



**ET-LCGT Interferometric Telescopes Exchange of Scientists**

# **KAGRA 11th Face to face meeting**

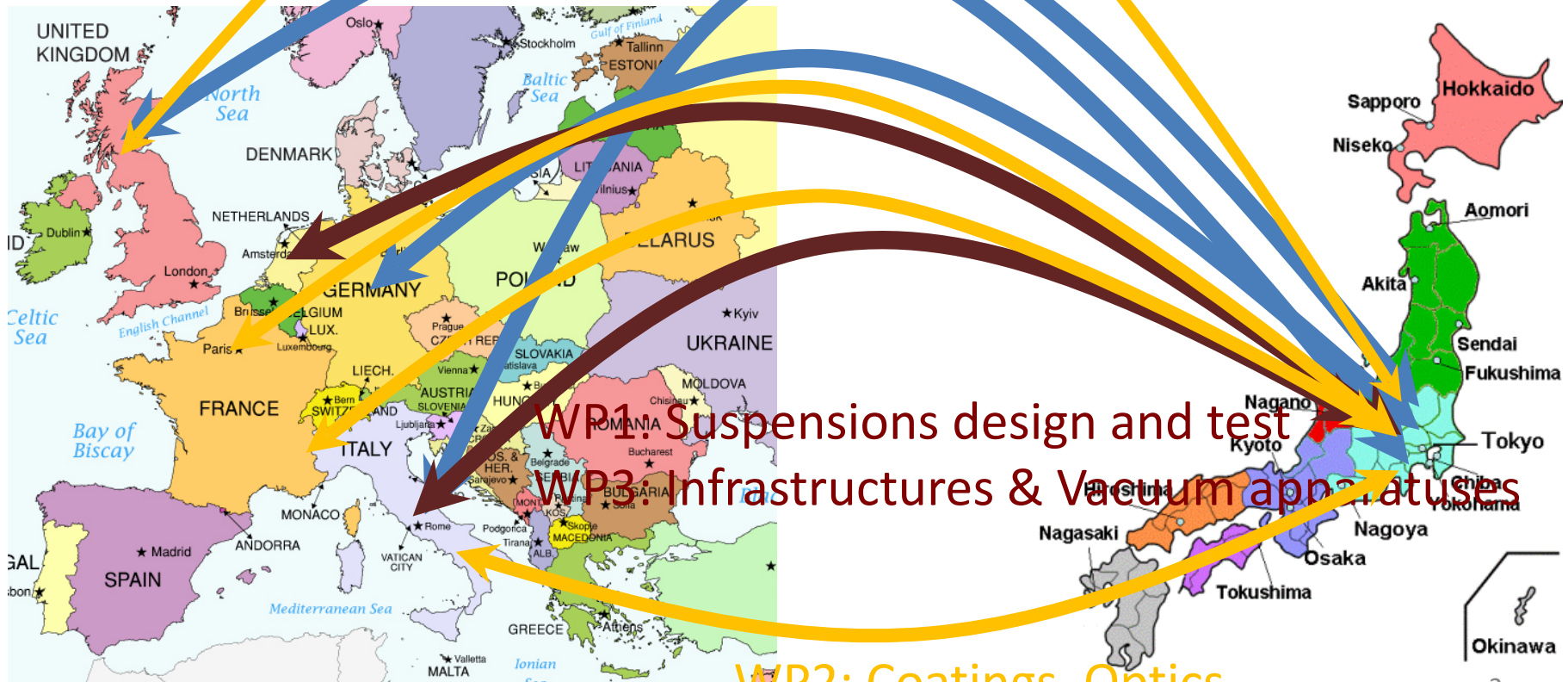
E. Majorana

**February 5-7, 2015, Hongo Campus, The University of Tokyo**

# Project No.: 295153: ELITES



WP1, WP2: Suspensions materials, fibres



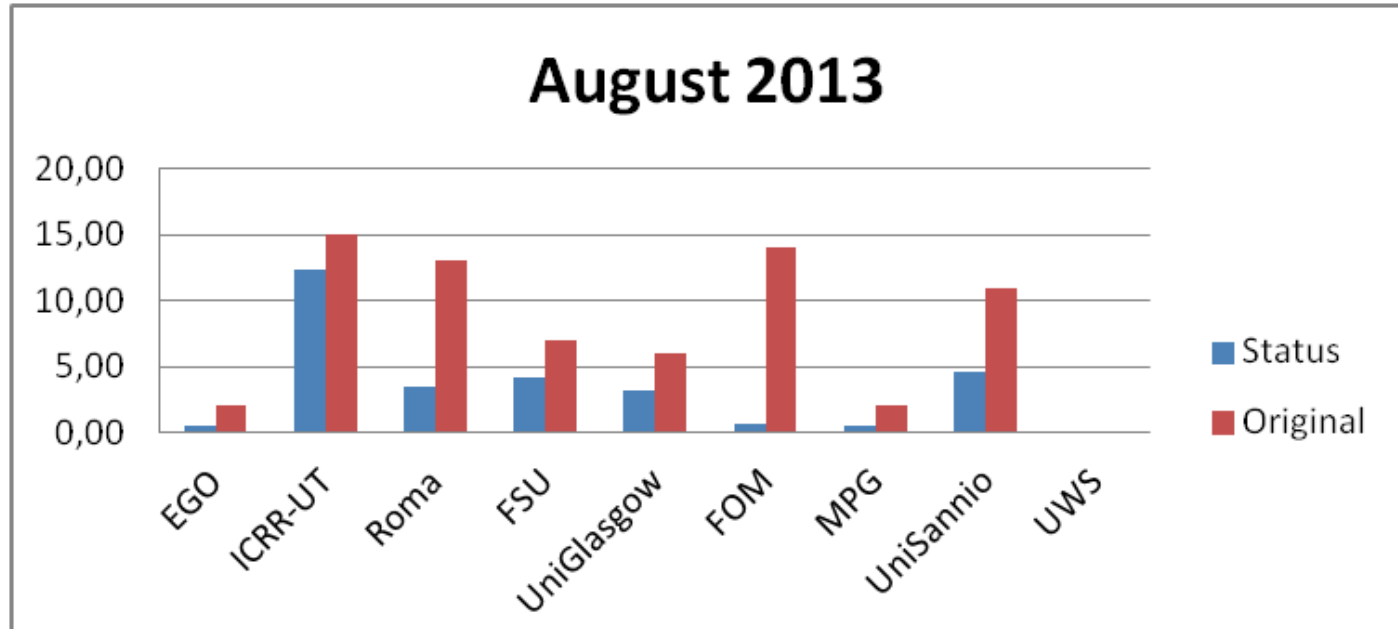
WP1: Suspensions design and test  
WP3: Infrastructures & Vacuum apparatuses

WP2: Coatings, Optics

# ELiTES Partners

ID	Institute	Country
1	EGO	Italy/France
2	Institute for Cosmic Rays Research (ICRR)- University of Tokyo	Japan
3	Università degli Studi di Roma "La Sapienza"	Italy
4	Friedrich-Schiller-Universität (FSU) - Jena	Germany
5	University of Glasgow	UK
6	Stichting Voor Fundamenteel Onderzoek der materie - FOM	NL
7	Max Plank Gesellschaft zur Foerderung der Wissenschaften E.V. - MPG	Germany
8	Università del Sannio	Italy
9	University of West Scotland (UWS)	UK
10	Centre National de la Recherche Scientifique (CNRS)	France

# MANPOWER



Just after 1.5 years (over 4) ELiTES experienced a dramatic reduction of exchange participation with respect to what planned, especially by some groups, mainly due to the engagements in construction of AdV. **The situation improved in 2014 but a lower impact had to be envisaged.**

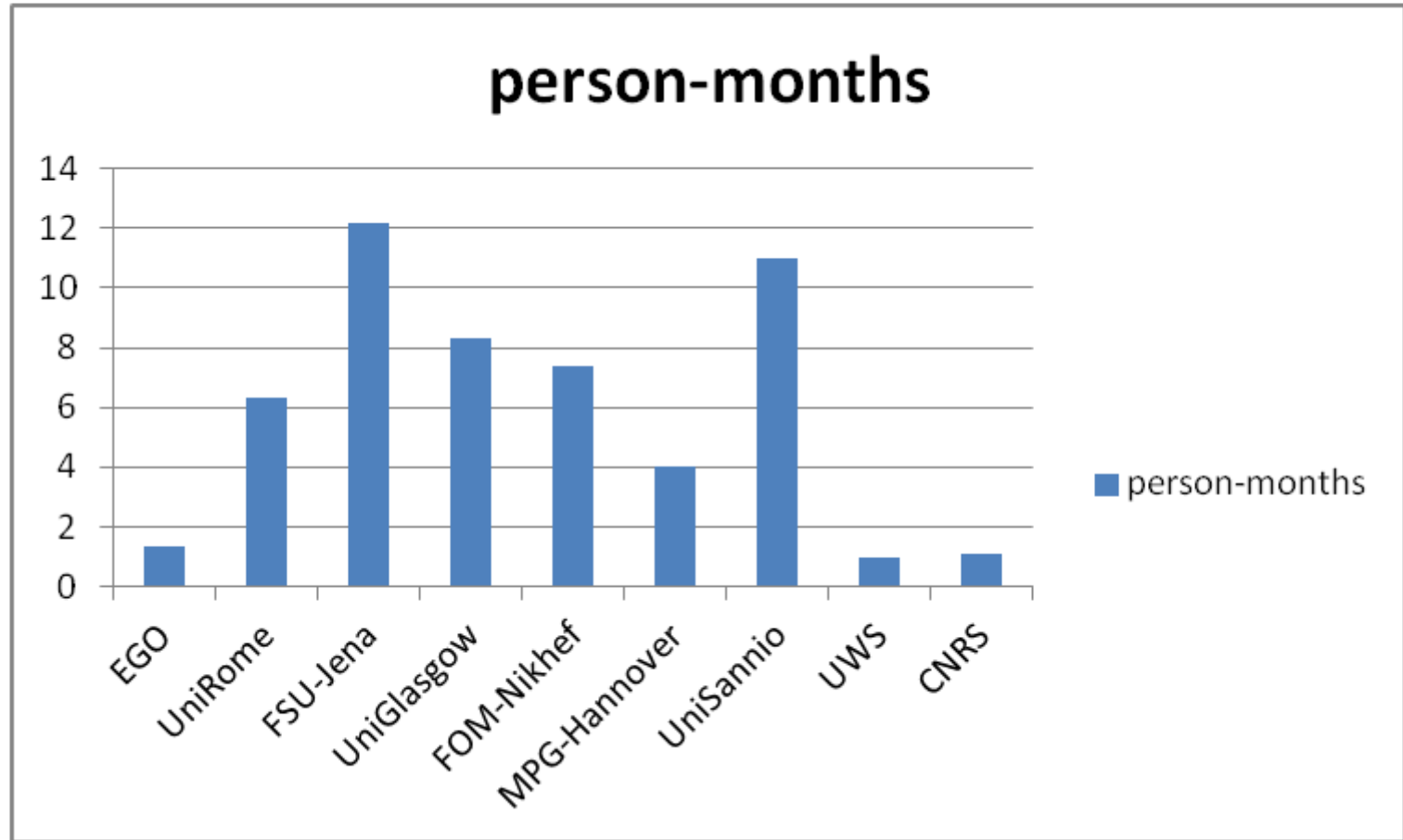
→ CNRS joined in 2014

→ A new plan was negotiated in 2014, in order to reallocate at least partially the initial funding.

**CNRS, specifically, LMA is mainly involved in WP2 activities, coating thermal noise and optics**

# Secondments

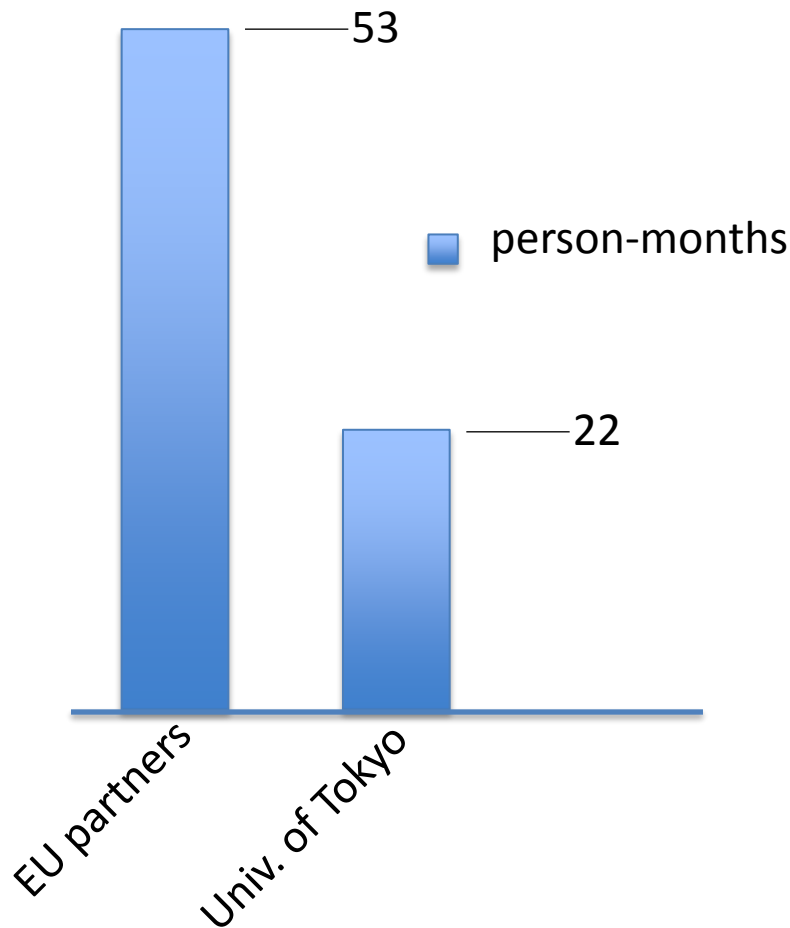
- However, ELiTES generated, until now, more than 53 man-months of presence of European scientists in Japan



- a stimulating bridge EU and JapaneseGW communities

# Secondments

ELiTES motivated, **only upon the base of scientific exchange**, - i.e. by supporting scientific activity through laboratory facilities – **a significant participation of Japanese young scientists** in Europe supported by Japanese institutions (mainly JSPS).



University of Tokyo, as partner of ELiTES Program, gathers the contribution of research institutions involved in KAGRA

- ➔ Participation mainly leading to support KAGRA implementation
- ➔ Participation strictly coordinated with KAGRA manpower demand

# Scientific production

ELiTES program aims to strengthen the collaboration and the scientific exchange of ideas and know-how between Japanese and European scientists and is focused practical solutions leading to the implementation of KAGRA as well as R&D subjects aimed to 3<sup>rd</sup> generation detectors.

- Scientific outcome, even if limited to specific items, is expected
- Mobility in international context, useful for young scientists
- ELiTES has no budget for experiments, only for traveling

Posters and talks provided at ET project conferences and GWDAW  
At least 6 paper published reporting ELiTES acknowledgements.

<http://www.et-gw.eu/elites-related-publications>

# Papers

D. Heinert, S. Kroker, D. Friedrich, S. Hild, E.-B. Kley, s. Leavey, I. W. Martin, A. Tünnermann, S. P. Vyatchanin, K. Yamamoto, **Calculation of thermal noise in grating reflectors**, *Phys. Rev. D* **88** (2013) 042001

R. Douglas, A. A. van Veggel, L. Cunningham, K. Haughian, J. Hough, S. Rowan, **Cryogenic and room temperature strength of sapphire jointed by hydroxide-catalysis bonding**, *Class. Quantum Grav.* **31** (2014) 4 5001

A. Khalaidovski, G. Hofmann, D. Chen, J. Komma, C. Schwarz, C. Tokoku, N. Kimura, T. Suzuki, A. O. Scheie, E. Majorana, R. Nawrodt, K. Yamamoto, **Evaluation of heat extraction through sapphire fibers for the GW observatory KAGRA**, *Class. Quant. Gravity*, **31**, 105004 (2014). arXiv:1401.2346 [astro-ph.IM]

M. Punturo, K. Somiya, **Underground gravitational wave observatories: KAGRA and ET**, *Int. J. Mod. Phys. D* **22**, 1330010 (2013)

F. Frasconi, E. Majorana, L. Naticchioni, F. Paoletti and M. Perciballi, **A vertical accelerometer for cryogenics implementation in third-generation gravitational-wave detector**, *Meas. Sci. Technol.* **25** (2014) 015103 (9pp)

D. Chen, L. Naticchioni, A. Khalaidovski, K. Yamamoto, E. Majorana, Y. Sakakibara, C. Tokoku, T. Suzuki, N. Kimura, S. Koike, T. Uchiyama and S. Kawamura, **Vibration measurement in the KAGRA cryostat**, *Class. Quantum Grav.* **31** (2014) 224001 (12pp)

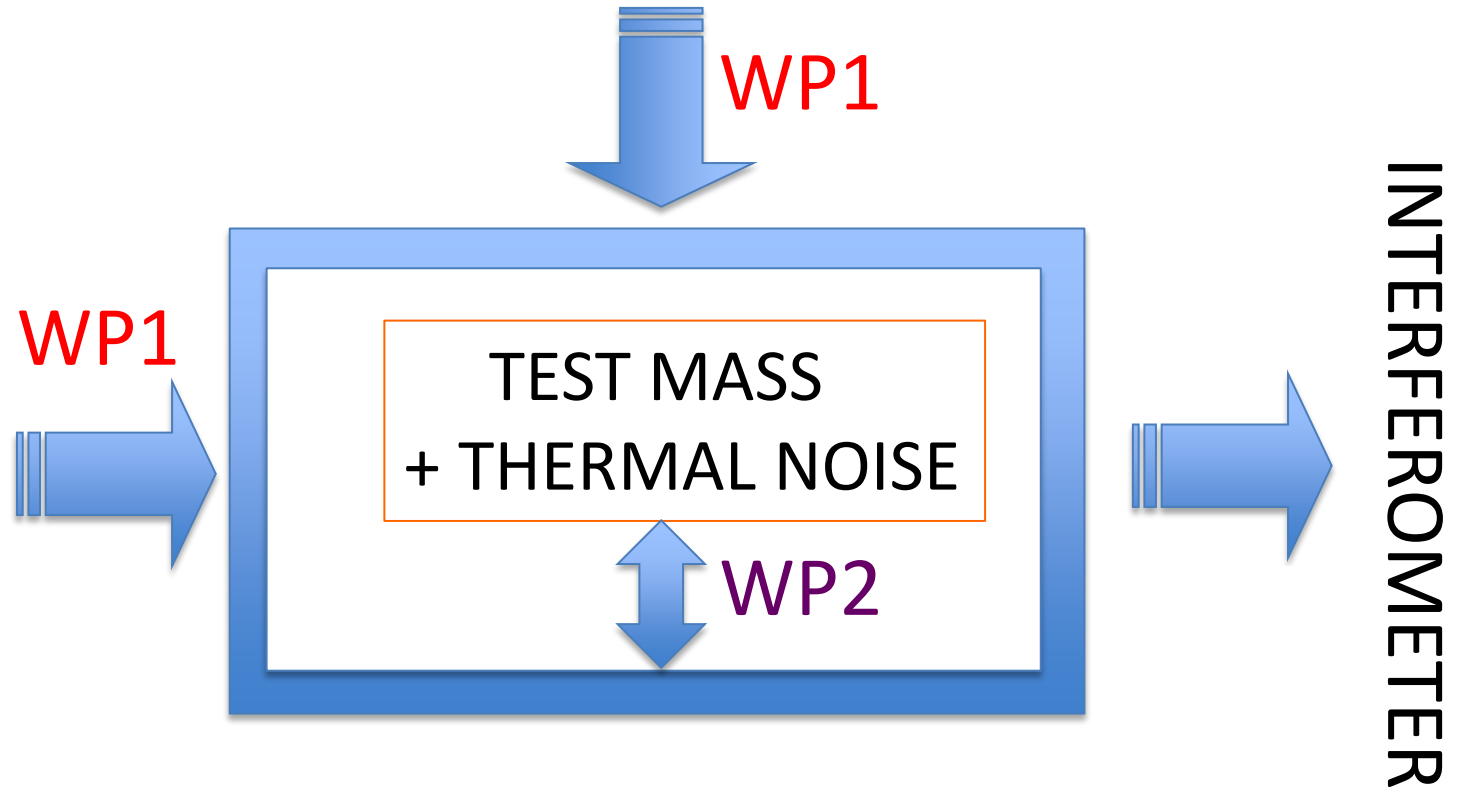


# Conferences

- GWADW 2013 (Elba 19 May 2013),  
<https://agenda.infn.it/conferenceOtherViews.py?confId=5484&view=standard>
- - 5th ET Symposium - Einstein Telescope (Hannover 22 Oct 2013) <http://www.et-gw.eu/meetandevt>
- GWADW 2014 (Takayama 25 May 2014),  
<http://www.gravity.ircs.titech.ac.jp/GWADW2014/index.htm>
- - 2nd ELiTES general meeting (Tokyo 4 Dec 2013)  
<https://events.ego-gw.it/indico/conferenceDisplay.py?confId=7>
- .....

# JOINT TASKS RELATED TO THE CRYOGENIC PAYLOAD

SEISMIC ISOLATION



**FRUITFUL ACTIVITY  
DELIVERED**

- **Cryostats technical noise** (KEK, ICRR, Roma)
- **Suspension design and modeling for KAGRA** (ICRR, NIKHEF, Roma, Sannio)
- **Sapphire thermal conductivity** (Jena, ICRR, Roma)
- **Sapphire mechanical Q measurements** (ICRR, Jena, Glasgow, Roma)
- **Sapphire bonding techniques and breaking strength, cryogenic cycling** (Glasgow, KEK)
- **Q VS composite material and bonding** (Jena, ICRR, Glasgow, KEK, NIKHEF)
- **Sapphire Blade design and clamping** (ICRR )
- **Sapphire components design, selection and manufacturing** (ICRR, Jena, Roma)



**ELiTES reports  
(overall still missing)**



**Test facility at ICRR dedicated  
to the test of payload concept**



**Test facility at KEK dedicated  
to payload prototype**

## What is missing and next DELIVERABLES

urgent

- **KAGRA & ET: room temperature VS cryogenics interface, vertical mechanical filters for heat links and, for suspension thermal noise, parallel approaches, for ET and KAGRA (KEK, NAOJ, Roma\* ?, Sannio ?)**
- **KAGRA & ET: Direct payload control in cryogenic environment, partially addressed for KAGRA (NAOJ, UT, ICRR, NIKHEF?, Roma?, Glasgow?)**
- **ET: Stray-light baffles, successfully developed by KAGRA, no idea for ET (NAOJ, UT, ICRR, NIKHEF?, Roma?, Glasgow?)**
- **ET: Cryogenic system, successfully developed by KAGRA, just tentative ideas for ET (NAOJ, UT, ICRR, NIKHEF?, Roma?, Glasgow?)**

## DELIVERABLES AREN'T JUST USEFUL STUDIES. THEY ARE, ALSO, DUE DOCUMENTS

### Task 1.1

**month 24;** Seismic attenuator and Suspension overall model including control issues.

**month 36;** Standalone performance of seismic isolation system and payload prototype will be tested also in presence of cryogenic links.

### Task 1.2

**month 48;** Overall report on cryogenic payload, including heat link, and projection of KAGRA design results on ET applications.

### Task 1.3

**month 36;** The need of further seismic isolation chains dedicated to thermal links will be assessed and a preliminary design for cryogenic application will be focused in a dedicated note.

### Task 1.4

**month 48;** A realistic scheme of sensor and actuators conceived for payload control in KAGRA and a possible application for ET will be resumed in a dedicated document.



**Task 1.2 and 1.3 have to be delayed or re-negotiated with EC**

DELIVERABLES AREN'T JUST USEFUL STUDIES. THEY ARE, ALSO, DUE DOCUMENTS

### Task 2.2

**month 24;** Coating loss model, dielectric mixture mechanical loss model; database of cryogenic properties of bulk and coatings materials.

**month 36;** Report on mirror thermal noise: verify HR coatings on sapphire substrates for KAGRA and comparison with HR coatings on silicon substrates for ET.

### Task 2.3

**month 24** Report on the bonding of sapphire test pieces for KAGRA and comparison with bonded silicon components planned for use in ET.

**month 48;** Overview of the thermal noise and cryogenic performance of sapphire and silicon suspensions.

### Task 2.4

**month 48;** Report on mirrors for filter cavities



**Task 3.1:**

**month 40;** Report about the impact of pulse-tube compressor disturbance onto environmental noise background in cavern GW interferometer installations

**Task 3.2:**

**month 48;** A preliminary study of ET radiation shield based upon KAGRA configuration.

**Task 3.3:**

**month 48;** Overview of contamination free designs, description and detailed analysis.

**A major contribution towards ET design is probably expected by W3**

# conclusions

- The program covers four years and we are approaching to the last.
- Some partners, more directly involved in AdV were underperforming due to manpower lack
- Nevertheless the scientific outcome was effective and it is still quite promising.
- Next exchanges are crucial for KAGRA payload prototyping and suspensions.



K. Yamamoto and T. Tomaru special guests during AdV END mirror payload assembly (June-July '15)

