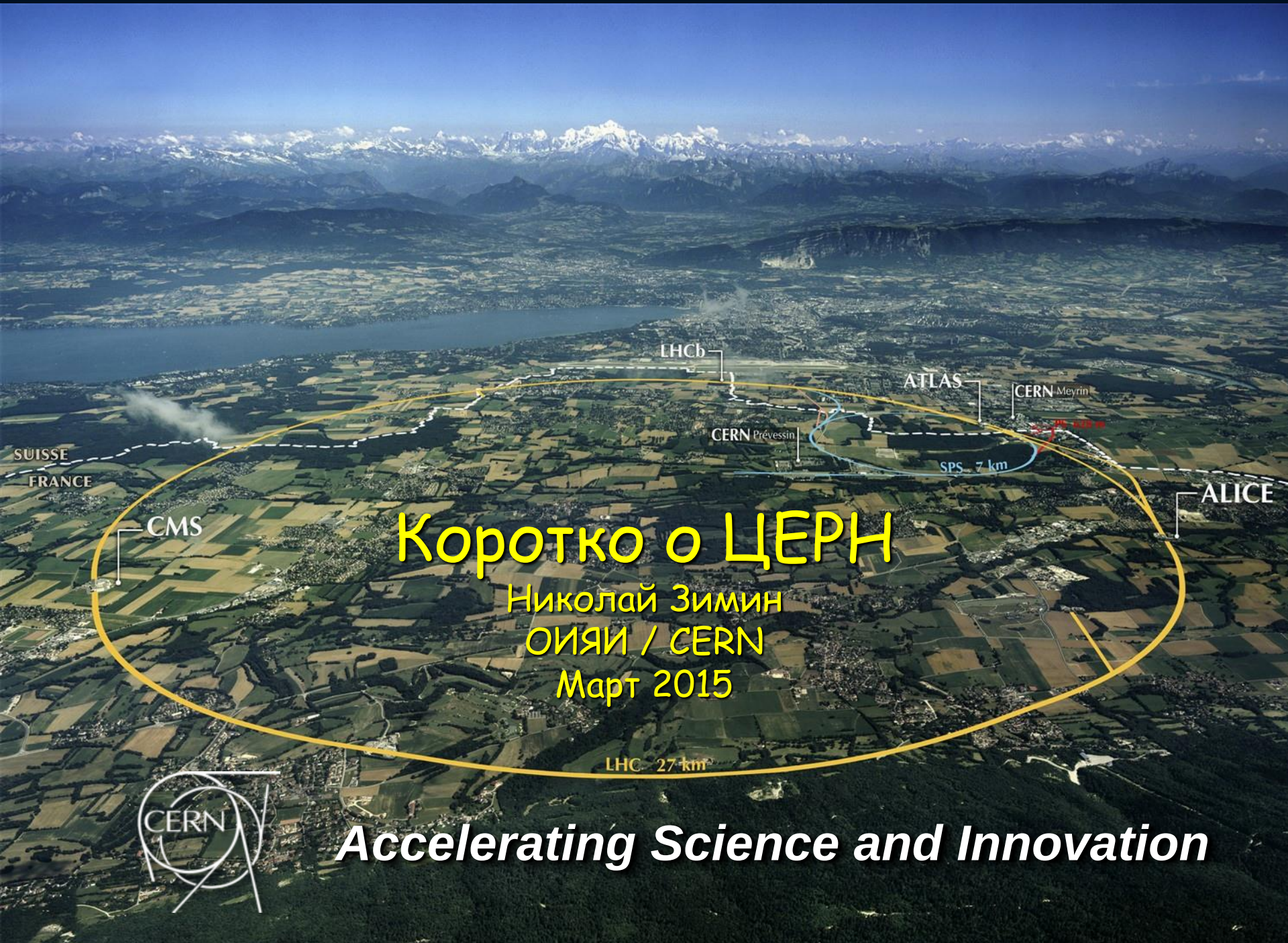


Коротко о ЦЕРН

Николай Зимин
ОИЯИ / CERN

Март 2015

Accelerating Science and Innovation

В 1945 Европа была в руинах

Исследователи покинули Европу, в основном в США

30 ноября 2009 LHC Новый мировой рекорд!

Early this morning CERN's Large Hadron Collider become the world's highest energy particle accelerator, having accelerated its twin beams of protons to an energy of **1.18 TeV** . This exceeds the previous world record of 0.98 TeV, which had been held by the US Fermi National Accelerator

CERN основан в 1954: 12 Европейских стран

"Наука во имя мира"

Сегодня: 21 страна-участница

~ 2300 штатных сотрудников
~ 1050 контрактников
> 10000 пользователей

Budget (2012) ~1000 MCHF

Member States: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, the Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom

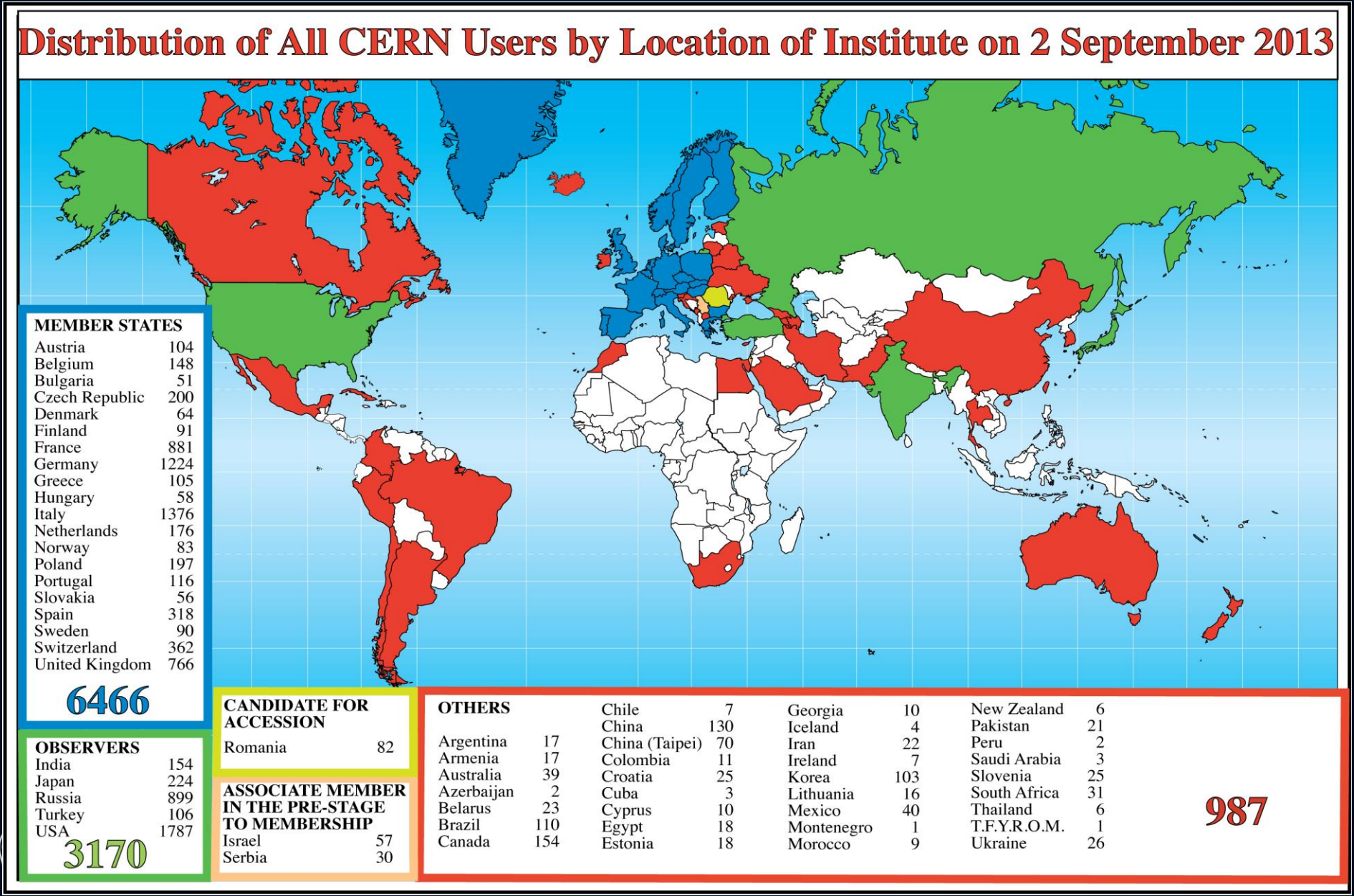
Candidate for Accession: Romania

Associate Members in the Pre-Stage to Membership: Serbia

Applicant States: Cyprus, Slovenia, Turkey

Observers to Council: India, Japan, the Russian Federation, the United States of America, Turkey, the European Commission and UNESCO , ОИЯИ

Наука все более и более глобальна



Основные задачи ЦЕРНа

- Продвигать - Push forward the frontiers of knowledge

  E.g. the secrets of the Big Bang ... what is the matter like within the first moments of its existence?

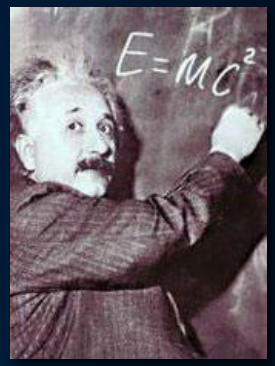
- Развивать - Develop technologies for accelerators and detectors

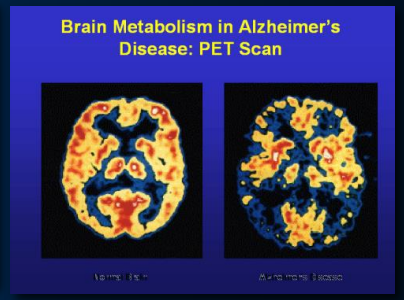
  Information technology - the Web and the GRID

  Medicine - diagnosis and therapy

- Готовить - Train scientists and engineers of tomorrow

- Объединять - Unite people from different countries and cultures



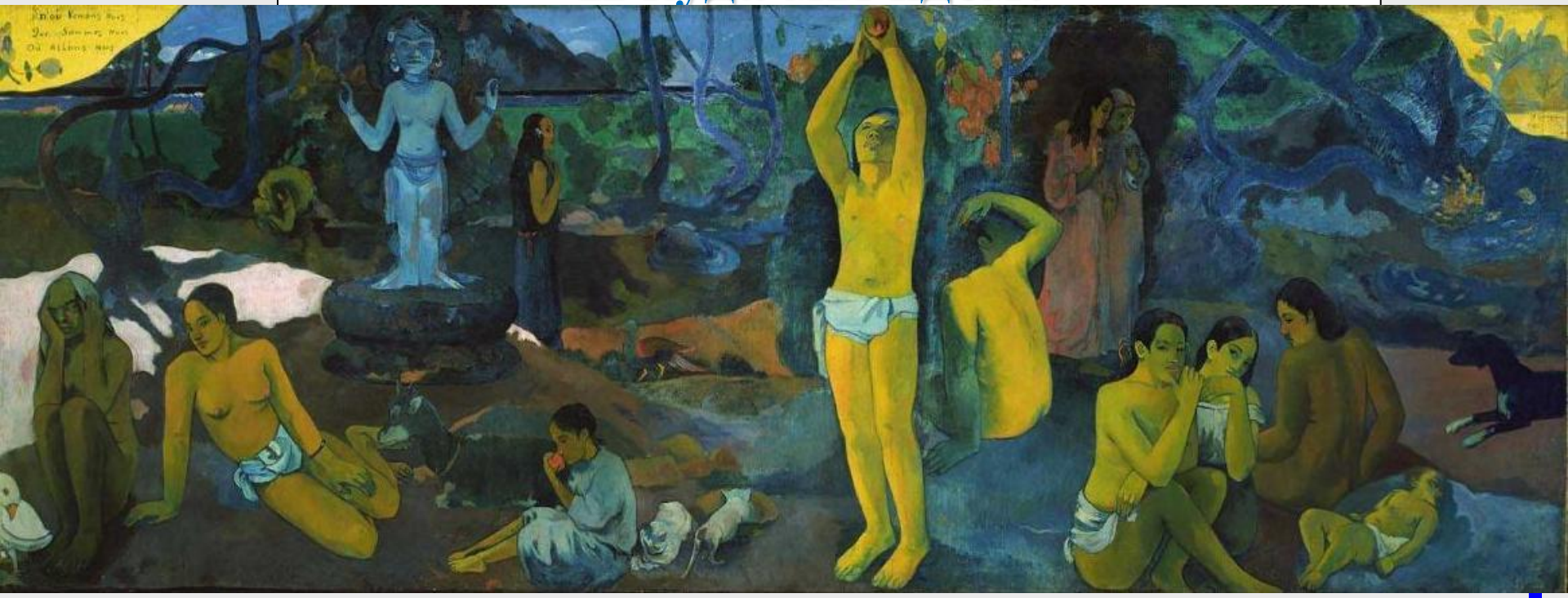


Для человечества:

“Откуда мы появились?

Кто мы?

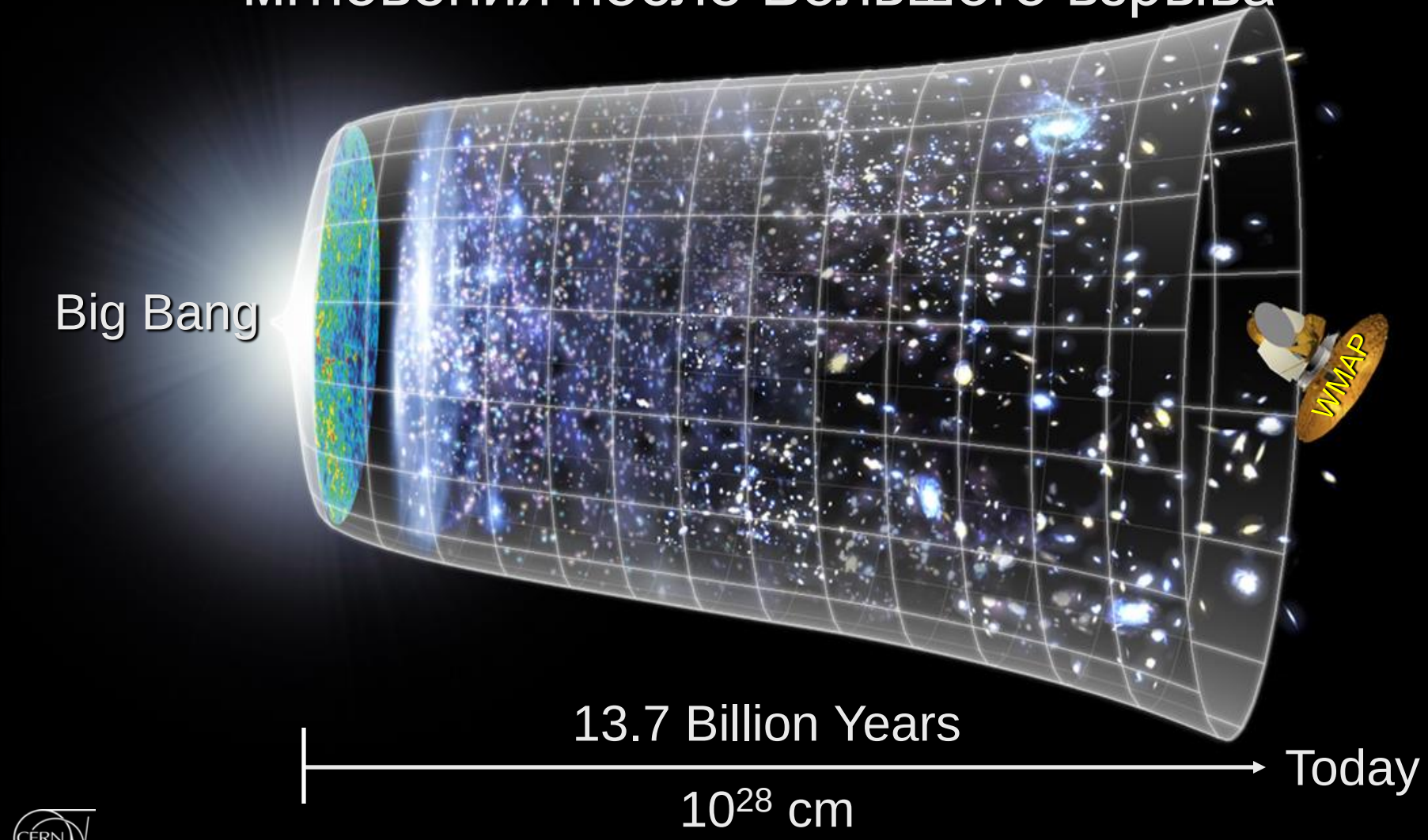
И куда мы идем?”

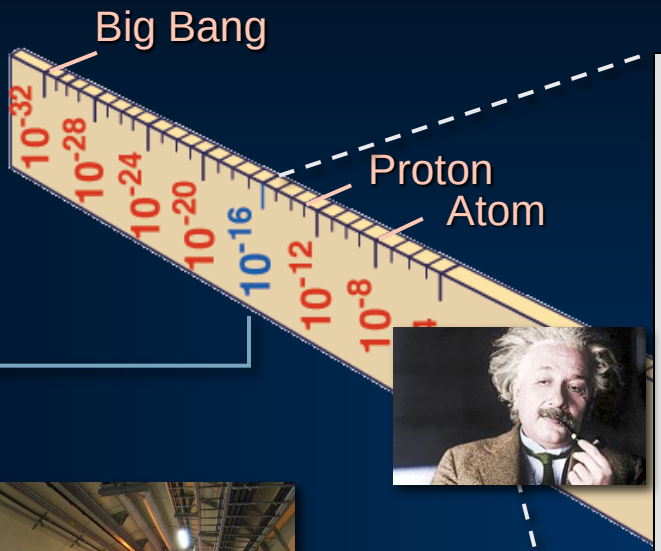


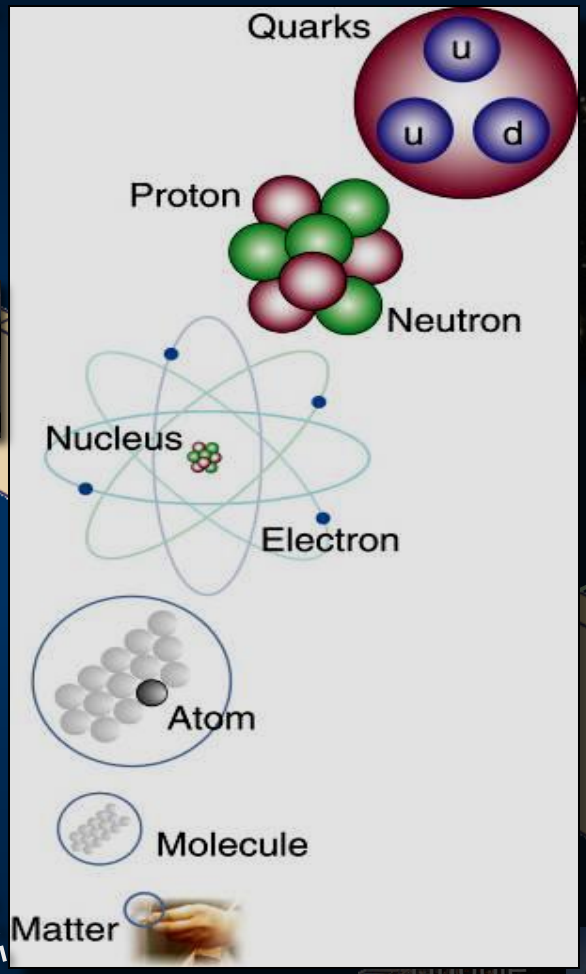
Главная цель физики частиц, CERN и LHC:
Из чего «сделана» Вселенная?

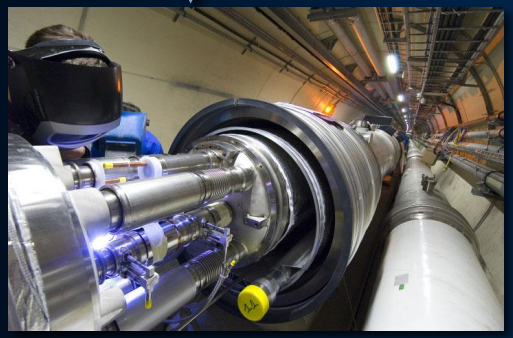
Основные Вызовы:

Понять, что было во Вселенной в первые мгновения после Большого взрыва



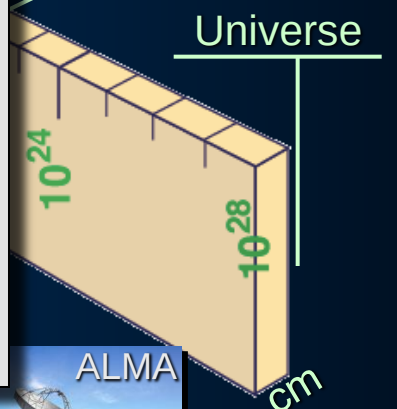


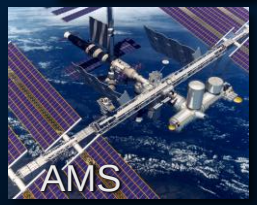




LHC

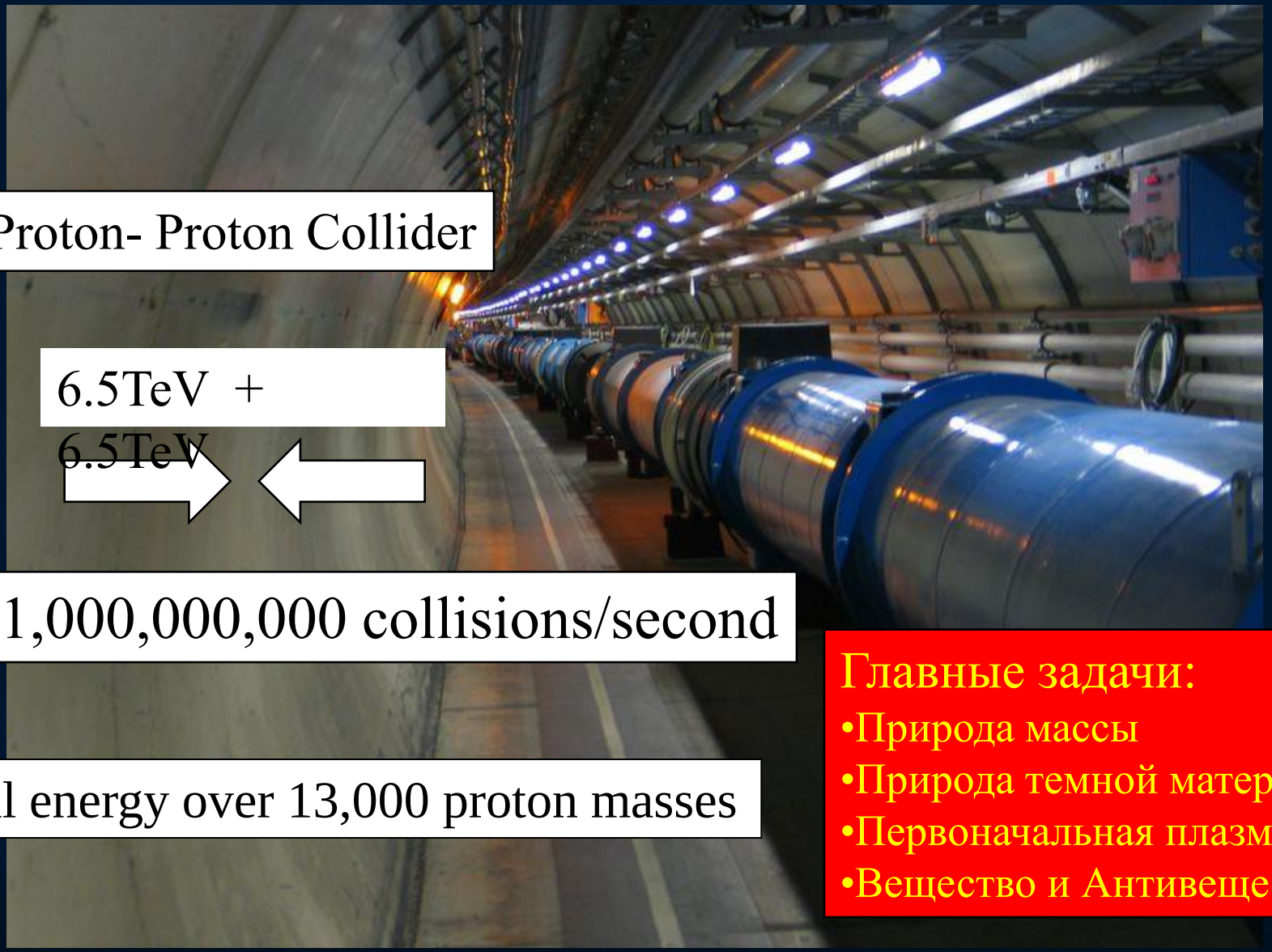
Super-Microscope





Study physics laws of first moments after Big Bang
increasing Symbiosis between Particle Physics,
Astrophysics and Cosmology

Большой адронный коллайдер (LHC)



Proton- Proton Collider

6.5TeV +
6.5TeV

1,000,000,000 collisions/second

Total energy over 13,000 proton masses

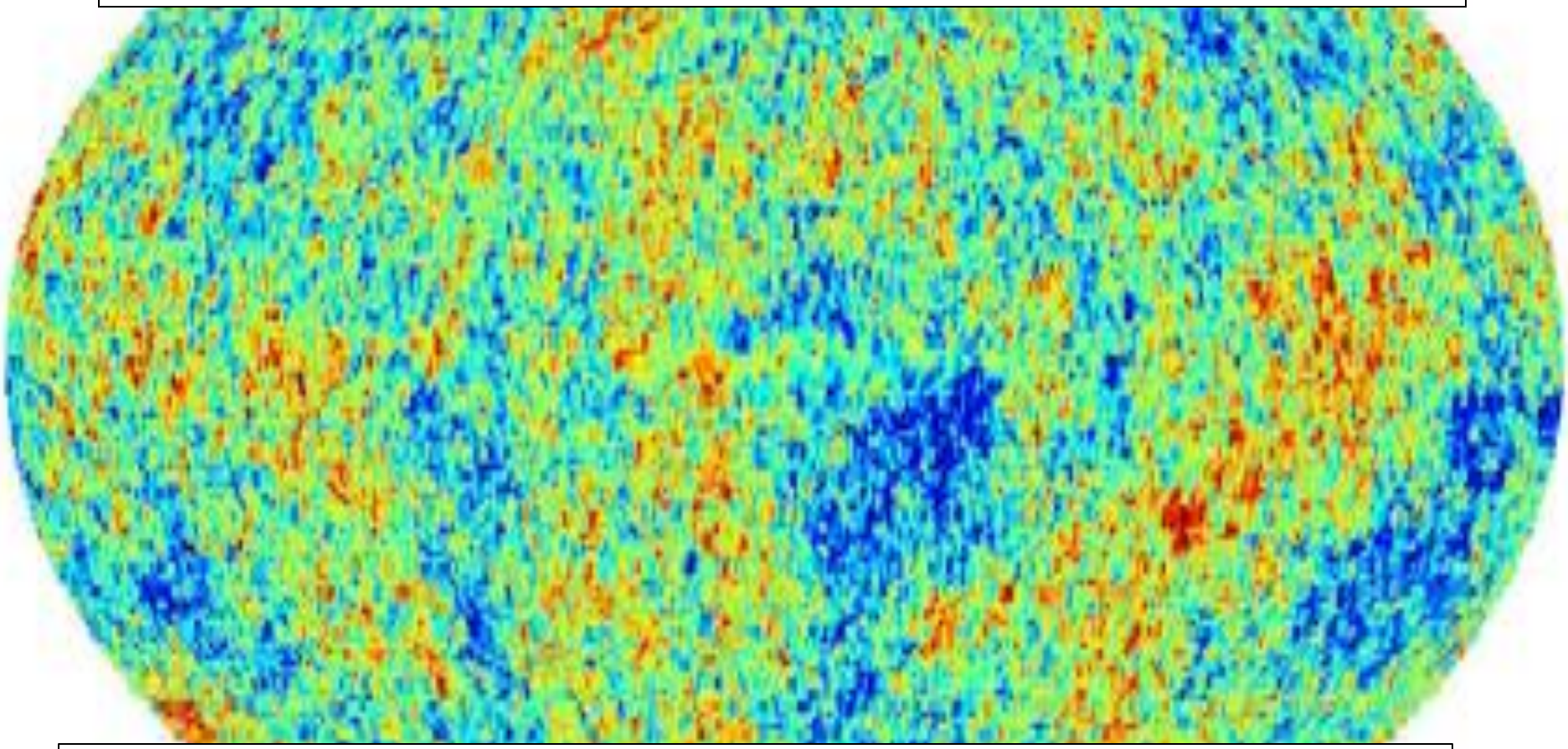
Главные задачи:

- Природа массы
- Природа темной материи
- Первоначальная плазма
- Вещество и Антивещество

Наиболее «пустое» место Солнечной системы

Вакуум как в межпланетном прстранстве: давленение в пучковых трубках в 10 раз меньше, чем на поверхности Луны.

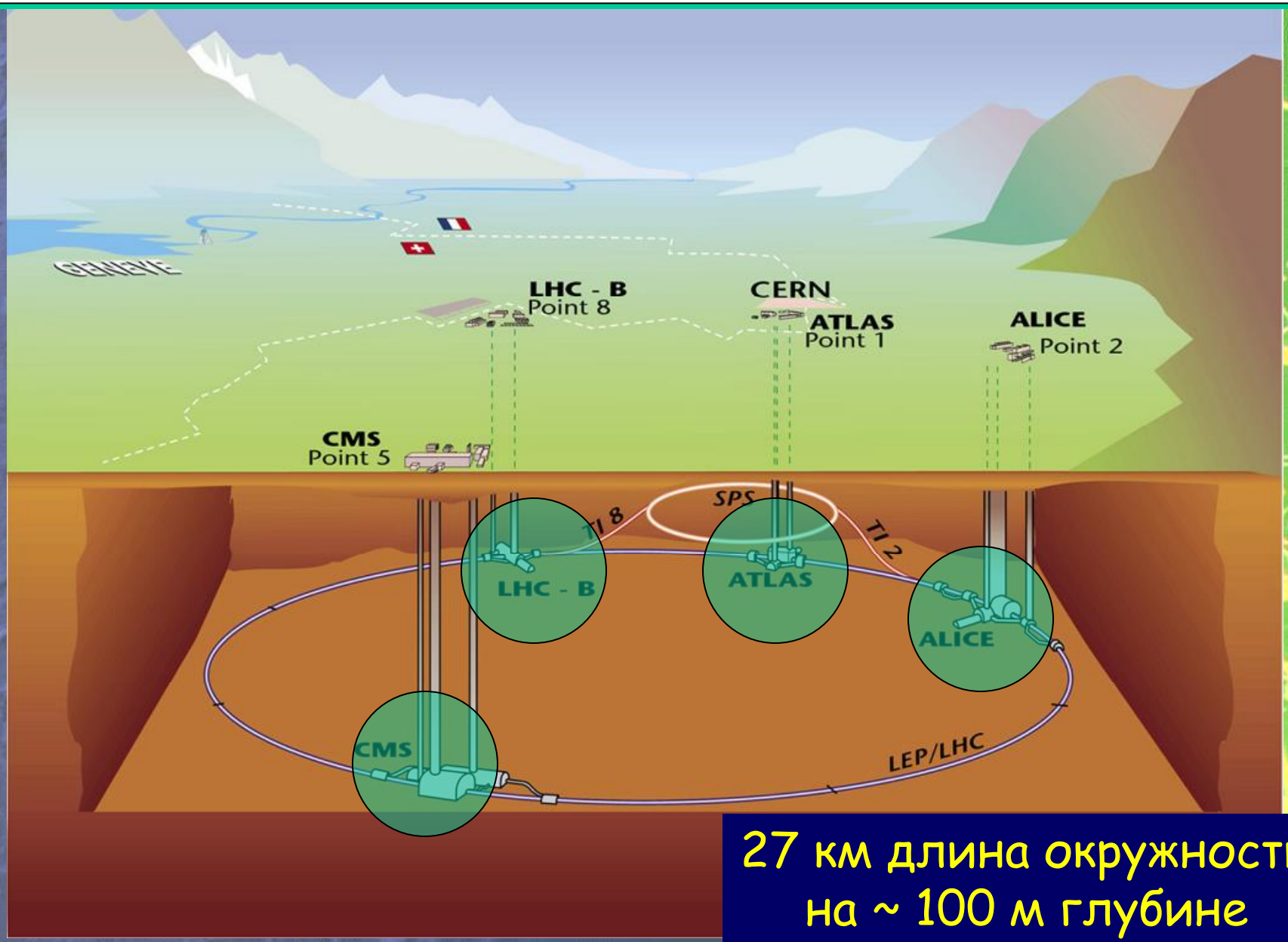
И «холоднее», чем в открытом космосе



LHC 1.9 K = - 271 C

Открытый космос 2.7 K = - 270 C

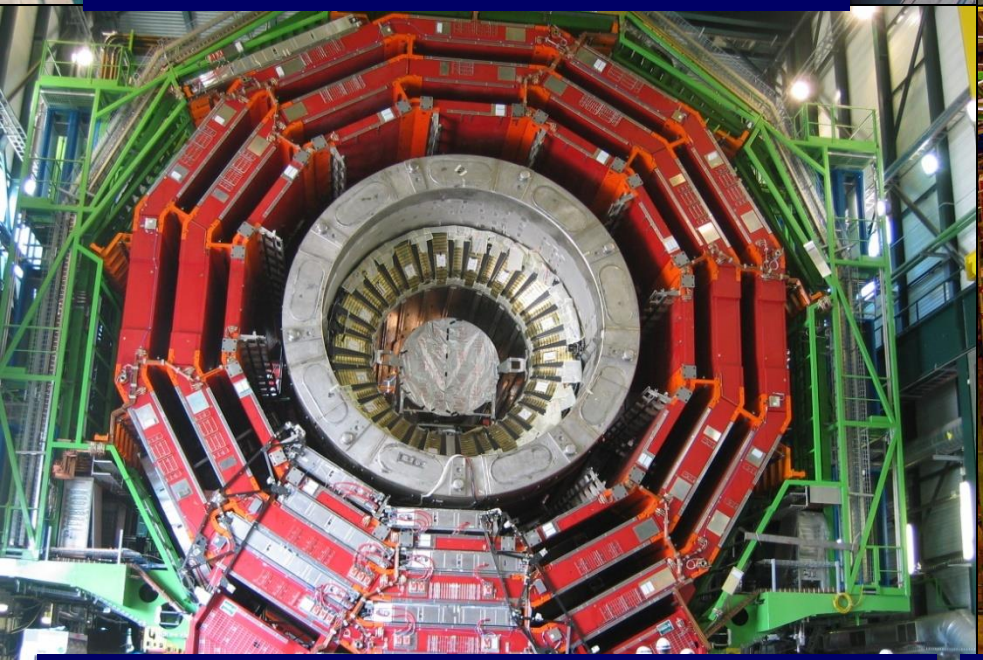
Общий вид LHC и экспериментов



27 км длина окружности
на ~ 100 м глубине

ALICE: «Исходная» плазма

ATLAS: Хиггс, суперсимметрия, ..



CMS:Хиггс, суперсимметрия, ...

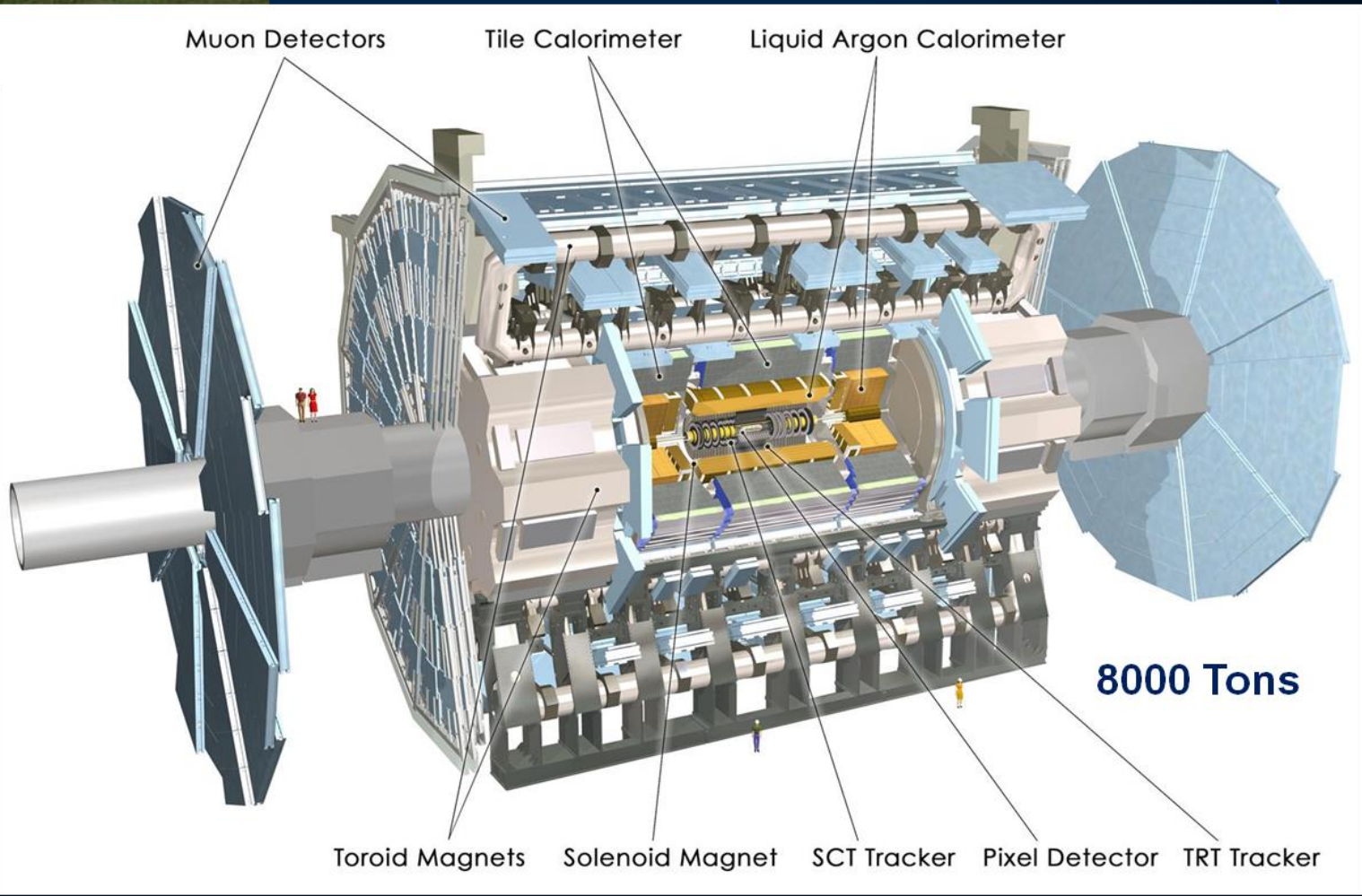
LHCb: Различия вещества-антивещес

ATLAS Detector

45 m

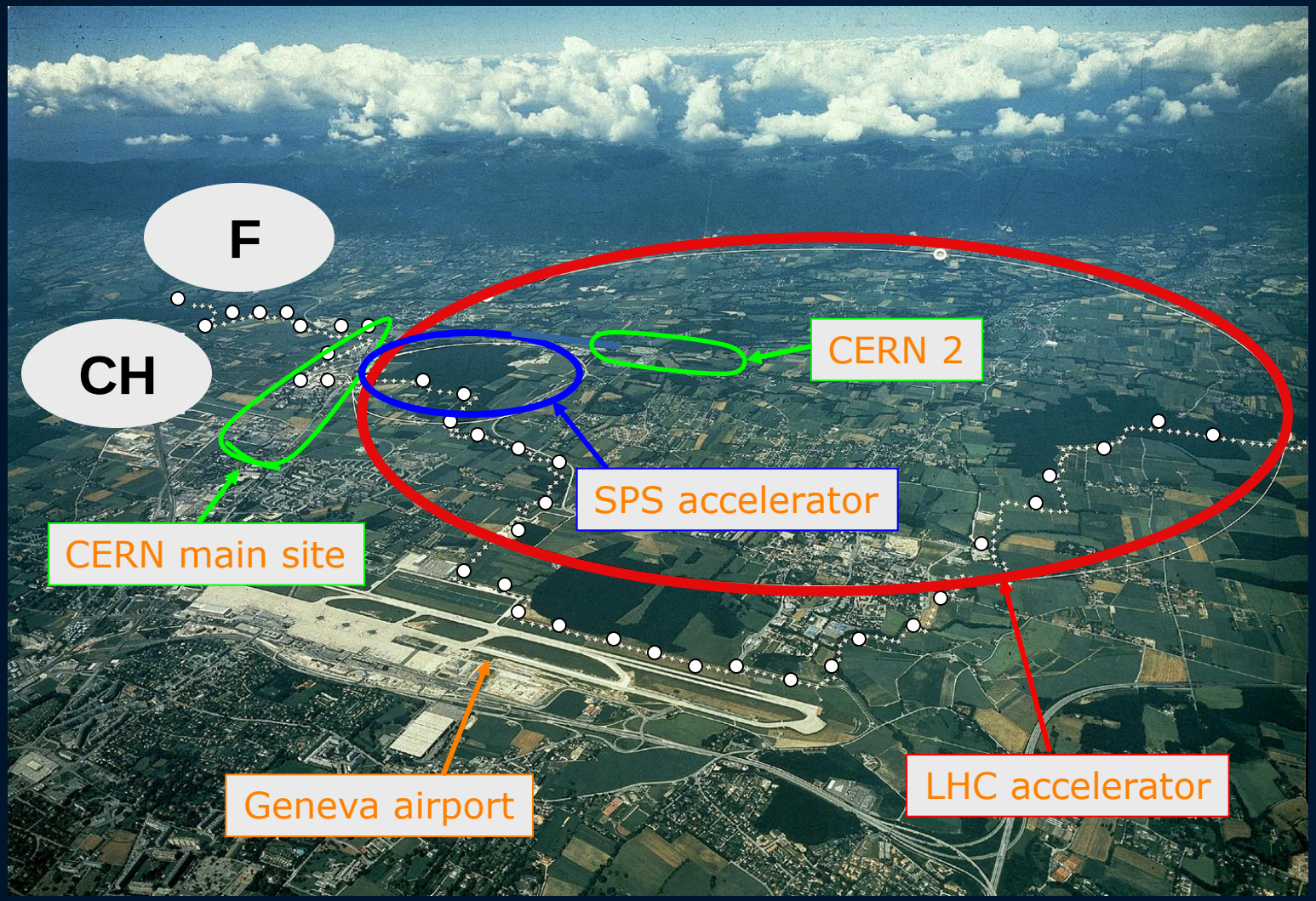
ATLAS superimposed to the 5 floors of building 40

25 m



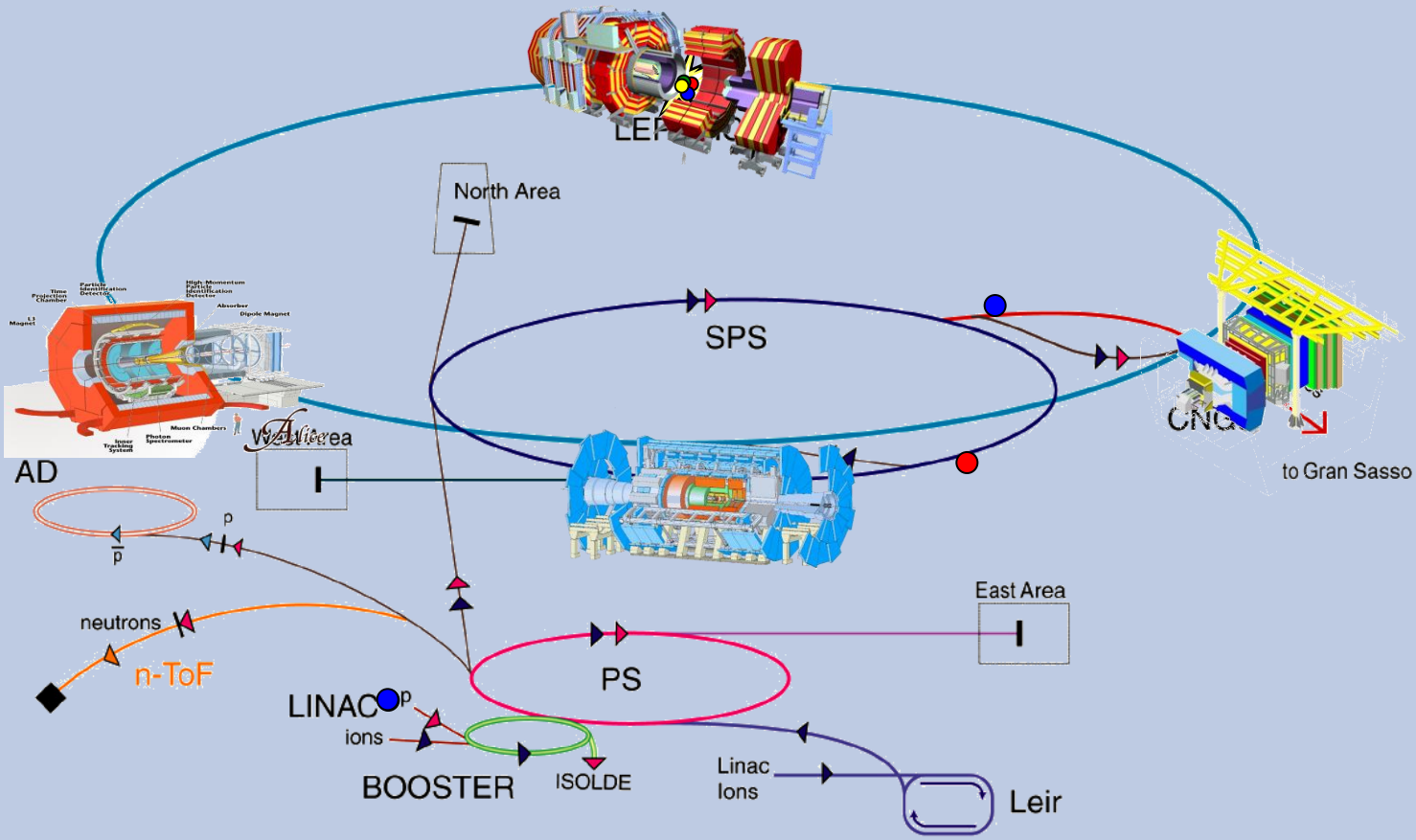
Наиболее «горячее» место во Вселенной

Столкновения частиц создают (в маленьком объеме) темературы, в миллиарды раз выше, чем на Солнце


F
CH
CERN 2
SPS accelerator
CERN main site
Geneva airport
LHC accelerator

Large Hadron Collider

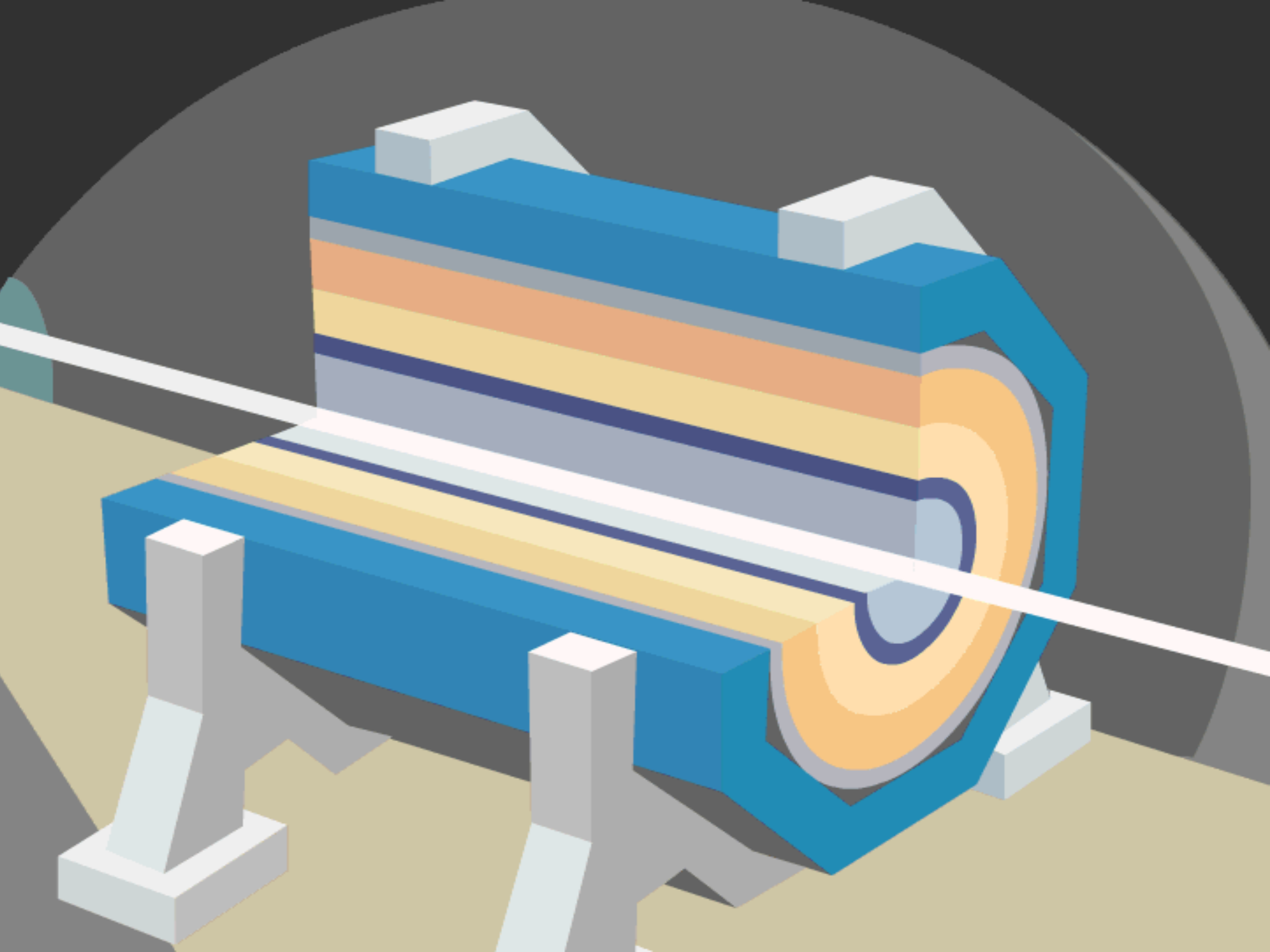
Столкновения протонов... ...регистрируются в гигантских детекторах



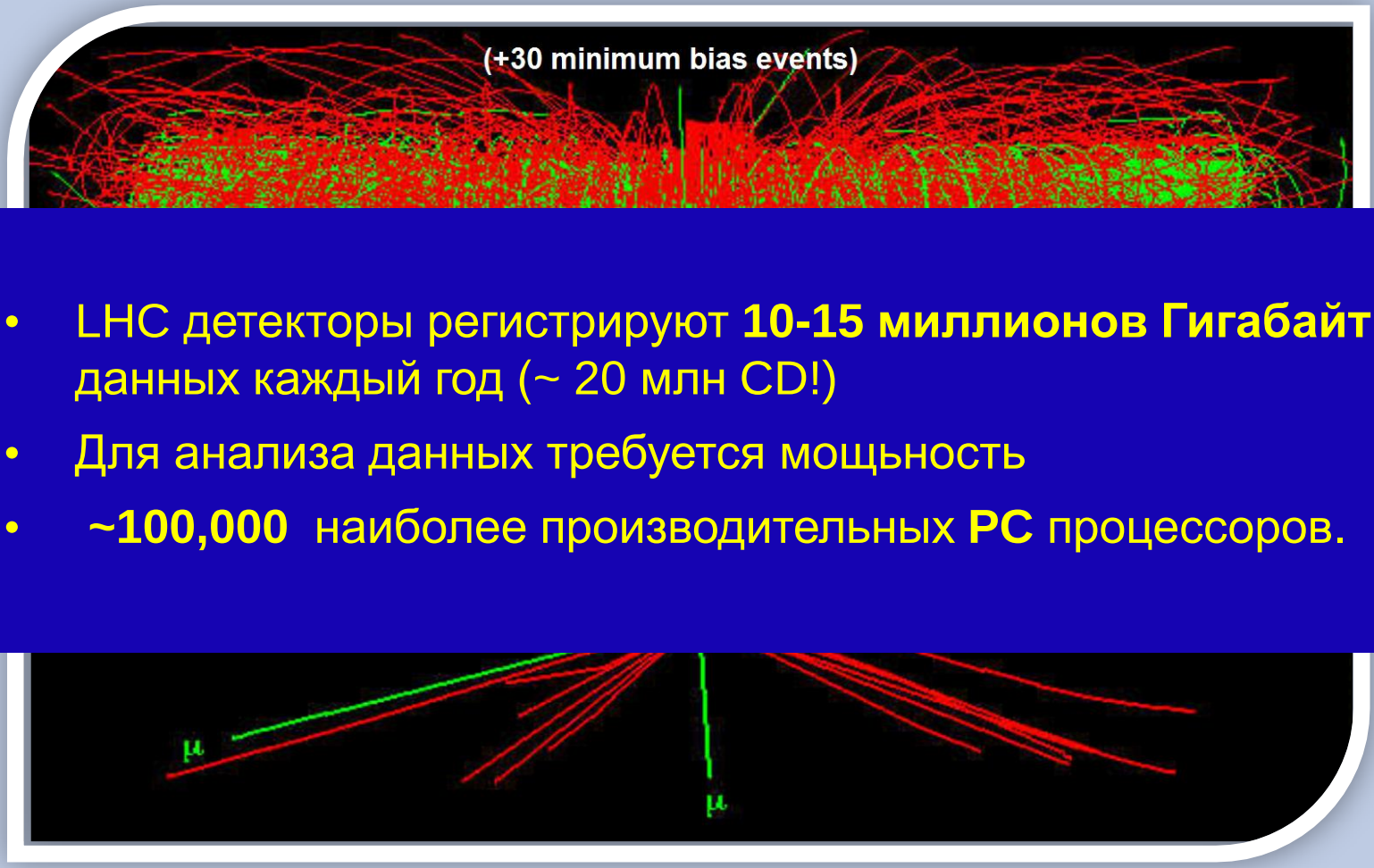
p (proton)
ion
neutron
p̄ (antiproton)
proton/antiproton conversion
neutrino

AD Antiproton Decelerator
PS Proton Synchrotron
SPS Super Proton Synchrotron

LHC Large Hadron Collider
n-ToF Neutron Time of Flight
CNGS Cern Neutrinos Gran Sasso

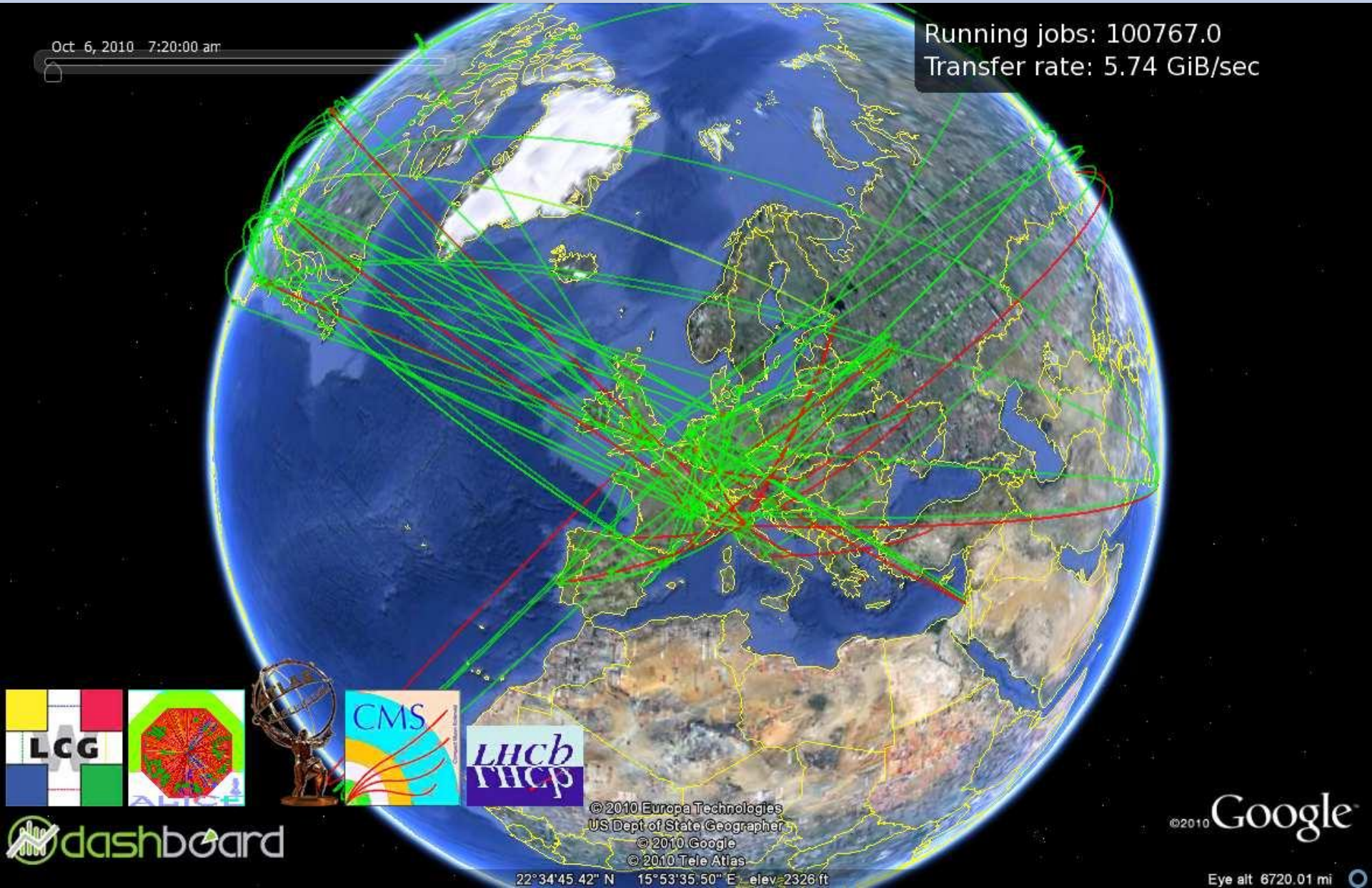


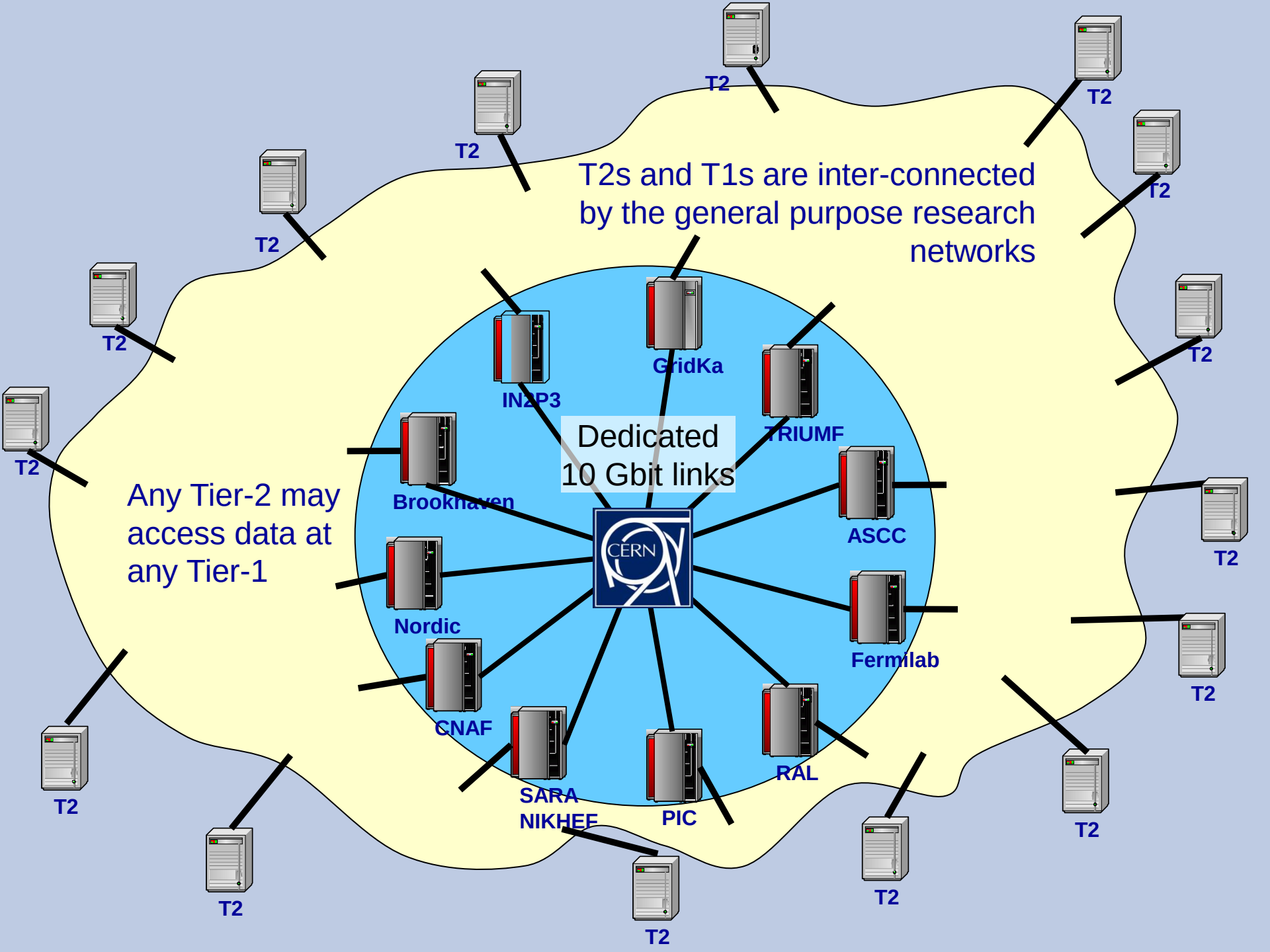
❑ Поиск новых частиц требует отбор и анализ невообразимого колличества данных, зарегистрированных детекторами на LHC



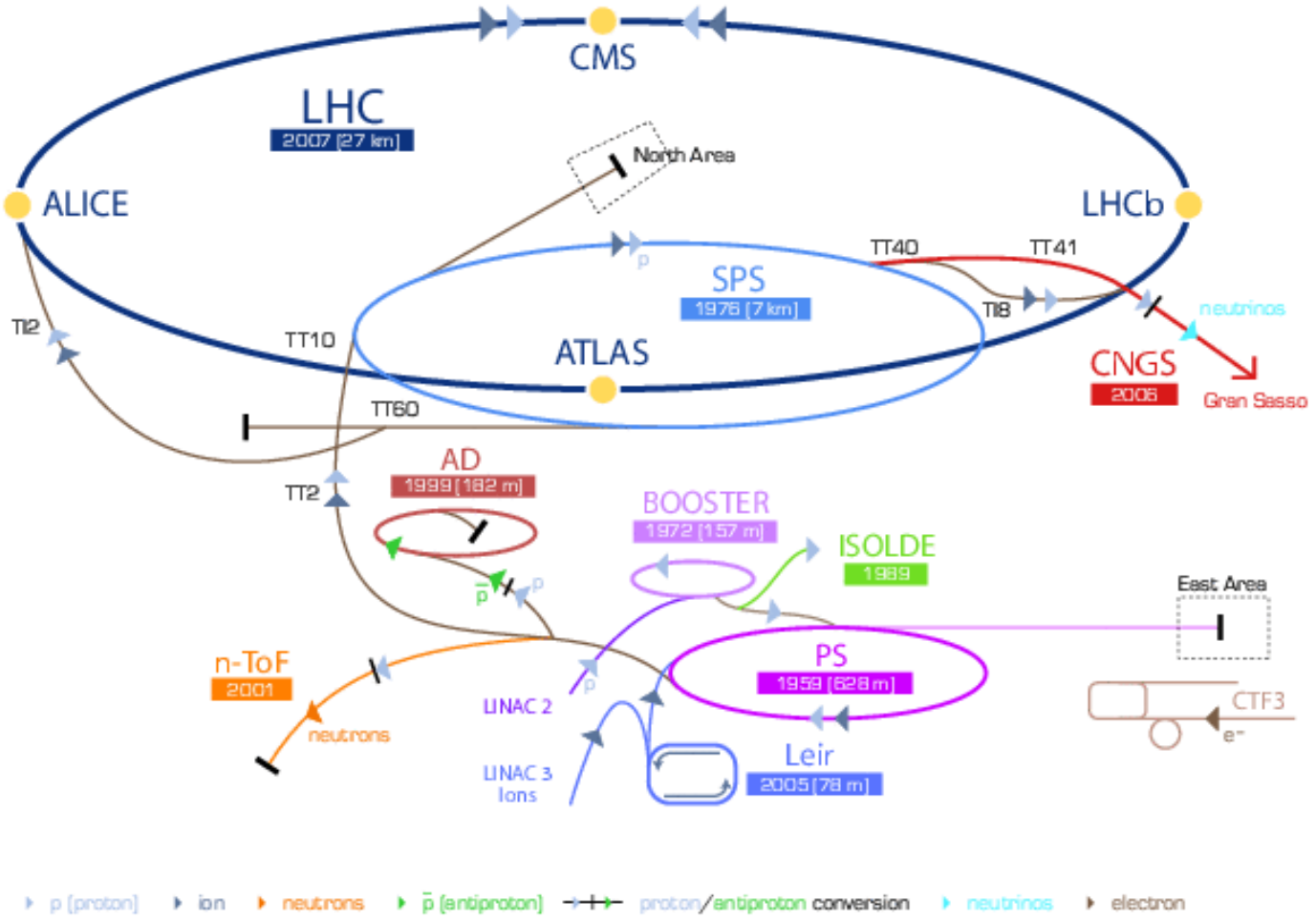
- LHC детекторы регистрируют **10-15 миллионов Гигабайт** данных каждый год (~ 20 млн CD!)
- Для анализа данных требуется мощьность
- **~100,000** наиболее производительных **PC** процессоров.

LCG - LHC Computing GRID



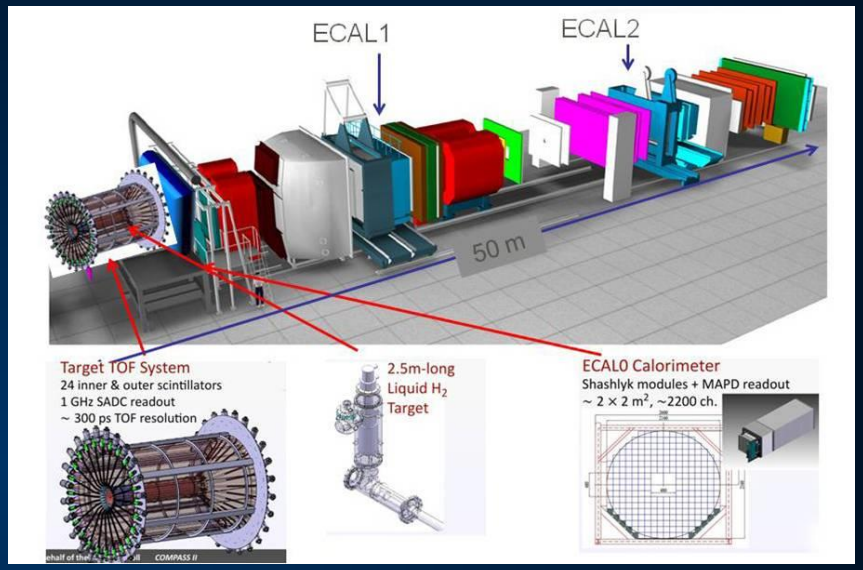

T2s and T1s are inter-connected by the general purpose research networks
Any Tier-2 may access data at any Tier-1
Dedicated 10 Gbit links
CERN
GridKa
IN2P3
TRIUMF
Brookhaven
ASCC
Nordic
Fermilab
CNAF
RAL
SARA
NIKHEF
PIC
T2

CERN – самый большой комплекс ускорителей

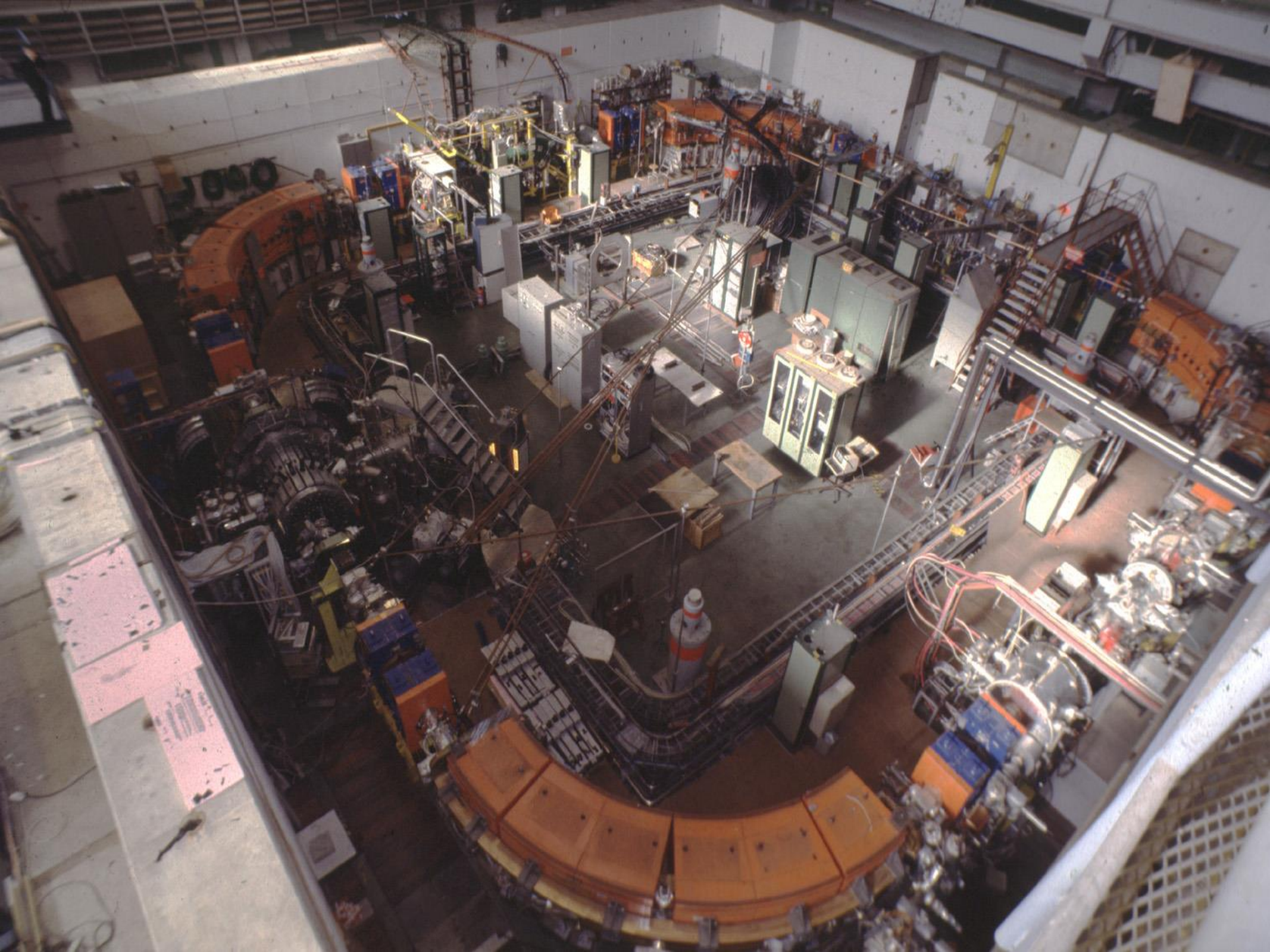


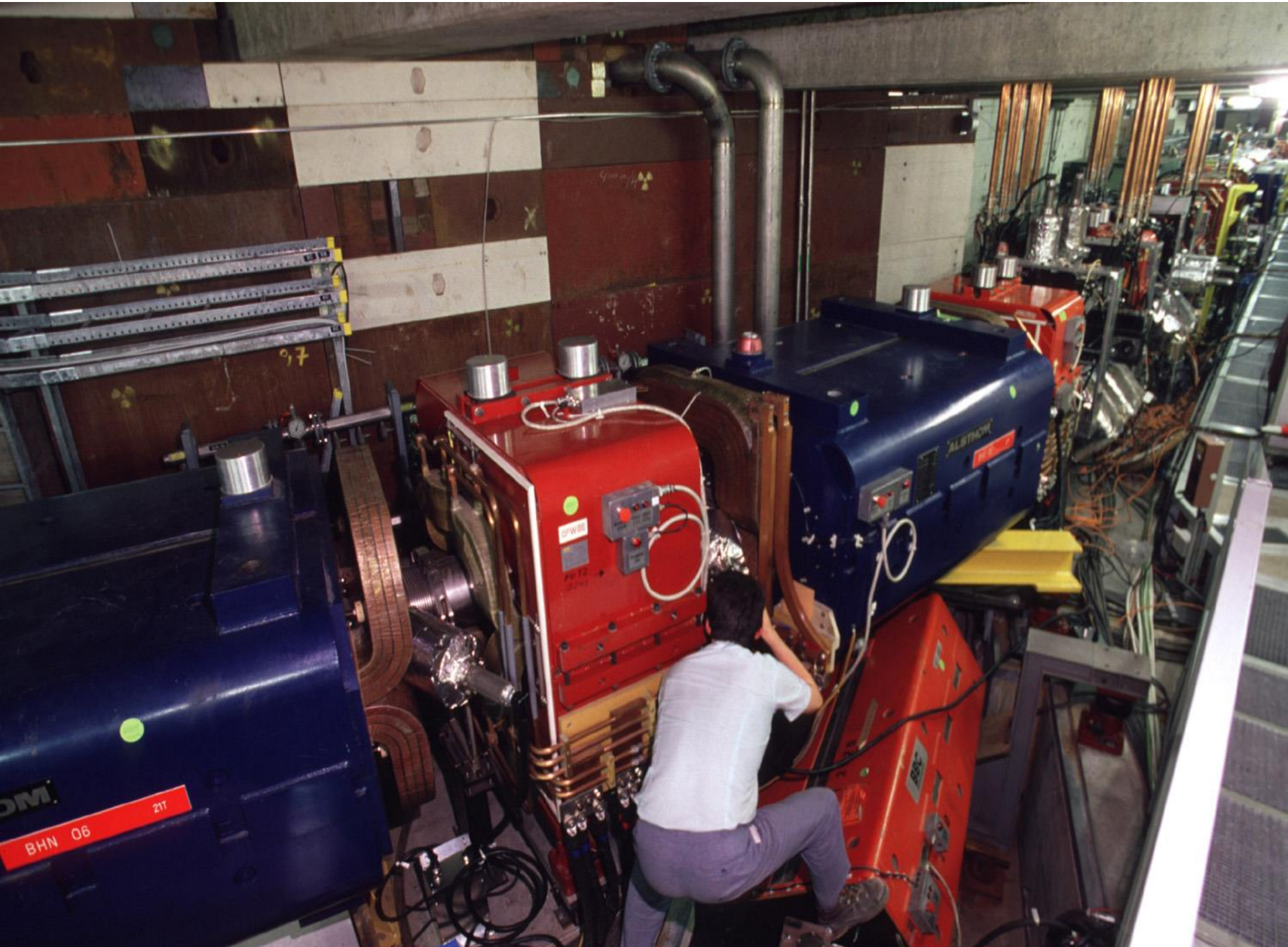
Программа экспериментов на выведенных пучках SPS (Эксперименты на фиксированных мишенях)

COMPASS - изучение структуры протонов (спиновой)



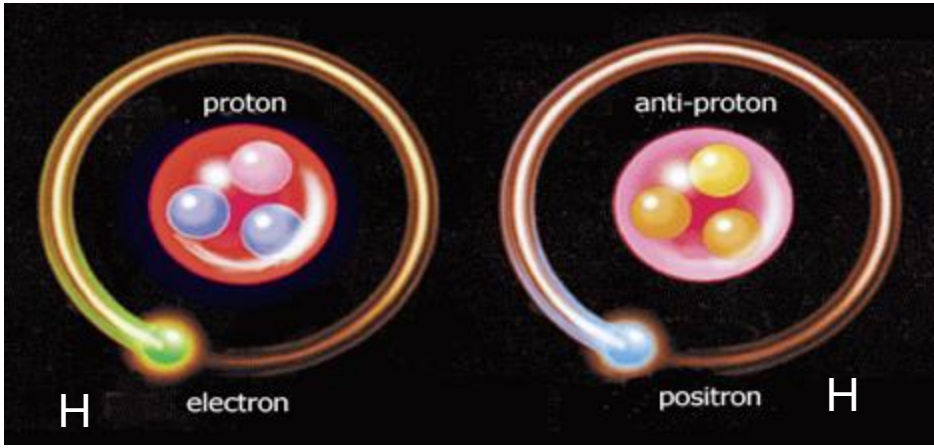
NA62 - изучение распадов Каонов (поиск новых и изучение редких распадов)




BHN 06
217
ALSTHOM

Физика антивещества

Сравнение вещества и антивещества
Фундаментально для теории



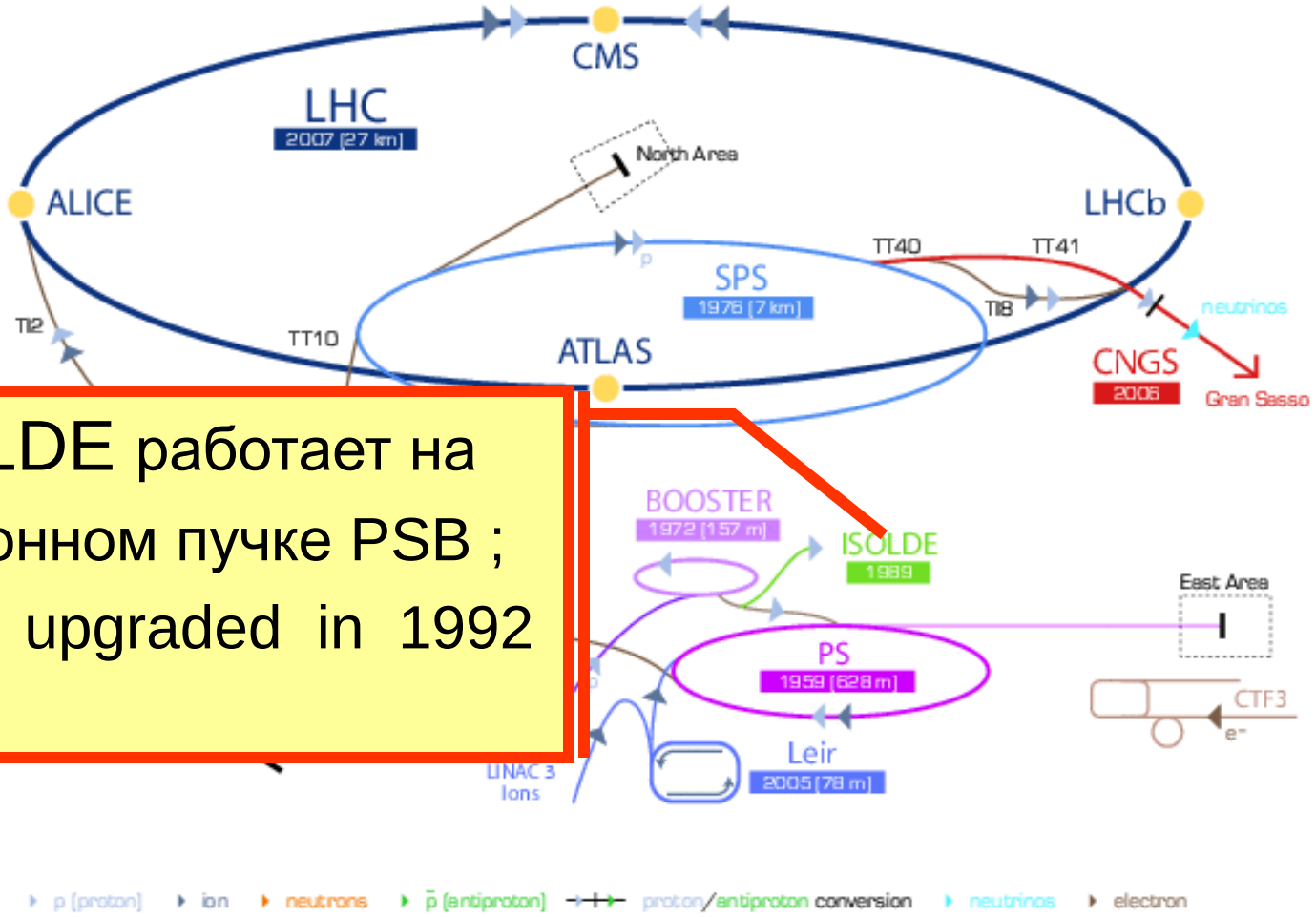
ASACUSA
ATRAP
ALPHA

Ловушки анти-H в магнитном поле типа «бутылки»

AEGIS Наблюдение свободного падения анти-H
Эксперимент Галилея, антивещество!

ACE Биологический эффект
анти-p -> терапия

Ускорительный комплекс CERN, работает не только для LHC



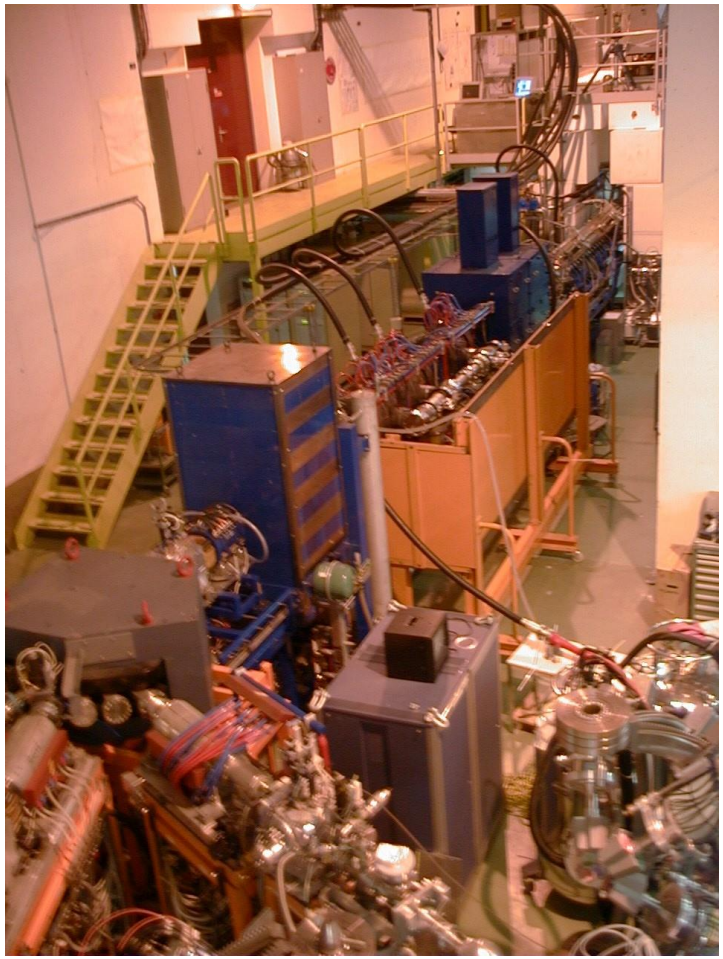
ISOLDE работает на протонном пучке PSB ; 1967 upgraded in 1992

ИЗОЛЬДА - Isotope Separator On Line РЕКС - Radioactive beam EXperiment

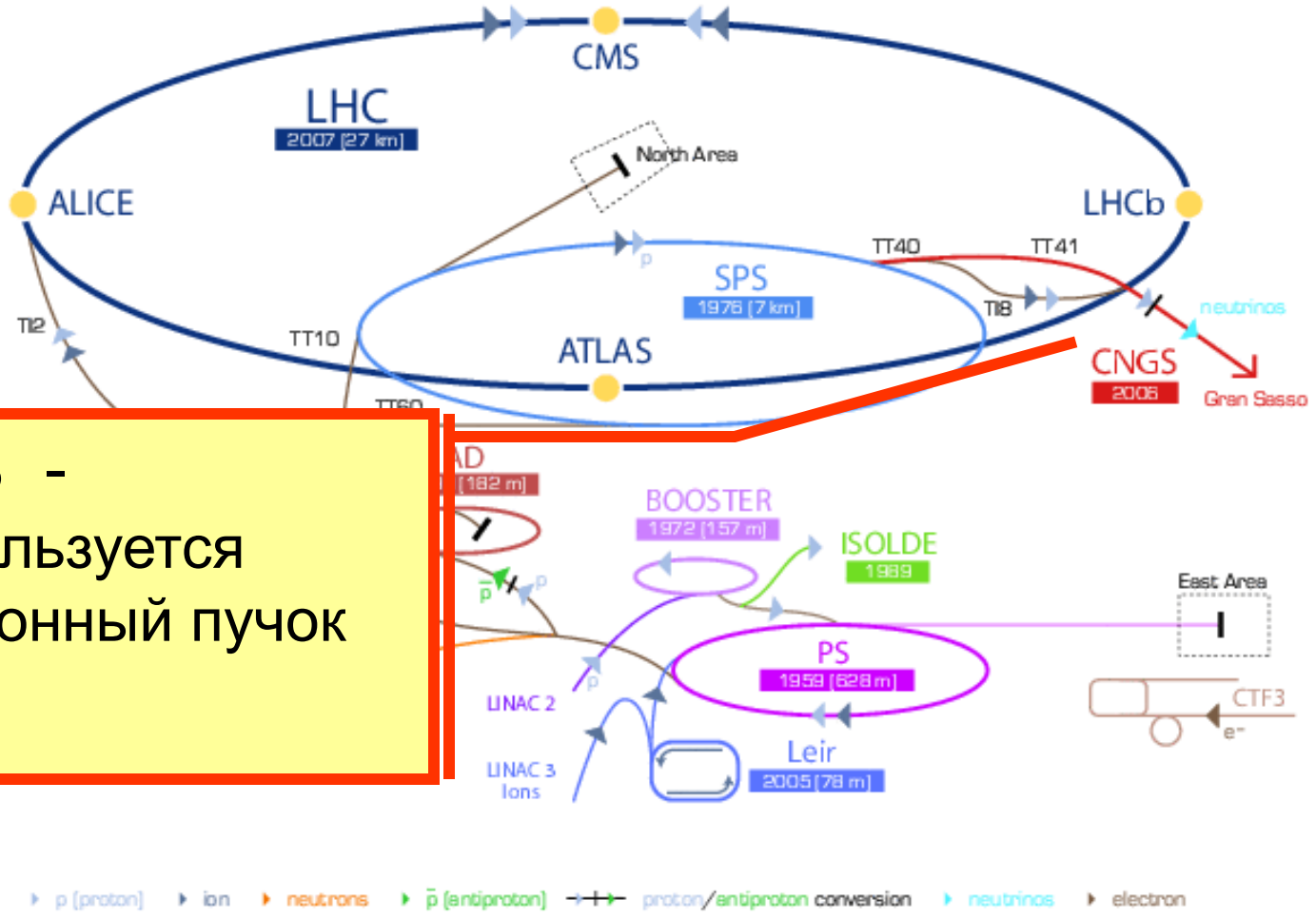
Фабрика алхимии (для ядерной физики)

Низко-энергетические пучки радиоактивных ядер на Бустере протонного синхротрона (PSB).

Могут производить более чем 1000 различных радиоактивных изотопов для широкой области исследований



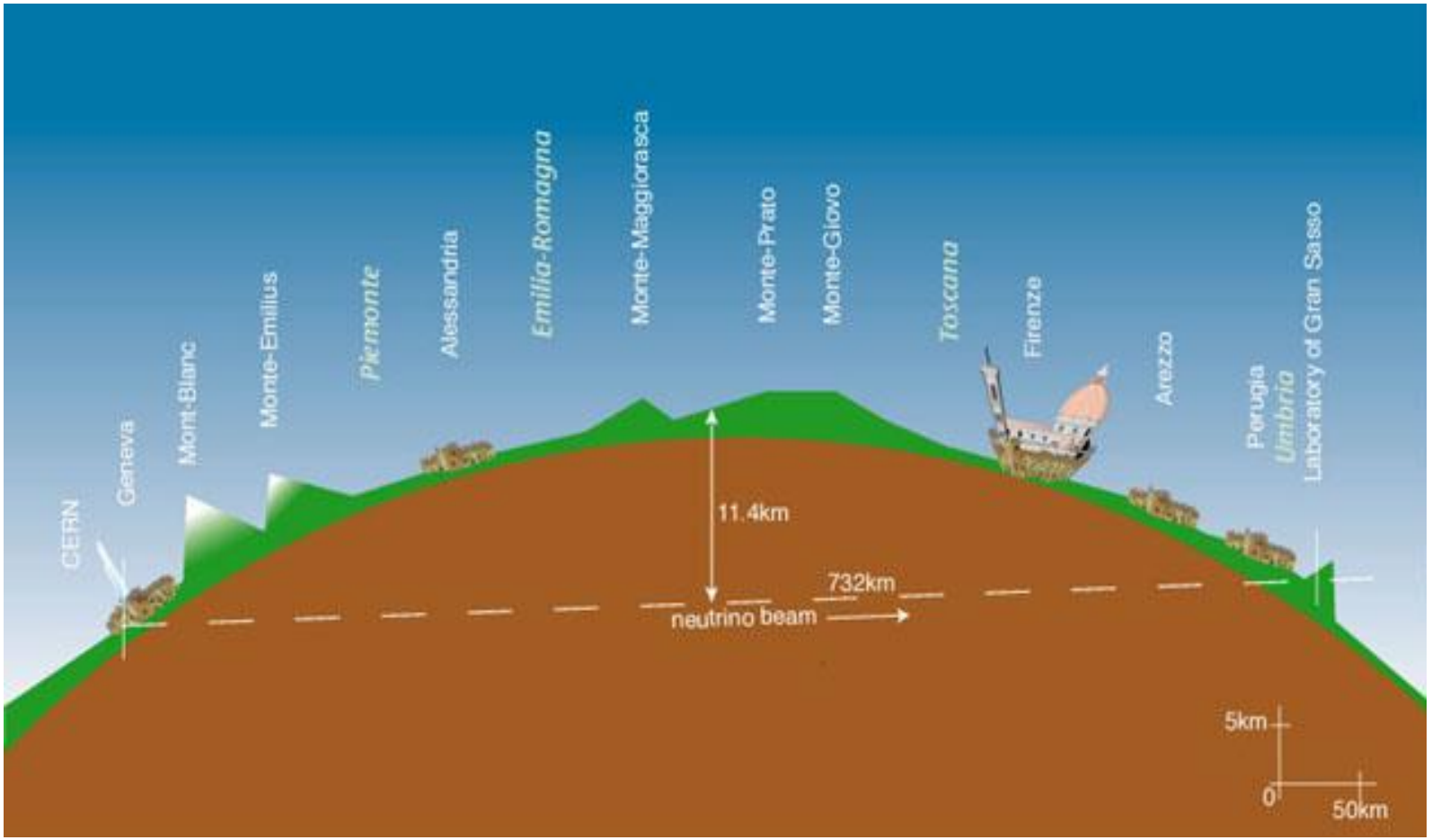
Ускорительный комплекс CERN, работает не только для LHC



CNGS -
используется протонный пучок SPS

CNGS – CERN Neutrino to Gran Sasso experiment - исследуются свойства нейтрино

CERN sends muon neutrinos to the Gran Sasso National Laboratory (LNGS), 732 km away in Italy. There, two experiments, OPERA and ICARUS, wait to find out if any of the **muon neutrinos** **have transformed into** **tau neutrinos.** To create the neutrino beam, a proton beam from the Super Proton Synchrotron (SPS) is used.



«Исследования климата»

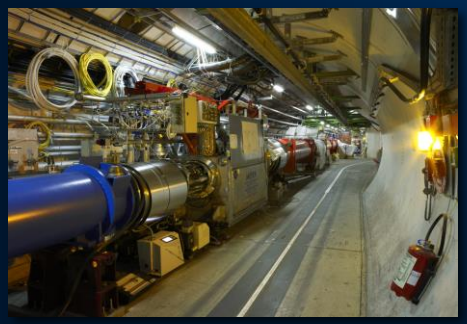
Космические лучи - > образование облаков
(cosmic rays “simulated “ by T11 beam, clouds created in a large climatic chamber

Innovation
Education
CERN
uniting people
Research

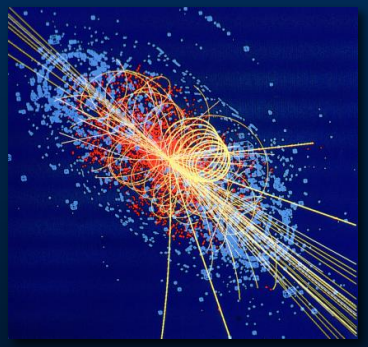
CERN: Физика частиц и инновации

- Связывает фундаментальные исследования и развитие передовых технологий

- CERN Развиваемые технологии и инновации



Accelerating particle beams



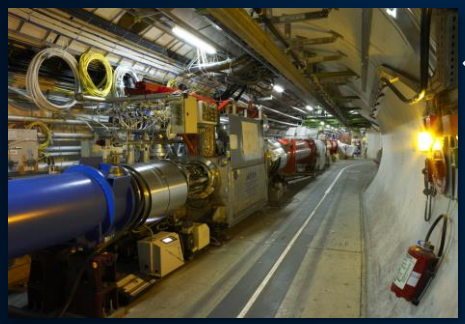
Detecting particles

Large-scale computing (Grid)

CERN

Медицинские приложения, вышедшие из физики частиц

Объединение физики, биологии и медицины для борьбы с раком

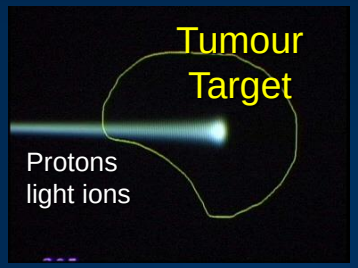


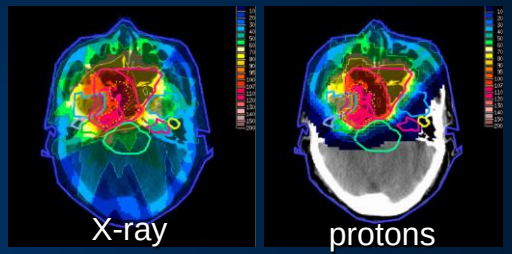
Accelerating particle beams

~30’000 accelerators worldwide

~17’000 used for medicine

Адронная терапия

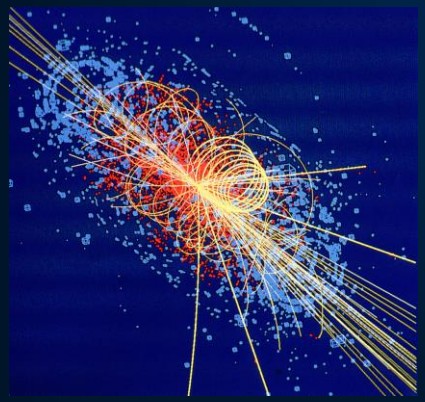




Leadership in Ion Beam Therapy now in Europe and Japan

>70’000 patients treated worldwide (30 facilities)

>21’000 patients treated in Europe (9 facilities)

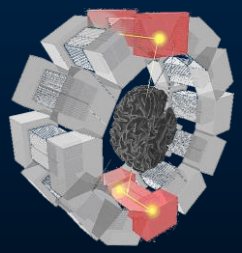


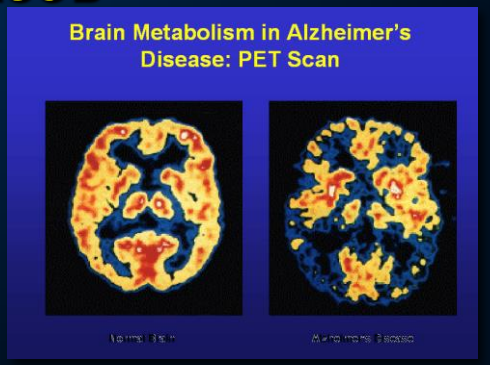
Detecting particles

Восстановление образов

PET Scanner

Clinical trial in Portugal for new breast imaging system (ClearPEM)

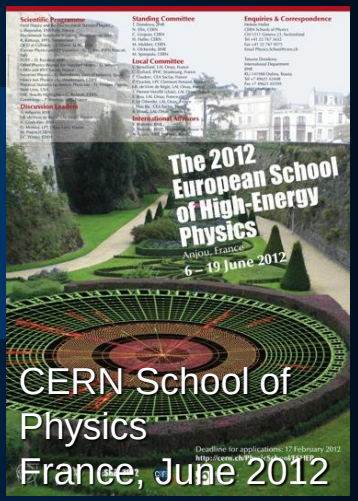




CERN Образовательные программы

Научные сотрудники
Academic Training Programme

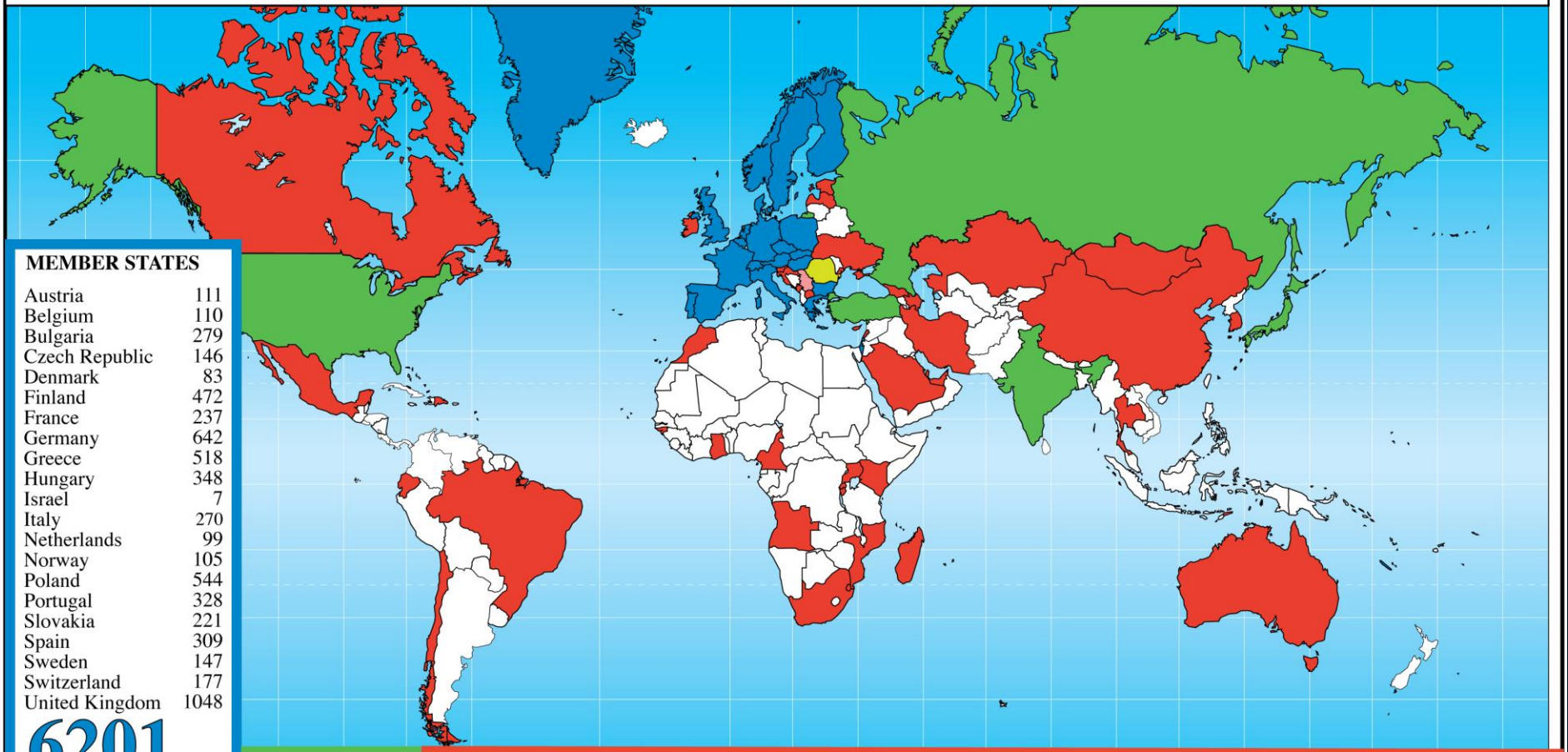
Молодые научные сотрудники
CERN School of High Energy Physics
CERN School of Computing
CERN Accelerator School



Студенты-физики
Summer Students
Programme

Школьные учителя физики
International and National
Programmes

Teacher Programme Participants 1998 - 2013 (Total: 7087)



MEMBER STATES	
Austria	111
Belgium	110
Bulgaria	279
Czech Republic	146
Denmark	83
Finland	472
France	237
Germany	642
Greece	518
Hungary	348
Israel	7
Italy	270
Netherlands	99
Norway	105
Poland	544
Portugal	328
Slovakia	221
Spain	309
Sweden	147
Switzerland	177
United Kingdom	1048

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CANDIDATE FOR ACCESSION	
Romania	12

ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP	
Serbia	14

OBSERVER STATES	
India	2
Japan	5
Russia	193
Turkey	3
USA	65

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OTHERS									
Angola	4	China	1	Ireland	5	Morocco	2	Swaziland	1
Australia	5	Croatia	1	Kazakhstan	3	Mozambique	17	Thailand	7
Azerbaijan	1	Cyprus	8	Kenya	4	Qatar	1	T.F.Y.R.O.M.	11
Brazil	114	Dominican Rep.	21	Latvia	1	Rwanda	17	Timor-Leste	7
Burundi	1	Ecuador	2	Lebanon	1	Sao Tome	4	Uganda	3
Cameroon	3	Estonia	46	Madagascar	2	Saudi Arabia	1	Ukraine	77
Canada	3	Georgia	74	Malta	36	Singapore	2	U.A.E.	1
Cape Verde	3	Ghana	6	Mexico	6	Slovenia	21		
Chile	3	Guinea Bissau	1	Mongolia	1	South Africa	6		
		Iran	1	Montenegro	13	South Korea	44		

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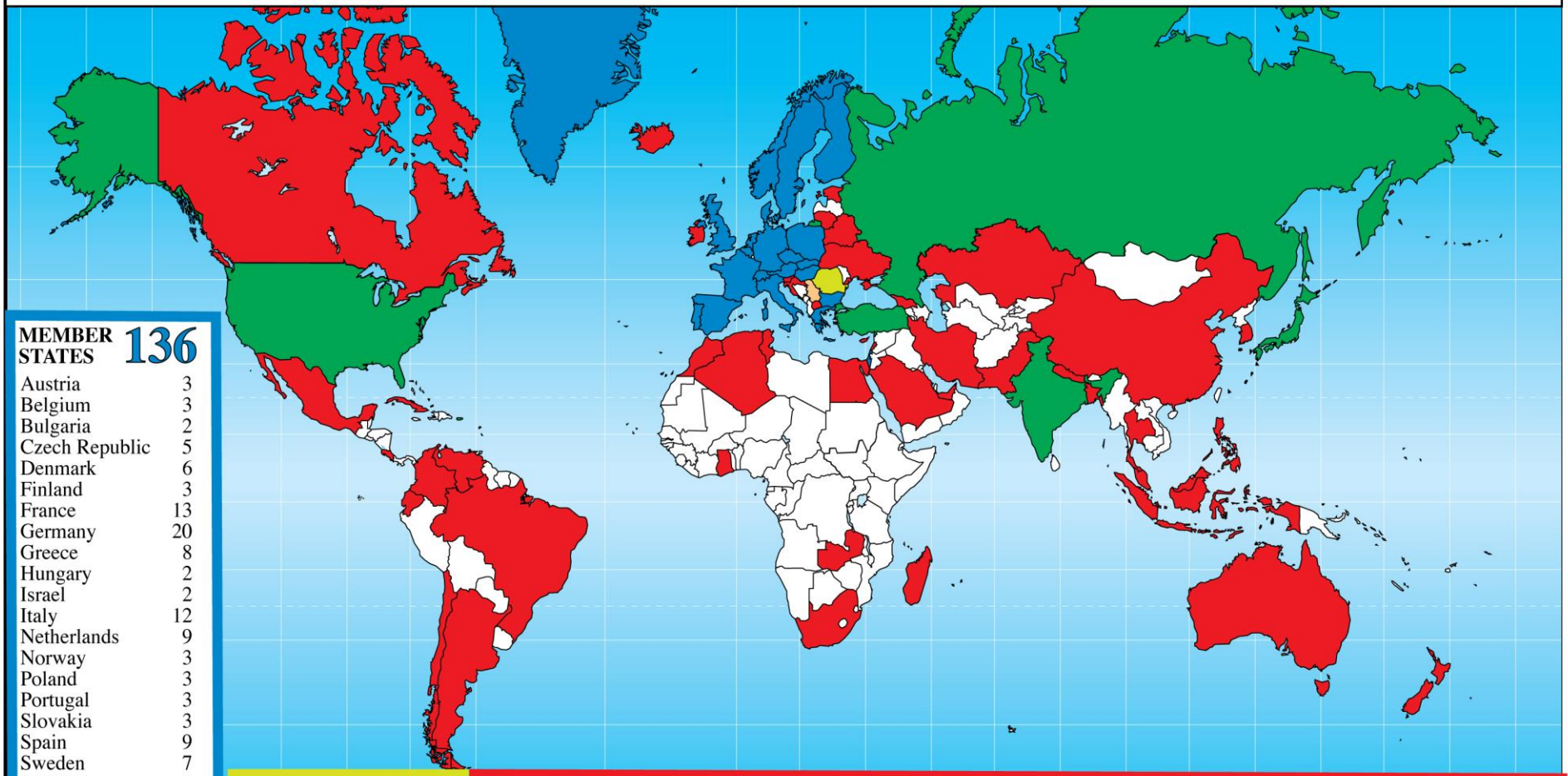
Summer Students 2013



MEMBER STATES 136

Austria	3
Belgium	3
Bulgaria	2
Czech Republic	5
Denmark	6
Finland	3
France	13
Germany	20
Greece	8
Hungary	2
Israel	2
Italy	12
Netherlands	9
Norway	3
Poland	3
Portugal	3
Slovakia	3
Spain	9
Sweden	7
Switzerland	4
United Kingdom	16

OBSERVERS 43

India	7
Japan	5
Russia	9
Turkey	6
USA	16

CANDIDATE FOR ACCESSION

Romania	3

ASSOCIATE MEMBER IN THE PRE-STAGE TO MEMBERSHIP

Serbia	2

OTHERS

Algeria	2	China	5	Estonia	4	Korea, South	2	New Zealand	1	Tunisia	1
Argentina	1	Colombia	1	Georgia	1	Lebanon	1	Pakistan	4	Ukraine	2
Australia	1	Comoros	1	Ghana	1	Lithuania	2	Palestine	1	U.A.E.	2
Bangladesh	1	Costa Rica	1	Hong Kong	4	Madagascar	1	Philippines	1	Venezuela	1
Belarus	1	Croatia	3	Iceland	1	Malaysia	3	Saudi Arabia	1	Zambia	1
Benin	1	Cuba	1	Indonesia	3	Malta	3	Slovenia	1		
Brazil	1	Cyprus	2	Iran	2	Mexico	2	South Africa	2		
Canada	5	Ecuador	3	Ireland	1	Morocco	2	Thailand	2		
Chile	1	Egypt	4	Kazakhstan	1	Nepal	1	T.F.Y.R.O.M.	2		

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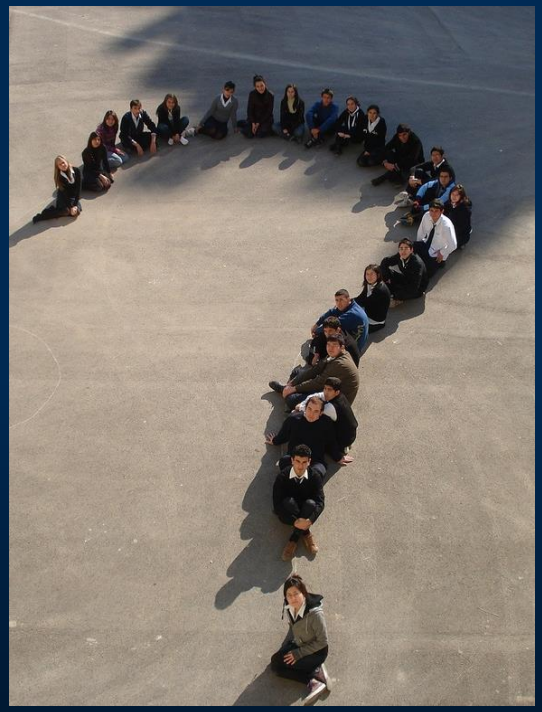
Summer Students 2012

Персонал

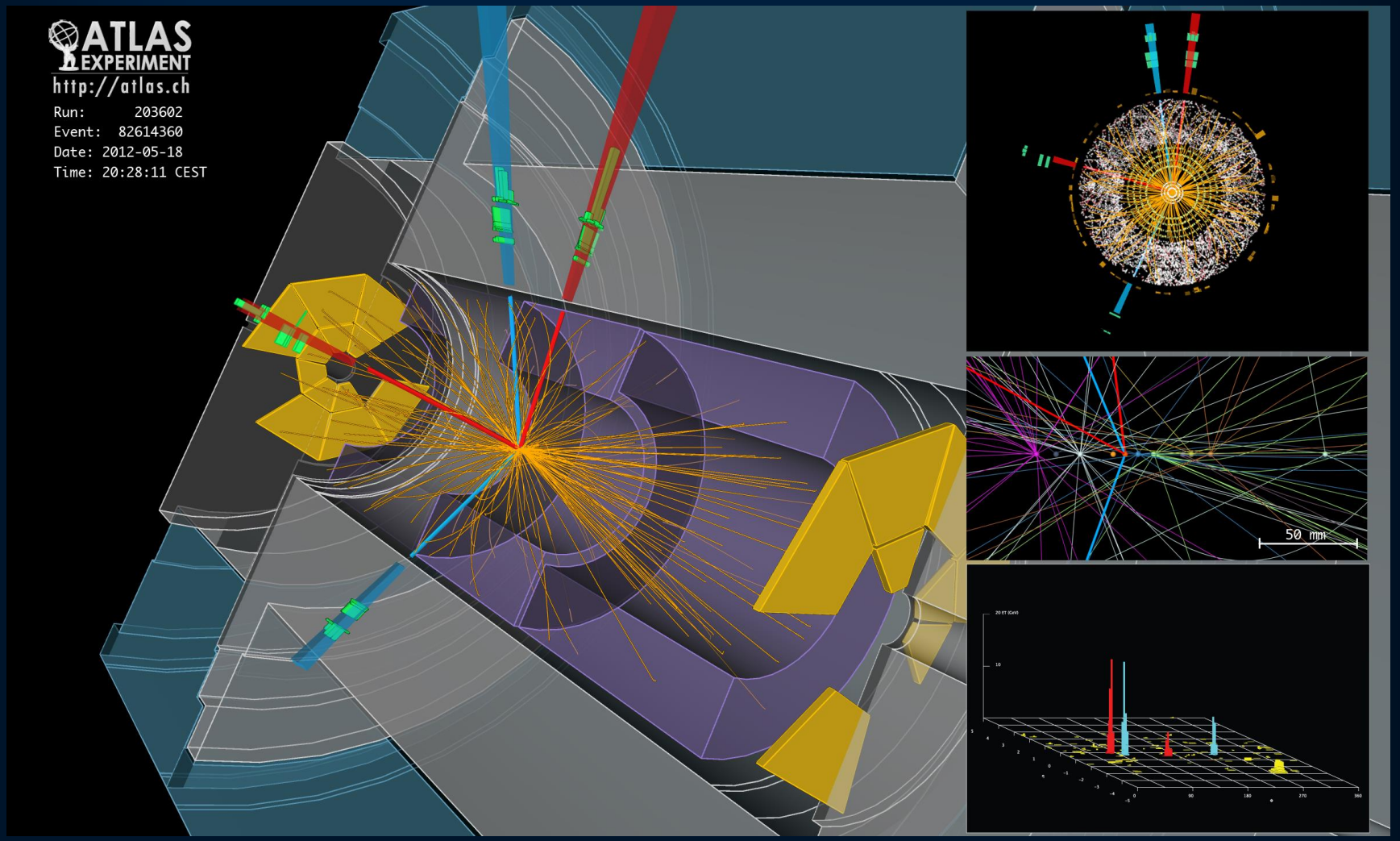


Сотрудники

- **Physicists**
  - **Experimental**
  - **Theoretical**
- **Applied Physicists and Engineers**
- **Technicians**
- **Craftsmen**
- **Administrative personnel**
- **Fellows**
- **Doctoral Students**
- **Technical Students**
- **Associates**
- **Summer Students**
- **Employees of CERN**
- **Users**

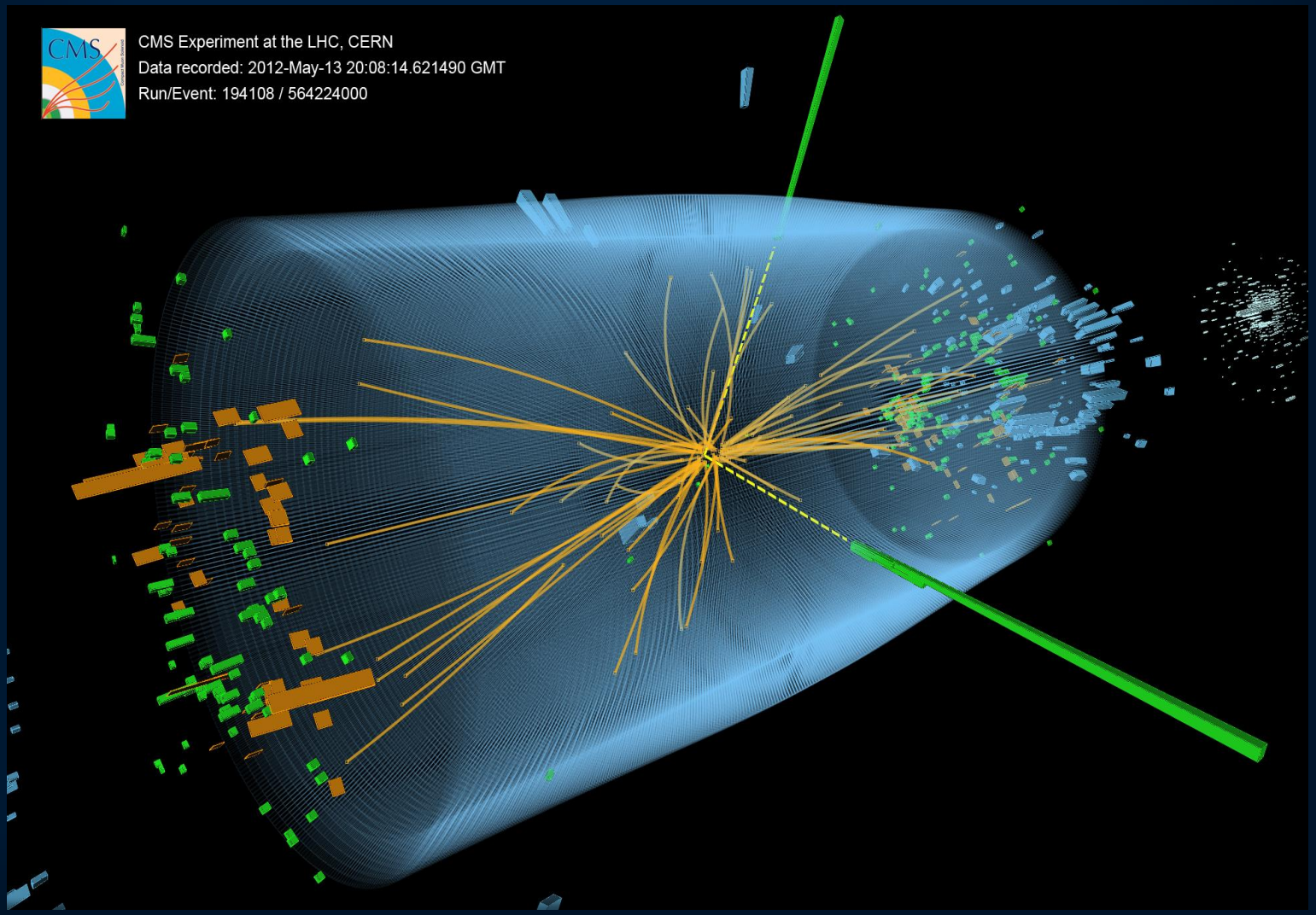
4 July 2012: CERN press conference

“CERN experiments observe particle consistent with long-sought Higgs boson”

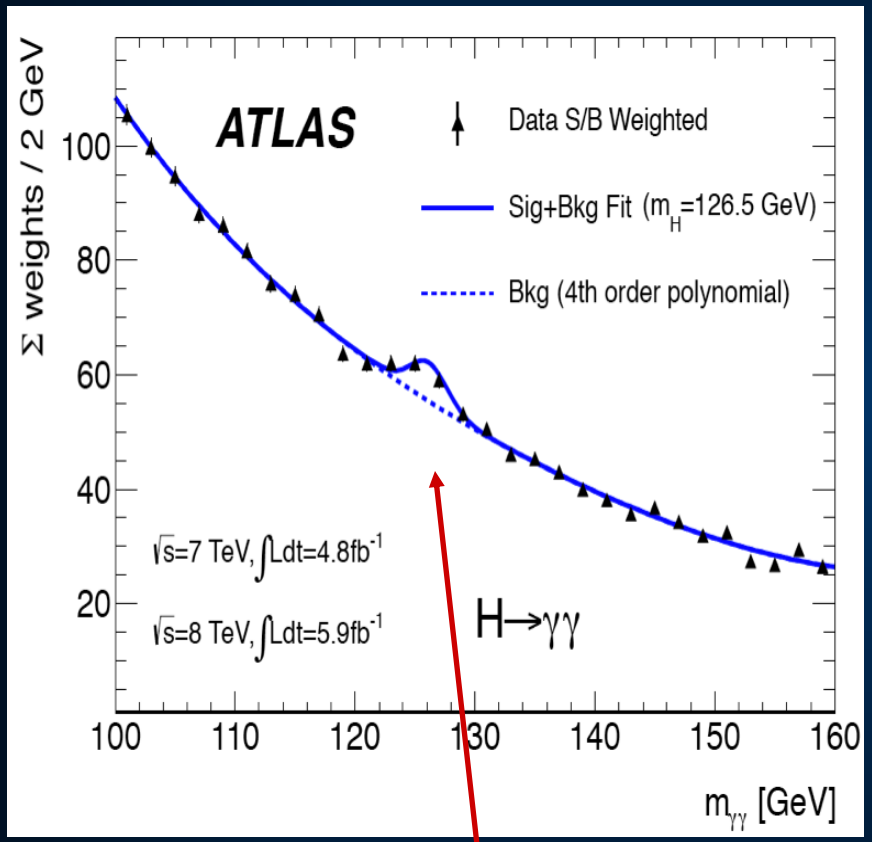


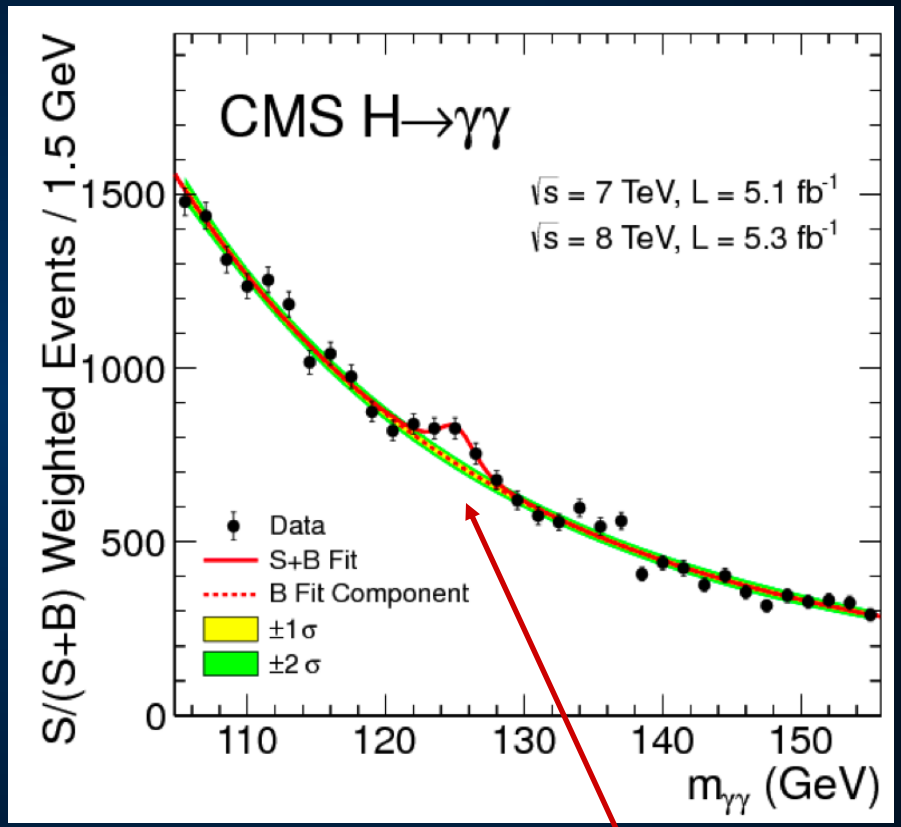
4 July 2012: CERN press conference

“CERN experiments observe particle consistent with long-sought Higgs boson”



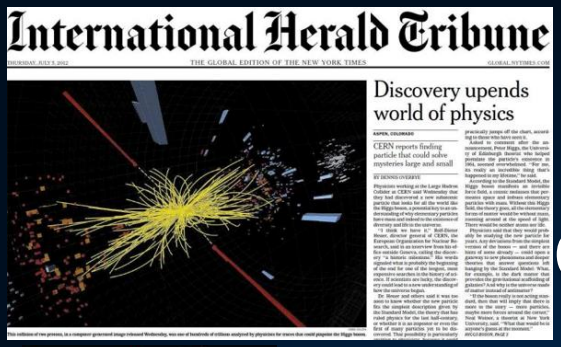
Higgs decay to $\gamma\gamma$, ATLAS and CMS, summer 2012 data

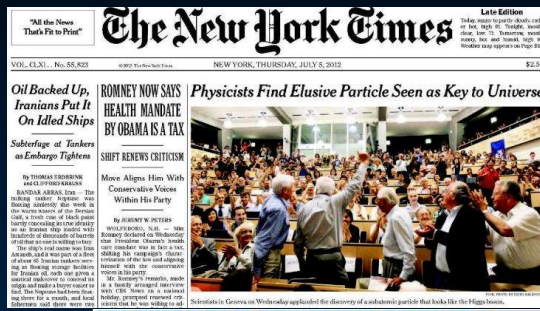




July 4th at CERN, after the Higgs seminar

4 JULY 2012
CERN Press conference


International Herald Tribune
THE GLOBAL EDITION OF THE NEW YORK TIMES
Discovery upends world of physics
CERN reports finding particle that could solve mysteries large and small


The New York Times
Late Edition
Oil Backed Up, Iranians Put It On Idled Ships
Subterfuge at Tankers as Embargo Tightens
ROMNEY NOW SAYS HEALTH MANDATE BY OBAMA IS A TAX
SHIFT RENEWS CRITICISM
Move Aligns Him With Conservative Voices Within His Party
Physicists Find Elusive Particle Seen as Key to Universe
Scientists in Geneva on Wednesday applauded the discovery of a subatomic particle that looks like the Higgs boson.


The Economist
In praise of charter schools
Britain's banking scandal spreads
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A power struggle at the Vatican
When Lonesome George met Nora
A giant leap for science
Finding the Higgs boson


ヒッグス粒子 発見か
新素粒子検出 年内に結論
日米欧2チーム


EDIÇÃO LISBOA Qui 5 JUL 2012
Por dia, Deco recebe 87 casos por causa de sobreendividamento p14
HOJE: HERÓIS MARVEL
publicopt
Milhares de moradores de bairros sociais em risco de perderem RSI
A mudança está a passar despercebida, mas deve afectar milhares de beneficiários de RSI que vivem em habitação social agora, morar numa casa camarária é uma forma de rendimento Portugal, 12
Ministério de Portas contrata funcionário de CDS-PP
Lusófona diz que Relvas deu todos os dados para ter curso
"PARTÍCULA DE DEUS" EXISTE. MAS A HISTÓRIA NÃO ACABA AQUI
Destaque, 2/3
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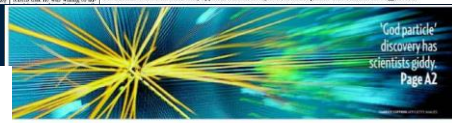
Spécial Festival d'Avignon
La 66e fête du théâtre démarre le 7 juillet
Le Monde
Le Monde des livres
Les coups de cœur de la rédaction
Science : la matière dévoilée
Le boson de Higgs, particule manquante pour expliquer l'Univers, vient d'être découvert
Les physiciens du CERN de Genève ont prouvé son existence à 99,9999 %
IMPÔTS CE QUI VA CHANGER
7,2 milliards de plus dès 2012
Réforme fiscale à l'automne
ALGÉRIE L'INDÉPENDANCE
Une fête sans panache
La souffrance, mais pas de haine
Ces livres qui explorent l'histoire


'God particle' discovery has scientists giddy.
Page A2


The Gazette
MONTREAL | THURSDAY, JULY 5, 2012 | SINCE 1778 | BREAKINGNEWS.ATMONTREALGAZETTE.COM
EL PAIS
EL PERIÓDICO GLOBAL EN ESPAÑOL
A solas con la prueba del VIH
De Villota pierde el ojo derecho
Pistorius estará en los Juegos
Hallada la partícula clave para a comprensión del universo
La Audiencia Nacional imputa a toda la cúpula de Bankia


В ТЕАТРЫ БУДУТ ПУСКАТЬ ПО МОБИЛЬНЫМ ТЕЛЕФОНАМ
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МК
№144 (25.980)
5 июля 2012
ПОСЛЕДНИЙ КИРПИЧ В СТЕНУ МИРОЗДАНИЯ
«КРЕМЛЕВСКИЕ» САМОЛЕТЫ ПРИШЛОСЬ МЕНЯТЬ НА ПЕРЕПРАВЕ
МЕТРО СПУСТЯТ НА ВОДУ


AD
ALGEMEEN DAGBLAD
donderdag 5 juli 2012
EINDELIJK GELIJK NA 48 JAAR
Zieke Kaj en zijn moeder toch samen in de VS
SPORTWERELD VAN PERSIE


Frankfurter Allgemeine
ZEITUNG FÜR DEUTSCHLAND
Fünf Tote bei Geiselnahme in Karlsruhe
Masse macht's
Große Mehrheit im


DANGEROUS MOVE
Freeing captured animals may lead to disasters
IMPORTANT MATTER
Scientists claim to have discovered 'God particle'
MOVIE PLOT
Iron Man film company looks to China for screen success
CHINA DAILY
THURSDAY, July 5, 2012
chinadaily.com.cn


THE TIMES OF INDIA
UNDER FIRE FROM OPPN, AKHILESH ROLLS BACK CAR BONANZA FOR MLAS
ADJUSTING DIESEL PRICE BETTER THAN TAXING CARS, SAYS MONTEK
BLADE RUNNER PISTORIUS SET FOR OLYMPIC HISTORY: TO RUN 400M & RELAY
Big bang moment: Scientists may have found 'God particle'
Adarsh scam: Finally, CBI charges sheets 13


THE HINDU
INDIA'S NATIONAL NEWSPAPER SINCE 1878
RARE CHOLA INSCRIPTIONS
MAY HAVE BEEN POISONED
SUBBARAO ON MFIS
RAHANE RETURNS
Elusive particle found, looks like Higgs boson
CERN physicists hail evidence of game-changing discovery of subatomic particle


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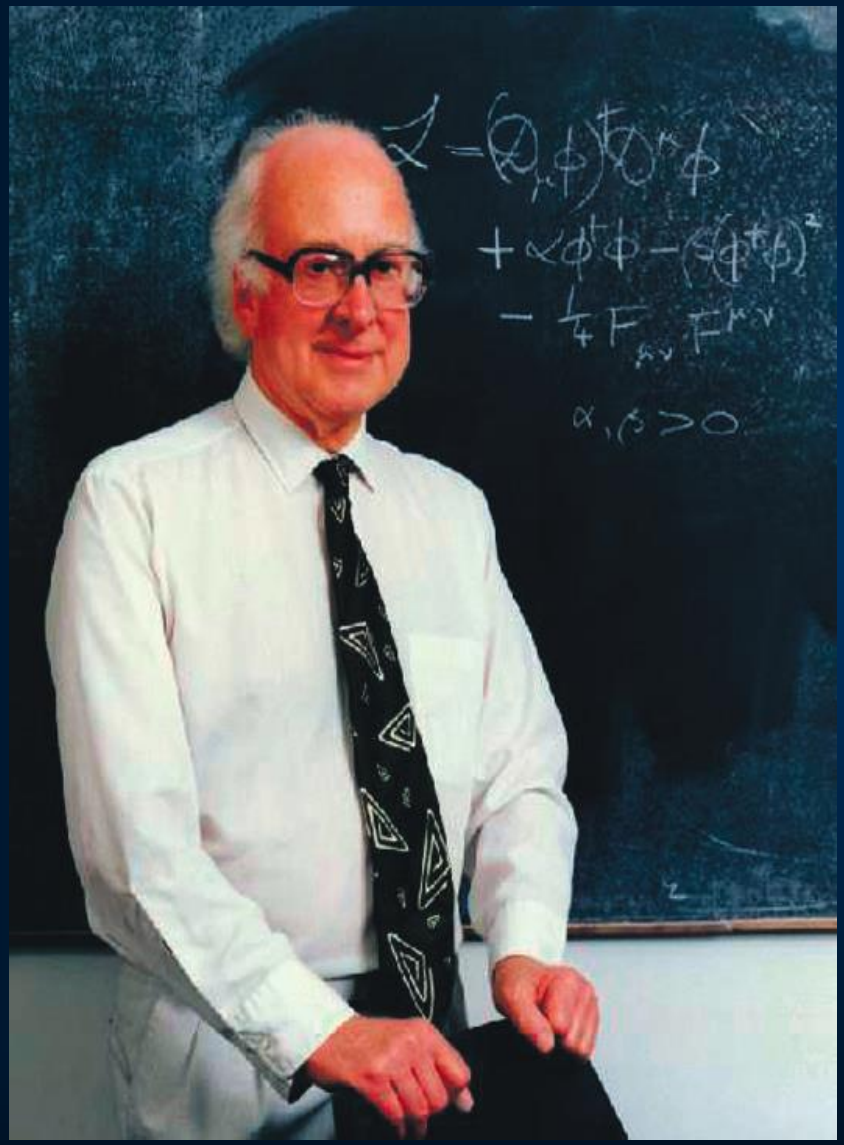
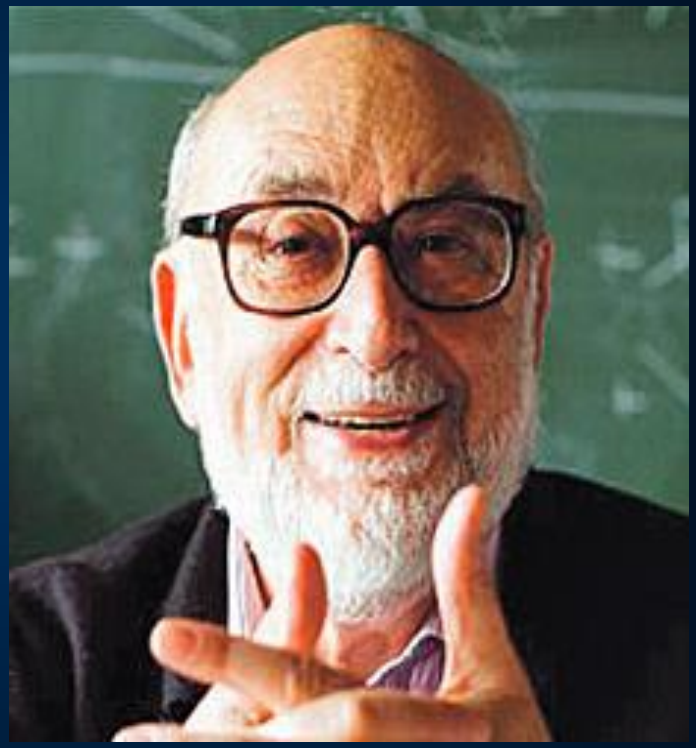
La particella che può svelare i segreti dell'universo
UN'AZIENDA IN OSTAGGIO


gazeta
WYBORCZA.PL
Ukraińcy biją się o język. Rosyjski
Cząstkę Higgsa fizycy najpierw wymyślili, potem szukali 40 lat
BOSKA MASA


আনন্দবাজার পত্রিকা
বিজ্ঞানের 'ঈশ্বর' দর্শন
সত্যেন্দ্রনাথকে বিনম্র প্রণাম
'পেয়েছি, যা খুঁজছিলাম'

Peter Higgs and Francois Englert





Огромное спасибо за неослабевающее внимание !

CERN experiments observe particle consistent with long-sought Higgs boson
Geneva, 4 July 2012.

At a seminar held at CERN[1] today as a curtain raiser to the year's major particle physics conference, ICHEP2012 in Melbourne, the ATLAS and CMS experiments presented their latest preliminary results in the search for the long sought Higgs particle. **Both experiments observe a new particle in the mass region around 125-126 GeV**.

*"**We observe in our data clear signs of a new particle, at the level of 5 sigma, in the mass region around 126 GeV**. The outstanding performance of the LHC and ATLAS and the huge efforts of many people have brought us to this exciting stage,"* said ATLAS experiment spokesperson Fabiola Gianotti, *"but a little more time is needed to prepare these results for publication."*

*"**The results are preliminary but the 5 sigma signal at around 125 GeV we're seeing is dramatic**. This is indeed a new particle. We know it must be a boson and it's the heaviest boson ever found,"* said CMS experiment spokesperson Joe Incandela. *"**The implications are very significant and it is precisely for this reason that we must be extremely diligent in all of our studies and cross-checks**."*

ATLAS and CMS experiments present Higgs search status

13 December 2011. In a seminar held at CERN[1] today, the ATLAS[2] and CMS[3] experiments presented the status of their searches for the Standard Model Higgs boson.

Their results are based on the analysis of considerably more data than those presented at the summer conferences, sufficient to make significant progress in the search for the Higgs boson, but not enough to make any conclusive statement on the existence or non-existence of the elusive Higgs.

The main conclusion is that the Standard Model Higgs boson, if it exists, is most likely to have a mass constrained to the range 116-130 GeV by the ATLAS experiment, and 115-127 GeV by CMS.

Tantalising hints have been seen by both experiments in this mass region, but these are not yet strong enough to claim a discovery.

30th November 2009 LHC sets new world record

Early this morning CERN's Large Hadron Collider become the world's highest energy particle accelerator, having accelerated its twin beams of protons to an energy of **1.18 TeV** . This exceeds the previous world record of 0.98 TeV, which had been held by the US Fermi National Accelerator

What next ?

OPERA experiment invites scrutiny of unexpected results