

INFN: L'Italia & la fisica dei nuclei e delle particelle

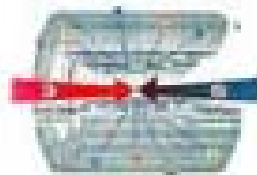
INFN: Istituto Nazionale di
Fisica Nucleare



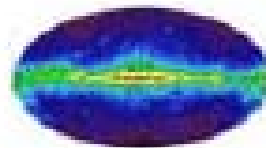
INFN, cos'è ?

dal nostro sito WEB

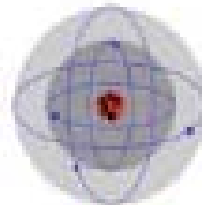
- “ L'INFN, Istituto Nazionale di Fisica Nucleare, è l'istituto che promuove, coordina ed effettua la ricerca scientifica nel campo della fisica subnucleare, nucleare e astroparticellare, nonché lo sviluppo tecnologico necessario alle attività in tali settori. Opera in stretta connessione con l'Università e nell'ambito della collaborazione e del confronto internazionale. ”
- Le attività di ricerca sono così raggruppate:



FISICA
PARTICELLARE



FISICA
ASTROPARTICELLARE



FISICA
NUCLEARE



FISICA
TEORICA



RICERCA
TECNOLOGICA

INFN, perchè?

dal nostro sito WEB

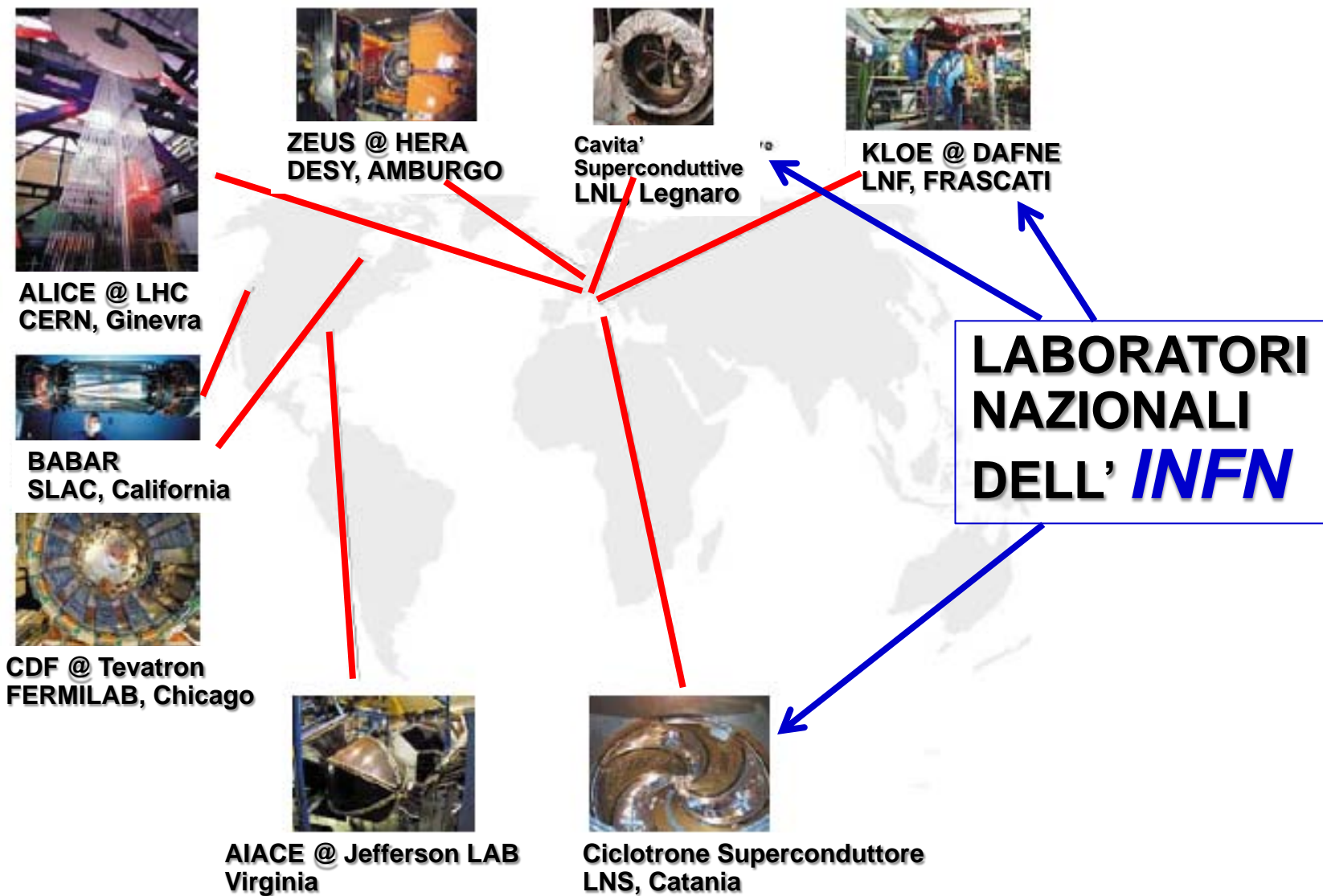
- “ L'INFN venne istituito l'8 agosto 1951 da gruppi delle **Università di Roma, Padova, Torino e Milano** al fine di proseguire e sviluppare la tradizione scientifica iniziata negli anni '30 con *le ricerche teoriche e sperimentali di fisica nucleare di Enrico Fermi e della sua scuola.* ”

- *Perche' non semplicemente una collaborazione fra 4 grandi Università?*

- **La ricerca in fisica nucleare e (successivamente) delle particelle ha bisogno di STRUTTURE e di risorse per realizzarle:**
 - *Laboratori*
 - *Officine*
 - *Personale tecnico (e amministrativo)*

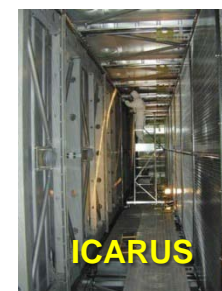
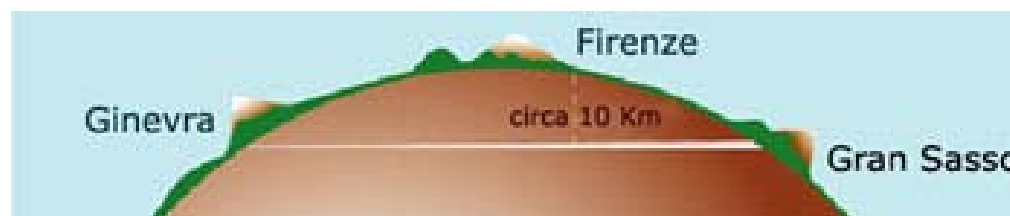
L' INFN & LA FISICA CON GLI ACCELERATORI

PARTICELLE & NUCLEI



■ Neutrini (ν) da

- **Cosmo**: laboratori nelle profondita' marine, NEMO (Sicilia)
- **Sole** : esperimenti GALLEX, GNO, BOREXINO al LNGS
- **Acceleratori** : esperimenti OPERA, ICARUS al LNGS

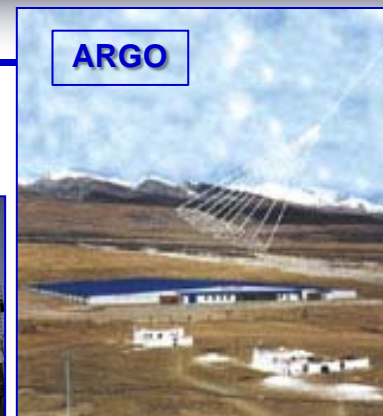


- ## ■ Ricerca di segnali di materia oscura (non sappiamo nulla di circa il 96% dell'universo: materia oscura & energia oscura)

- Al Gran Sasso, grazie al silenzio della montagna:
DAMA, CRESST, HDMS

ASTROPARTICELLE, NEUTRINI & EVENTI RARI

- **Segnali dal cosmo**
 - I raggi gamma di alta energia- **ARGO (Tibet)**
 - **MAGIC**
- **Onde gravitazionali prodotte da masse accelerate:**
 - **VIRGO**, in Toscana (interferometri ottici)
 - barre ultracriogeniche **Nautilus (Frascati)** e **Auriga (Legnaro)** (barre risonanti)
- **Spettrometri volanti per studiare la composizione dei raggi cosmici**
 - **PAMELA**
 - **AMS**



PAMELA



AMS montato sullo SHUTTLE

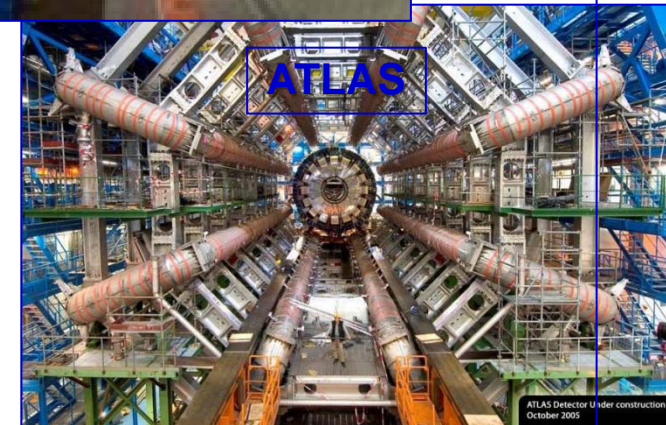
INFN - SVILUPPO TECNOLOGICO

I 3 PILASTRI TECNOLOGICI PER LA SPERIMENTAZIONE

- **ACCELERATORI DI PARTICELLE**



- **RIVELATORI DI PARTICELLE**

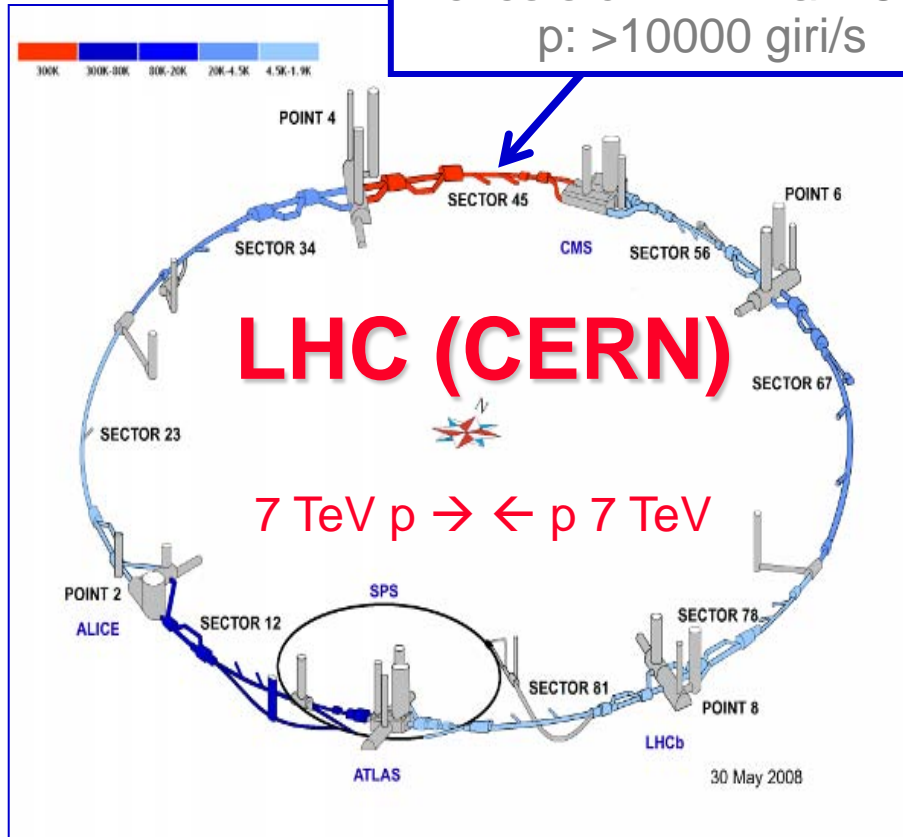


- **CALCOLO**

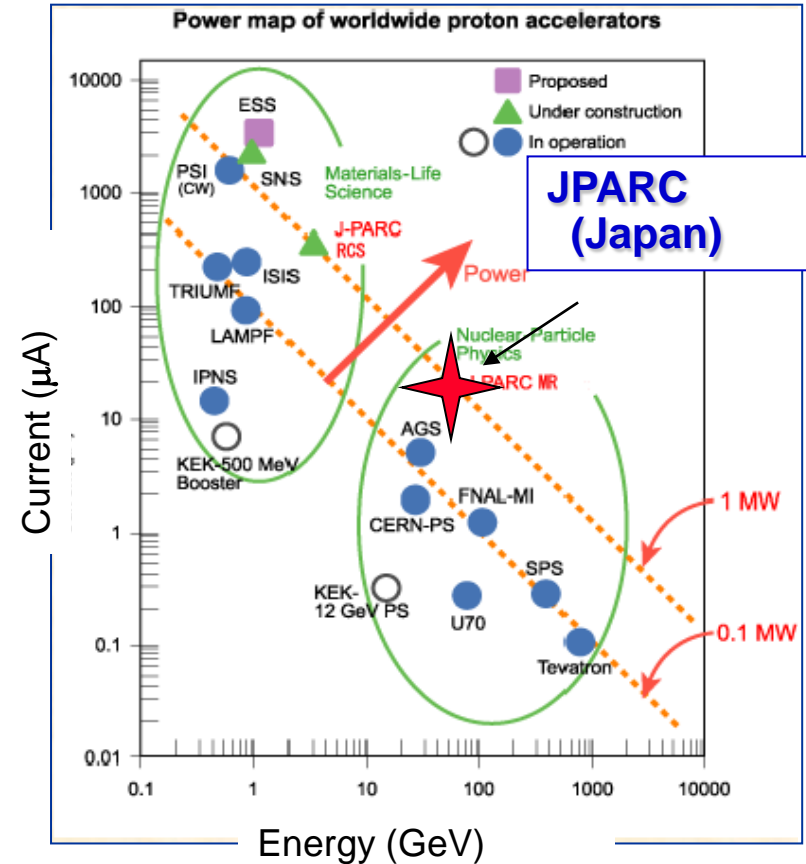


particle accelerators with increasing energy and intensity

circolo di 27 km a 1.9 °K
 $p: >10000$ giri/s



INIZIO OPERAZIONE: 2009
 Oggi: 3.5 TeV → ← 3.5 TeV

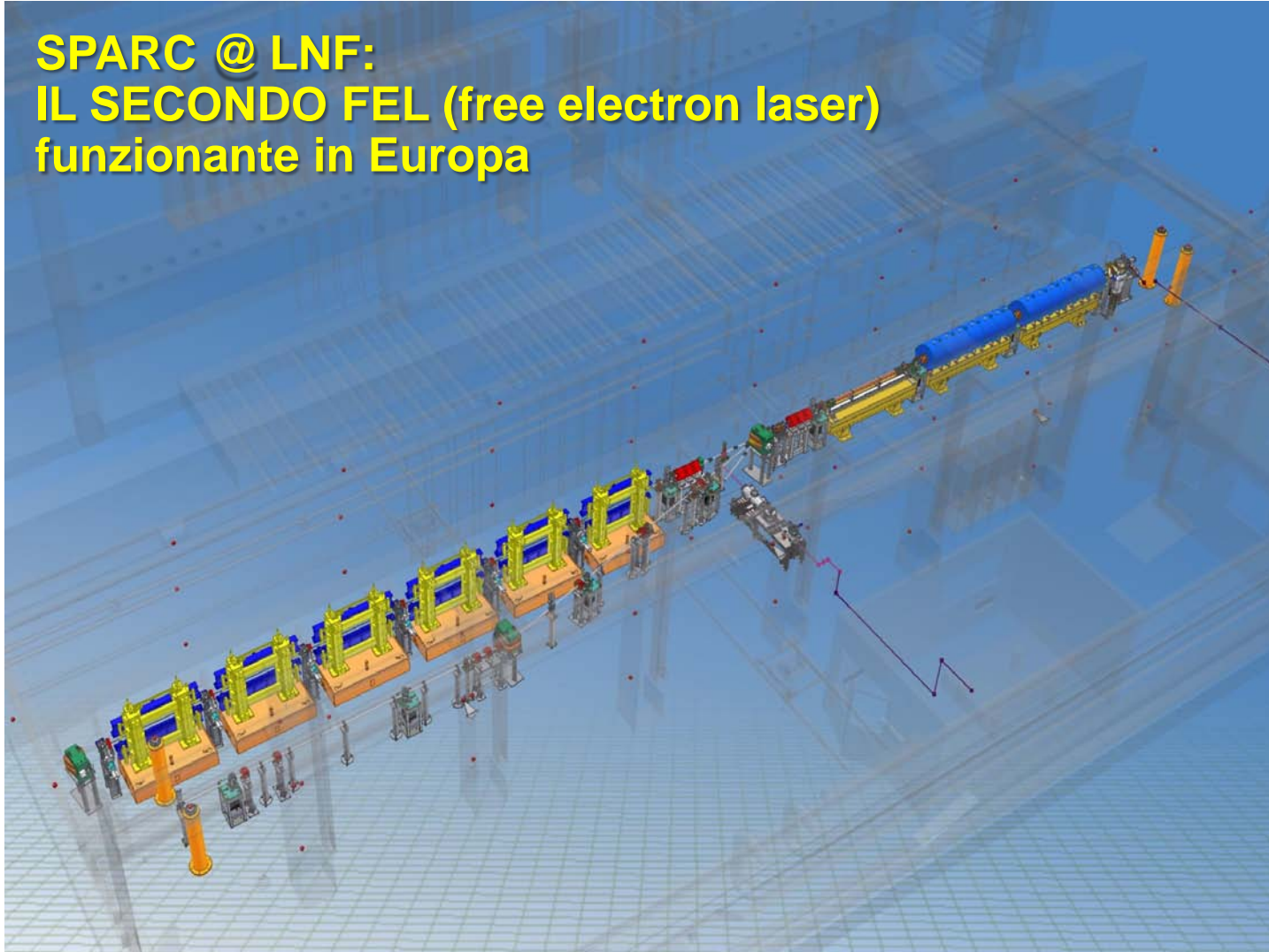


JPARC (Japan)

INIZIO OPERAZIONE: ULTIMO QUARTO 2008

TECNICHE ACCELERATICI: UN RECENTE SUCCESSO DELL' INFN

**SPARC @ LNF:
IL SECONDO FEL (free electron laser)
funzionante in Europa**



IONIZING PARTICLE DETECTORS

- **WHICH RELEVANCE FOR THE PROGRESS OF PHYSICS?**
 - central while designing an experiment is designing an apparatus, namely a suitable collection of detectors, able to measure the interaction under study with the required performance:
 - resolution efficiency rate capability sample purity
 - up to a large extent the experiment and its apparatus cannot be disentangled →
no progress in physics possible w/o progress in the detector sector
 - detectors are invented, developed, designed and built by the physicists
 - the relevance of detector development is widely recognized
 - an example: NOBEL PRIZE (1992) awarded to George CHARPAK for “for his invention and development of particle detectors, in particular the multiwire proportional chamber”
 - but the list is longer



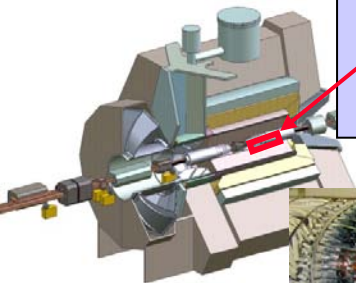
1927: C.T.R. Wilson, Cloud Chamber
1939: E. O. Lawrence, Cyclotron & Discoveries
1948: P.M.S. Blacket, Cloud Chamber & Discoveries
1950: C. Powell, Photographic Method & Discoveries
1954: Walter Bothe, Coincidence Method & Discoveries
1960: Donald Glaser, Bubble Chamber
1968: Luis Alvarez, Bubble Chamber & Discoveries
1992: Georges Charpak, Multi Wire Proportional Chamber

RIVELATORI, ESEMPI:
tutte realizzazioni di
INFN - SEZIONE DI TRIESTE

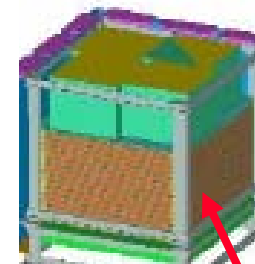
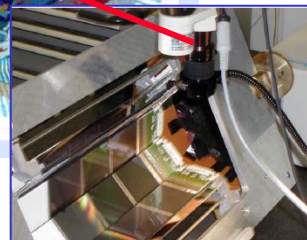
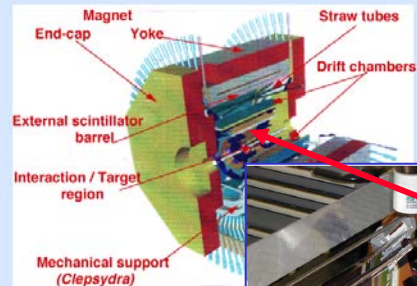
SOLID STATE TRACKERS & TRIESTE

BABAR @ SLAC B-factory

Silicon Vertex Tracker
5 layers (double-sided Si sensors)
vertexing + tracking (+ dE/dx)



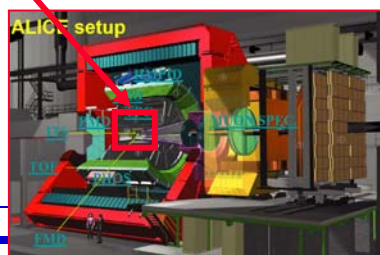
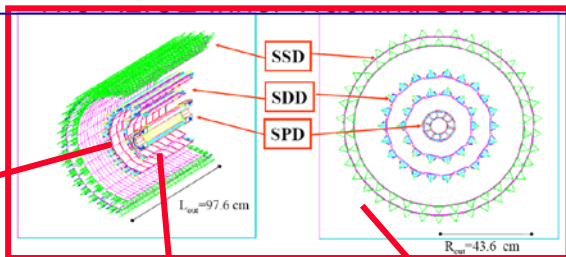
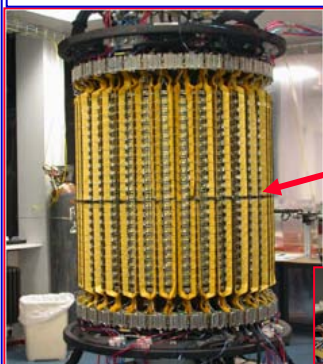
FINUDA @ Frascati Φ -factory



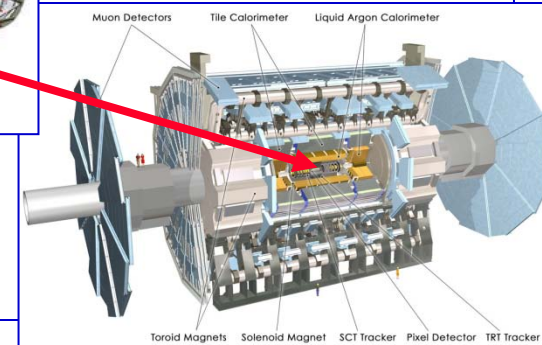
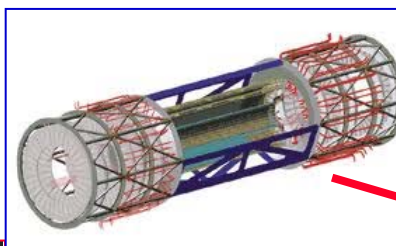
AGILE
space-born
exp. for γ



ALICE @LHC: strips & Si drift s

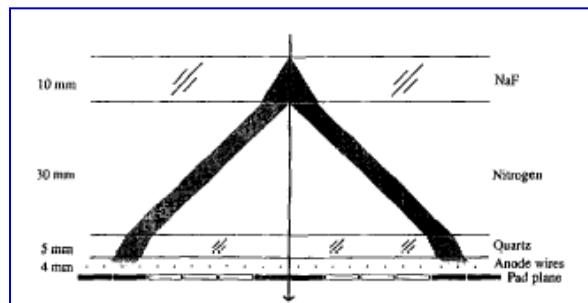


ATLAS @LHC: pixel detector

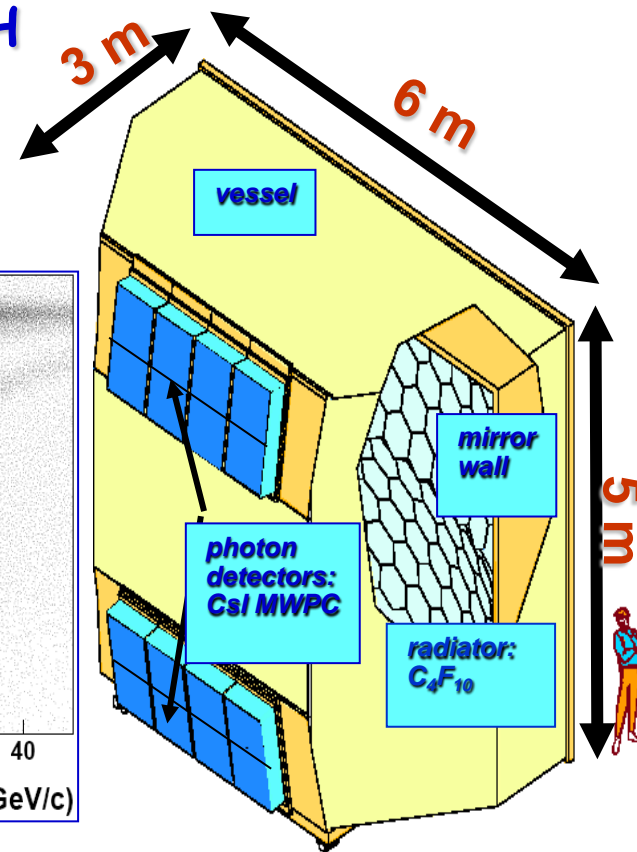
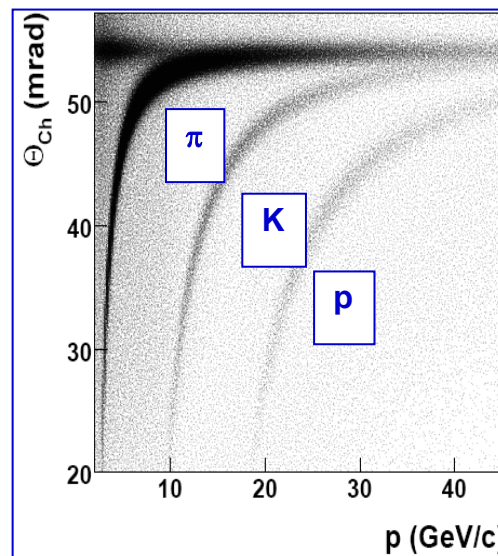


RICHes AND TRIESTE

CAPRICE RICH - the first flying RICH



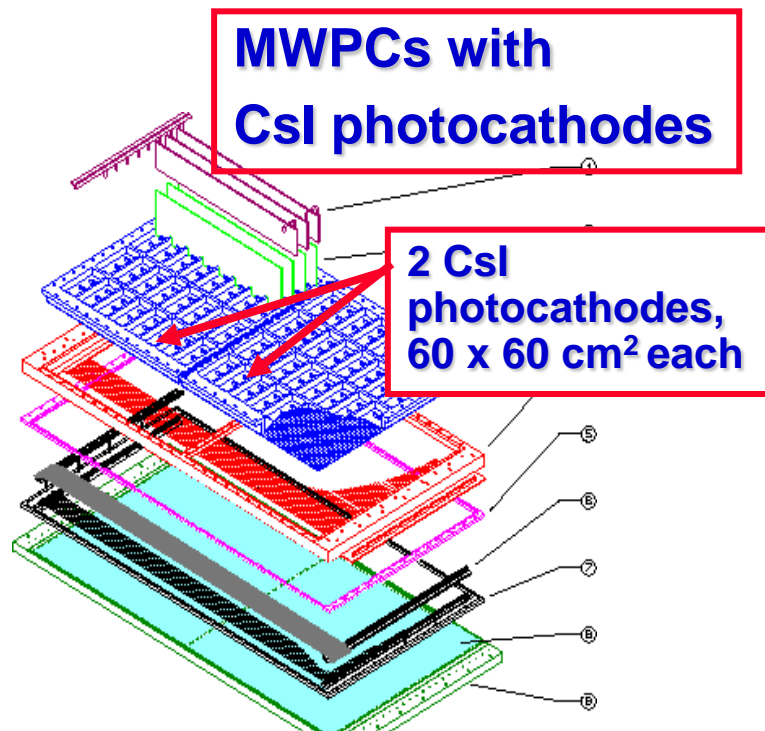
COMPASS RICH-1 - counter designed in TS the largest RICH in operation



SINGLE PHOTON GASEOUS DETECTORS AND TRIESTE

THE PRESENT

MWPCs with CsI photocathodes
for COMPASS RICH-1



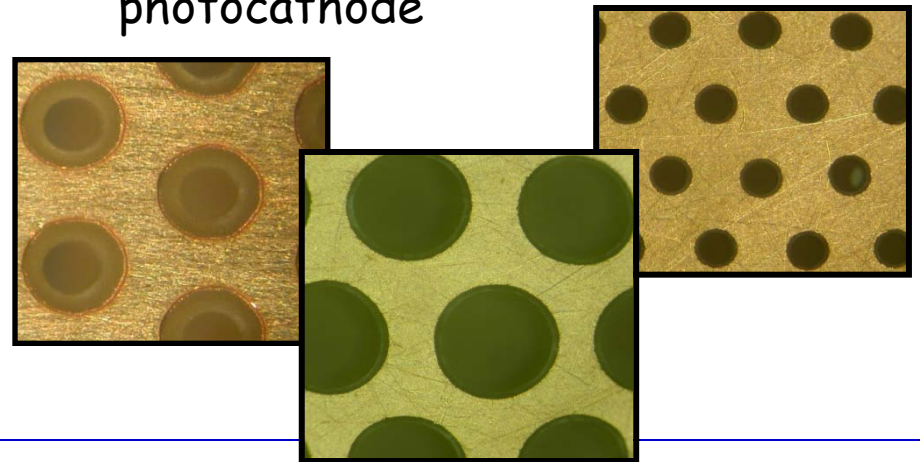
8 chambers, 5.5 m² in total; the largest CsI MWPC system in operation so far

TOWARDS THE FUTURE

R&D: THGEM (Thick GEM) based photon detectors for future applications in COMPASS

Thick GEM-like e-multipliers

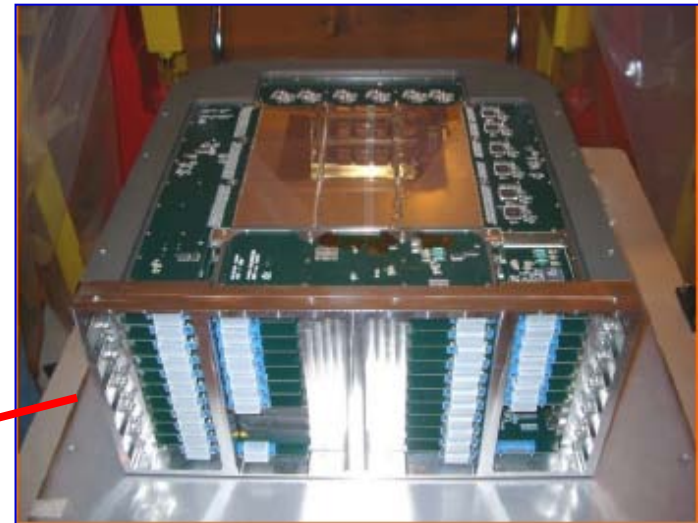
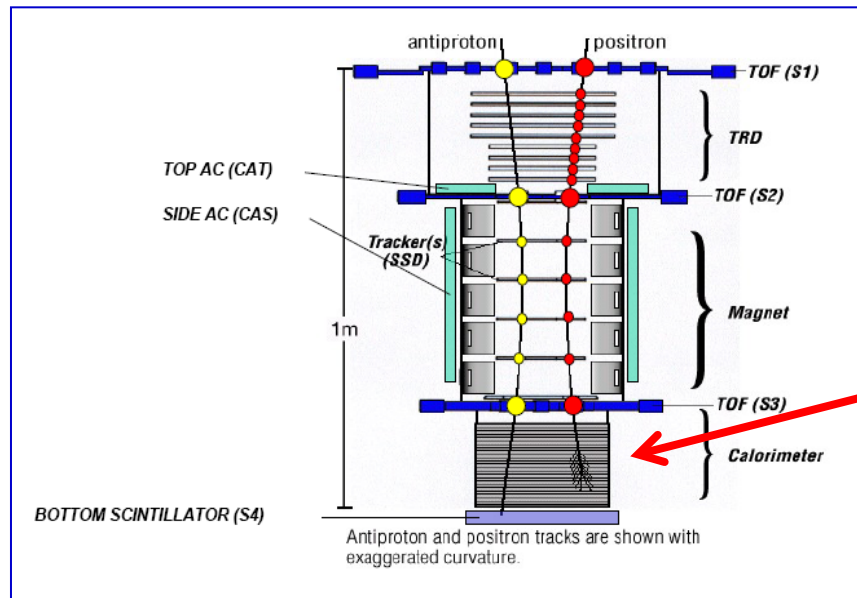
- manufactured by standard PCB
- drilling and Cu etching
- Coupled to a reflective photocathode



ELECTROMAGNETIC CALORIMETERS

SAMPLING

- Si - Cosmic ray composition in a space-born experiment
Si-W calorimeter for PAMELA



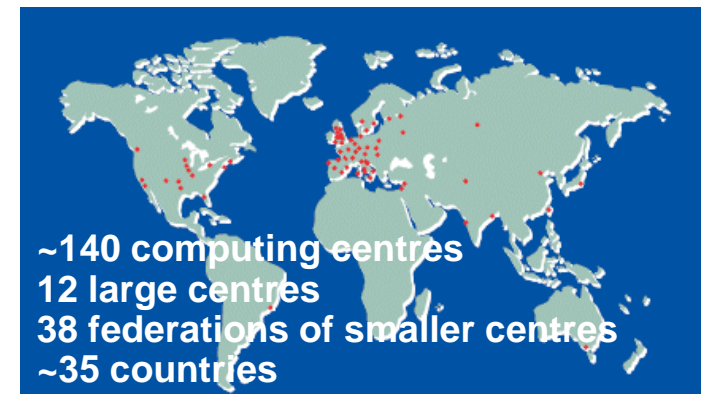
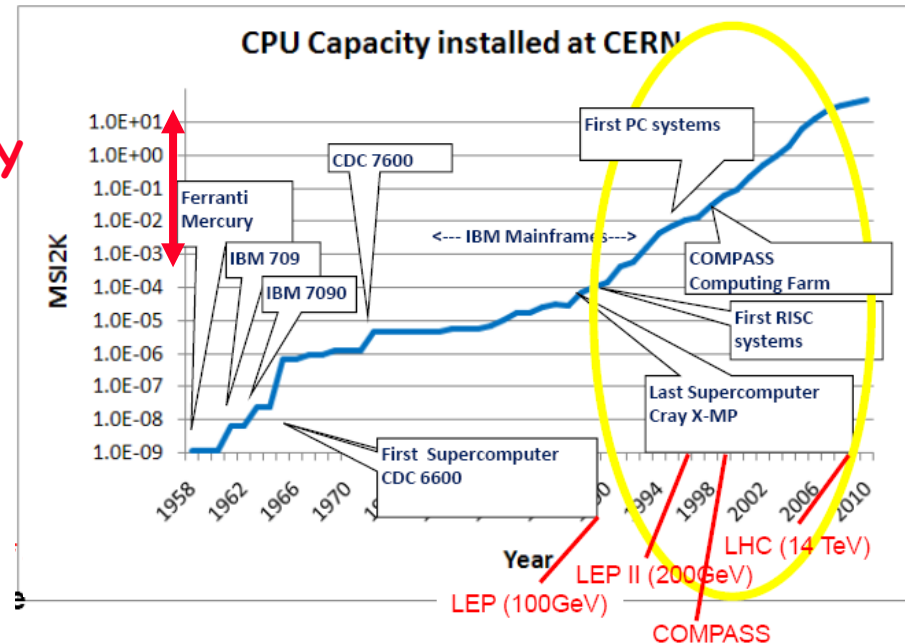
computing power and techniques to digest information in the petabyte range

- about CPU capacity:
@ CERN
5 ORDERS OF MAGNITUDE IN 18 Y

- about amount of data:
 - COMPASS > 1 PB / year (running)
 - LHC experiments: > 10 PB / year corresponding to a column of CD's about 20 km high !

- about techniques: **the GRID**
 - an infrastructure that provides seamless access to computing power and data storage capacity distributed over the globe

a new global tool after WWW (invented at CERN)



Computer Farm



Yesterday (2001): The Compass Trieste Farm

- "White box" dual single core 1 GHz processor PCs, 512 MB RAM (~ 0.8 kSI2k)
- PC disk servers (up to 1 TB/machine), few TB of total storage

First Computer Farm in Italy completely managed by **INFN**

computer farm is a group of networked servers that are housed in one location. A computer farm streamlines internal processes by distributing the workload between the individual components of the farm and expedites computing processes by harnessing the power of multiple servers. The farms rely on load-balancing software that accomplishes such tasks as tracking demand for processing power from different machines, prioritizing the tasks and scheduling and rescheduling them depending on priority and demand that users put on the network. When one server in the farm fails, another can step in as a backup.

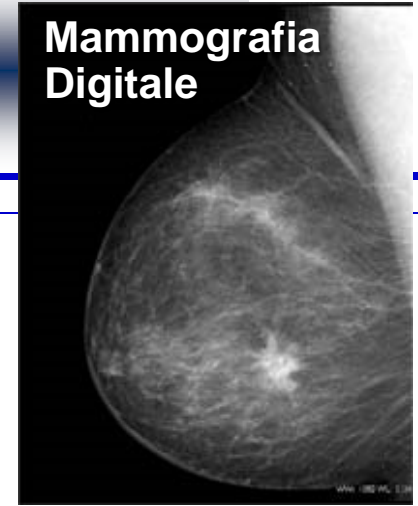
Today (2012): The INFN Trieste Farm

- "Rack-mount" dual quad-core >2.26 GHz processor PCs, 24 GB RAM (360 HEP-SPEC06 = ~ 125 kSI2k)
- General Parallel File System, 124 TB of total storage
- Open to GRID activities

But GRID Tiers, it is one of the biggest

INFN farms installed nowadays





Tecnologie e applicazioni interdisciplinari

■ Applicazioni mediche

- **Diagnostica** (mammografia digitale)
- **Progetto CALMA** : un sistema di acquisizione e di analisi di immagini mammografiche (supporto automatico allo screening)
- **Cura**
 - Tumori dell'occhio a LNS: fasci di protoni dal ciclotrone superconduttore
 - La costruzione del CNAO (Ministero Salute, INFN: co-direzione dell'alta tecnologia): fasci di protoni e ioni di Carbonio per trattamenti oncologici

■ **tecniche non distruttive per la salvaguardia dei beni culturali**

- **Datazione e analisi con tecniche**
 - IBA (Ion Beam Analysis) e
 - AMS (Accelerator Mass Spectrometry)
- **Datazione determinando la presenza di isotopi rari (^{14}C)**

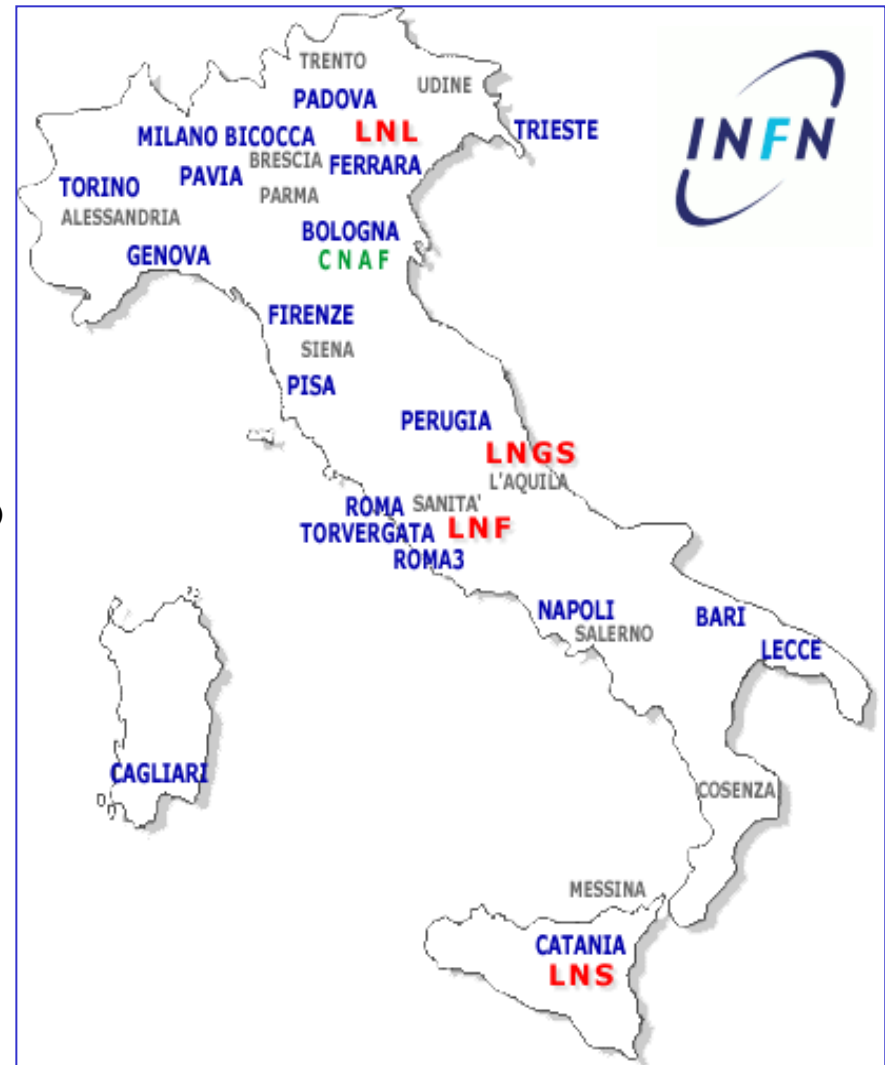


... ECCETERA ...

quanto abbiamo fugacemente visto assieme e' solo un campionario rappresentativo dell'attivita' INFN

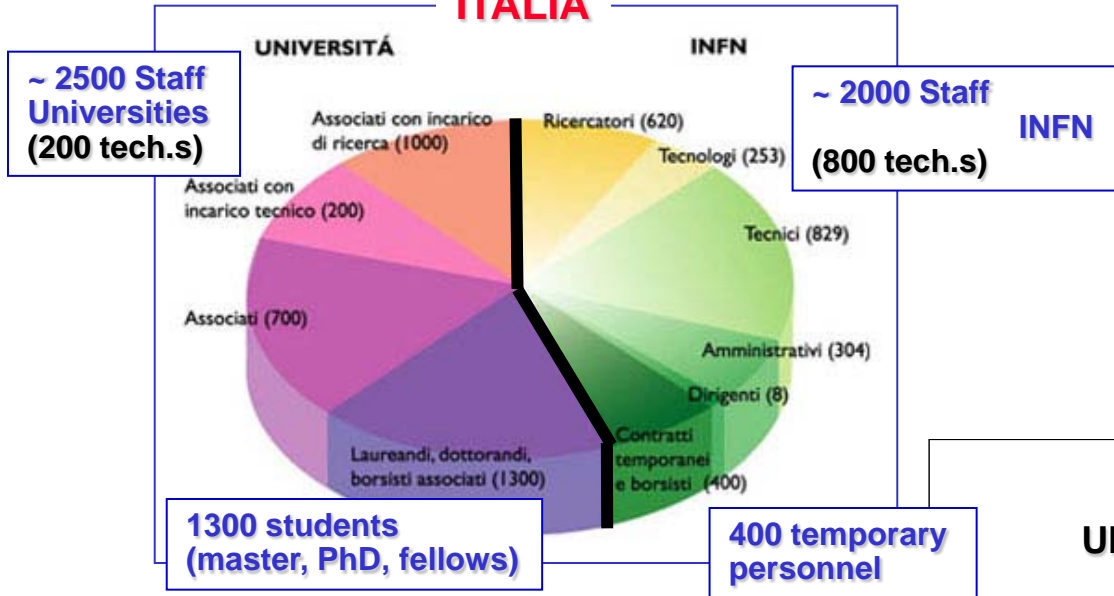
INFN - struttura

- **4 Laboratori Nazionali**
 - **LNL** - Laboratori Nazionali di Legnaro
 - **LNGS** - Laboratori Nazionali del Gran Sasso
 - **LNF** - Laboratori Nazionali di Frascati
 - **LNS** - Laboratori Nazionali del SUD
- **20 "Sezioni" c/o 20 Università (fra cui Trieste)**
- **11 "Gruppi Collegati", c/o Università (fra cui Udine, che è Gruppo collegato di Trieste)**

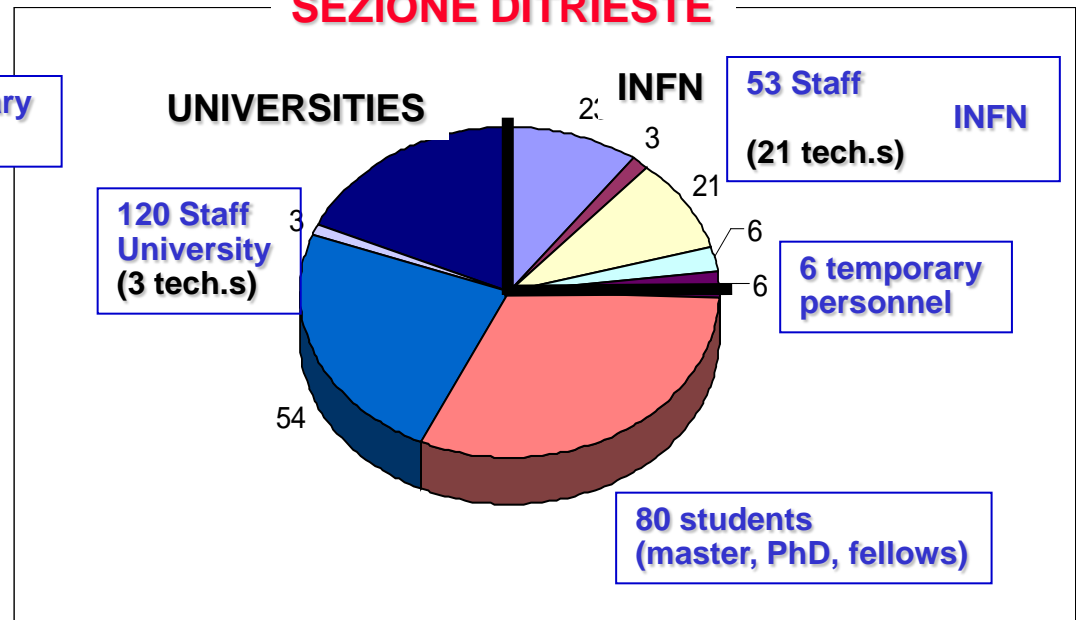


INFN - personale

ITALIA



SEZIONE DI TRIESTE



BUONA GIORNATA CON
LA **PHYSICS MASTERCLASS 2012**
A TRIESTE !!!