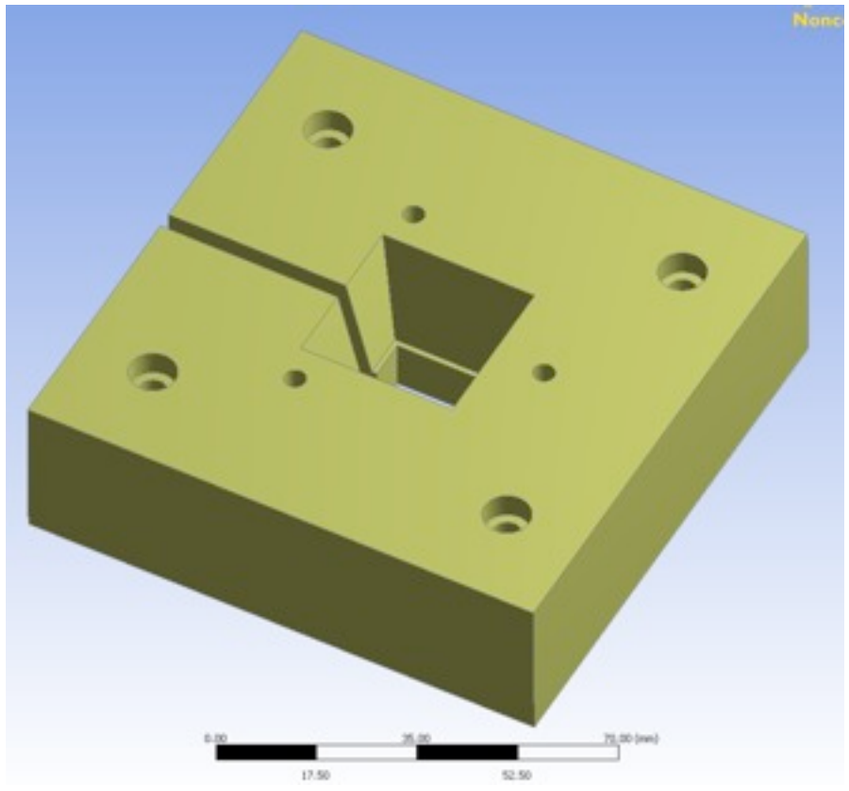
Cryo payload meeting

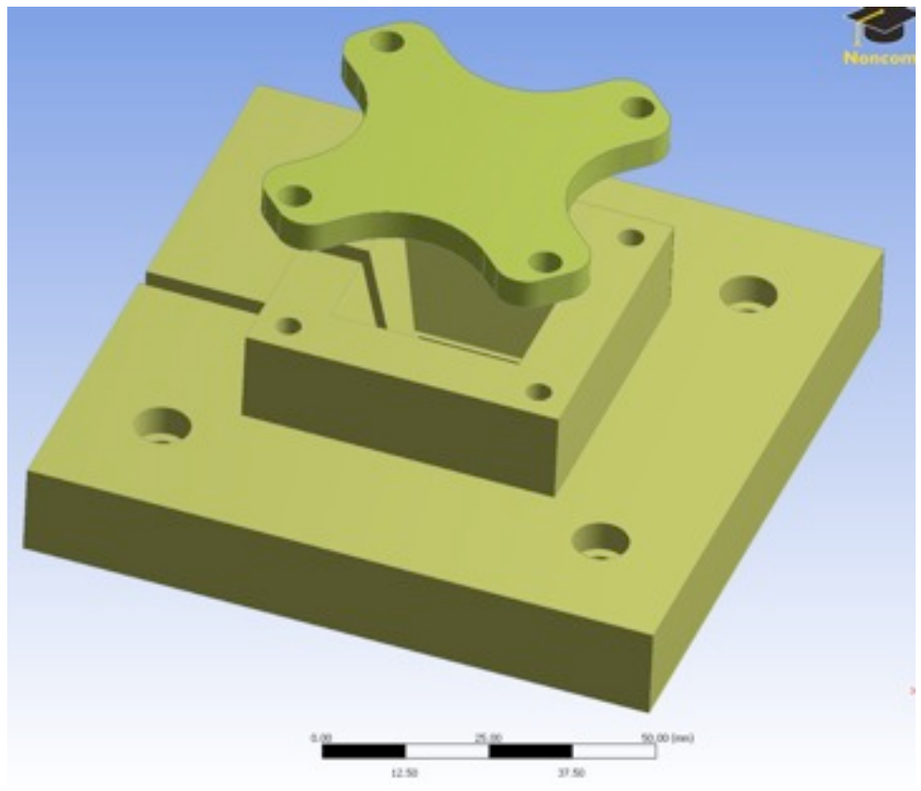
Dan Chen

2014/5/13 Cryo-payload meeting

Experiment in Rome and Jena

1. I have already gotten a visa for this trip.
2. Jig for Q measurement in Rome is manufacturing.
3. Do we order a diffusion bonding sample for Q measurement?





Thermal noise calculation

1. I am writting a note about the way to calculate TN.
2. There is a technical issue for the calculation. (Gravity is shaking the mass) I am asking Jena people.

熱雑音の計算

Dan Chen

2014/4/26
chen2014042601*

1 序論

Levin の熱雑音を求める式

$$S_x(f) = \frac{2k_BT}{\pi^2 f^2}\frac{W_{diss}}{F_0^2} \tag{1}$$

を導く。ここで $S_x(f)$ は熱雑音のパワースペクトルで単位は m^2/Hz であるため、このルートをとればよく見る単位になる。k_B, T, f はそれぞれボルツマン定数、温度、周波数である。F_0 はマスに加える振動的な力の振幅であり、W_{diss} はその力を加えたときに振り子内で散逸した時間平均のエネルギーである。具体的には以下のようになる。

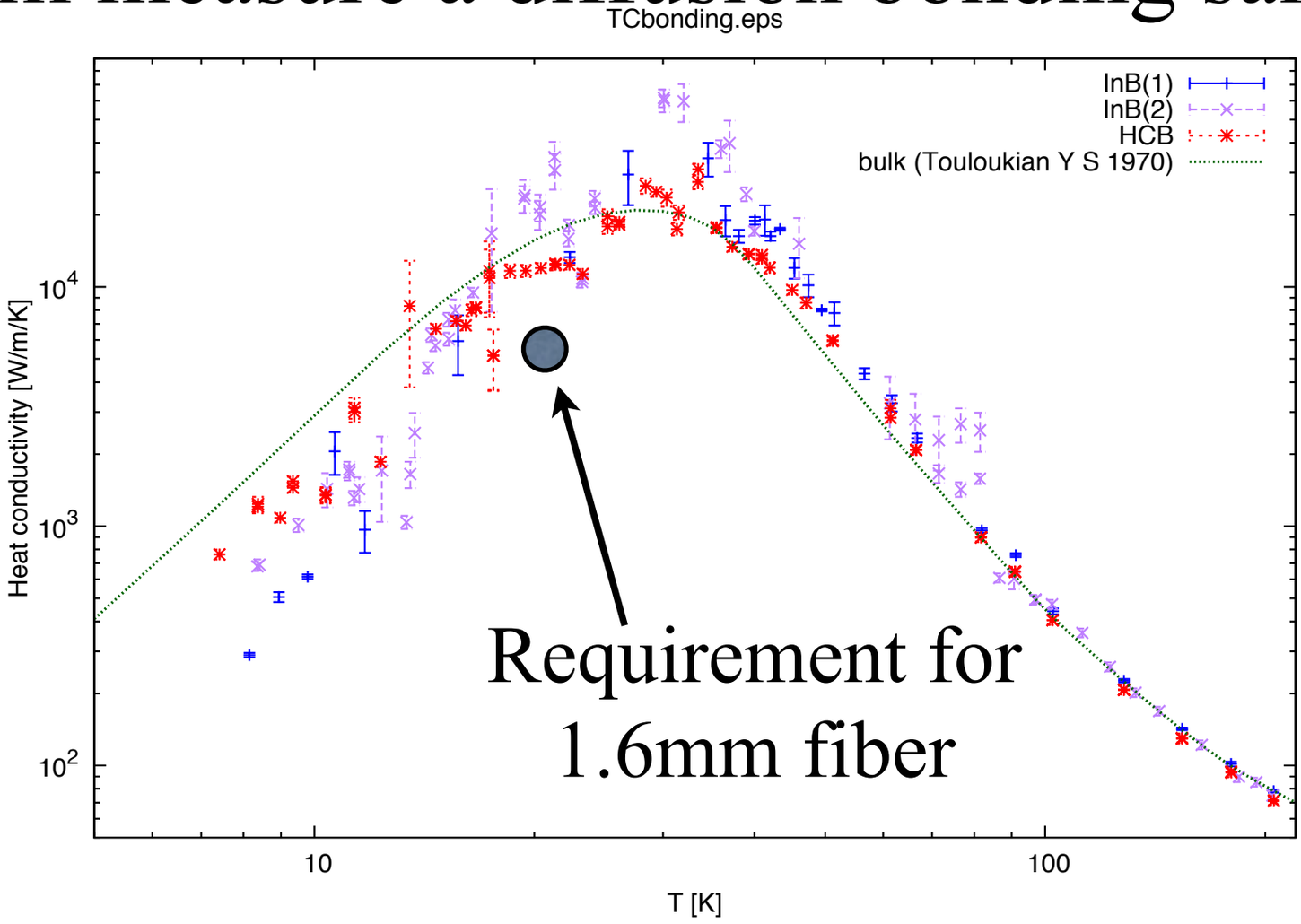
$$W_{diss} = 2\pi f \int u(x,y,z)\phi(f,x,y,z)dV \tag{2}$$

ここで $\mathrm{u}(x,y,z)[\mathrm{J/m}^3]$ は振り子内でたまっているエネルギー密度である。ϕ は各点、各周波数での Mechanical loss である。ここでは ϕ を一般的に周波数と位置に依存するとしたが、振り子の各点ですべて同じであれば、積分の外にだせる。

2 準備

Heat conductivity measurement

1. We have measured heat conductivity of HCB and In bonding(with oxide layer).
2. Dispassion is large.
3. The value is OK for KAGRA.
4. We will measure a diffusion bonding sample.



Paper of vibration measurement

1. I got comments from Luca and Sascha.
2. I am writing the 2nd version...

(KAGRA cryo-compatible vibration isolation design)

D. Chen[1], L. Naticchioni[2], A. Khalaidovski[1], K. Yamamoto[1], E. Majorana[2], Y. Sakakibara[1], C. Tokoku[1], T. Suzuki[3], N. Kimura[3], S. Koike[3], T. Uchiyama[1], S. Kawamura[1]

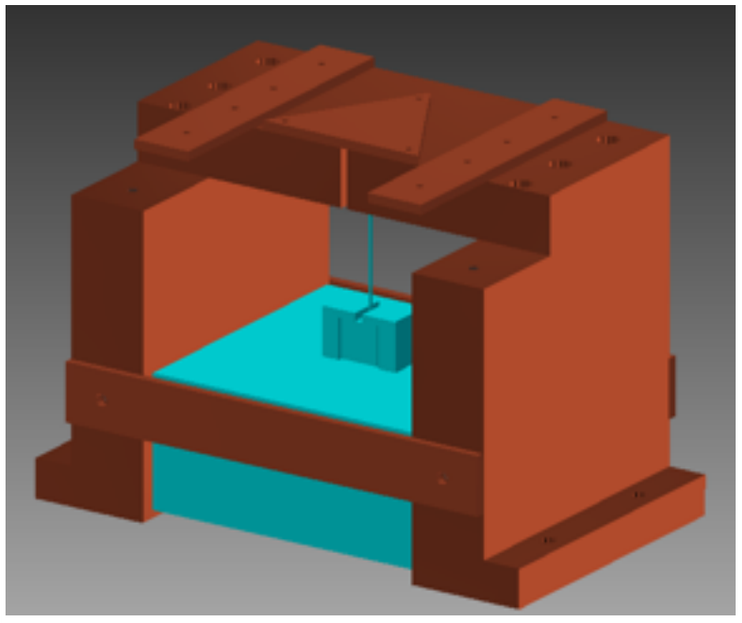
[1] Institute for Cosmic Ray Research (ICRR), The University of Tokyo, 5-1-5, Kashiwanoha, Kashiwa, Chiba, 277-8582, Japan
[2] INFN, Sezione di Roma 1, I-00185 Rome, Italy
[3] High Energy Accelerator Research Organization (KEK), 1-1 Oho, Tsukuba, Ibaraki, 305-0801, Japan

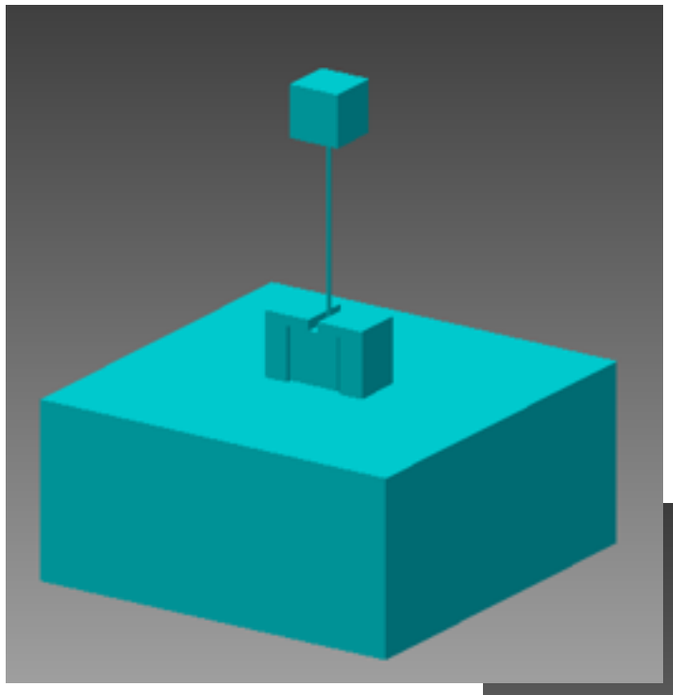
E-mail: chendan@icrr.u-tokyo.ac.jp

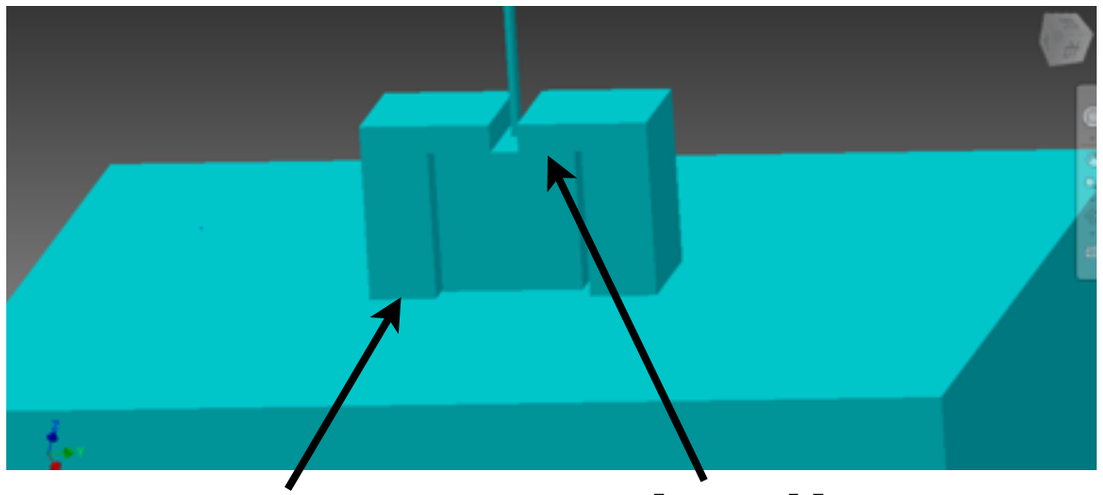
Abstract. The Japanese gravitational wave observatory KAGRA will be operated at cryogenic temperatures to reduce thermal noise. The main interferometer mirrors will be placed in individual cryostats that will be operated using four cryocooler units each. Because of existing connections between these cryocoolers and the mirrors through soft metal heat links and subsequently through parts of the inner cryostat structure, vibration from the cryocoolers and from the ground might couple into the mirror suspension and affect the measurement sensitivity. In this paper, we present the measurement of vibration transfer functions from the outside into the inner radiation shield of the cryostat measured at cryogenic temperatures at the cryostat production site in Yokohama, Japan. Basing on these, a prediction for the vibration at the observatory site in the Kamioka mine was derived. Our results show that with the current design the seismic noise goal formulated for KAGRA could not be achieved at all frequencies. Finally, we present a possible design optimization making it possible to fully achieve the KAGRA design sensitivity.

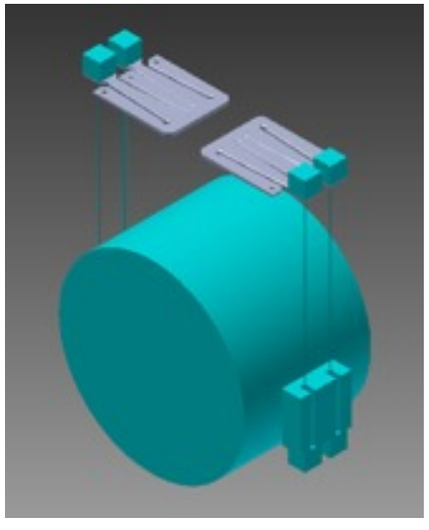
One fiber experiment

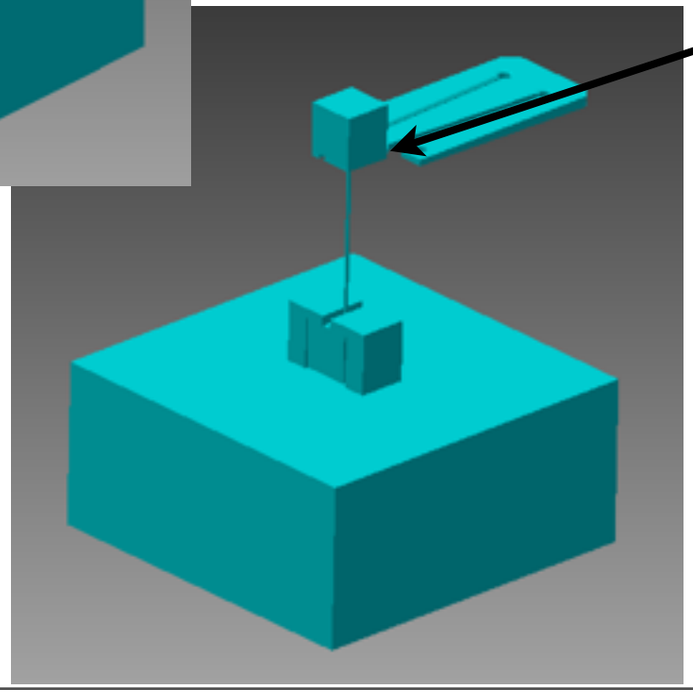
1. I am designing one fiber experiment.
2. Purpose: heat extraction measurement through bondings, Q measurement











One fiber experiment

1. I am designing one fiber experiment.
2. Purpose: heat extraction measurement through bondings, Q measurement
3. I have already written drawings of sapphire part for manufacturing. I will contact with Shinkoshya.