The aim is to observe thermodynamic temperature fluctuations [1] in a mesoscopic structure by fast thermometry [2].

**Setup**

We consider a system at temperature \( T \) with heat capacity \( C \) connected to heat baths at temperatures \( T_i \) via thermal conductances \( G_{th,i} \). The heat balance equation reads

\[
\sum_i Q_i = C \dot{T} + \sum_i G_{th,i} (T - T_i)
\]

With the help of the two equations above, we obtain the Lorentzian spectrum of temperature fluctuations as

\[
S_T(\omega) = \frac{S_T(0)}{1 + (\omega/\omega_c)^2}
\]

with low-frequency noise

\[
S_T(0) = 2k_B T^2 / \sum_i G_{th,i}
\]

And cut-off (angular) frequency

\[
\omega_c = \sum_i G_{th,i} / C
\]

**Possible realization**

Measure RF-reflection on a tunnel junction attached to a small metal particle

Expected magnitude of the effect at \( T = 100 \text{ mK} \),

\[
\langle \delta T^2 \rangle \sim (10 \text{ mK})^2
\]

\[
\omega_c / 2\pi \sim 100 \text{ kHz}
\]

suggests that the experiment is within a realistically achievable range.

**Preliminary measurements**
