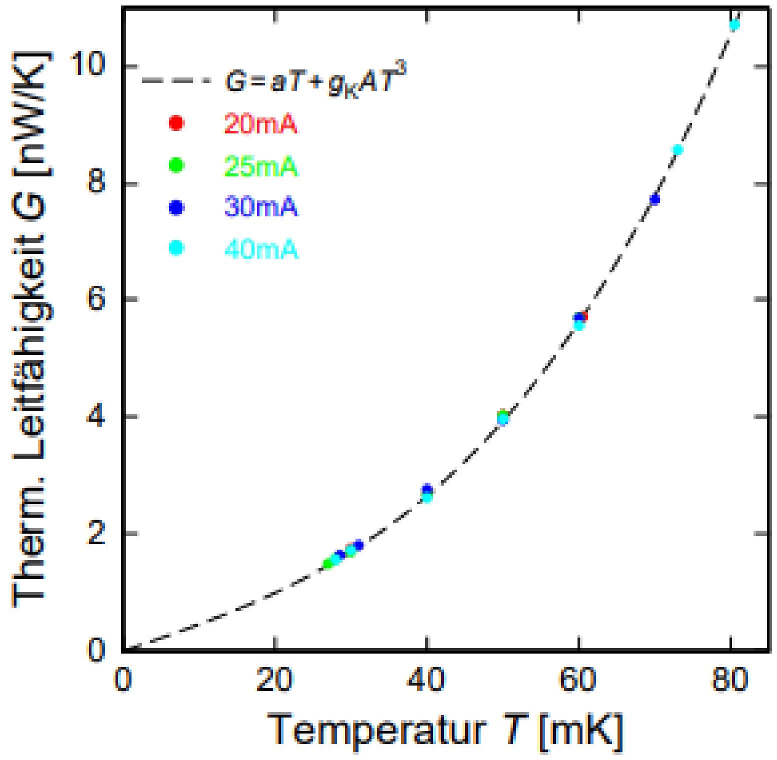
Weekly report (19/02/11)

Thermal conductance of gold links

1. Signal decay

$$G_{\rm ges} = aT + g_{\rm K}AT^3 \quad \Leftarrow \quad G_{ze}$$

to bath — to substrate



- measured

$$G_{\rm ges} = \frac{\delta E}{\int \delta T(t)\,{\rm d}t} \qquad \delta T(t) = ({\rm d}\Phi_{\rm S}/{\rm dT})^{-1}\delta\Phi_{\rm S}({\rm t})$$

$$\Rightarrow \quad a = 44{\rm nW/K^2} \quad g_{\rm K} = 626{\rm W/K^4/m^2}$$

- calculated

$$a = 41{\rm nW/K^2} \quad g_{\rm K} = 640\,{\rm W/K^4/m^2}$$

Constant a

- from electrical resistivity (Wiedemann-Franz law) of gold bar connecting sensor and bath(40*0.2*200μm^3)
- $\rho = 0.024\Omega m$
- proportional to (contacting area)/(length)

2. Signal rise

- If rise time is not limited by spin-electron relaxation time(100ns at 35mk) it is predominantly determined by gold link between absorber and sensor

- $6\mu W/K$ for five cylindrical gold bar (radius : $7\mu m$, height : $4.5\mu m$)

- G_{eb}

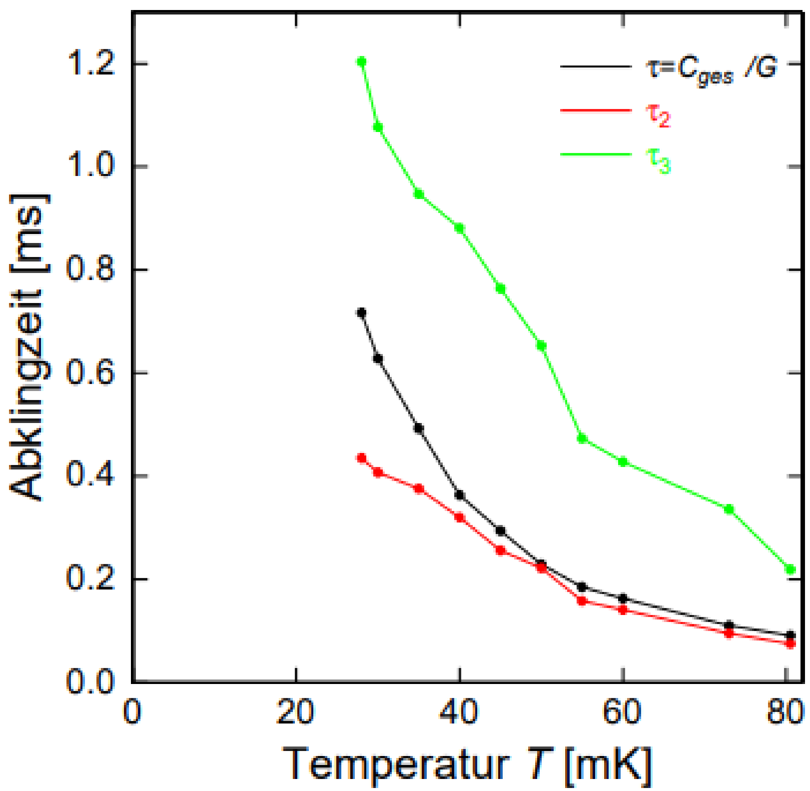
$$\tau_{0/1} = \frac{C_e G_{ze} + C_z(G_{ze} + G_{eb})}{2G_{ze}G_{eb}} \mp \sqrt{\frac{[C_e G_{ze} + C_z(G_{ze} + G_{eb})]^2}{4G_{ze}^2 G_{eb}^2} - \frac{C_z C_e}{G_{ze}G_{eb}}}$$

Quadrupole moment of gold

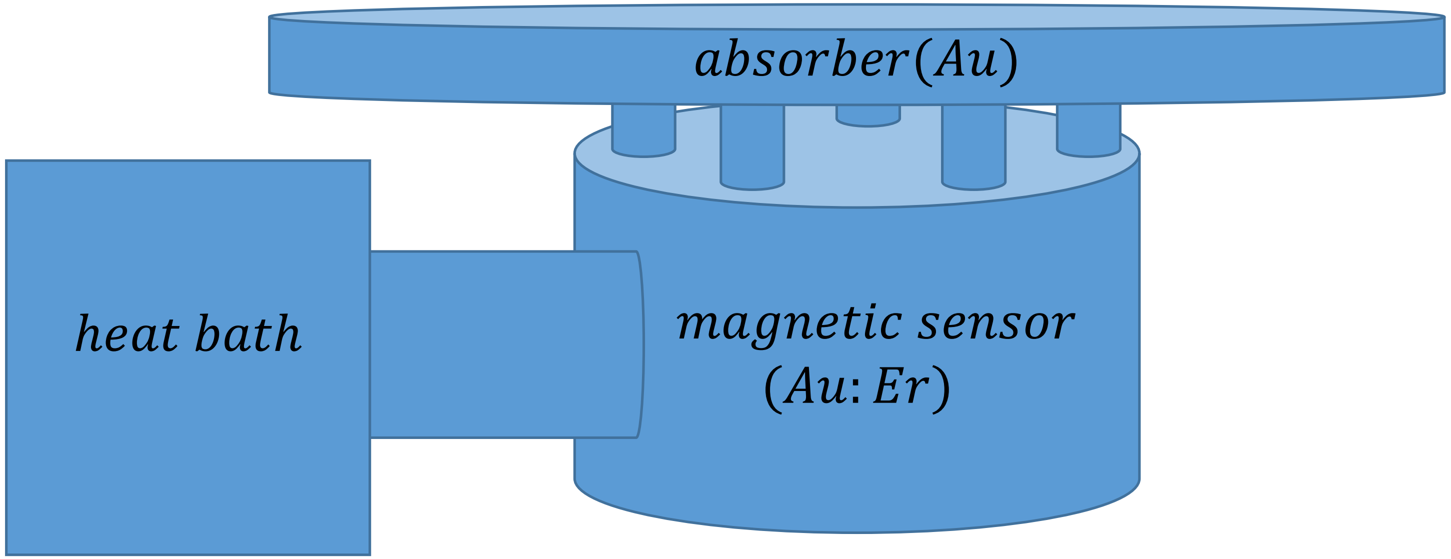
- It affects on decay of spin

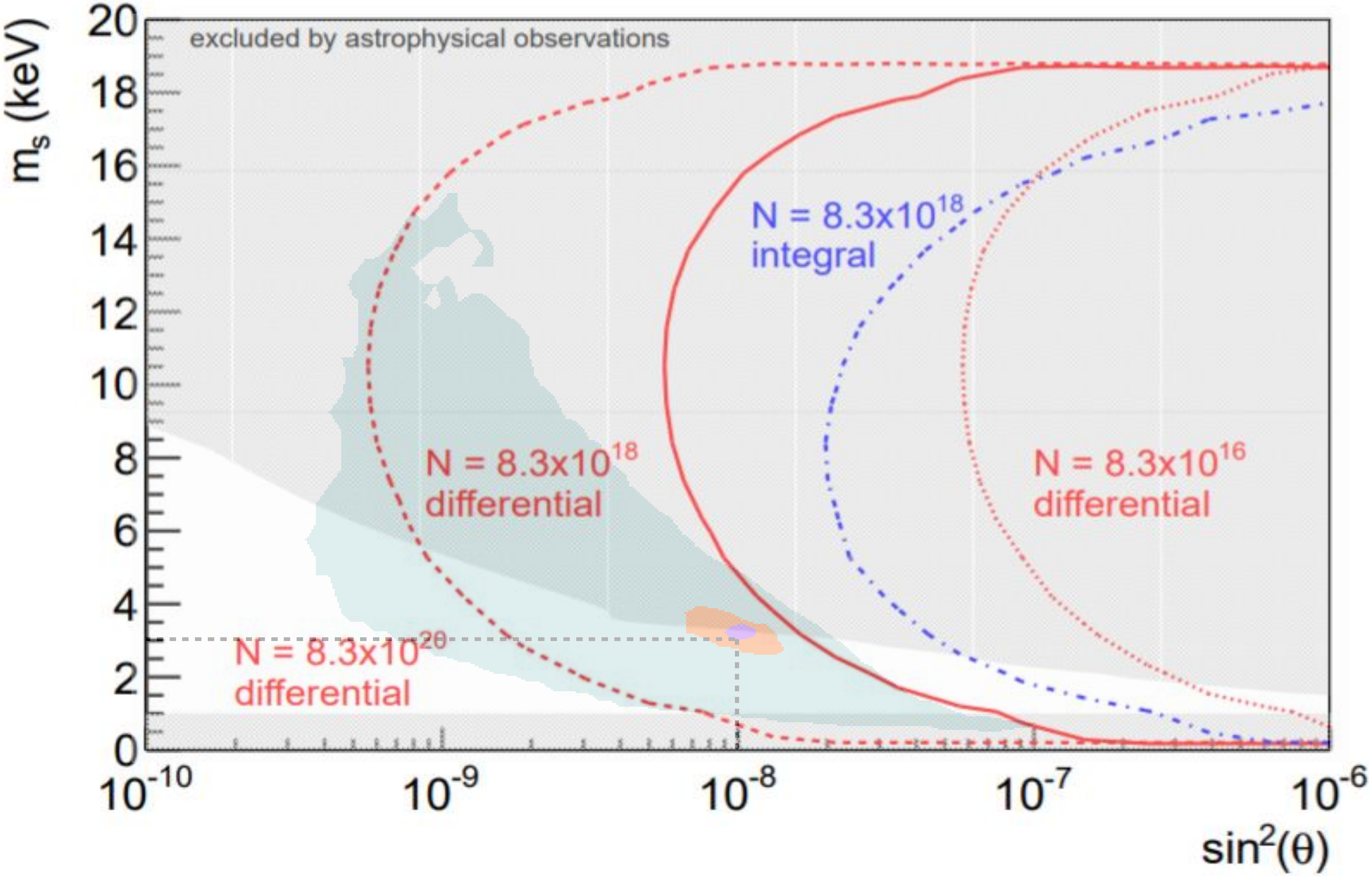
$$\phi(t) = \phi_1 e^{t/\tau_1} + \phi_2 e^{t/\tau_2} + \phi_3 e^{t/\tau_3}$$

1. Thermalization of quadrupole moment ($\tau_1 \sim 100\mu s$)
2. Equilibrate of spin to bath(τ_2)
3. Equilibrate of quadrupole moment to bath(τ_3)



backup


absorber(Au)
heat bath
magnetic sensor
(Au: Er)



excluded by astrophysical observations
m_s (keV)
20
18
16
14
12
10
8
6
4
2
0
N = 8.3x10^18
integral
N = 8.3x10^18
differential
N = 8.3x10^16
differential
N = 8.3x10^20
differential
10^-10
10^-9
10^-8
10^-7
10^-6
sin^2(θ)