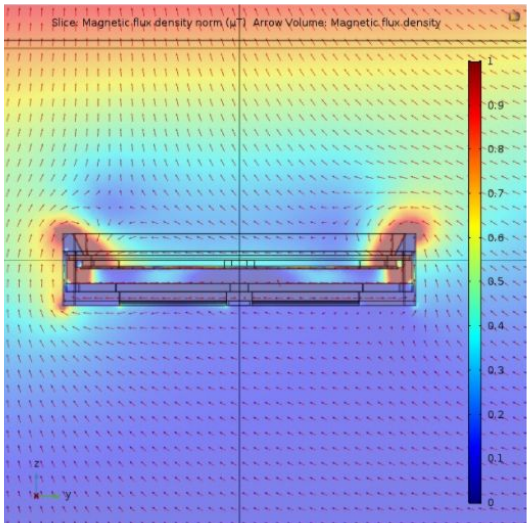


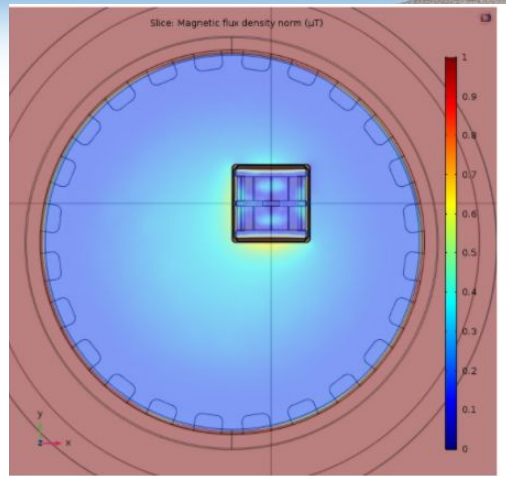
Final Remarks

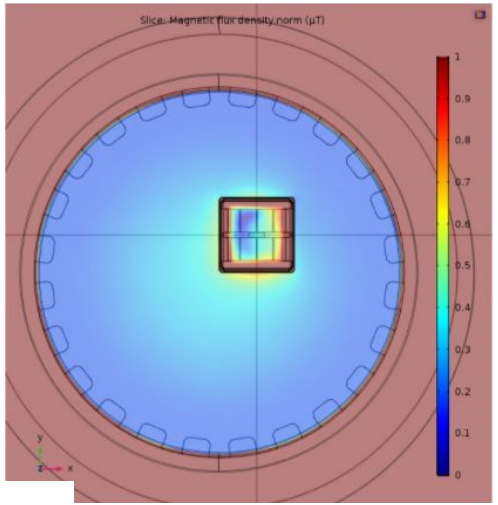
BA experience shows that:

- Combining the receiver and module magnetic shielding factors is not trivial, and it requires dedicated full-model simulations.
- TES magnetic susceptibility? This scheme is optimized for SQUIDs

BA full model Comsol simulations (Schillaci+ in prep)







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