

Report of 4th ET symposium (Cryogenic)

Kazuhiro Yamamoto

**Institute for Cosmic Ray Research
The university of Tokyo**

**KAGRA domestic collaboration meeting
17 December 2012**

Review talks

Afternoon 4th of Dec.

Realization and Technologies I

Fulvio Ricci

“Vision Talk on Cryogenics fo ET“

Kazuhiro Yamamoto

“Current status of cryogenic system of KAGRA“

Coating and so on

Afternoon 5th of Dec.

Realization and Technologies II and III

Sheila Rowan,

“status of research at Glasgow on coatings“

Stuart Reid,

*“thin film deposition and characterization
facilities available in the UWS“*

Massimo Granata, *“loss in the coatings”*

Stefanie Kroker, *“grating reflectors”*

Coating and so on

Stuart Reid,

“thin film deposition and characterization facilities available in the UWS”

UWS stands for University of West Scotland
(near Glasgow airport).

Many apparatus **for thin film**

He **will buy** machine for **IBS**.

His plan : Investigation of **reflective coating**

DLC is also possible.

Coating and so on

Massimo Granata, “*loss in the coatings*”

Measurement of mechanical loss
of $\text{Ta}_2\text{O}_5/\text{SiO}_2$ coating at cryogenic temperature

Peak at cryogenic temperature was **found**.

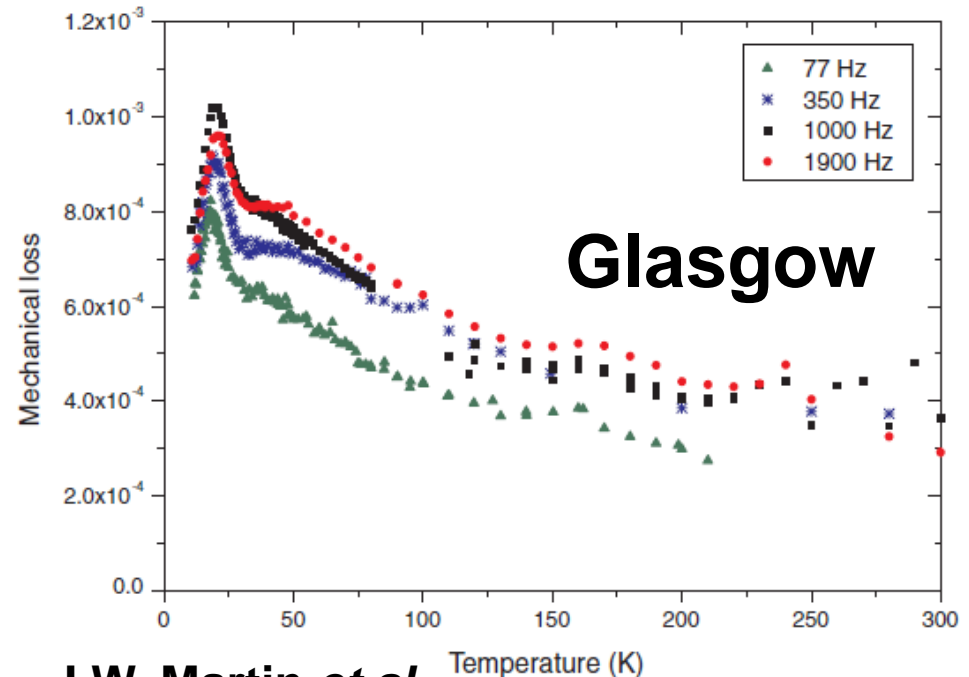
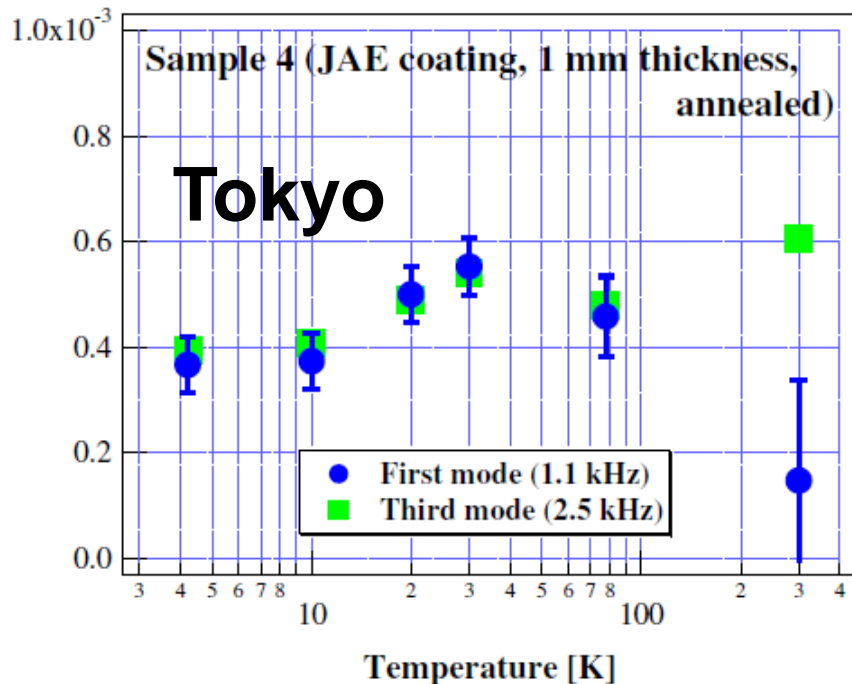
Future plan : **Friction between layers**

Coating and so on

Discrepancy between Tokyo and Glasgow

Ta_2O_5/SiO_2

Ta_2O_5 or SiO_2



I.W. Martin *et al.*,

Classical and Quantum Gravity

27 (2010) 225020.

K. Yamamoto *et al.*,
Physical Review D 74 (2006) 022002.

Fibers and so on

Afternoon 5th of Dec.

Realization and Technologies II and III

Karen Haughian, “*Silicate bonding of Silicon*“

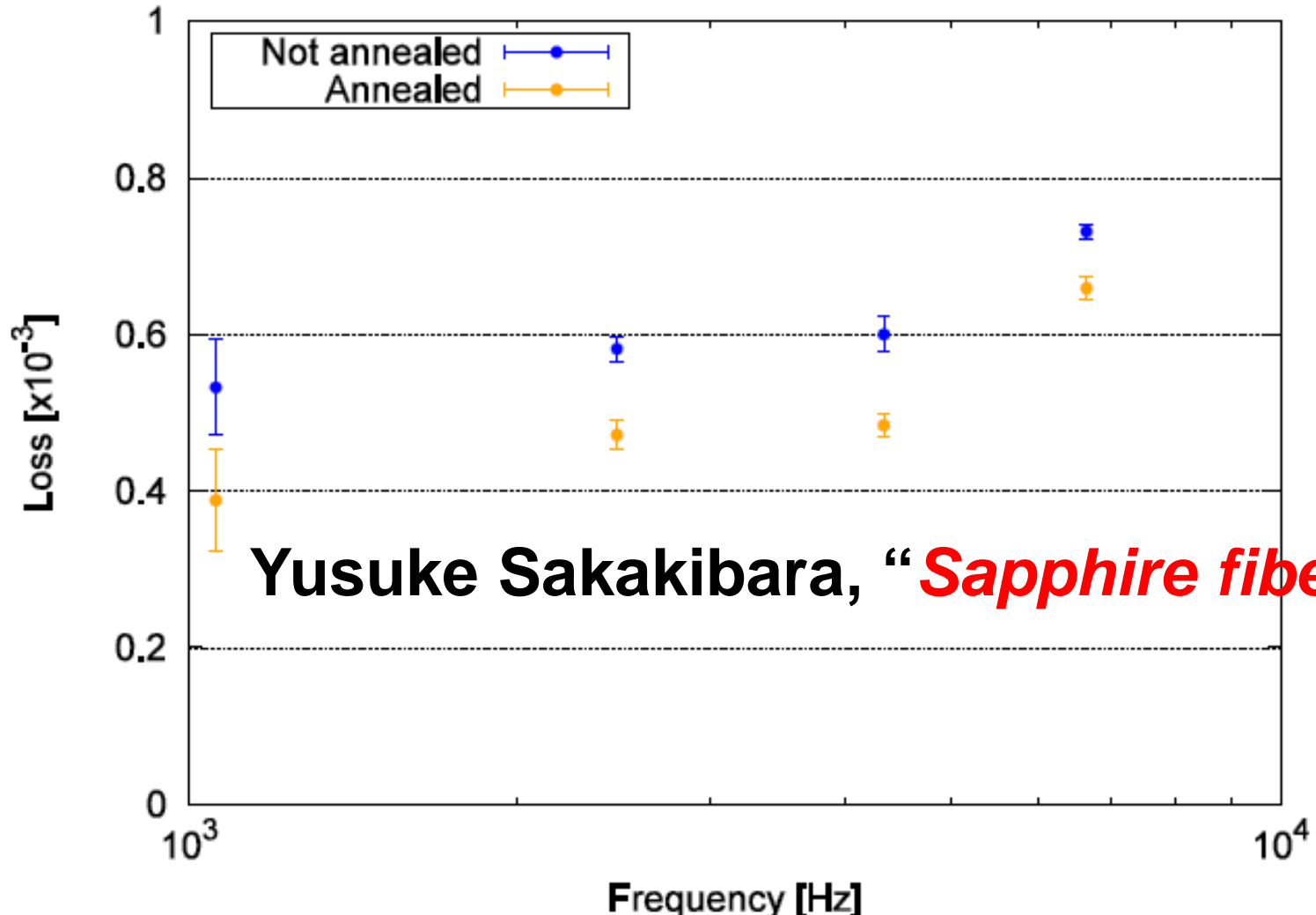
Giles Hammond, “*Cryogenic Silicon Suspensions*“

Yusuke Sakakibara, “*Sapphire fibers*”

Result

Coating loss

- Comparable to result of K. Yamamoto
- Annealing decreases loss of coating
- Measurement in cryogenic temperature will be conducted in future



Yusuke Sakakibara, “*Sapphire fibers*”

Fibers and so on

Yusuke Sakakibara, “*Sapphire fibers*”

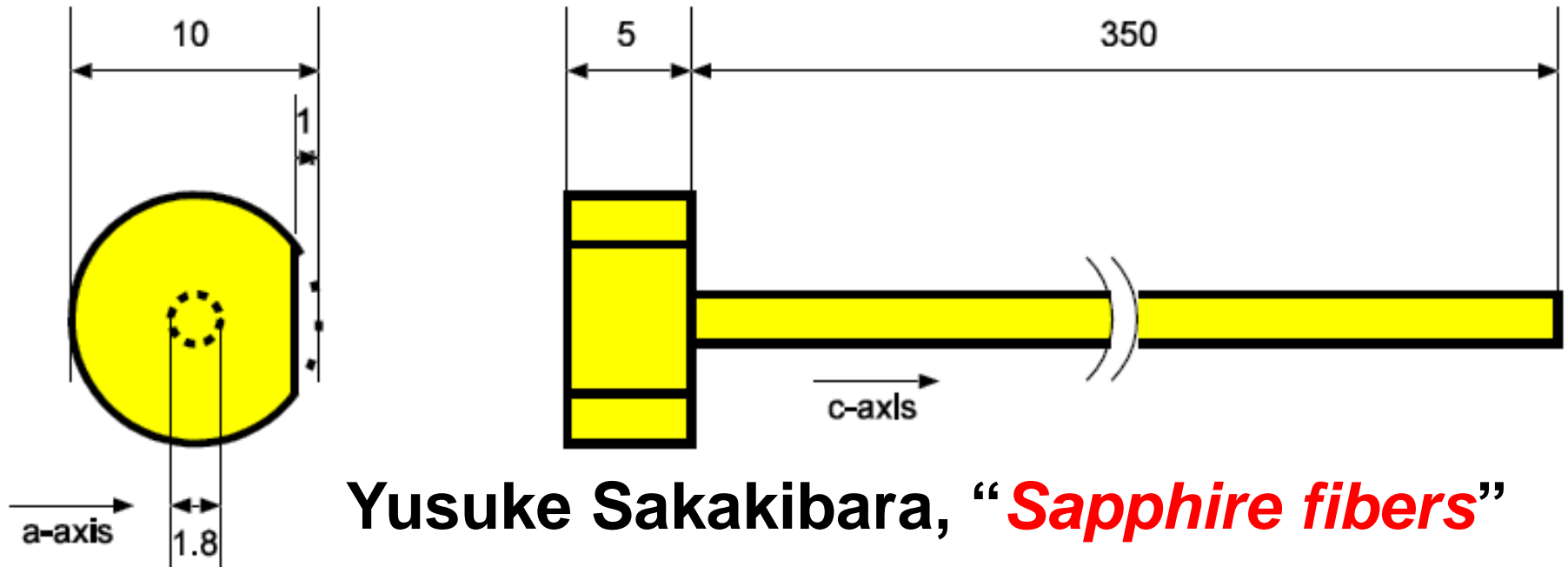
Quality check

Q-value and **profile** of **Moltech** fibers:

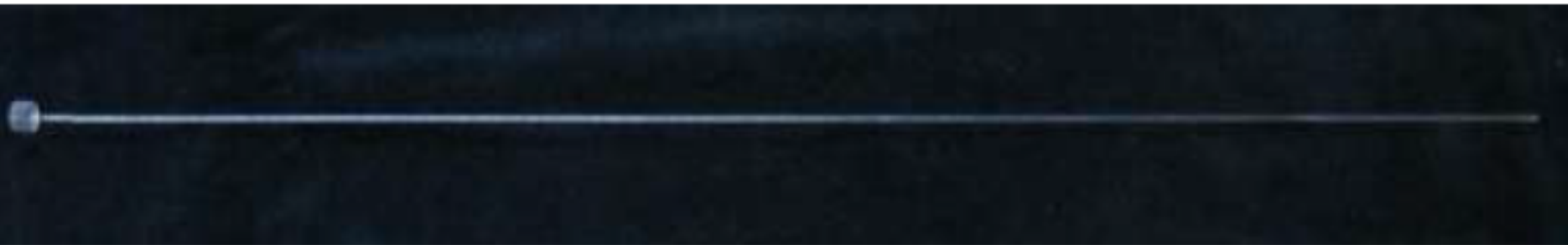
Y. Sakakibara at **Glasgow** and **Jena**.

Sample

- Sapphire fiber from Moltech
- Grown along c-axis

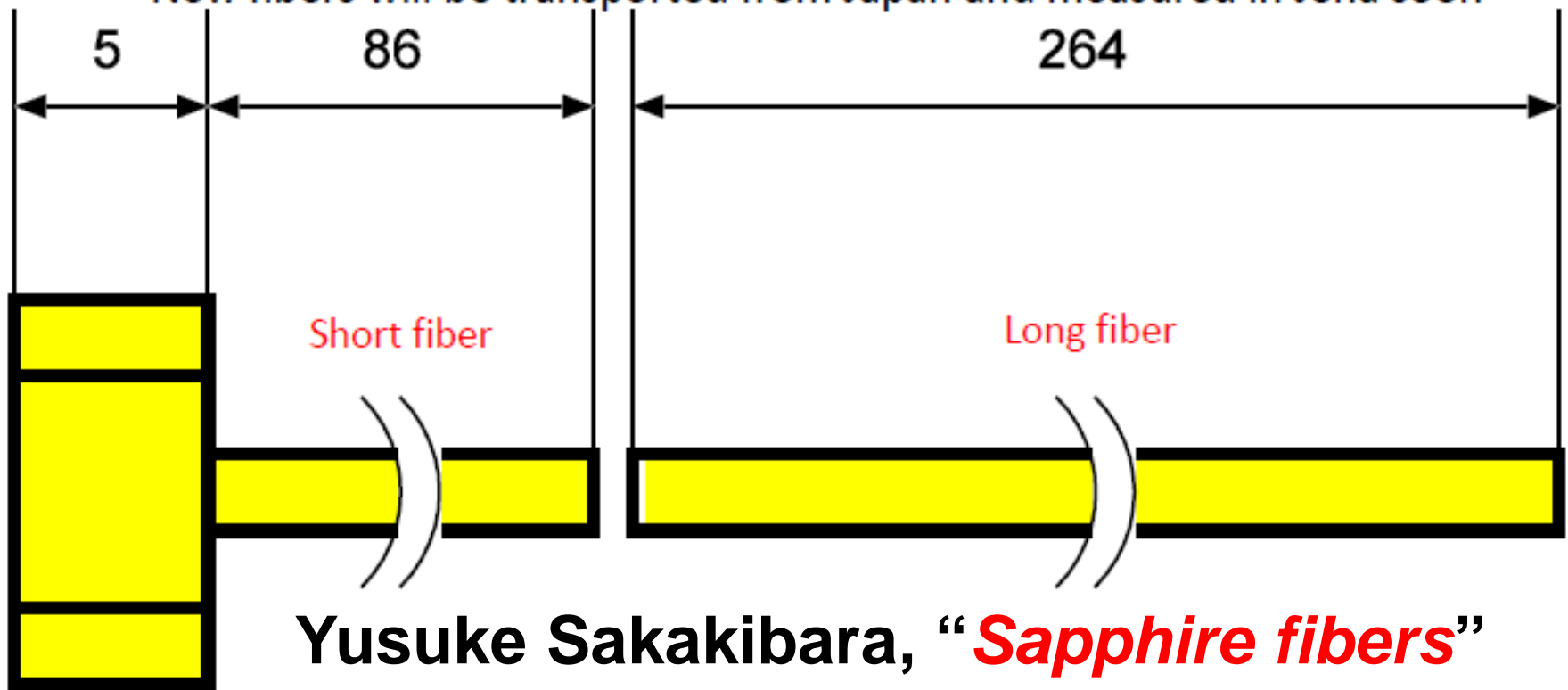


Yusuke Sakakibara, “*Sapphire fibers*”



Sample broken during transportation

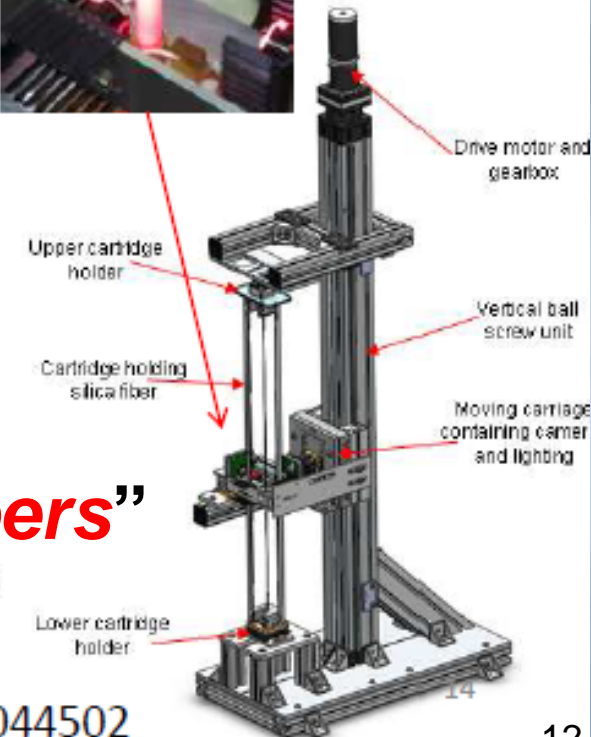
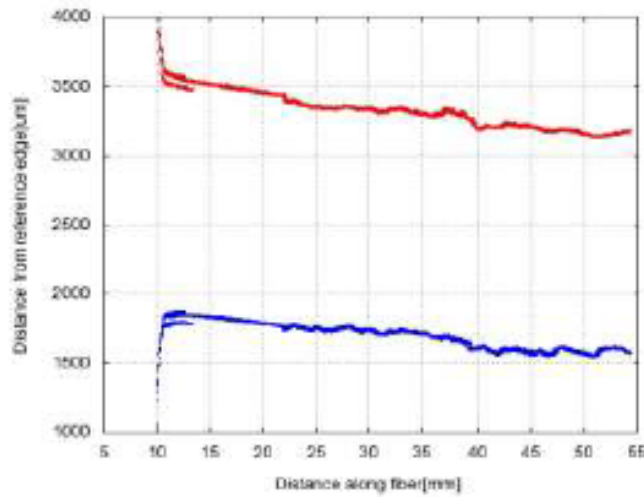
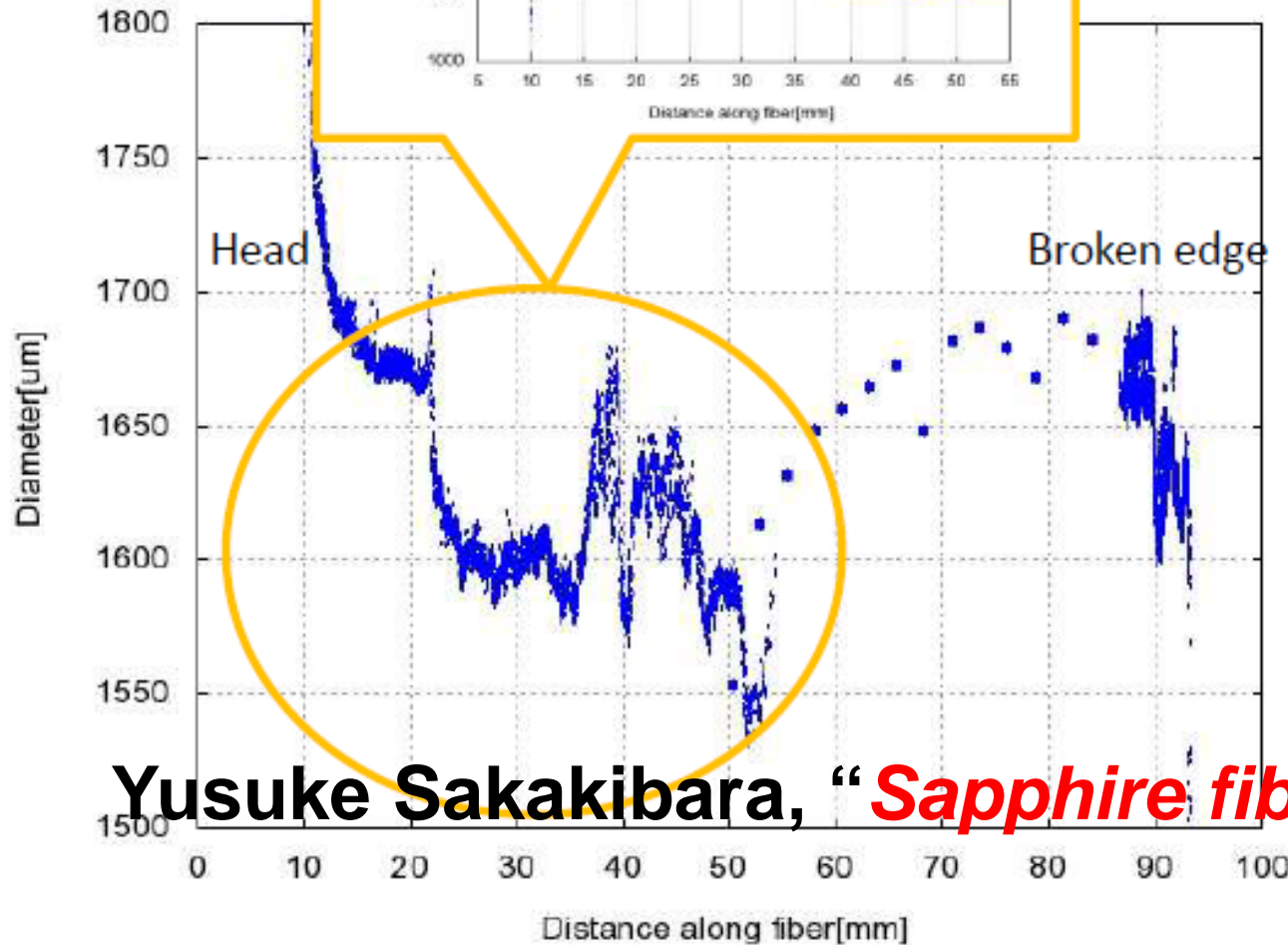
- Broken fiber
 - It had double enclosures during transportation
 - Packing more securely was necessary
 - Some force during transportation?
 - New fibers will be transported from Japan and measured in Jena soon



Yusuke Sakakibara, “*Sapphire fibers*”

Fiber profiles

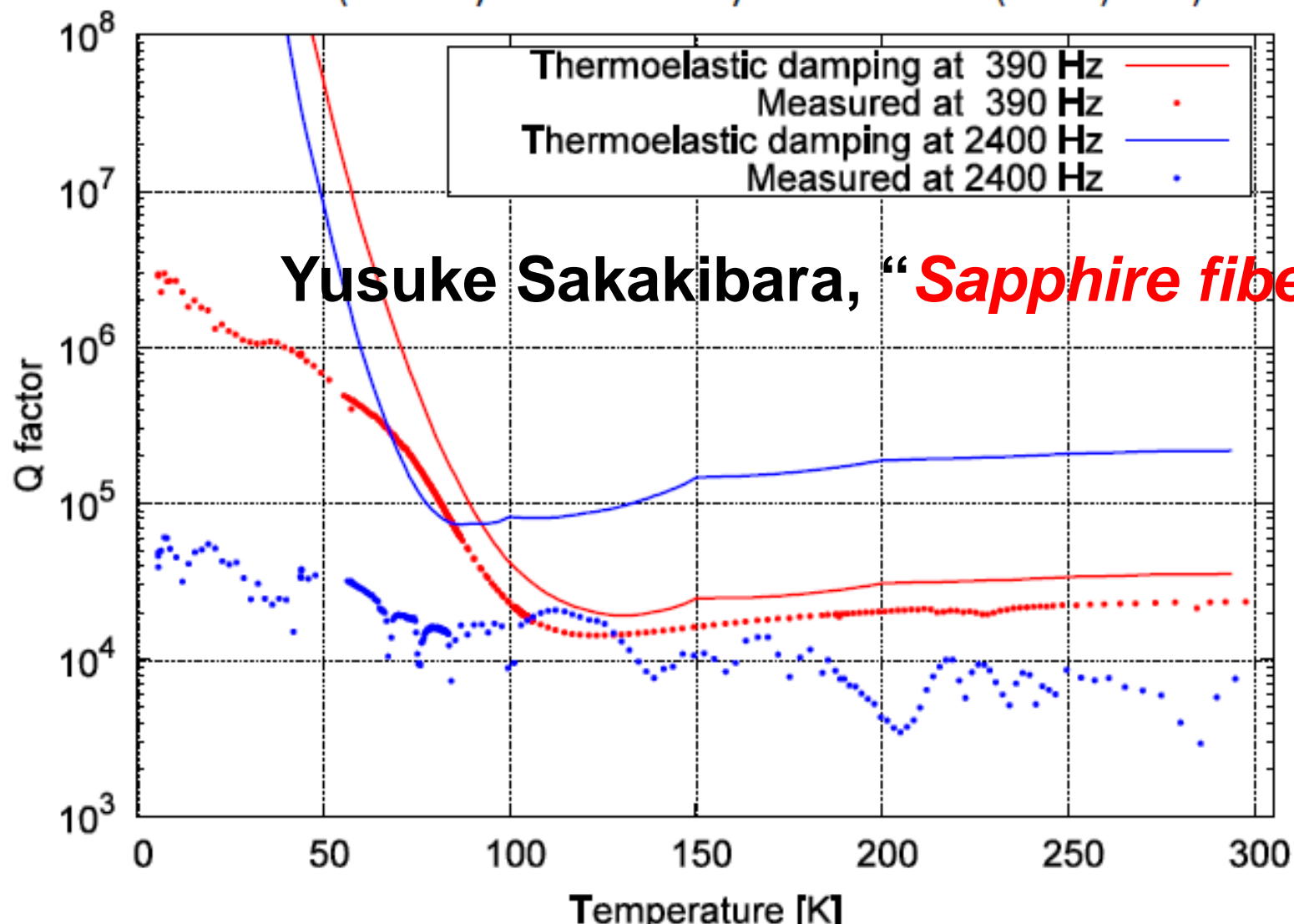
- Profiles taken by fiber profiler
- High magnification cameras measure diameter of fiber
- Surface roughness 0.1 mm



Yusuke Sakakibara, "*Sapphire fibers*"

Result

- Result of first mode (390 Hz) above 100 K is consistent with thermoelastic damping
- Second mode (2400 Hz) has higher loss than thermoelastic damping
- Comparable with result of another sapphire fiber 1.1×10^7 at 199 Hz and 6K (T. Uchiyama et al. Phys. Lett. A **273** (2000) 310)



Fibers and so on

Yusuke Sakakibara, “*Sapphire fibers*”

Quality check

Q-value and **profile** of **Moltech** fibers:

Y. Sakakibara at **Glasgow** and **Jena**.

Although they are **broken**,

the measurement result is **promising**.

Two **Moltech** fibers and two **IMPEX** fibers

were **sent** to **Jena** (29th of Nov.).

Sapphire fibers

Sapphire fibers with nail heads

Ettore Majorana asked **IMPEX HighTech GmbH**
(German company).

They **can make similar fibers**
(nail heads on the **both** ends).

Finally ...

Sapphire fibers

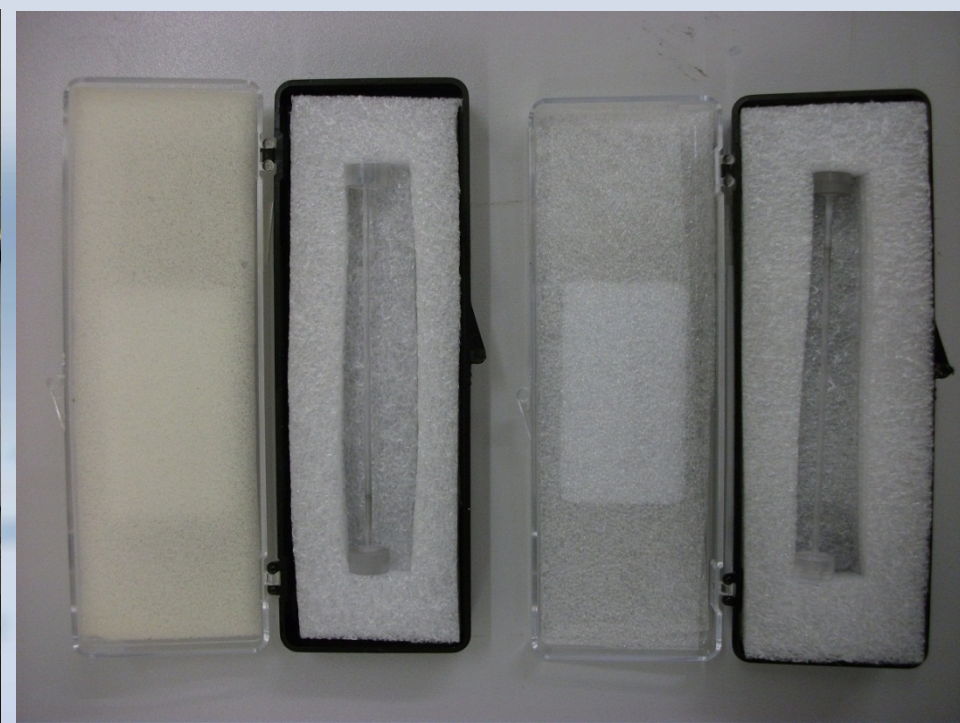
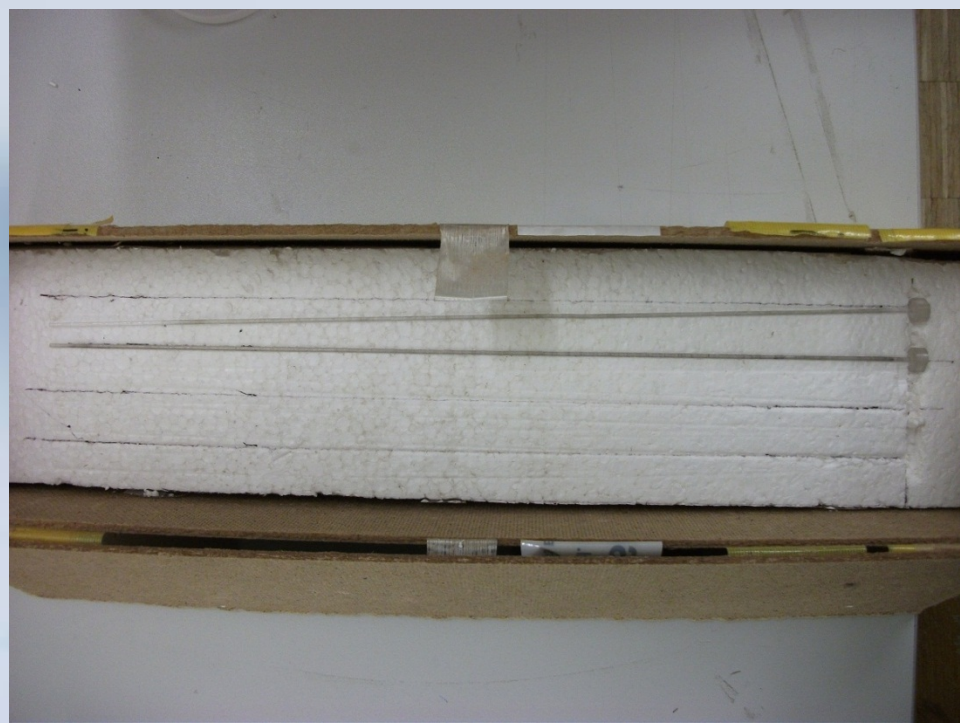
Sapphire fibers with nail heads



IMPEX fibers arrived ! (15th of Nov.)

Sapphire fibers

Two **Moltech** fibers and two **IMPEX** fibers
were **sent** to **Jena** (29th of Nov.).



They survived ! (Photos from Jena)

Jena

6th-7th Dec. 2012

**Kazuhiro visited Friedrich-Schiller-Universitaet Jena.
Yusuke measured Q-values of sapphire fibers.**

<http://gwdoc.icrr.u-tokyo.ac.jp/cgi-bin/private/DocDB/ShowDocument?docid=1420>

Jena

6th-7th Dec. 2012

Ronny, Christian, Ettore (skype from Rome), Yusuke, and Kazuhiro discussed the strategy.

In Jena

**Q-value with other type clamps,
Thermal conductivity,
Unbroken Moltech fibers, IMPEX fibers,
X-ray (crystal structure), impurity measurement**

Around March, these fibers will be sent to Rome and Ettore continue the investigation.

Jena

6th-7th Dec. 2012

Ronny, Christian, Ettore (skype from Rome), Yusuke, and Kazuhiro discussed the strategy.

**In Rome,
Ettore ordered other IMPEX fibers (manufacturing procedure is different). They will arrive on the end of January.**

Q-measurement system in Jena could be exported to Japan. If possible, students and Post doc are exchanged.

Jena

Weihnachtsmarkt in Jena



Frohe Weihnachten !