



Welcome address  
to the participants to the  
LHCOPN-LHCONE meeting in Rome (Italy)

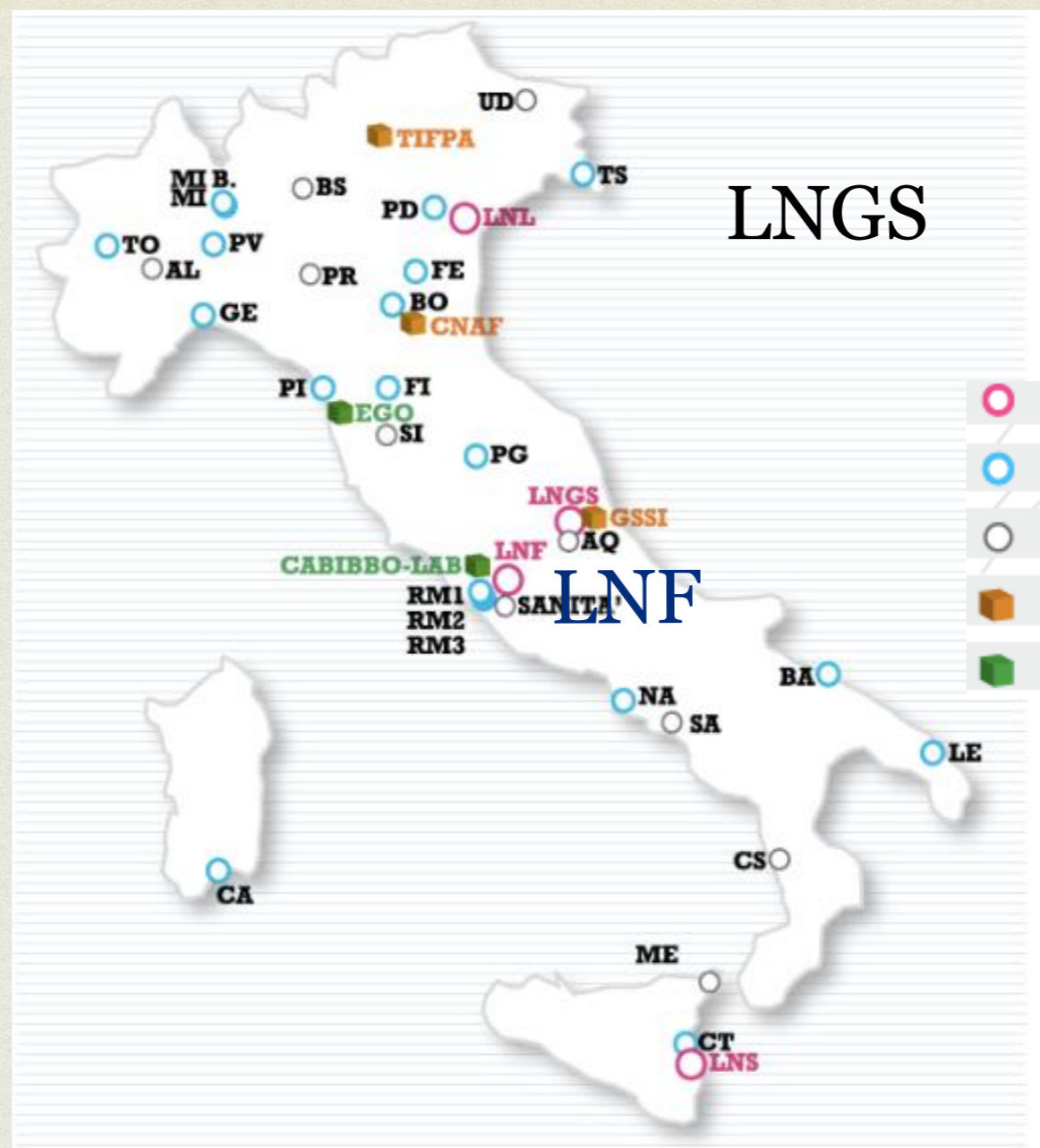
Speranza Falciano

INFN Executive Board

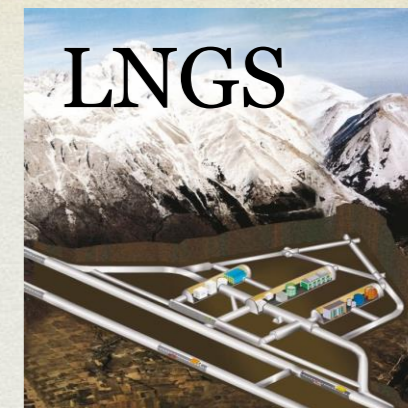
# INFN GEOGRAPHICALLY



LNL



	laboratories	4
	divisions	20
	associated groups	10
	national centres	3
	consortia	2



LNGS



LNS

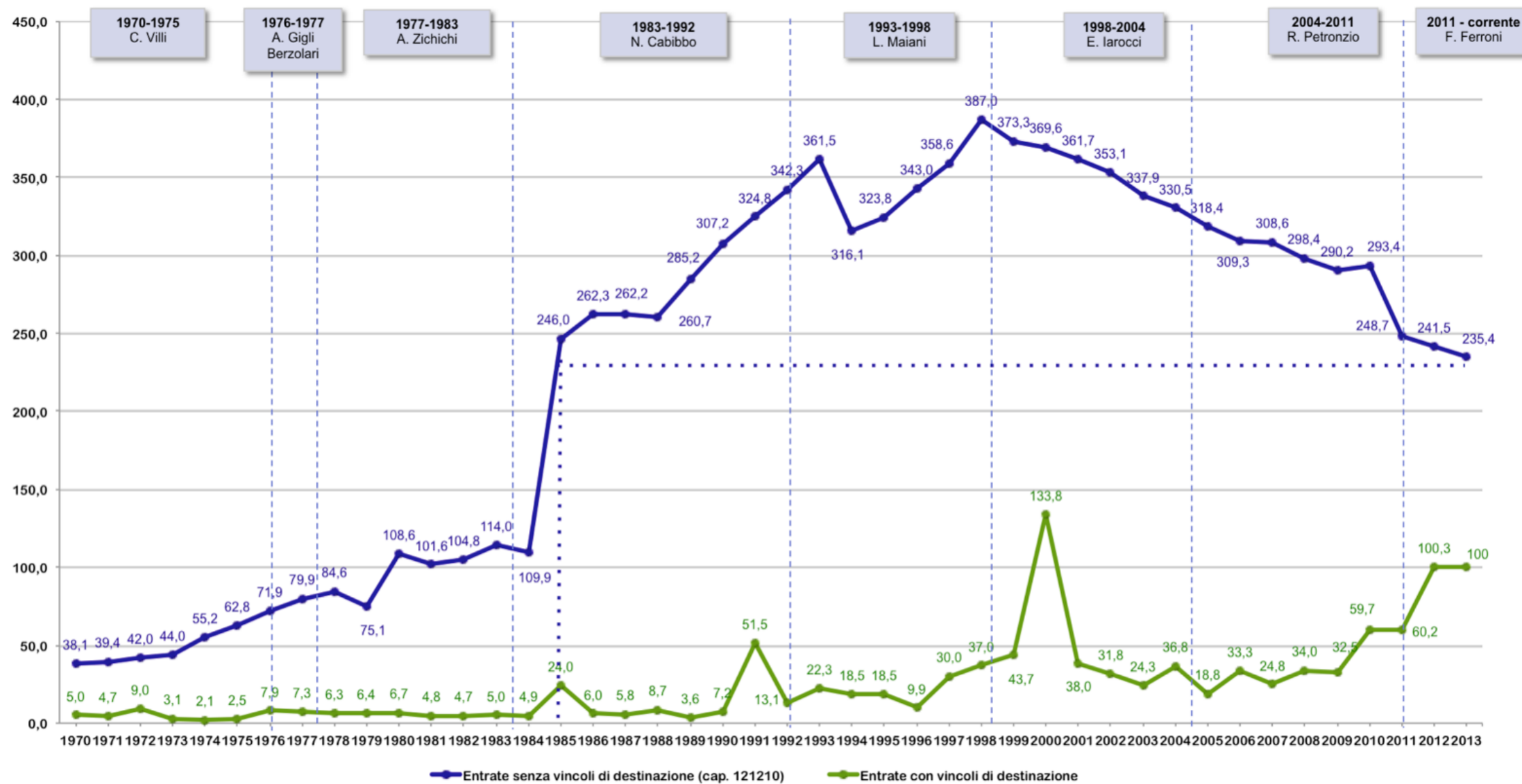


LNF

# INFN FINANCIALLY

**Serie storica delle Entrate secondo il vincolo di destinazione  
a prezzi costanti 2012 (milioni di euro)**

Fonte: Bilanci Consuntivi; per il 2013 Bilancio di Previsione



# INFN HUMANLY

DG  
 Researcher  
 Engineers  
 Tech  
 Administration  
 Post-Doc

Researcher (f.t.)  
 Engineers  
 Researcher (p.t.)  
 Ph. D. Post-Doc

Researcher (p.t.)  
 from other Inst.

Senior (still active)

Senior (emeritus)

Foreigner Inst.

Others

## INFN

- 1 Dirigente
- 610 Ricercatori
- 230 Tecnologi
- 692 Tecnici
- 301 Amministrativi
- 197 Associati Borsisti, Assegnisti

## UNIVERSITÀ

- 843 Associazioni con incarico di ricerca
- 109 Associazioni con incarico di collaborazione tecnica
- 651 Associazioni scientifiche/tecnologiche/tecniche
- 1280 Laureandi, Dottorandi, Borsisti, Assegnisti

## ALTRI ENTI

- 158 Associazioni scientifiche/tecnologiche/tecniche

## SENIOR

- 217 Associazioni scientifiche/tecnologiche/tecniche

## ATTRIBUITI DAL PRESIDENTE

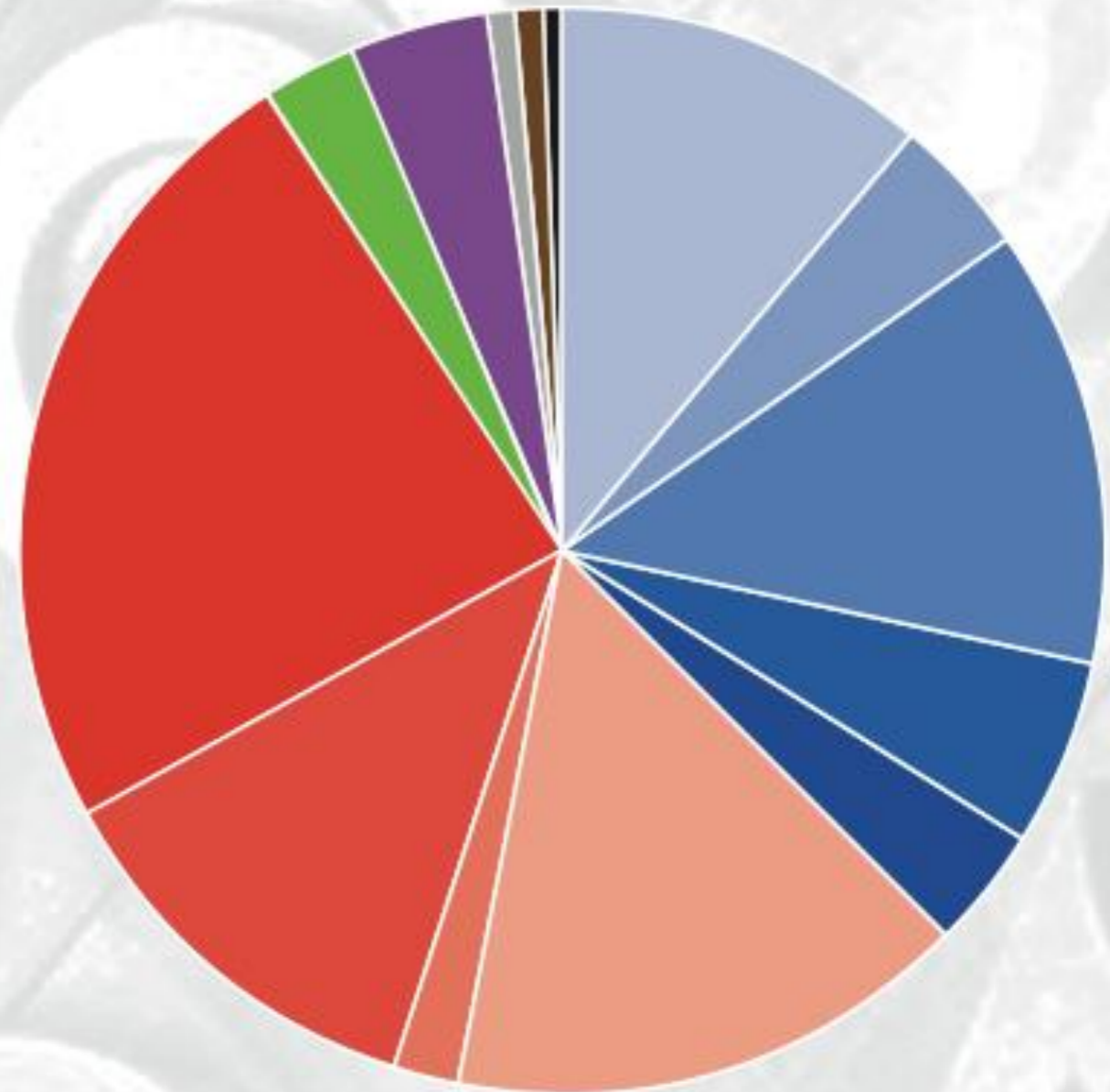
- 56 Incarichi di ricerca e associazioni scientifiche

## STRANIERI

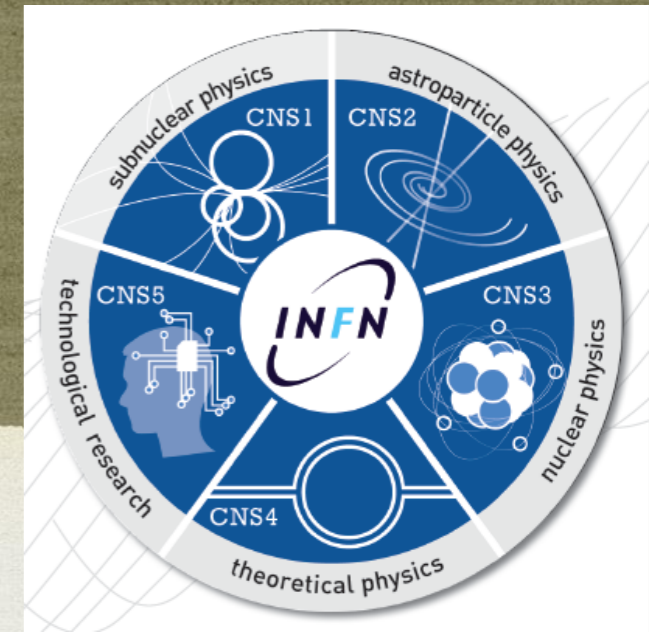
- 41 Associazioni

## ALTRE ASSOCIAZIONI

- 23 Associazioni scientifiche/tecnologiche E.P. e contratti art. 19



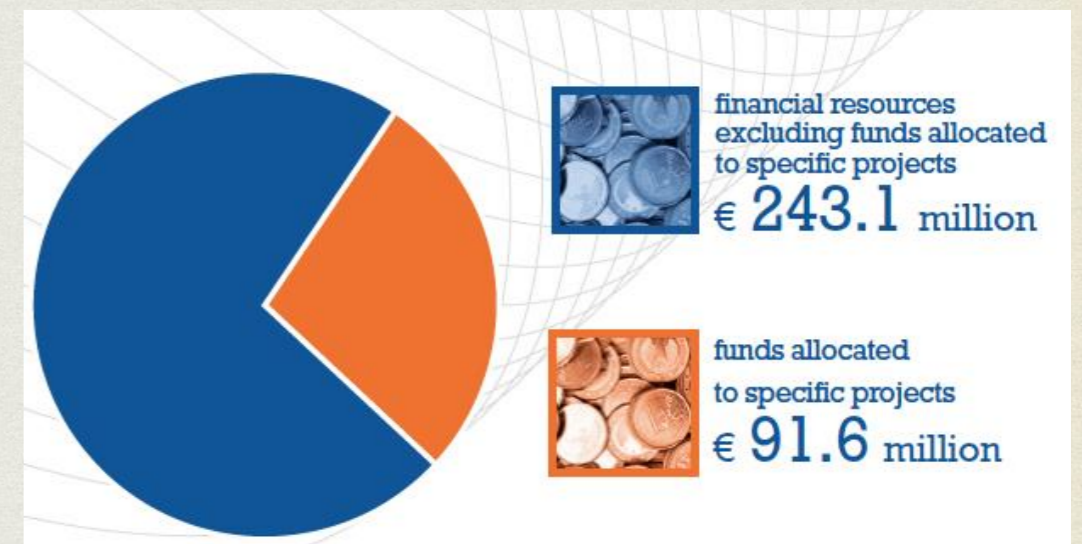
# THE LINES OF RESEARCH



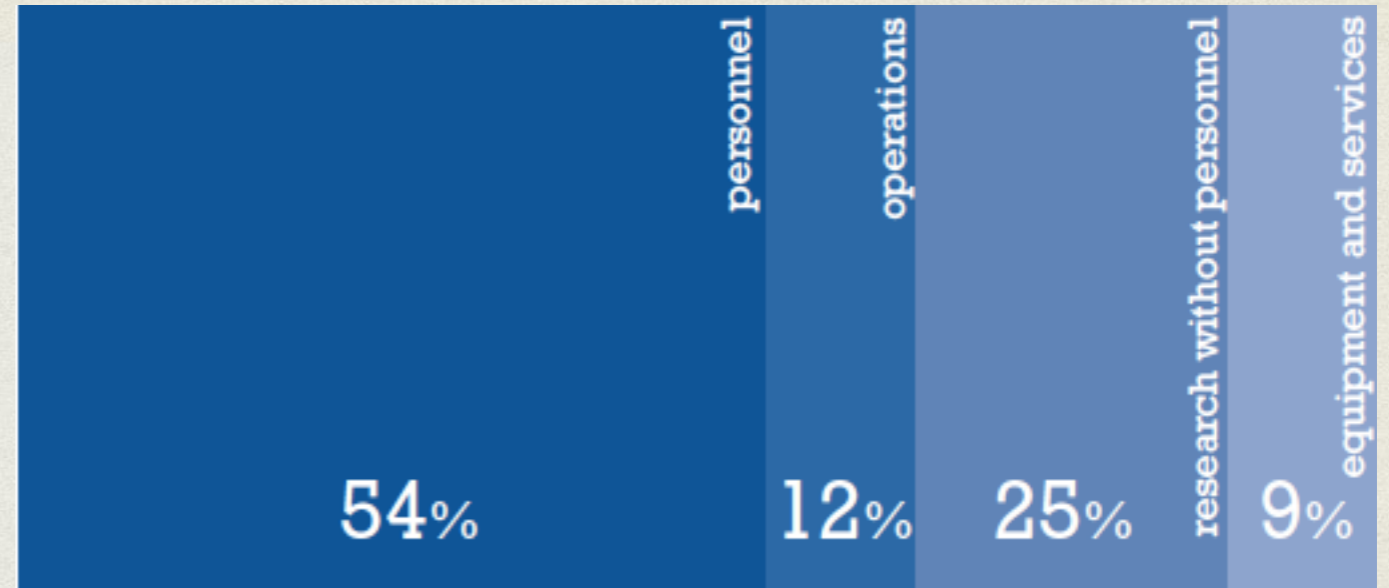
- Particle Physics (with accelerators)
- Astroparticle Physics (includes all  $\nu$  )
- Nuclear Physics (includes ALICE)
- Theoretical Physics
- Research & Development (+Accelerators)

# INFN BUDGET

- It is composed by few different pieces
- Its total is above 300 MEuro
- The 'unlabeled' part is about 240 MEuro
- Then there are 'premium projects', special projects, external funds.....in variable proportions



# 4 LINES OF BUDGET



- Salaries : 135 ME
- Research direct costs : 50 ME
- Infrastructures & operations: 60 ME
- ‘Other’ projects (this money does not commute with anything else)

# BUDGET: DIRECT COSTS OF RESEARCH

- CSN<sub>1</sub> 20 MEuro
- CSN<sub>2</sub> 14 MEuro
- CSN<sub>3</sub> 10 MEuro
- CSN<sub>4</sub> 1.5 MEuro
- CSN<sub>5</sub> 5 MEuro
- this is our core business: travels, consumables, investment
- does not include electric power, lab services, personnel



# THE SPECIAL PROJECTS

- IFMIF for ITER
- XFEL (Germany)
- Extreme Light Infrastructure EuroFEL (East Europe)
- European Spallation Source (Sweden)
- **Gran Sasso** Science Institute

# LHC

We participate in all LHC experiments, about 800 FTE's. Very important responsibilities.

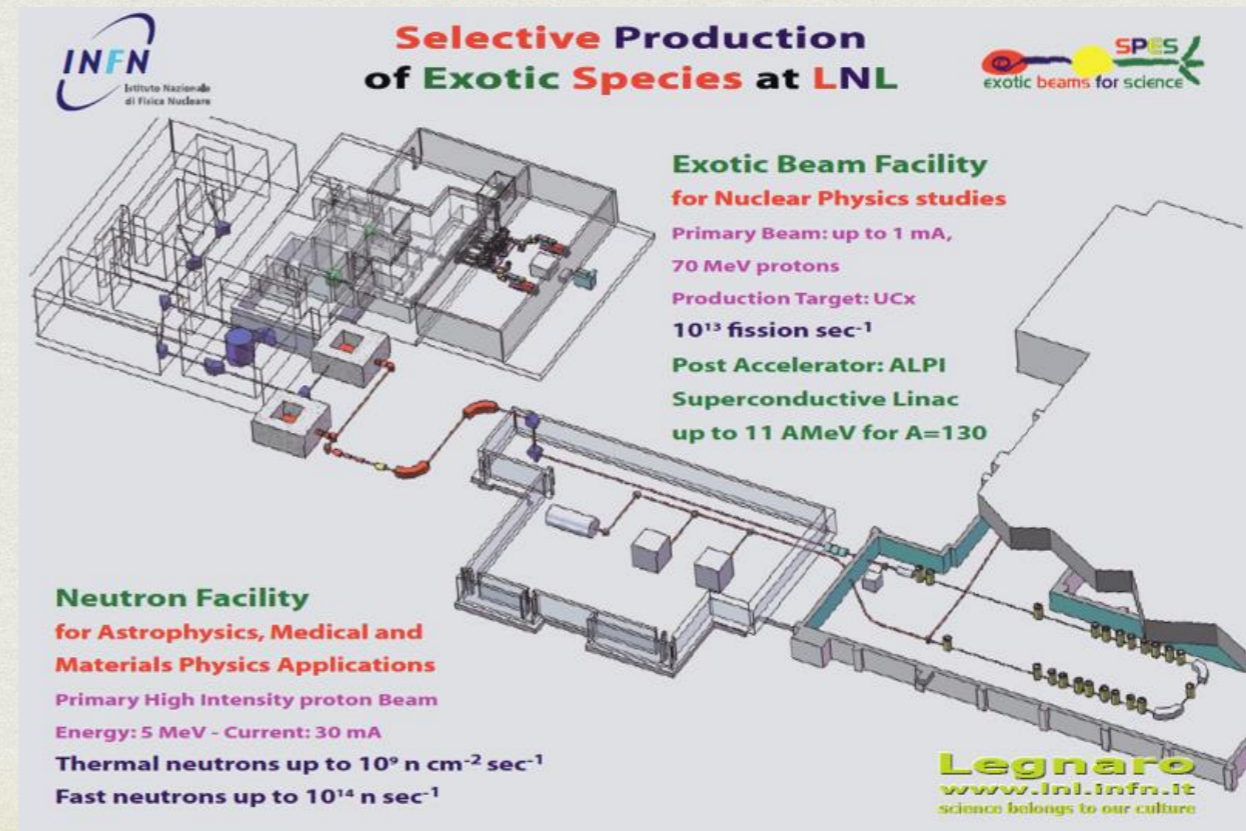
# LNL



# LNL

1. Radioactive Ion Beams are produced by proton induced fission on a UCx direct target at a rate of  $10^{13}$  fission/s.
2. Neutron rich re-accelerated beams will be available at energies up to 13 MeV/u in the mass region  $A=130$ .
3. Re-acceleration will be performed by the superconducting linear accelerator complex (PIAVE-ALPI) of the Laboratori Nazionali di Legnaro.
4. The facility for applied physics is based on proton and neutron beams from a two exit port cyclotron (70 MeV, 500 microA) and the high intensity RFQ TRASCO (5 MeV, 30 mA).

Working out an agreement with a private company for radioisotopes production

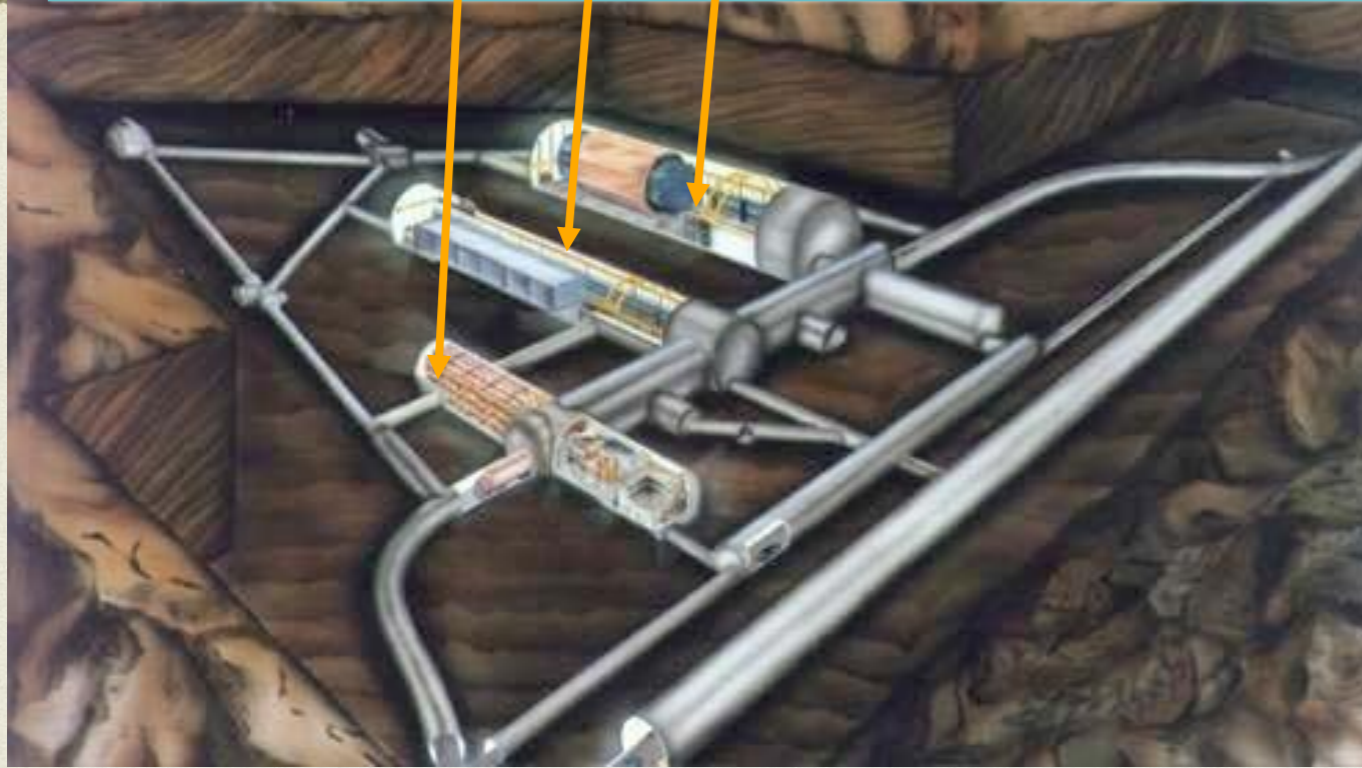


# INFN-GRAN SASSO NATIONAL LABORATORY



# GRAN SASSO LABORATORY

3 main halls A B C ~100 x 20 m<sup>2</sup> (h 20 m)



**Muon Flux**

$$3.0 \cdot 10^{-4} \mu \text{m}^{-2} \text{s}^{-1}$$

**Neutron Flux**

$$\begin{array}{l} 2.92 \cdot 10^{-6} \text{ n cm}^{-2} \text{ s}^{-1} \quad (0-1 \text{ keV}) \\ \text{Depth: } 1400 \text{ m} \quad (3800 \text{ m w.e.}) \\ 0.86 \cdot 10^{-6} \text{ n cm}^{-2} \text{ s}^{-1} \quad (> 1 \text{ keV}) \end{array}$$

Surface: 17800 m<sup>2</sup>

Volume: **180000** m<sup>3</sup>

Rn in air: 20-80 Bq/m<sup>3</sup>

ISO 14001

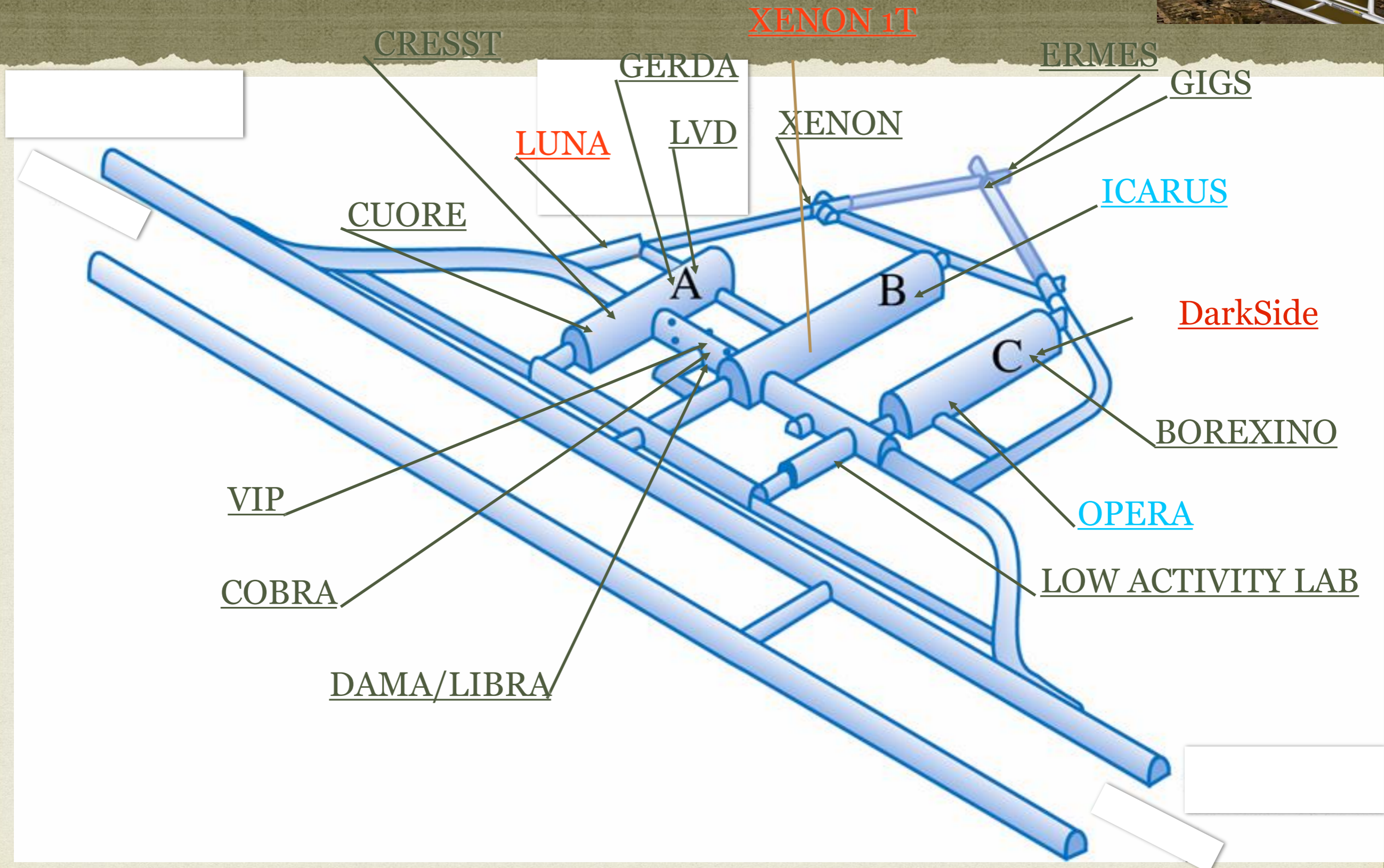
Ventilation: 1 Lab volume/3 h

Electrical power: 1300 kW

external facilities



# A BUSY LAB



# Physics at LNGS

The inventory of Universe  
and the dark matter

DAMA/LIBRA

CRESST

XENON

CTF-Dark Side R&D

LBL - CNGS  
OPERA

Icarus T600

Properties of neutrinos and their role in cosmic evolution

2<sup>0</sup>νββ

CUORE

GERDA

COBRA

Lucifer R&D

What about the interior of  
the Sun and the Earth

BOREXINO

LUNA

LVD

What about the  
supernova explosions



# SEVERAL TECHNOLOGIES AT WORK IN LNNGS

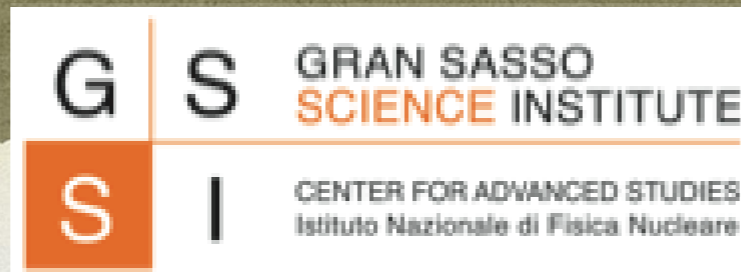
- Liquid Argon cryostat for hundreds of Tons
- Large Area counter detectors (RPC's)
- Liquid scintillators at highest purity
- Double phase liquid Xenon detectors
- Radiopure NaI scintillators
- Large volume Germanium detectors
- Large volume bolometers at few mK operation

# GRAN SASSO SCIENCE INSTITUTE

- Role of INFN in preparing excellent researcher fully recognized by Ministry of University and Research
- Funding (**12ME/year**) for starting a Ph.D. school (Physics, Mathematics and Computing Sciences, Social Sciences\*)
- in L'Aquila for contributing to revive the local economy after the earthquake
- A great proof of confidence, a big challenge and an enormous responsibility

\***Smart Cities, Cultural Heritage, Risk assessment and Disaster Recovery**

# PHYSICS



## **GSSI Board**

### **Director**

*E. Coccia (INFN and U. Rome Tor Vergata)*

### **Coordinators**

Physics: *F. Vissani (INFN-LNGS)*

Mathematics & CS: *P. Marcati (U. L'Aquila)*

Social Science: *A. Calafati (U. Ancona)*

### **Representatives:**

*A. De Simone (Sissa)*

*R. De Nicola (IMT)*

*N. Bellini (Sant'Anna)*

**Industrial Liason Office:** *F. Arneodo (INFN-LNGS)*

**Administration:** *S. Antidormi (INFN-LNF)*

**Technical Supervision:** *O. Ciaffoni (INFN-LNF)*

**Press Office:** *A. Varaschin (INFN)*

## **PhD in Astroparticle Physics**

### **Research lines**

Neutrino Physics: nature, mass, oscillation

Dark Matter

Nuclear Astrophysics

High Energy Astrophysics

Gravitational Waves

Physics beyond the Standard Model

### **Board of Professors**

*Felix Aharonian (Max Planck and DIAS)*

*Frank Calaprice (Princeton University)*

*Eugenio Coccia (U. Roma Tor Vergata and GSSI)*

*Guido Martinelli (SISSA)*

*Antonio Masiero (U. Padua and INFN)*

*Sergio Petrerá (U. L'Aquila and GSSI)*

*Carlo Rubbia (CERN and GSSI)*

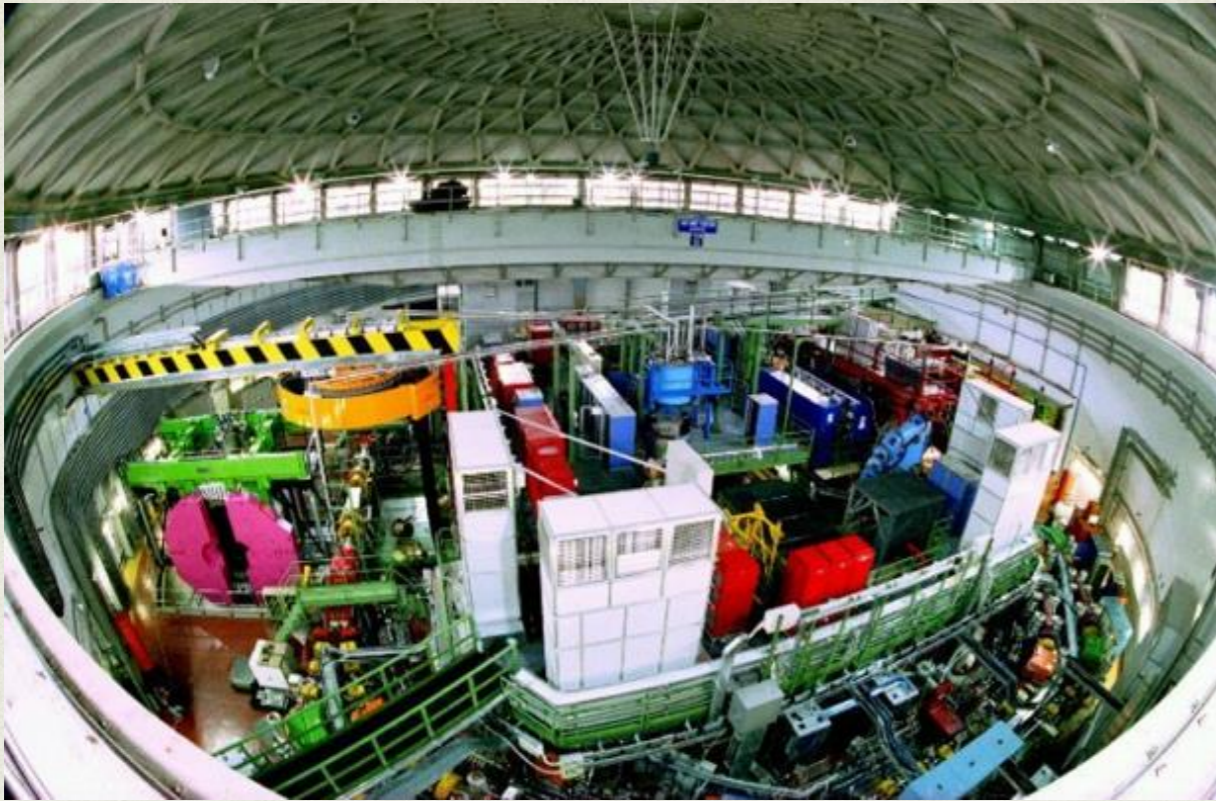
*Goran Senjanovic (ICTP and GSSI),*

*Francesco Vissani (LNGS and GSSI)*

*The PhD degree will be released jointly with prestigious educational institutions such as the post-graduate School for Advanced Studies (SISSA) of Trieste (Physics and Mathematics), the Scuola Superiore Sant'Anna of Pisa (Social Sciences) and IMT Lucca (Computer Science).*

LNFRASCATI

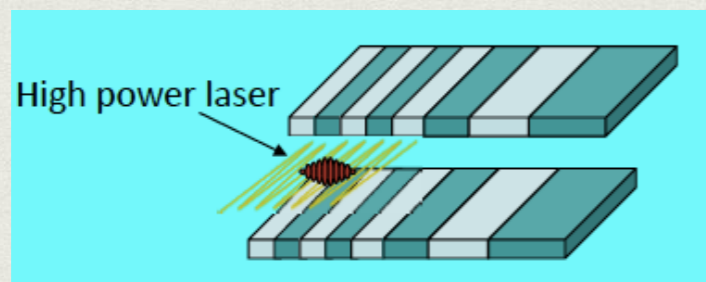
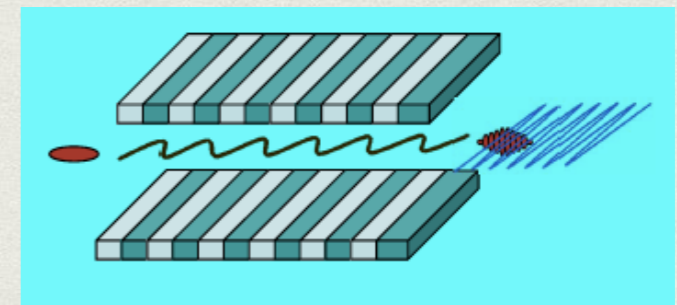
# DAFNE & KLOE



- DAΦNE ->  $\Phi$ -factory
- KLOE -> Recent upgrade of the detector, ready to run in 2014 for 10 months

# A NEW FRONTIER : MARRYING LASERS AND PARTICLE BEAMS

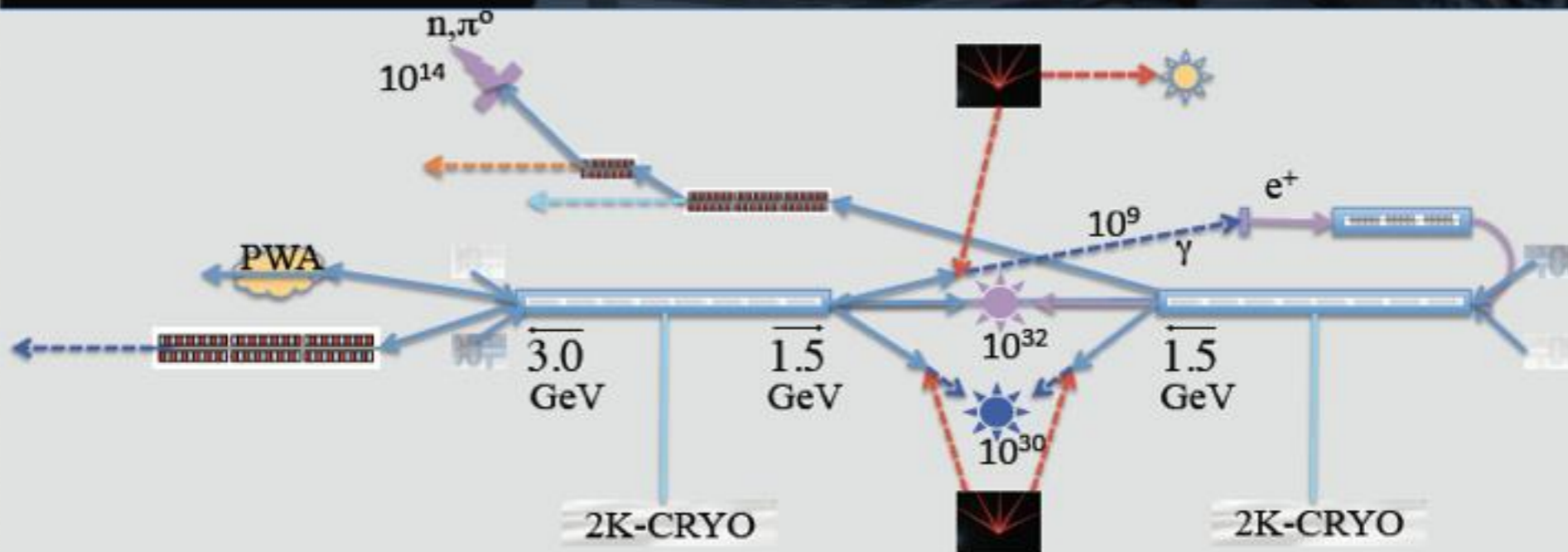
**Seeding a High Gain Free Electron Laser:  
transfer coherence from the Laser to  
the FEL radiation through the Electron  
Beam**



**Inverse Free Electron Laser:  
transfer energy from the Laser to the  
Electron Beam through the FEL  
radiation**

# A PROJECT FOR LNF

**IRIDE** is a large infrastructure for fundamental and applied physics research. Conceived as an **innovative** and **evolutionary** tool for **multi-disciplinary investigations** in a wide field of scientific, technological and industrial applications, it will be a high intensity “**particle beams factory**”.

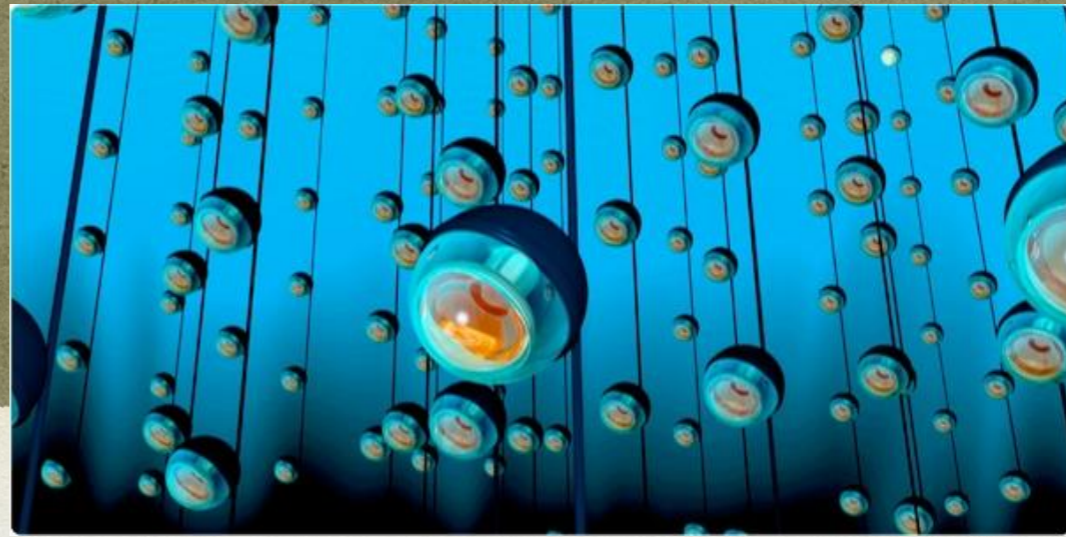


Based on a combination of a **high duty cycle radio-frequency superconducting electron linac** (SC RF LINAC) and of **high energy lasers** it will be able to produce a high flux of **electrons, photons (from infrared to gamma rays)**, neutrons, protons and eventually **positrons**, that will be available for a wide national and international scientific community interested to take profit of the most advanced particle and radiation sources.

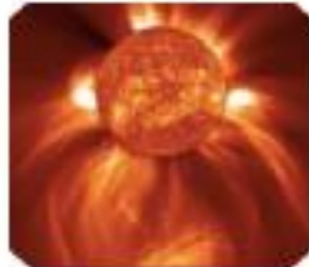
- Science with photons
- Cluster and nanoparticles
- Protein imaging, movie of chemical reaction
- THz radiation source
- Neutrography
- Advanced gamma ray Compton scattering
- gamma-electron linear collider
- gamma-gamma linear collider
- electron-positron linear collider
- Particle Wake field acceleration



# LNS



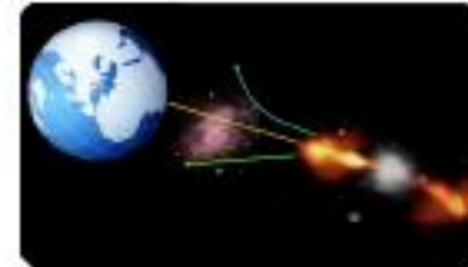
## LNS activity overview



Nuclear Physics



Accelerators



Astroparticle Physics



Detector systems



Ion Sources



Theory



INFN-Energy

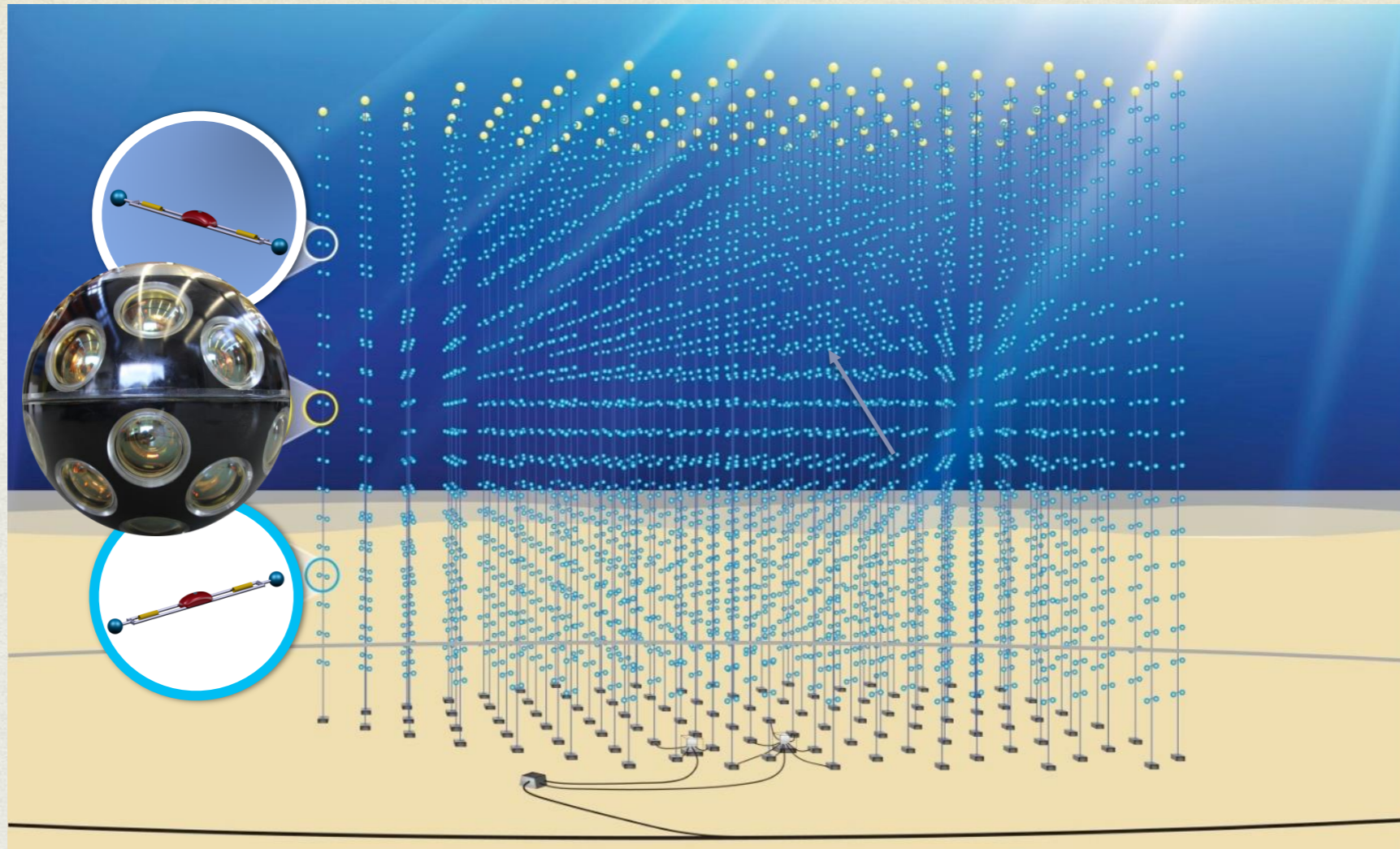


Protontherapy



Multidisciplinary facilities

# FIRST TOWER DEPLOYED



Very high energy neutrinos from sources in cosmo.

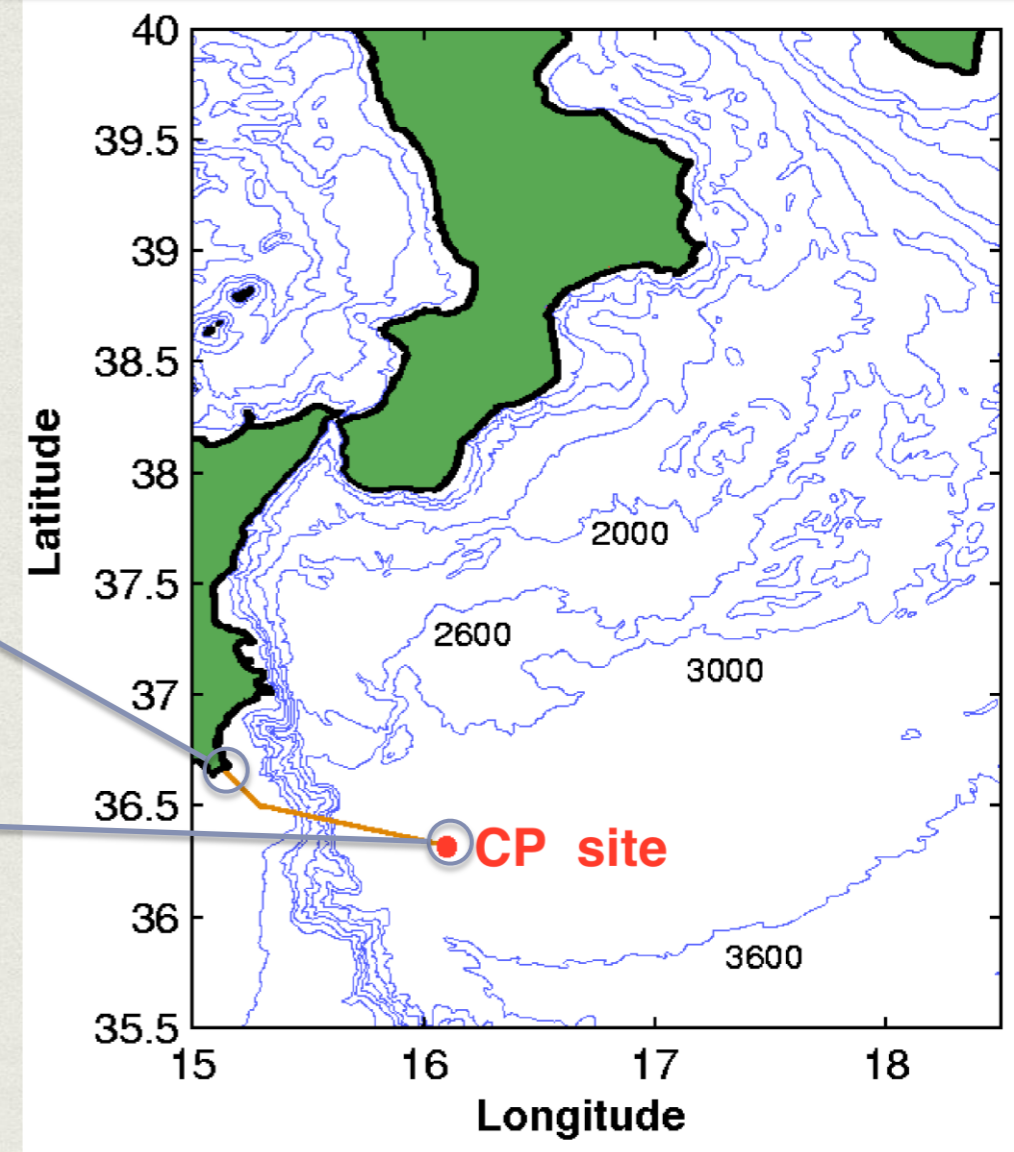
# THE CAPO PASSERO SITE

Capo Passero is one of the candidate sites for the installation of KM3NeT  
Deep sea site studied and fully characterized in the past 12 years  
Already existing infrastructure with to be upgraded for KM3NeT-Italia



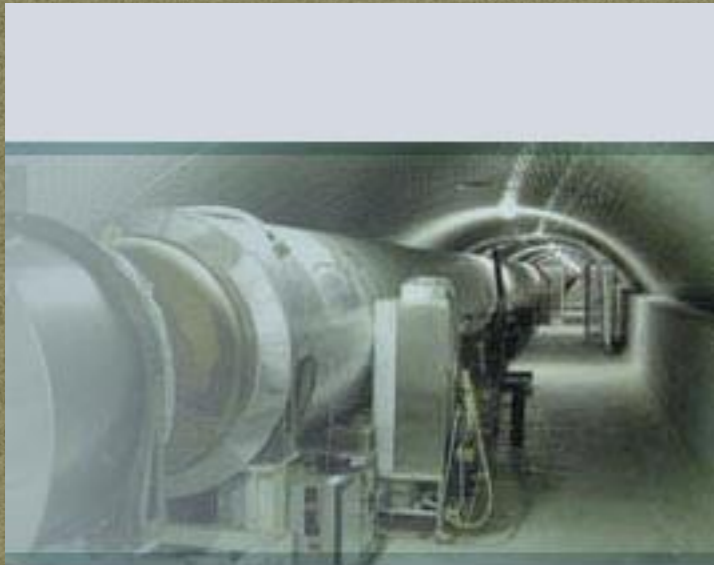
## Present infrastructures

- Deep-sea 10 kW DC/DC converter
- Main 100 km electro-optical cable
- Power feeding system
- Shore station
- High bandwidth (1 Gbps) connection to LNS



VIRGO

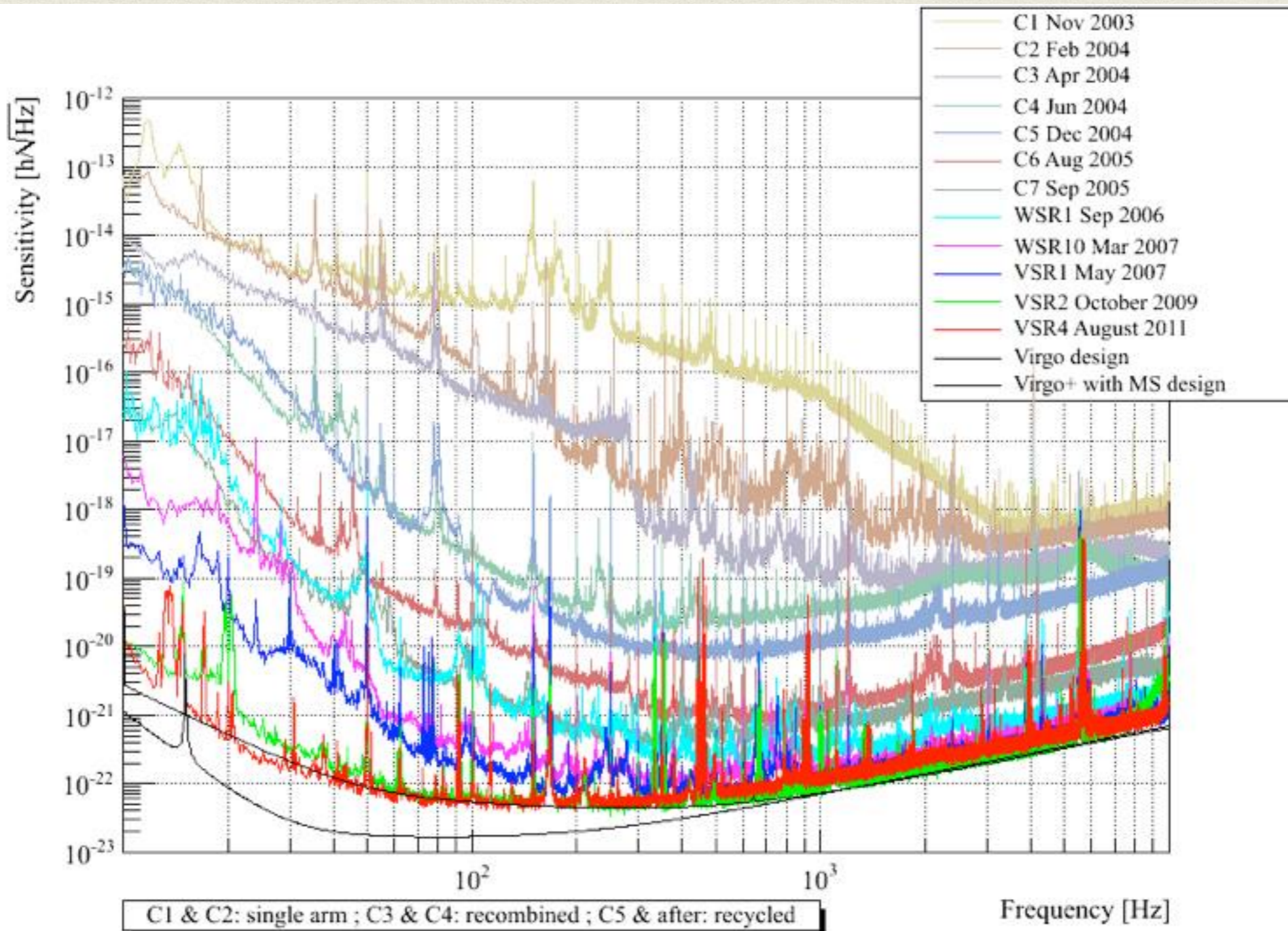
# EGO-VIRGO



The  
Gravitational Waves  
quest



# Sensitivity achieved



# CNAF

- The center for research and development in the field of information and communication technologies INFN.
- **TIER1** : the Italian node (1° level)
- of the LHC GRID network.



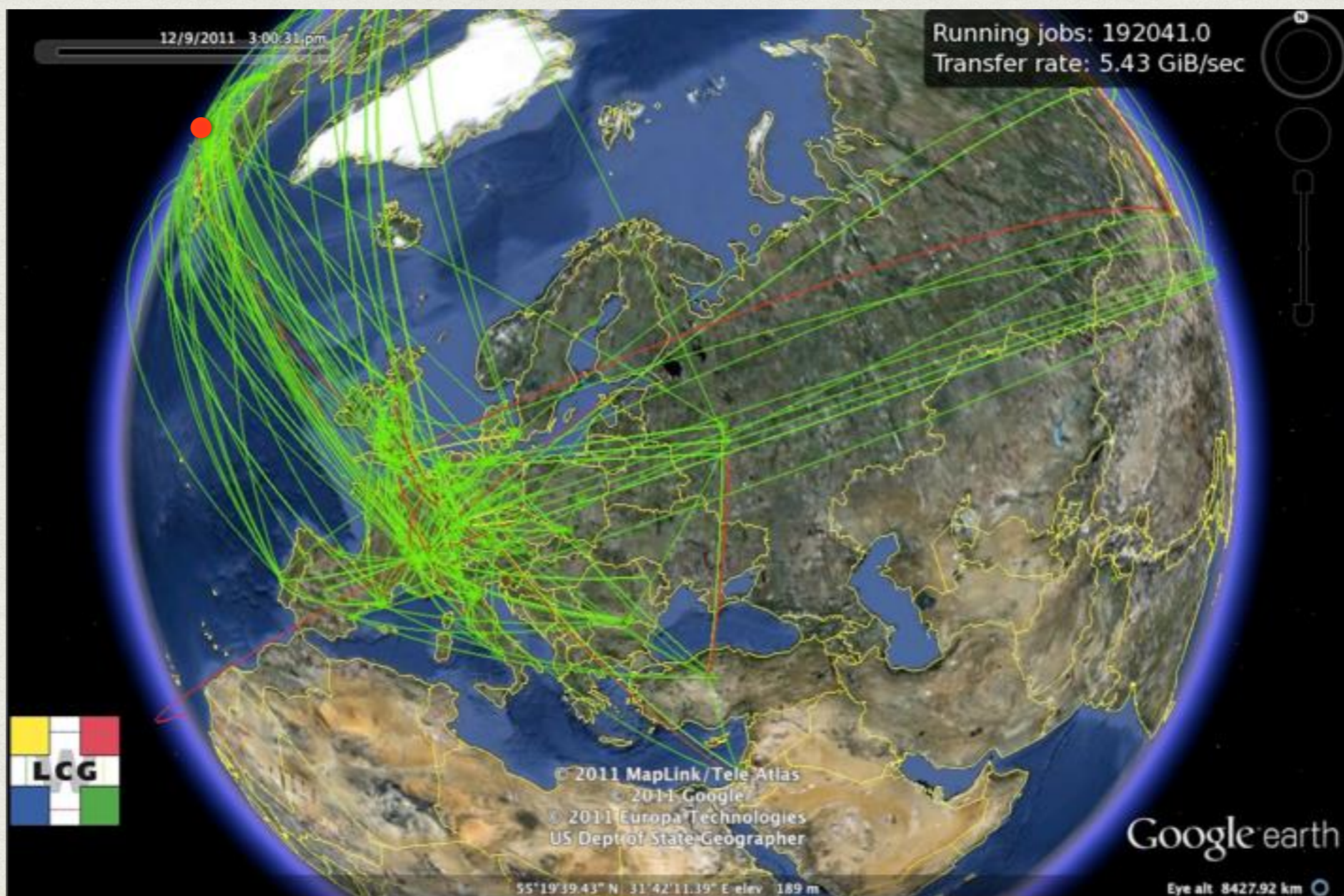
# LHC COMPUTING & NETWORKING @ INFN

We participate in all LHC experiments (ATLAS, CMS, ALICE, LHC-b, TOTEM), about 800 FTE's. Very important responsibilities.

The italian contribution to the LHC Computing has been very important and of high efficiency (see next slides).



# the INFN Tier1 Computing Center



# LHC COMPUTING & NETWORKING @ INFN

- At INFN the evolution of the geographical network is discussed within the National Scientific Committees (CSN) for what concerns the requirements and within the Computing and Networking Committee (CCR) for what concerns the implementation.
- The implementation is developed together with the Consortium GARR (Rete Italiana dell'Università e della Ricerca)
- The evolution of the backbone of the current research network has been carried out on the basis of the requirements defined by INFN.
- Today we might be able to connect in short time all the Tier's at a 100Gb/s .

**INFN and LHCOPN - LHCONE**

# LHCOPN/ONE INFN CONNECTIONS

**All INFN LHC TIERs are connected to LHCONE via GARR and GEANT.**

◆ **TIER1 - INFN CNAF (4x10 Gb/s)**

- Connected to LHCOPN at 20Gb/s

✓ 2 Dedicated and differentiated 10 Gb/s links to CERN

✓ +1 Backup 10Gb/s link via CBF (Cross Border Fiber) through Karlsruhe

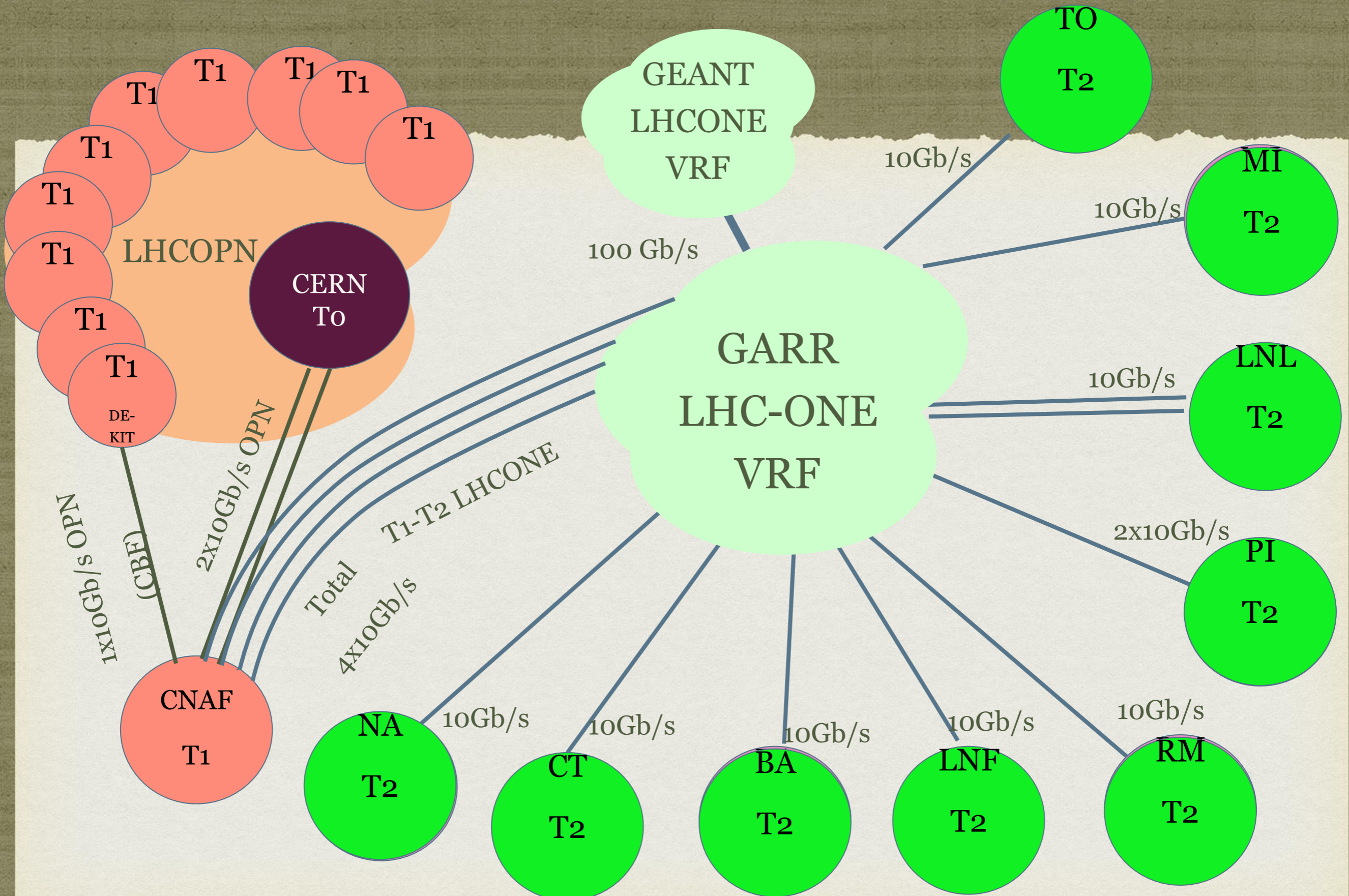
- Connected to LHCONE at 40Gb/s (20 Gb/s in sharing with LHCOPN)

◆ 9 TIER2s

All Connected to LHCONE with a dedicated 10Gb/s

- INFN Bari (1x 10Gb/s)
- INFN Catania (1x 10Gb/s)
- INFN Milano (1x 10Gb/s)
- INFN LNF (Frascati National Laboratories) (1x 10Gb/s)
- INFN LNL (Legnaro National Laboratories) (1x10Gb/s)
  - INFN Napoli (1x10Gb/s)
  - INFN Pisa (2x10Gb/s)
  - INFN Roma(1x10Gb/s)
  - I - NFN Torino (1x10Gb/s)

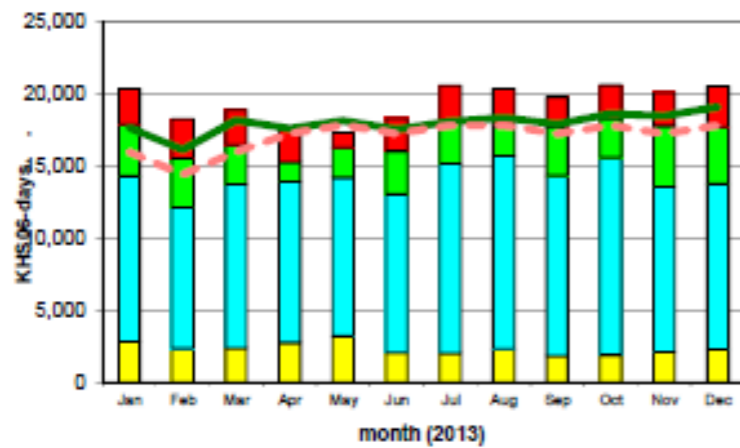
# LHCOPN AND LHCONE NETWORK IN ITALY



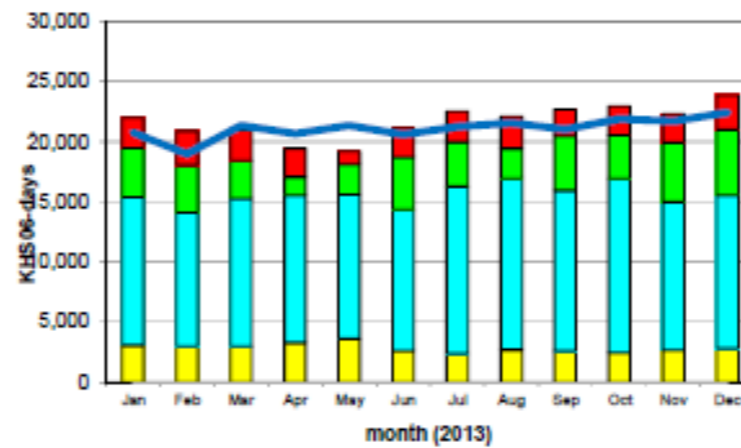
# ALL TIER1

## Summary of Tier-1s

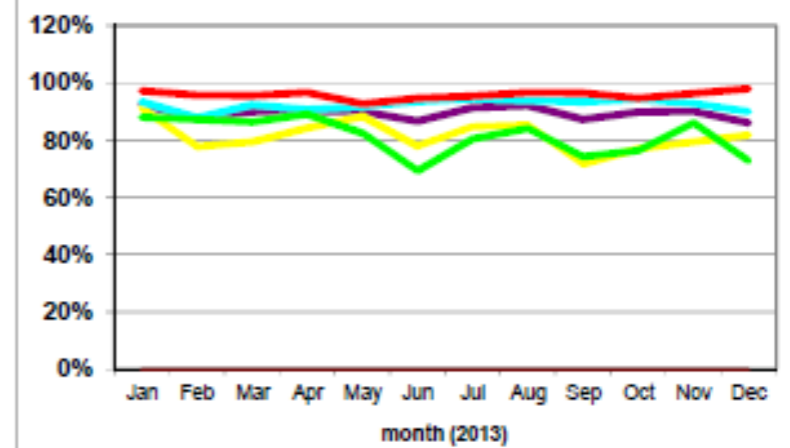
CPU Time Delivered



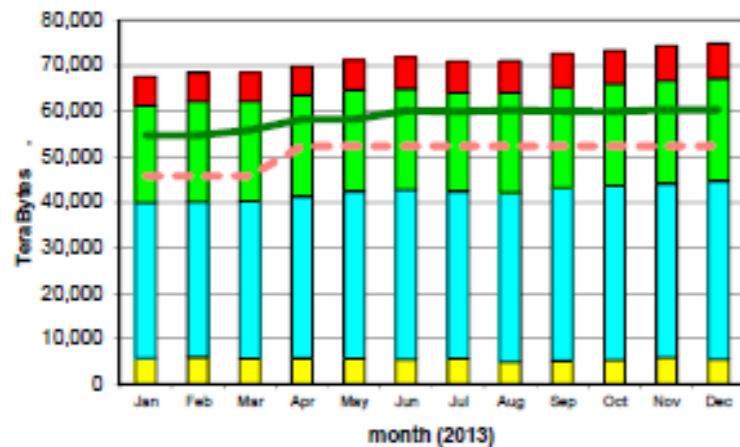
Wall-clock Time Delivered



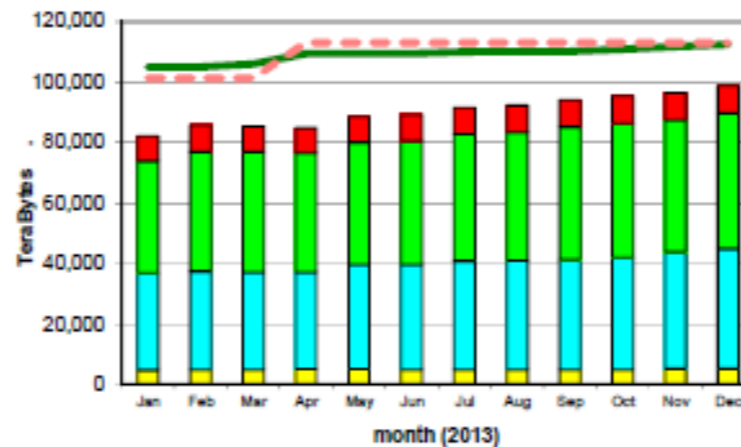
Ratio of CPU : Wall\_clock Times



Disk Storage Used



Tape Storage Used

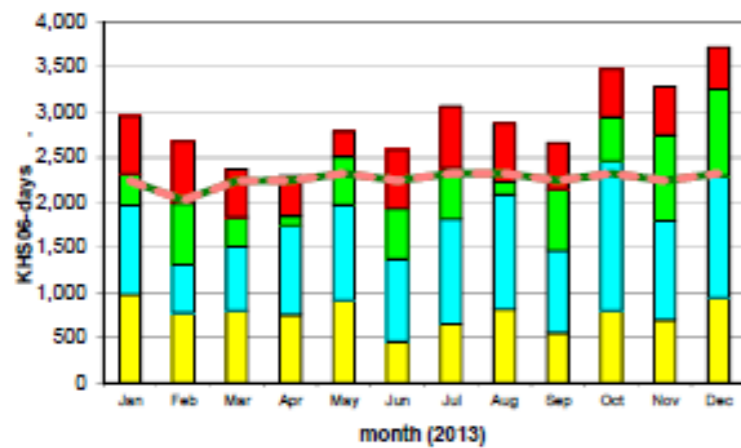


ALICE ■ CMS ■ installed capacity (inc. efficiency factor) — installed capacity (w/o efficiency factor) —  
 ATLAS ■ LHCb ■ MoU commitment (inc. efficiency factor) - - - - - site average - cpu:wall\_clock ratio —

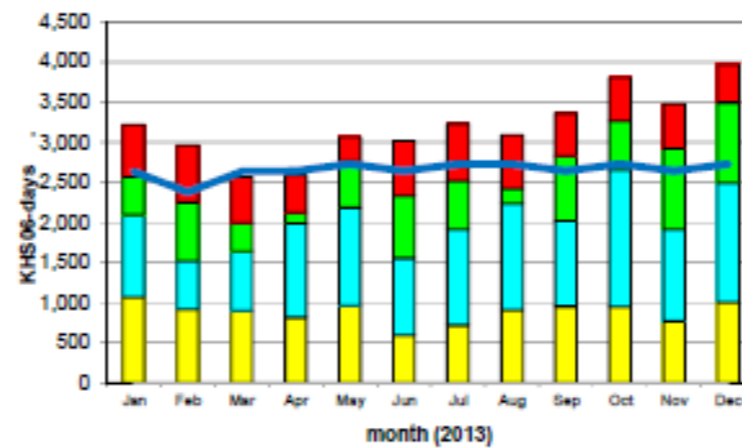
# CNAF ONLY

## CNAF

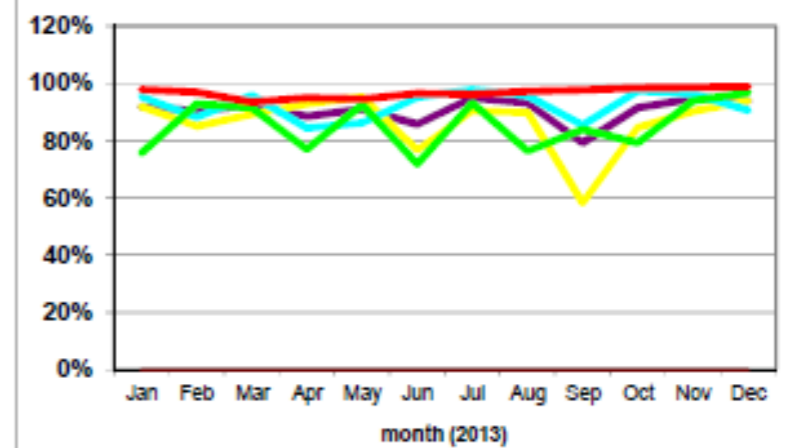
CPU Time Delivered



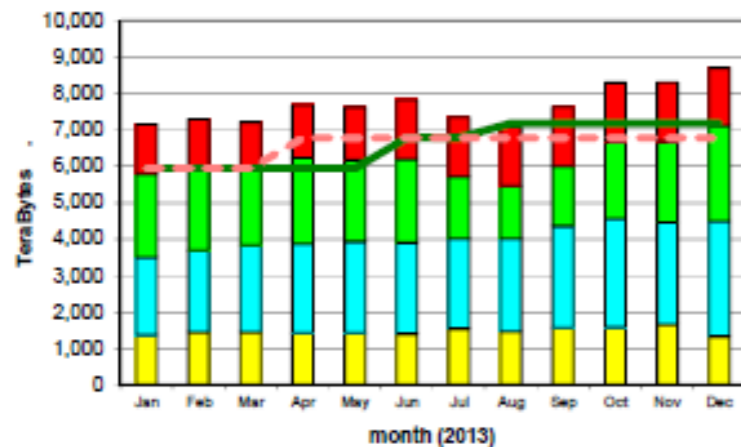
Wall-clock Time Delivered



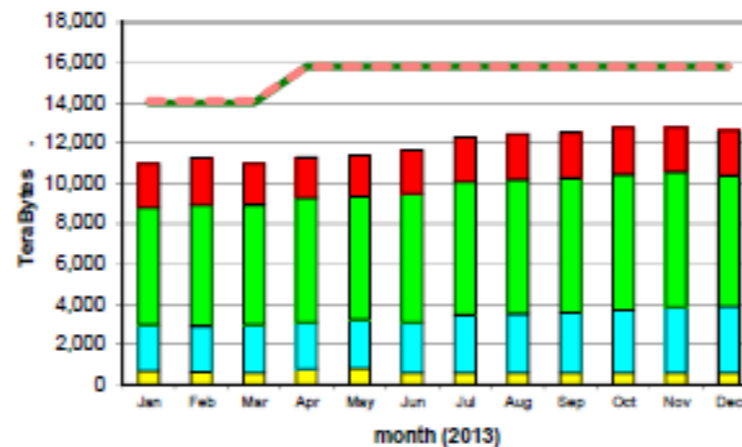
Ratio of CPU : Wall\_clock Times



Disk Storage Used



Tape Storage Used



ALICE CMS installed capacity (inc. efficiency factor) installed capacity (w/o efficiency factor)   
 ATLAS LHCb MoU commitment (inc. efficiency factor) site average - cpu:wall\_clock ratio

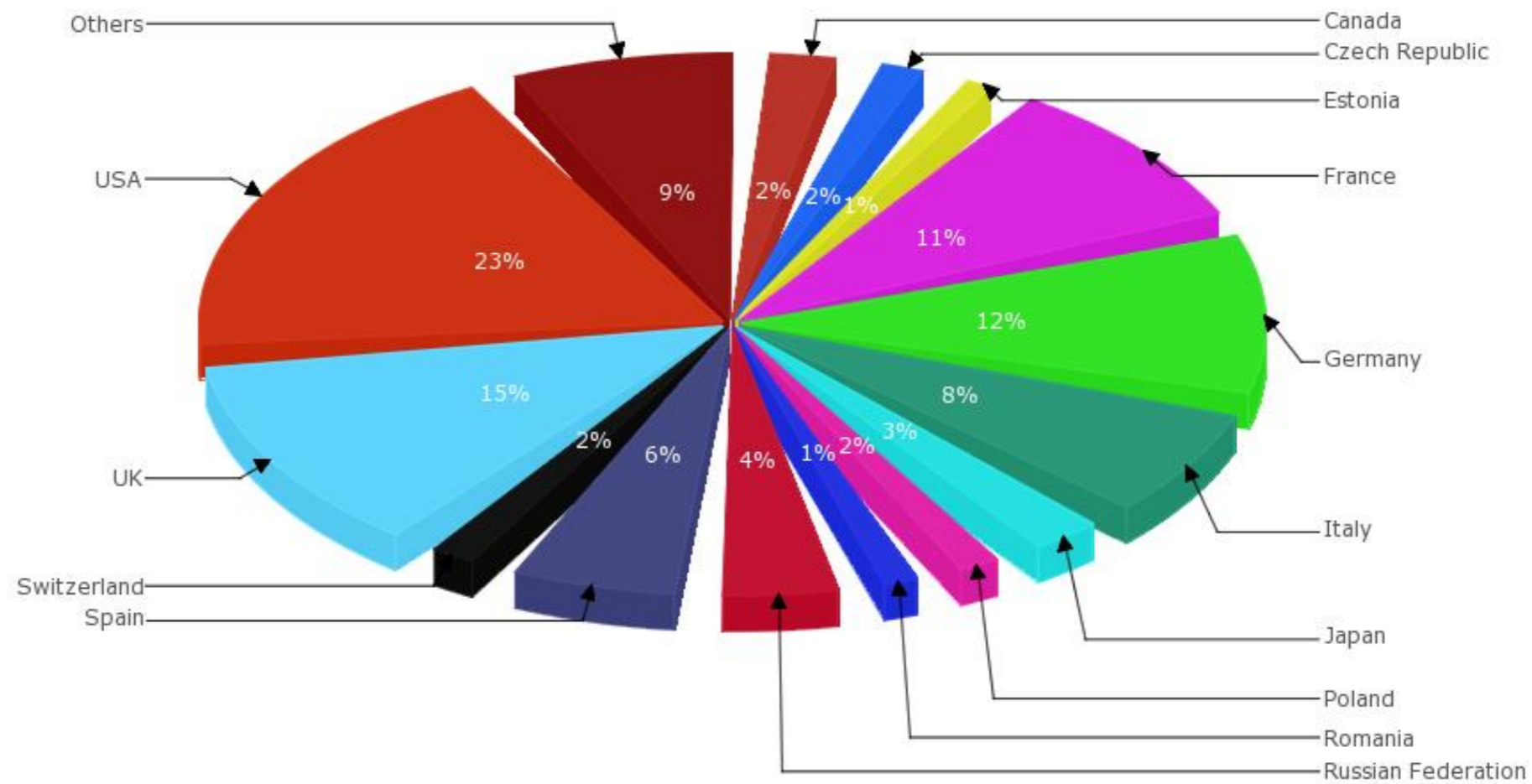


# TIER<sub>2</sub> CPU TIME PER COUNTRY

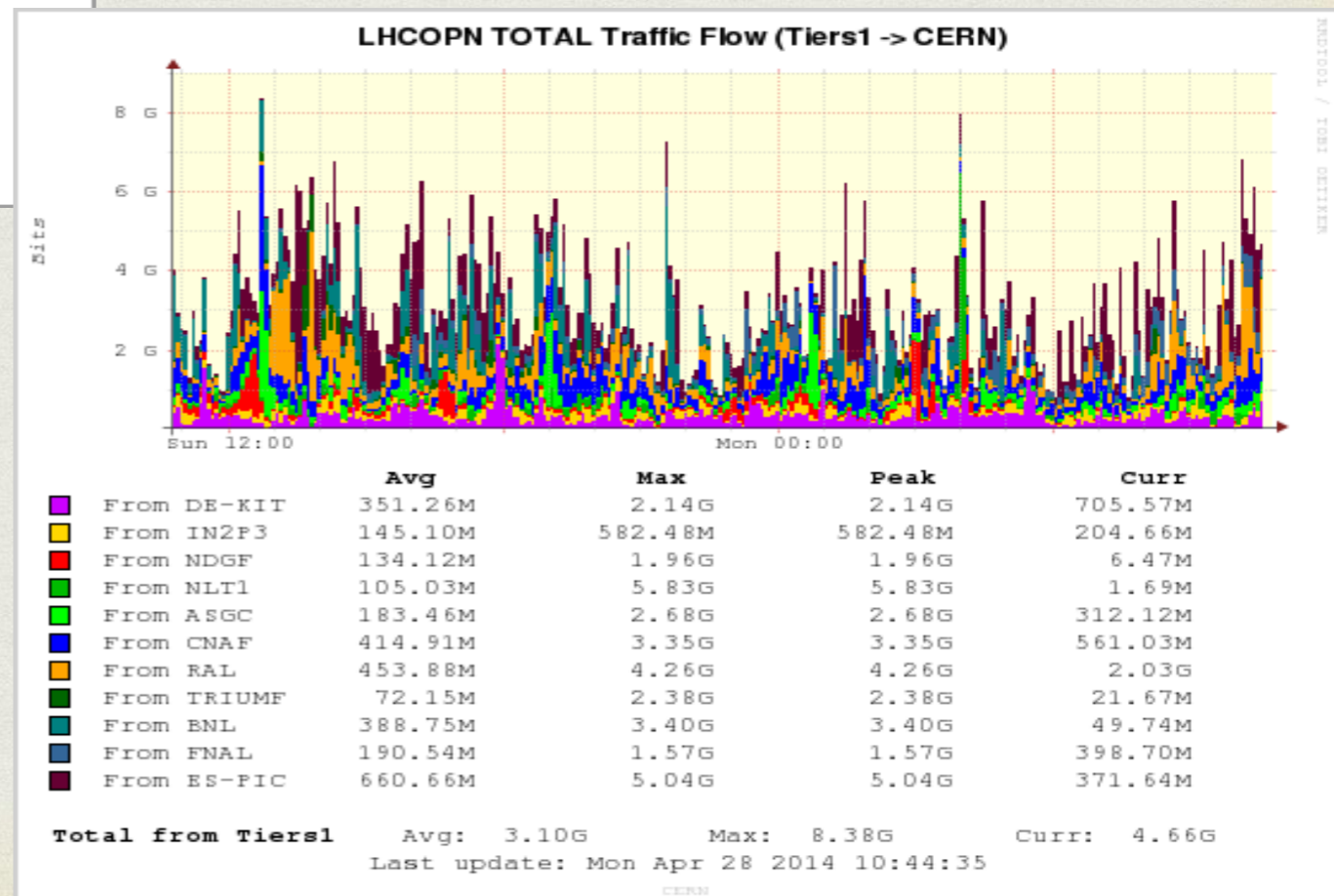
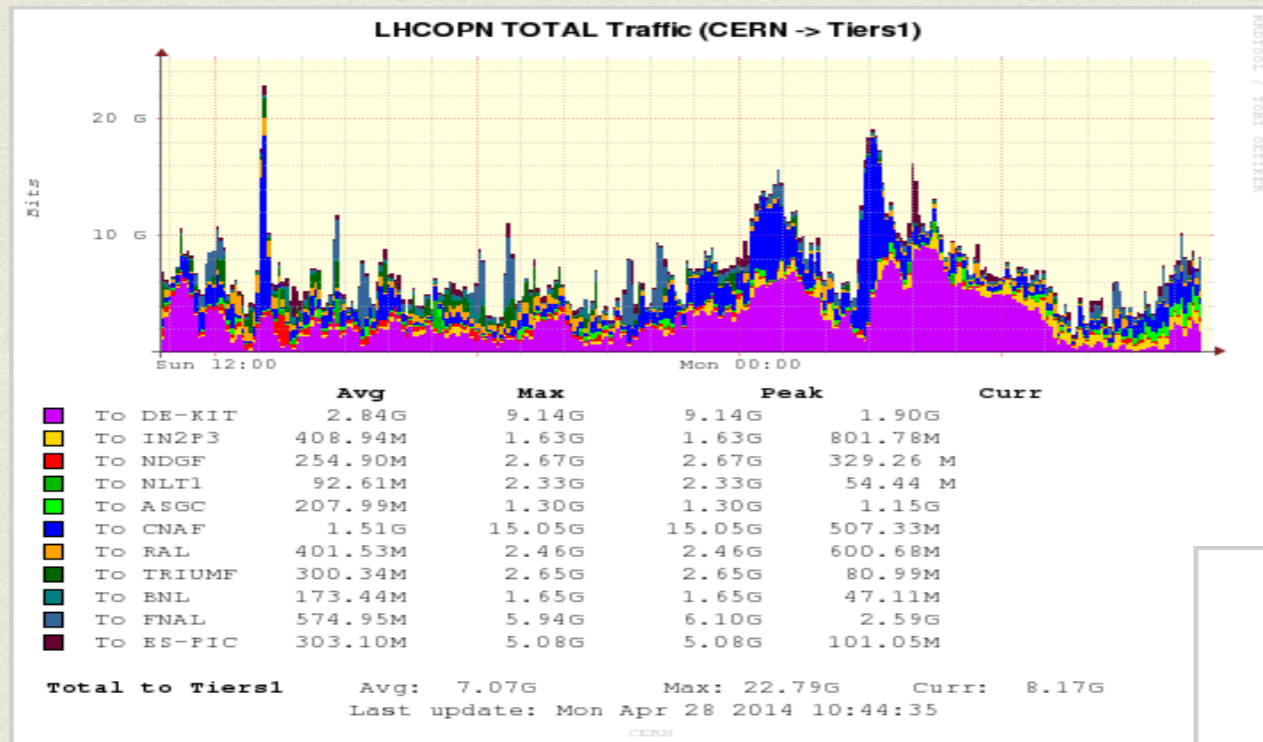
Developed by CESGA 'EGI View': / normcpu-HEPSPEC06 / 2013:5-2014:4 / COUNTRY\_T2-DATE / top10 (x) / GRBAR-LIN / I

2014-04-28 06:38

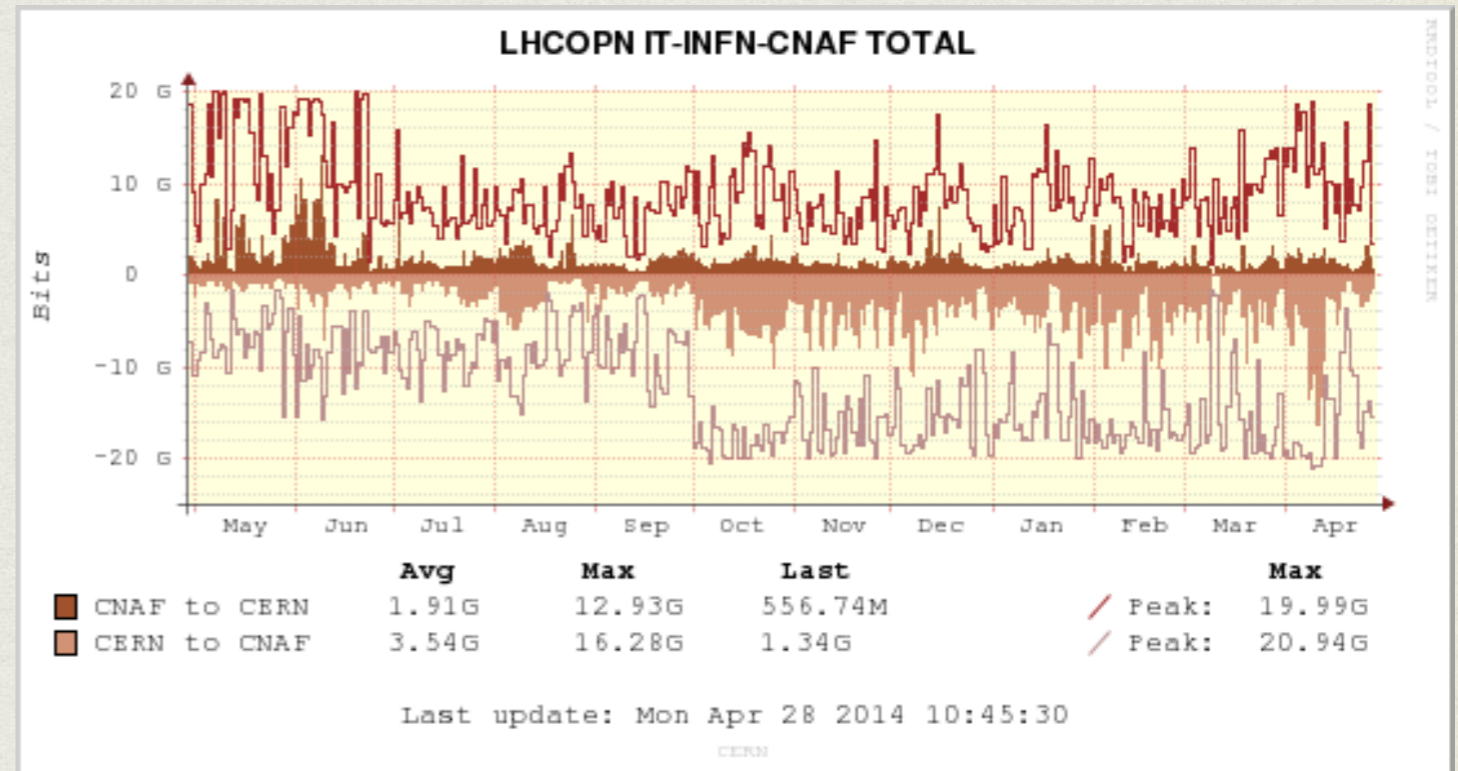
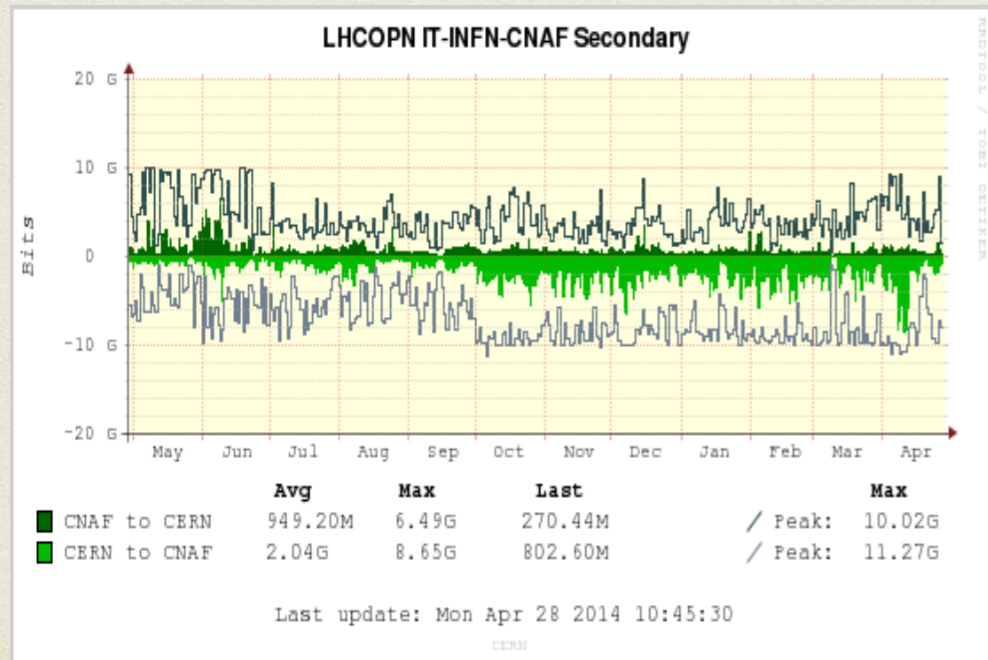
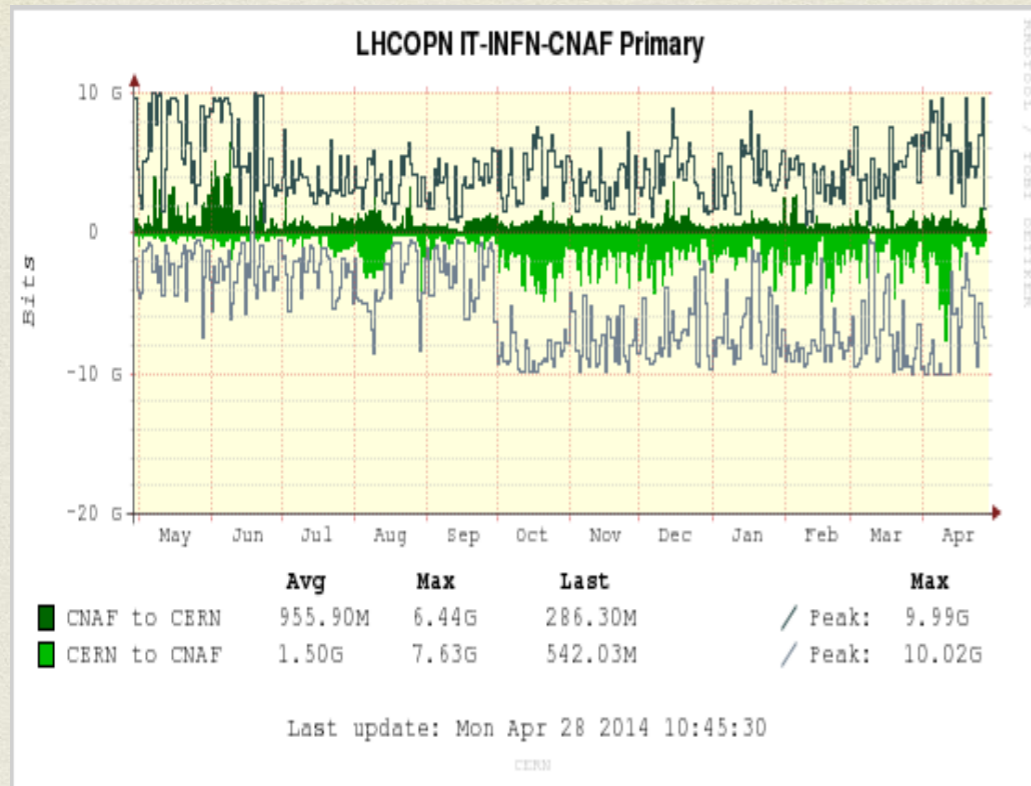
TIER2 Normalised CPU time (HEPSPEC06) per COUNTRY\_T2



# LHCOPN TRAFFIC (TOTAL)



# LHCOPN TRAFFIC (CNAF\_ITALY)



I wish you a nice meeting !