

# Einstein Telescope-IT @ LNF



## Proposta di apertura sigla locale Gr. II

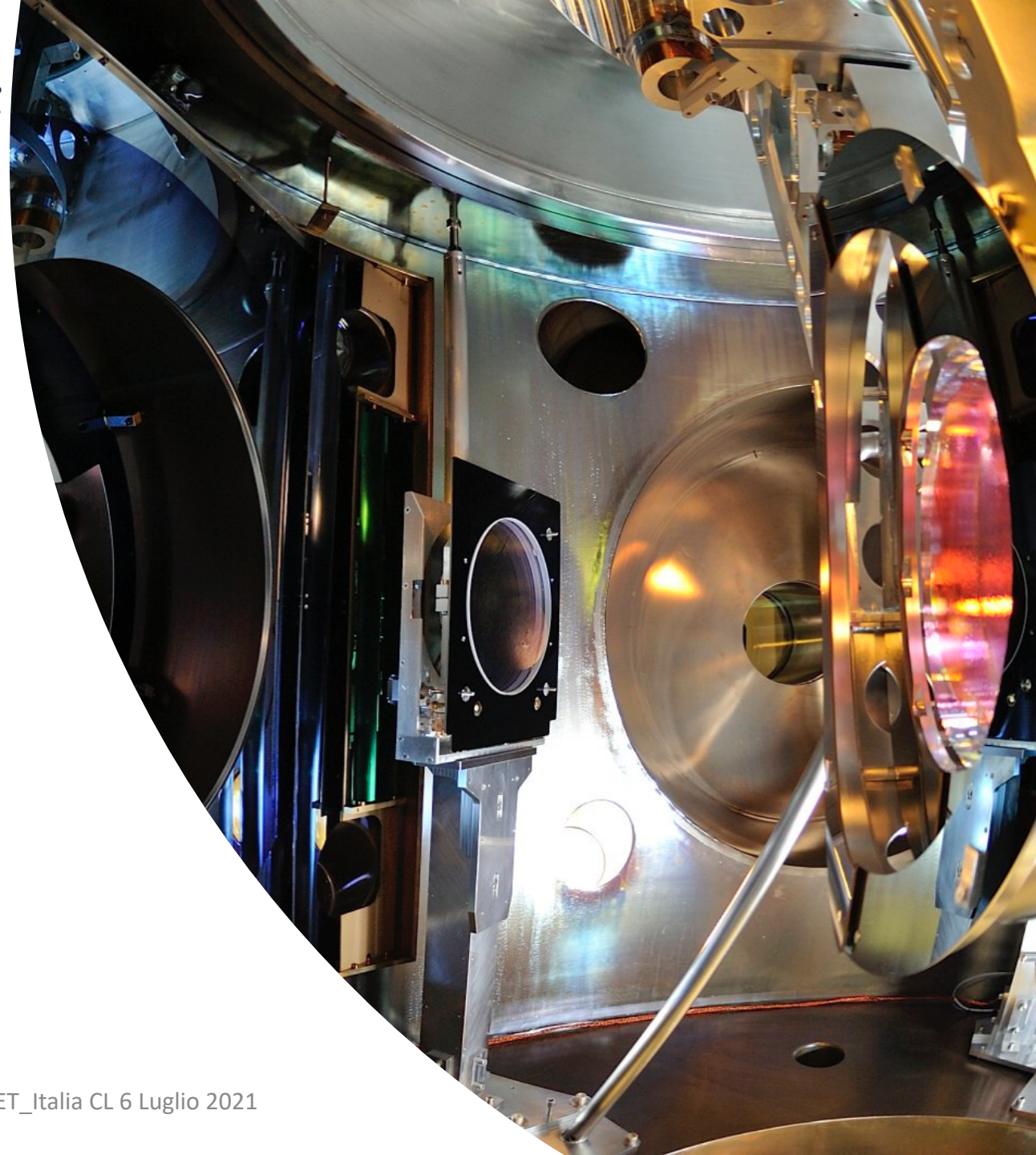
# Einstein Telescope-IT @ LNF

LNf is proposing to contribute and participate to the ET-Italia project, aiming to develop the required R&D to produce a technical design study for the construction of a third generation Gravitational Waves detectors.

The possibility that Italy may host this infrastructure in Sardinia, makes our contribution strategic to enter from the beginning to this exiting enterprise.

The new design will be based on longer arms (10 km each) and cryogenically cooled mirrors

**R&D on Vacuum and Cryogenics for  
Einstein Telescope @LNF**



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## ET ESFRI Proposal: the consortium level

- The ET ESFRI consortium is composed by the institutions signing the ET consortium agreement (CA)
  - Very light CA at this level
  - 41 Institutions signed the ET consortium
  - The ET consortium is coordinated by INFN and Nikhef (Stan Bentvelsen, Antonio Zoccoli)



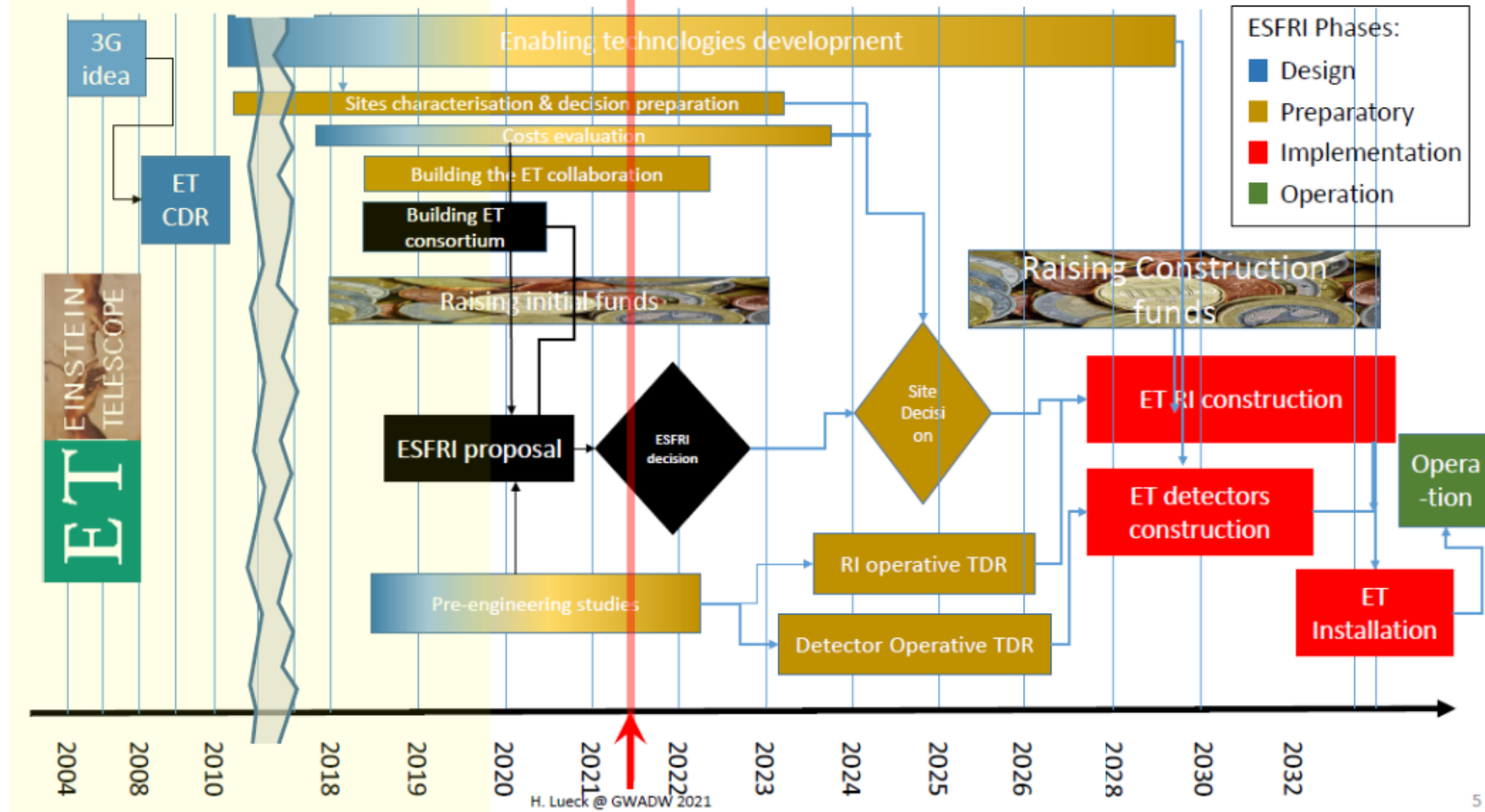
From LKV Sept2020, modified

<https://www.google.com/maps/d/edit?mid=1ljTBCqTyCmVncbYaeUVpGABudceyg2b&usp=sharing>

# Einstein Telescope-IT @ LNF



Slide: Michele Punturo



H. Lueck @ GWADW 2021

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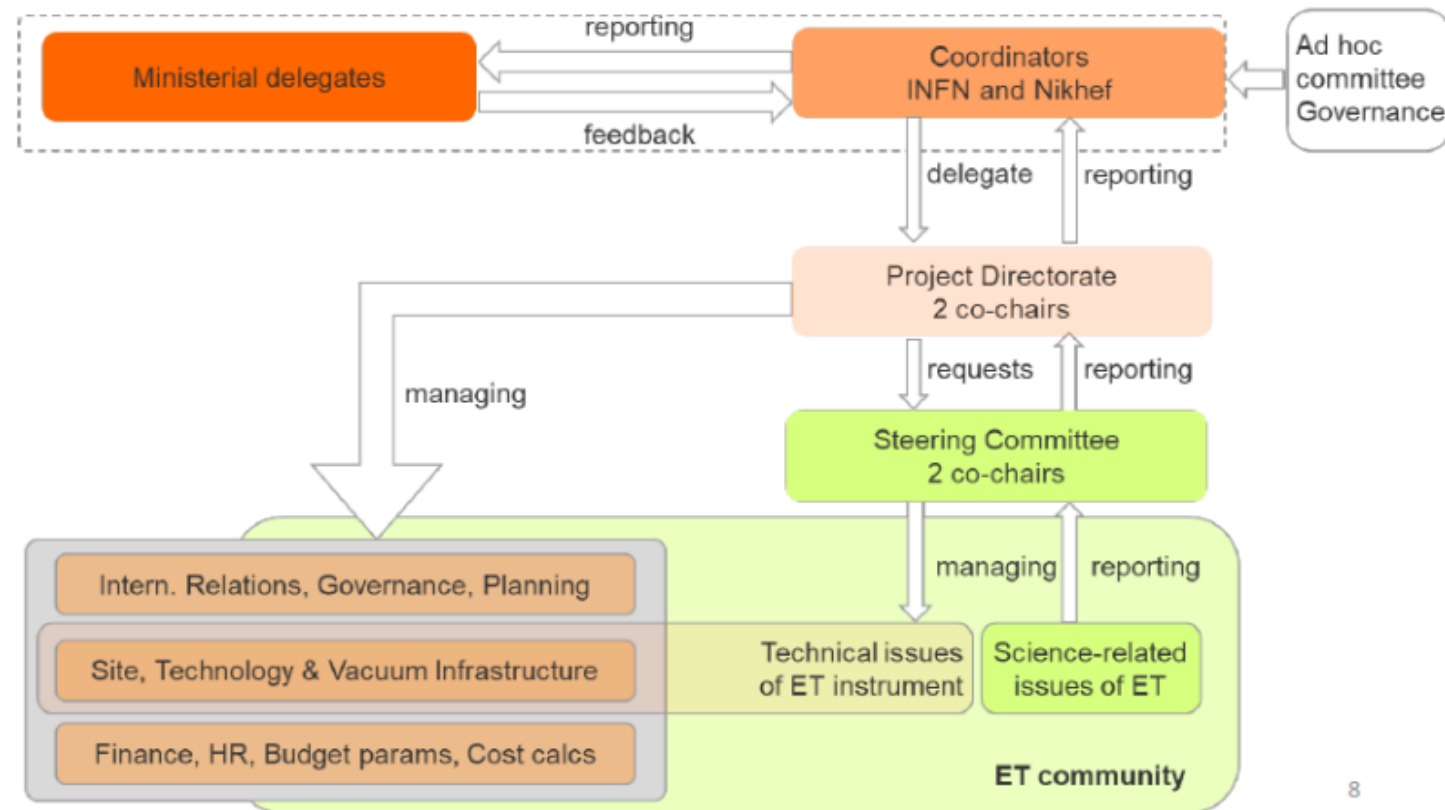


ESFRI

## Towards a governance in the Preparation phase



Structure implemented by agencies: an interim structure for the ET project organization until establishment of a Council



# Einstein Telescope-IT @ LNF

ESFRI

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## ESFRI announces new RIs for Roadmap 2021



30.06.2021

### PRESS RELEASE

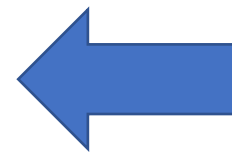
ESFRI announces the 11 new Research Infrastructures to be included in its Roadmap 2021

€4.1 billion investment in excellent science contributing to address European challenges

After two years of hard work, following a thorough evaluation and selection procedure, ESFRI proudly announces the **11 proposals** that have been scored high for their science case and maturity for implementation and will be included as new Projects in the **ESFRI 2021 Roadmap Update**.

The new ESFRI Projects are:

- **EBRAINS** - European Brain ReseArch INfrastructureS, a distributed digital infrastructure at the interface of neuroscience, computing and technology, offering scientists and developers advanced tools and services for brain research.
- **EIRENE RI** - Research Infrastructure for EnvIRonmental Exposure assessment in Europe, the first EU infrastructure on human exposome (environmental determinants of health).
- **ET** - Einstein Telescope, the first and most advanced third-generation gravitational-wave observatory, with unprecedented sensitivity that will put Europe at the forefront of the Gravitation Waves research.
- **EuPRAXIA** - European Plasma Research Accelerator with Excellence in Applications, a distributed, compact and innovative accelerator facility based on plasma technology, set to construct an electron-beam-driven plasma accelerator in the metropolitan area of Rome, followed by a laser-driven



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## LNF tasks: Vacuum

- **Outgassing** surface treatment studies; inner surface treatments.
- **Bake-out** Needs of In situ bake-out system
- **Procurement of certified materials and corrosion tests** anti-corrosion (external wall of the tube)
- **Pipe VAC projections** Overall feasibility projections

## LNF tasks: cryogenics

- **Materials and outgas** Cryostat VAC-CRYO studies: Multi layer cryo super-insulation VS degassing rate. Water presence adsorption/desorption
- **LowT VAC** Cryotrap and Cryostat long pipes.
- **Cold Surfaces and coating** Thermal radiation shields, emissivity studies, radiative cooling.
- **Thermal duct** Cryostat mechanics (includes thermal duct)

# Einstein Telescope-IT @ LNF

Part of this research activity is part of a call, just presented to gr. V (National responsible: Ettore Majorana – Rome 1)



Independently from the outcome of this call, ET- Italia needs some of the foreseen activities to be started anyway, being crucial for the R&D of the project.

We wish to enter in ET-Italia starting with the following activities:

- **Emissivity study & test of cryostat thermal shields and UHV vacuum pipes (G. Delle Monache)**
- **Outgassing/absorption study & test of SS inner surfaces (A. Liedl)**
- **Cryogenic Vacuum issues: detrimental frost formation on the optics (L. Spallino & M. Angelucci)**
- **Electrostatic charging mitigation (L. Spallino & M. Angelucci)**

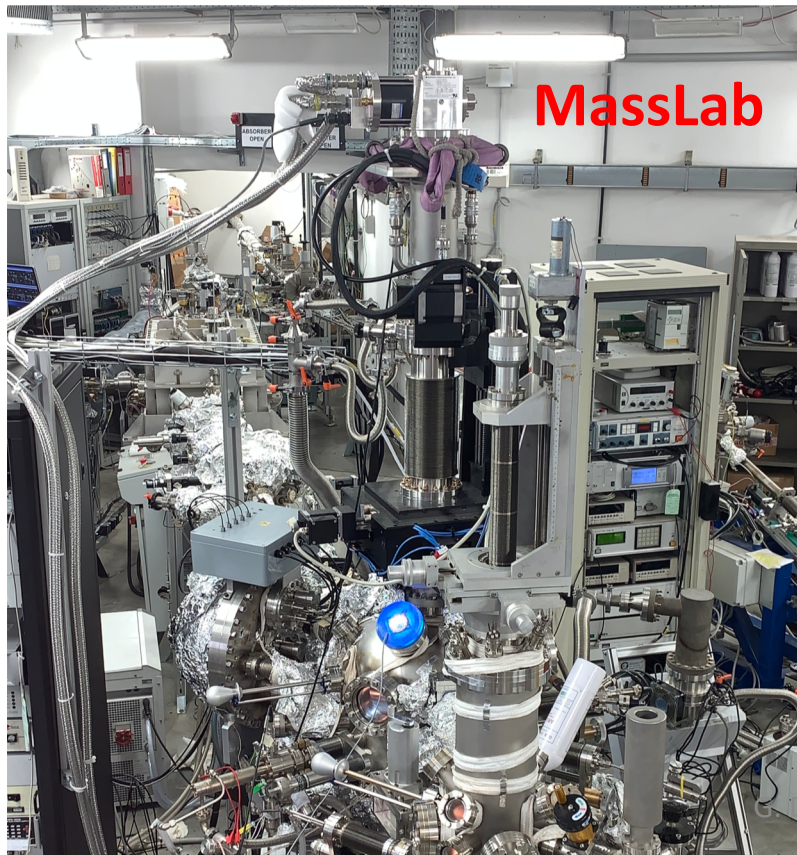
## Will grant visibility to LNF



# Cryogenic Vacuum Issues

Mirror Temperature will define tower operating pressure since, **at cryogenic temperature, residual gas will cryosorb on the mirror surface inducing detrimental effects on the optical properties**

**An active mitigation method is mandatory to remove the unavoidable frost formation on the optics**



# Electrostatic charging



Both VIRGO and LIGO optics undergo to **inhomogeneous electrostatic charging that may induce unwanted noise**

**The existing mitigation method cannot be applicable at cryogenic temperature since microns of N<sub>2</sub> will cryosorb on the surface**

At MassLab there two “state of the art” UHV set-ups equipped with cryogenic manipulators for hosting small samples (10x10mm<sup>2</sup>) at <20 K, electron guns, XPS, SEY, QMS and other spectroscopies to perform:

Surface studies of mirrors materials at RT and LT before and after cryosorption of gases and electrostatic charging.

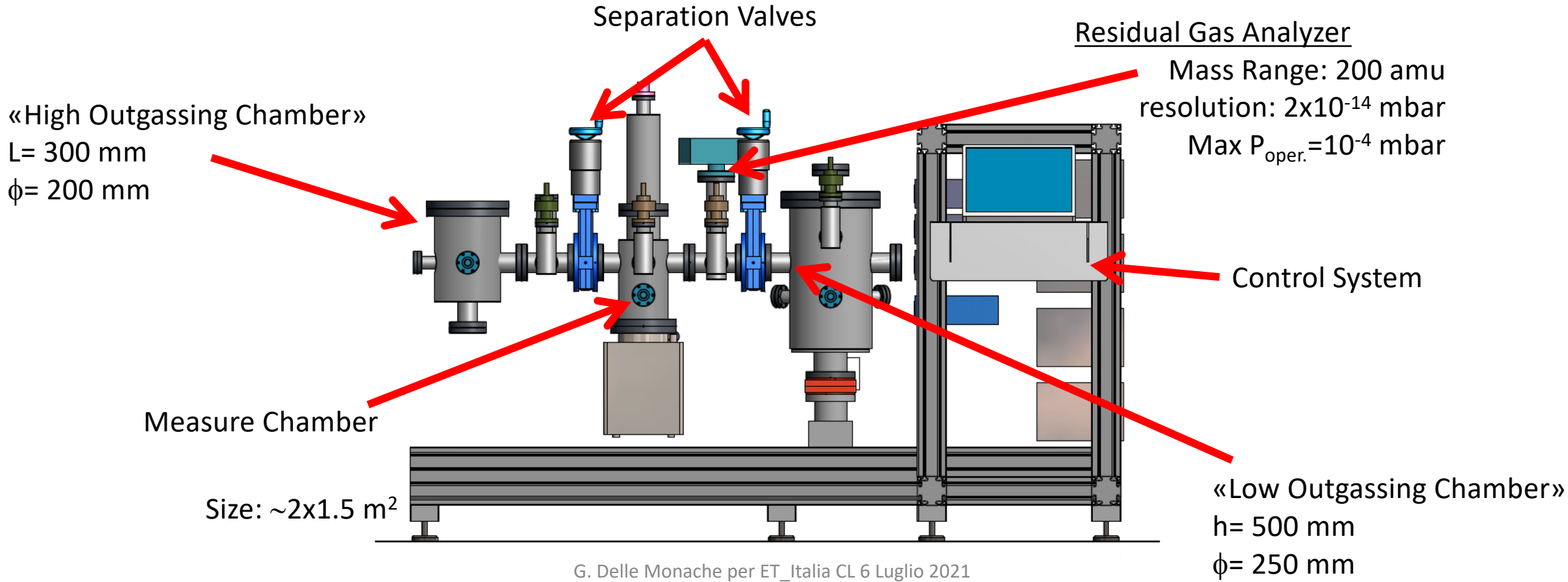
# Outgassing rate Measurement

Characterization of the Outgassing rate is a step mandatory part for the R&D of the vacuum chamber's inner surfaces. A system able to measure outgassing, in terms of rate and emitted gases, is needed.



The R&D studies include not only the material choice but also the effects of heat treatments and thin film coatings.

## LATINO «OUTGASSING RATE SYSTEM» AT LNF-INFN



G. Delle Monache per ET\_Italia CL 6 Luglio 2021

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Marco Angelucci	30
Simone Bini	10
Roberto Cimino	40
Fara Cioeta	10
<u>Giovanni Delle Monache *</u>	<u>40</u>
Andrea Liedl	30
Lucia Sabbatini	10
Luisa Spallino	40

**Total FTE ~ 2**

**down to 1 on GR. V call approved (dotazioni)**

## Requests

6 k€ missions

Collaboration meetings

40 k€ consumable

Instrumentation for vacuum and cryogenic tests

2 mu electronic serv.

Cabling

2 mu cryogenic serv.

LN2 external connection for “handy” cryostat