Radiation and Activation with SoLID

Outline

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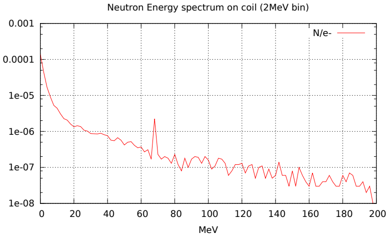
Radiation on Coils (From director review)

Radiation limit $\frac{Neutron_{(E_N>0.1MeV)}}{cm^2} = 10^{19}\frac{N}{cm^2}$ for NbTi

see http://supercon.lbl.gov/WAAM/WAAM_Talks/Al%20Zeller%20WAAM.pdf

FLUKA Simulation FULL FLUX integrated in the total Coil

Also considering that FLUKA is off of an order of magnitude in this angle range, we are expecting a flux of $Neutron_{(E_N>0.1MeV)} = 10^{18}N$, well in the limit for NbTi



Limit of $10^{19}\frac{N}{cm^2}$ for NbTi

What effect is expected around the limit of $10^{19}\frac{N}{cm^2}$ with a superconductor of NbTi?

more detailes can be found at
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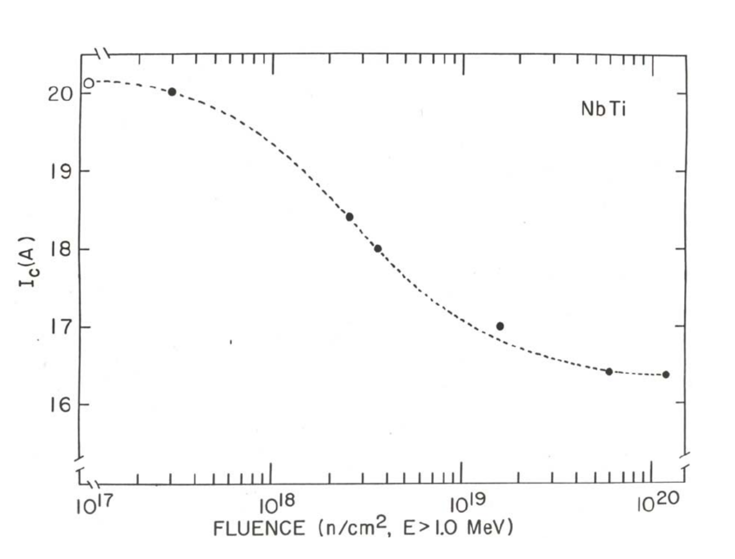
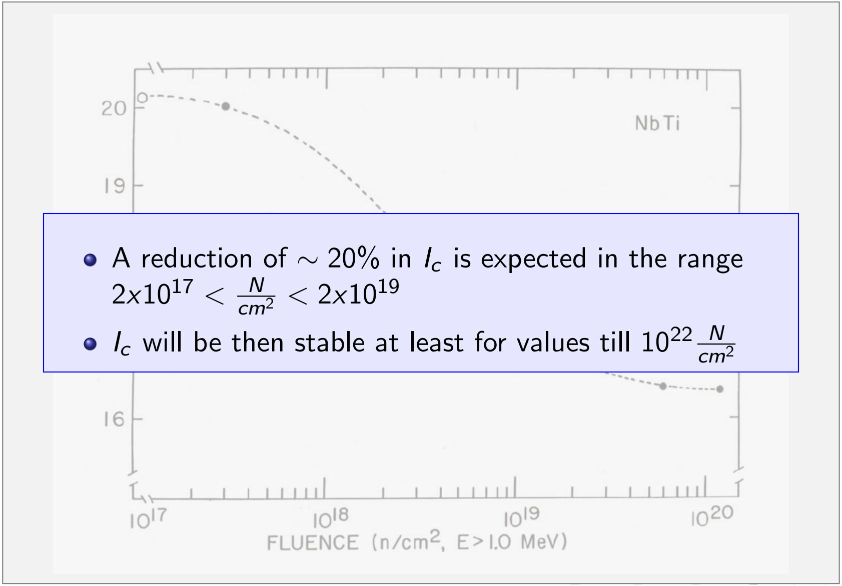
The direct offect of high neutron fluxes on NbTi superconductor will affect the Critical Current (I_c)

- I_c = The maximum current that a superconductor can carry with zero resistance.
- A current greater than I_c will cause the superconductor to revert to its normal state.

How high fluence of neutrons affects I_c



How high fluence of neutrons affects I_c



- A reduction of $\sim 20\%$ in I_c is expected in the range $2x10^{17} < \frac{N}{cm^2} < 2x10^{19}$
- I_c will be then stable at least for values till $10^{22}\frac{N}{cm^2}$

Update Simulation on coil design

Suggested updates from communications with J.Benesch

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As for neutron damage to NbTi: did your calculations take into account 1. the 3-5 mm of stainless steel which is the inner bore of the cryostat
2. the 3-5 mm of aluminum thermal shield 3-5 cm beyond (1)
3. the 6+ mm of stainless steel which is the helium vessel
4. any winding forms left at the inner diameter of the coils
5. the copper matrix in which the NbTi is imbedded.  Typical conductors of the era were 66-80% copper with balance NbTi (2:1 to 4:1 Cu:SC).
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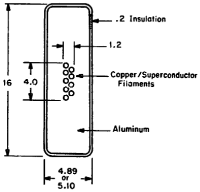
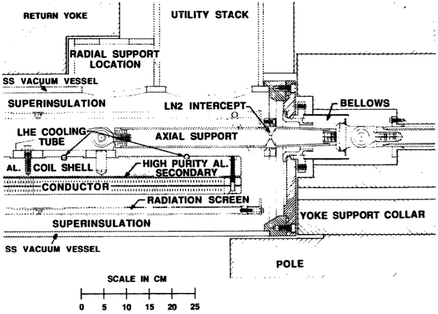
Update Simulation on coil design

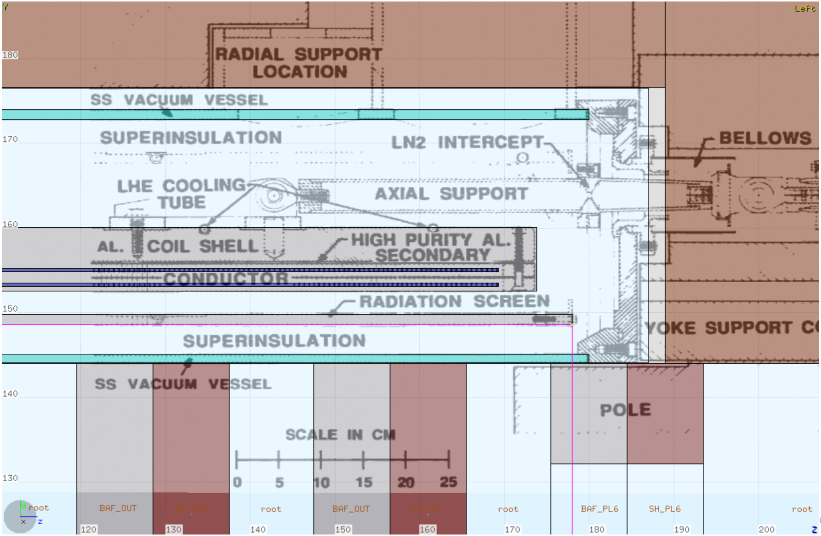
Coil design for CLEOII





Update Simulation on coil design

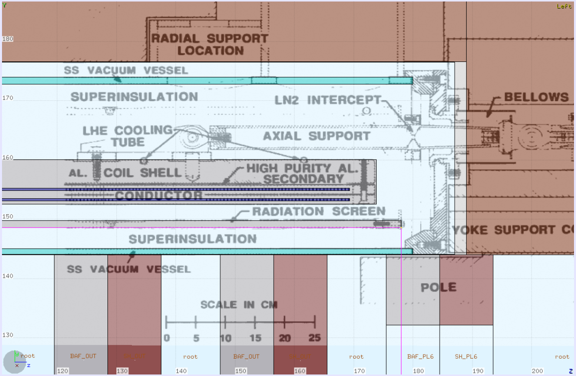
Simulation update



Lifetime on NbTi superconductor carried by SoLID

Different SoLID configurations

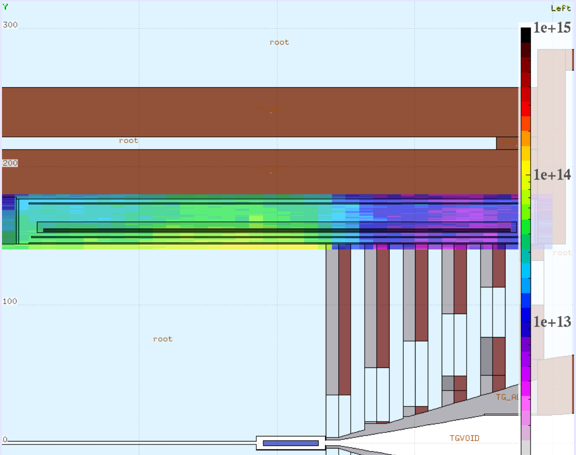
The PVDIS configuration with Deuterium target present the main source for neutron fluxes on the coils



Lifetime on NbTi superconductor carried by SoLID

Expected PVDIS neutron fluence $\frac{N}{cm^2}(E > 1MeV)$

Dose for 2000h at $100\mu A$



Lifetime on NbTi superconductor carried by SoLID

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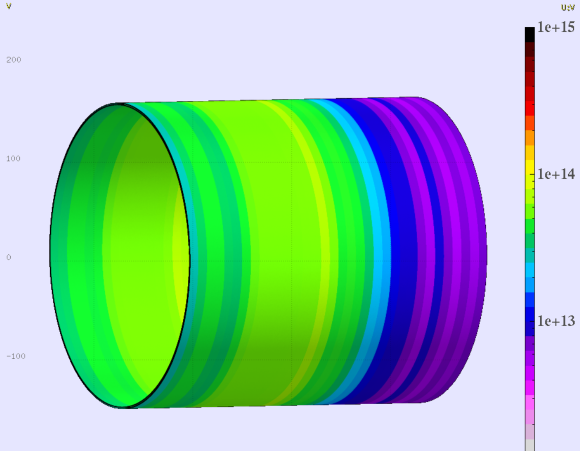

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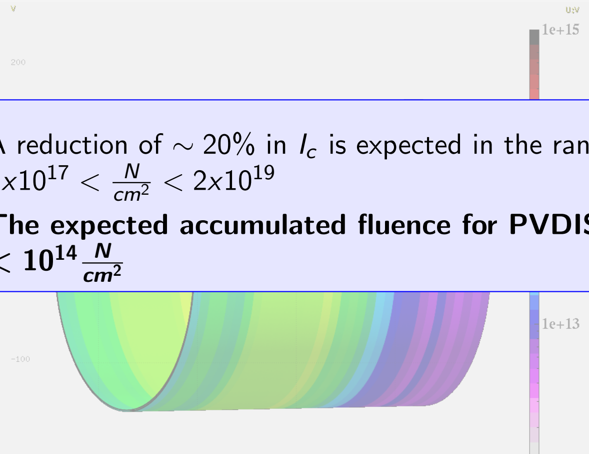

- A reduction of $\sim 20\%$ in I_c is expected in the range $2x10^{17} < \frac{N}{cm^2} < 2x10^{19}$
- **The expected accumulated fluence for PVDIS is $< 10^{14}\frac{N}{cm^2}$**