



**From CMS hybrid circuits
to inflation theory:
“Più donne nella fisica”
2024**

**+ donne
nella fisica**

16th december 2024

Martina La Rosa



- It is possible to apply if enrolled in a master's program in one of the following fields:

CSN1 Subnuclear Physics,

CSN2 Astroparticle Physics,

CSN3 Nuclear Physics,

CSN4 Theoretical Physics,

CSN5 Technological Research and Accelerator Physics.

What is it about?

- **women's role in physics**

It's a project aimed at promoting and **supporting women** in the study of Physics, with the main goal of increasing women's participation in research.

- **only 25 award-winning women**

It consists in a competition declared by INFN for the awarding of **25 scholarships** for female students enrolled in a Master's Degree Program in Physics or Science of the Universe.



- It is possible to apply if enrolled in a master's program in one of the following fields:

CSN1 Subnuclear Physics,

CSN2 Astroparticle Physics,

CSN3 Nuclear Physics,

CSN4 Theoretical Physics,

CSN5 Technological Research and Accelerator Physics.

What is it about?

- Winning students obtain a **scholarship** and benefit from a **tutor** (an INFN researcher or associate) who will guide them through their studies.
- The contest is announced annually. To be eligible to participate, **academic prerequisites** must be met.

+donne nella fisica

- The **award ceremony** for the year 2024 was held on the 24th of October at Sapienza University, Rome.



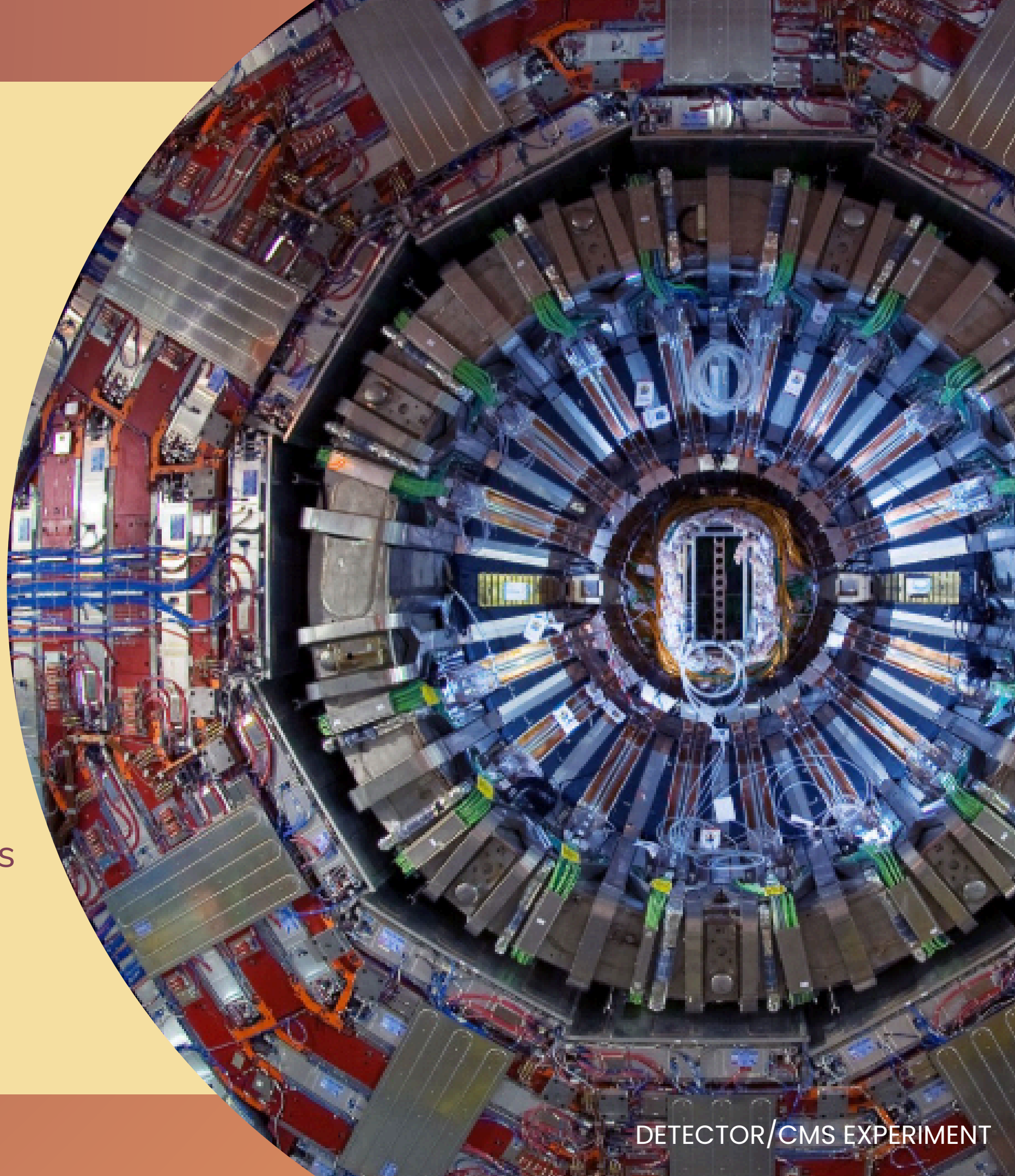
[HTTPS://HOME.INFN.IT/](https://home.infn.it/)

- The winning students were officially awarded and had the opportunity to present themselves and talk about their future plans.



“Testing of the new front-end hybrid circuits for the phase-2 upgrade of the CMS Tracker”

OBJECTIVE: to verify the functionality of the electronics that will be used during the **CSM Phase 2 Upgrade**, by testing the modules before they are assembled.



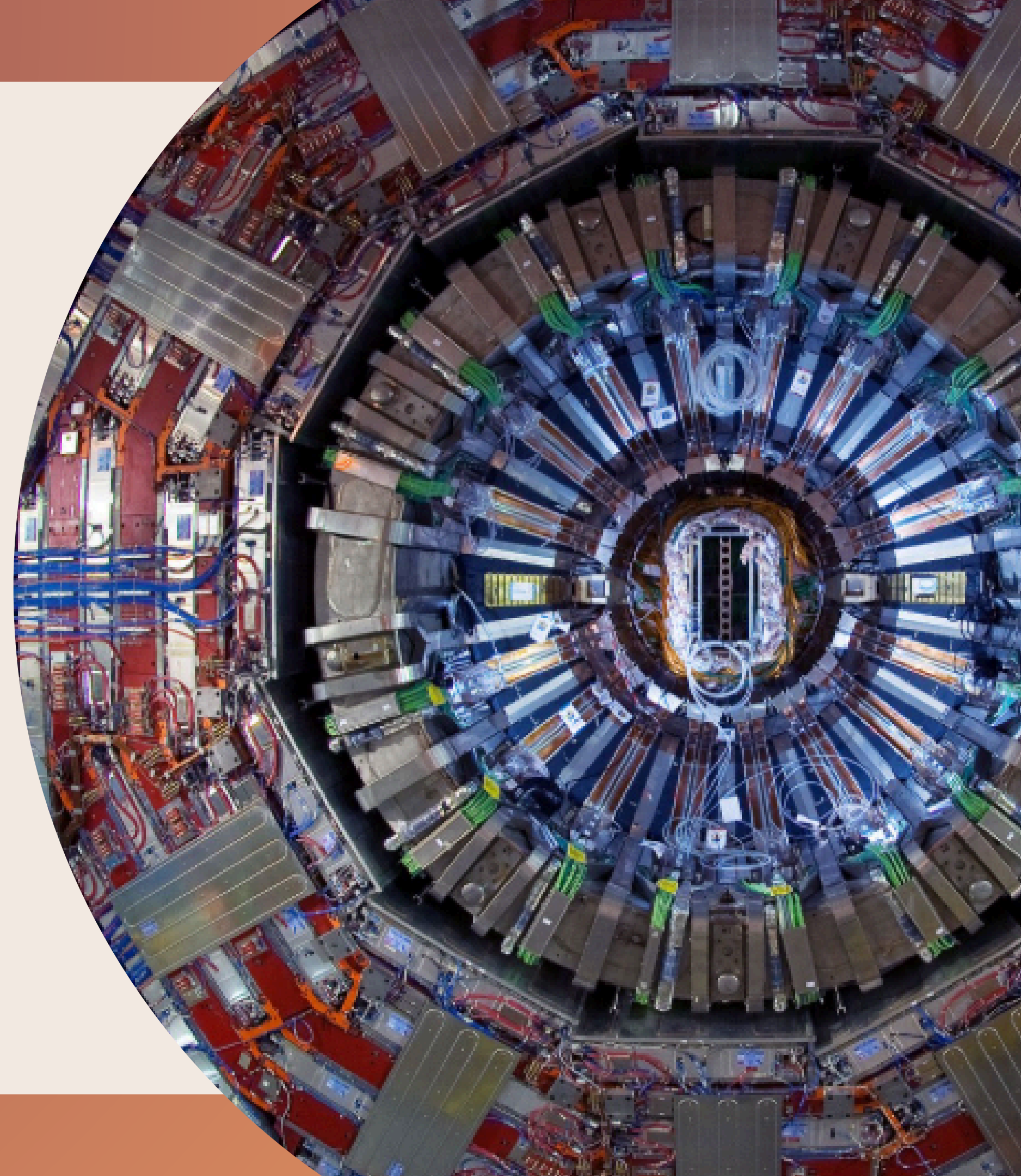
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LHC



Long
Shutdown 3

High Luminosity
LHC



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LHC

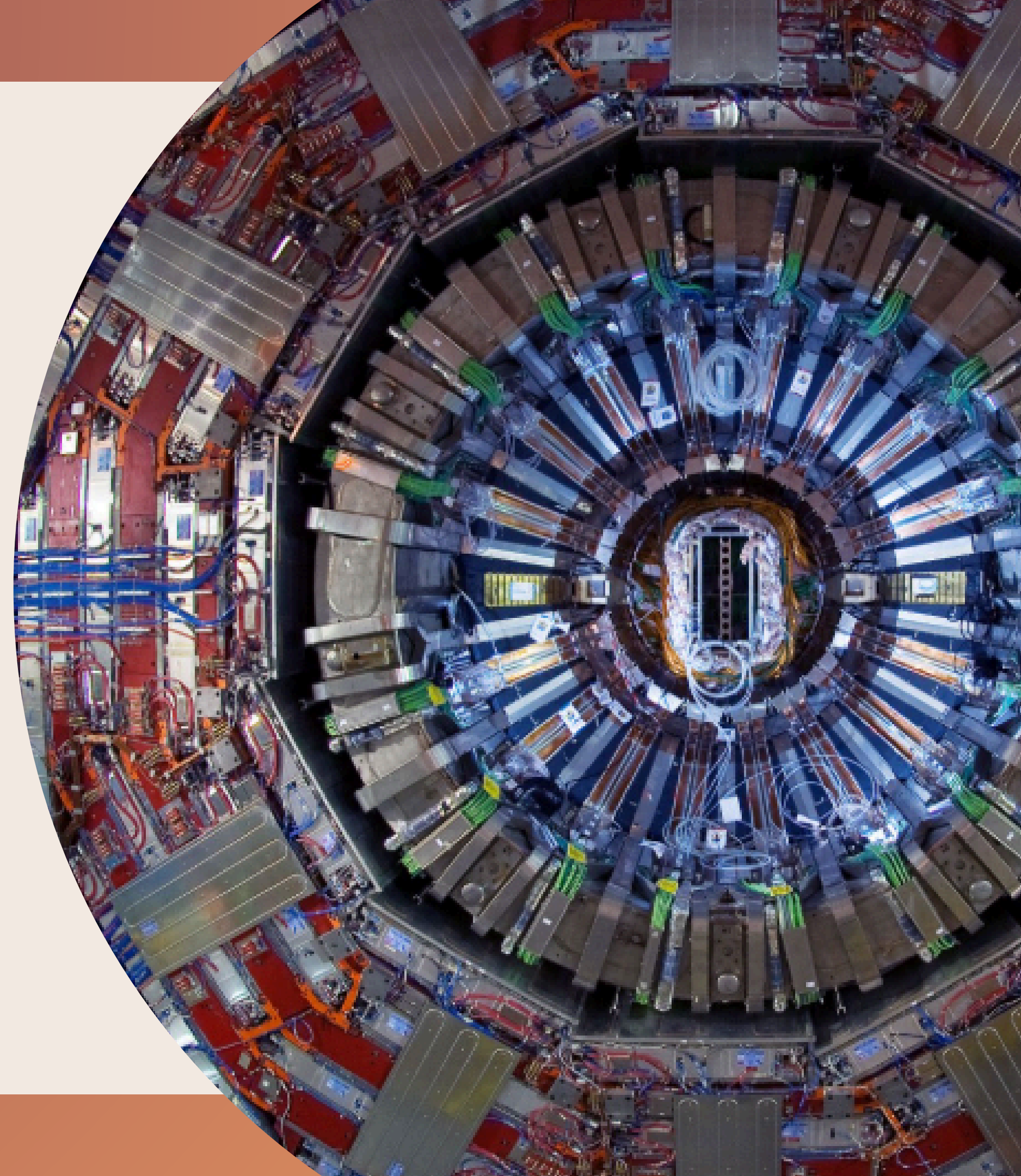


Long
Shutdown 3

**High Luminosity
LHC**

Improvements in:

- Structure design
- Detection devices
- Electronic components



“Testing of the new front-end hybrid circuits for the phase-2 upgrade of the CMS Tracker”

CMS



CMS Phase 2 Upgrade

THE TRACKER HAS BEEN REDESIGNED TO MEET THE NEW REQUIREMENTS AND TO SUCCESSFULLY ACHIEVE THE FOLLOWING OBJECTIVES:

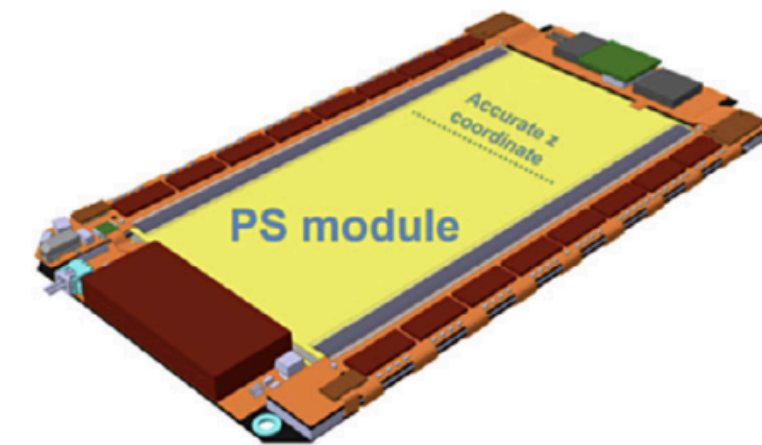
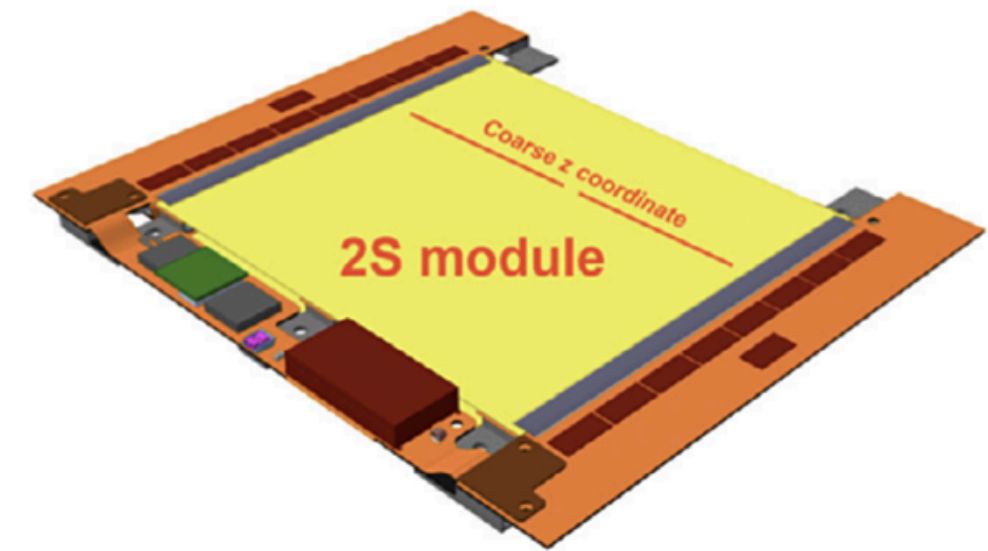
- Increased granularity
- Higher radiation tolerance
- Material budget reduction
- Increased hermeticity

2S and PS modules

The Outer Tracker will be composed of **pT modules**, meant for the measurement of the **transverse momentum** of particles.

The pT modules are divided into two categories: **2S** and **PS**.

Both modules consist of two silicon sensors spaced a few millimeters apart.

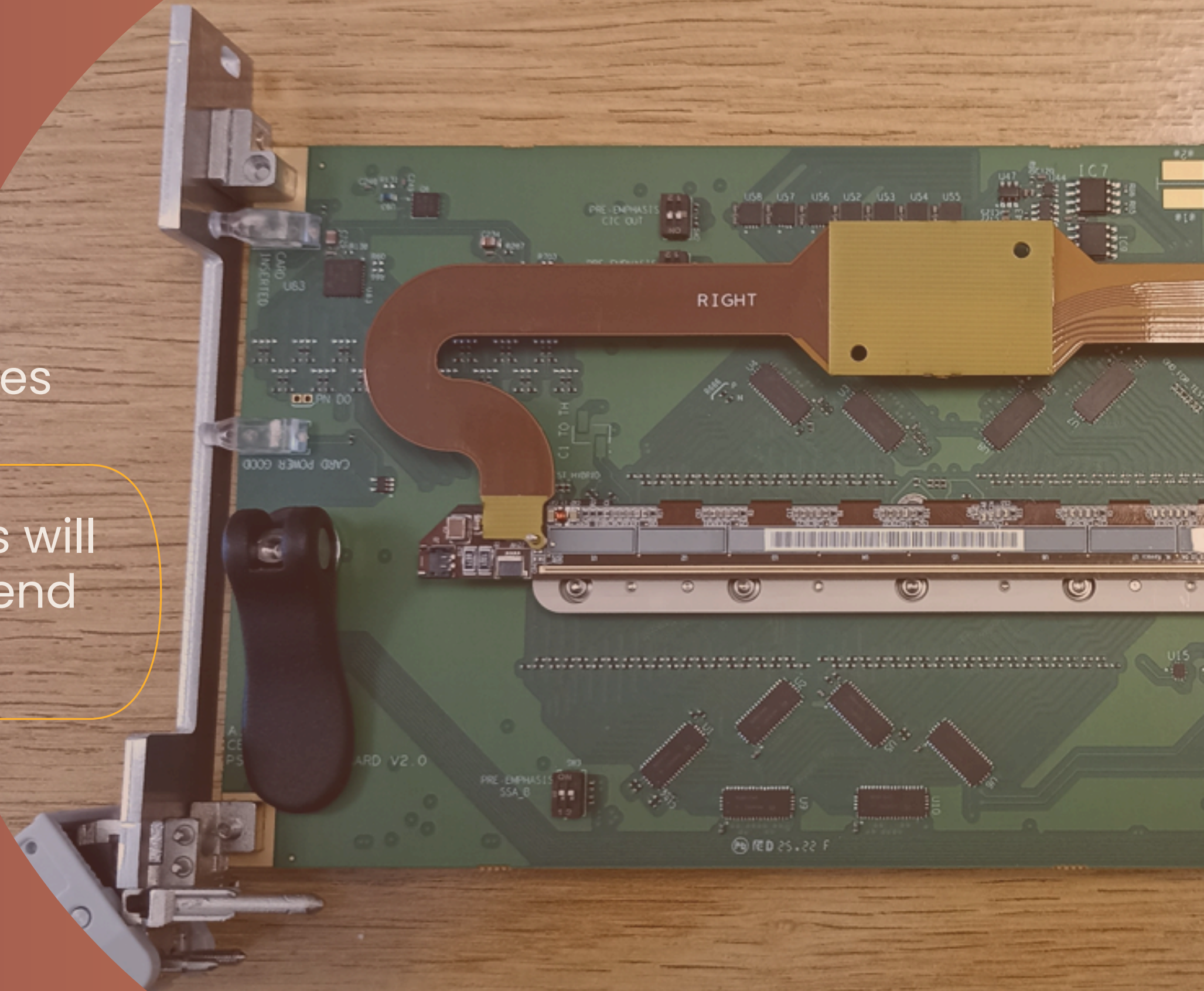


CMS collaboration, Nuclear Instruments and Methods in Physics Research

PS-FEH

front-end hybrids of the PS modules

For the Outer Tracker, 14.000 modules will be used, which means 28.000 front-end hybrid circuits



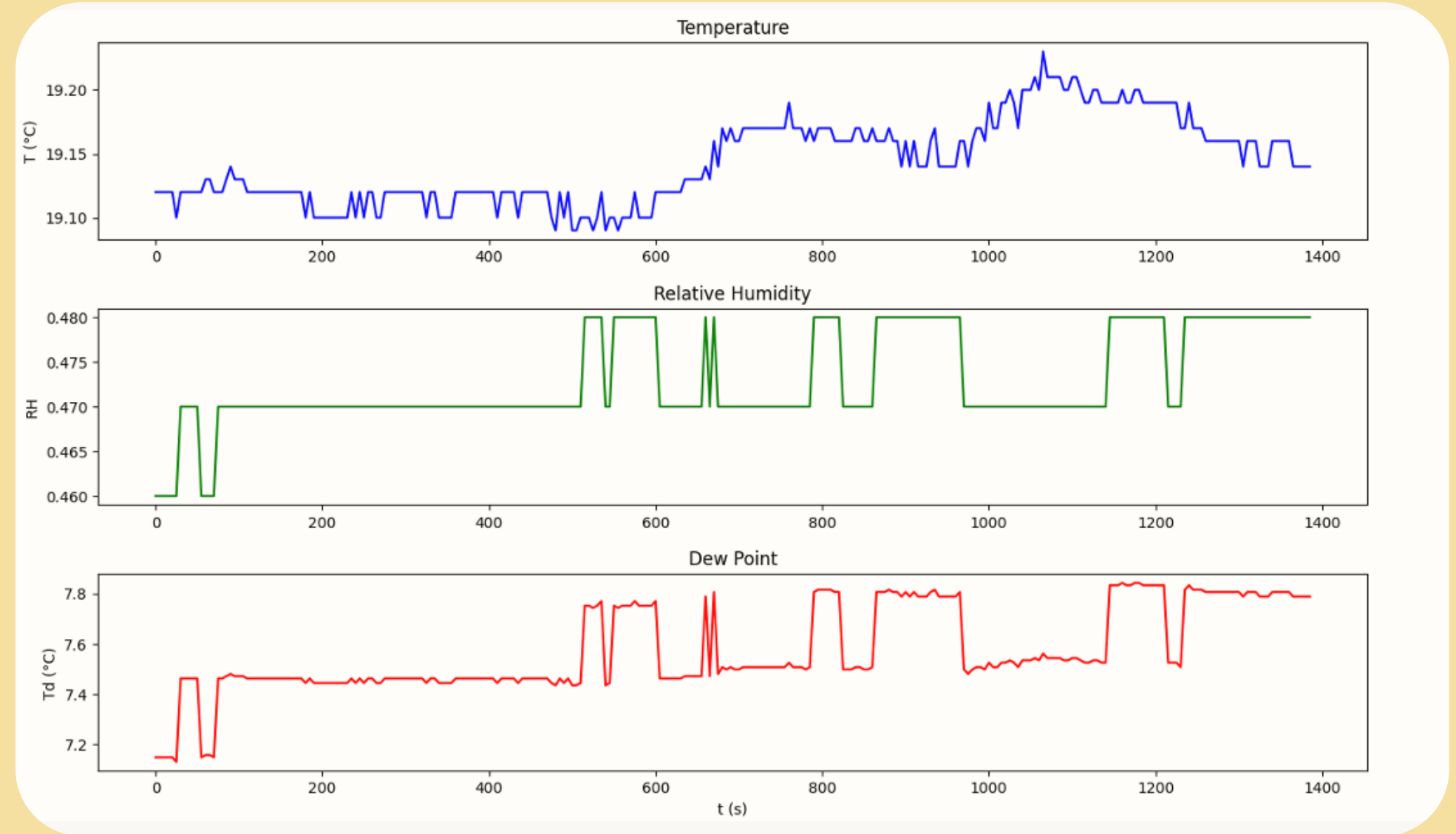
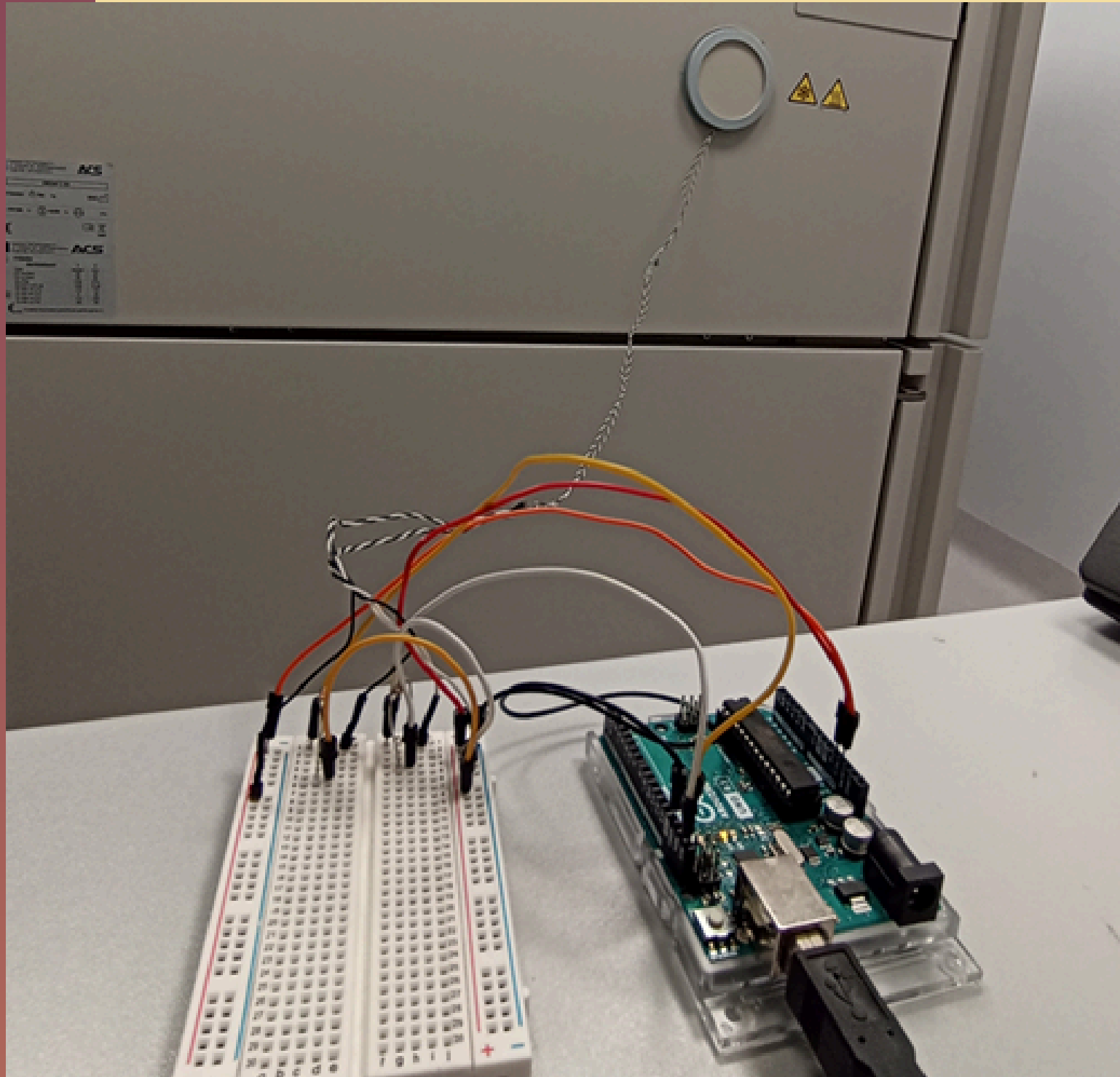


PS-FEH FUNCTIONAL TESTING

Three institutes involved located in:

1. Budapest
2. Genoa
3. Catania

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- Functional tests on a total of about **9.000 circuits** at the University of Catania.



PS-FEH FUNCTIONAL TESTING

- Temperature
- Relative humidity
- Dew point

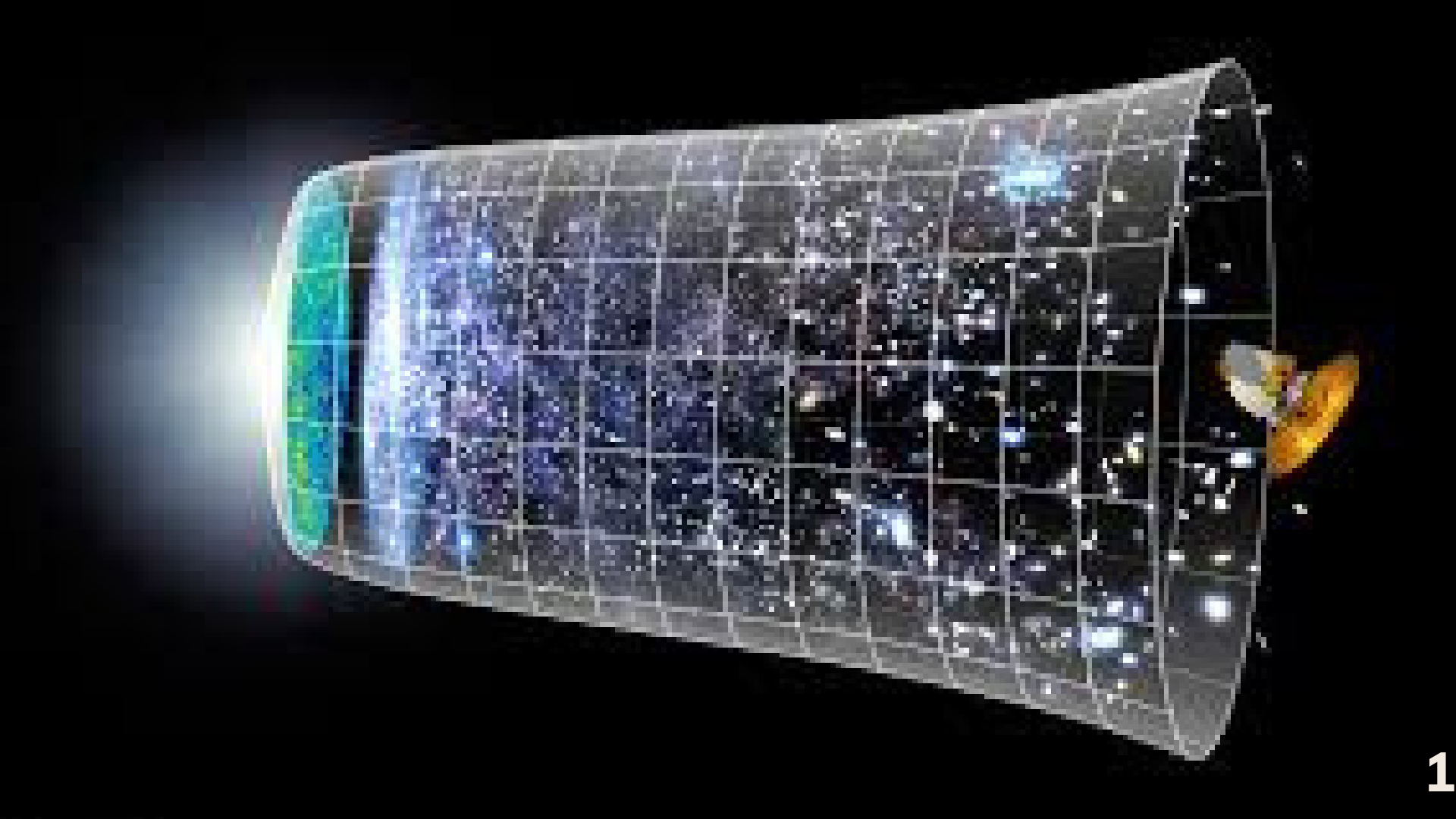


**From an experimental
thesis...**



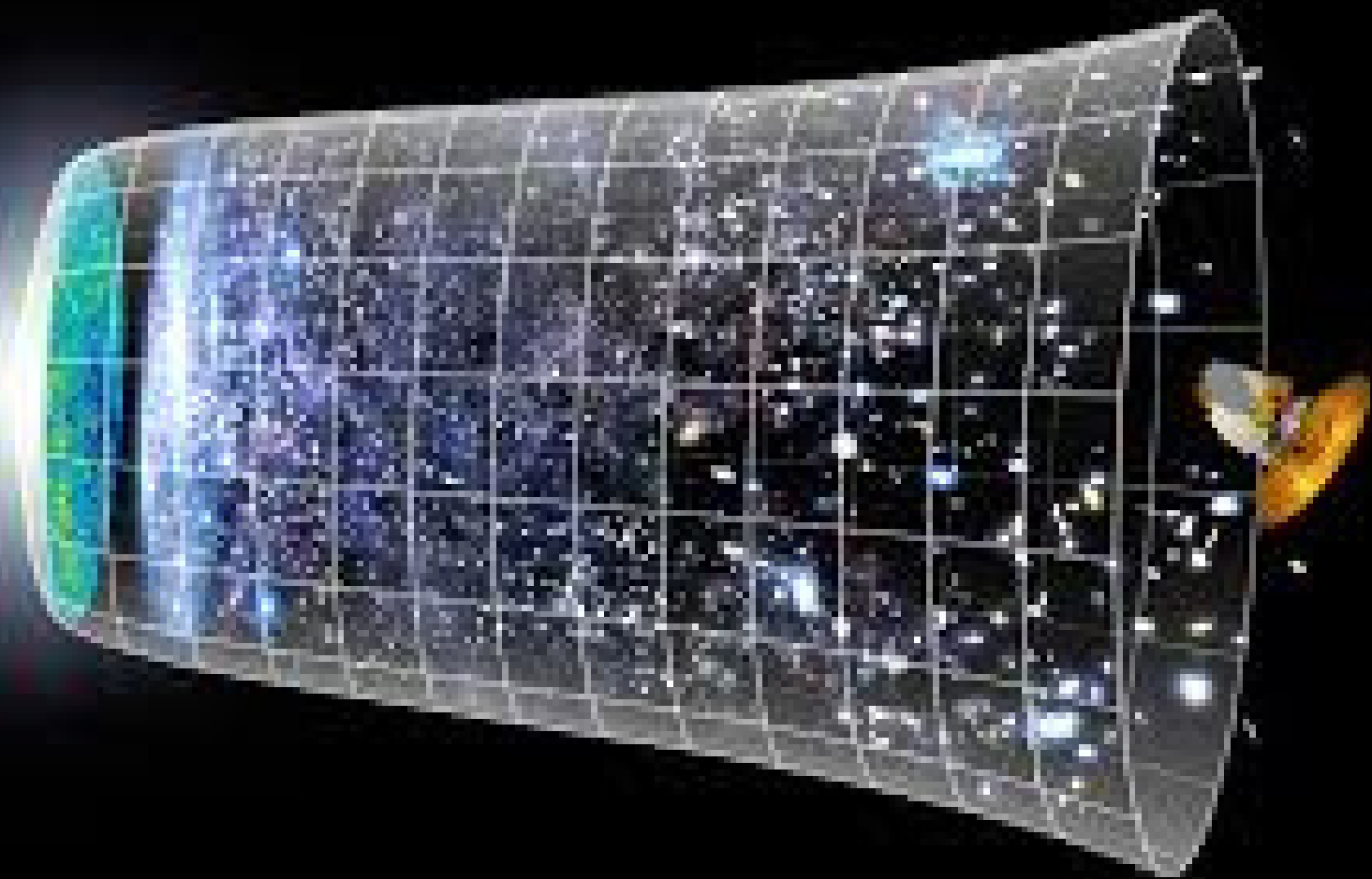
...to a theoretical one

Early Universe



Early Universe

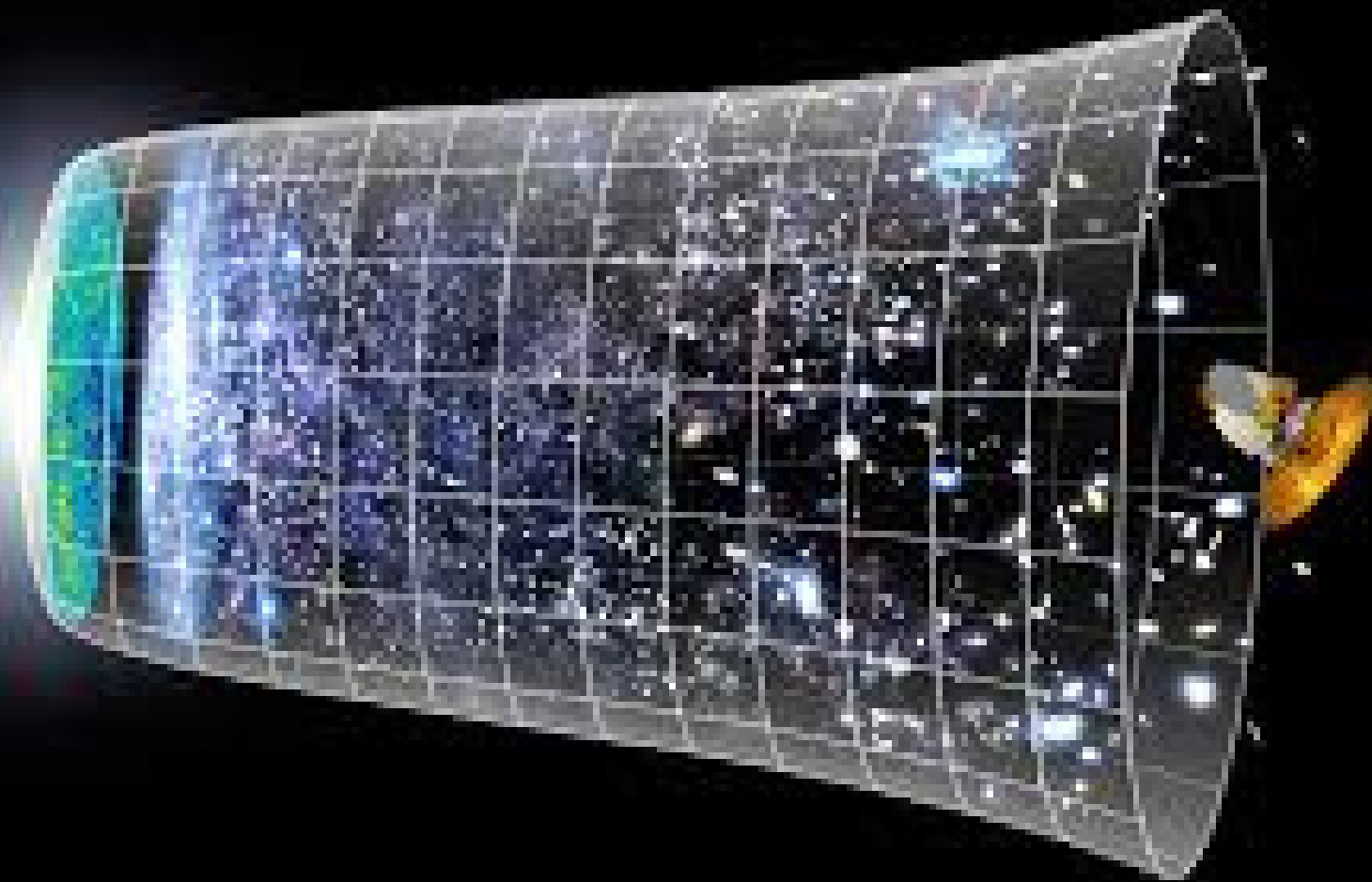
Cosmological Inflation



Early Universe

Cosmological Inflation

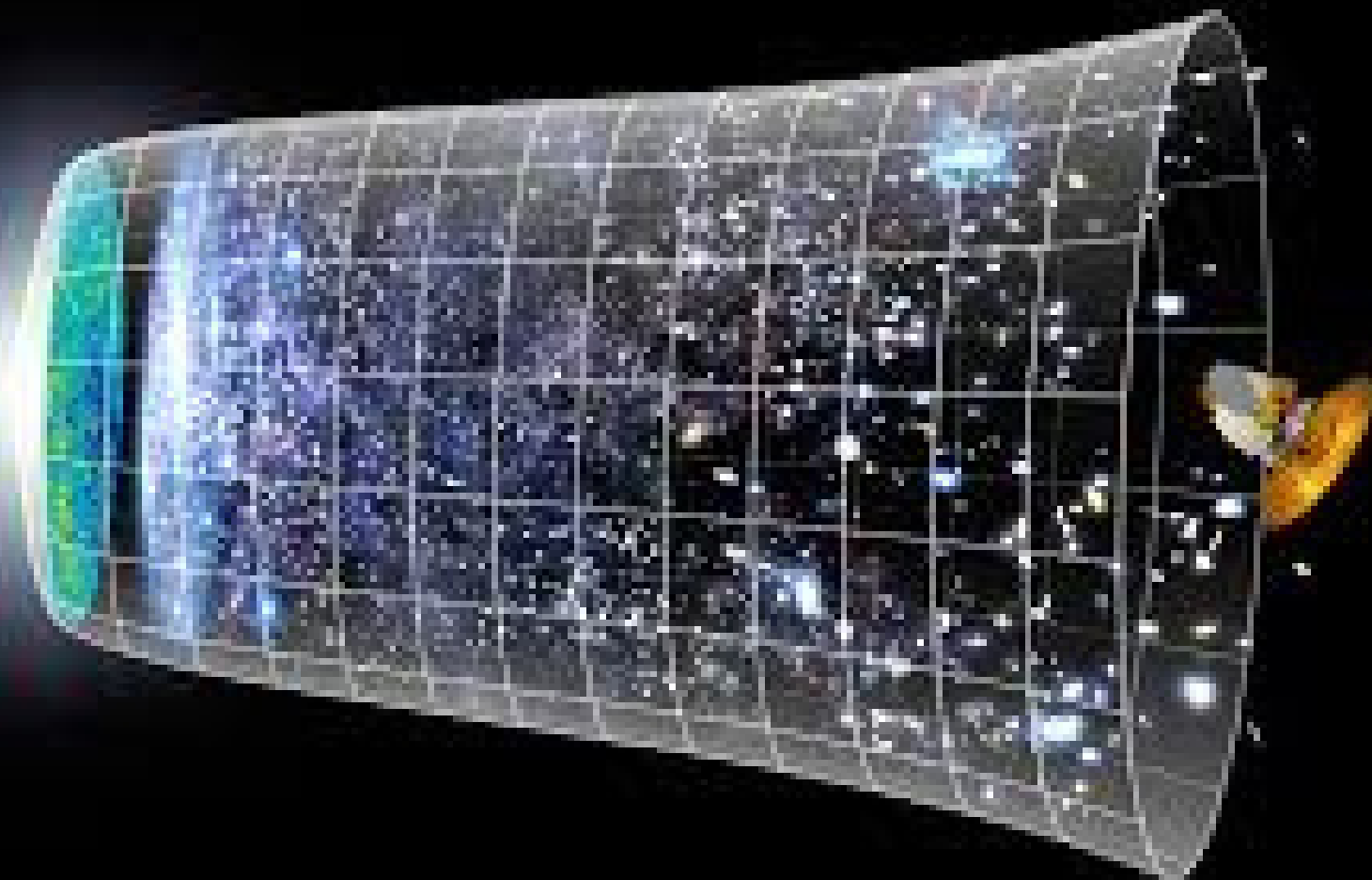
Primordial
Gravitational Waves



Early Universe

Cosmological Inflation

Primordial
Gravitational Waves



- **primordial black holes or dark matter models associated with inflationary isocurvature fluctuations;**
- **cosmological perturbations;**
- **detectability prospects of gravitational waves generated by early universe phenomena.**

**Thank you
for your
attention**



Martina La Rosa
Bologna, 16/12/2024