My work in 2016

7-2

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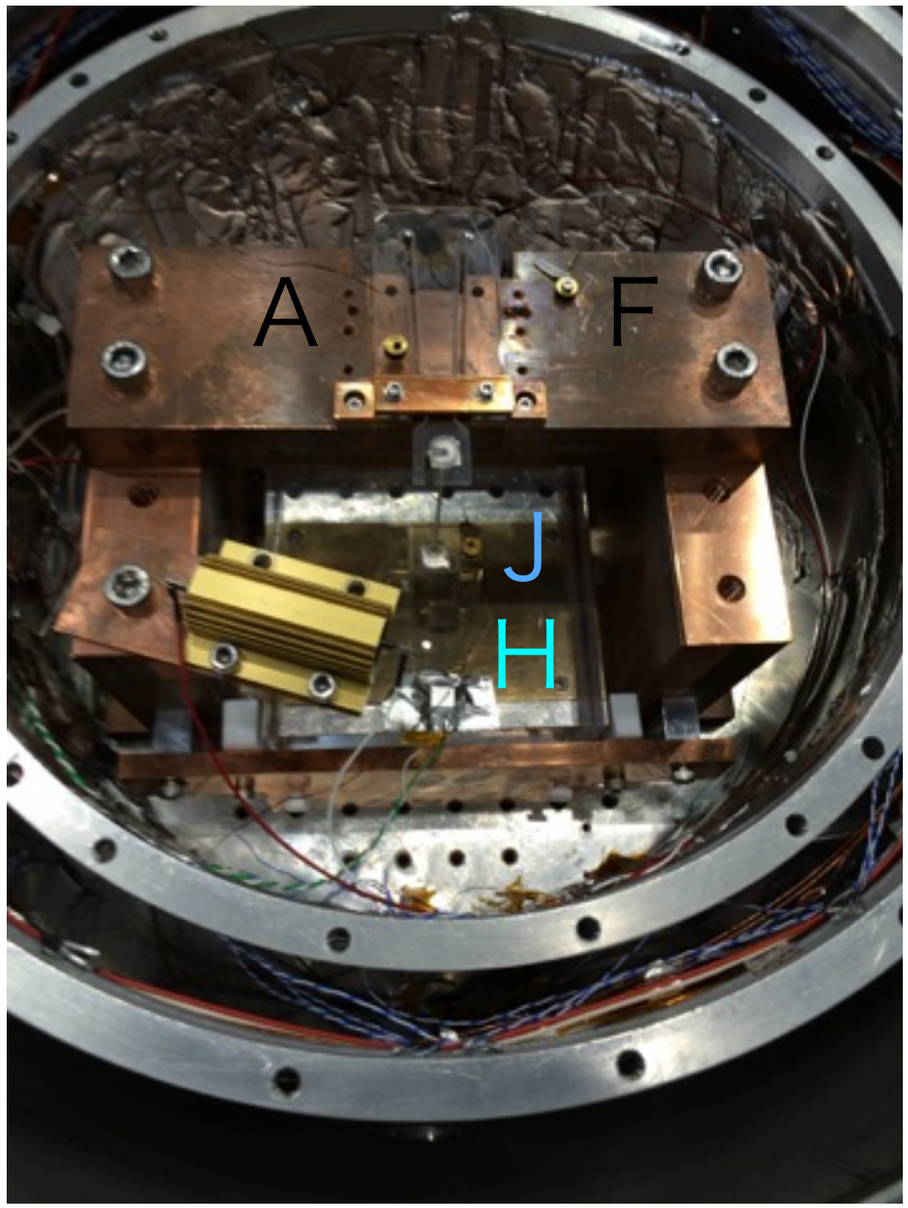
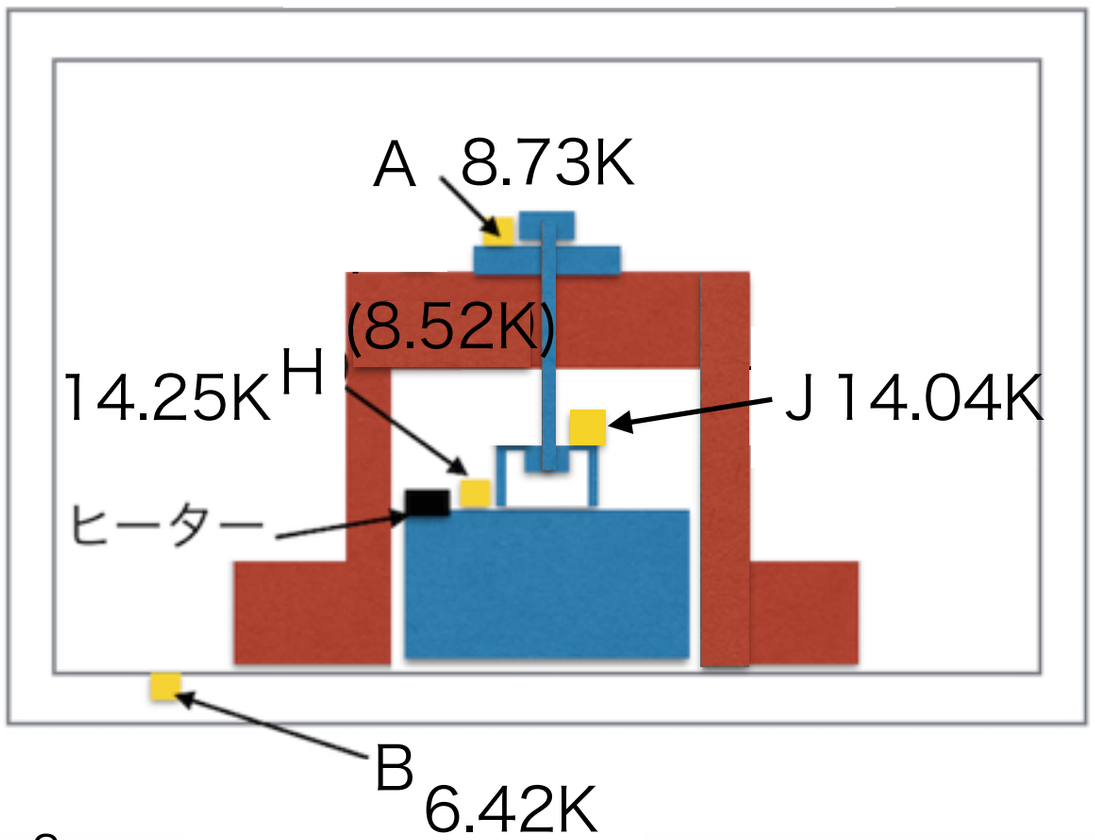
heat load test(5th)

I analyzed the result.

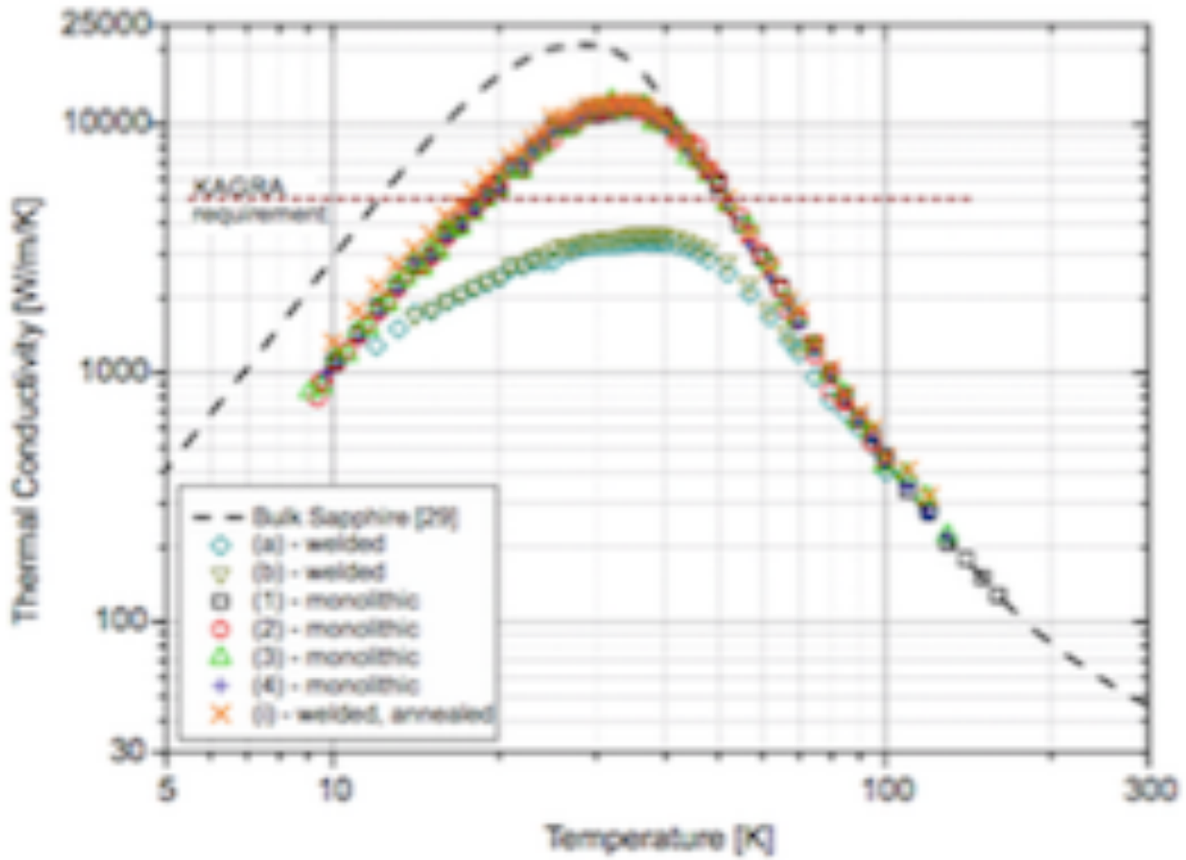


When the power of the heater is 0.2475W…



Analysis

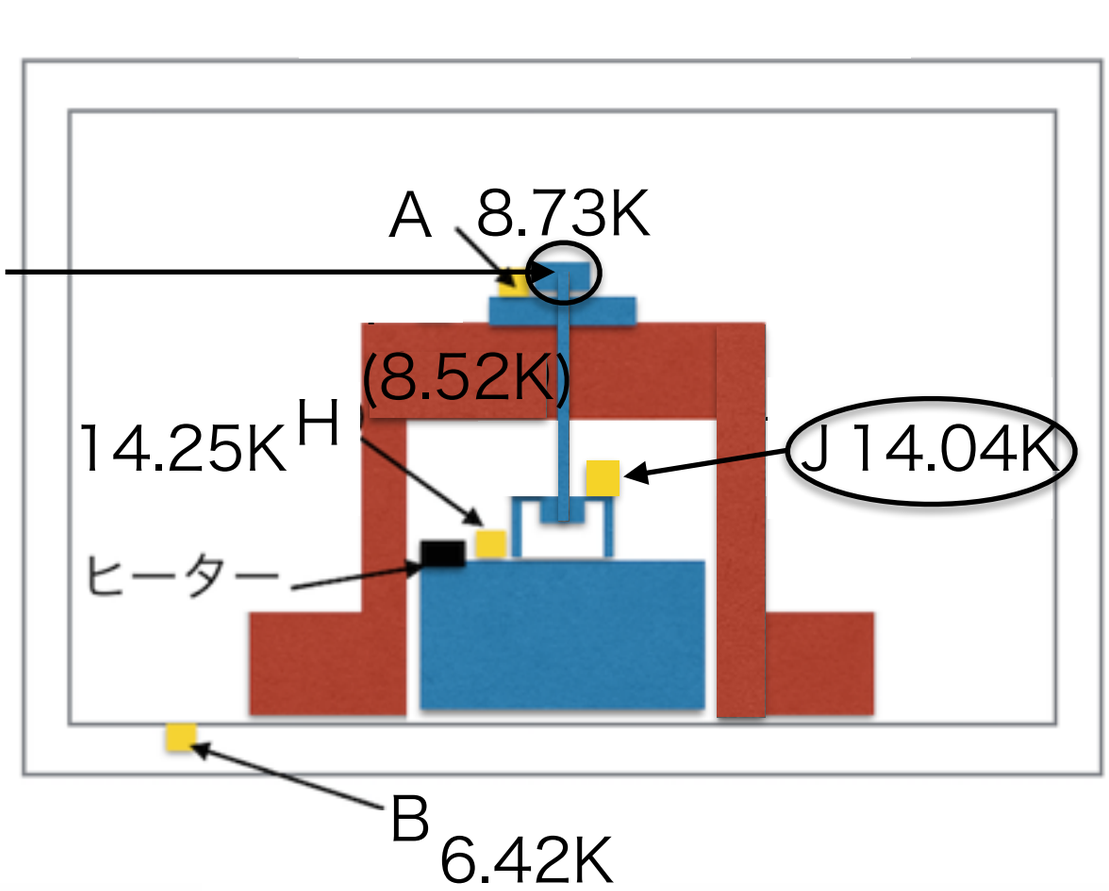
- We know the thermal conductivity of the sapphire fiber whose diameter is 1.6mm (Sascha's data).



Analysis

- I tried to calculate the temperature of the upper head of the fiber depending on the temperature of the hanger.

How much?



problem

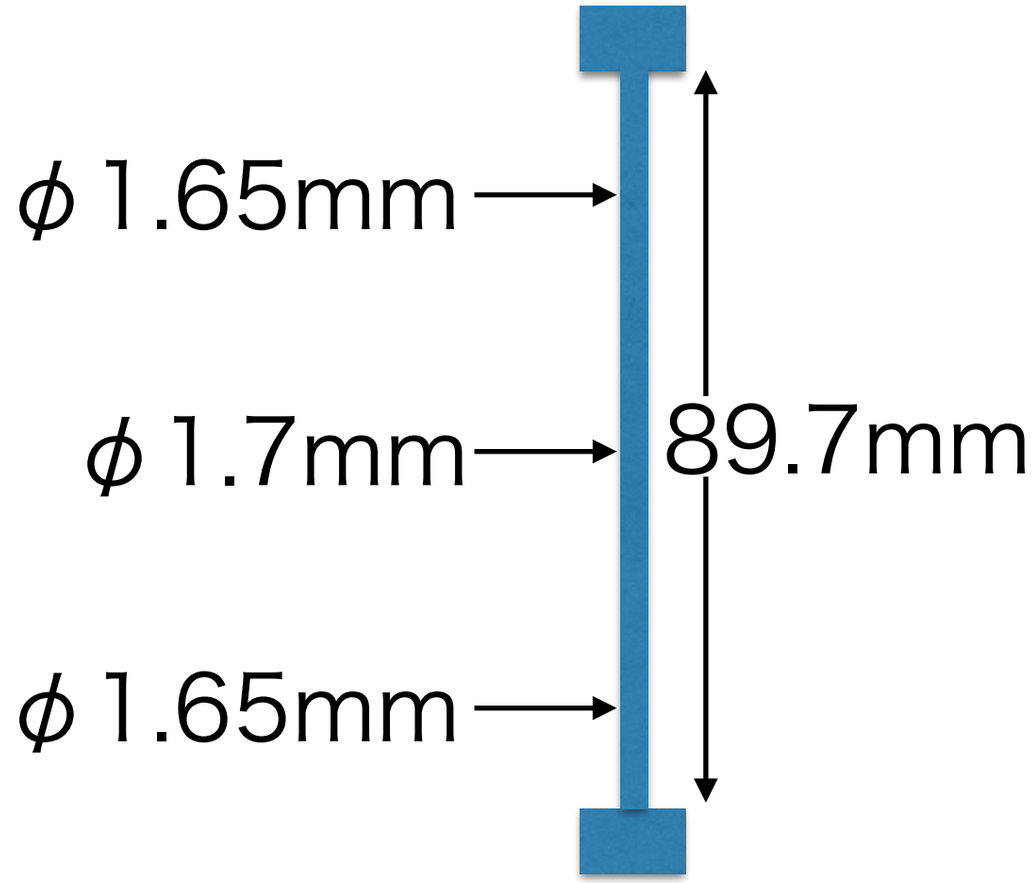
- First, I ignored the thermal resistance of Indium in order to make the issue simpler.
- 0.2475[W]= $\int_{T_{upperhead}}^{14.04} \kappa \frac{S}{l} dT$　　14.04K…$T_{lowerhead}$
- S=2.0×10^{-6}[m^2]、l=0.09[m]
- κ =1.07T^3　*(9.5[K]<T<14[K], no data for under 9.5K)*
- $T_{upperhead}$*=-7.6[K]→Something is wrong…*

problem

- The datas have some error, so I tried to explain the strangeness by the error.

problem

- I measured the diameter and the length of the fiber using the vernier micrometer（ノギス）and found that the diameter is 1.65-1.7mm and the length is 89.7mm.



problem

- First I assumed the whole diameter to be 1.7mm to make the issue simpler （S=2.27×10^{-6}[m^2]、l=0.0897[m]）.

- $\kappa = 1.14T^3$ (Size effect)

- $0.2475 = \int_{T_{upperhead}}^{14.04} \kappa \frac{S}{l} dT$

- $T_{upperhead}$=8.21[K] (Still smaller than the temperature of the blade（8.73K）)

problem

- I checked the error of these things.
- The power which went through the fiber
- The temperature
- The diameter of the fiber
- The thermal conductivity

problem

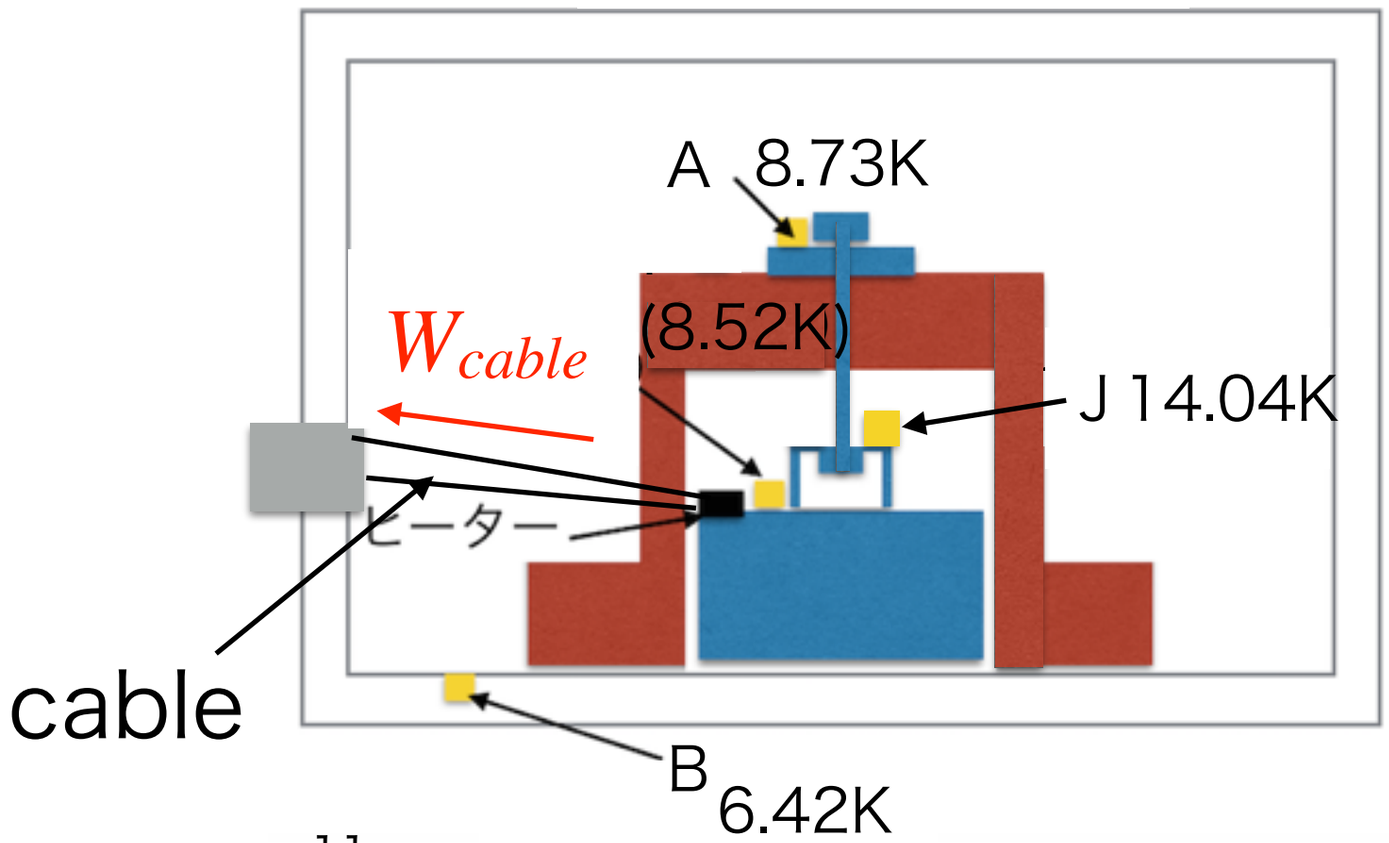
- The power which went through the fiber
- The temperature
- The diameter of the fiber
- The thermal conductivity

problem

- The power of the heater was 0.2475W, but some of them went to the shield through the cable.

- I calculated the heat which went through the cable.

$$W_{cable} = \int_{6.42}^{14.25} \kappa \frac{S}{l} dT$$



problem

- The result… W_{cable}=1.0[mW]

- $W_{fiber}=W_{all}-W_{cable}=0.2465$[W]

- $0.2465=\int_{T_{upperhead}}^{14.04}\kappa\frac{S}{l}dT \rightarrow T_{upperhead}=8.27[K]$

- Still lower than the temperature of the blade（8.73K）.

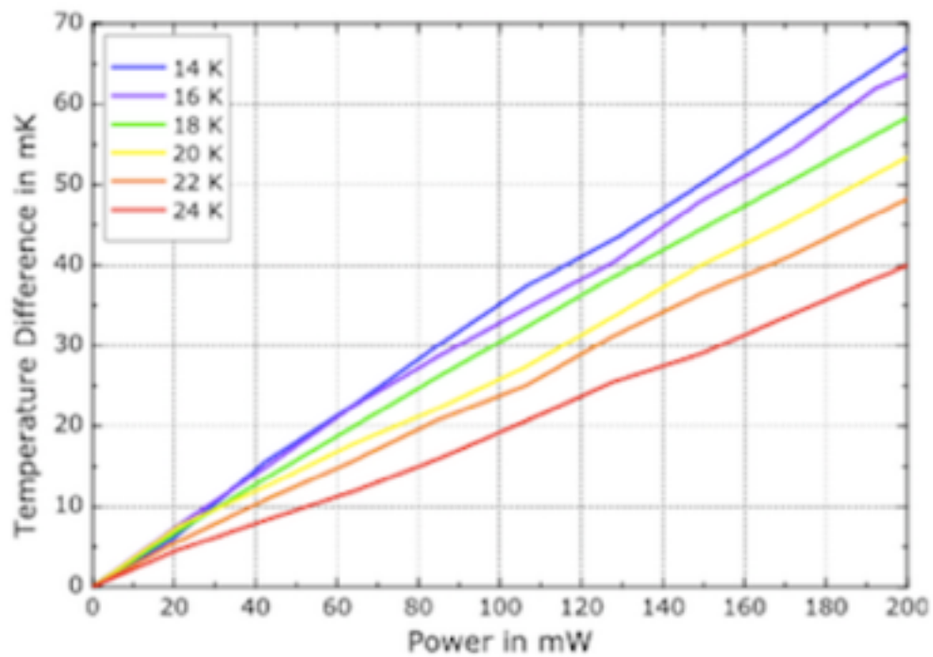
problem

- The power which went through the fiber
- The temperature
- The diameter of the fiber
- The thermal conductivity

problem

- So far, I have ignored the thermal resistance of Indium.

- From now, I account for that of Indium.



problem

- The error bar of each sensor is expected to be 0.10K.

- hanger…14.04±0.10K

- lower head of the fiber…13.73±0.10K

- $0.2465=\int_{T_{upperhead}}^{13.73\pm0.10}\kappa\frac{S}{l}dT$

- $T_{upperhead}$=4.28~7.00[K], less than the blade temperature.

problem

- The power which went through the fiber
- The temperature
- The diameter of the fiber
- The thermal conductivity

problem

- I measured the diameter of the fiber using the vernier micrometer（ノギス）, so the error is about 0.05mm（ϕ should be 1.65~1.75mm）.
- $0.2465=\int_{8.73}^{13.73\pm0.10}\kappa\frac{S}{l}dT$ 8.73K…T_{blade} $13.73\mathrm{K}\ldots T_{lowerhead}$
- Result…ϕ＝1.79~1.85mm→It can't be explained.

problem

- The power which went through the fiber
- The temperature
- The diameter of the fiber
- The thermal conductivity

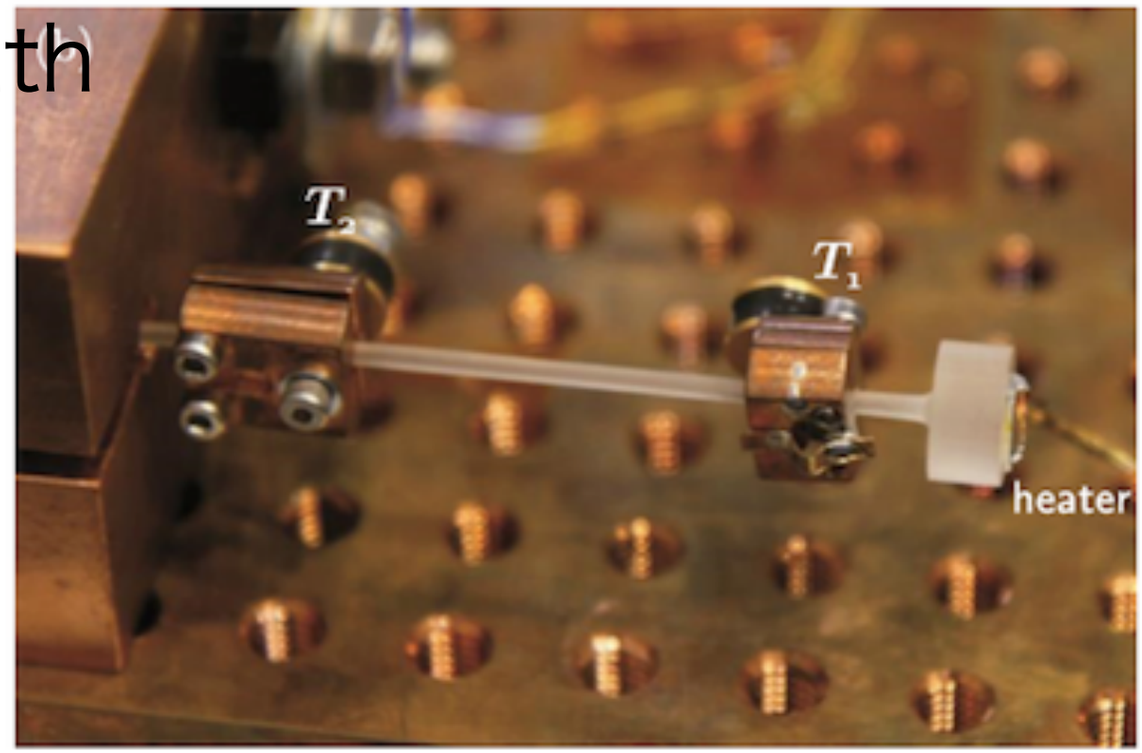
problem

- The thermal conductivity of the fiber depends on the fiber.

Solution

I want to measure it almost the same way as Sascha.
In that case, I will use the smaller cryostat after Ushiba-san's experiment.
During the experiment, I will also measure Q-value of one fiber prototype.

Heat bath



Future work

- I will measure the thermal conductivity of the fiber.

- I will also measure Q-value of one fiber prototype.