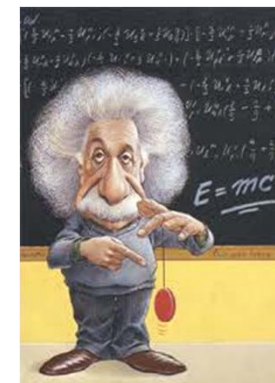




**Fisica:
un passaporto
per nuove frontiere**

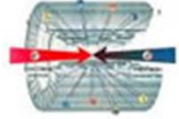


Alessandro Feliciello
I.N.F.N. - Sezione di Torino

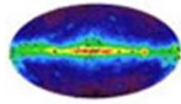
Sommario

- Introduzione
 - fisica delle **particelle**
 - fisica **nucleare**
- Come nasce un esperimento
 - l'esperimento **OBELIX**
 - l'esperimento **FINUDA**
- Un po' di attualità
 - primi risultati da **LHC**
 - il **neutrino** ~~superluminare~~
- Le ricadute tecnologiche
 - strumenti di calcolo
 - **web** e **GRID**
 - applicazioni **mediche**
 - studio e salvaguardia di **beni culturali**

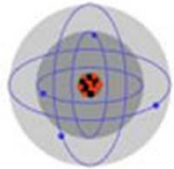
L'Istituto Nazionale di Fisica Nucleare



I. fisica delle particelle



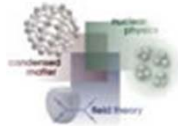
II. astrofisica particellare



III. fisica nucleare

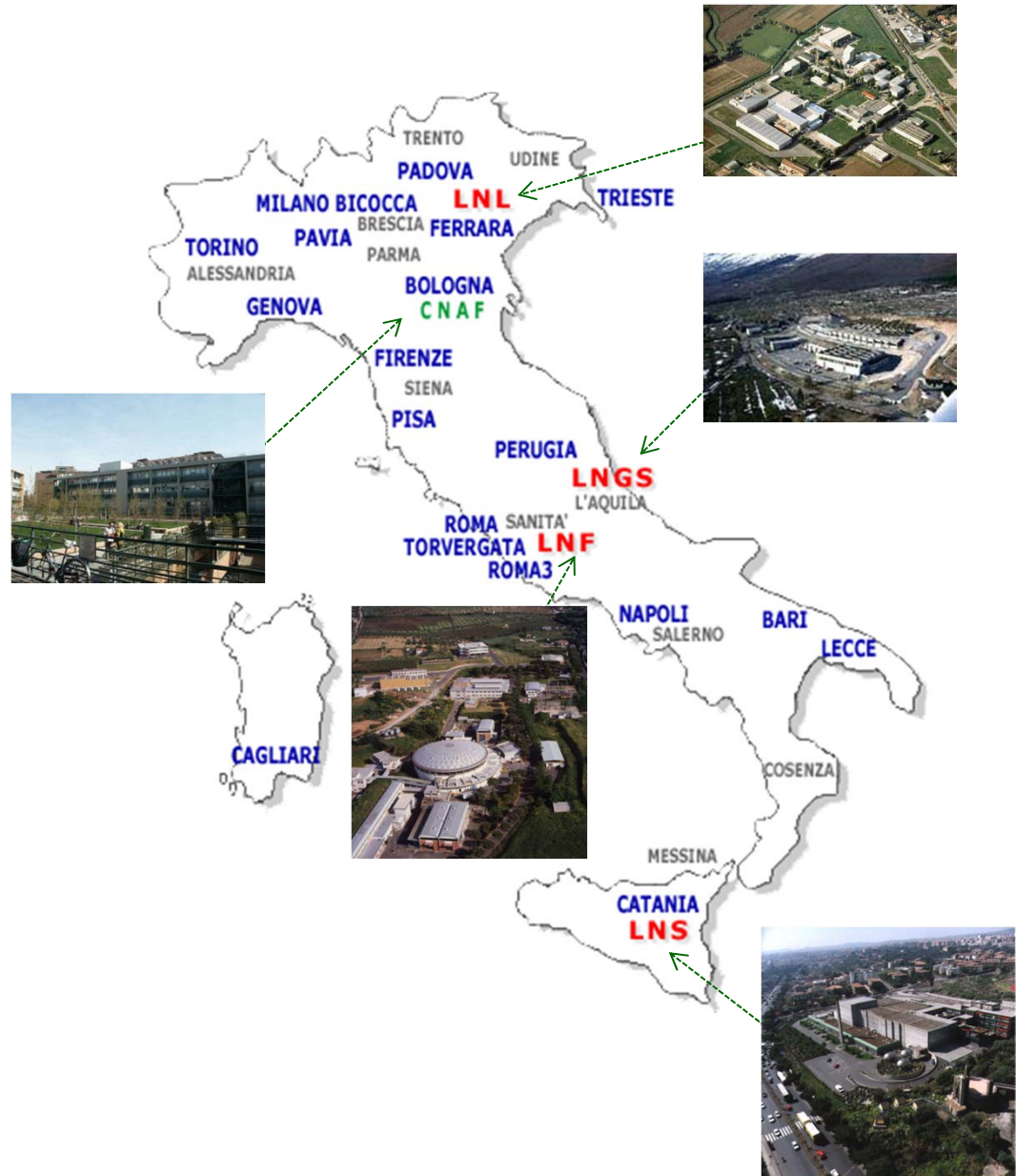


V. ricerca tecnologica



IV. fisica teorica

<http://www.infn.it>



Le domande fondamentali

L'uomo da sempre si chiede:

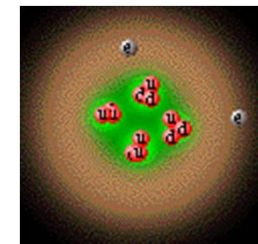
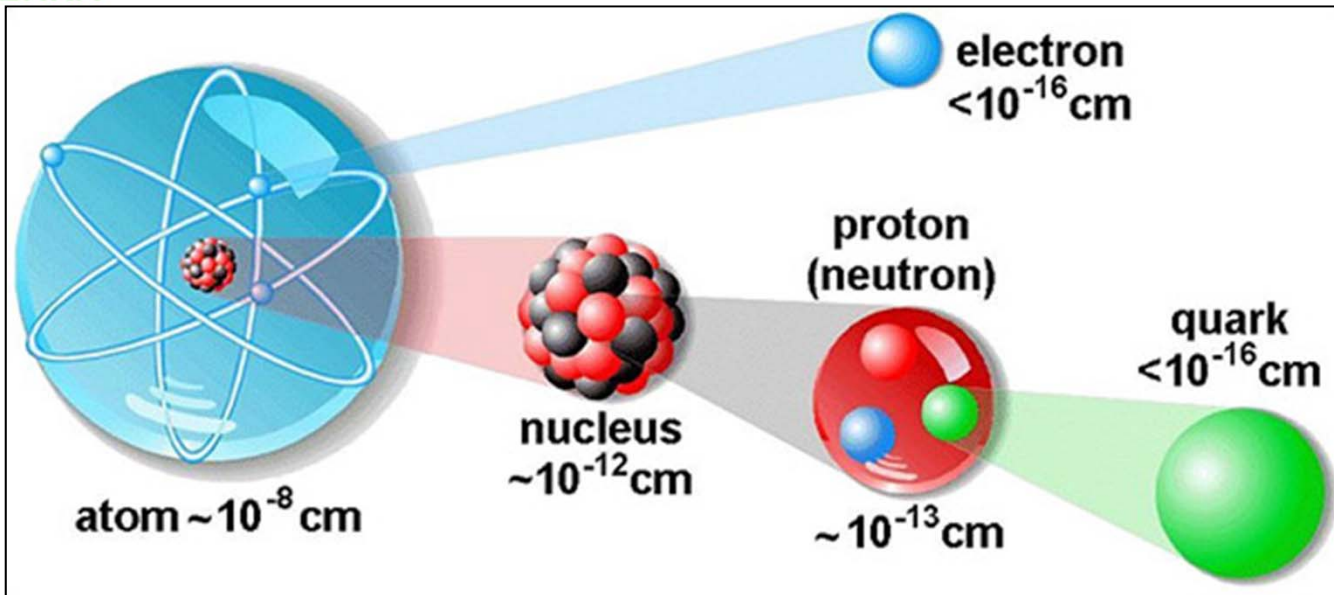
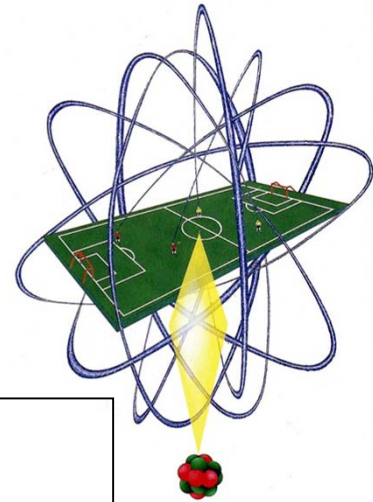
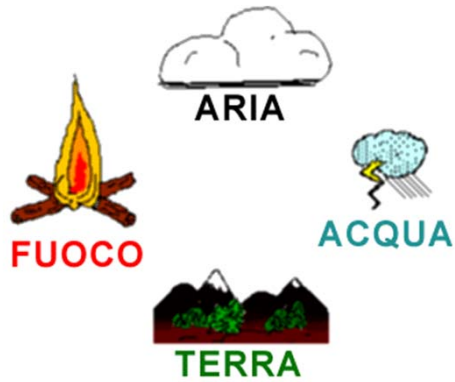
di che cosa è composta la materia?

cosa la tiene insieme?

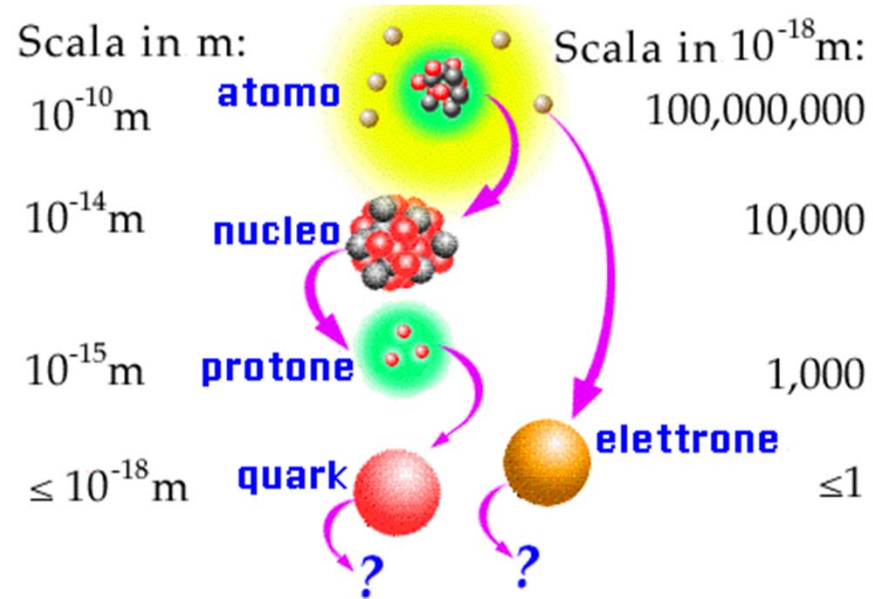
cosa genera la massa?



Di che cosa è costituita la materia?

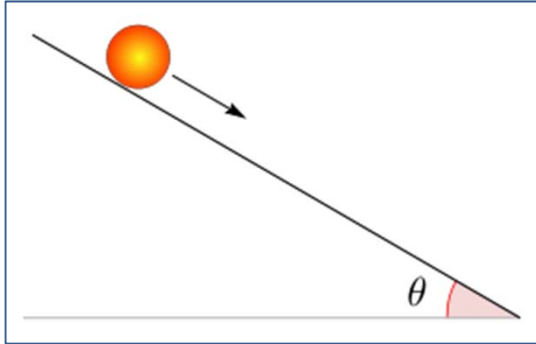


Le dimensioni del problema



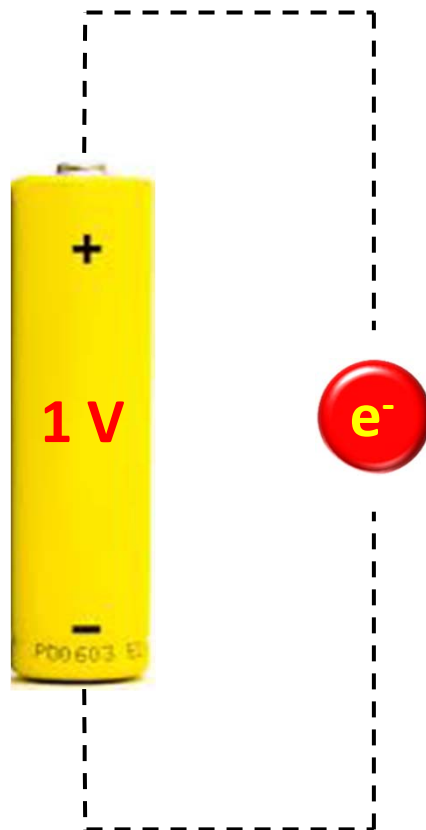
Valore	Potenza di 10	Prefisso	Simbolo
1.000.000.000.000.000.000	10^{18}	<u>Exa</u>	E
1.000.000.000.000.000	10^{15}	<u>Peta</u>	P
1.000.000.000.000	10^{12}	<u>Tera</u>	T
1.000.000.000	10^9	<u>Giga</u>	G
1.000.000	10^6	<u>Mega</u>	M
1.000	10^3	<u>Chilo</u>	k
100	10^2	<u>Etto</u>	h
10	10	<u>Deca</u>	da
0,1	10^{-1}	<u>Deci</u>	d
0,01	10^{-2}	<u>Centi</u>	c
0,001	10^{-3}	<u>Milli</u>	m
0,000001	10^{-6}	<u>Micro</u>	μ
0,000000001	10^{-9}	<u>Nano</u>	n
0,0000000000001	10^{-12}	<u>Pico</u>	p
0,0000000000000001	10^{-15}	<u>Femto</u>	f
0,0000000000000000001	10^{-18}	<u>Atto</u>	a

Le energie in gioco



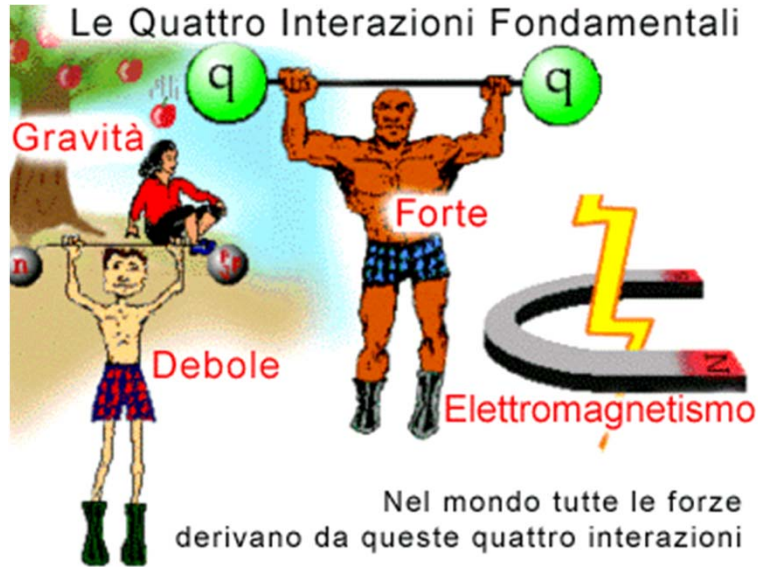
1 eV corrisponde all'aumento di energia di un elettrone sottoposto ad una differenza di potenziale di 1 V.

- 1 eV = $1,6 \times 10^{-19}$ Joule
- 1 MeV = 10^6 eV
- 1 GeV = 10^9 eV
- 1 TeV = 10^{12} eV



1 TeV è circa l'energia cinetica di una zanzara!

Che cosa tiene insieme la materia?



- forte
- elettromagnetica
- debole
- gravitazionale

	intensità	raggio d'azione
• forte	10^{38}	$\approx 10^{-15}$ m
• elettromagnetica	10^{36}	∞
• debole	10^{25}	$\approx 10^{-18}$ m
• gravitazionale	1	∞

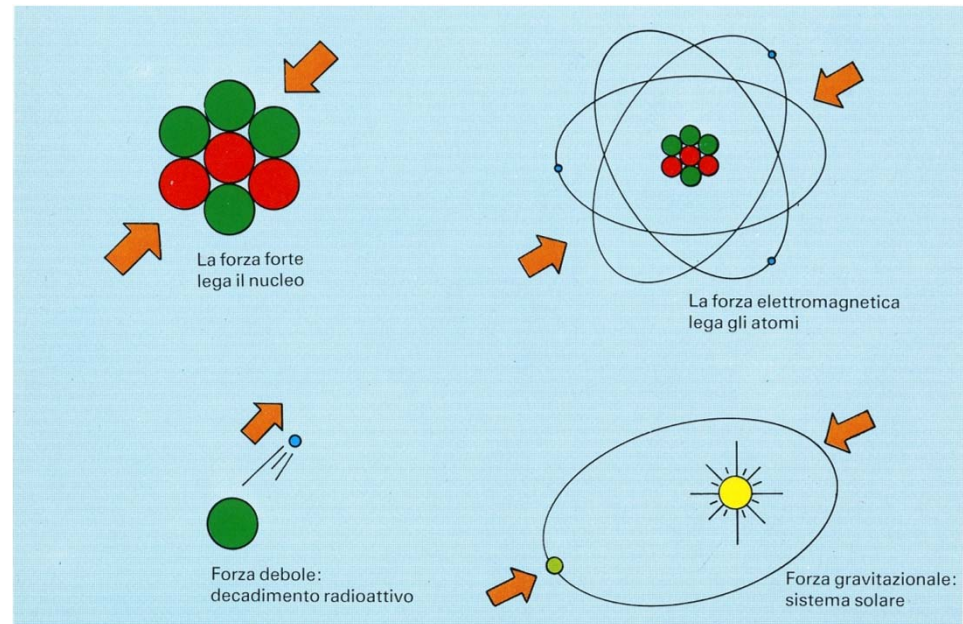


Tavola del modello standard

Standard Model of FUNDAMENTAL PARTICLES AND INTERACTIONS

The Standard Model summarizes the current knowledge in Particle Physics. It is the quantum theory that includes the theory of strong interactions (quantum chromodynamics or QCD) and the unified theory of weak and electromagnetic interactions (electroweak). Gravity is included on this chart because it is one of the fundamental interactions even though not part of the "Standard Model."

FERMIONS

Leptons spin = 1/2			Quarks spin = 1/2		
Flavor	Mass GeV/c ²	Electric charge	Flavor	Approx. Mass GeV/c ²	Electric charge
ν_e electron neutrino	$<1 \times 10^{-8}$	0	u up	0.003	2/3
e electron	0.000511	-1	d down	0.006	-1/3
ν_μ muon neutrino	<0.0002	0	c charm	1.3	2/3
μ muon	0.106	-1	s strange	0.1	-1/3
ν_τ tau neutrino	<0.02	0	t top	175	2/3
τ tau	1.7771	-1	b bottom	4.3	-1/3

Spin is the intrinsic angular momentum of particles. Spin is given in units of \hbar , which is the quantum unit of angular momentum, where $\hbar = h/2\pi = 6.58 \times 10^{-25}$ GeV s = 1.05×10^{-34} J s.

Electric charges are given in units of the proton's charge. In SI units the electric charge of the proton is 1.60×10^{-19} coulombs.

The **energy** unit of particle physics is the electronvolt (eV), the energy gained by one electron in crossing a potential difference of one volt. **Masses** are given in GeV/c² (remember $E = mc^2$), where $1 \text{ GeV} = 10^9 \text{ eV} = 1.60 \times 10^{-10}$ joule. The mass of the proton is $0.938 \text{ GeV}/c^2 = 1.67 \times 10^{-27} \text{ kg}$.

matter constituents
spin = 1/2, 3/2, 5/2, ...

BOSONS

force carriers
spin = 0, 1, 2, ...

Unified Electroweak spin = 1			Strong (color) spin = 1		
Name	Mass GeV/c ²	Electric charge	Name	Mass GeV/c ²	Electric charge
γ photon	0	0	g gluon	0	0
W⁻	80.4	-1			
W⁺	80.4	+1			
Z⁰	91.187	0			

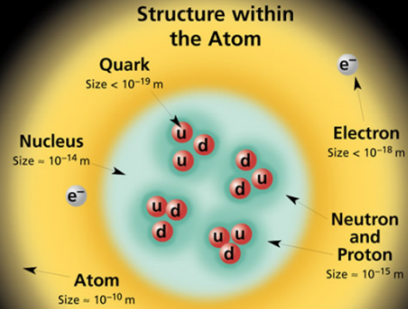
Color Charge
Each quark carries one of three types of "strong charge," also called "color charge." These charges have nothing to do with the colors of visible light. There are eight possible types of color charge for gluons. Just as electrically-charged particles interact by exchanging photons, in strong interactions color-charged particles interact by exchanging gluons. Leptons, photons, and **W** and **Z** bosons have no strong interactions and hence no color charge.

Quarks Confined in Mesons and Baryons

One cannot isolate quarks and gluons; they are confined in color-neutral particles called **hadrons**. This confinement (binding) results from multiple exchanges of gluons among the color-charged constituents. As color-charged particles (quarks and gluons) move apart, the energy in the color-force field between them increases. This energy eventually is converted into additional quark-antiquark pairs (see figure below). The quarks and antiquarks then combine into hadrons; these are the particles seen to emerge. Two types of hadrons have been observed in nature: **mesons** $q\bar{q}$ and **baryons** qqq .

Residual Strong Interaction

The strong binding of color-neutral protons and neutrons to form nuclei is due to residual strong interactions between their color-charged constituents. It is similar to the residual electrical interaction that binds electrically neutral atoms to form molecules. It can also be viewed as the exchange of mesons between the hadrons.



If the protons and neutrons in this picture were 10 cm across, then the quarks and electrons would be less than 0.1 mm in size and the entire atom would be about 10 km across.

PROPERTIES OF THE INTERACTIONS

Baryons qqq and Antibaryons $\bar{q}\bar{q}\bar{q}$					
Baryons are fermionic hadrons. There are about 120 types of baryons.					
Symbol	Name	Quark content	Electric charge	Mass GeV/c ²	Spin
p	proton	uud	1	0.938	1/2
\bar{p}	anti-proton	$\bar{u}\bar{u}\bar{d}$	-1	0.938	1/2
n	neutron	udd	0	0.940	1/2
\bar{n}	anti-neutron	$\bar{u}\bar{d}\bar{d}$	0	0.940	1/2
Λ	lambda	uds	0	1.116	1/2
Ω^-	omega	sss	-1	1.672	3/2

Property	Interaction	Strong			
		Gravitational	Weak (Electroweak)	Electromagnetic	Residual
Acts on:		Mass - Energy	Flavor	Electric Charge	Color Charge
Particles experiencing:		All	Quarks, Leptons	Electrically charged	Quarks, Gluons
Particles mediating:		Graviton (not yet observed)	W⁺ W⁻ Z⁰	γ	Gluons
Strength relative to electromag. for two u quarks at:	10^{-18} m $3 \times 10^{-17} \text{ m}$	10^{-41} 10^{-41} 10^{-36}	0.8 10^{-4} 10^{-7}	1 1 1	25 60 Not applicable to hadrons
for two protons in nucleus					20

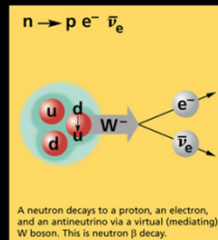
Mesons $q\bar{q}$					
Mesons are bosonic hadrons. There are about 140 types of mesons.					
Symbol	Name	Quark content	Electric charge	Mass GeV/c ²	Spin
π^+	pion	u\bar{d}	+1	0.140	0
K^-	kaon	s\bar{u}	-1	0.494	0
ρ^+	rho	u\bar{d}	+1	0.770	1
B^0	B-zero	d\bar{b}	0	5.279	0
η_c	eta-c	c\bar{c}	0	2.980	0

Matter and Antimatter

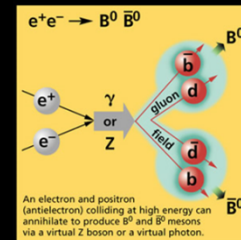
For every particle type there is a corresponding antiparticle type, denoted by a bar over the particle symbol (unless + or - charge is shown). Particle and antiparticle have identical mass and spin but opposite charges. Some electrically neutral bosons (e.g., Z^0 , γ , and $\eta_c = c\bar{c}$, but not $K^0 = d\bar{s}$) are their own antiparticles.

Figures

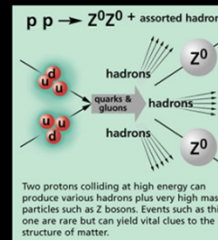
These diagrams are an artist's conception of physical processes. They are not exact and have no meaningful scale. Green shaded areas represent the cloud of gluons or the gluon field, and red lines the quark paths.



A neutron decays to a proton, an electron, and an antineutrino via a virtual (mediating) W^- boson. This is neutron β decay.



An electron and positron (antielectron) colliding at high energy can annihilate to produce B^0 and \bar{B}^0 mesons via a virtual Z boson or a virtual photon.



Two protons colliding at high energy can produce various hadrons plus very high mass particles such as Z^0 bosons. Events such as this one are rare but can yield vital clues to the structure of matter.

The Particle Adventure

Visit the award-winning web feature *The Particle Adventure* at <http://ParticleAdventure.org>

This chart has been made possible by the generous support of:

U.S. Department of Energy
U.S. National Science Foundation
Lawrence Berkeley National Laboratory
Stanford Linear Accelerator Center
American Physical Society, Division of Particles and Fields
BURLE INDUSTRIES, INC.

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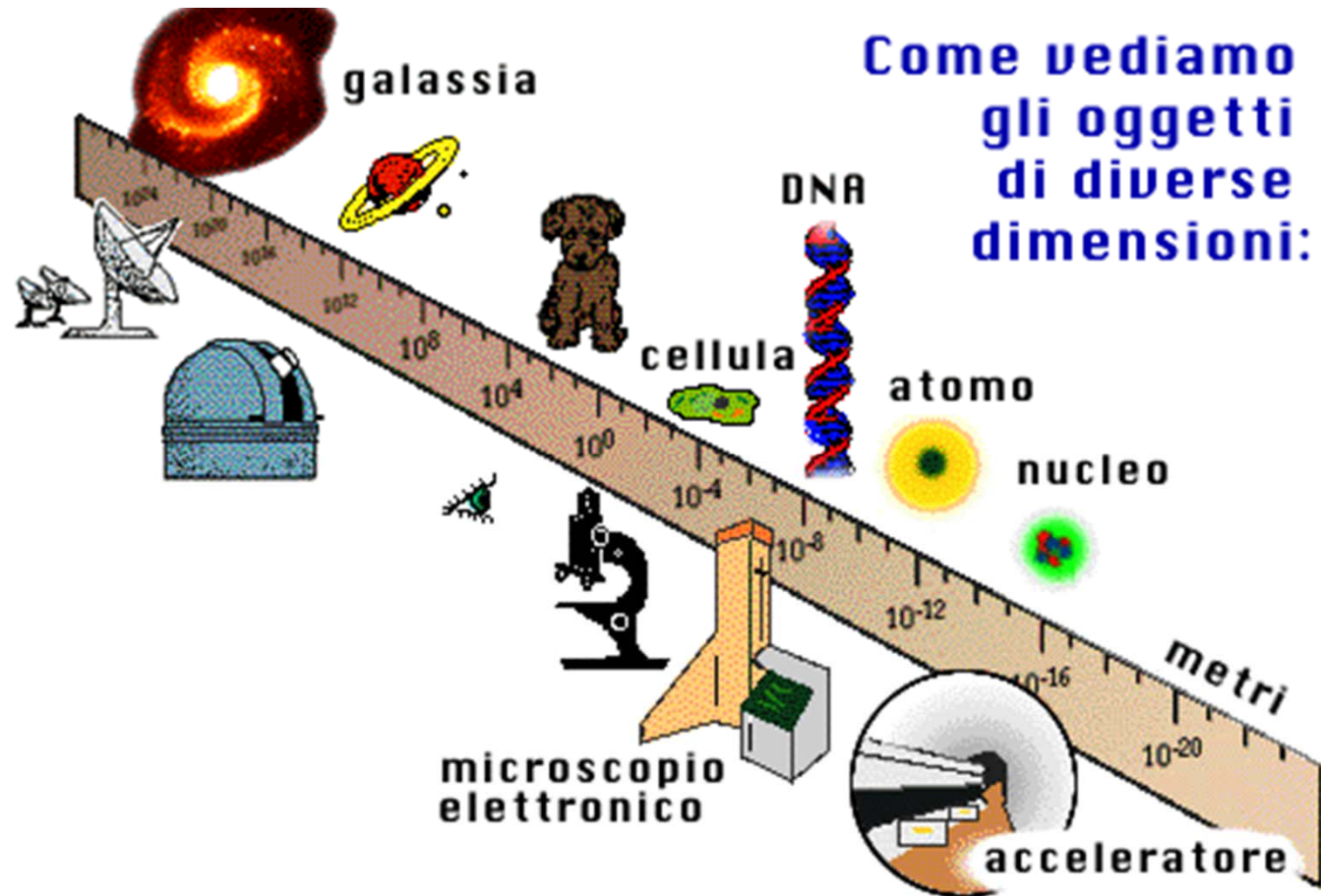
<http://CPEPweb.org>

Un martello sempre più grande!

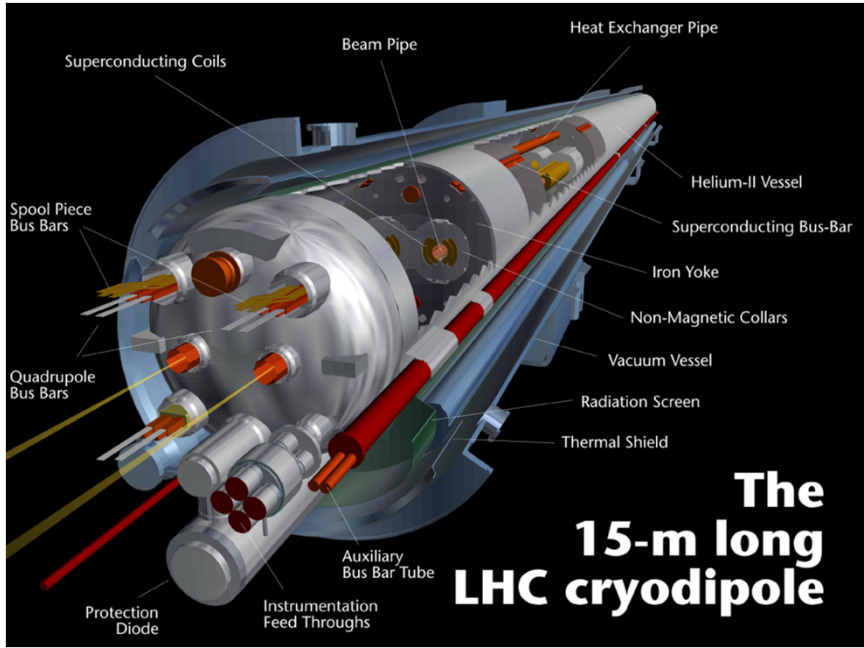


PRIMA

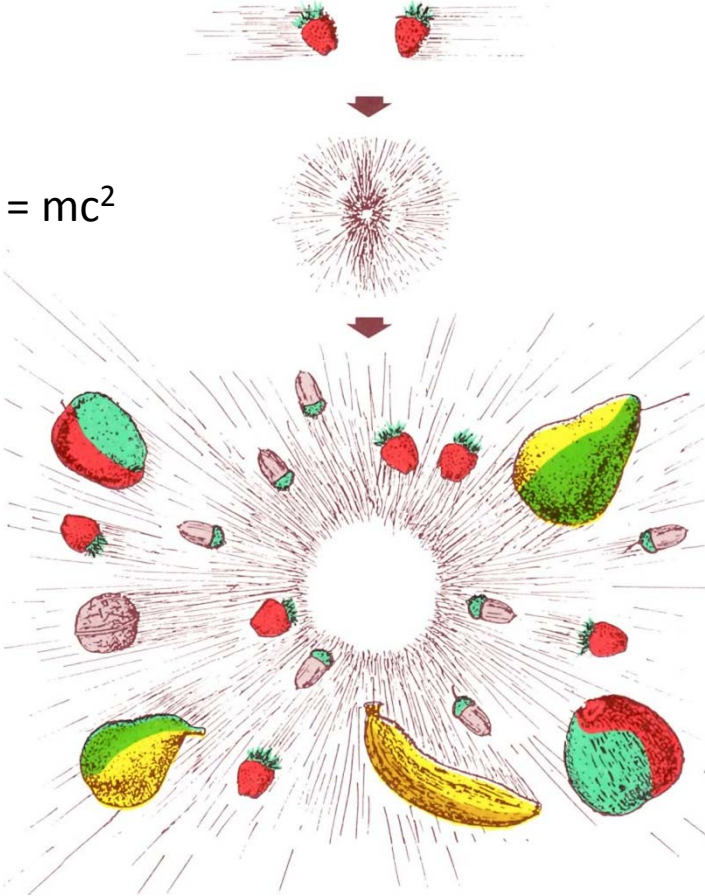
Lo strumento adatto



L'acceleratore LHC



$$E = mc^2$$



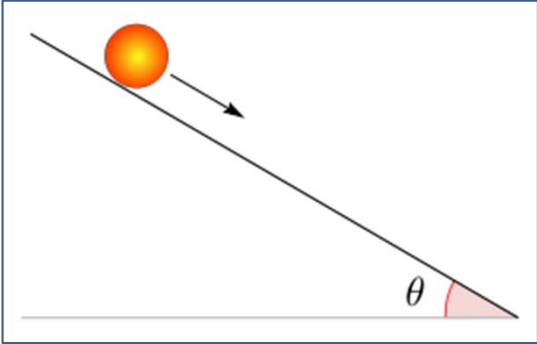
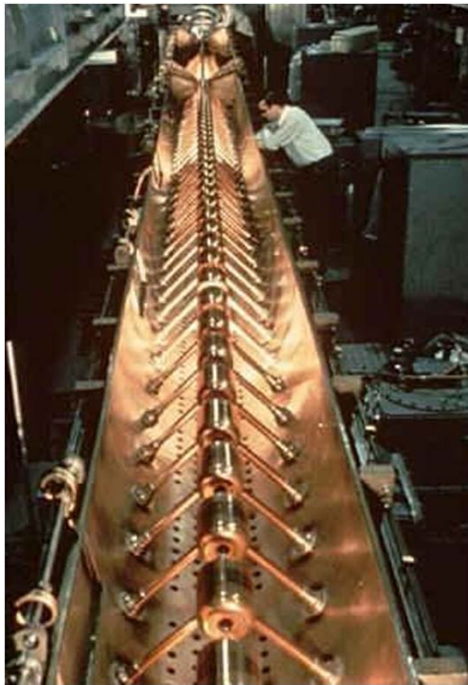
A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



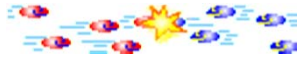
Gli acceleratori lineari



Il primo acceleratore di particelle realizzato a Cambridge da Cockroft e Walton nel 1932

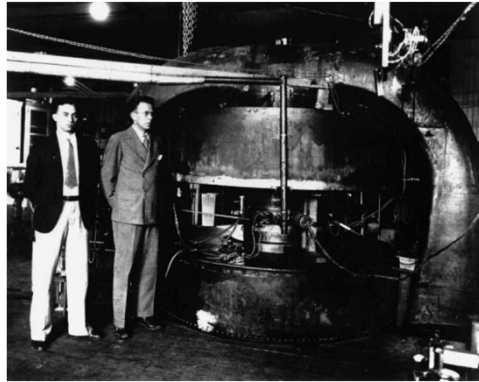
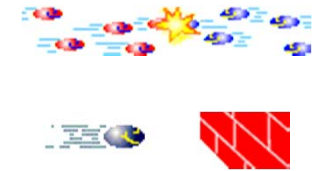


esperimenti a bersaglio fisso

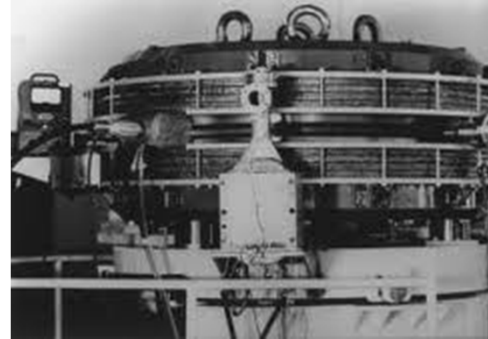


esperimenti con fasci collidenti

Gli acceleratori circolari



ciclotrone
(1929)



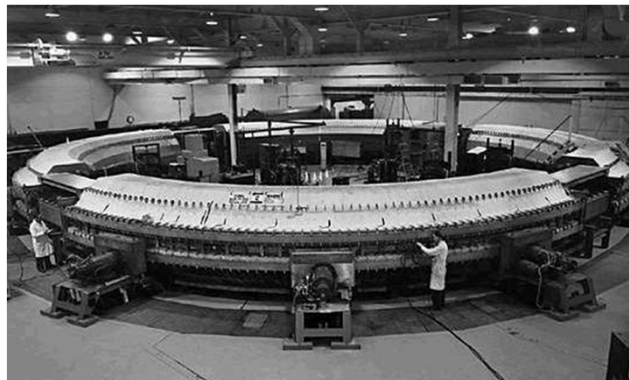
A.d.A.
(1961-1964)



betatrone
(6 MeV, 1942)



Adone
(1969-1993)



sincrotrone
(1952)



DA ΦNE
(2000- ...)

Gestire la complessità del sistema



LHC
(2008- ...)



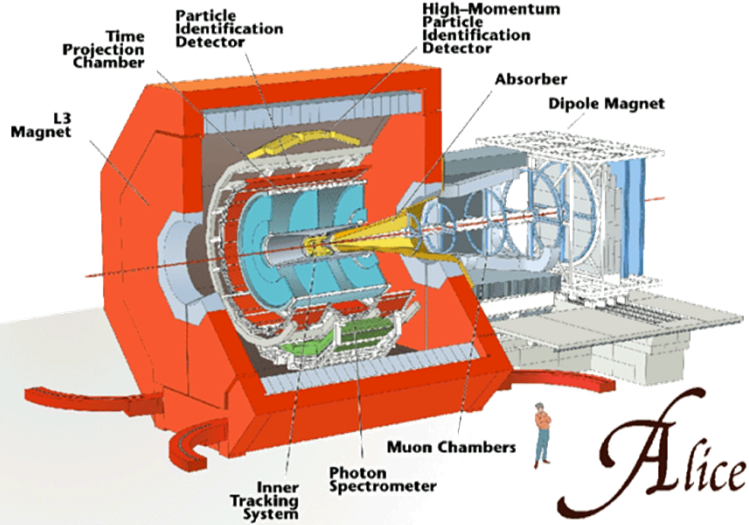
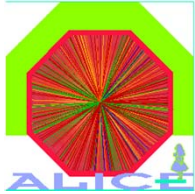
Sala controllo missioni spaziali Apollo
(1969)



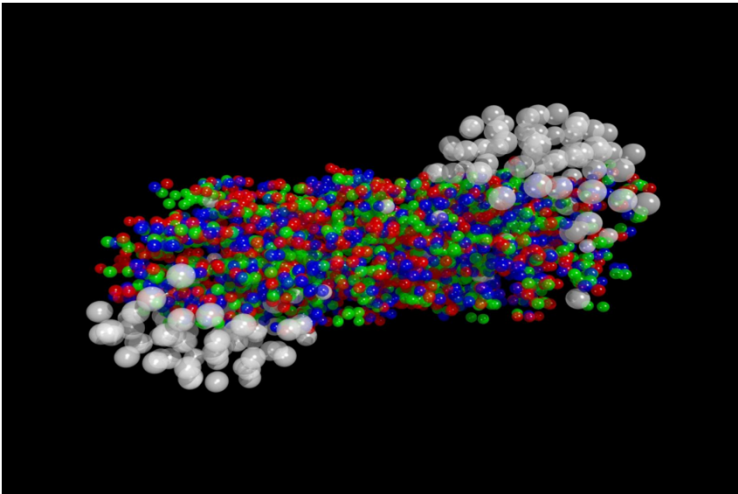
Sala di controllo principale
acceleratore LHC
(2008)



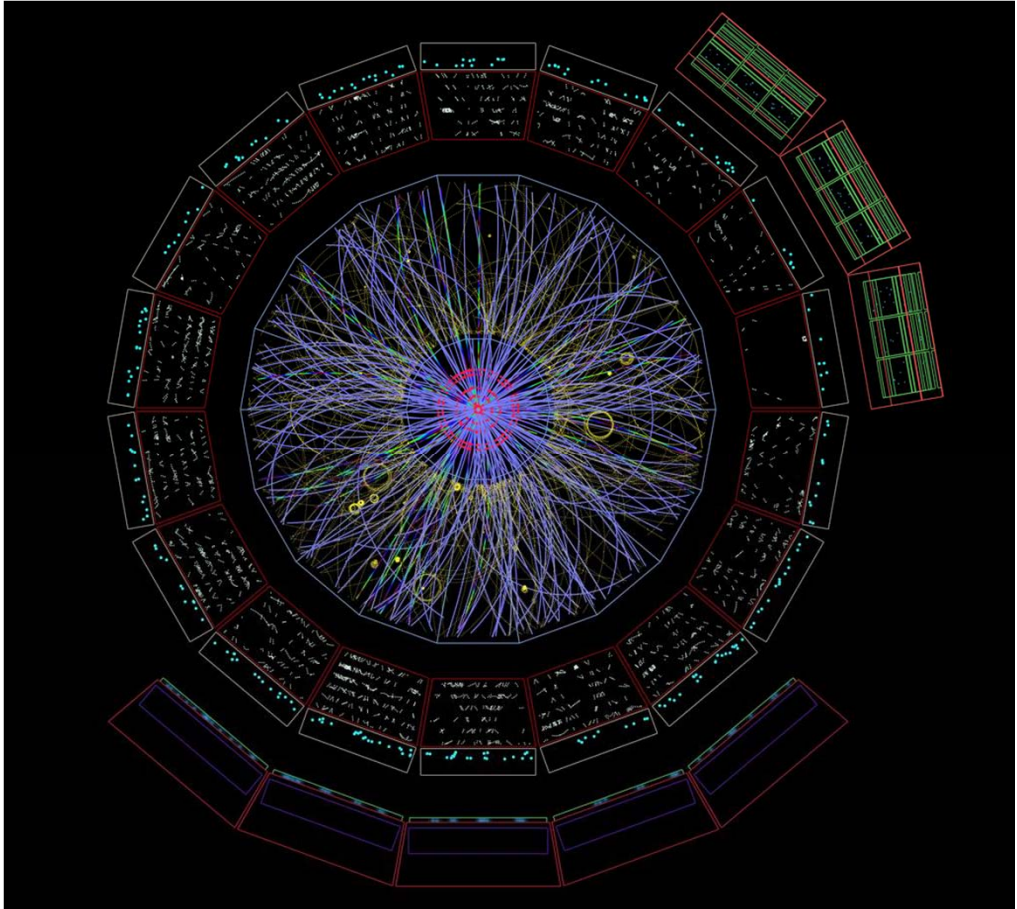
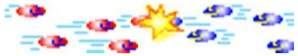
L'esperimento ALICE



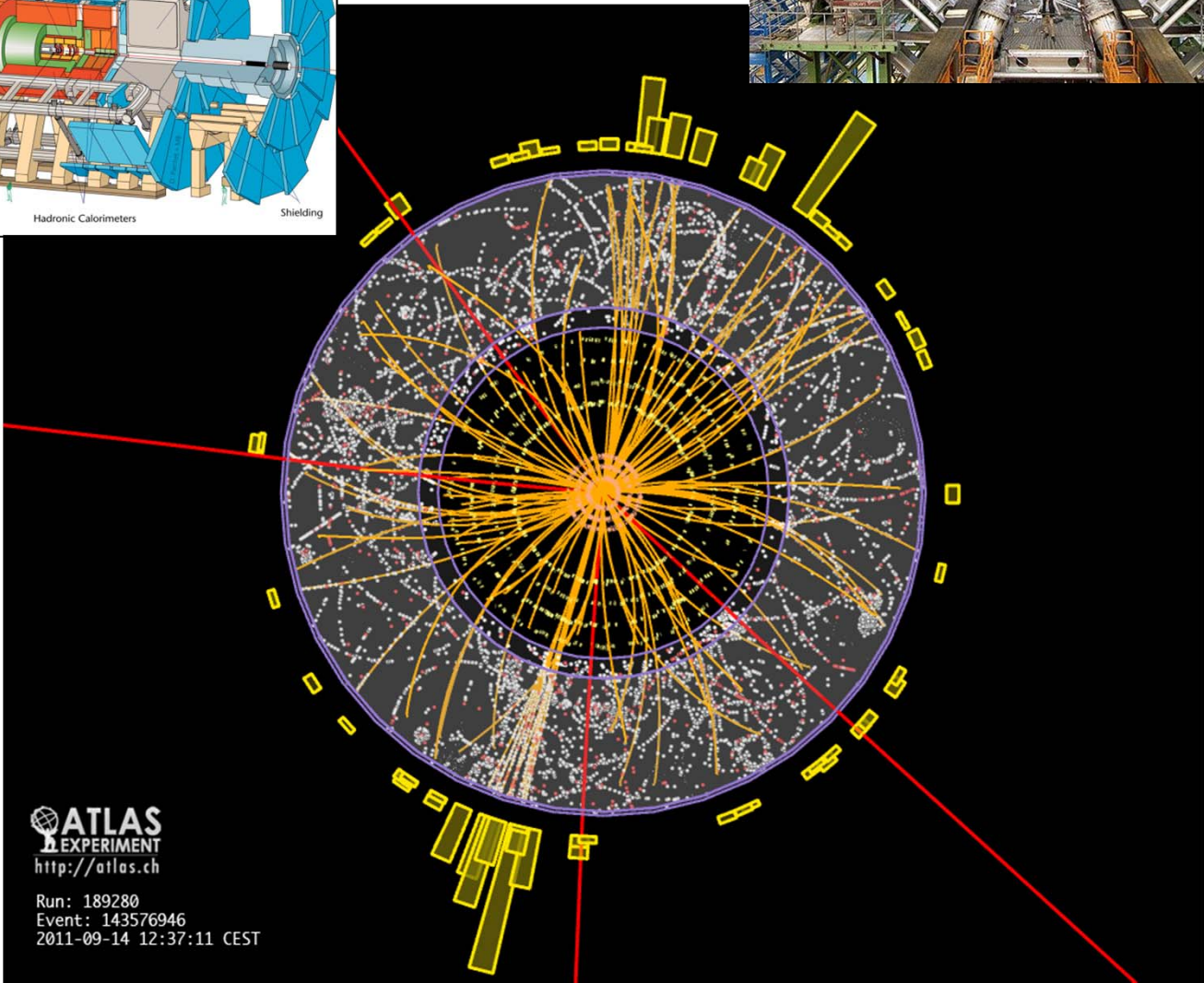
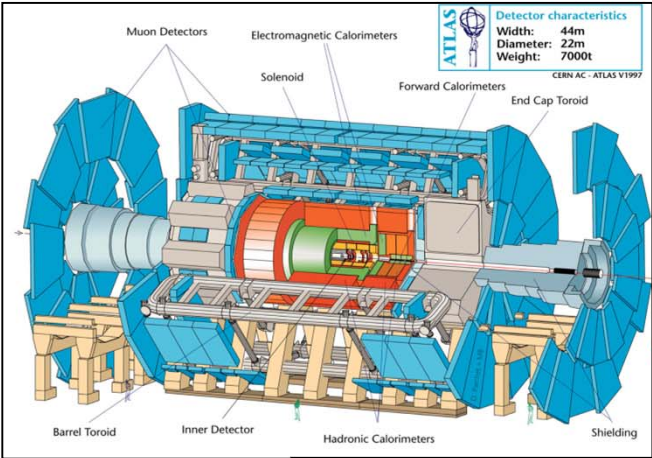
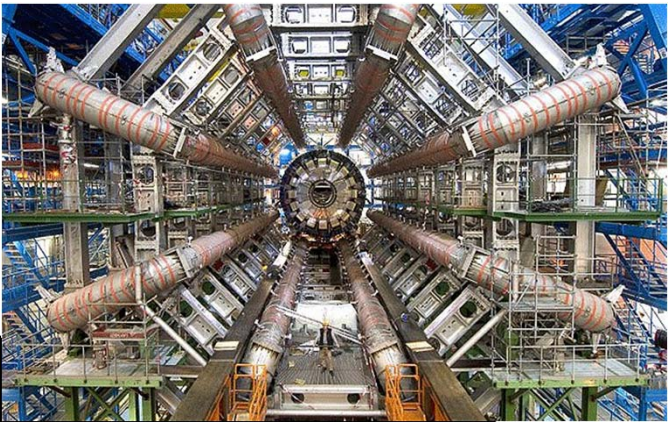
Alice



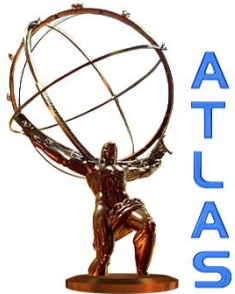
Pb + Pb @ 7 TeV



L'esperimento ATLAS



A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012

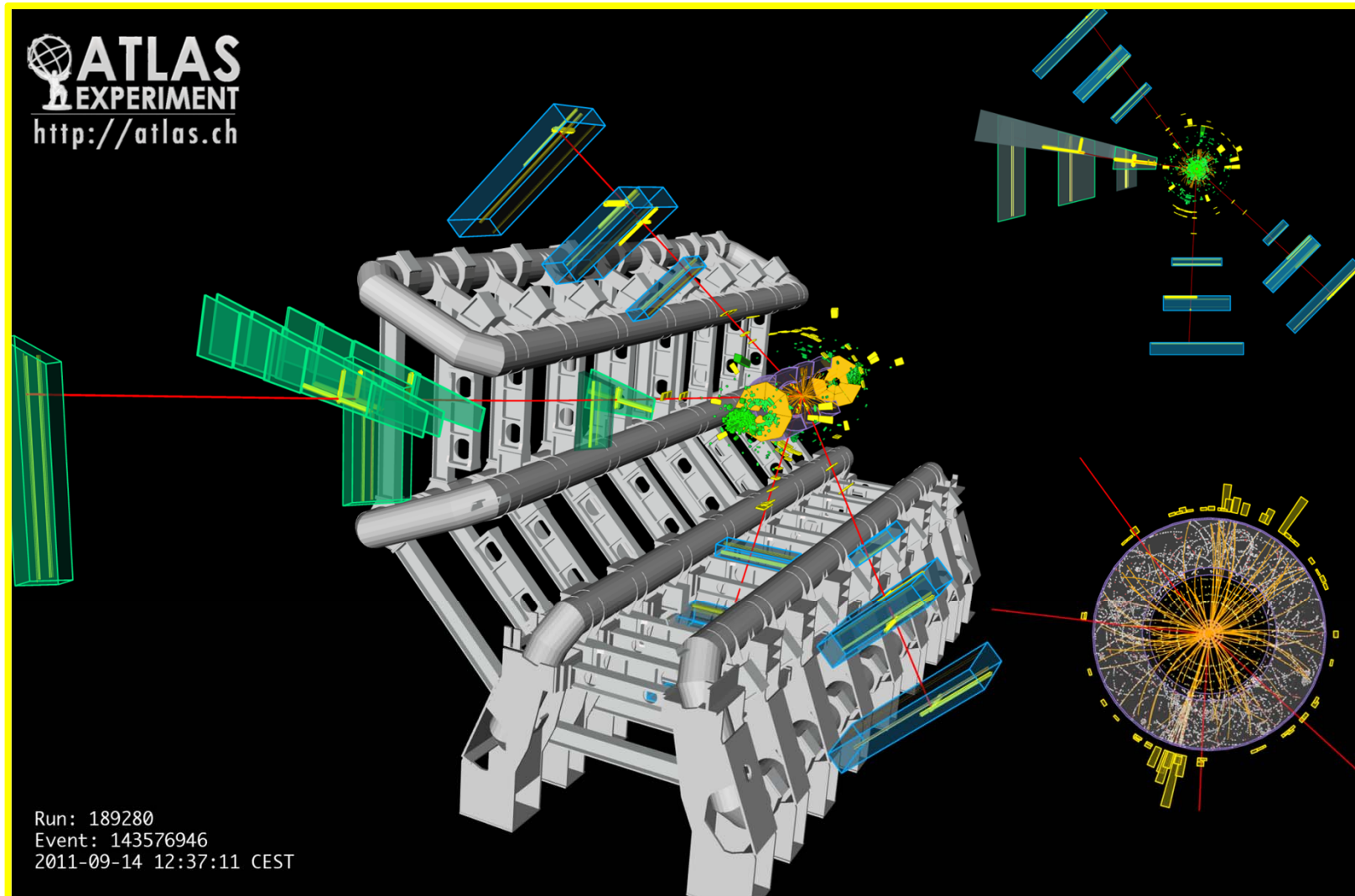


ATLAS
EXPERIMENT
<http://atlas.ch>

Run: 189280
Event: 143576946
2011-09-14 12:37:11 CEST



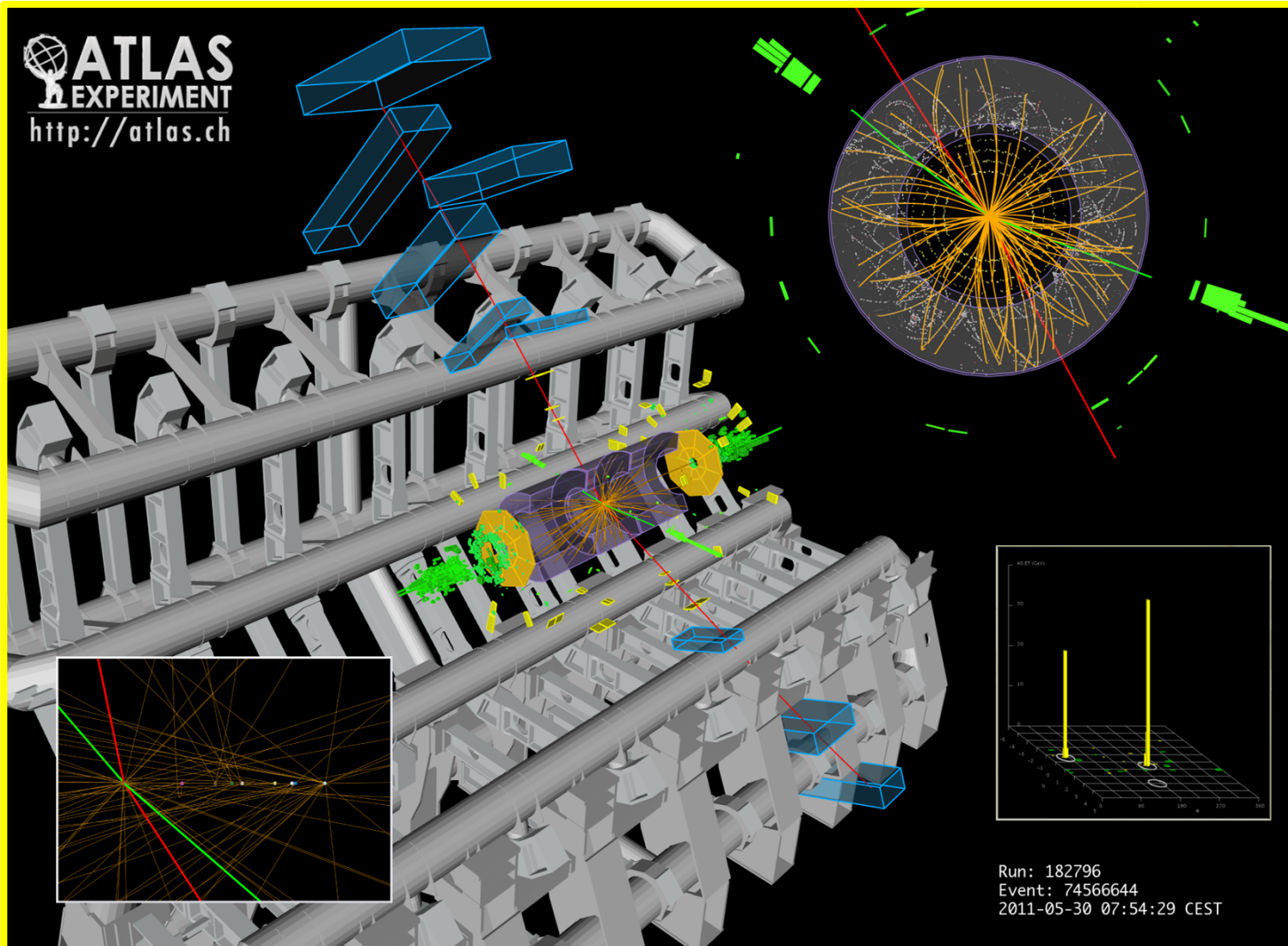
Il (famigerato) bosone di Higgs



4μ candidate with $m_{4\mu} = 124.6$ GeV

$p_T(\mu^-, \mu^+, \mu^+, \mu^-) = 61.2, 33.1, 17.8, 11.6$ GeV

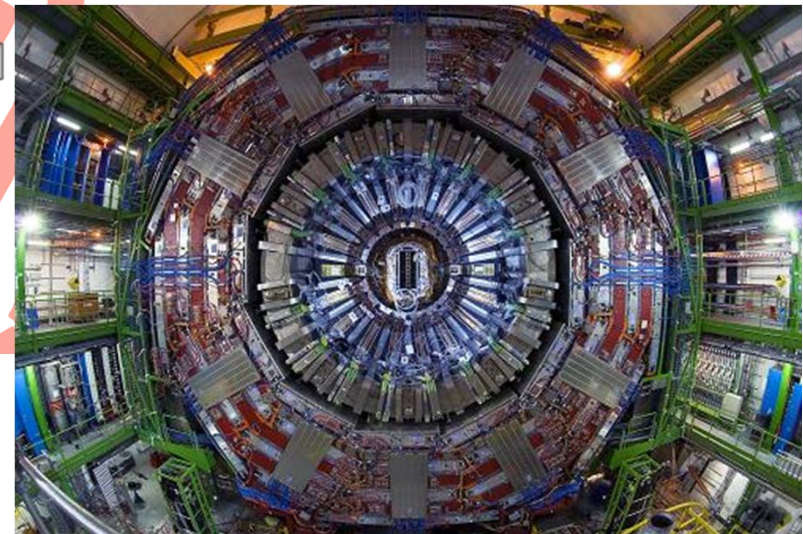
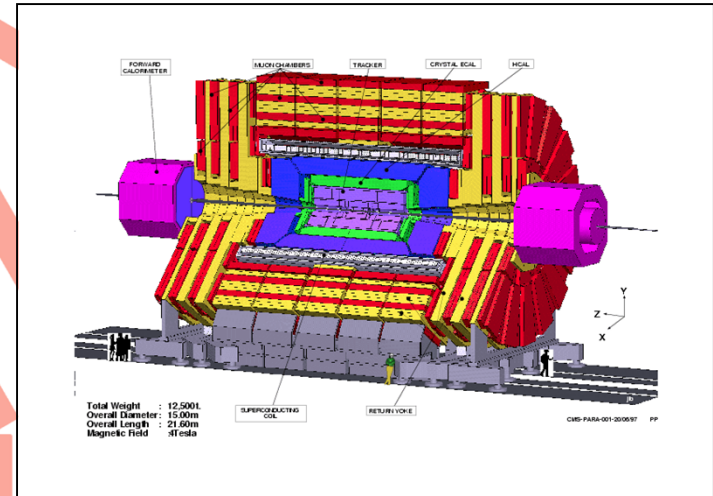
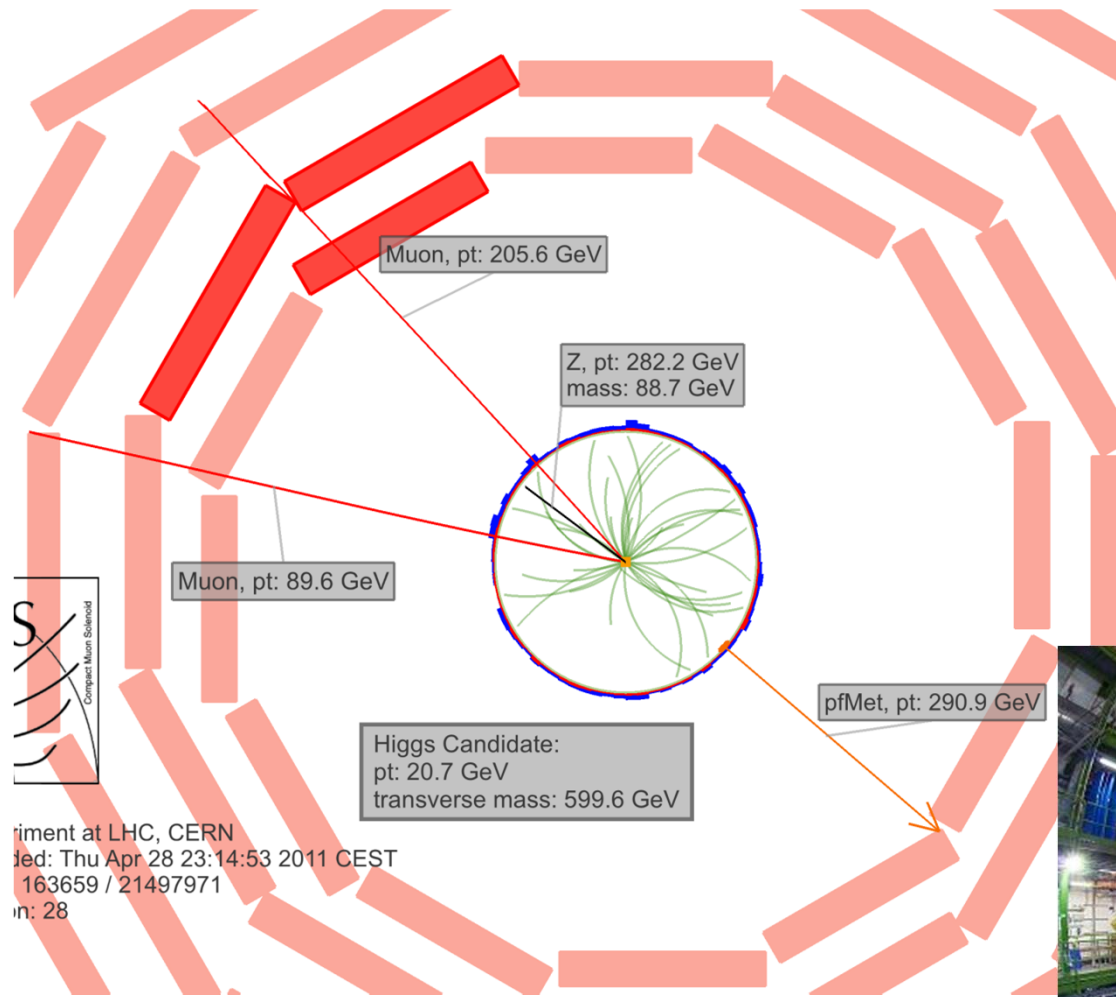
Il (famigerato) bosone di Higgs



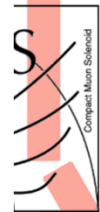
$2e2\mu$ candidate with $m_{2e2\mu} = 124.3$ GeV

$p_T(e^+, e^-, \mu^-, \mu^+) = 41.5, 26.5, 24.7, 18.3$ GeV

L'esperimento CMS



A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012

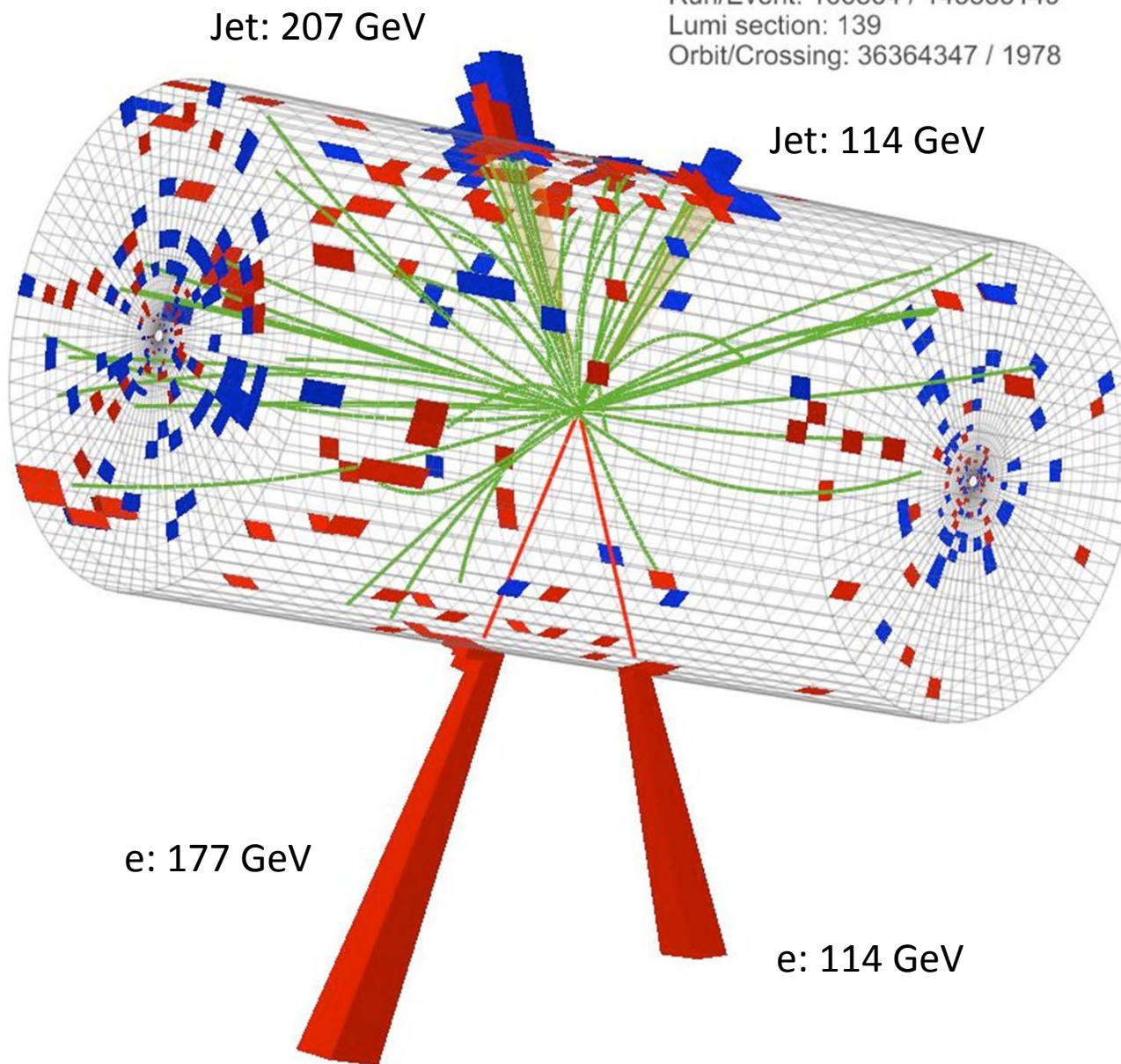


Experiment at LHC, CERN
 Date: Thu Apr 28 23:14:53 2011 CEST
 ID: 163659 / 21497971
 Page: 28

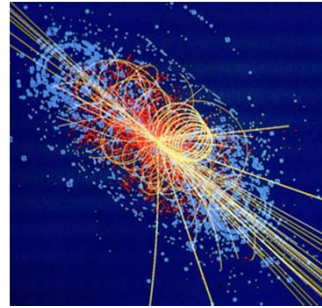
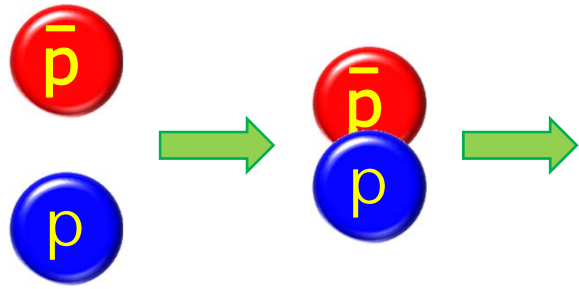
Il (famigerato) bosone di Higgs



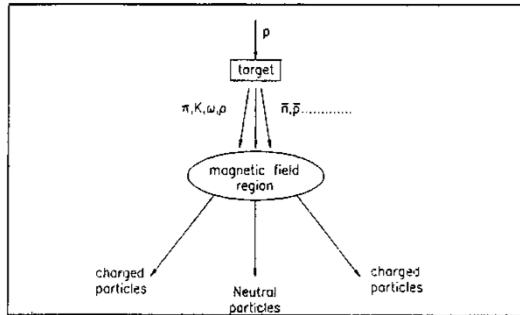
Run/Event: 166864 / 145883149
Lumi section: 139
Orbit/Crossing: 36364347 / 1978



Sperimentare con l'antimateria



$$E = mc^2$$

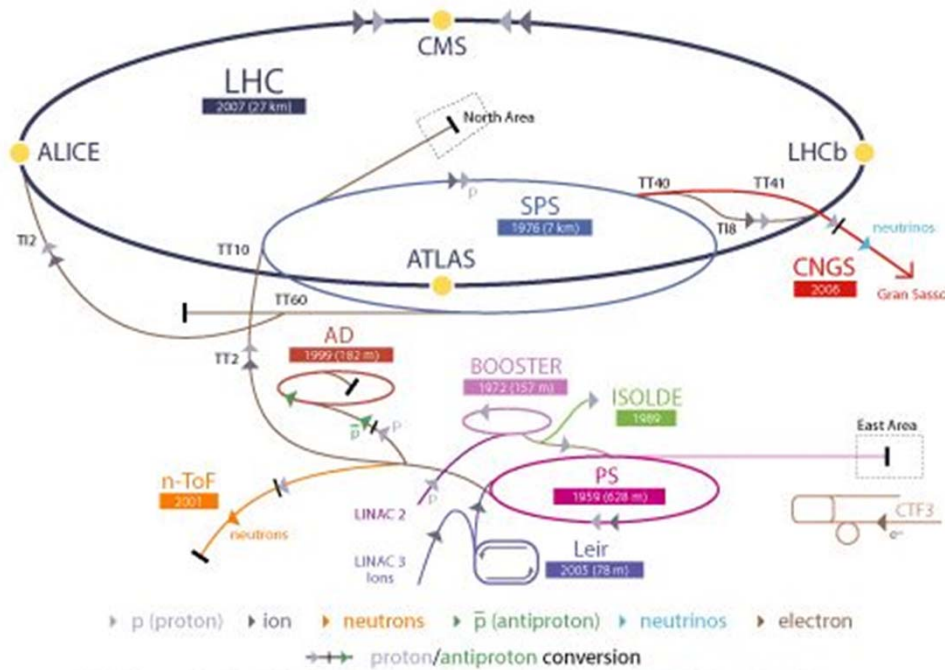


LEAR 1983 - 1996

Il laboratorio CERN



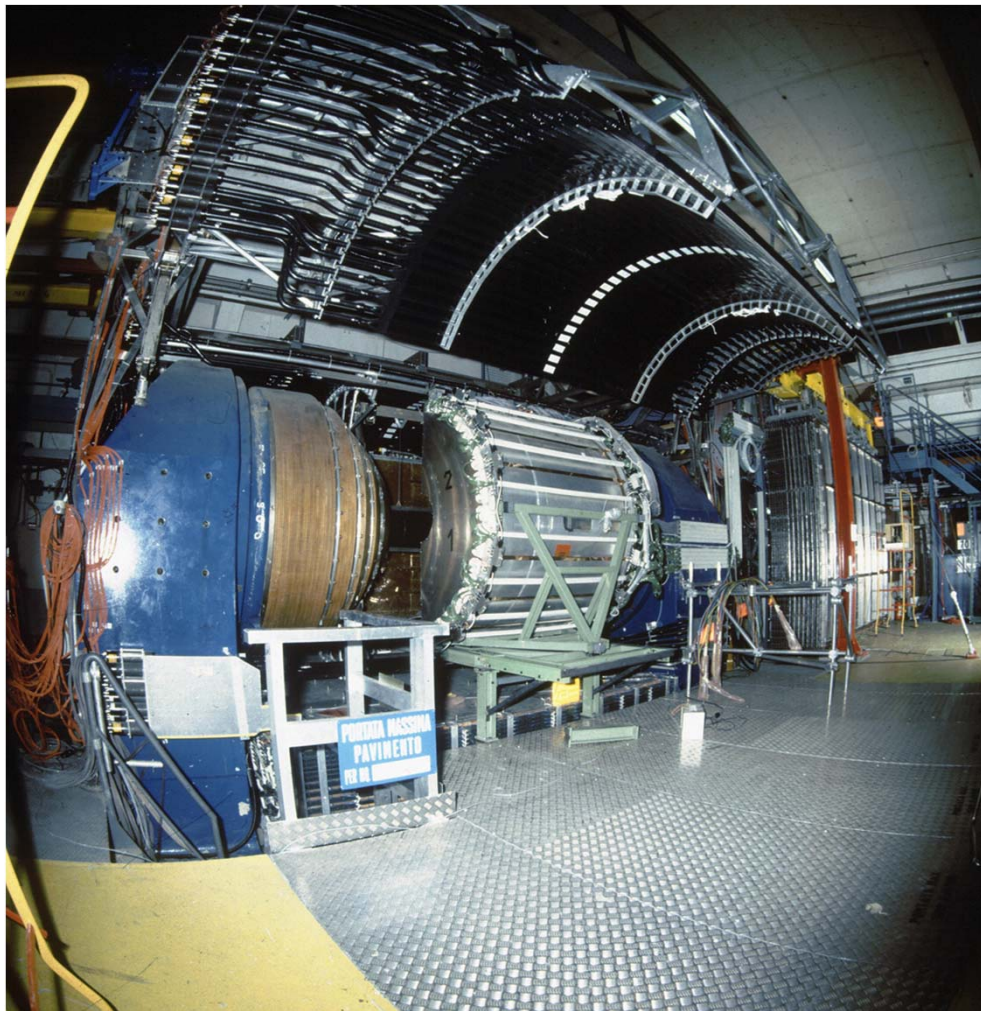
CERN Accelerator Complex



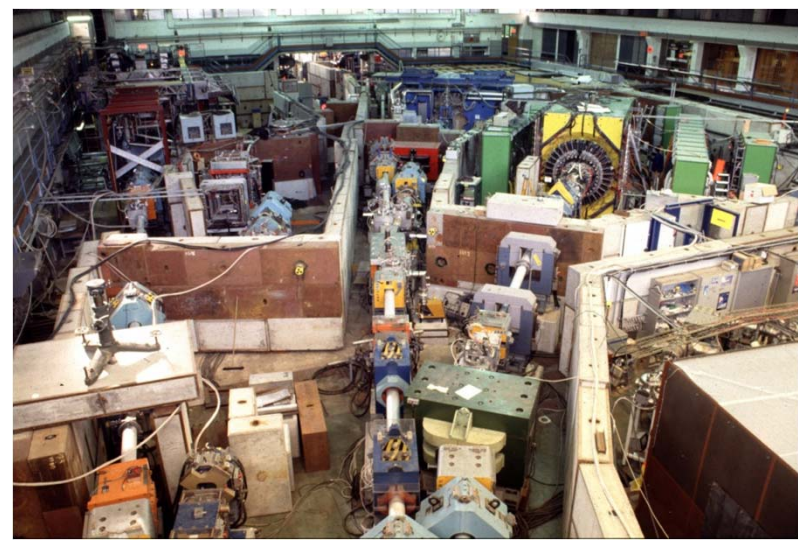
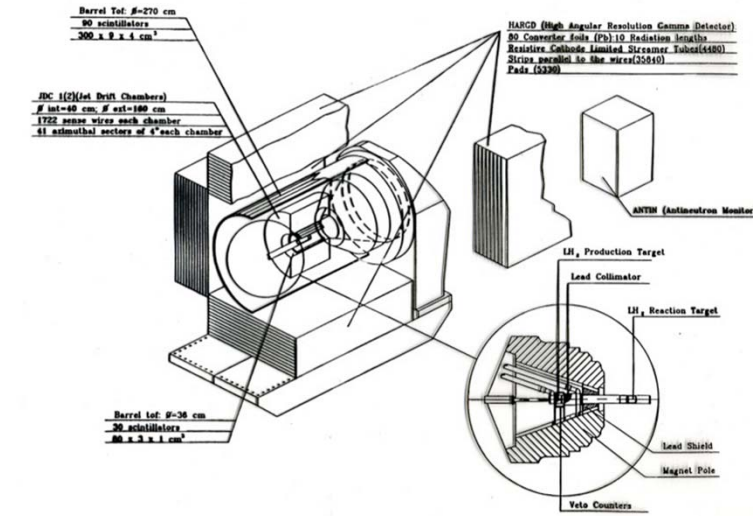
LHC Large Hadron Collider SPS Super Proton Synchrotron PS Proton Synchrotron
 AD Antiproton Decelerator CTF3 Clic Test Facility
 CNGS Cern Neutrinos to Gran Sasso ISOLDE Isotope Separator OnLine DEvice
 LEIR Low Energy Ion Ring LINAC LINear ACcelerator n-ToF Neutrons Time Of Flight



L'esperimento OBELIX



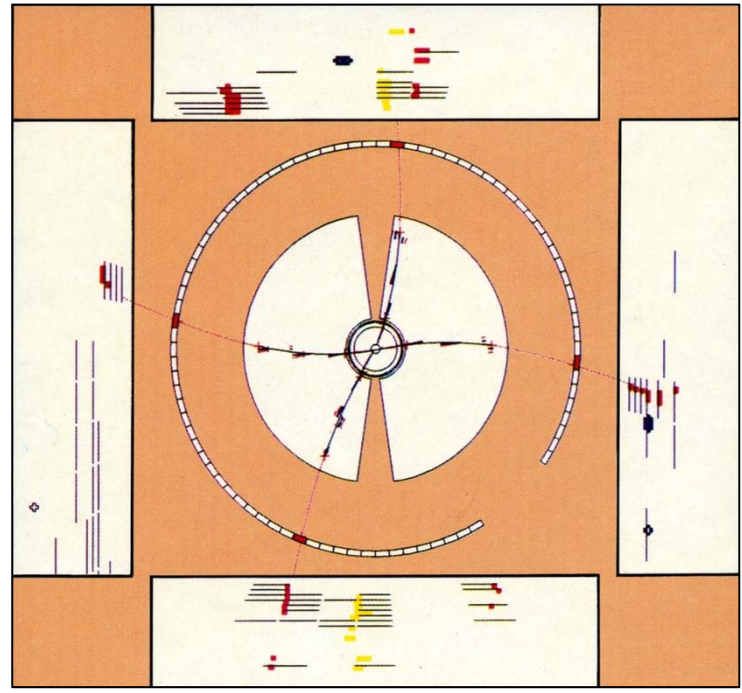
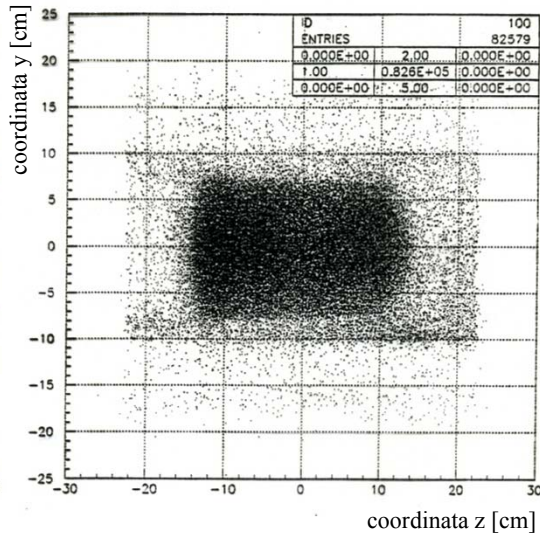
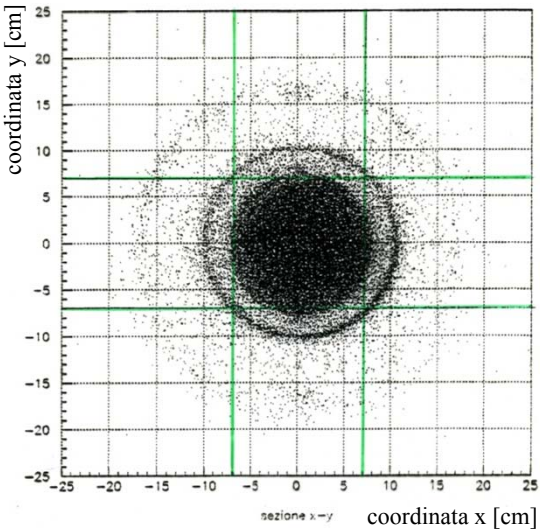
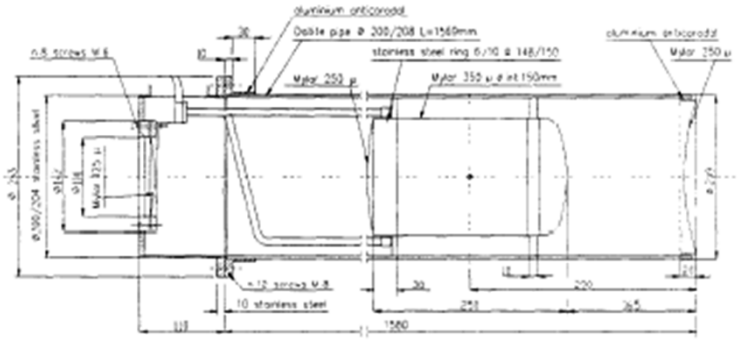
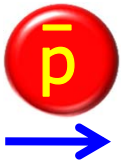
1990 - 1996



A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



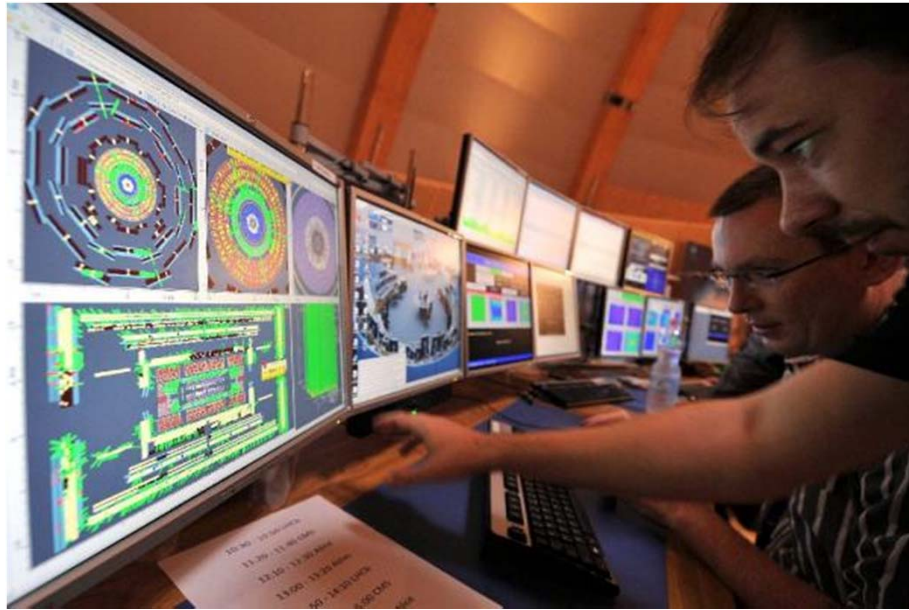
Una costosa radiografia!



A. Felciello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



Il ruolo dell'informatica



Cosa è un iper-nucleo?

Un **iper-nucleo** è il risultato di una **manipolazione genetica** effettuata su un nucleo

Particles

Leptons

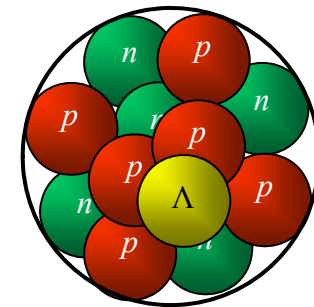
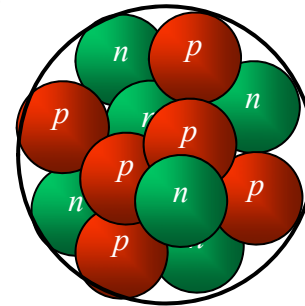
	Electric Charge		Electric Charge
Tau	-1	Tau Neutrino	0
Muon	-1	Muon Neutrino	0
Electron	-1	Electron Neutrino	0

Quarks

	Electric Charge		Electric Charge
Bottom	-1/3	Top	2/3
Strange	-1/3	Charm	2/3
Down	-1/3	Up	2/3

each quark: ●R, ●B, ●G 3 colors

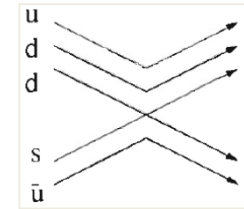
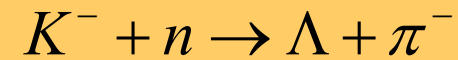
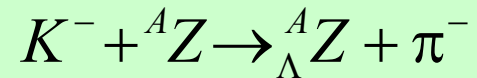
^{12}C



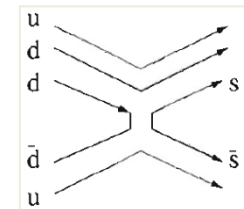
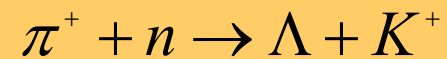
$^{12}_{\Lambda}\text{C}$

Produzione di iper-nuclei

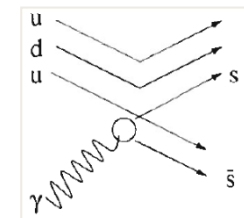
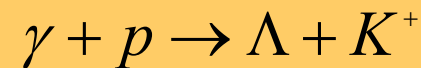
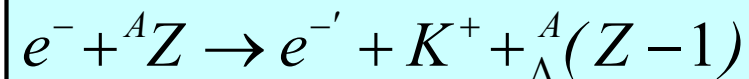
- 1) scambio di **stranezza** (in volo e a riposo):



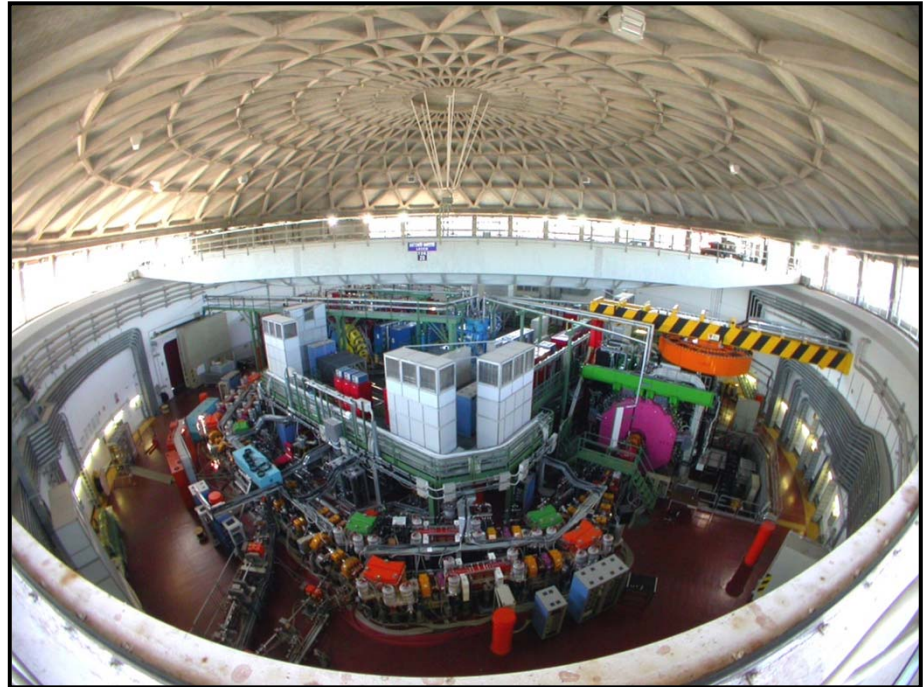
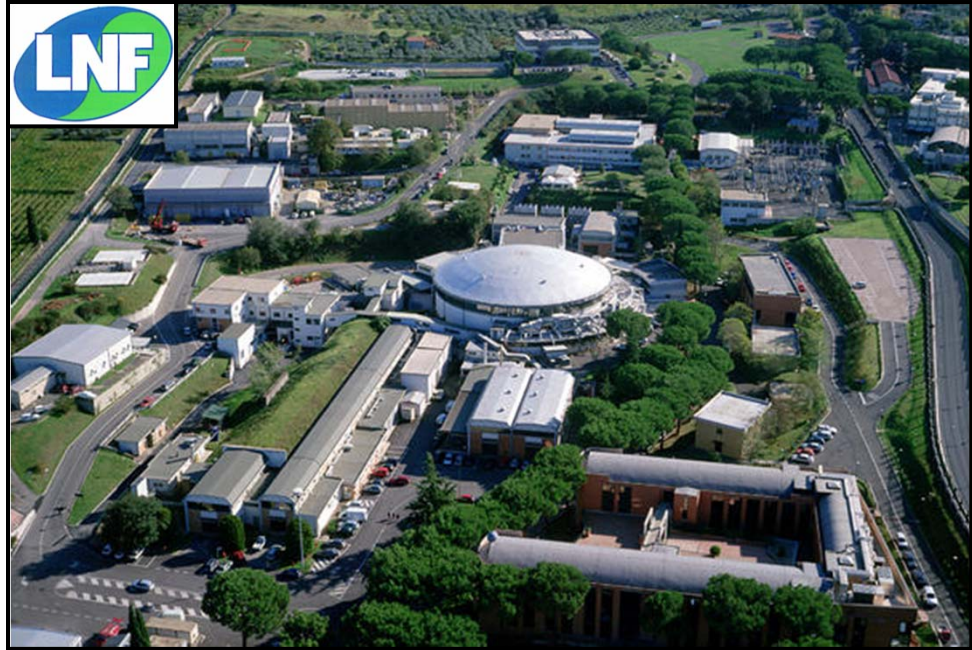
- 2) produzione associata di **stranezza**:



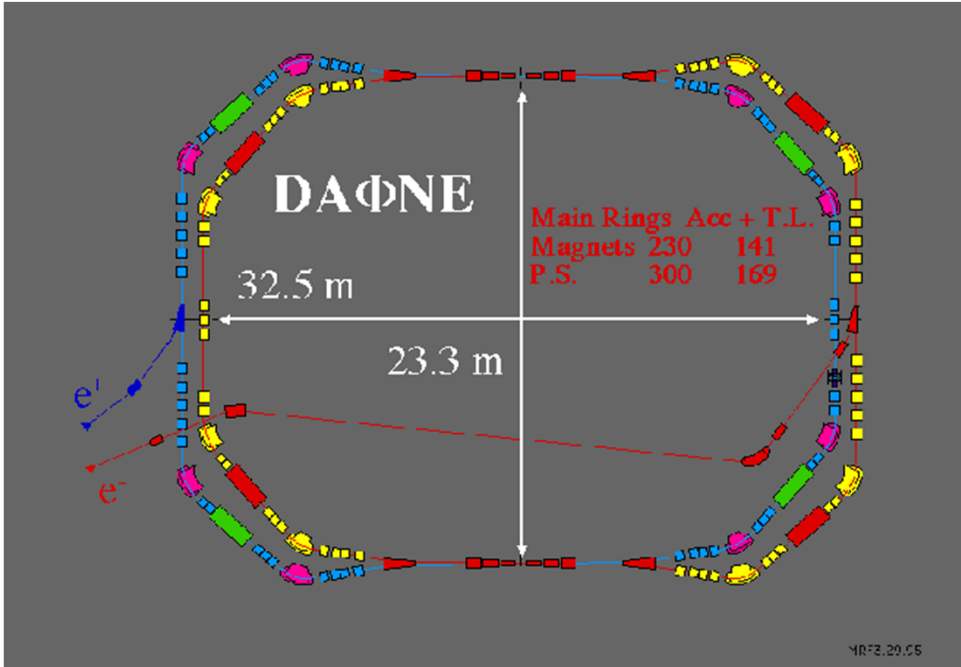
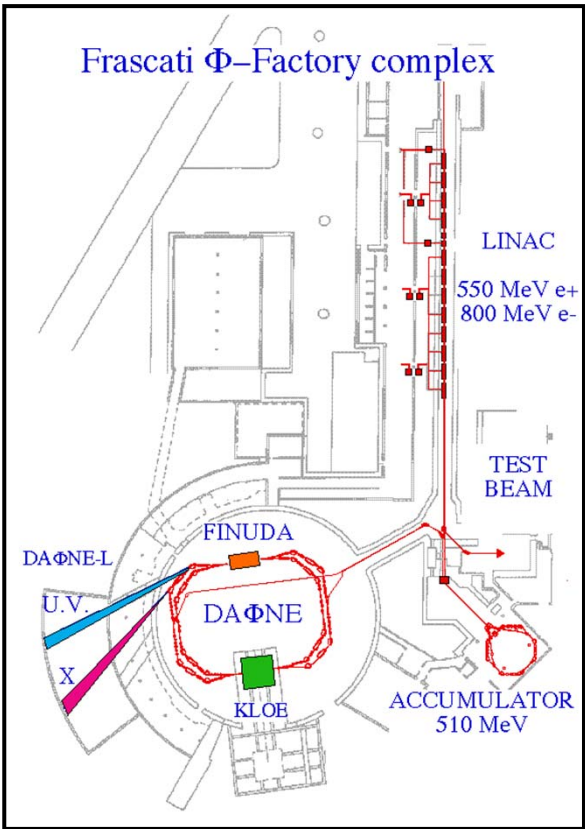
- 3) "elettro produzione":



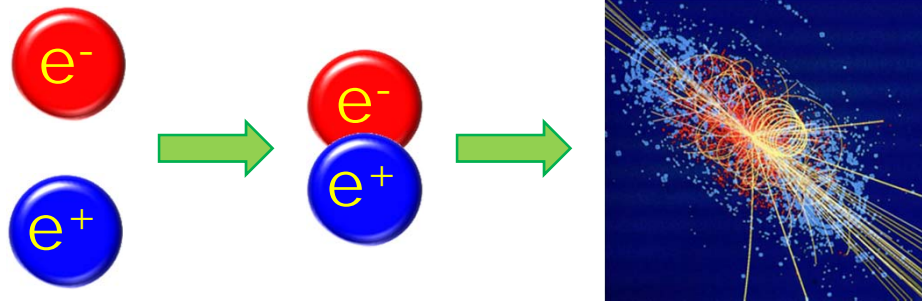
Il laboratorio LNF



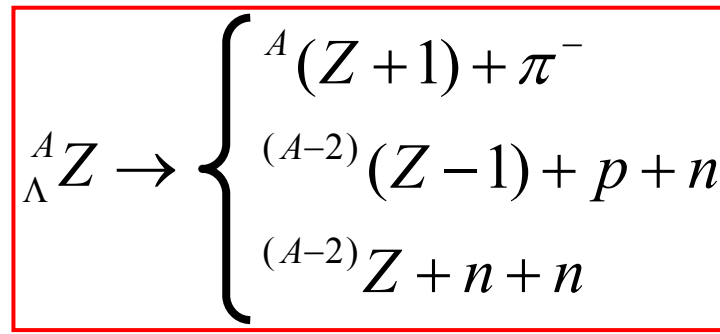
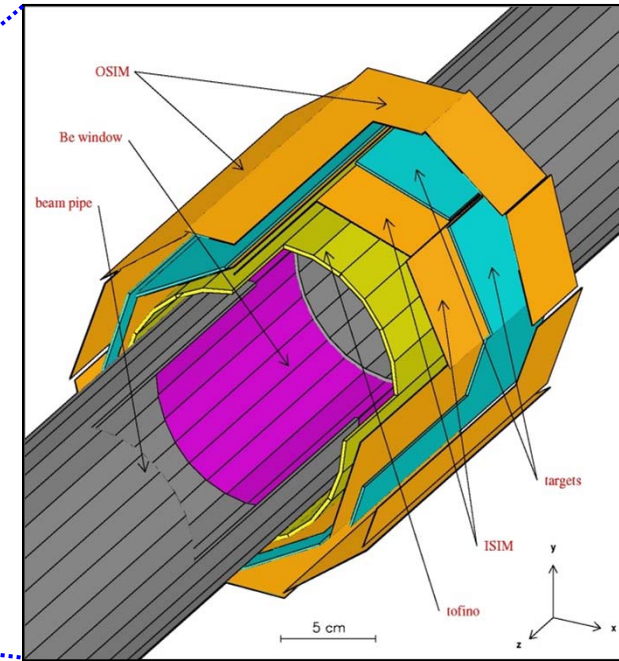
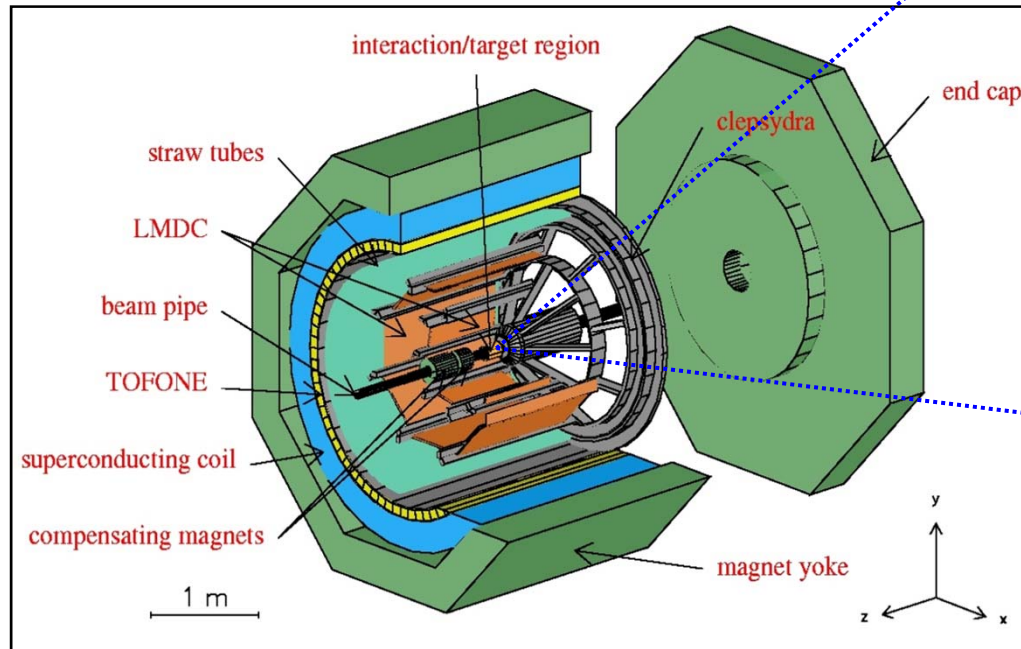
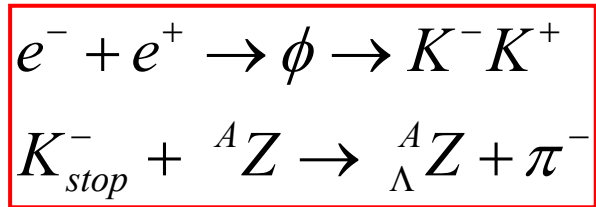
Il laboratorio LNF



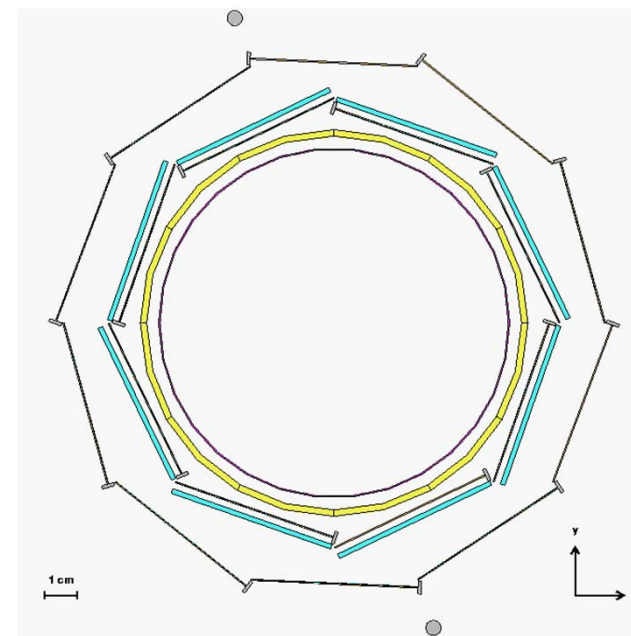
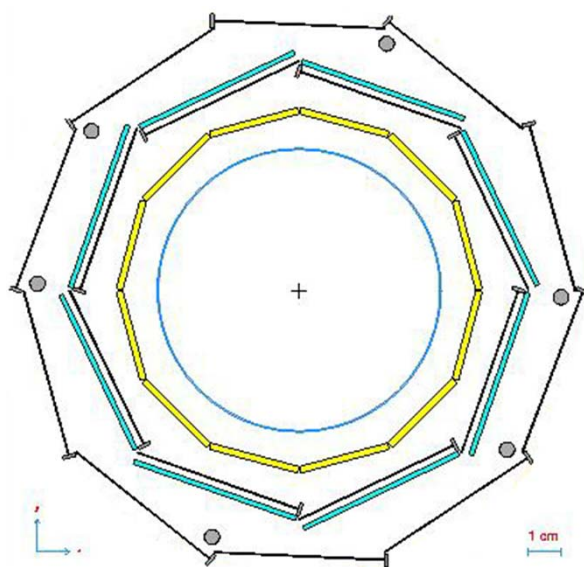
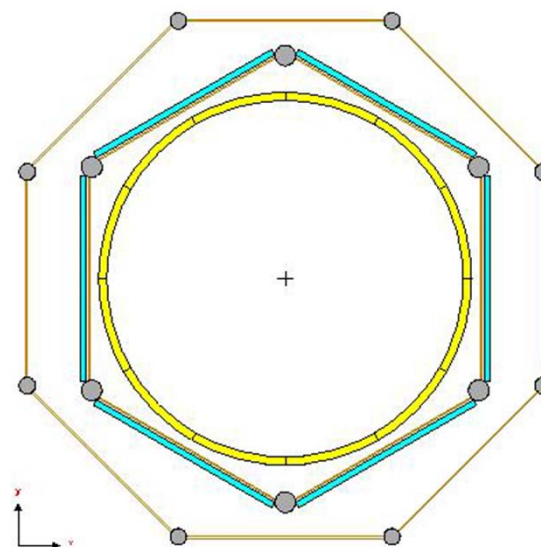
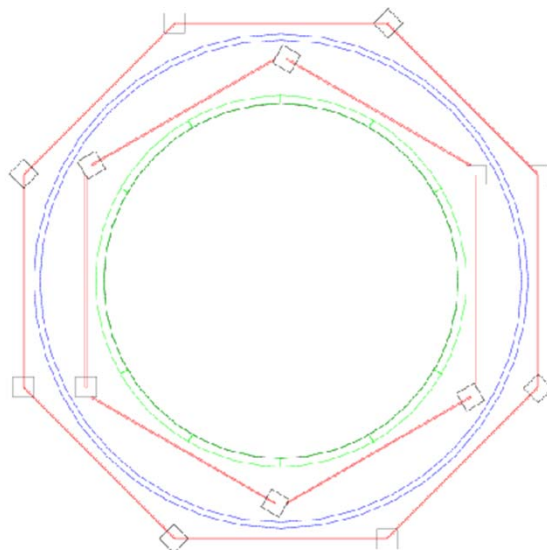
L'esperimento FINUDA



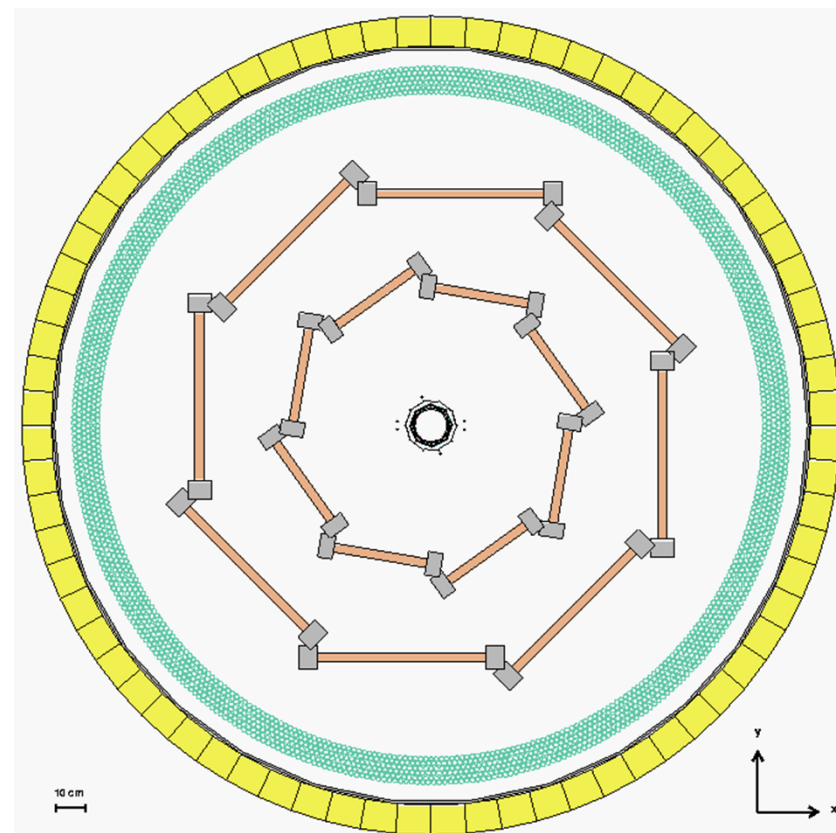
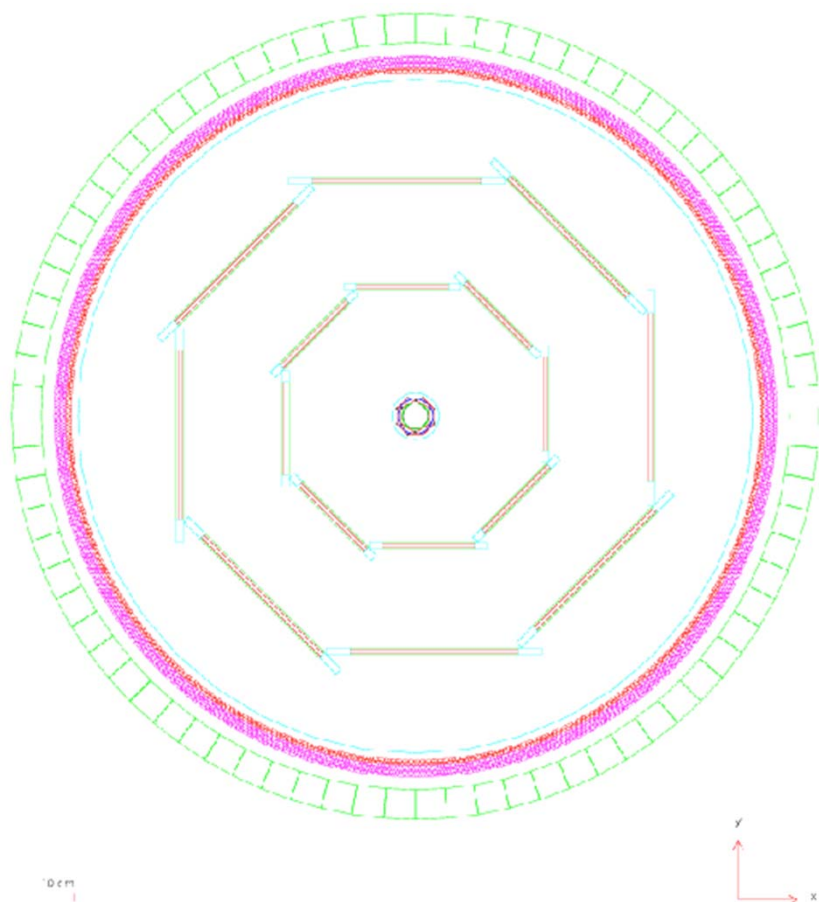
$E = mc^2$



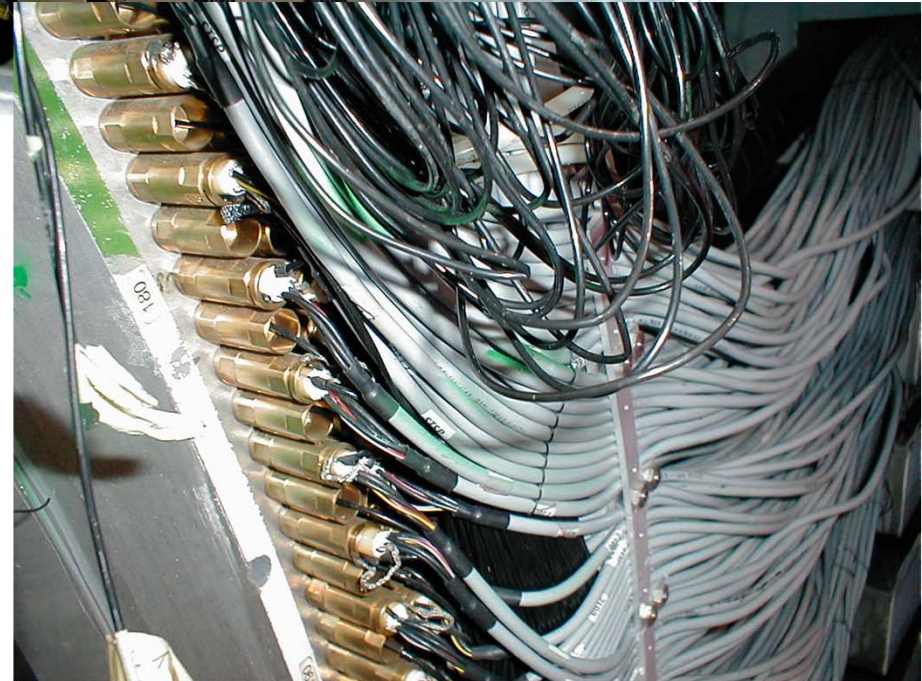
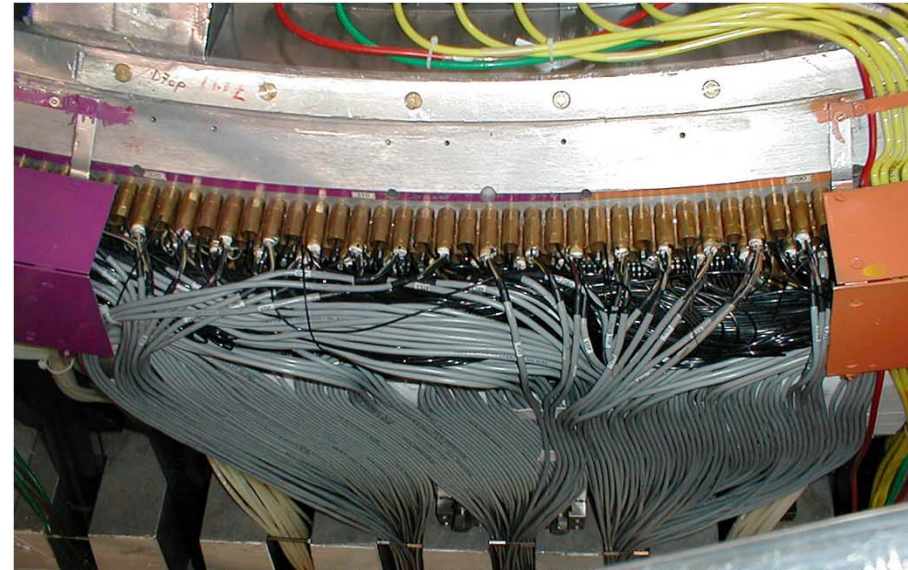
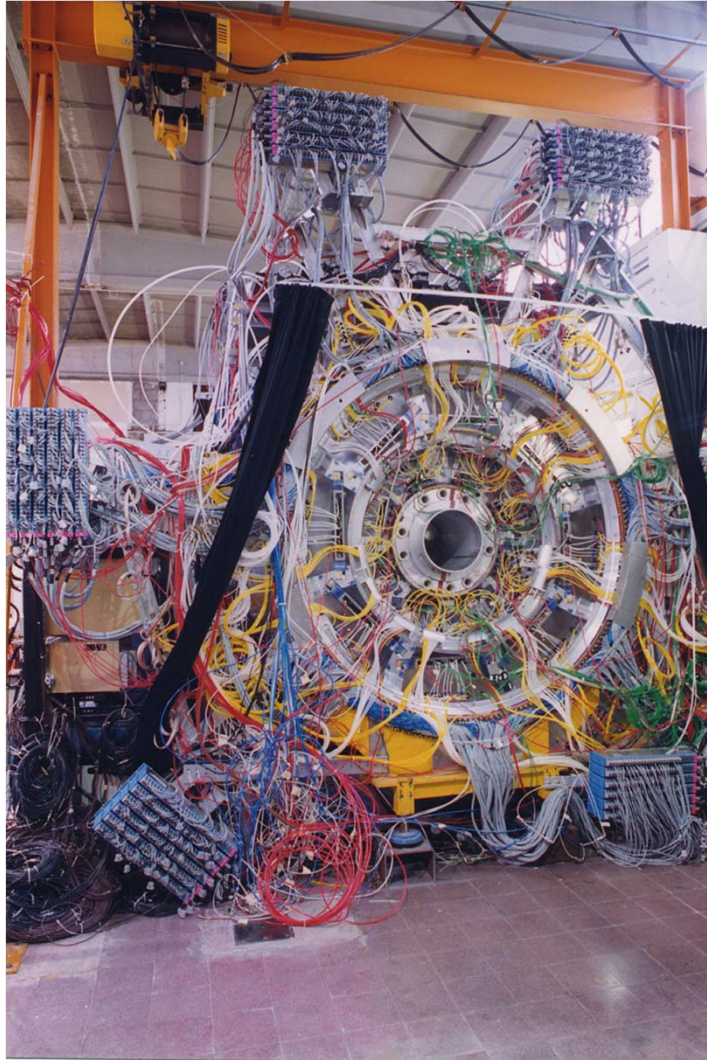
L'evoluzione del rivelatore



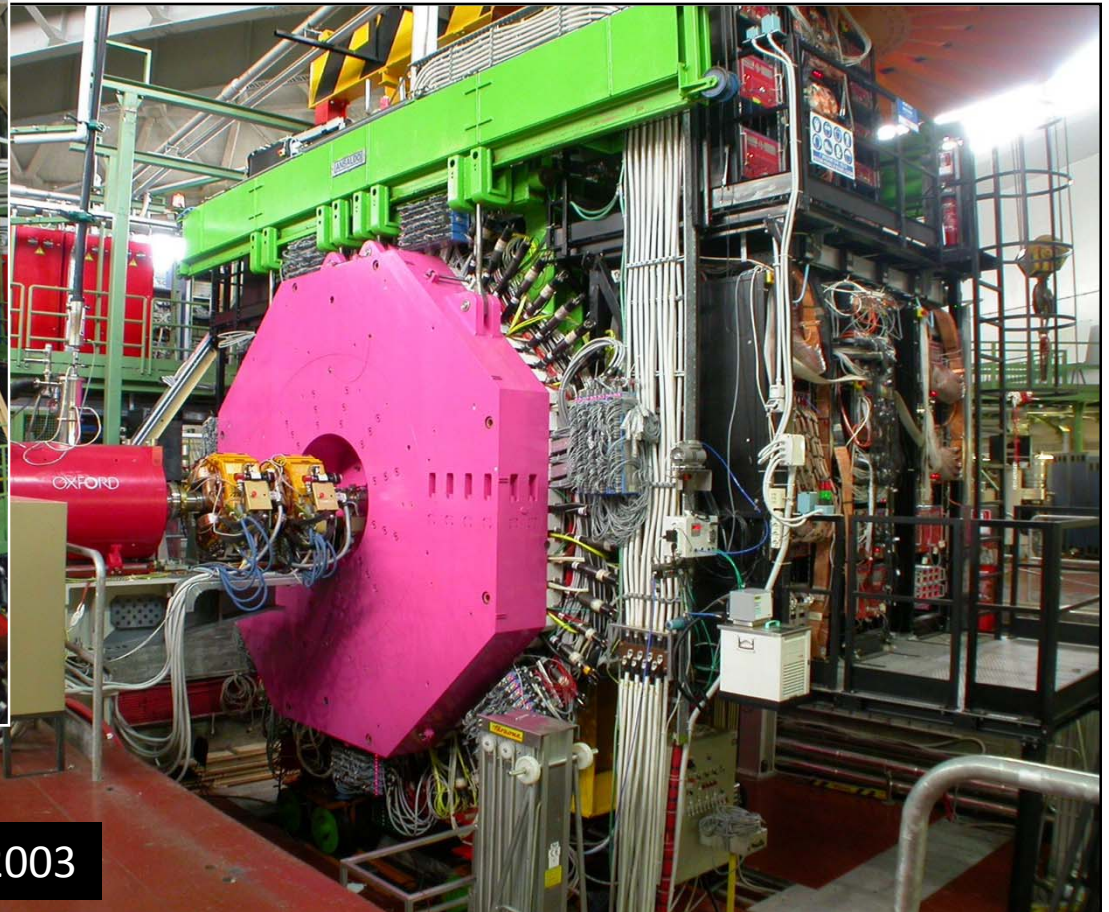
L'evoluzione del rivelatore



La fase realizzativa

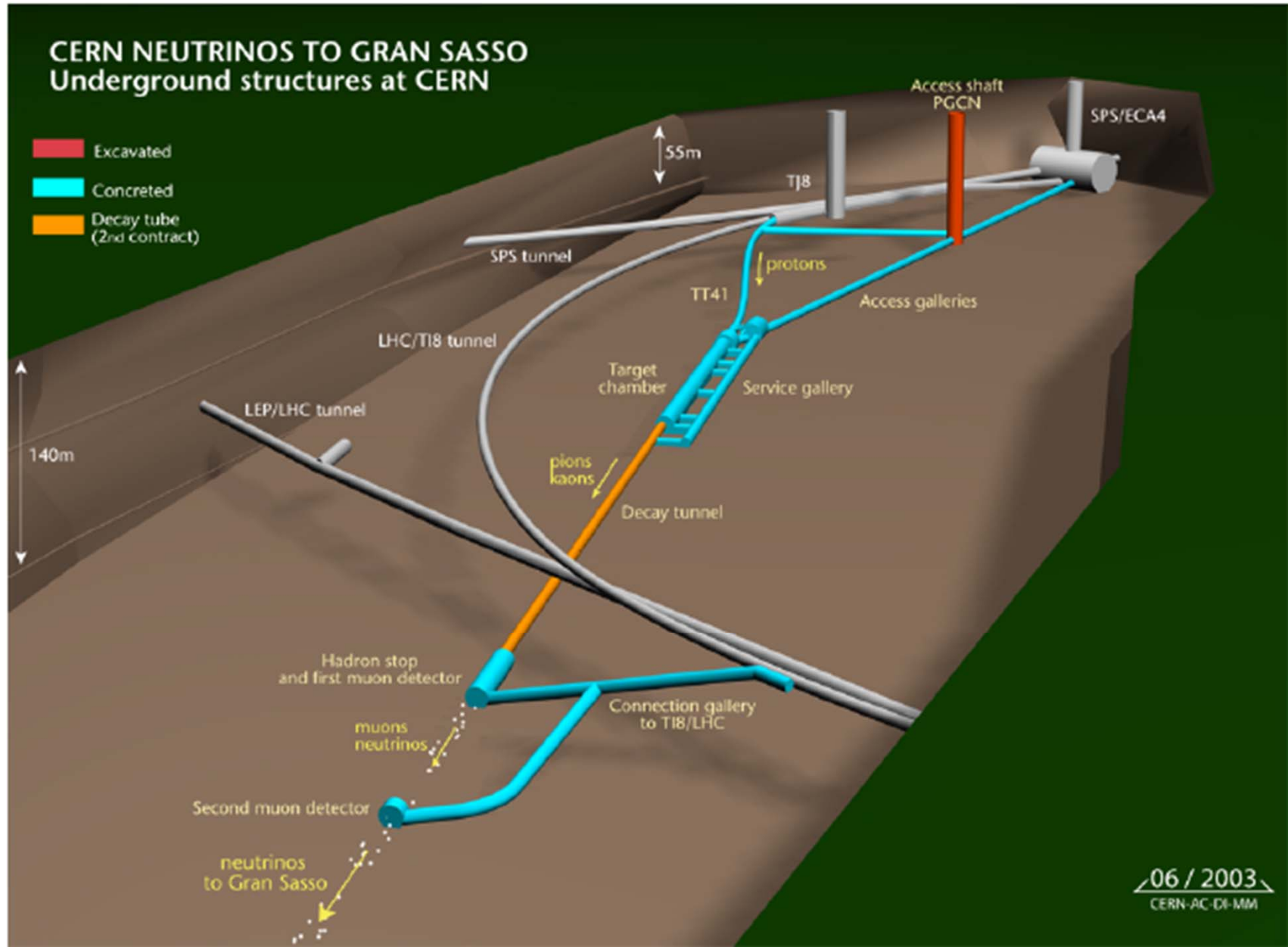


L'apparato FINUDA

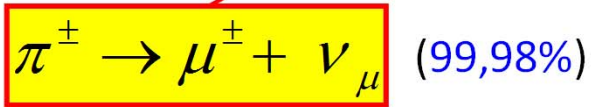
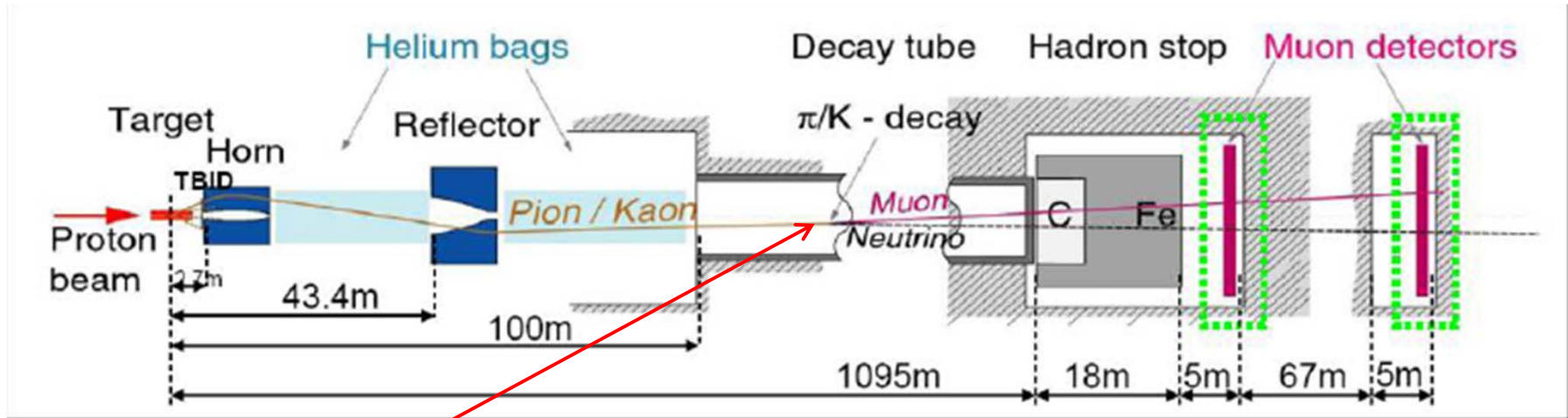


maggio 2003

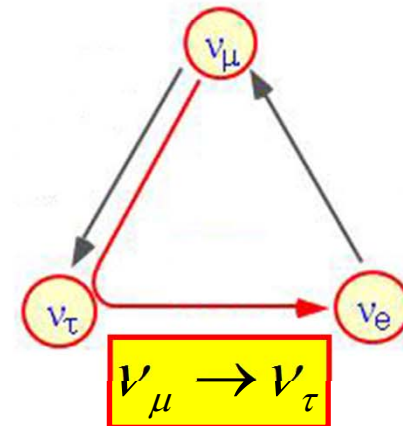
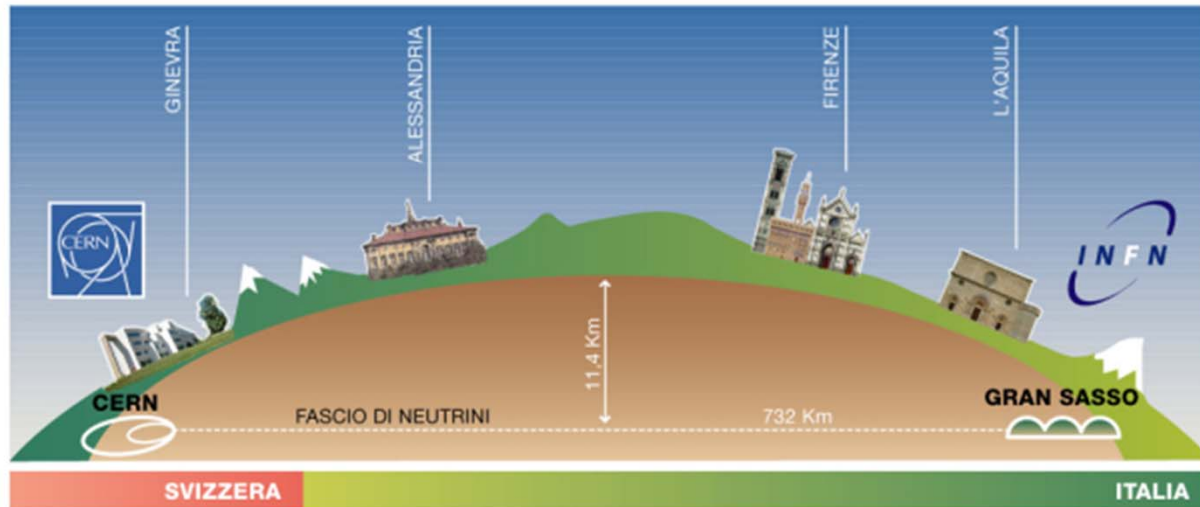
L'esperimento CNGS



L'esperimento CNGS



- ν_e e neutrino
- e^- electron
- ν_μ μ neutrino
- μ^- muon
- ν_τ τ neutrino
- τ^- tau

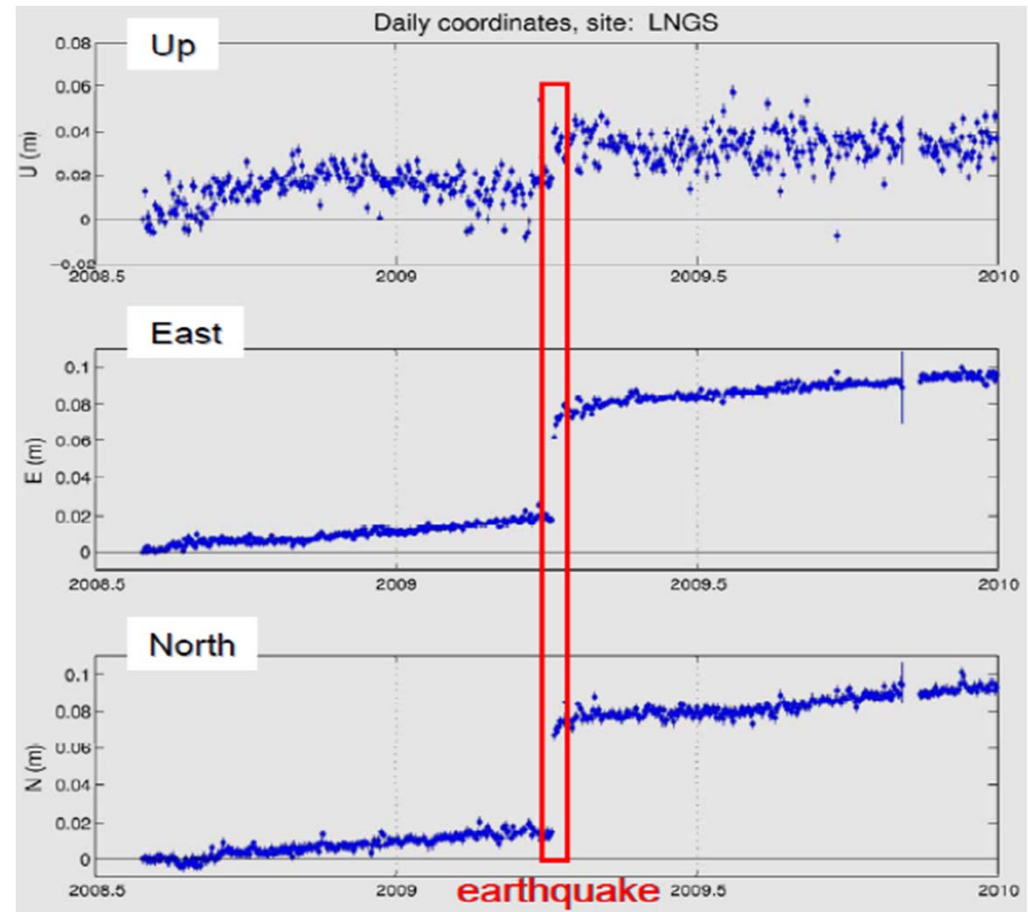


L'esperimento CNGS

la misura
della distanza
fra CERN e LNGS

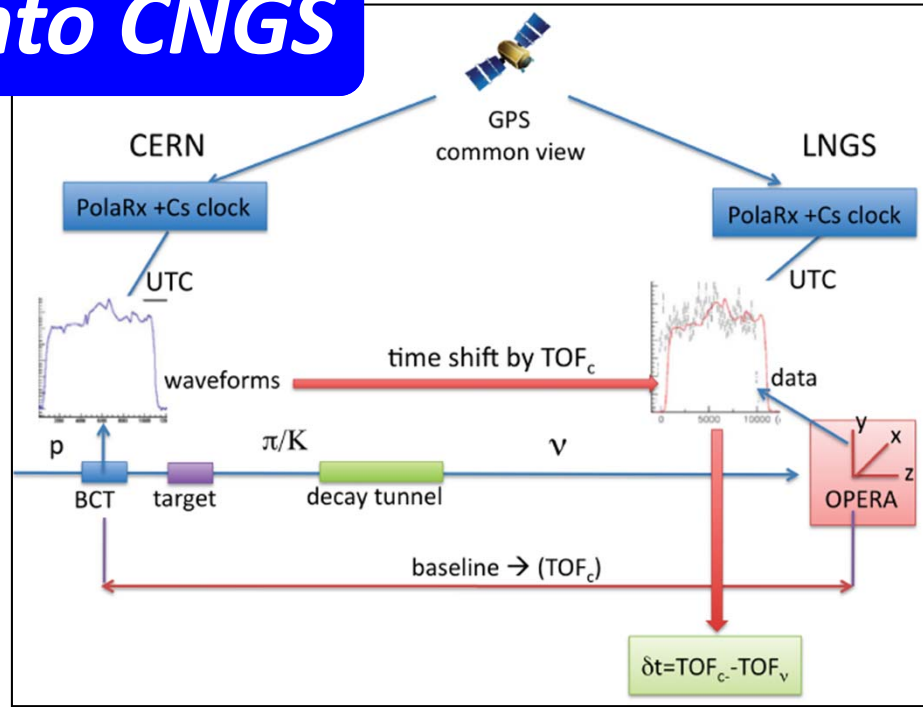
$731278,0 \text{ m} \pm 0,2 \text{ m}$

$731 \text{ km} \pm 20 \text{ cm}$

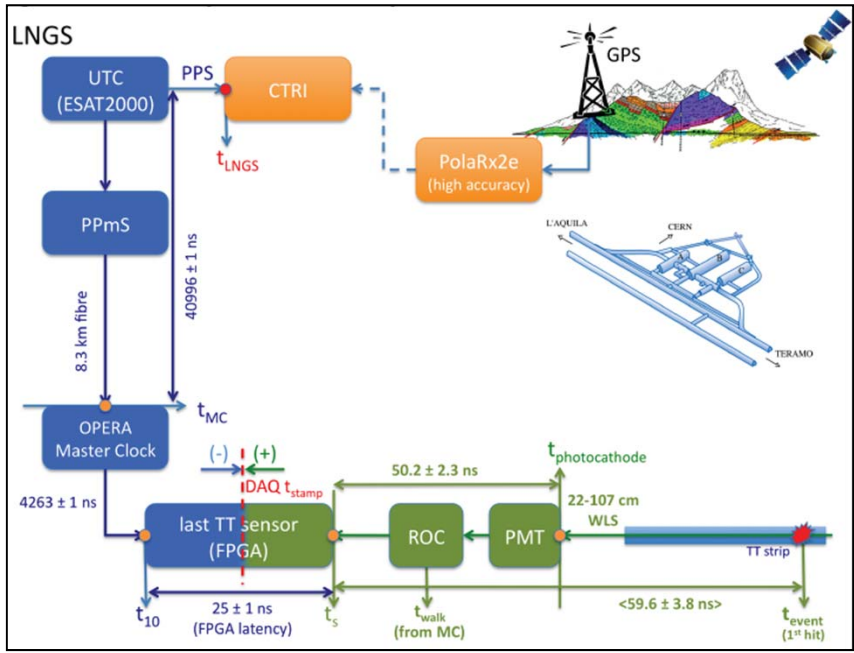
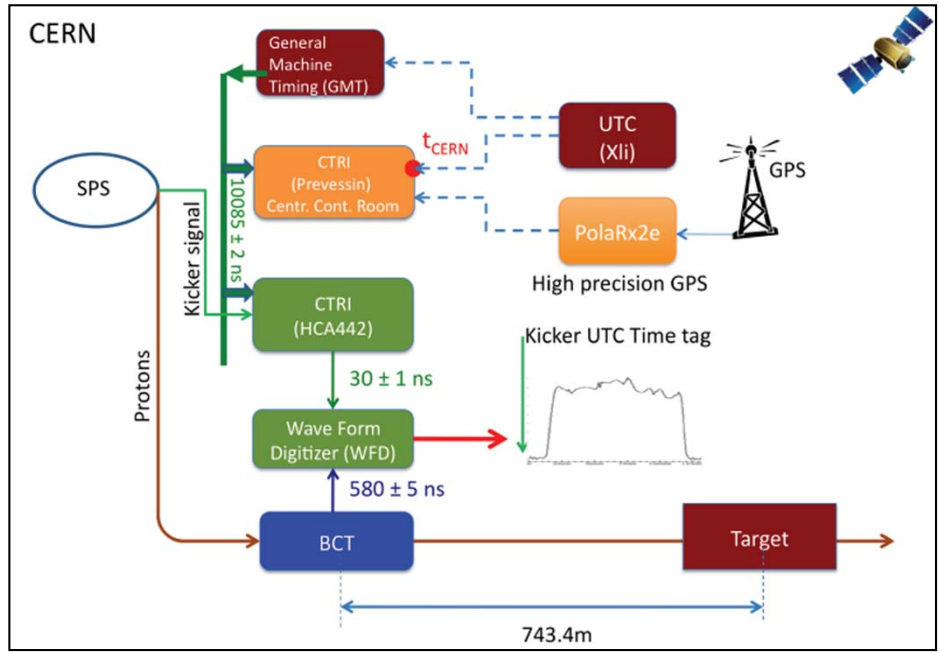


L'esperimento CNGS

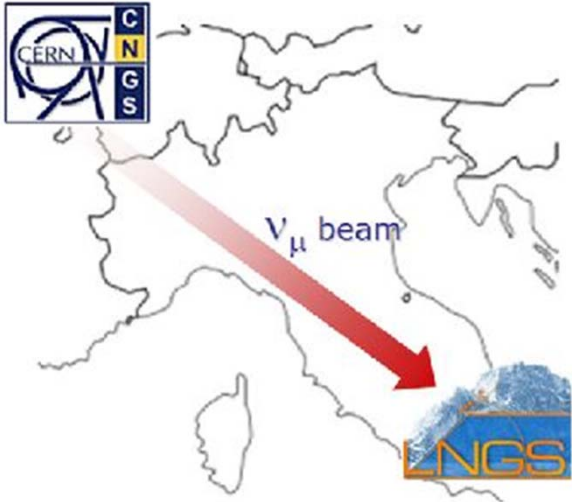
la misura dell'intervallo di tempo



$= (57,8 \pm 7.8) \text{ ns}$



Il laboratorio LNGS



A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



LABORATORI NAZIONALI DEL GRAN SASSO
TORNARE ALL'INIZIO VISITA

LNGS I NUMERI

- circa 750 SCENZIATI da 22 diversi Paesi
- circa 15 ESPERIMENTI in diverse fasi di realizzazione

GRAN SASSO schematico da 1.400 m di roccia

Tunnel autostrada A24 10.000m

SALA A: Cresti, Cuore, Gonda, Luna
SALA B: Icarus, Warp, Alcion
SALA C: Borexino, Opera
Dama/Libra

A24 di L'Aquila, A24 di Teramo

INIZIA VISITA GUIDATA



Il rivelatore OPERA



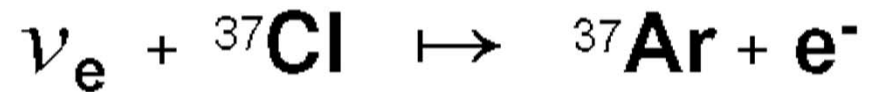
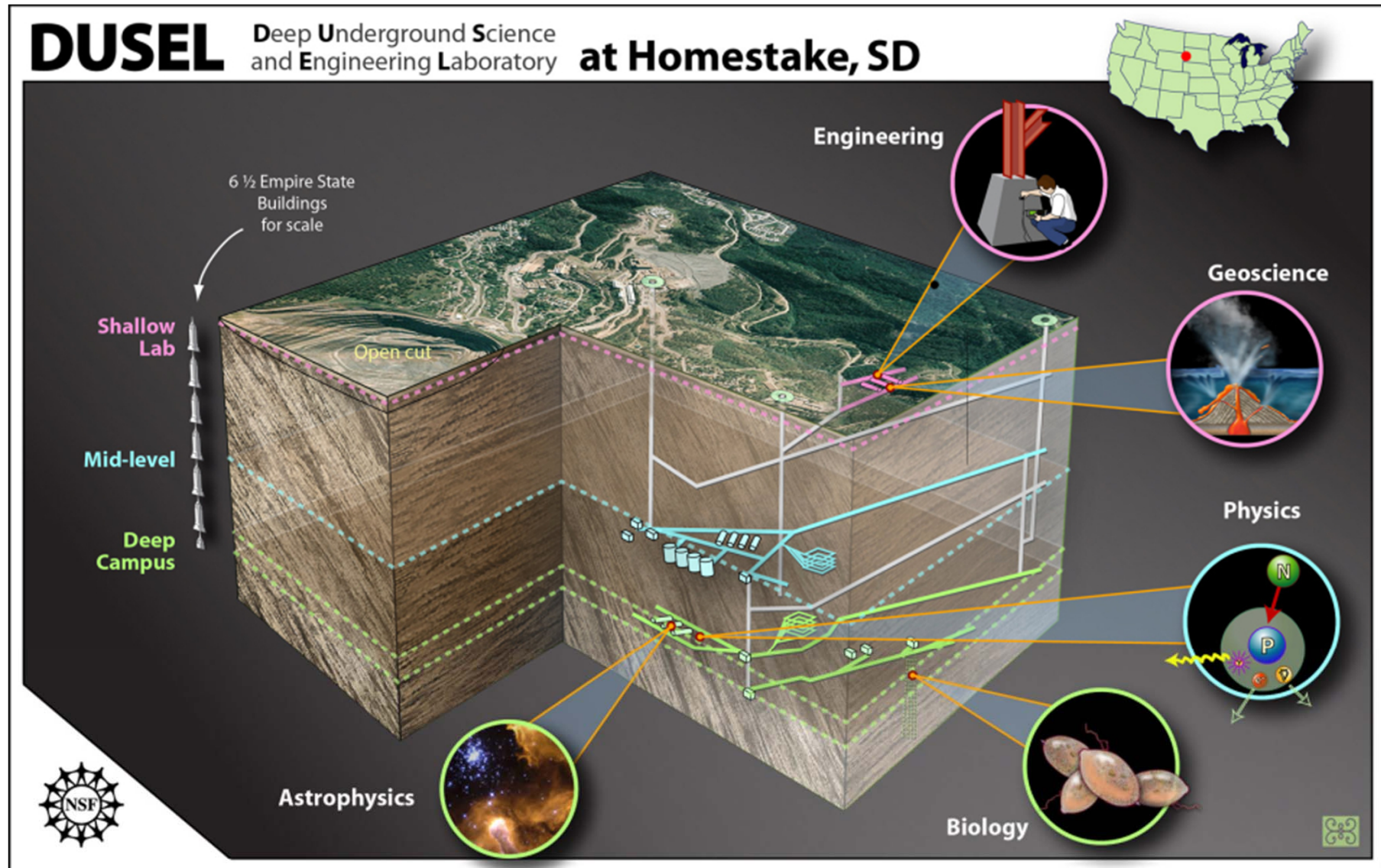
51



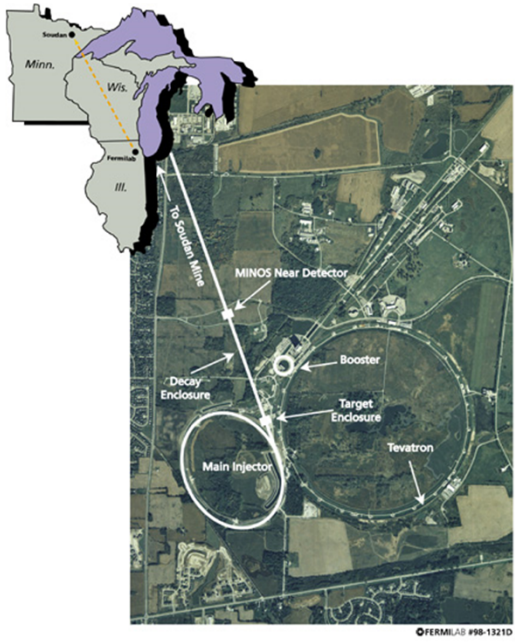
$$\nu_{\mu} \rightarrow \nu_{\tau}$$

L'esperimento di Davis

DUSEL Deep Underground Science and Engineering Laboratory at Homestake, SD

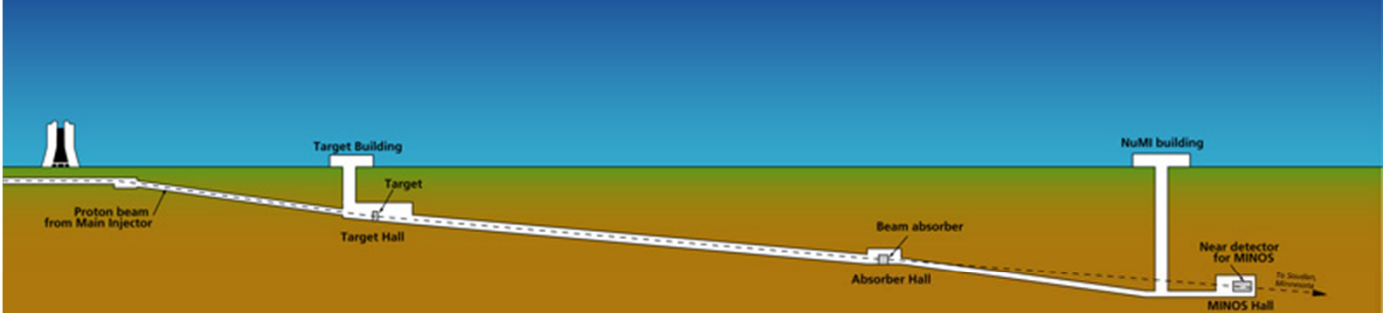


L'esperimento MINOS



NuMI Tunnel Project

Neutrinos at the Main Injector

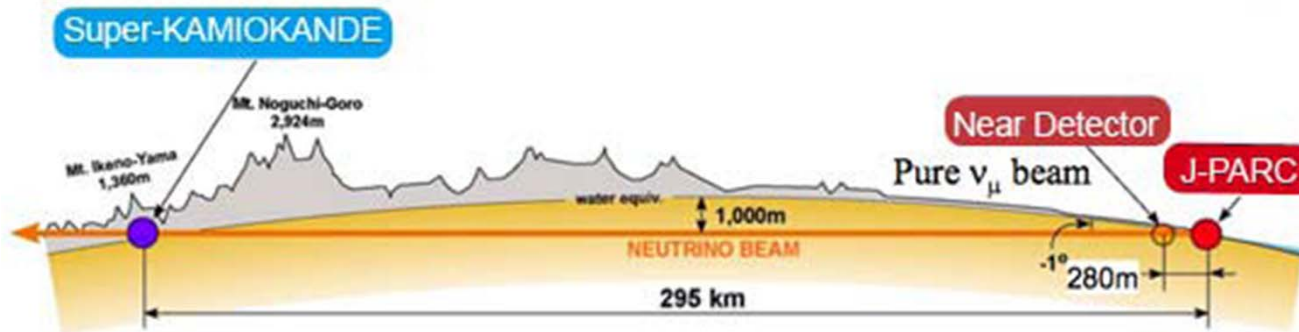
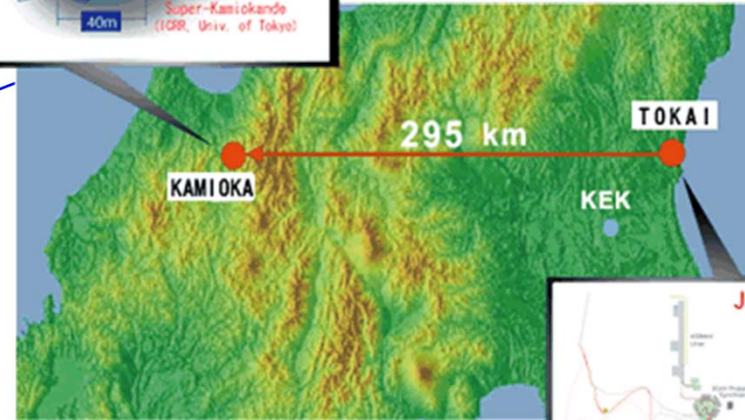
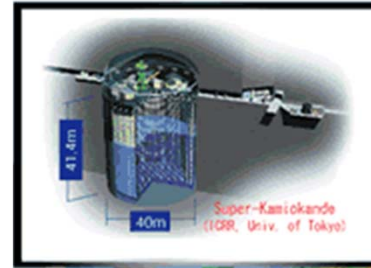


Main Injector Neutrino Oscillation Search

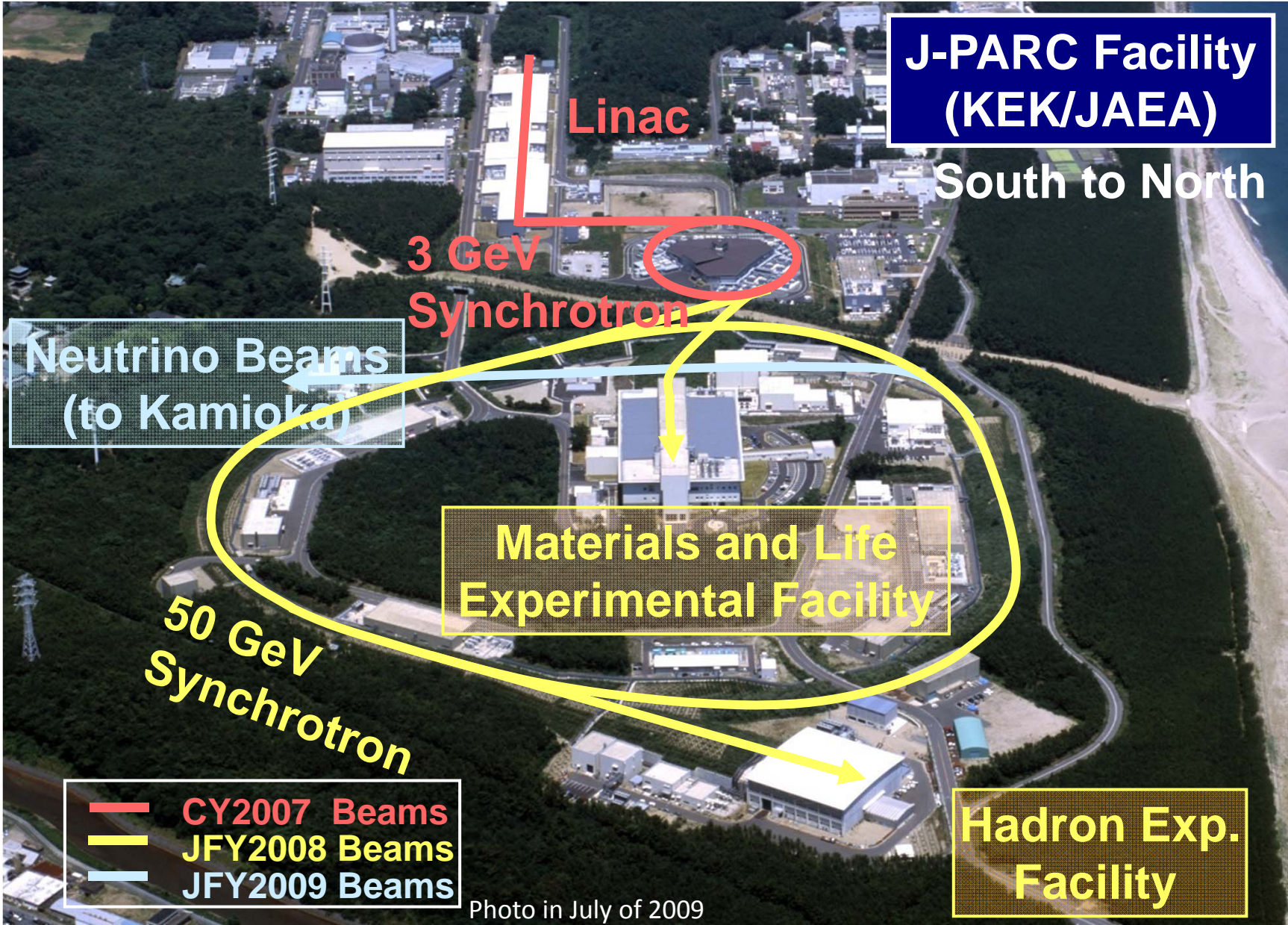
A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



L'esperimento T2K



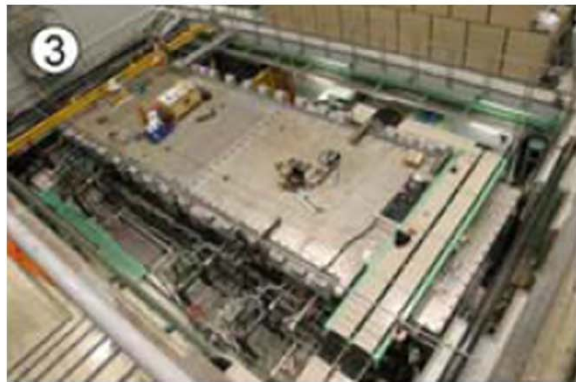
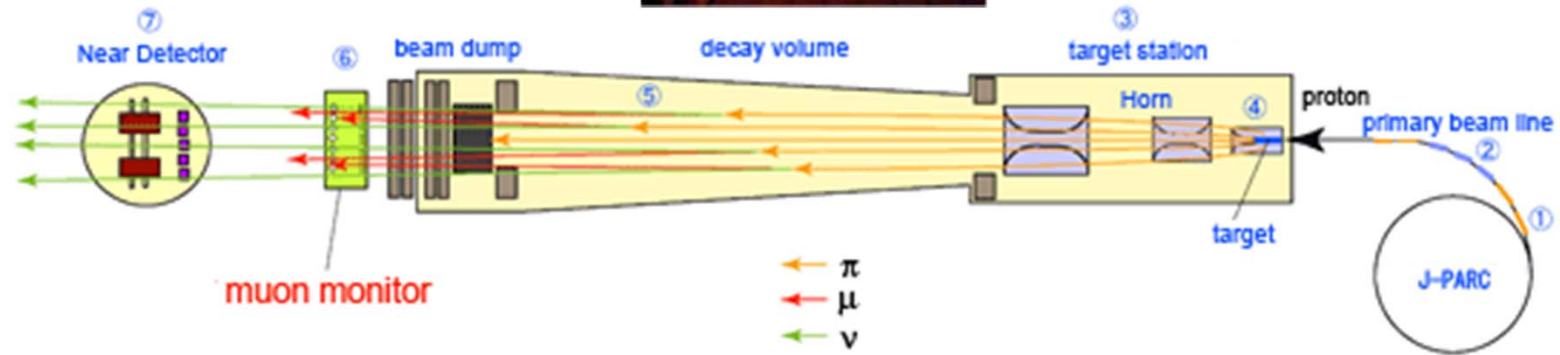
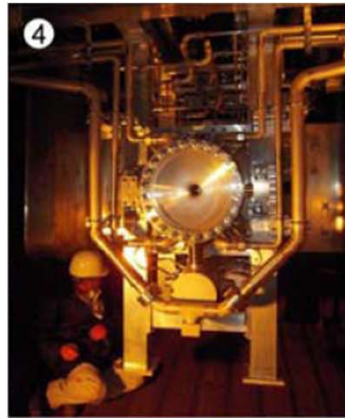
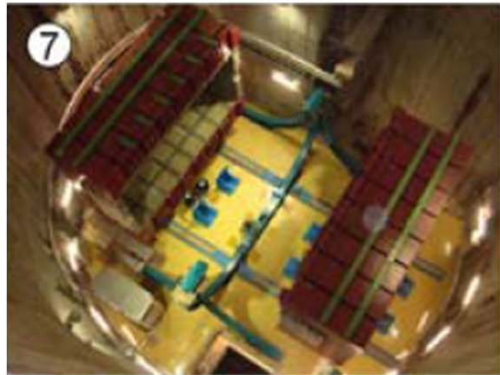
Il laboratorio J-PARC



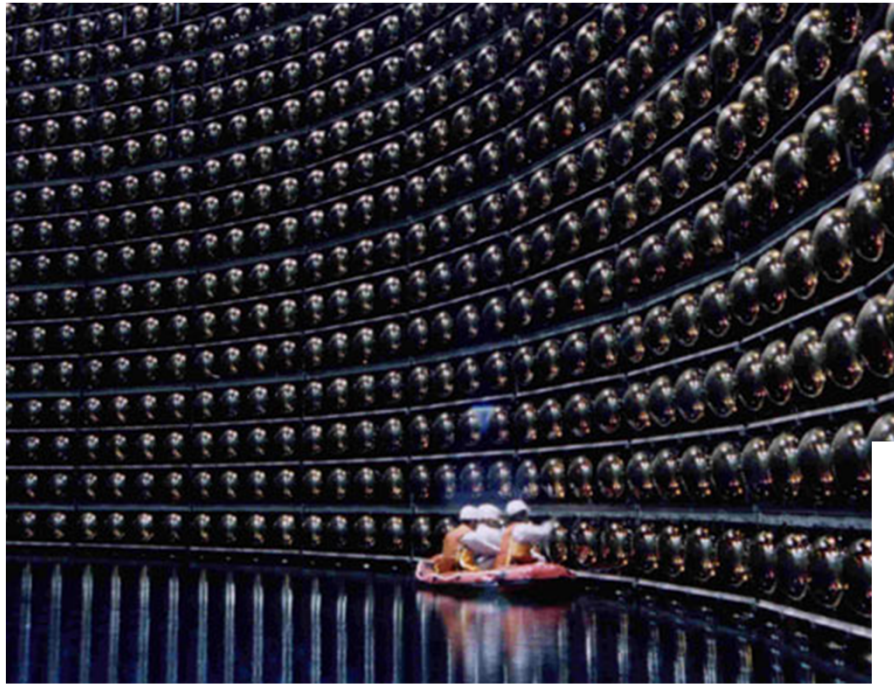
A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



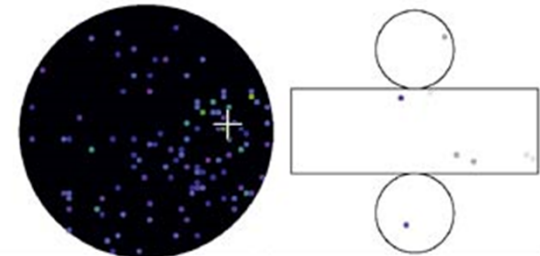
L'esperimento T2K



L'esperimento T2K

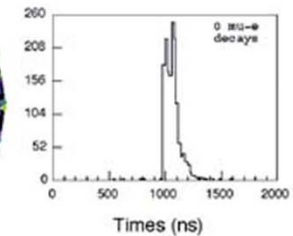
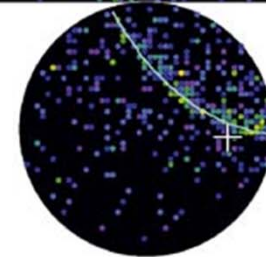
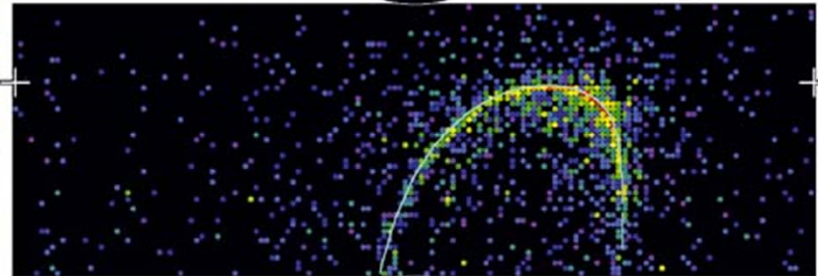


Super-Kamiokande IV
 T2K Beam Run 33 Spill 822275
 Run 66778 Sub 585 Event 134229437
 16-05-12:21:03:22
 T2K beam dt = 1902.2 ns
 Inner: 1601 hits, 3581 pe
 Outer: 2 hits, 2 pe
 Trigger: 0x80000007
 D_wall: 614.4 cm
 e-like, p = 381.8 MeV/c



Charge (pe)

- >26.7
- 23.3-26.7
- 20.2-23.3
- 17.3-20.2
- 14.7-17.3
- 12.3-14.7
- 10.0-12.2
- 8.0-10.0
- 6.2- 8.0
- 4.7- 6.2
- 3.3- 4.7
- 2.2- 3.3
- 1.3- 2.2
- 0.7- 1.3
- 0.2- 0.7
- < 0.2



Conseguenze del terremoto



Conseguenze del terremoto



Outside of LINAC building
is heavily damaged.

Conseguenze del terremoto



sottostazione elettrica
LINAC

ingresso principale
edificio LINAC



Conseguenze del terremoto



tunnel del LINAC

10 cm di acqua di mare



Conseguenze del terremoto



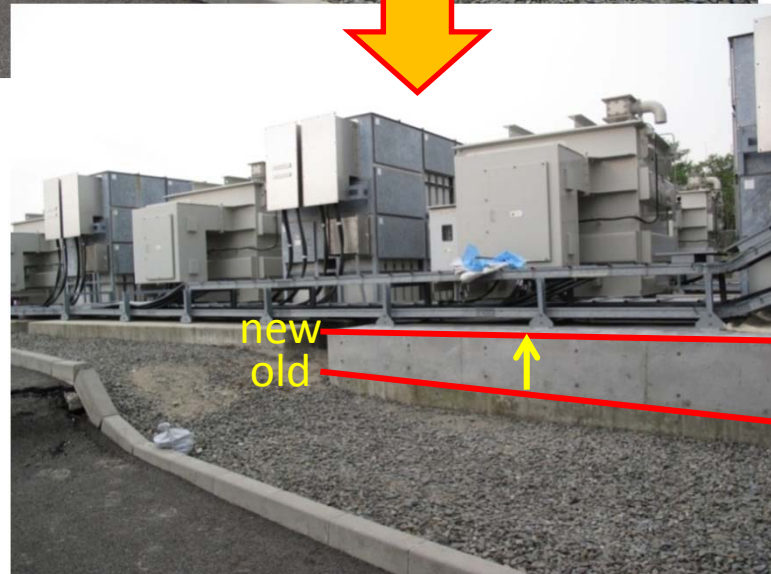
Immediately after the Earthquake



The bent stage was repaired. Power has been supplied to the RCS building.



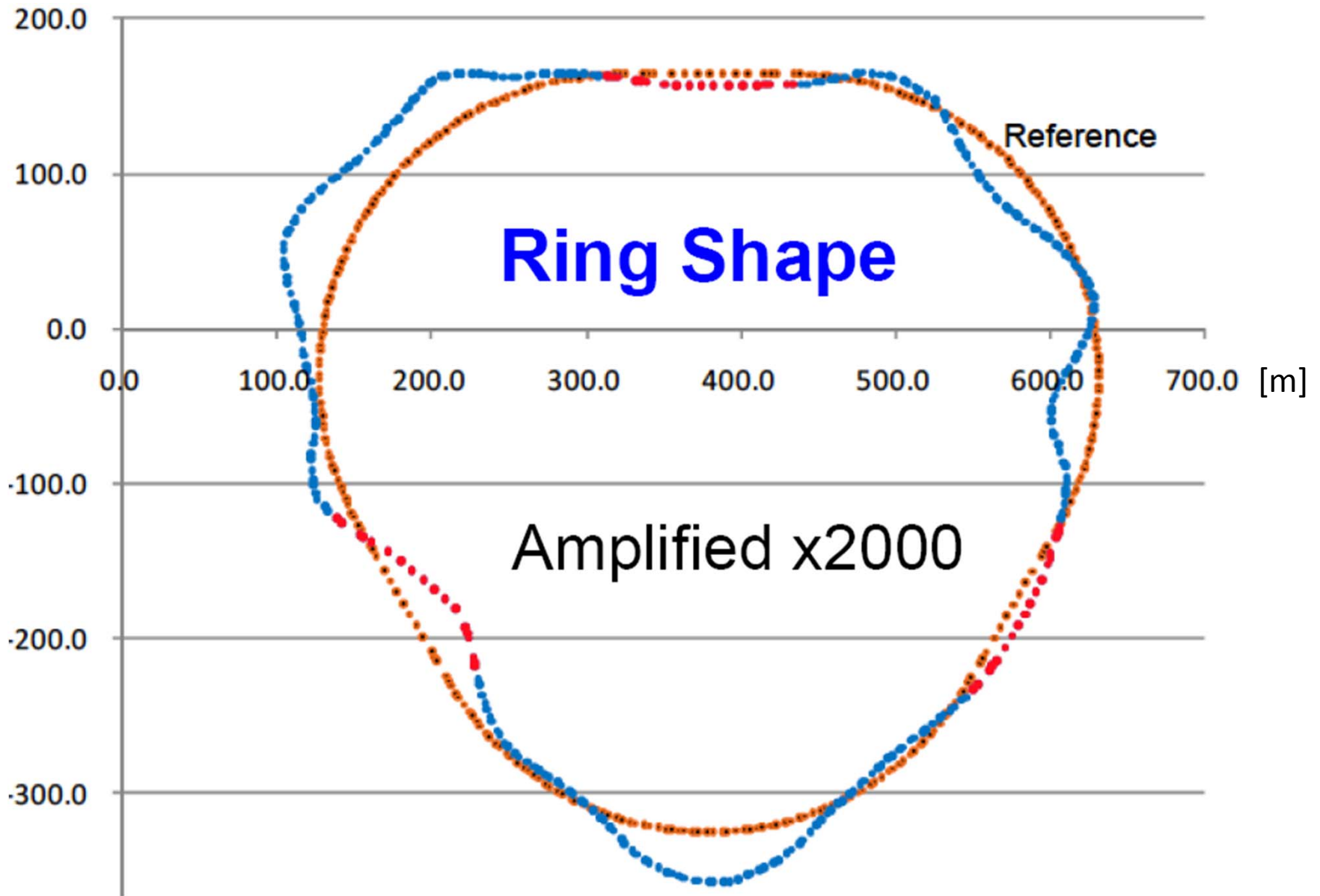
Immediately after the Earthquake



new
old

Tilted condenser transformers were straightened.

Conseguenze del terremoto



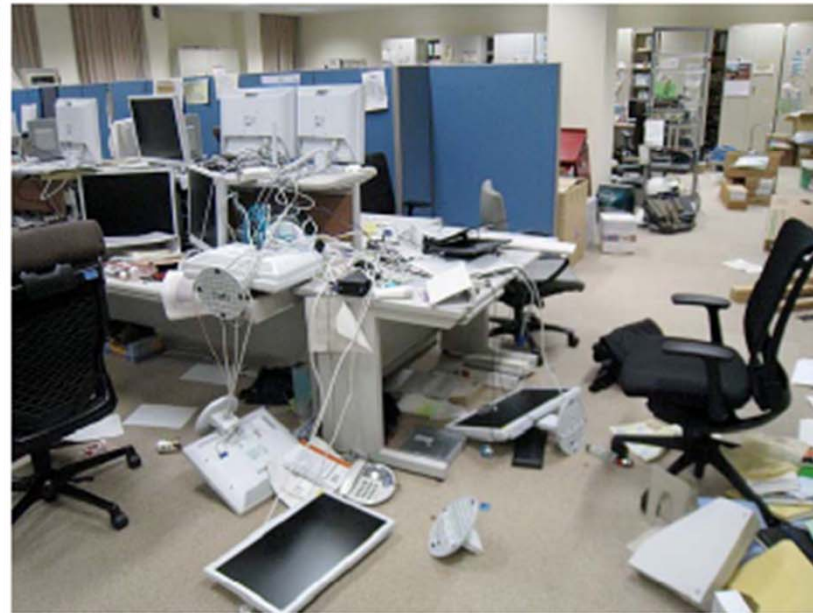
Conseguenze del terremoto



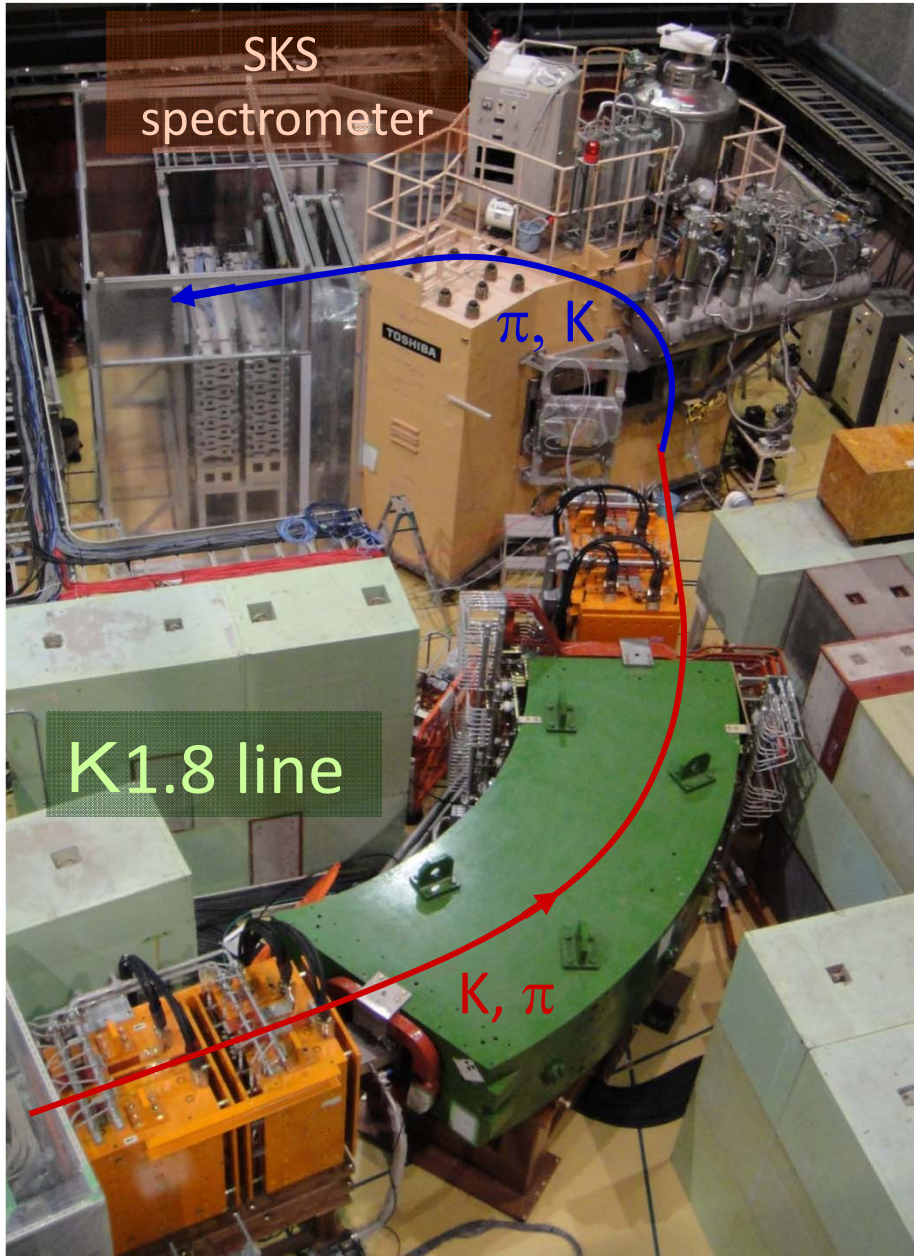
Conseguenze del terremoto



sala di controllo principale



Conseguenze del terremoto



Conseguenze del terremoto



Il disastro di Fukushima



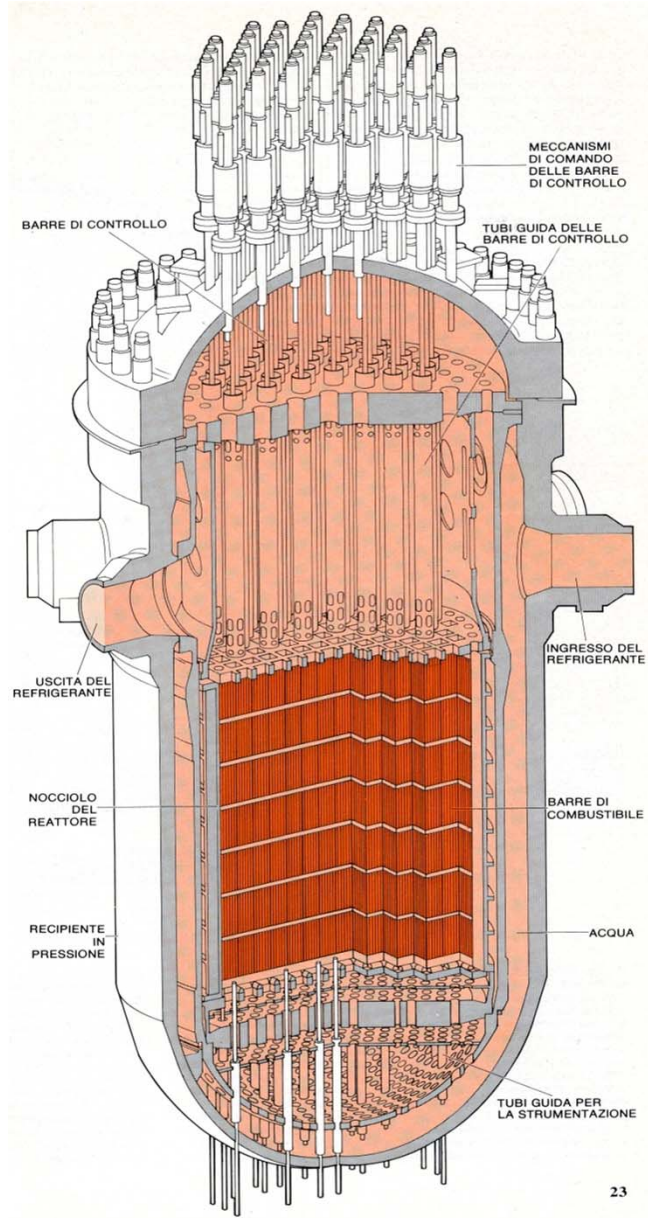
International Nuclear Safety Center at ANL, Aug 2005



A. Feliciello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



Il "nocciolo" del reattore nucleare



Scala INES

(International Nuclear and radiological Event Scale)

7	Incidente molto grave (Disastro nucleare)	Rilascio all'esterno di una grossa percentuale del materiale radioattivo contenuto in un impianto di grandi dimensioni, con gravi conseguenze ambientali e sulla salute (anche a lungo termine), su di un'area comprendente più nazioni.	Fukushima, 2011, Japan Chernobyl, 1986, Urss (oggi Rep. Ucraina)
6	Incidente grave	Rilascio all'esterno di materiale radioattivo in quantità tale da suggerire la completa attuazione delle contromisure previste dal piano di emergenza esterno al fine di limitare gravi effetti sulla salute della popolazione.	Kyshtym, 1957, Urss (oggi Rep. Russa)
5	Incidente con possibili conseguenze all'esterno dell'impianto	Rilascio all'esterno di materiale radioattivo in quantità tale da suggerire l'attuazione parziale delle contromisure previste dal piano di emergenza esterna.	Winscale, UK, 1957
4	Incidente senza conseguenze significative all'esterno dell'impianto	Rilascio all'esterno di materiale radioattivo nell'ordine di alcuni mSv alla persona più esposta. Non vi è necessità di azioni protettive, fatta eccezione per il controllo locale della catena alimentare.	Three Mile Island, USA, 1979
3	Guasto grave	Rilascio all'esterno di materiale radioattivo nell'ordine dei decimi di mV. Non sono necessarie misure protettive esterne al sito.	Windscale, UK, 1973
2	Guasto	Eventi con un significativo malfunzionamento, ma con un margine sufficiente per fare fronte a ulteriori guasti.	Saint Laurent, Francia, 1980
1	Anomalia	Deviazioni dal normale regime di funzionamento.	Buenos Aires, Argentina, 1983
0	Deviazione (non significativo per la sicurezza)		

L'incidente di Three mile island

Un reattore non è una bomba!



28 marzo 1979

Gli effetti biologici delle radiazioni

RADIOVITALE

Il Ricostituente radioattivo più efficace
ANEMIA, INDEBOLIMENTO GENERALE

Ho esaminato alcuni campioni della produzione del **RADIOVITALE** dell'anno 1923 ed ho riscontrato che in media vi è contenuto mesotorio in proporzione equivalente a microgrammi 0,017 di **radio-elemento** per ogni compressa.

Prof. Dott. G. M. CORBINO
della R. Università di Roma.

Il bromuro di mesotorio che si adopera per la preparazione del **RADIOVITALE** viene preventivamente controllato da M.me Curie. Riproduciamo uno dei certificati di misurazione:

ISTITUTO DEL RADIUM
PARIGI

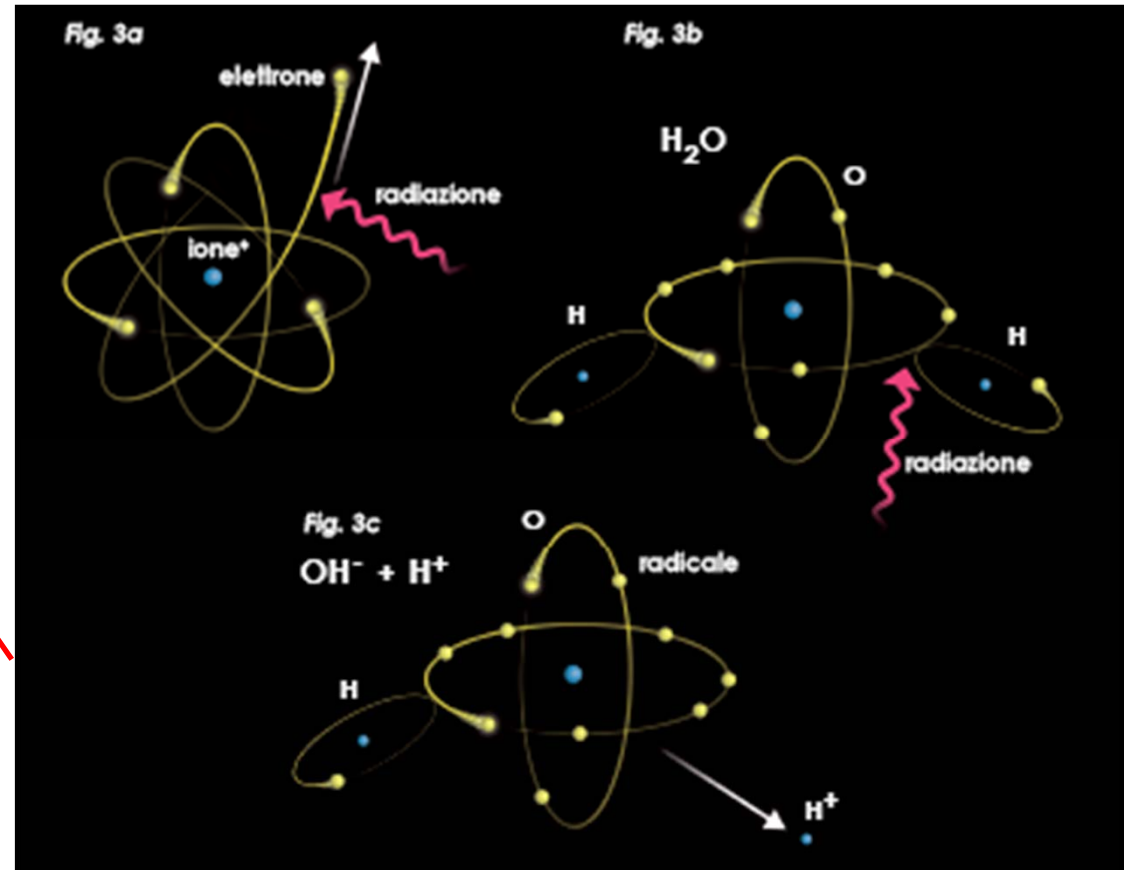
... Risultato di misura ... dei tubi n. 1669 - 1673 - 1674 - 1691 - 1692 - 1693 di bromuro di mesotorio, presentati dalla Ditta A. GAZZONI & C. ... L'irradiazione gamma ... è equivalente a quello di milligrammi 5,43 di **radio-elemento**.

Il Direttore del Laboratorio
M. CURIE

... Dopo un anno di osservazione e studio del **RADIOVITALE**, nei singoli casi, controllati coi relativi esami clinici, ho potuto constatare effetti benefici veramente eccezionali ... Oltre ad un miglioramento progressivo delle condizioni generali ho constatato uno spiccato miglioramento nella forma e numero dei globuli del sangue con aumento progressivo del tasso della emoglobina fino ad arrivare, in taluni, da 50 (cifra esprimevole un forte grado di anemia) a 85 cifra vicinissima alle condizioni normali.

Prof. Dott. EMILIO BOARI
della R. Università di Bologna.

A. GAZZONI & C. - BOLOGNA



Le ricadute tecnologiche

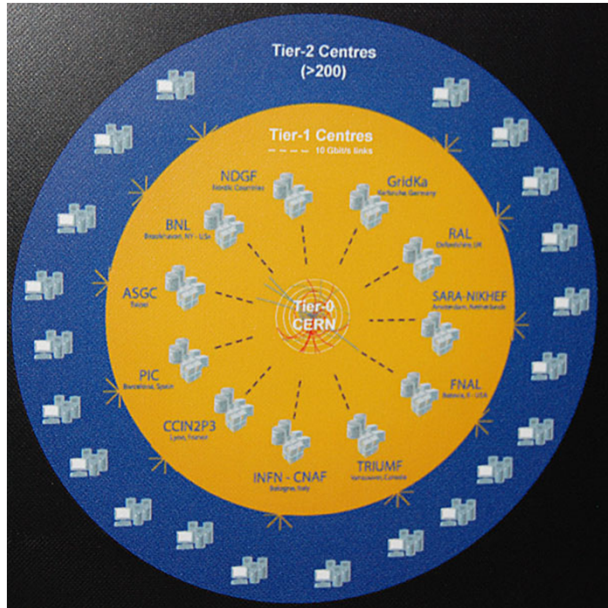
World Wide Web (WWW)



06 agosto 1991



GRID computing



MonALISA Repository for ALICE

★ Catalogue browser ★ Repository Home Administration Section ALICE Reports Events XML Feed Firefox Toolbar Mon

● Running jobs
 ● Running jobs but no ML info
 ● Site service problem(s) prevents job execution
 ● No jobs match the site resources
 ● ML service down & no runn

Map options Show xroold transfers

Jump to:

Repository Home - ALICE Web Page - ALICE Clusters - Contact - Links

Dynamic charts

close all

This page: bookmark, URL

Running jobs trend

9429 jobs

Running jobs trend

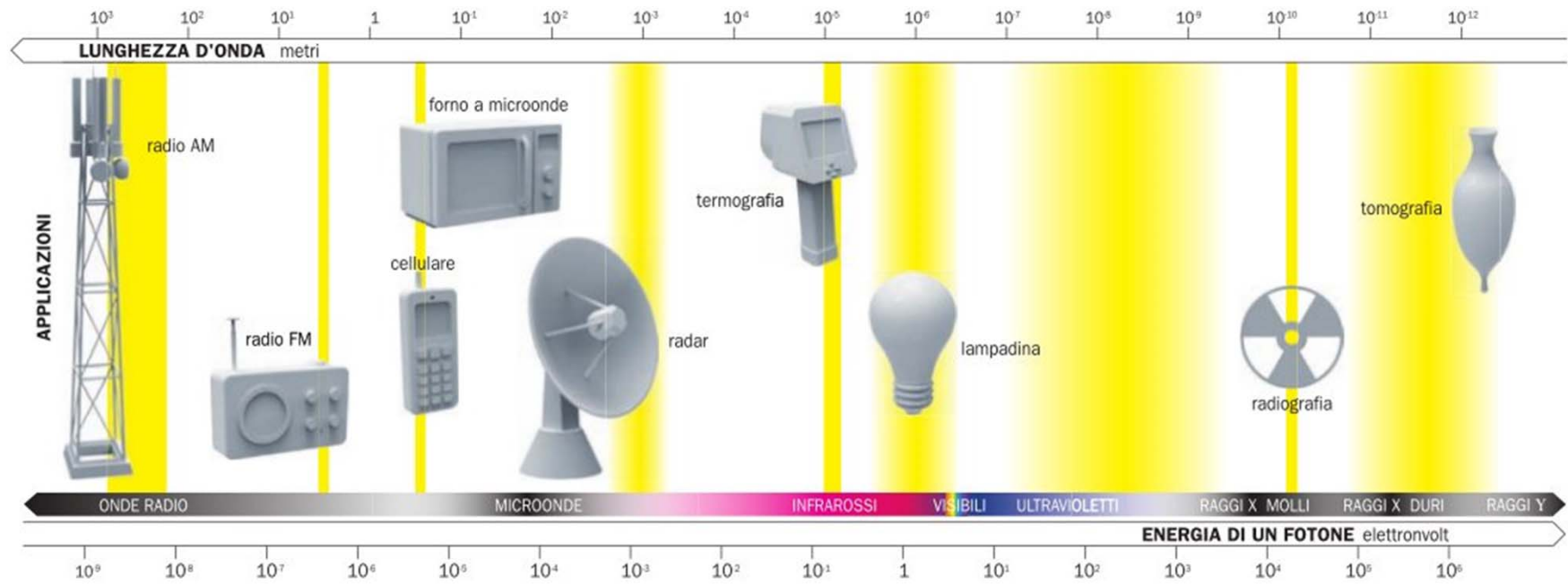
→ 24h
 → 12h
 → 6h
 → 1h

(click arrows for detailed view)

A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



La radiazione elettromagnetica

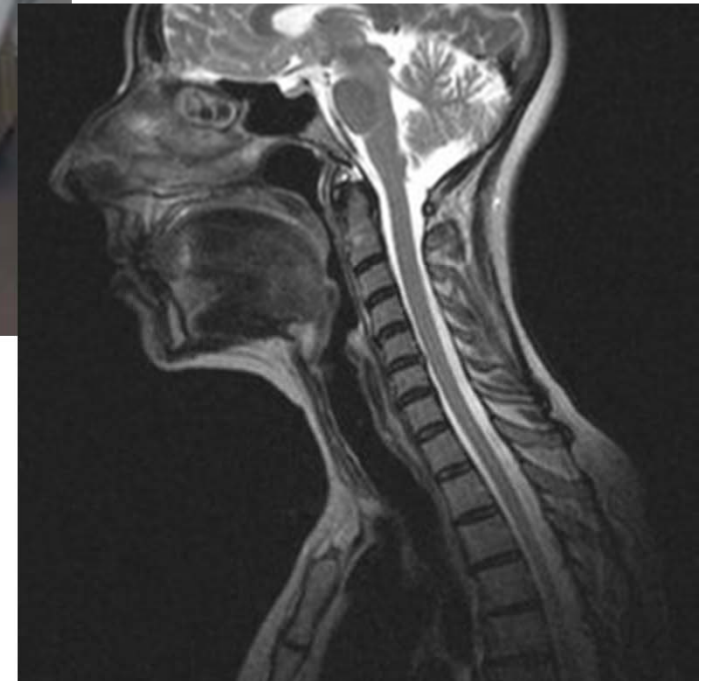


Contributi della fisica alla medicina

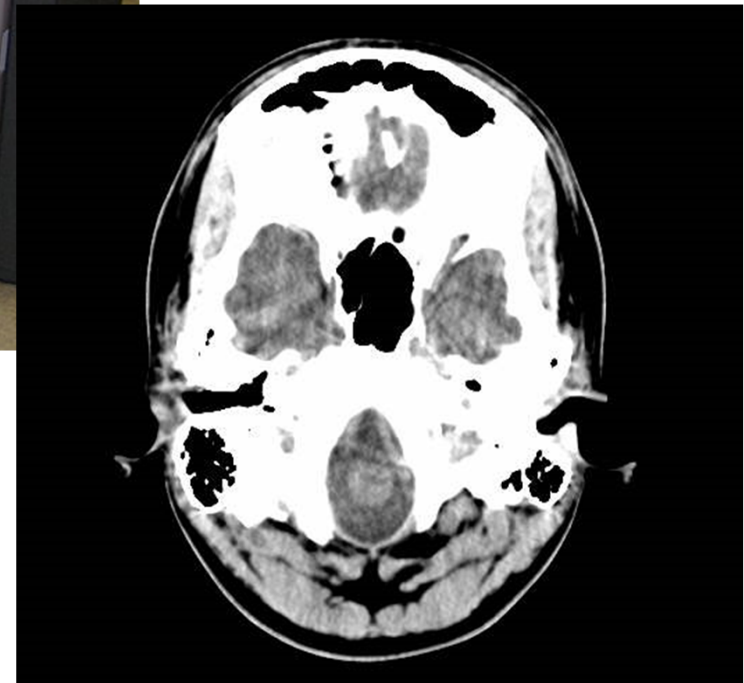
L'ecografia



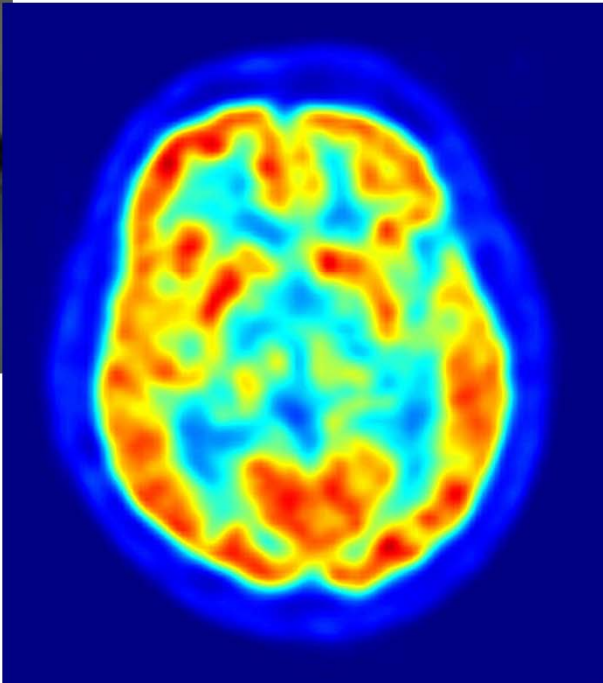
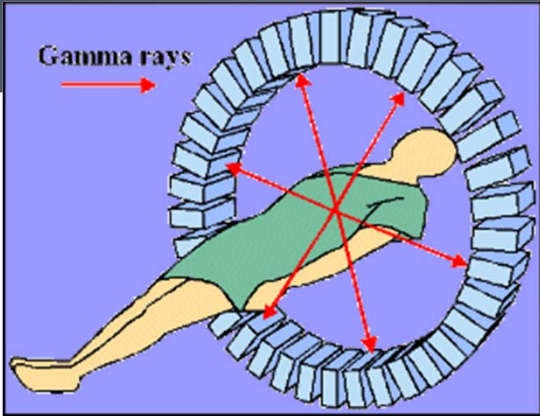
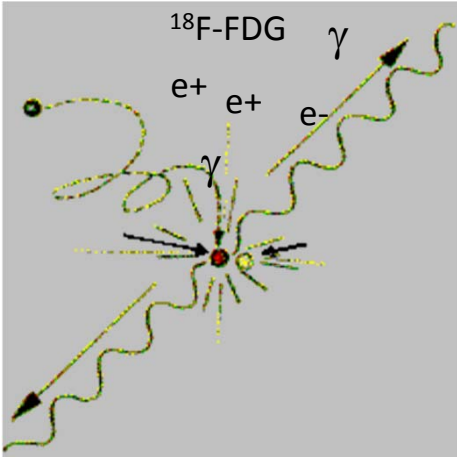
Risonanza Magnetica Nucleare (R.M.N.)



Tomografia computerizzata (T.C.)



Tomografia ad emissione di positroni (P.E.T.)



La P.E.T. nella diagnosi e nella cura dei tumori

**PET whole body
eseguita su un malato
oncologico prima e dopo
la chemioterapia**



**Prima della
chemioterapia**



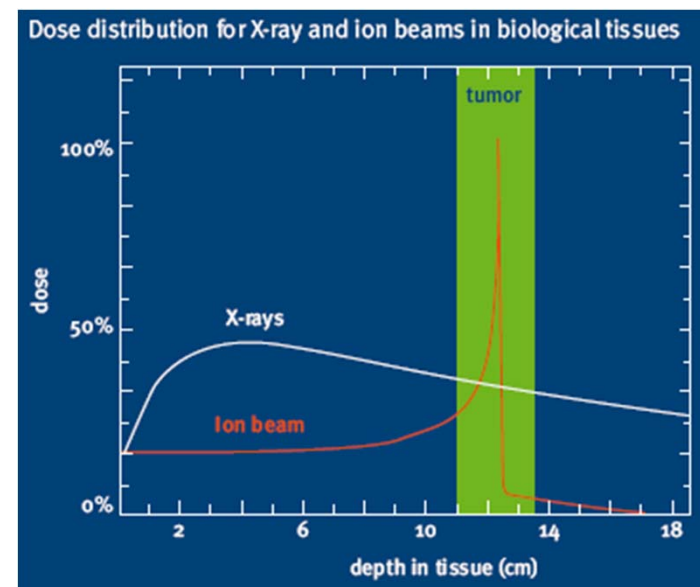
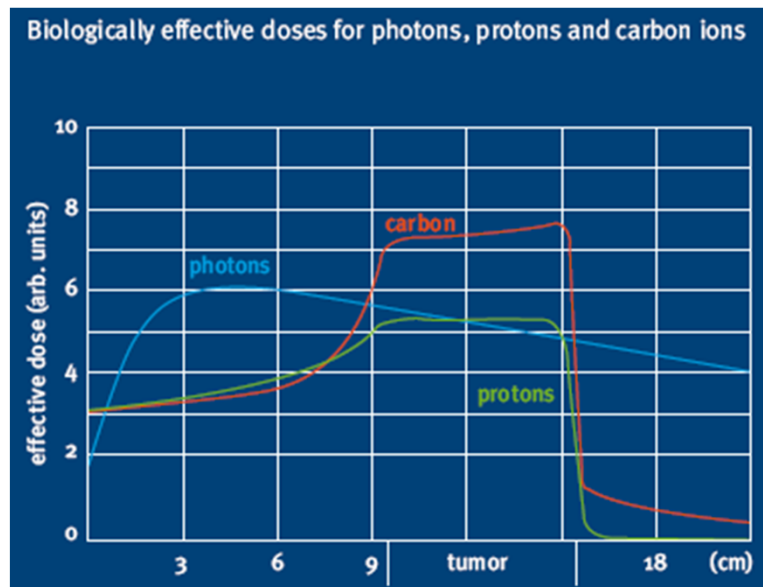
**2 mesi dopo la
chemioterapia**



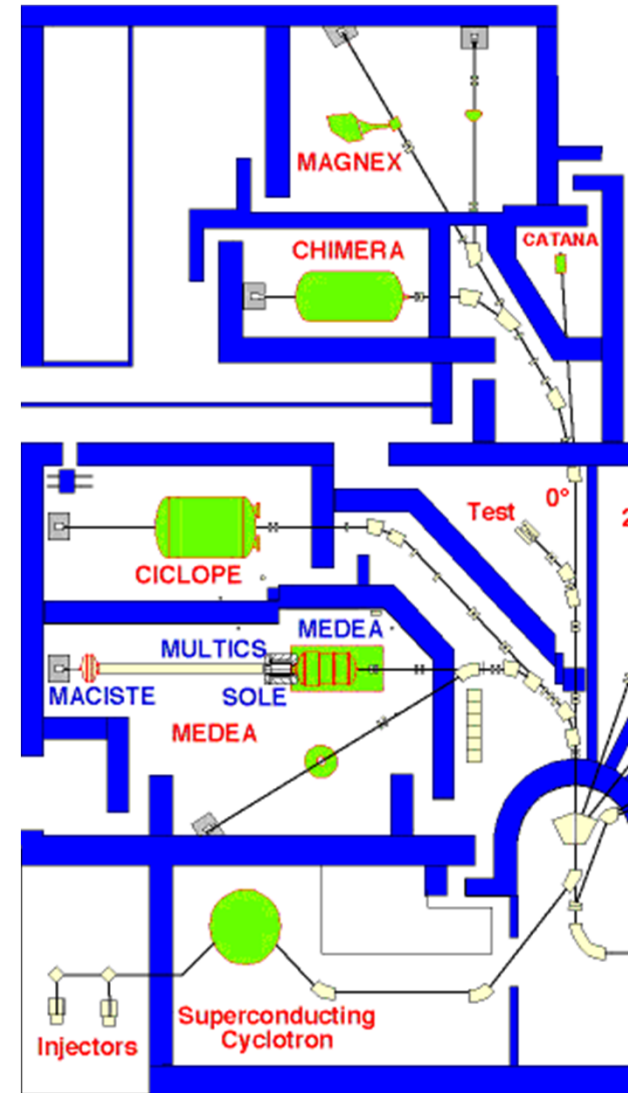
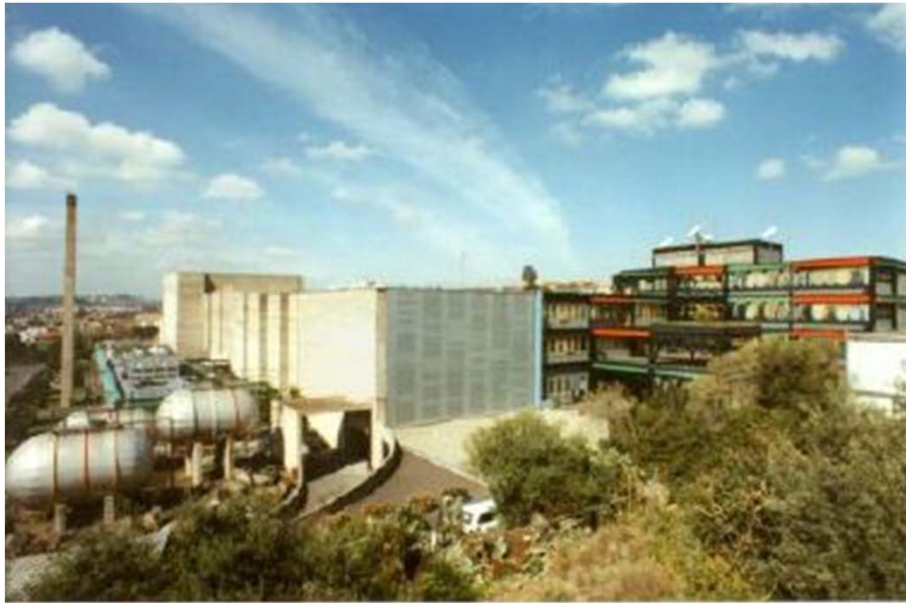
**4 mesi dopo la
chemioterapia**

Terapia con radiazioni

- radioterapia con **fotoni**: **cobaltoterapia**
 - acceleratore lineare
- radioterapia con **adroni**: **protoni** e **ioni**
 - Centro di AdroTerapia ed Applicazioni Avanzate (CATANA, Catania)
 - Centro Nazionale di Adroterapia Oncologica (C.N.A.O., Pavia)



Il laboratorio LNS



CATANA

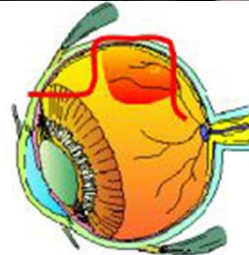
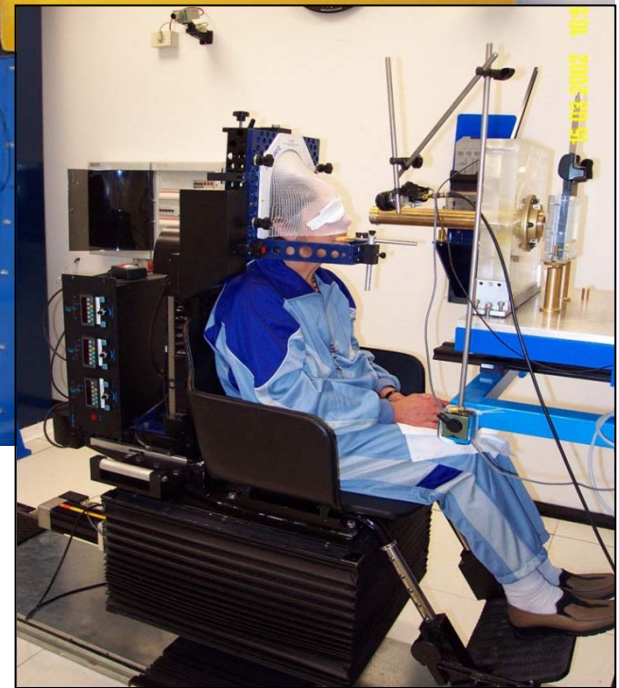
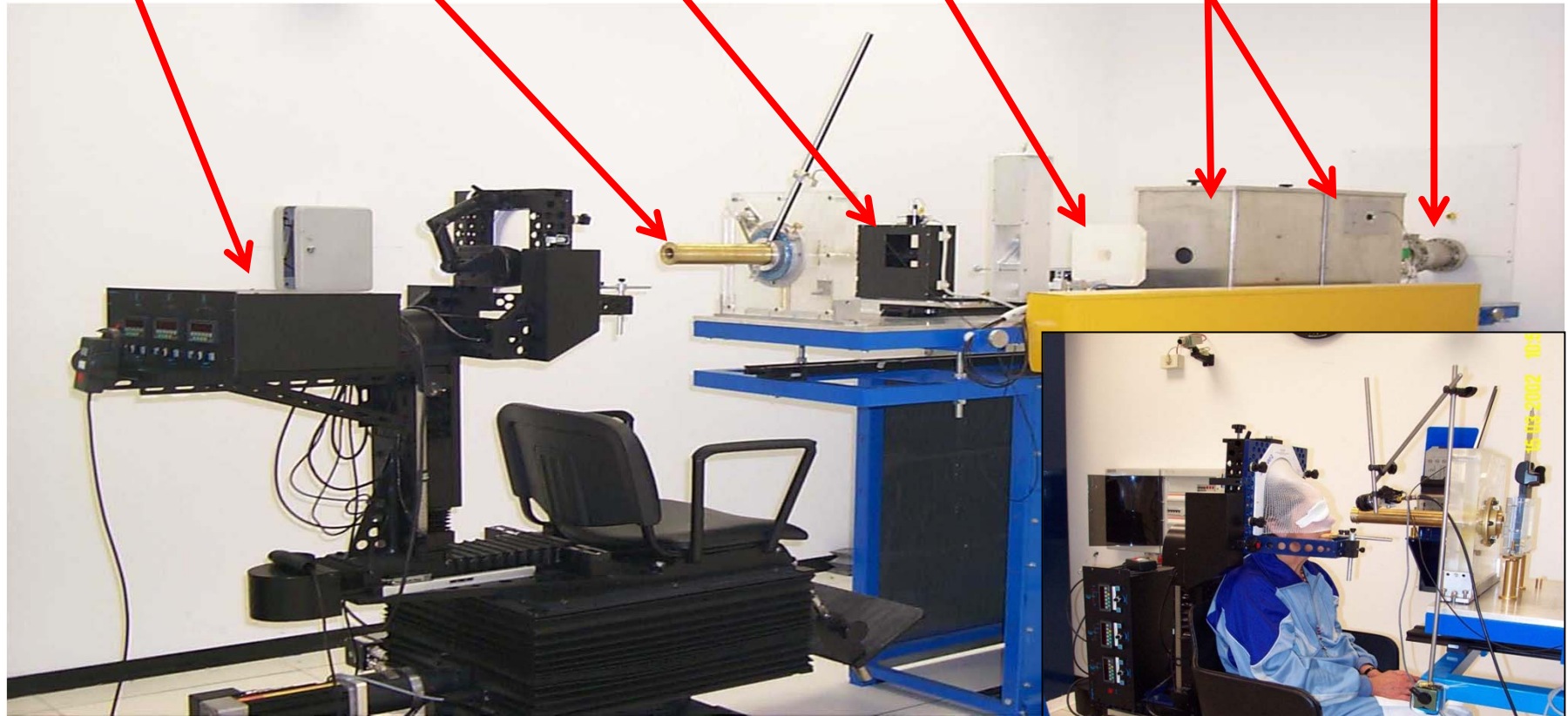
Motorized Chair
Final Collimator

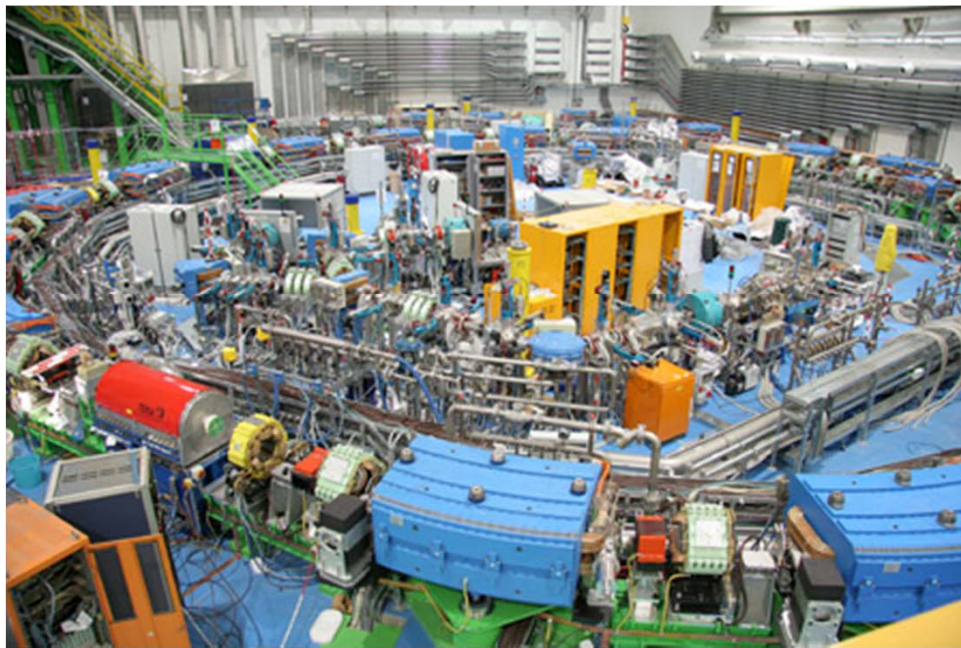
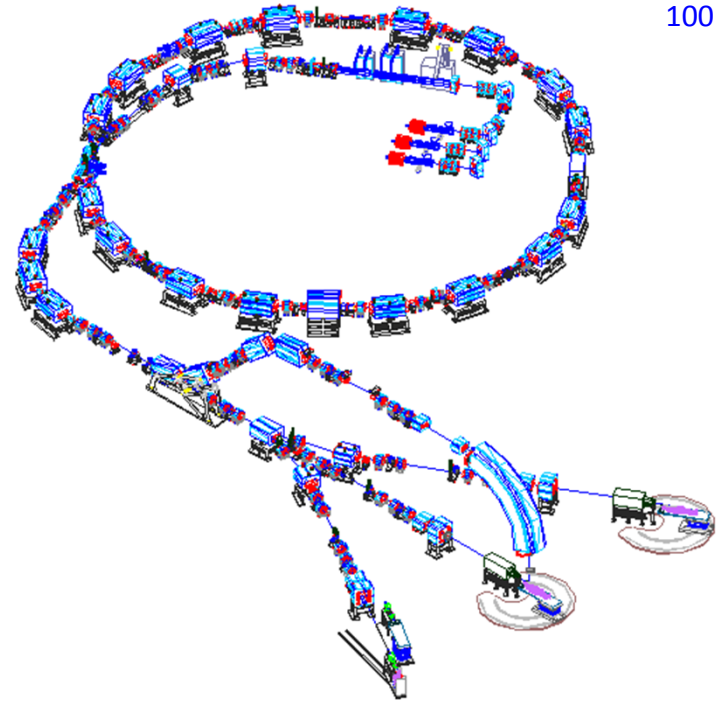
Centering Laser

Collimator

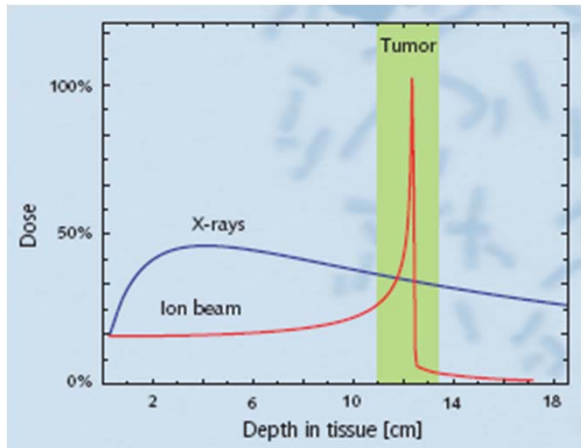
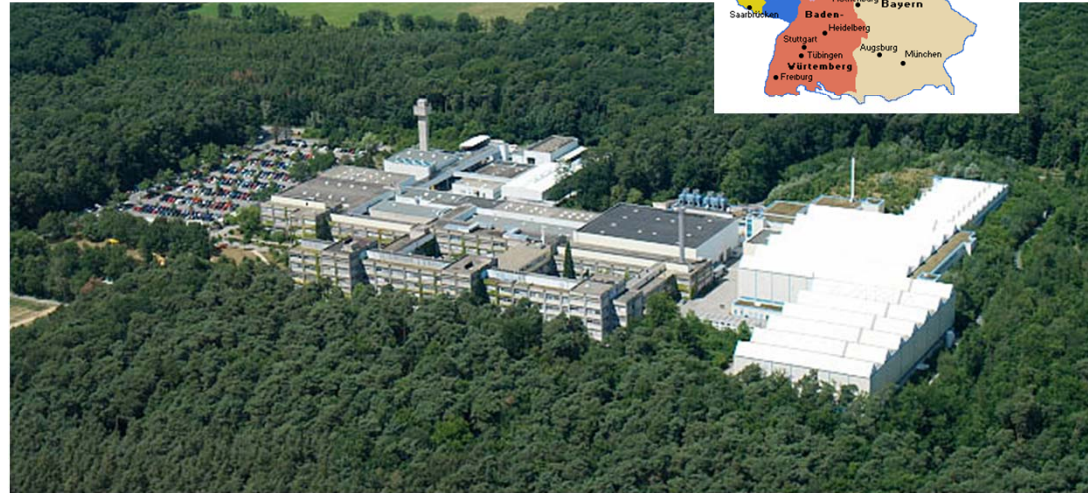
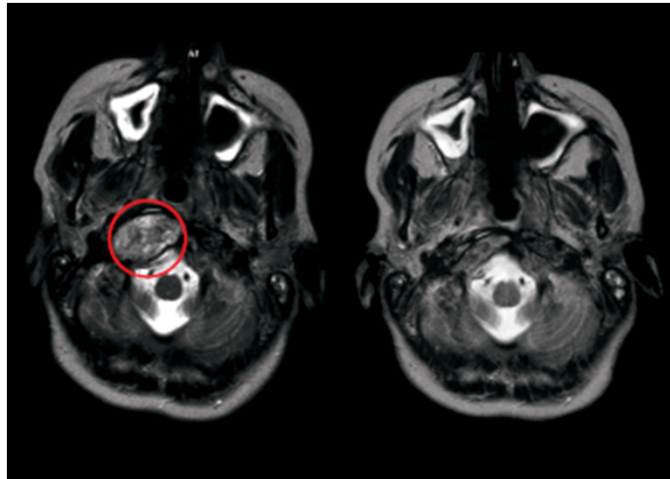
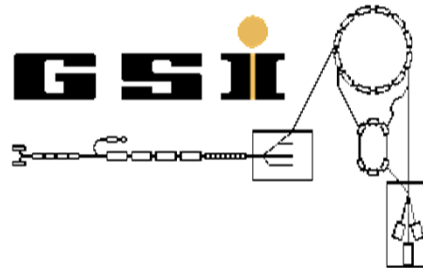
Range Shifter and Modulator

Exit Window

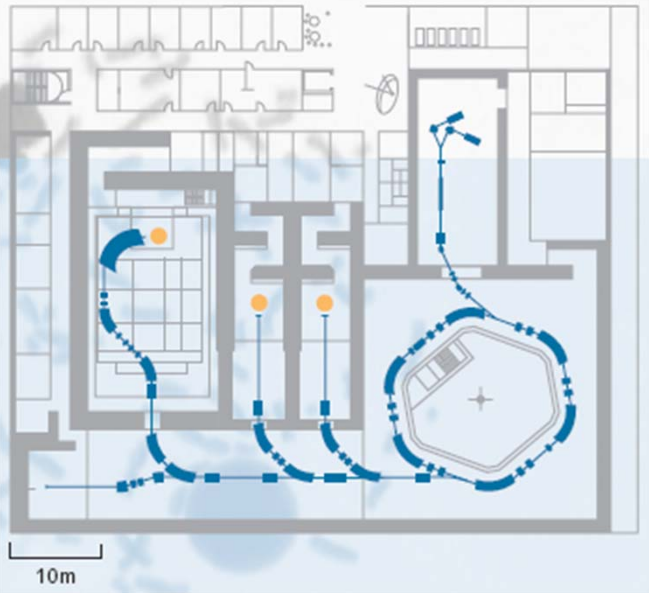




Terapia con ioni



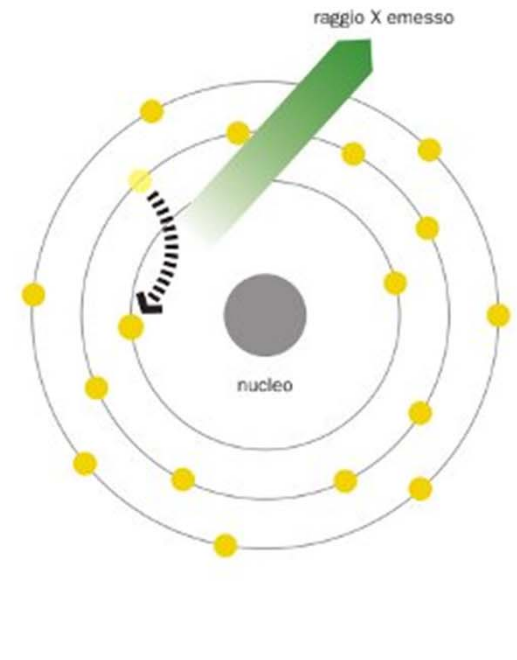
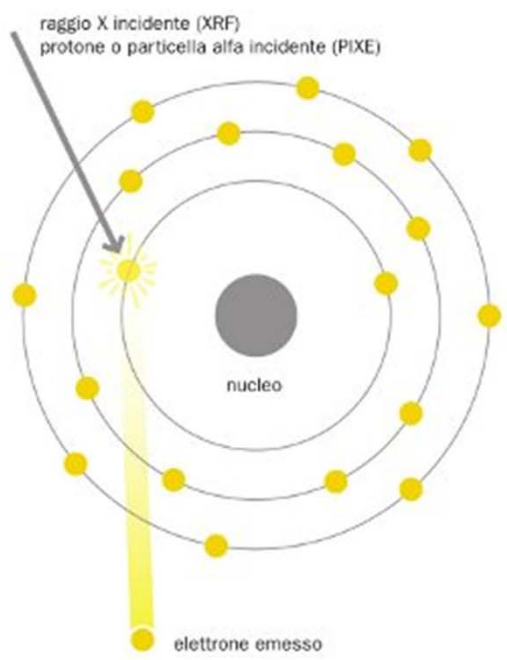
Terapia con ioni



Contributi della fisica all'arte

analizzare senza distruggere

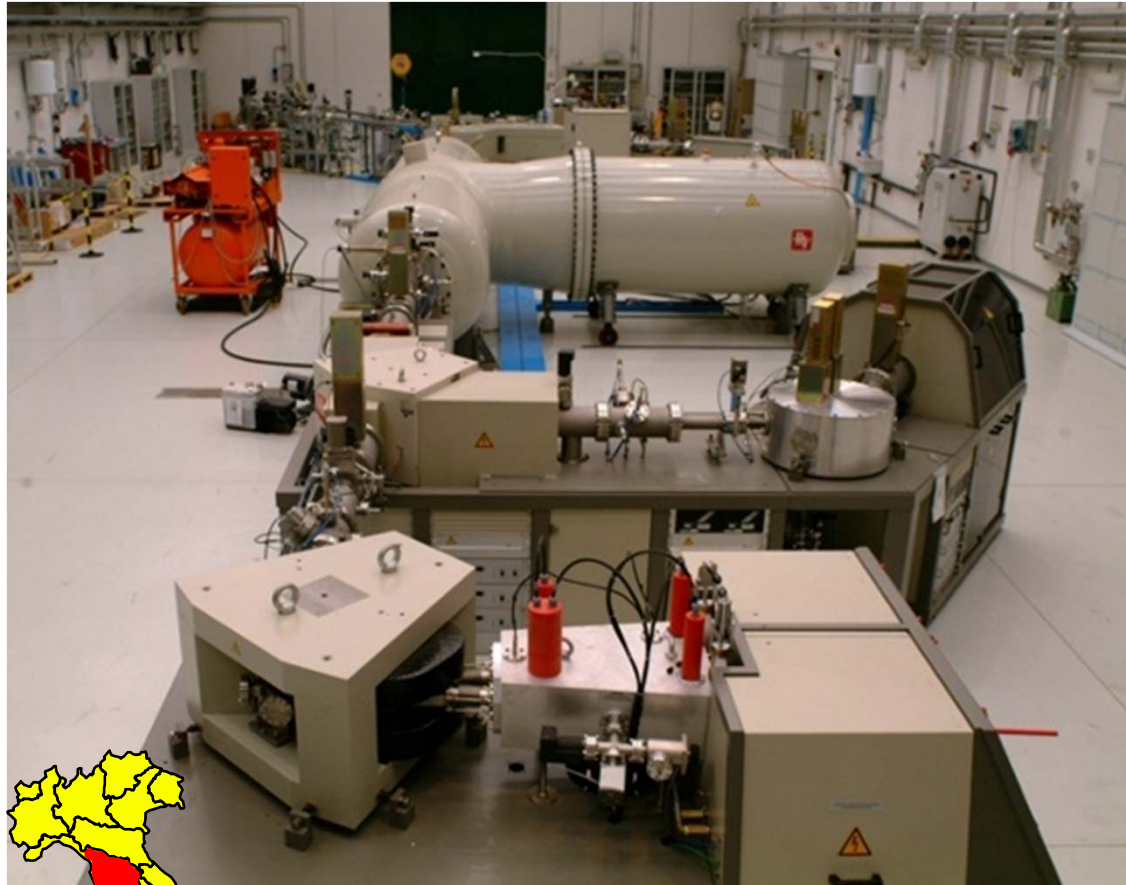
La tecnica Xrf (X ray fluorescence)



A. Felcicello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



Laboratorio di Tecniche Nucleari per i Beni Culturali (LABEC, Firenze)



Laboratorio di Analisi Non Distruttiva in Situ (LANDIS, LNS)



A. Felciello / Liceo M. Mazzarello, Torino, 28 febbraio 2012



Arrivederci a fisica!