Sterile neutrinos and Coherent Neutrino Nucleus Scattering (CNNS)

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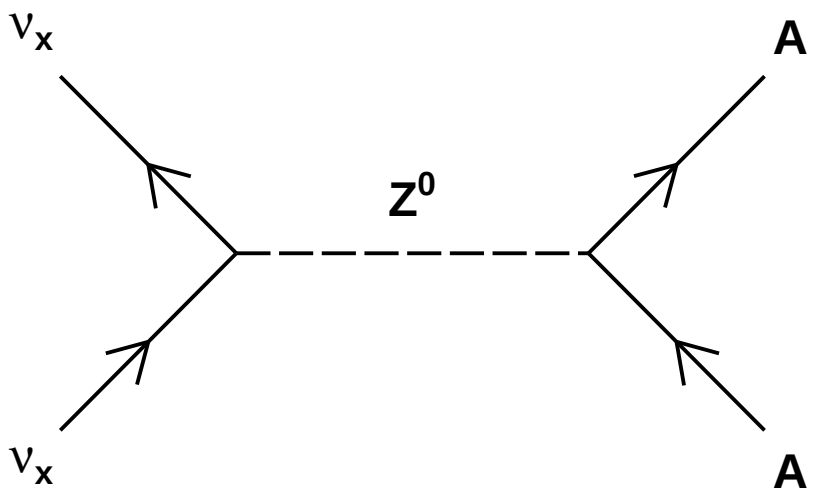
CNNS - A neutral current process



- Neutral current process $\Rightarrow$ CNNS independent of ν-flavor
- For low transferred momenta: Z^0 wave length comparable to radius of nuclei

$\Rightarrow$ ν scatters coherently off all nucleons

CNNS - Cross Section

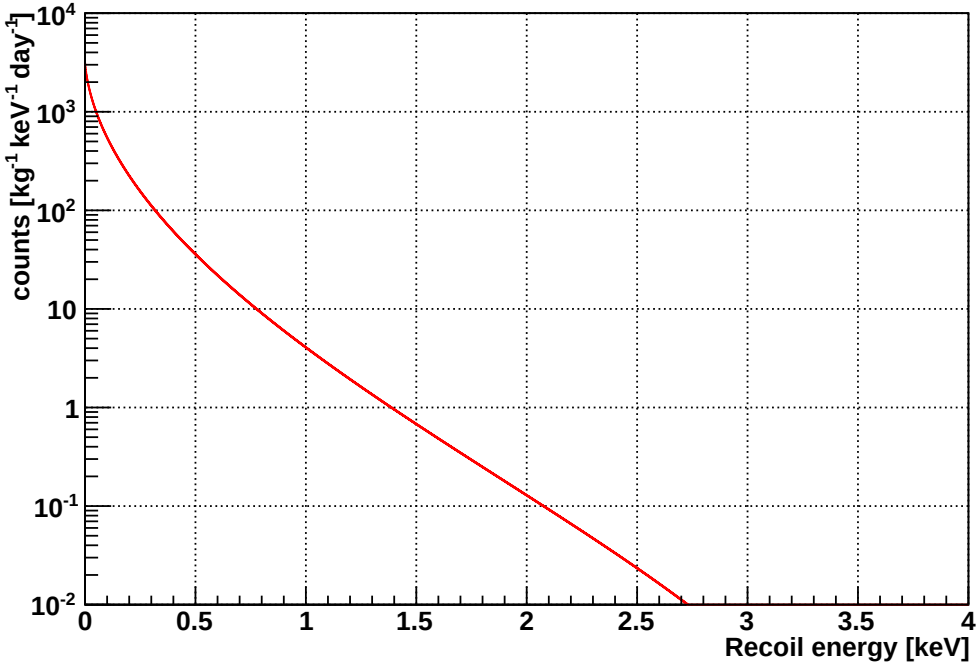
$$\frac{d\sigma(E_\nu, E_{rec})}{dE_{rec}} = \frac{G_F^2}{8\pi}\left[Z\left(4\sin^2\theta_W - 1\right) + N\right]^2 M\left(2 - \frac{E_{rec}M}{E_\nu^2}\right)$$

$$\sigma_{tot} = \frac{G_F^2}{4\pi}\left[Z\left(4\sin^2\theta_W - 1\right) + N\right]^2 E_\nu^2$$

with neutrino energy E_ν, recoil energy E_{rec}, Fermi constant G_F, Weinberg angle θ_W, mass of traget nucleus M, proton number Z and neutron number N.

$$\sin^2\theta_W = 0.23 \Rightarrow \sigma_{tot} \sim \frac{G_F^2}{4\pi} N^2 E_\nu^2$$

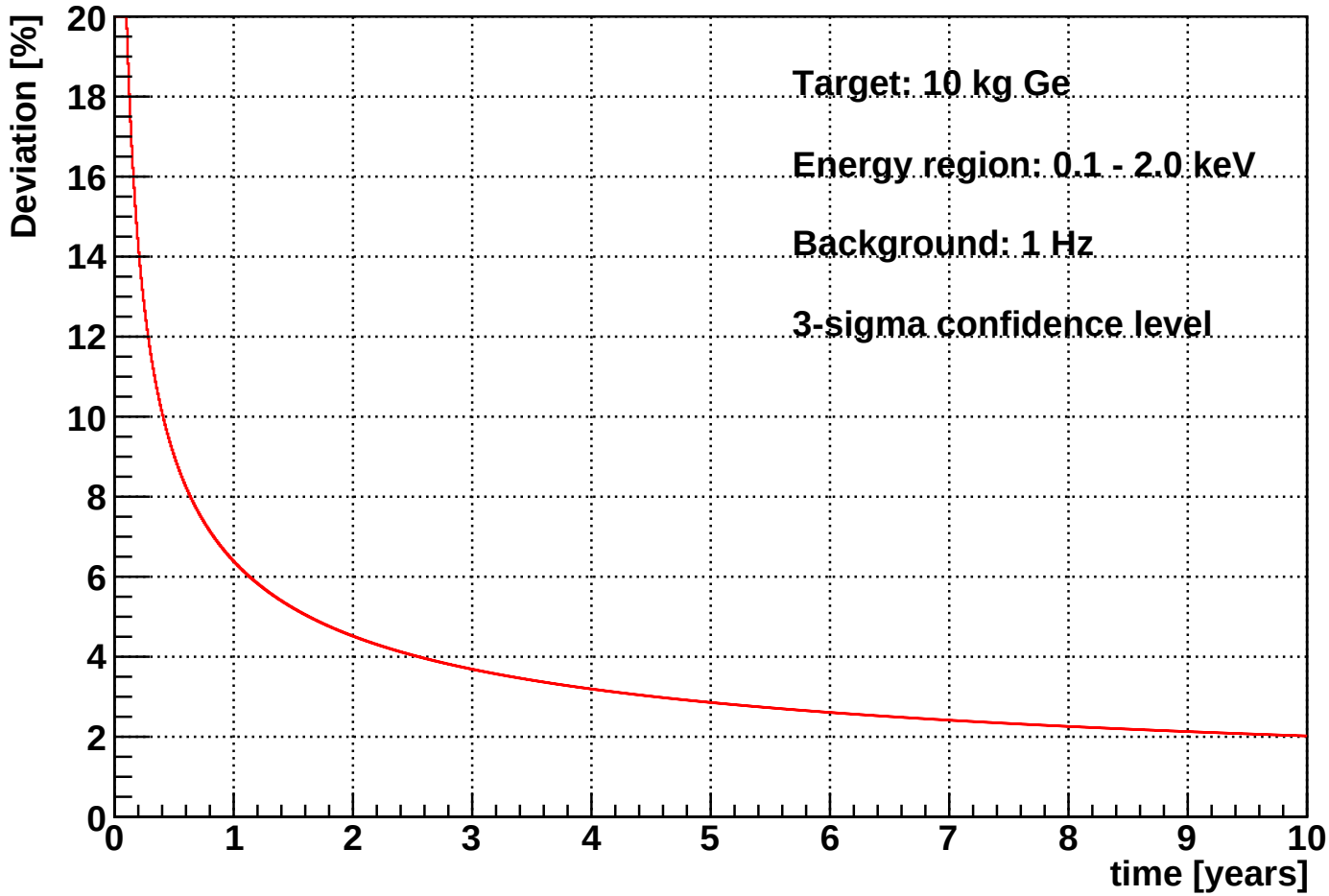
Expected spectrum for reactor neutrinos



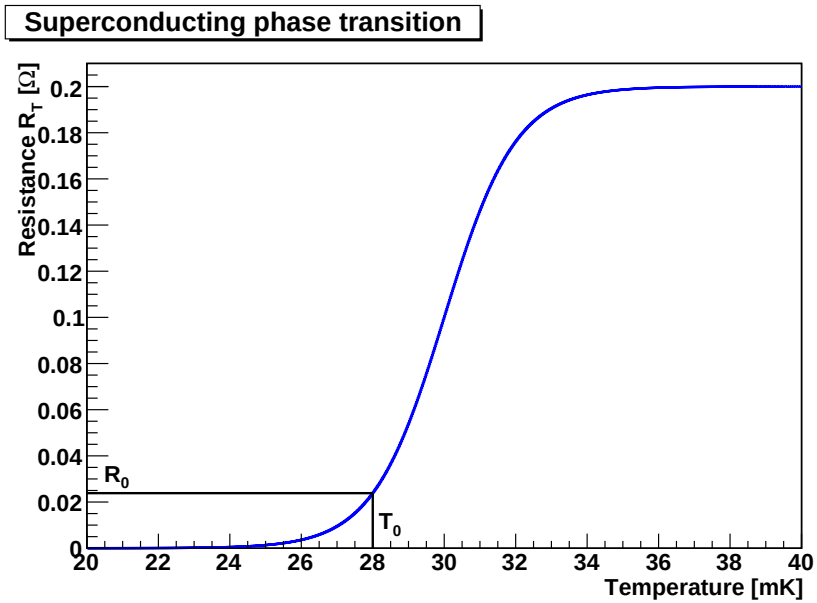
- Flux of $1.0 \cdot 10^{13} \frac{1}{\mathrm{cm}^2 \mathrm{s}}$
- Germanium as absorber

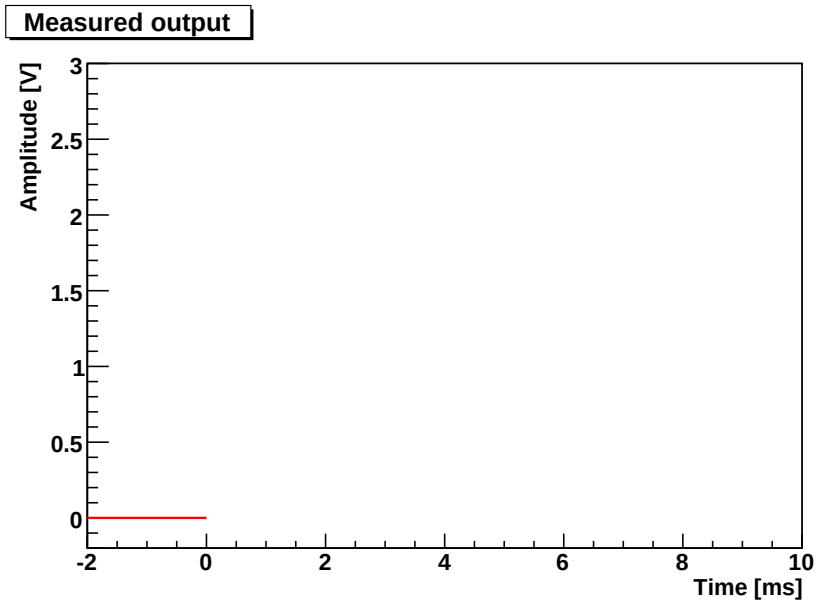
$\rightarrow$ For an energy threshold of 0.1 keV: 72.5 events per kg-day

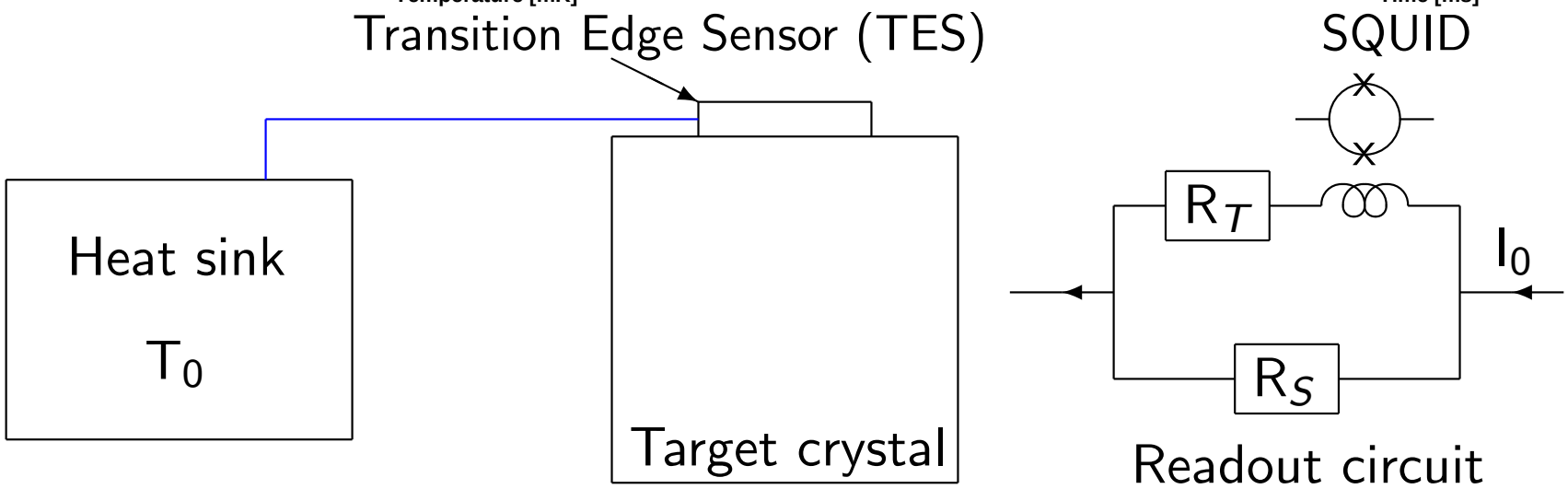
Sensitivity for sterile neutrinos



Working principle of cryogenic detectors







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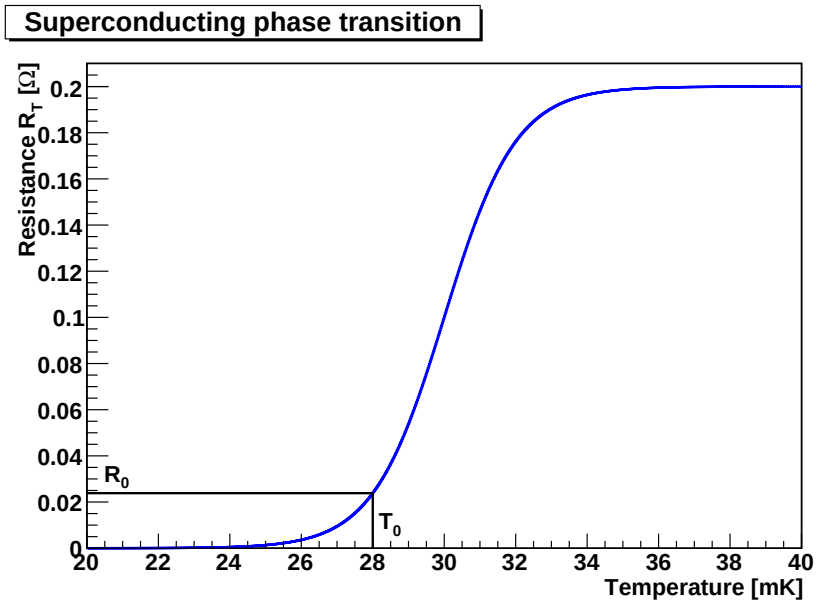

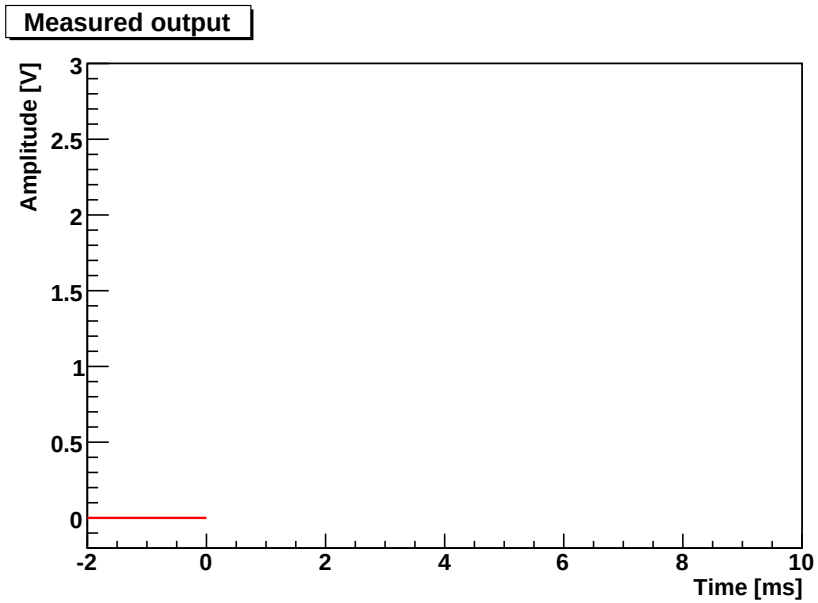

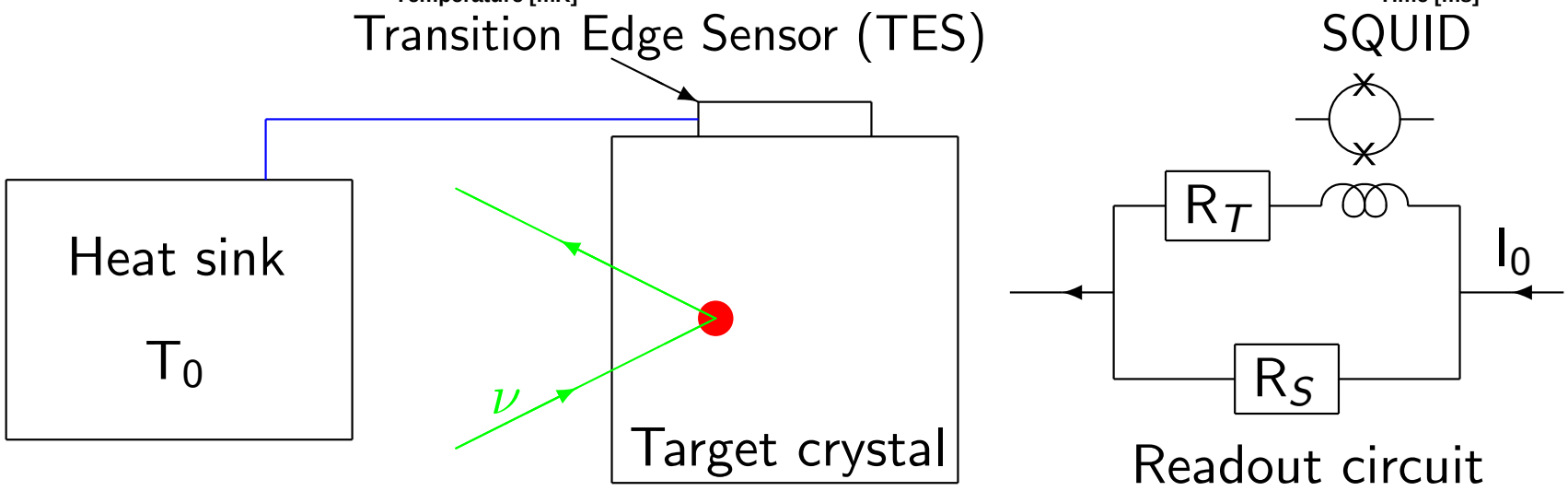

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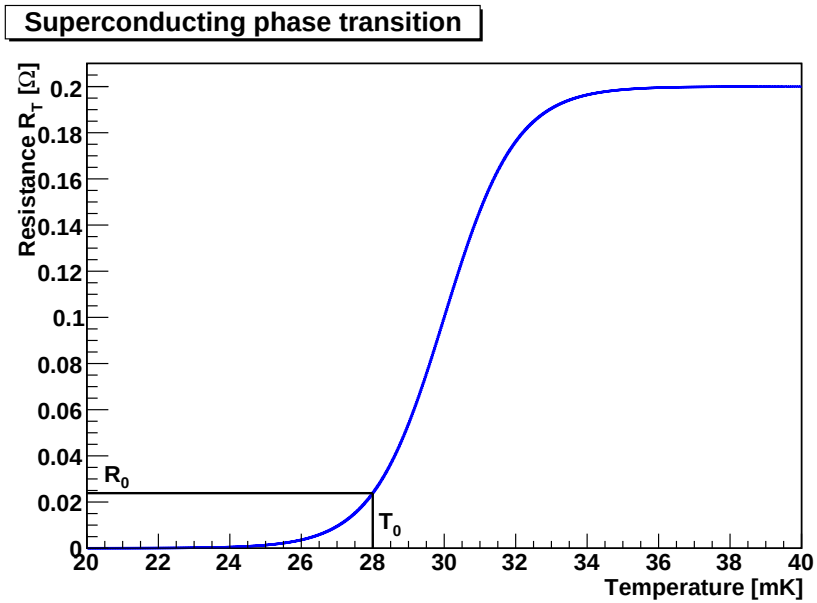

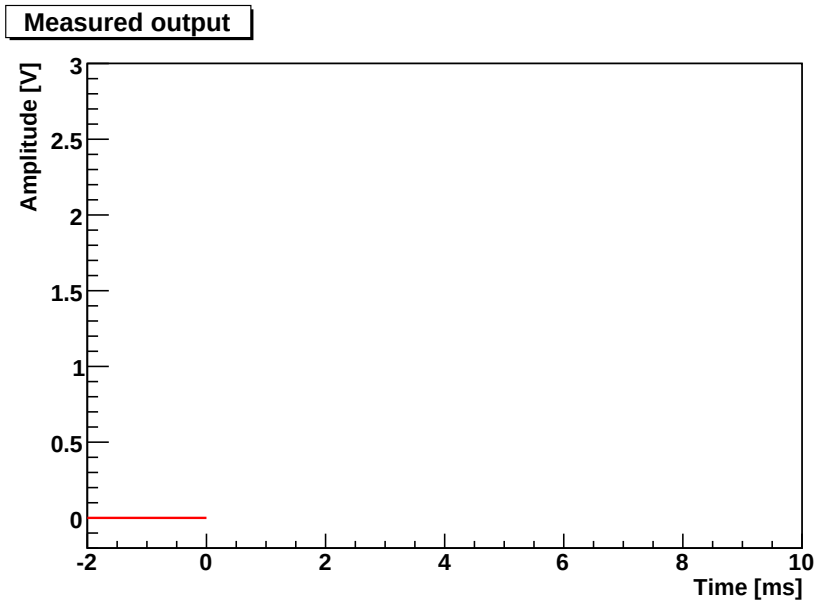

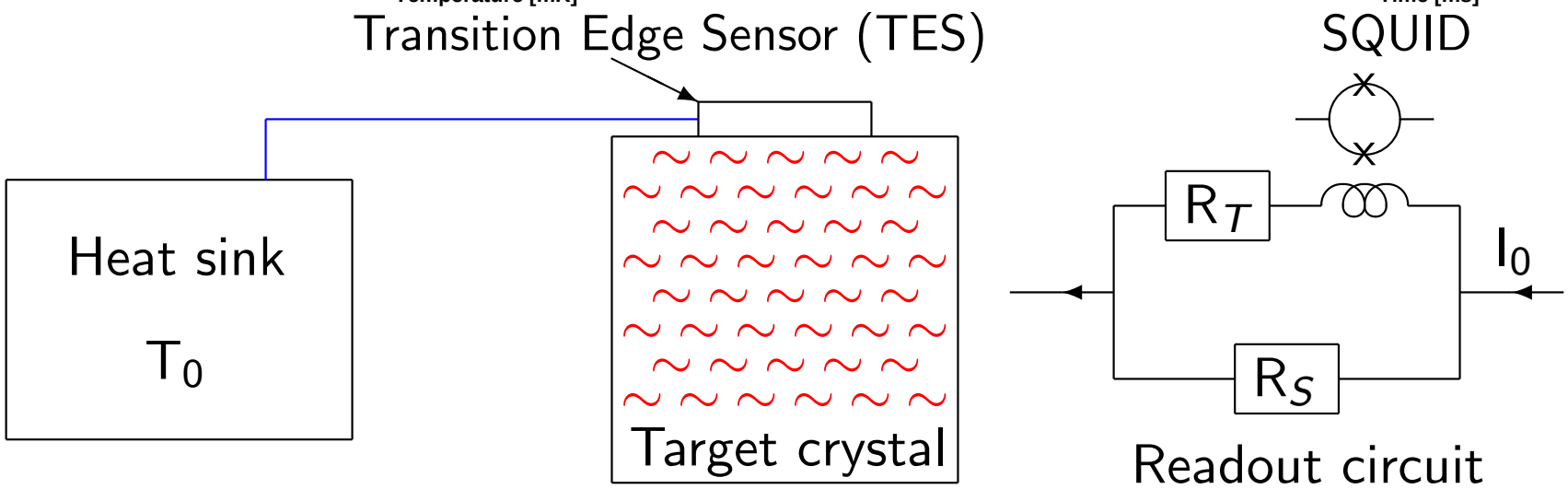

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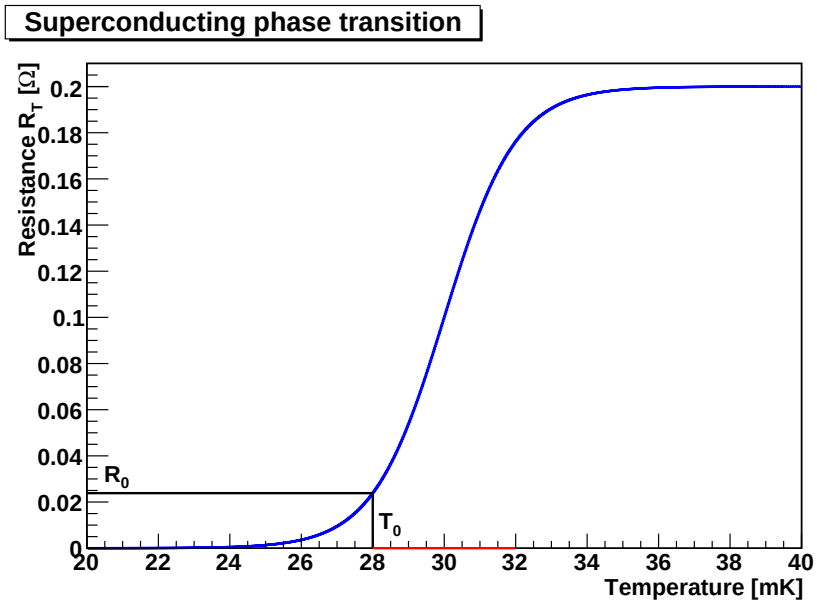

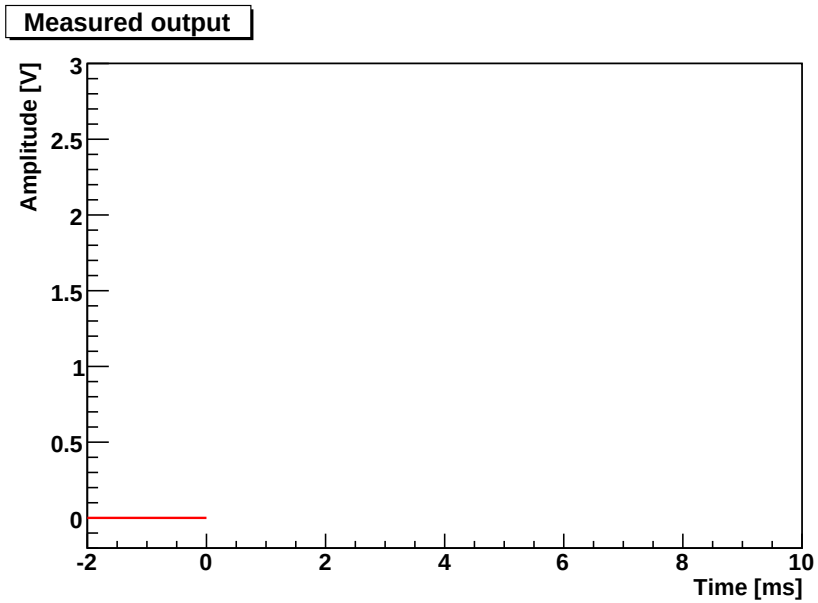

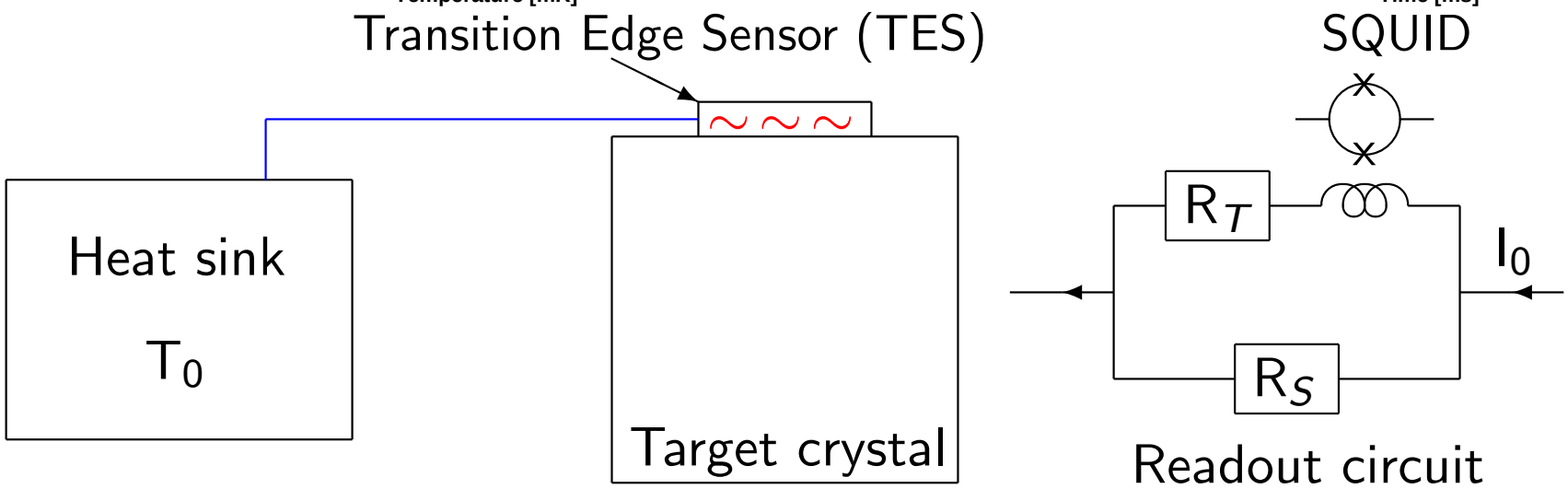

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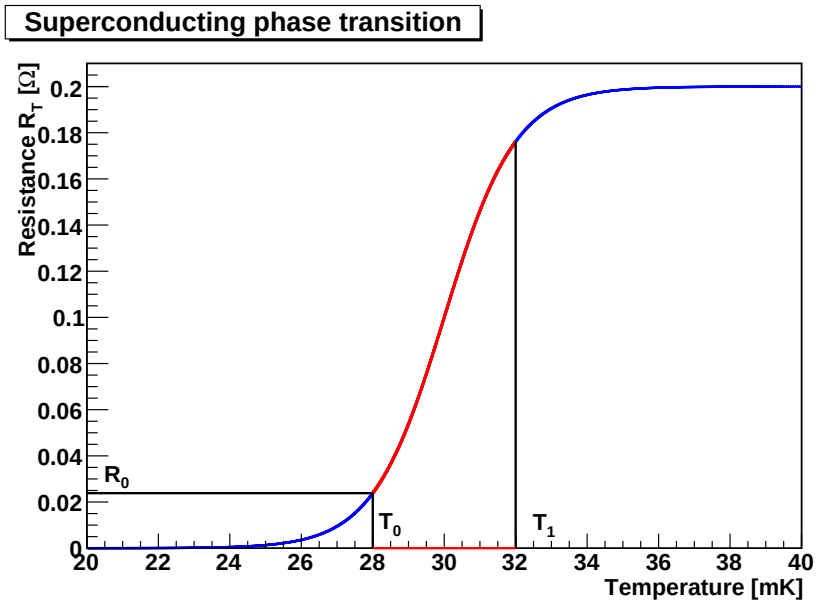

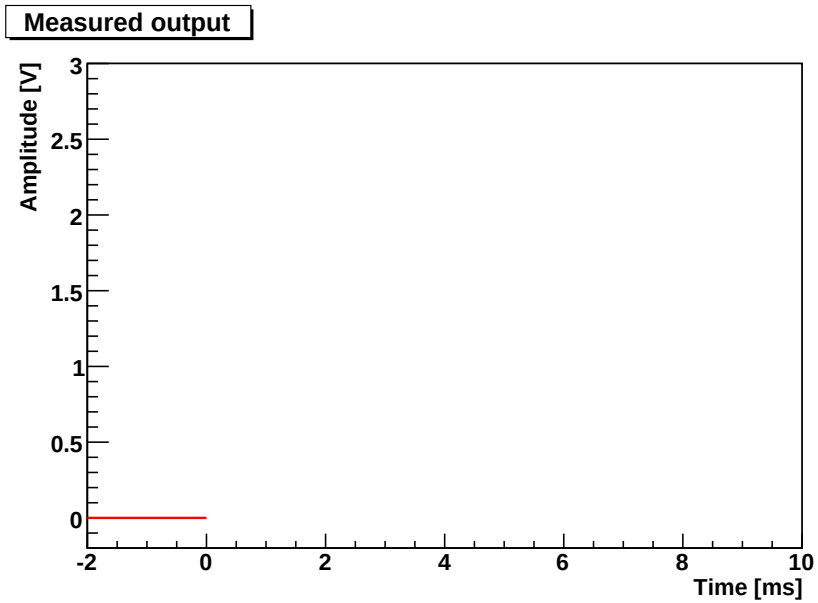

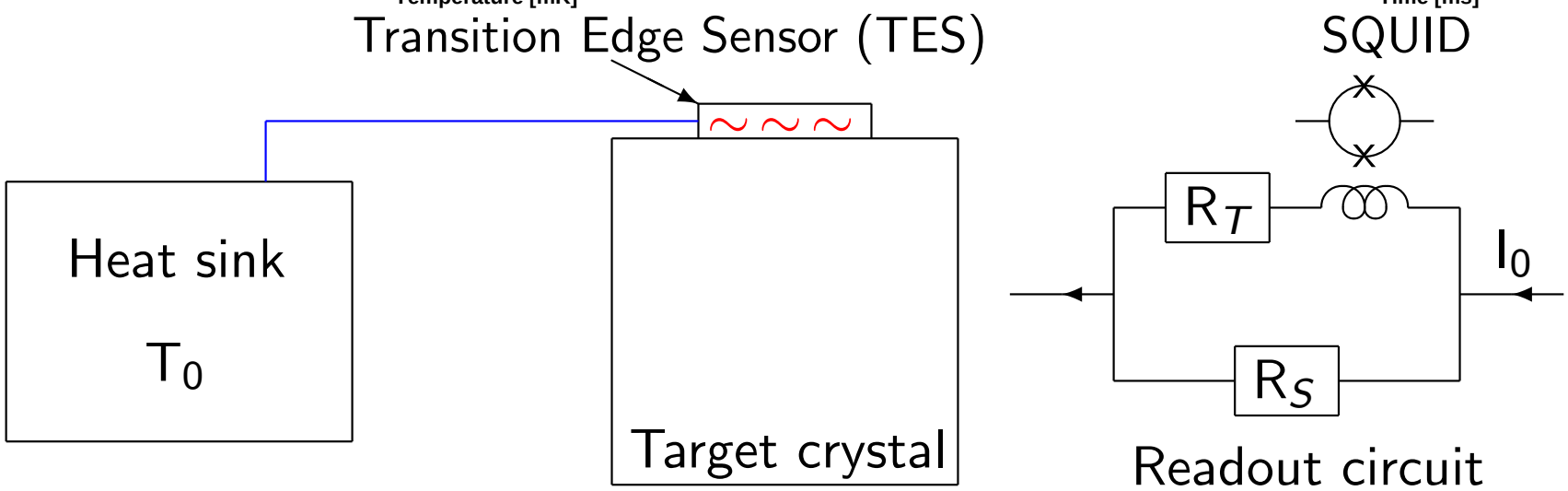

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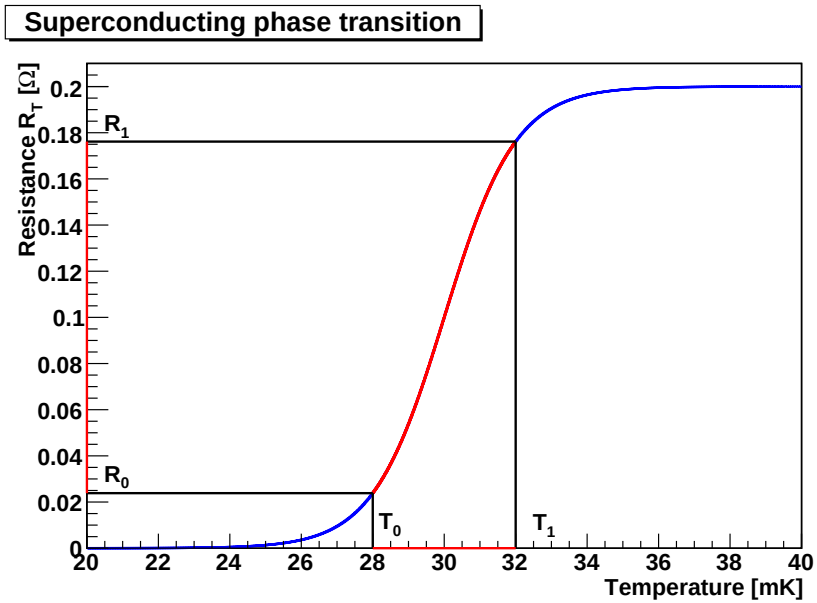

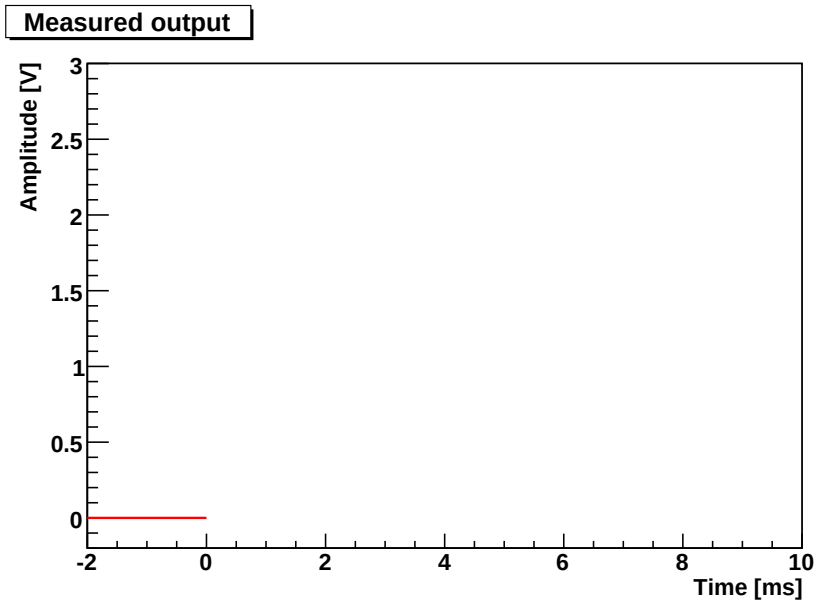

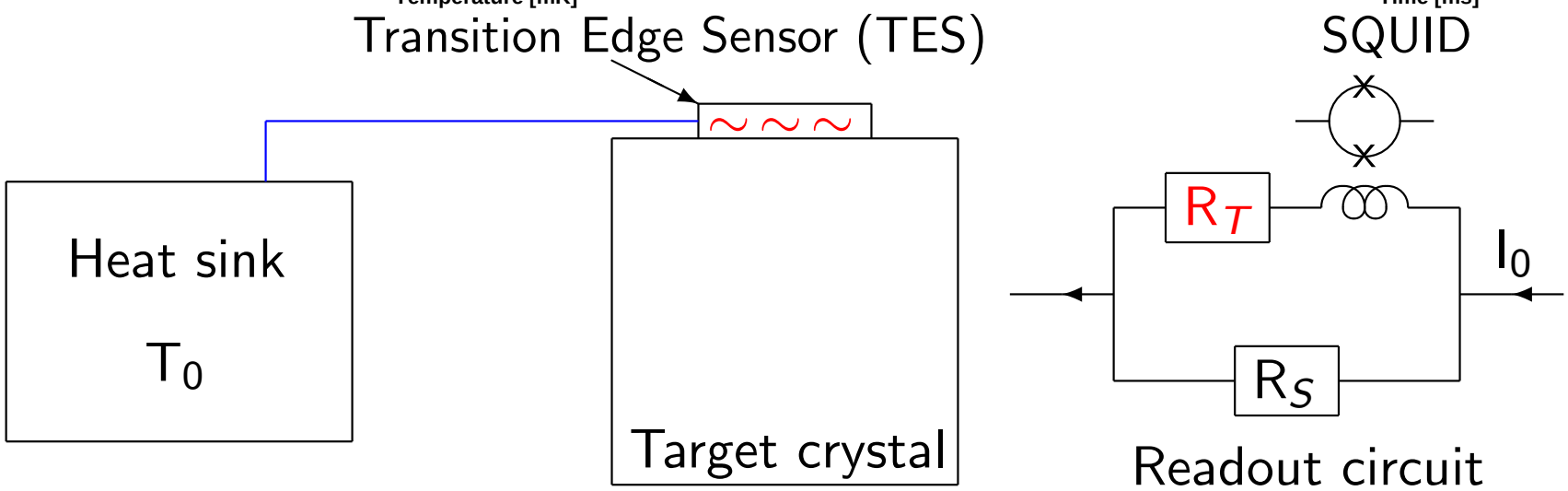

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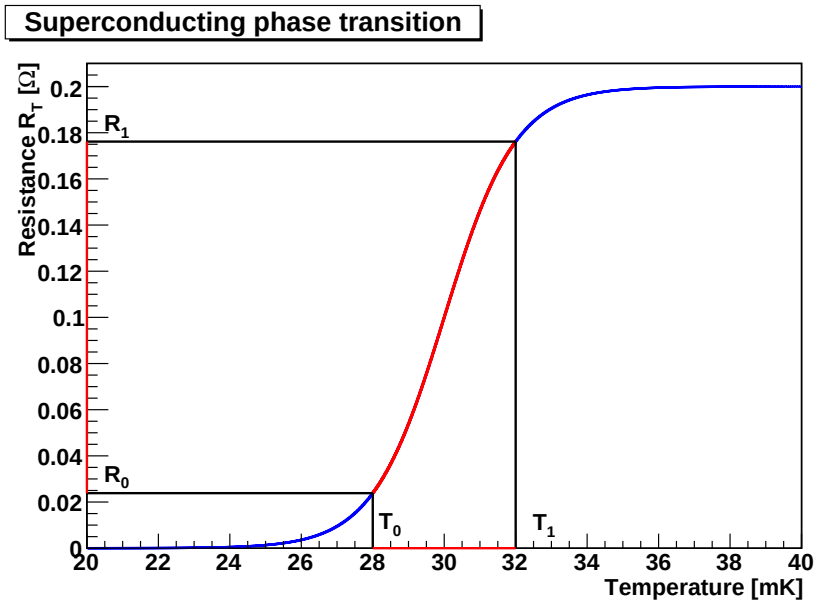

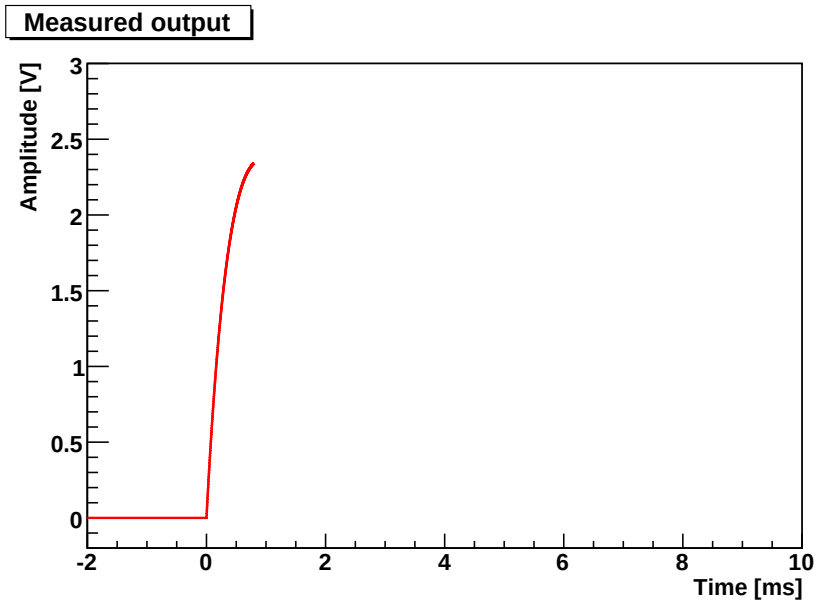

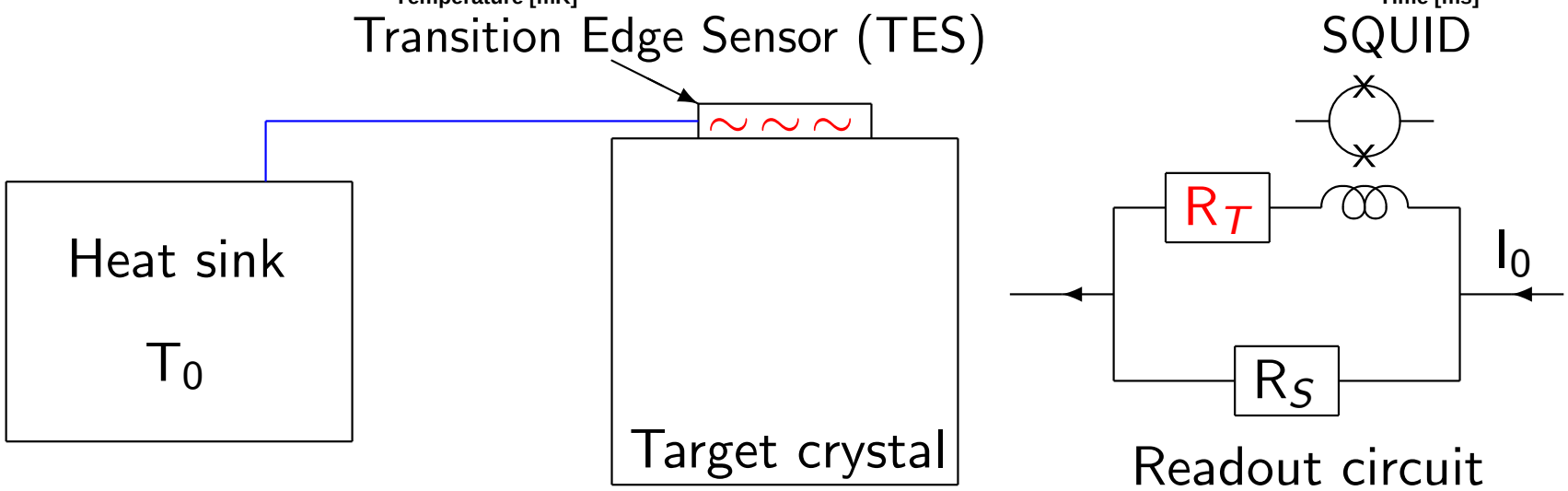

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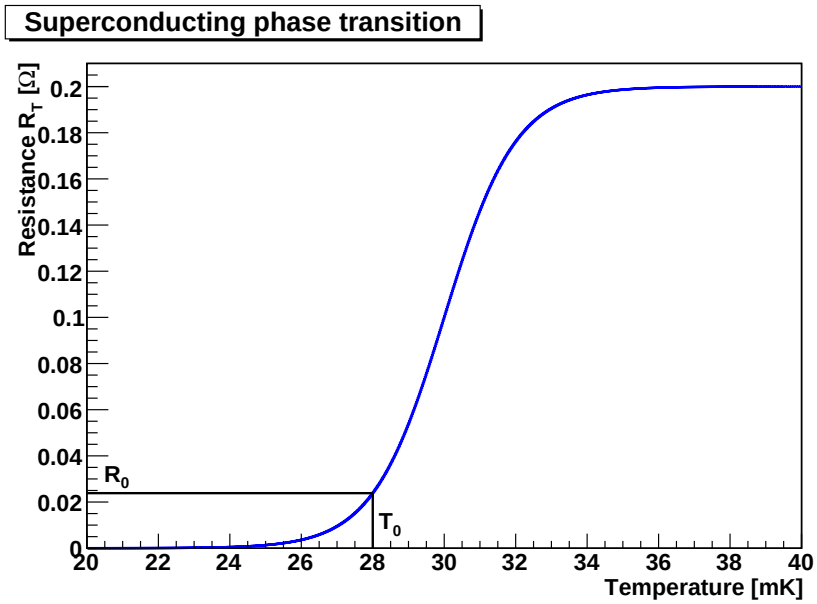
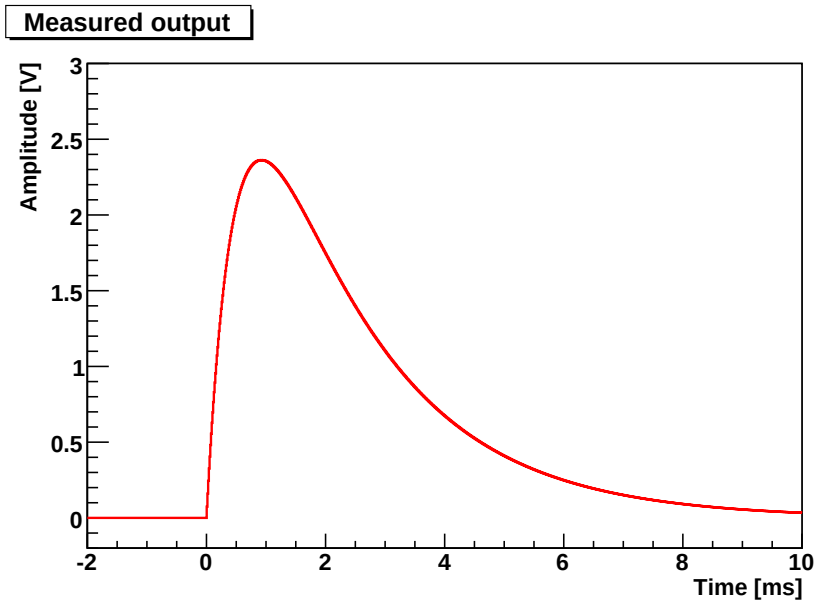
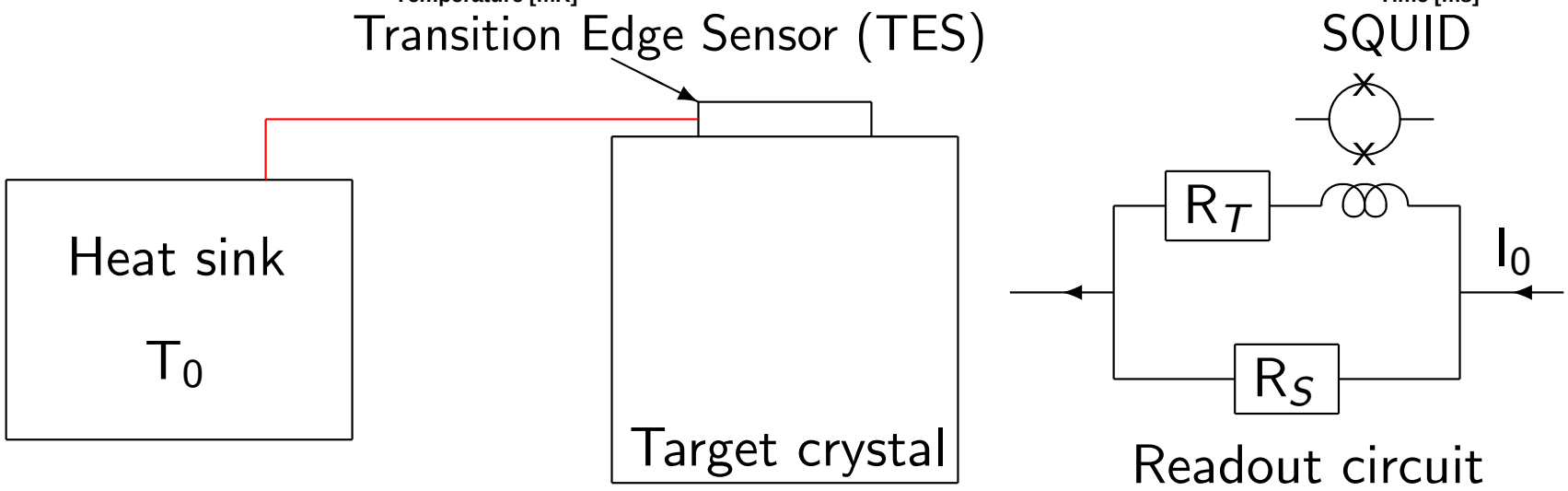
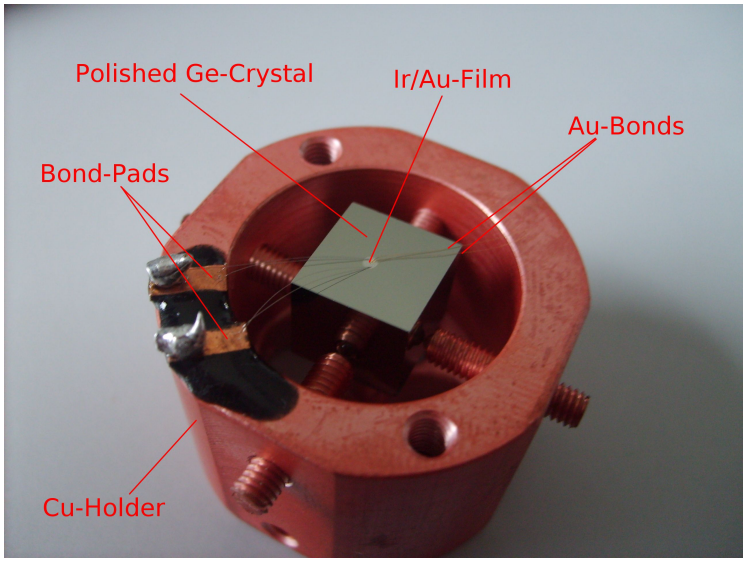
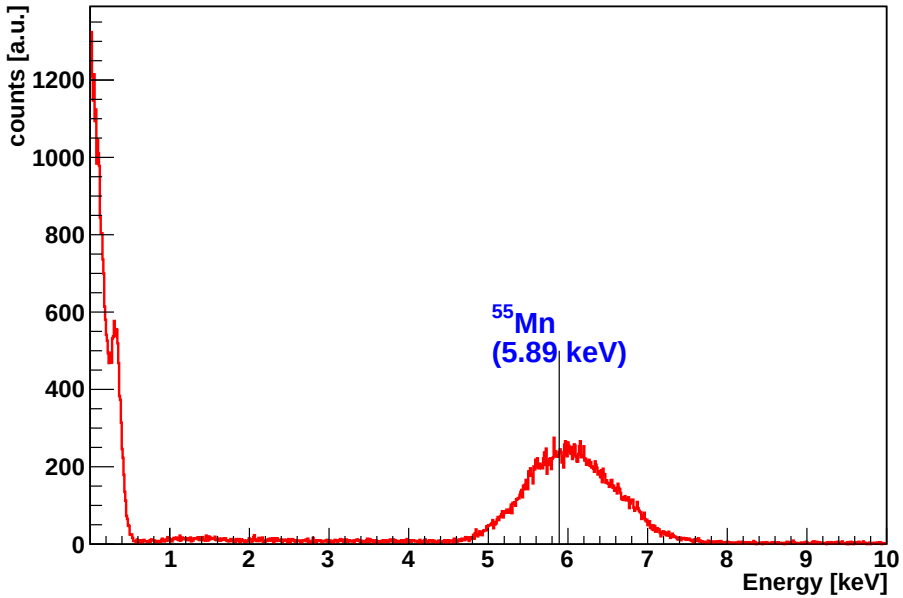






Current status of detector development





- Germanium absorber
- Mass of 3.2 g
- Ir/Au film as TES

- Spectrum of an ^{55}Fe source
- Energy threshold of $\sim$1 keV