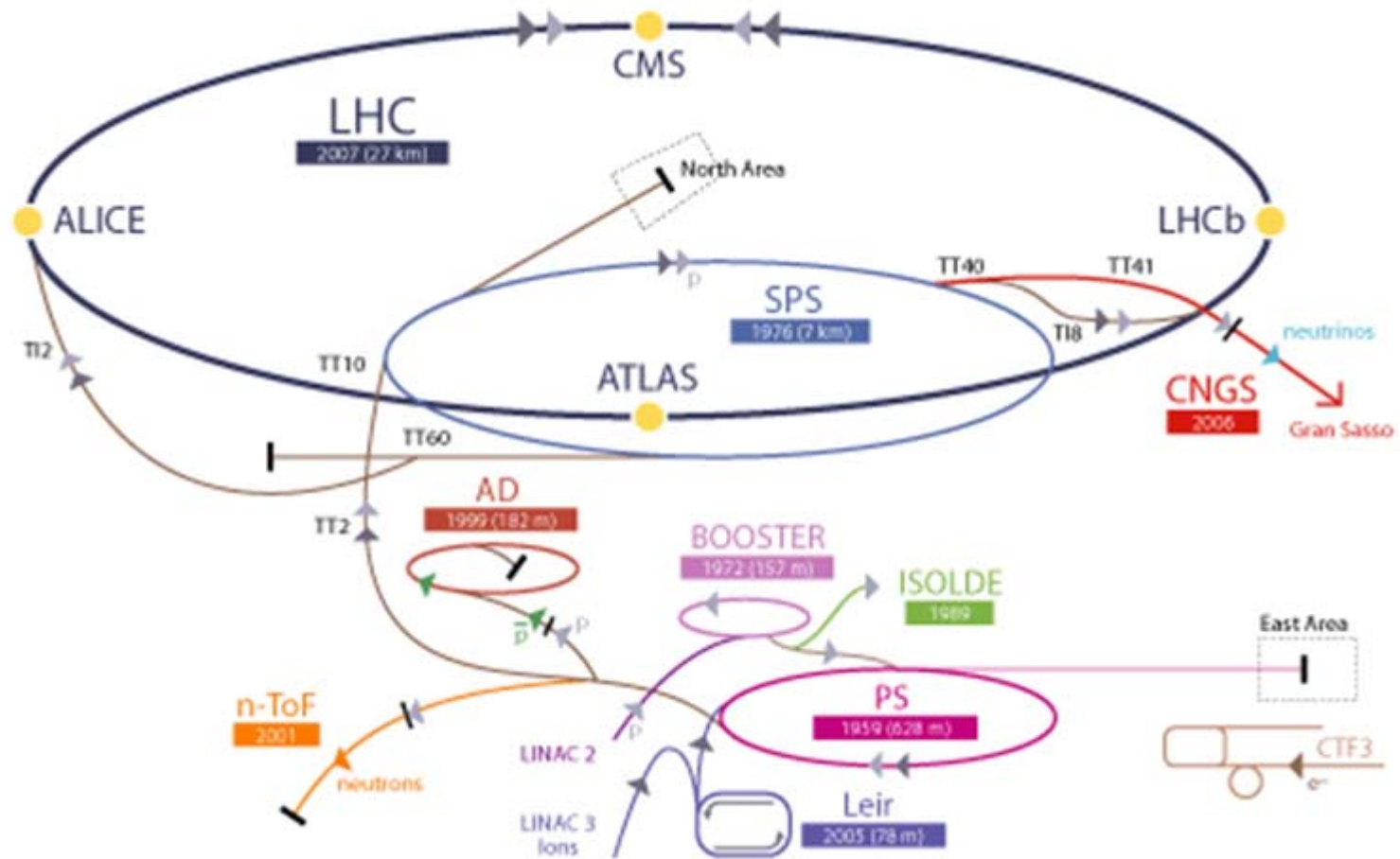


ЭКСПЕРИМЕНТЫ НА LHC

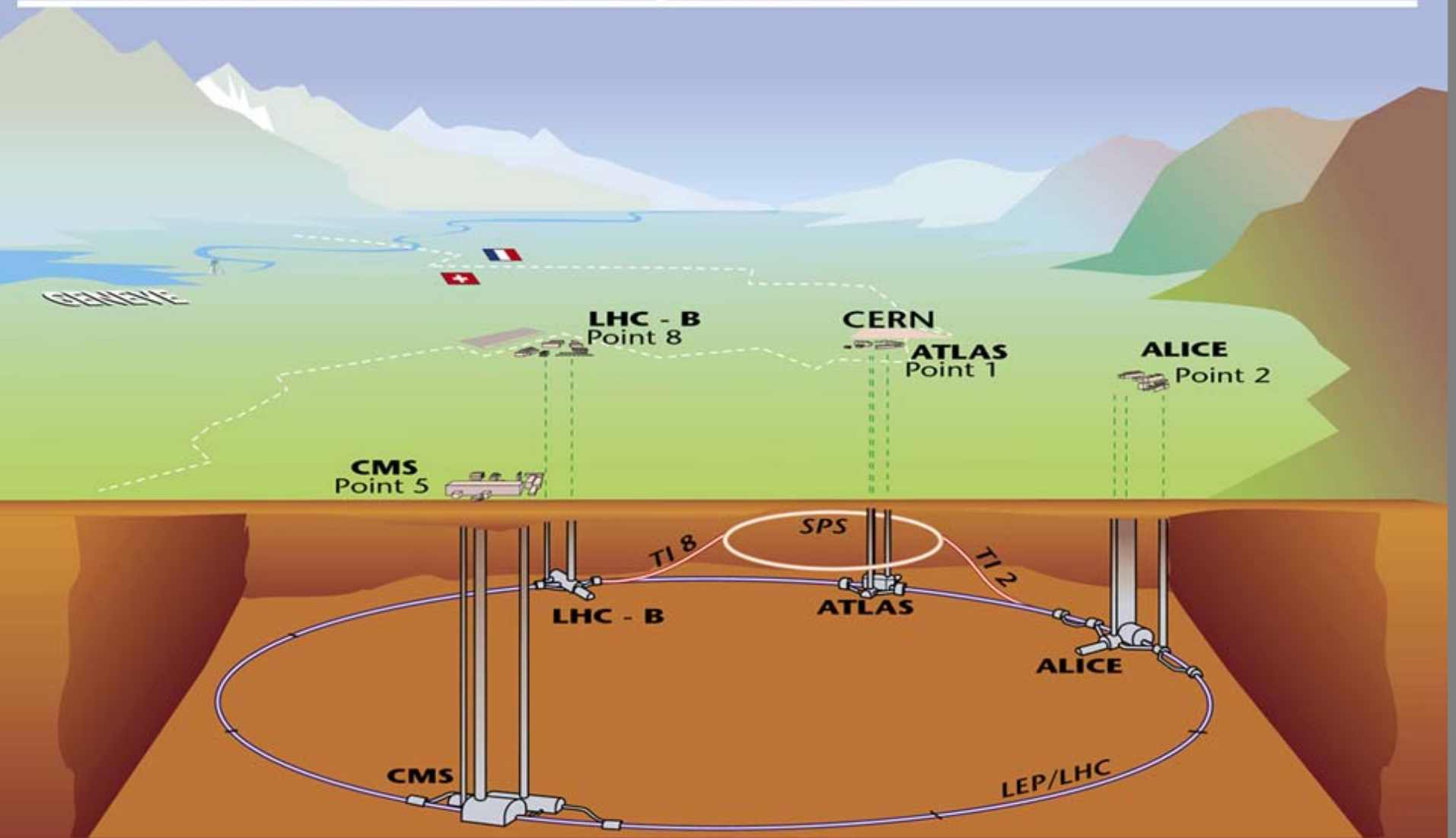
А.С.Водопьянов

The CERN accelerator complex

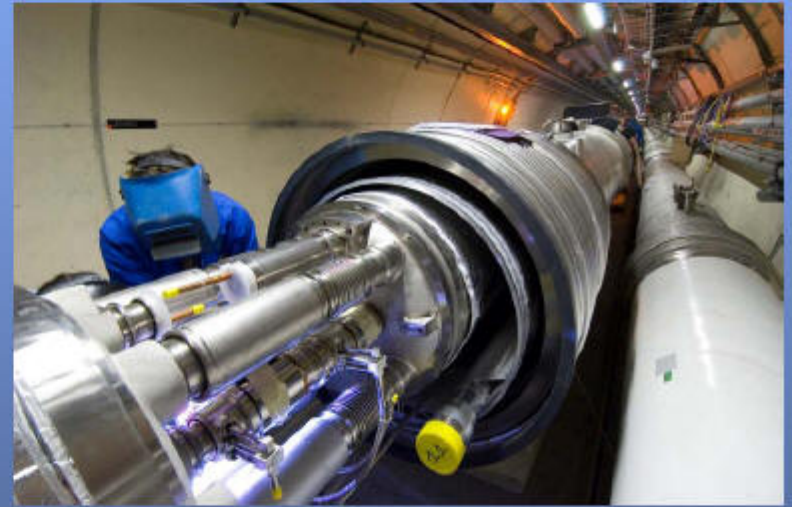


LINAC2- BOOSTER-PS-SPS-LHC

Overall view of the LHC experiments.



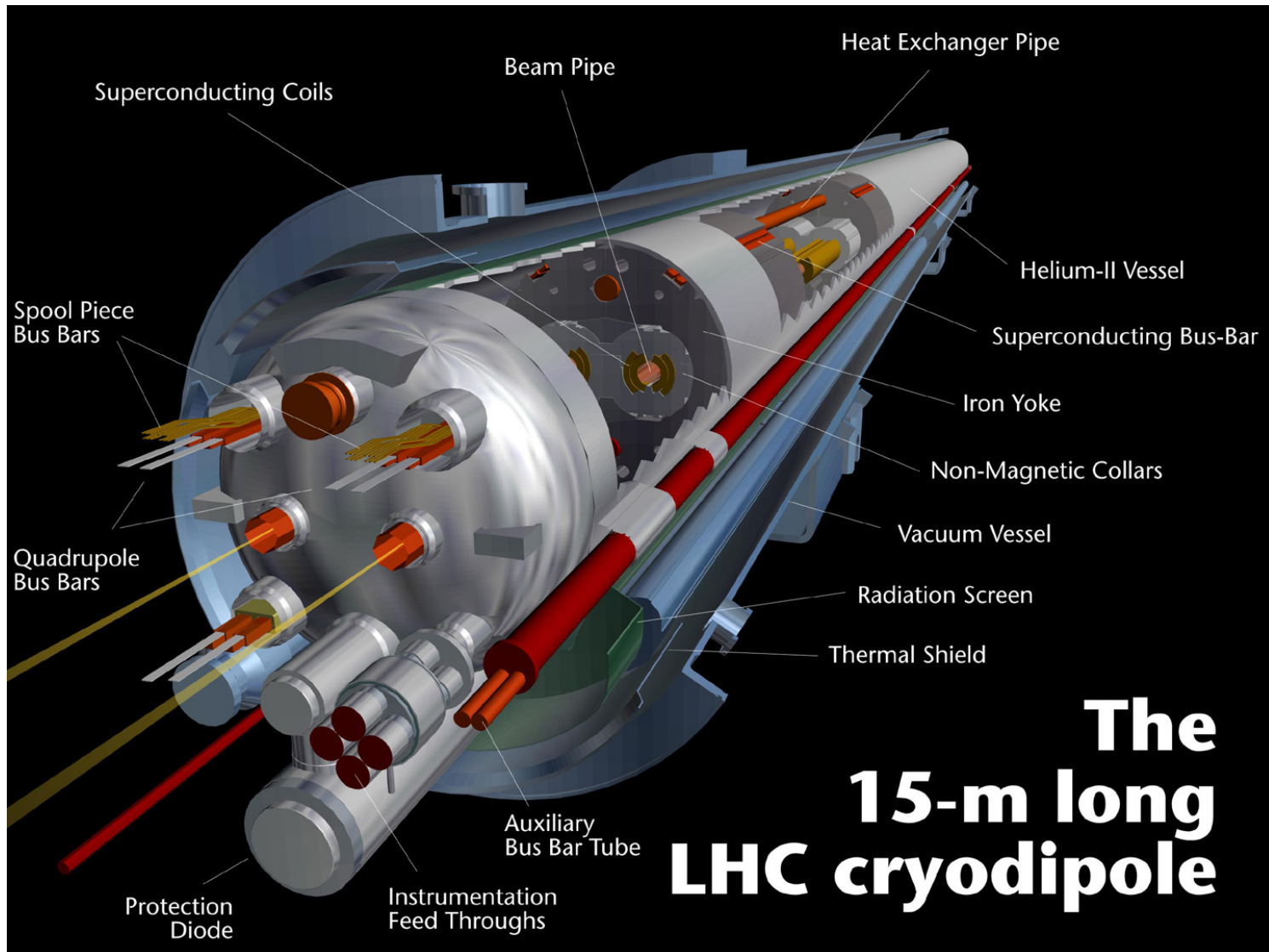
Underground



МАГНИТЫ LHC

1. Основным элементом коллайдера представлявшим в процессе создания серьёзную технологическую проблему являются сверхпроводящие дипольные магниты, работающие при температуре жидкого гелия 1.9 К. Длина окружности LHC составляет 27 км.
2. Магниты имеют две апертуры для пучков движущихся навстречу друг другу.
3. Длина диполя 14,3 м. Стоимость ~ 0,5 млн. шв. фр. Вес одного диполя около 35 тонн. Всего необходимо было 1232 диполя.
4. При энергии пучка 7 ТэВ эти магниты должны создавать поле около 8,4 Тесла при токе 11,800 А.
5. Для фокусировки пучка используется около 390 квадруполей.
6. Кольцо коллайдера разделено на 8 независимых секторов.
7. Запасенная энергия 1.29 ГДж на сектор или 11 ГДж на кольцо

Схема диполя ЛНС





CERN

LH... C'EST PAS SORCIER

23 November 2009 startup of LHC

LHC running 2009 - 2010

Energy Steps in p-p collisions

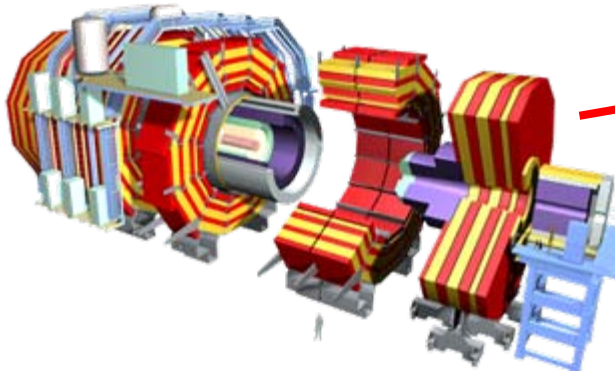
- **900 GeV collision energy (450+450 GeV);**
- **2,36 TeV collision energy (1,18+1,18 GeV);**
- **7 TeV collision energy (3,5 +3,5 TeV)**

Energy Steps in Pb-Pb collisions

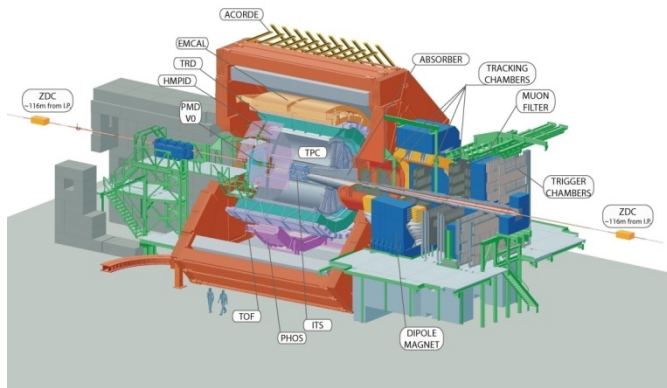
- **2,76 TeV collision energy**

LHC detectors

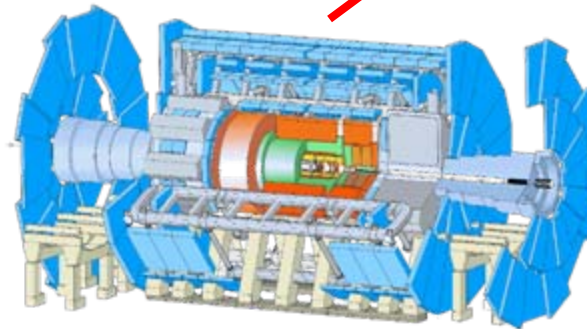
$p+p @ 14 \text{ TeV}$
 $Pb+Pb @ 5.5A \text{ TeV}$



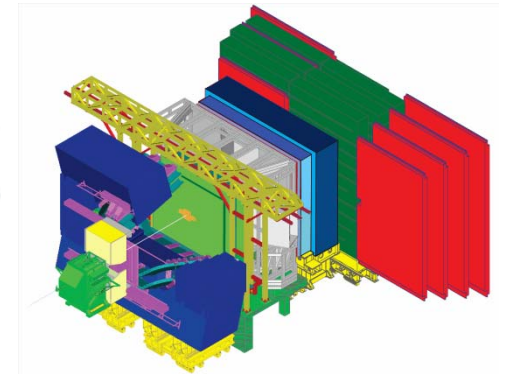
CMS



ALICE



ATLAS



LHCb

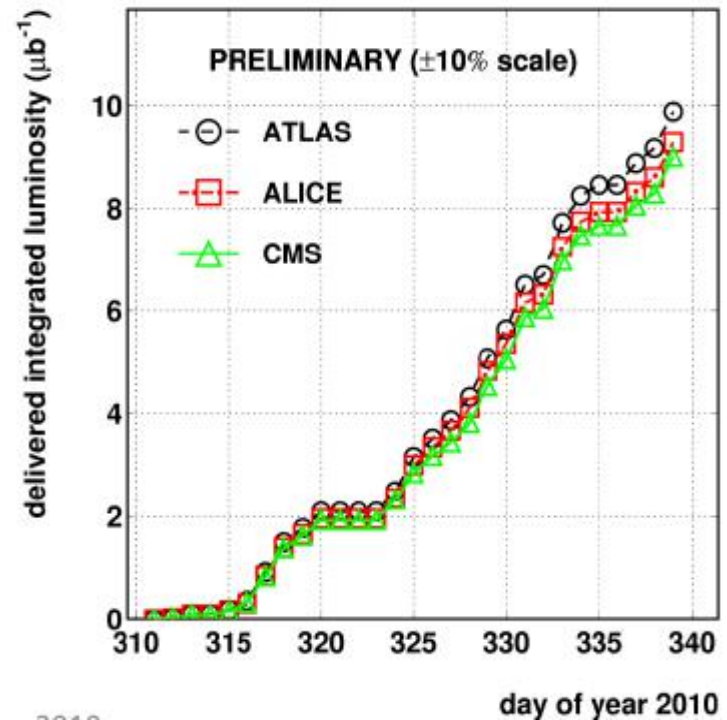
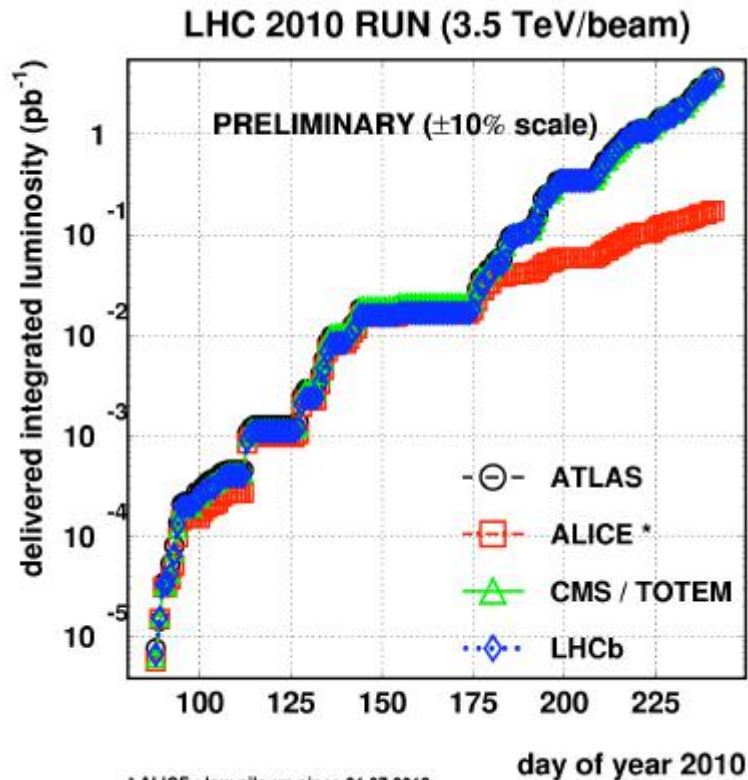
What Physics Questions might be answered at LHC

- *ALICE:*
 - *Chiral Symmetry breaking;*
 - *Origin of mass of hadrons;*
 - *Deconfinement;*
 - *Hadronization;*
- *ATLAS, CMS, LHCb:*
 - *Higgs mechanism;*
 - *Supersymmetry;*
 - *CP violation;*

Integrated luminosity in 2010 year for:

p-p at $(s)^{1/2} = 7 \text{ TeV}$

Pb-Pb at $(s_{NN})^{1/2} = 2.76 \text{ TeV}$



p-p at 7 TeV: 1.04 – 31.10, 7×10^8 minimum bias events.

Pb-Pb at 2.76 TeV: 8.11-6.12, 3×10^7 minimum bias events.

Size: 16 x 26 meters
Weight: 10,000 tons



TOF TRD

HMPID

PMD

ITS

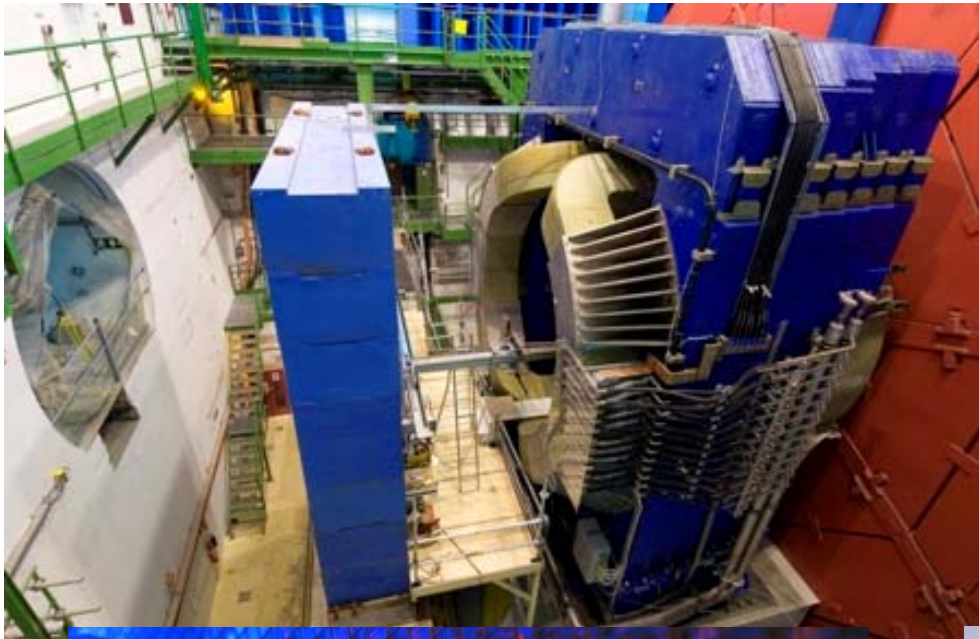
Muon Arm

PHOS

TPC

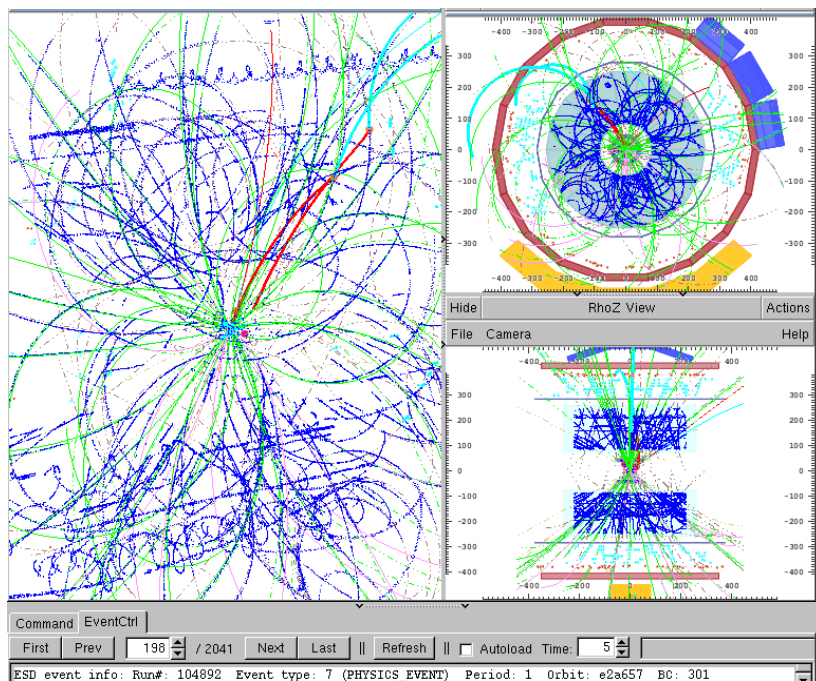
ALICE Set-up

Largest dipole magnet (850 ton, 9×7×4.5 m) and particle detectors

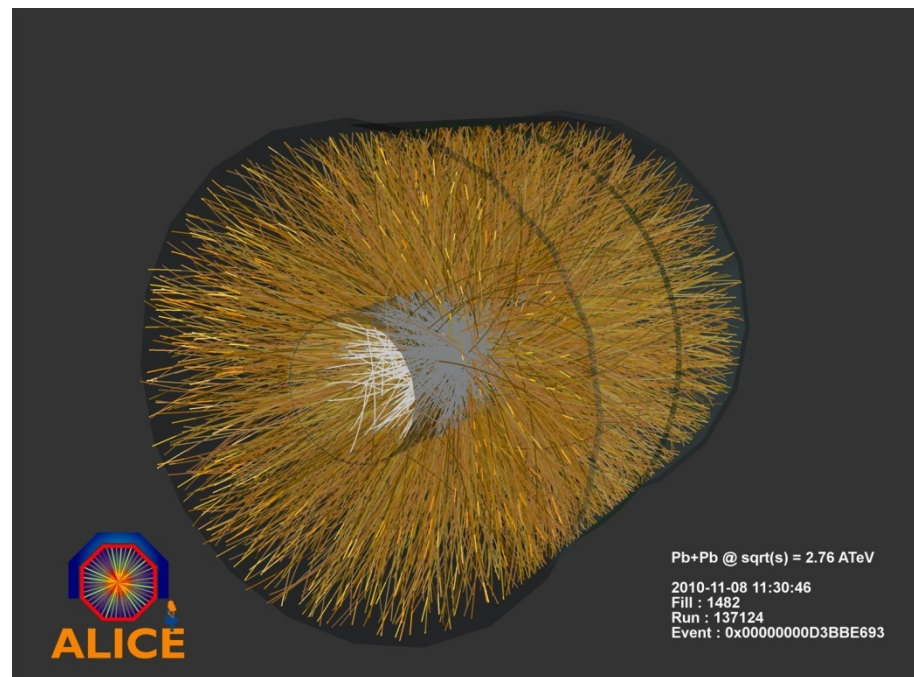


Display of high multiplicity events

in p-p at 7 TeV

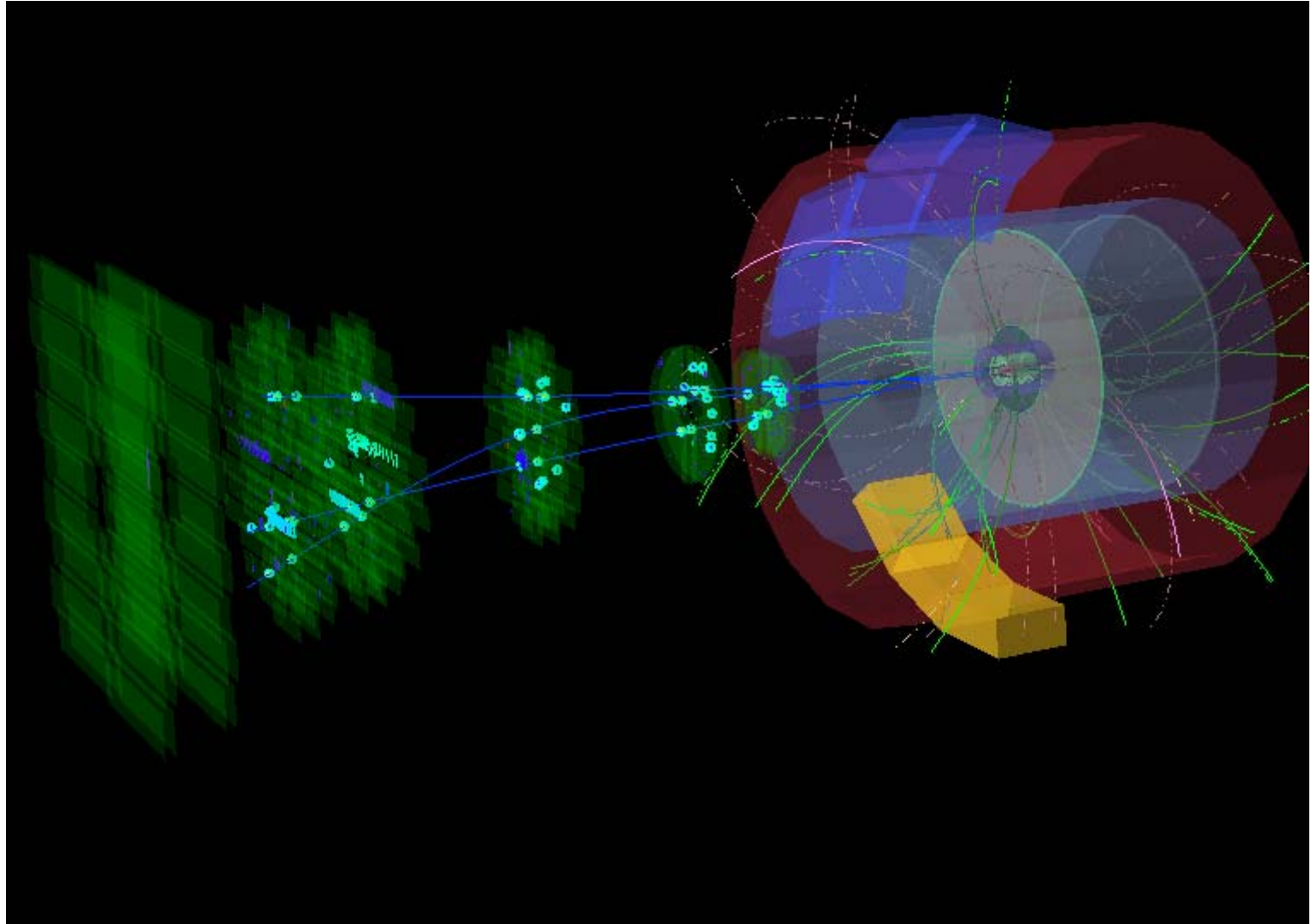


in Pb-Pb at 2.76 ATeV



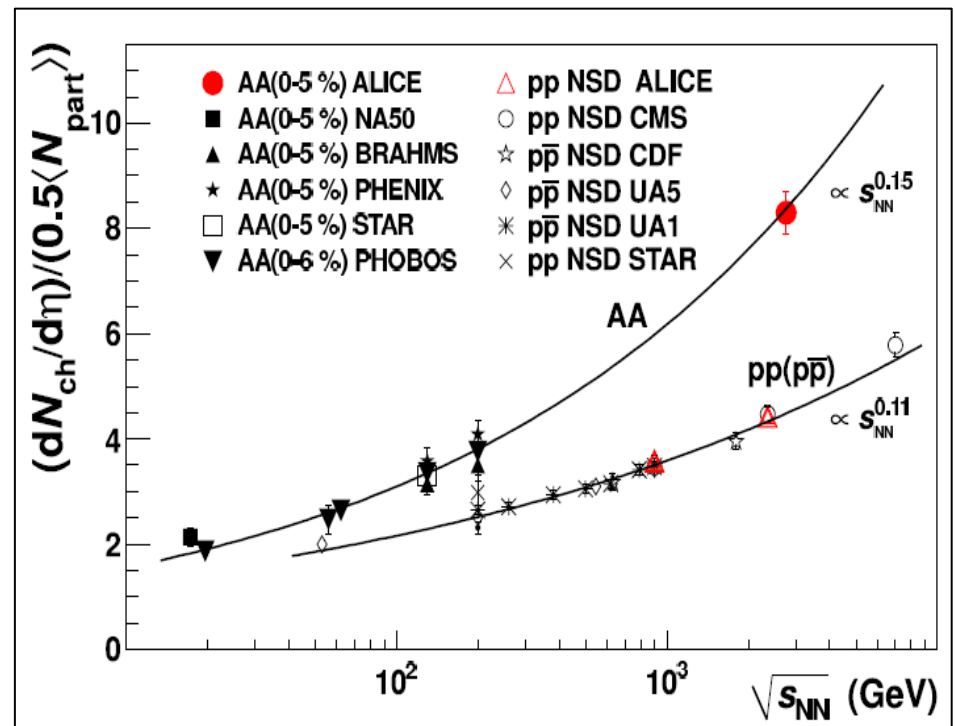
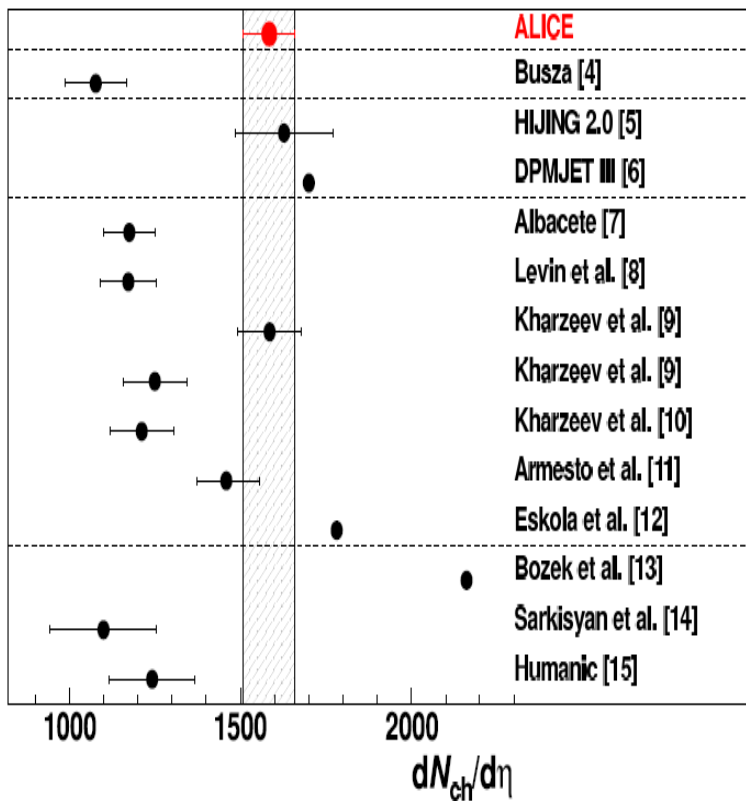
Dimuon Spectrometer

First J/Ψ candidate ($M \approx 2.88 \pm 0.15 \text{ GeV}/c^2$)

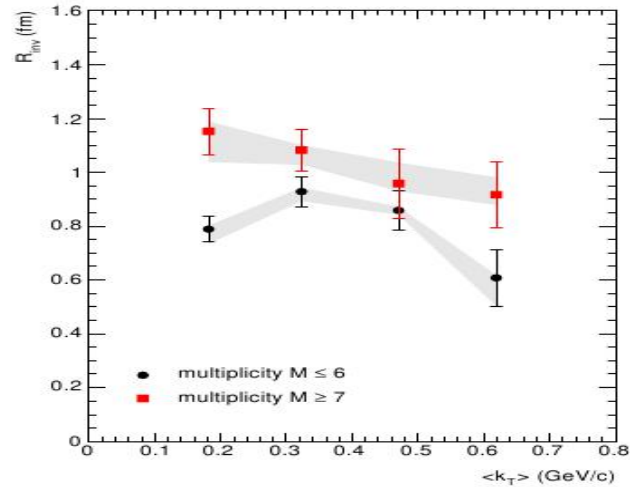
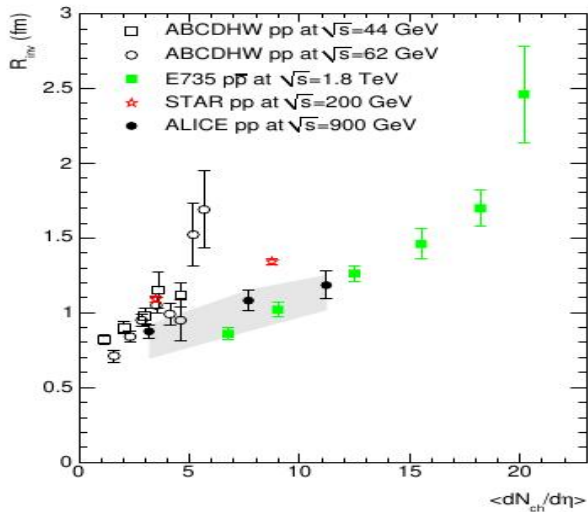


Charged particles density for Pb-Pb at 2.76 TeV

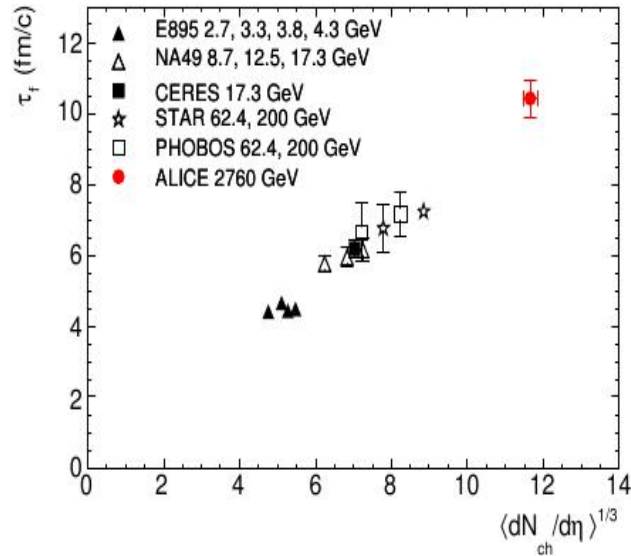
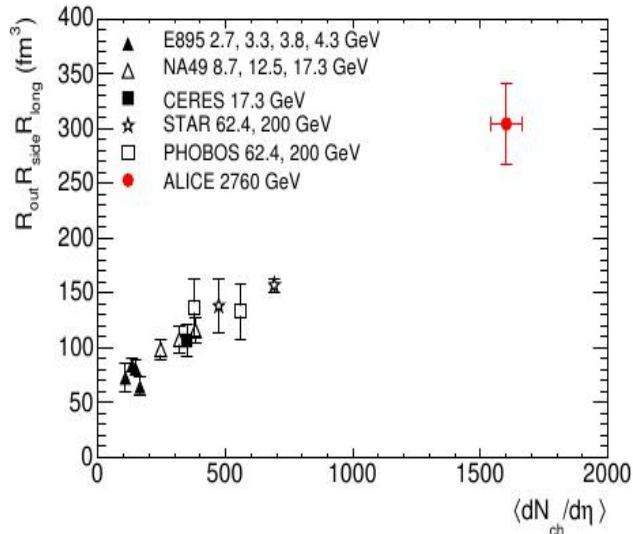
$$dN_{ch}/d\eta \sim 1600 \pm 76 \text{ (syst)}$$



Two-pions Bose-Einstein Correlation results.



p-p

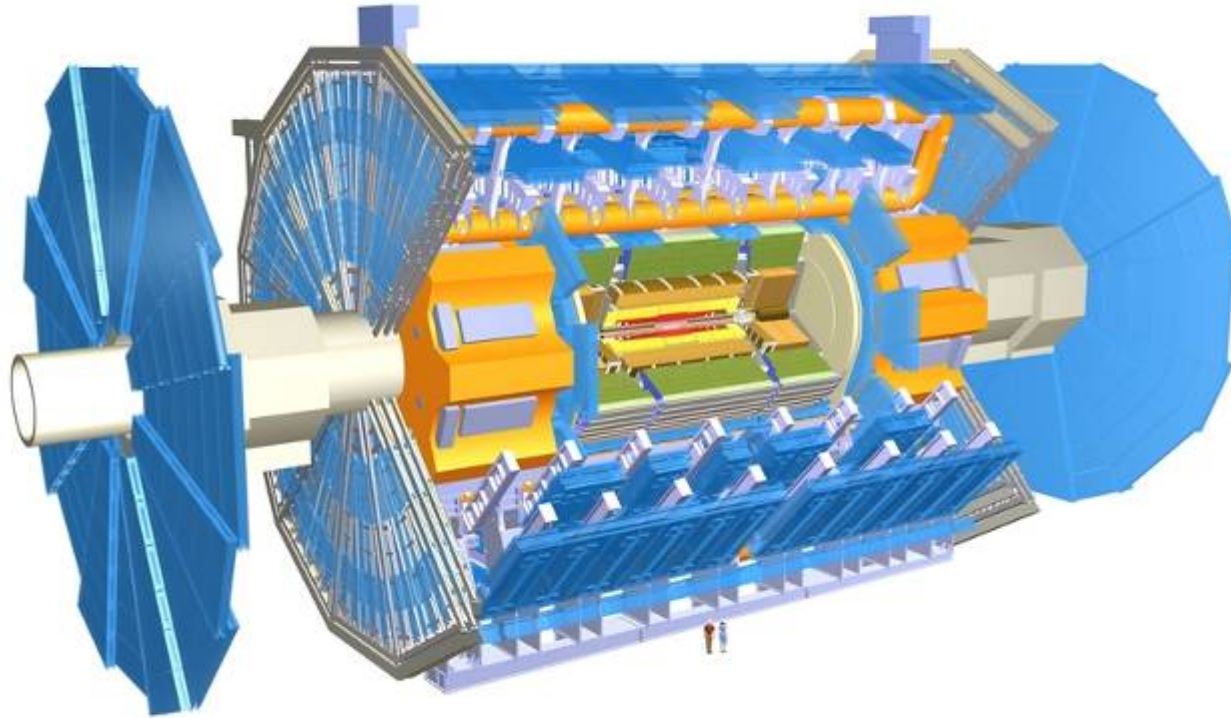


Pb-Pb(Au-Au)

(Volume of the particle source)

(Decoupling system time)

ATLAS detector



Diameter

25 m

Barrel toroid length

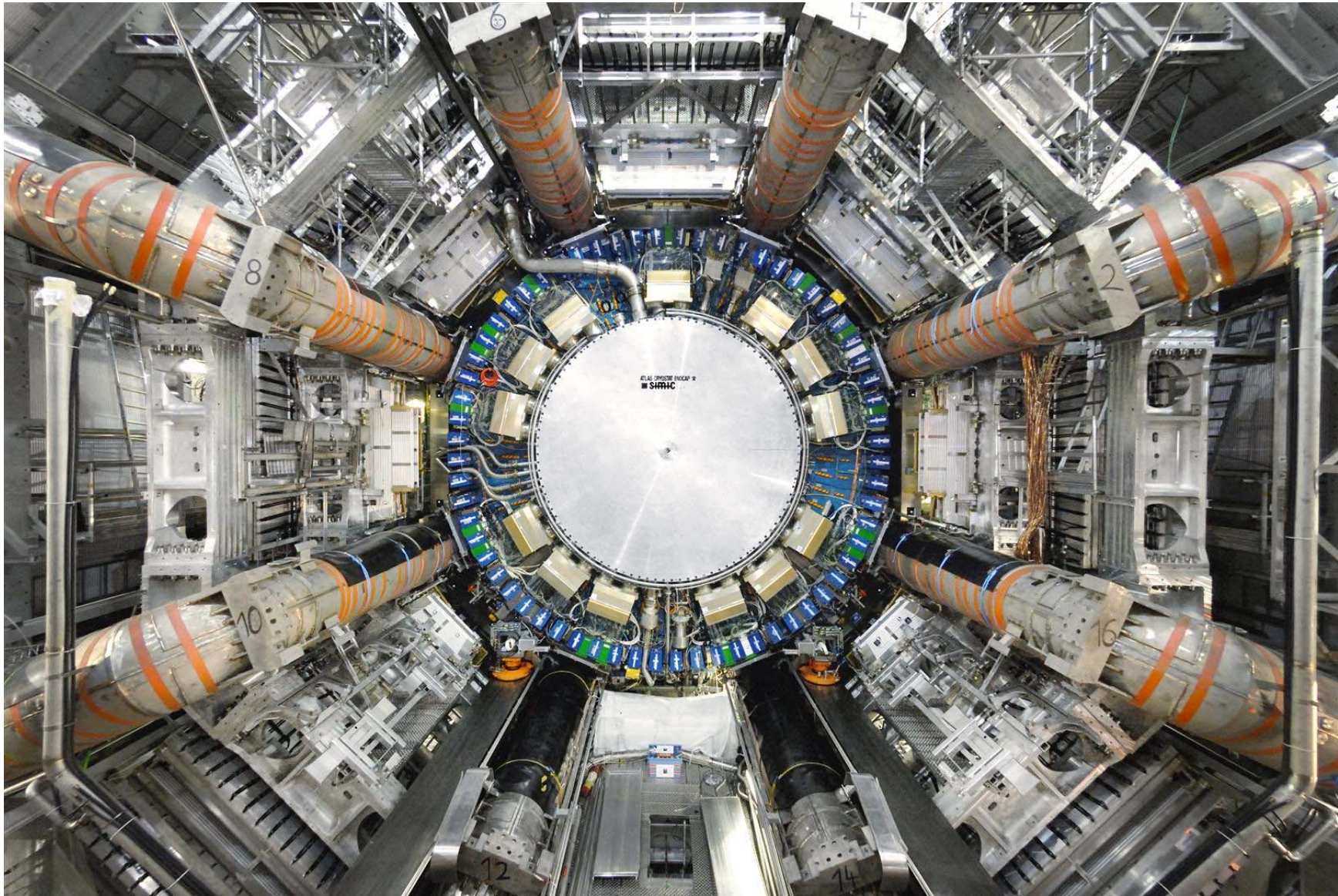
26 m

End-cap end-wall chamber span

46 m

Overall weight

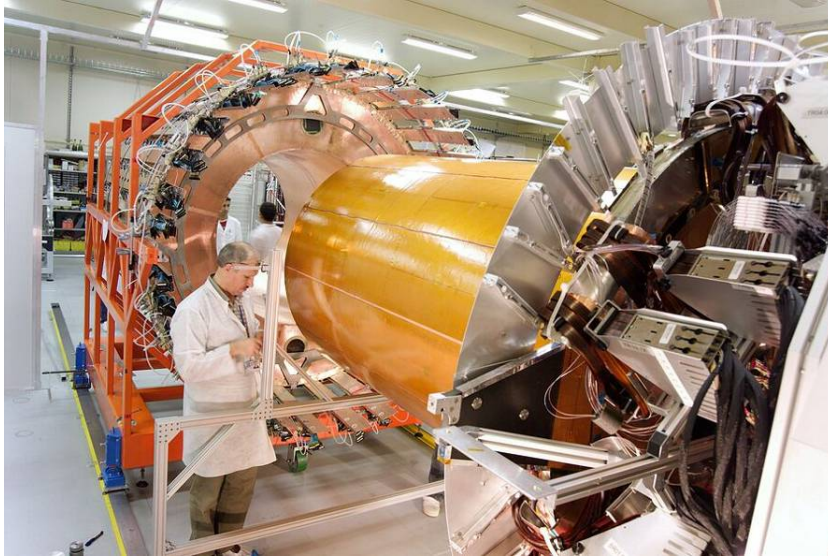
7000 Tons



JINR contribution to ATLAS

- 1. Transition Radiation Tracker (34 straw wheels; 3072 ch.each)**
- 2. Liq. Ar End-cap Hadron Calorimeter (40%)**
- 3. Hadron Tile Calorimeter**
- 4. Muon Chambers**
- 5. Temperature and radiation tests at IBR-2**

JINR contribution to ATLAS



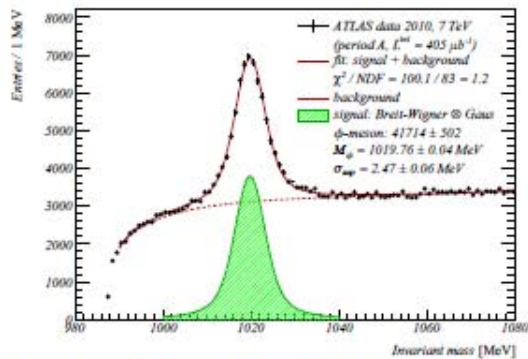
Transition Radiation Tracker based on straw tubes assembly

Barrel Tile Calorimeter;
LqAr Hadronic End-Cap Cal.
Muon Chambers



Selected ATLAS results

$\phi(1020)$ invariant mass: $\phi(1020) \rightarrow K^+ K^-$



- strangeness enhancement was proposed long ago as a signature of the phase transition to a deconfined plasma of quarks and gluons, the ϕ meson is a key experimental probe in this context due to its $s\bar{s}$ valence quark content.
- among light vector mesons, the ϕ meson is considered an excellent candidate for the study of medium modification effects due to its narrow width
- the fitted position of the $\phi(1020)$ mass peak is found to be in excellent agreement with PDG value
- ATLAS is sensitive to $\phi(1020)$ in kinematic range: $|\eta| < 1.5$ and $0.5 < p_T < 1.2$ GeV
- preliminary production cross section $\sigma(pp \rightarrow \phi X) = [0.92 \pm 0.01(\text{stat})] \text{mb}$
- the analysis of systematic uncertainties is still in progress

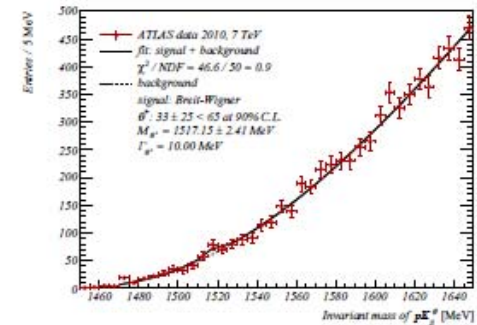
Exotic baryon state: $\Theta^+ \rightarrow p + K_S^0$

otic state Θ^+ with mass 1530 MeV and total width 15 MeV originally proposed by Dyakonov, etrov and Polyakov

$\Theta^+ = (uudd\bar{s})$, spin 1/2, ospin 0, strangeness +1
EPS, DIANA, CLAS, APHIR reported the bservation of Θ^+

ERA-B, DESY, BaBar, 'DF: no signal

o indication of a signal in K_S^0 mass spectrum was und in ATLAS data



Resonance	ATLAS	CDF
$K^*(890)^+$	123806 ± 3739	15695 ± 775
$\Lambda(1520)$	24653 ± 3023	3276 ± 327
Θ^+	33 ± 25	18 ± 56
90% C.L. on Θ^+	< 65	< 89

CMS Detector

SILICON TRACKER

Pixels ($100 \times 150 \mu\text{m}^2$)
~1m² ~66M channels

Microstrips (80-180 μm)
~200m² ~9.6M channels

CRYSTAL ELECTROMAGNETIC CALORIMETER (ECAL)

~76k scintillating PbWO₄ crystals

PRESHOWER

Silicon strips
~16m² ~137k channels

STEEL RETURN YOKE

~13000 tonnes

SUPERCONDUCTING SOLENOID

Niobium-titanium coil
carrying ~18000 A

HADRON CALORIMETER (HCAL)

Brass + plastic scintillator
~7k channels

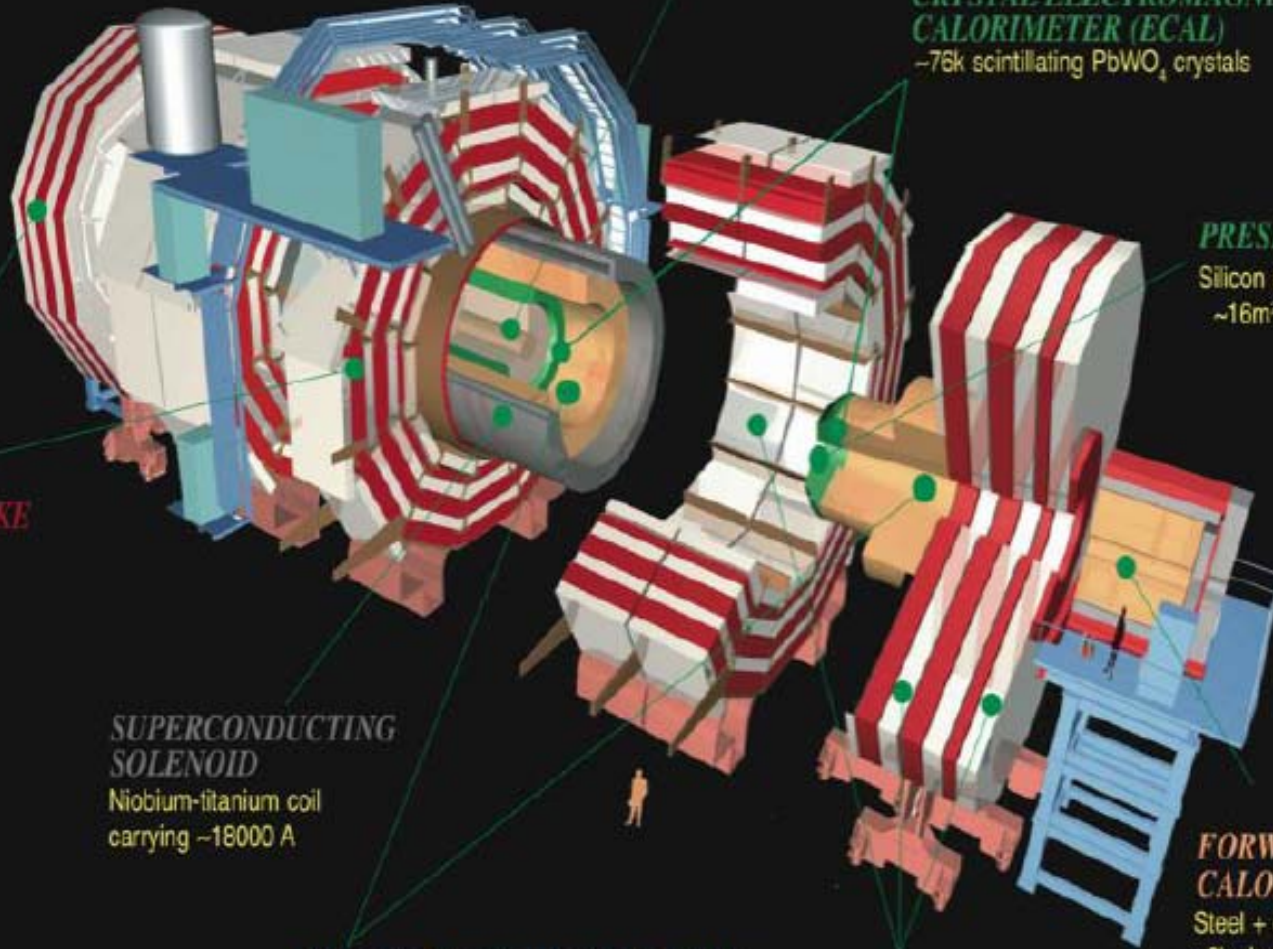
FORWARD CALORIMETER

Steel + quartz fibres
~2k channels

MUON CHAMBERS

Barrel: 250 Drift Tube & 480 Resistive Plate Chambers
Endcaps: 473 Cathode Strip & 432 Resistive Plate Chambers

Total weight : 14000 tonnes
Overall diameter : 15.0 m
Overall length : 28.7 m
Magnetic field : 3.8 T



JINR contribution to CMS

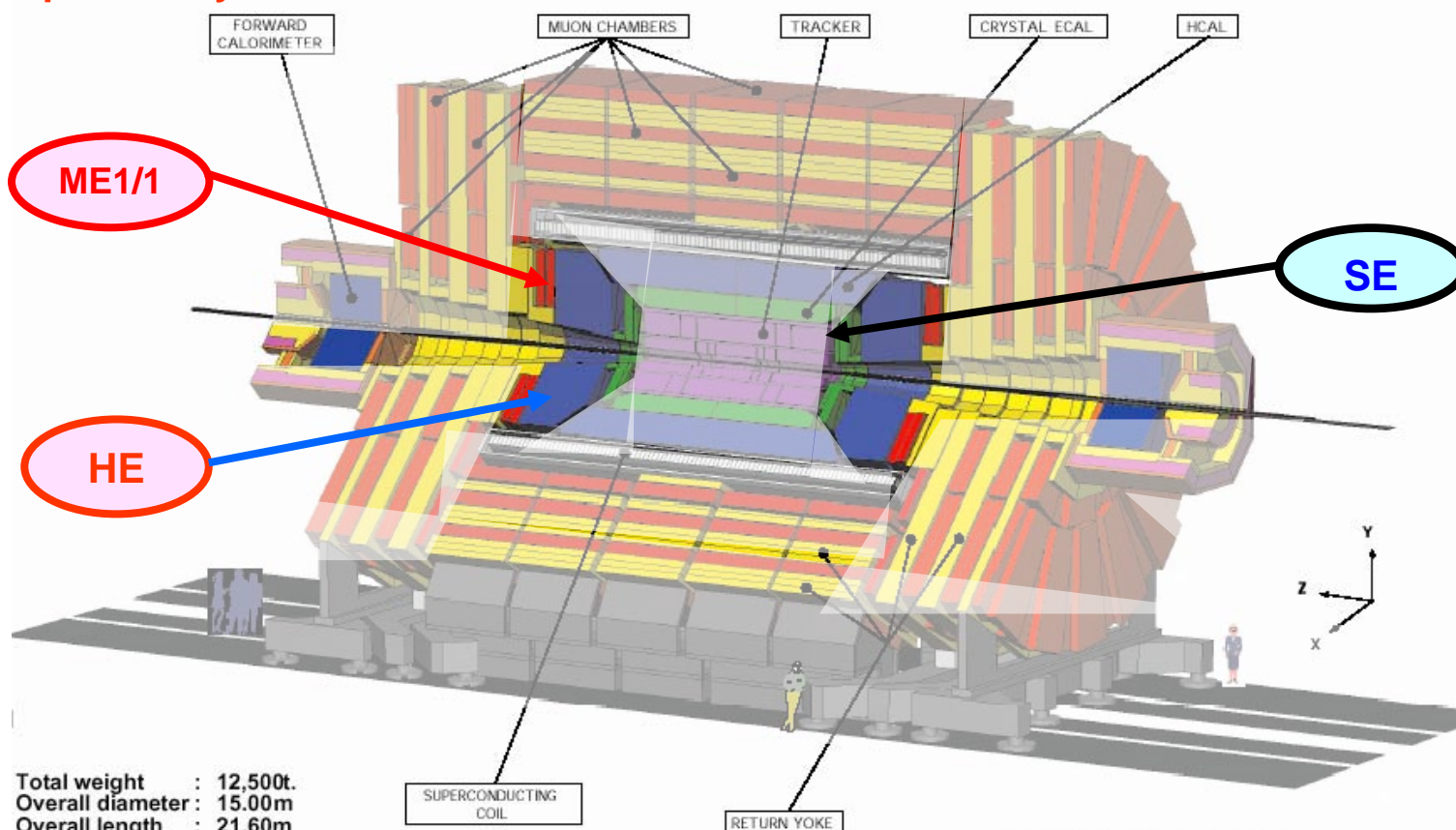
- 1. End-cap Hadron Calorimeter**
- 2. Muon system (ME1)**
- 3. Preshower (participation)**

JINR Participation in CMS Construction

RDMS bears
Full
Responsibility

JINR
Participates

CMS Compact Solenoidal Detector for LHC



Total weight : 12,500t.
Overall diameter : 15.00m
Overall length : 21.60m
Magnetic field : 4 Tesla

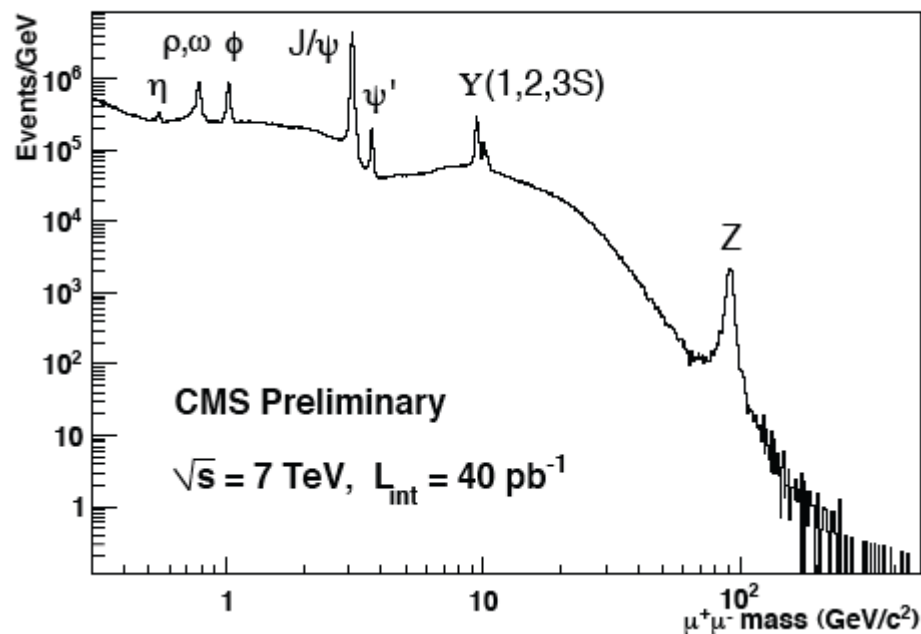
CMS-PARA-001-11/07/97

JLB.PP

CMS selected results

**Excellent performance
of the CMS detector**

New effects observed:



- **Ridge effect in pp-collisions;**
- **Direct observation of jet quenching in Pb-Pb collisions;**

Prospects for LHC running

- **3,5 TeV p-p running in 2011;**
- **steady increase of the luminosity;**
- **2,76 TeV short p-p run in 2011;**
- **2.76 TeV Pb-Pb run in 2011;**
- **p-p running at higher energy in 2012;**
- **shutdown for 15 – 19 months;**
- **further running until 2030**

СПАСИБО ЗА ВНИМАНИЕ