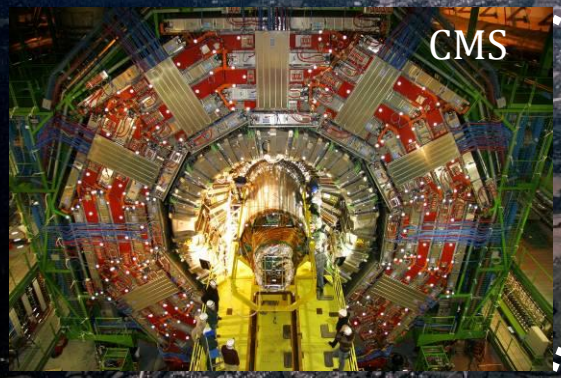
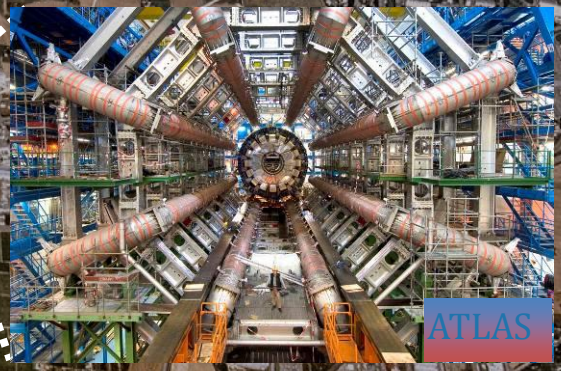
SUMMARY TALK
Michel Spiro
Highlights and Vision

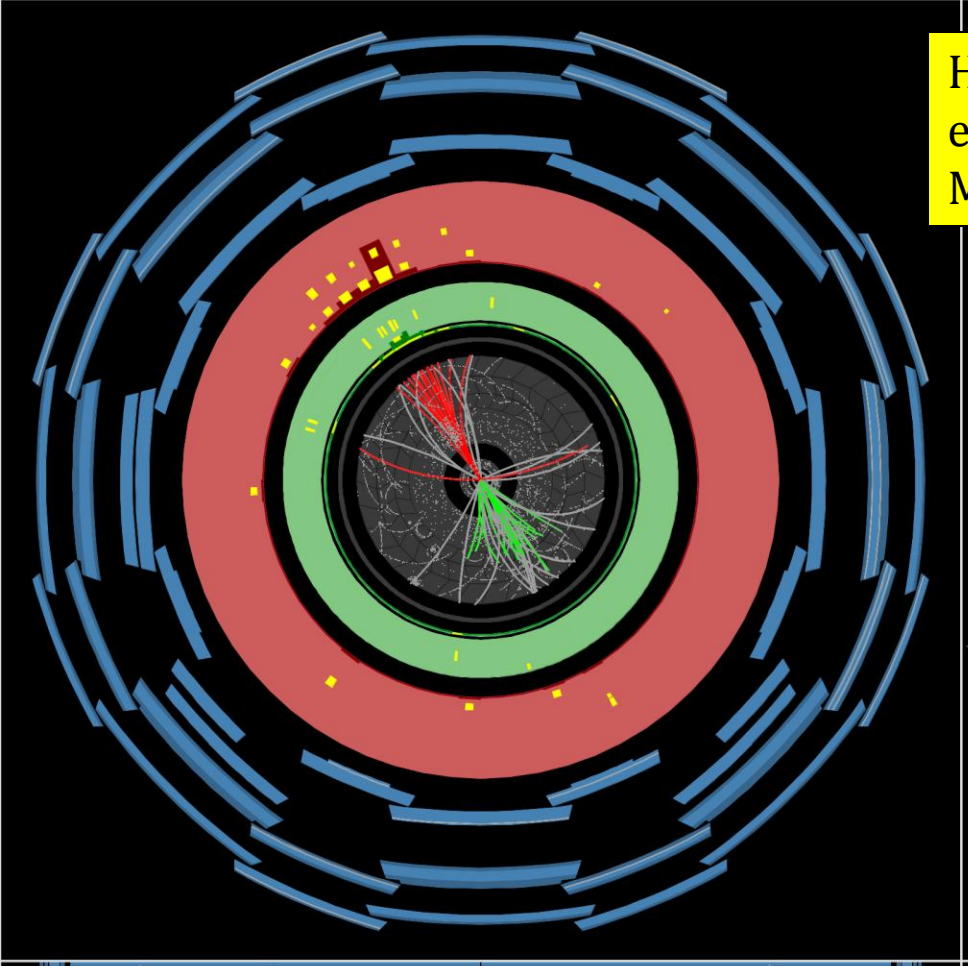
WHAT AN EVENT!!

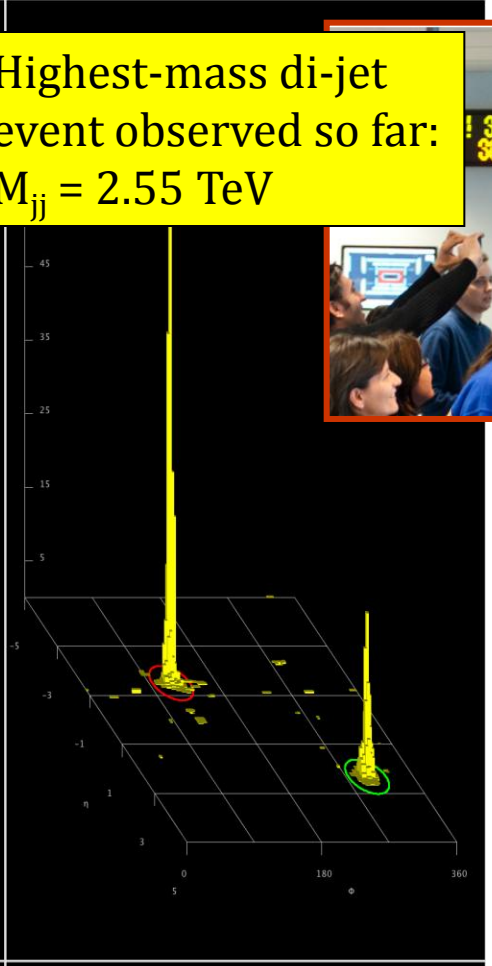
A new era for particle physics

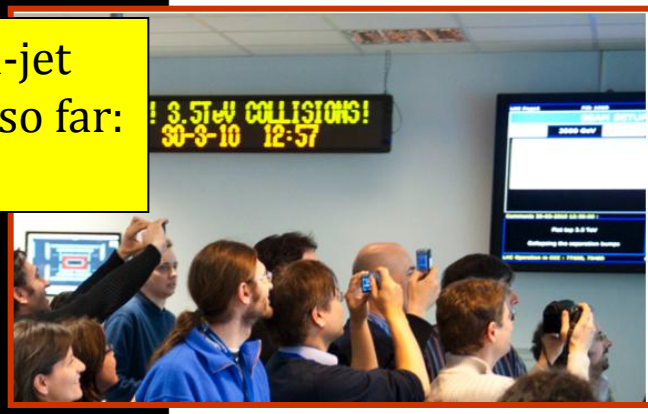




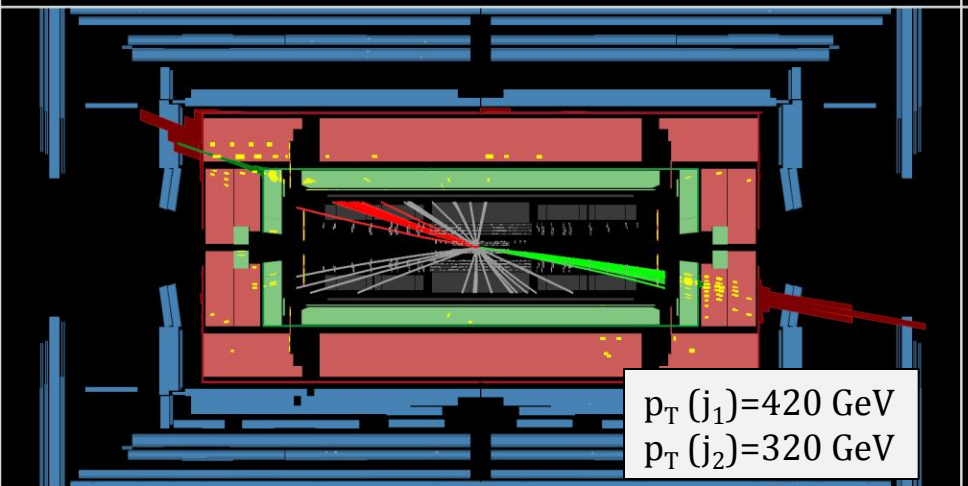
Highest-mass di-jet event observed so far:
M_{jj} = 2.55 TeV







Paris
ICHEP2010



p_T (j_1)=420 GeV
p_T (j_2)=320 GeV

ATLAS EXPERIMENT

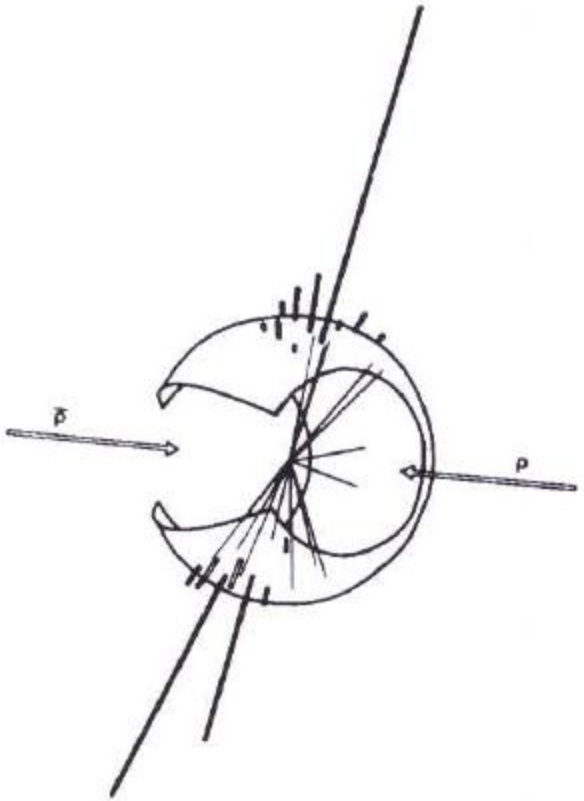
Run Number: 158548, Event Number: 5917927

Date: 2010-07-04 07:24:40 CEST

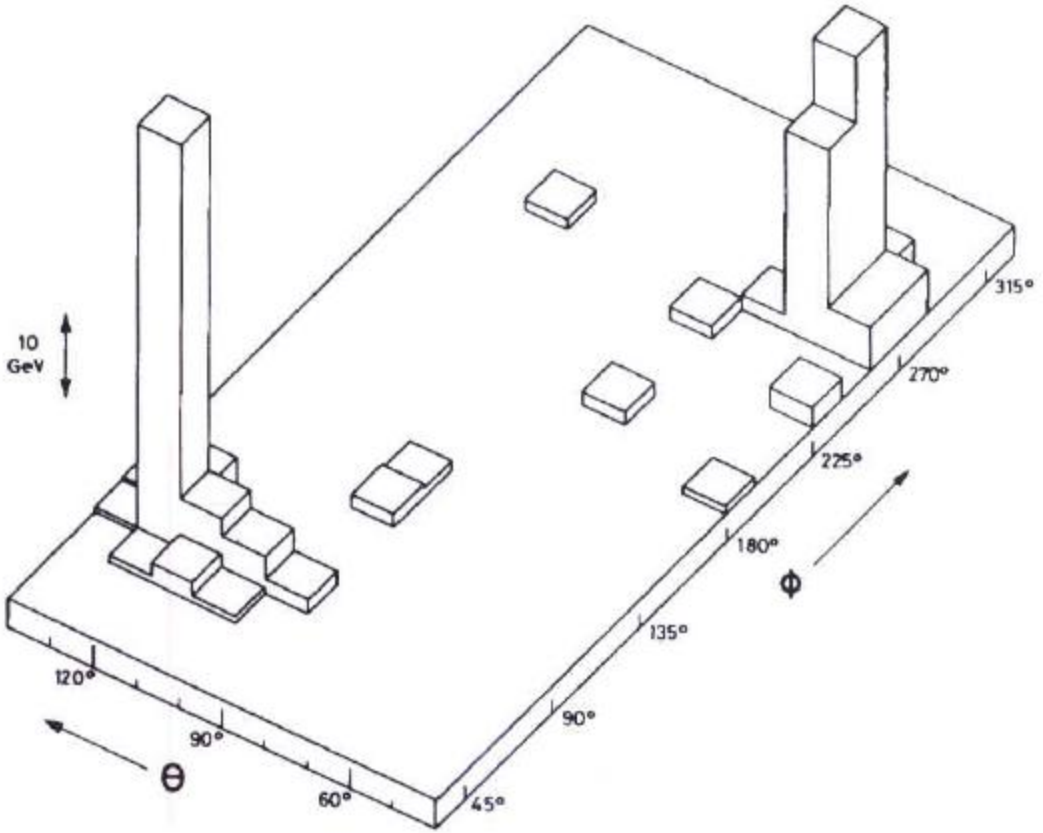
Event display shows uncalibrated energies

PARIS ICHEP1982: Jet discovery in p pbar collisions (UA2) *Note also that the event displays have become more sophisticated since the first spectacular events, hand-drawn, at a hadron collider …*

Volume 118B, number 1, 2, 3 PHYSICS LETTERS 2 December 1982



(a)

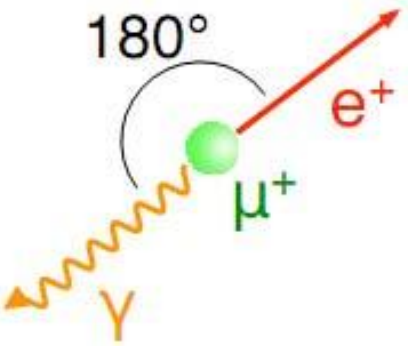


(b)

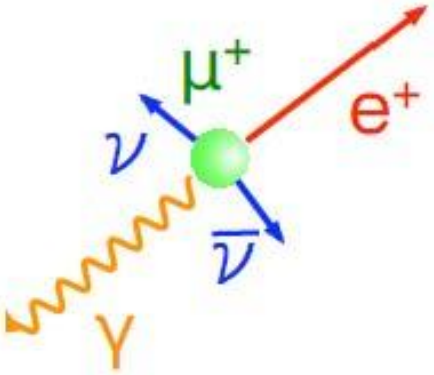
$\mu \rightarrow e\gamma$ **At PSI**

Signal and Background

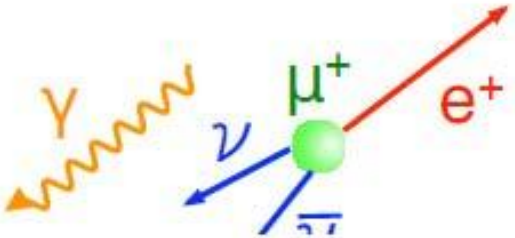
Signal



Prompt Background



Accidental Background



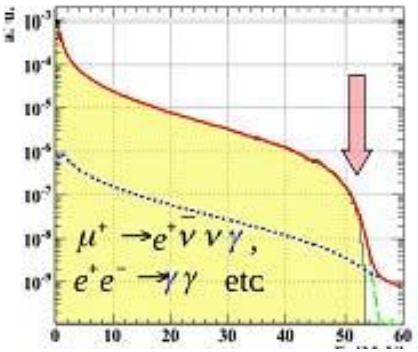
$$B_{acc} \propto \delta E_e \cdot (\delta E_\gamma)^2 \cdot (\delta \vartheta_{e\gamma})^2 \cdot \delta t_{e\gamma}$$

$e\gamma$		Radiative muon decay	Accidental pileup
Angle	Back-to-Back	Any angle	Any angle
Energy	52.8 MeV/c	< 52.8 MeV/c	< 52.8 MeV/c
Time	Same time	Same time	Flat

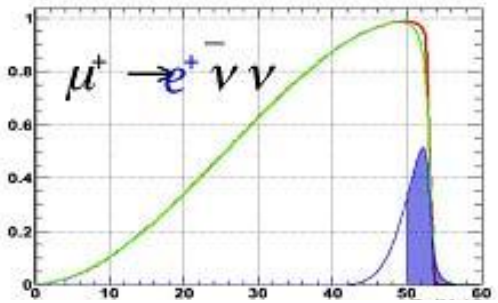
Dominant background is accidental.

Detector resolution is crucial.

γ BG



e^+ BG

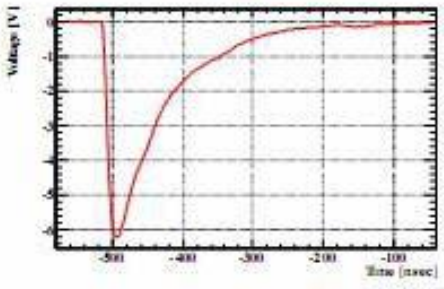


Event display

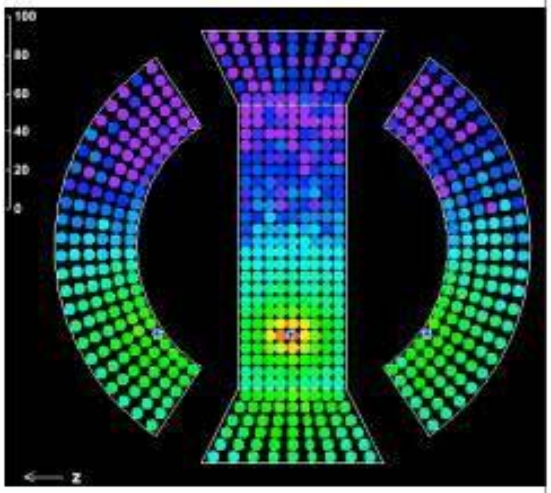
One of the most signal-like events.

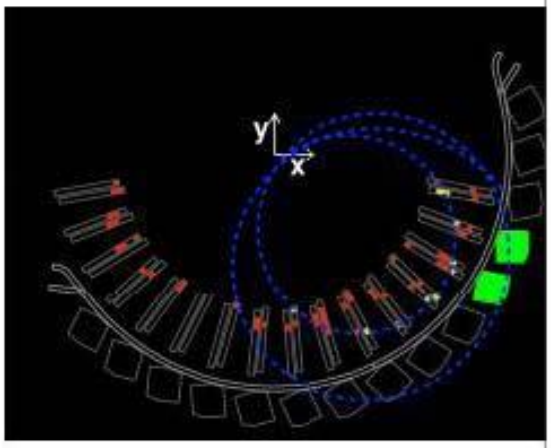
E_γ = 52.25 MeV
E_{e+} = 52.84 MeV
$\Delta\theta$ = 178.8 degrees
$\Delta T = 2.68 \times 10^{-11}$ s

Calorimeter sum WF



Calorimeter PMT hit map

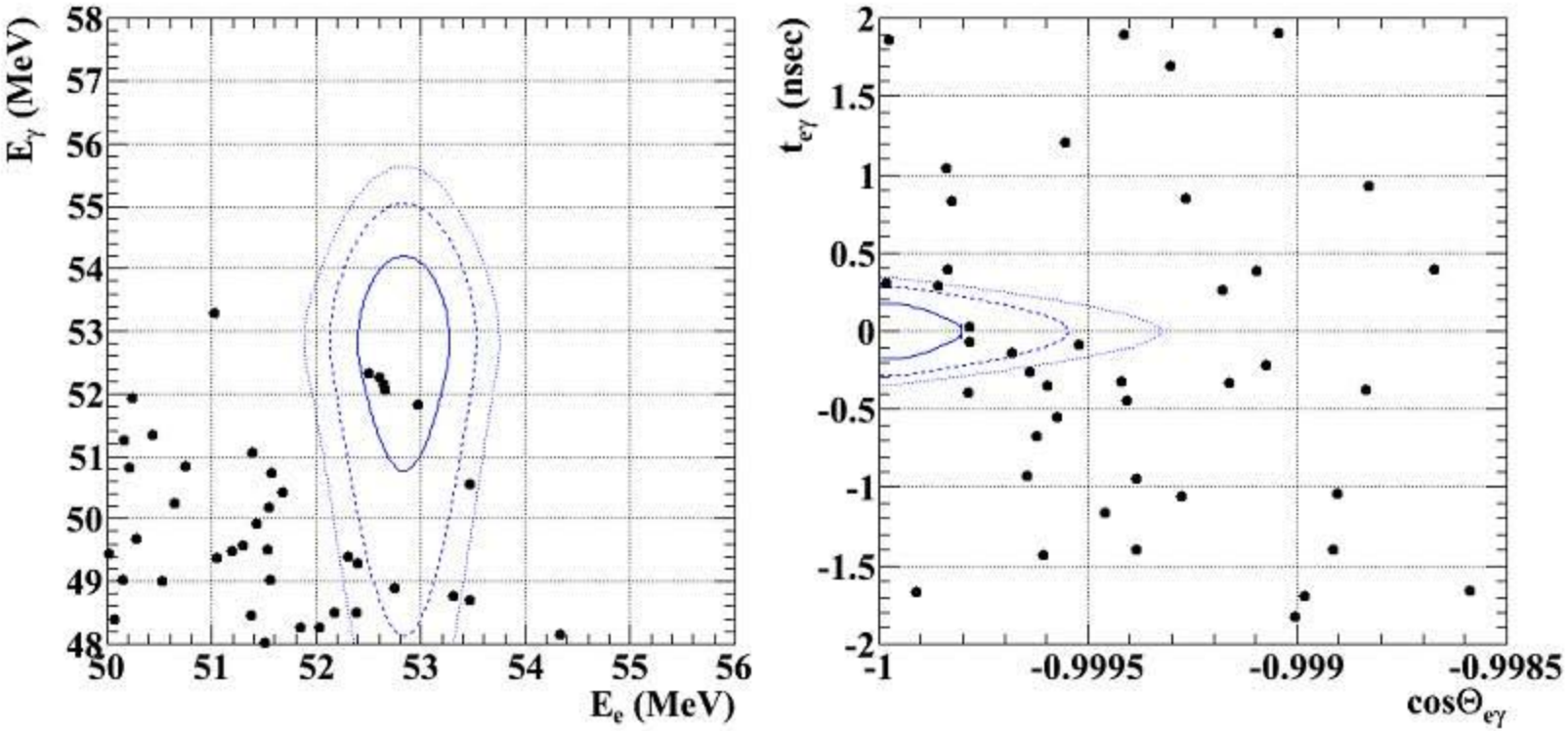




Spectrometer hits and a track

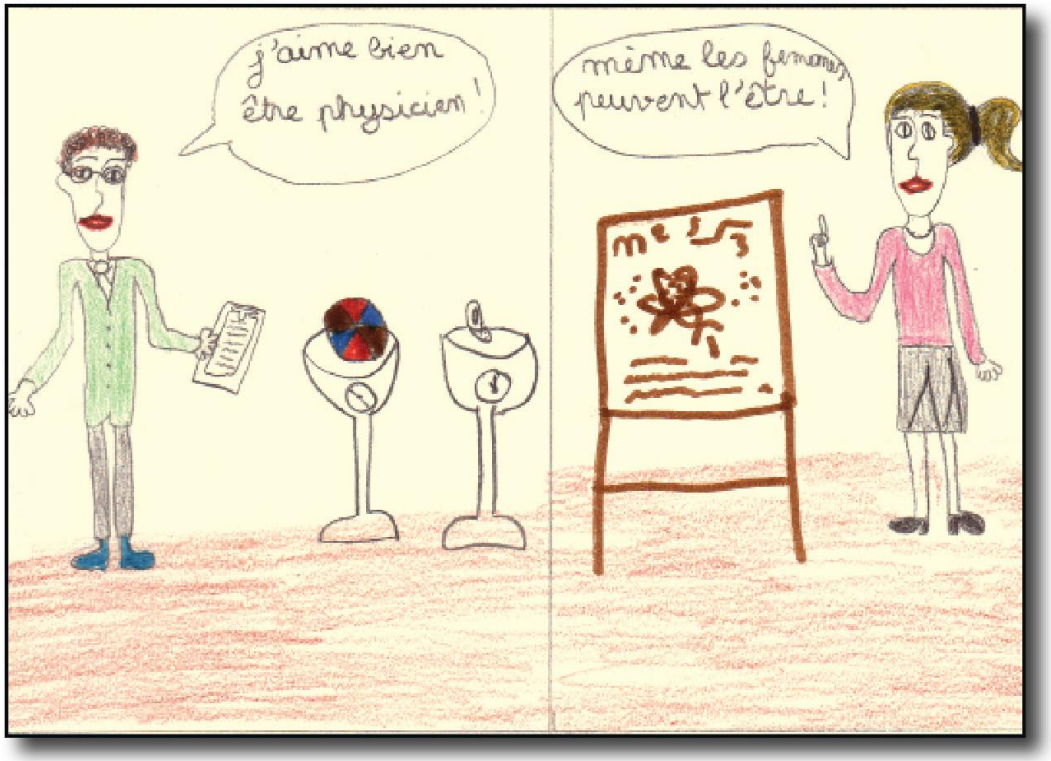
Each highly ranked event is checked carefully.

Event distribution after unblinding



Blue lines are 1(39.3 % included inside the region w.r.t. analysis window), 1.64(74.2%) and 2(86.5%) sigma regions.
For each plot, cut on other variables for roughly 90% window is applied.

Dessine-moi un physicien

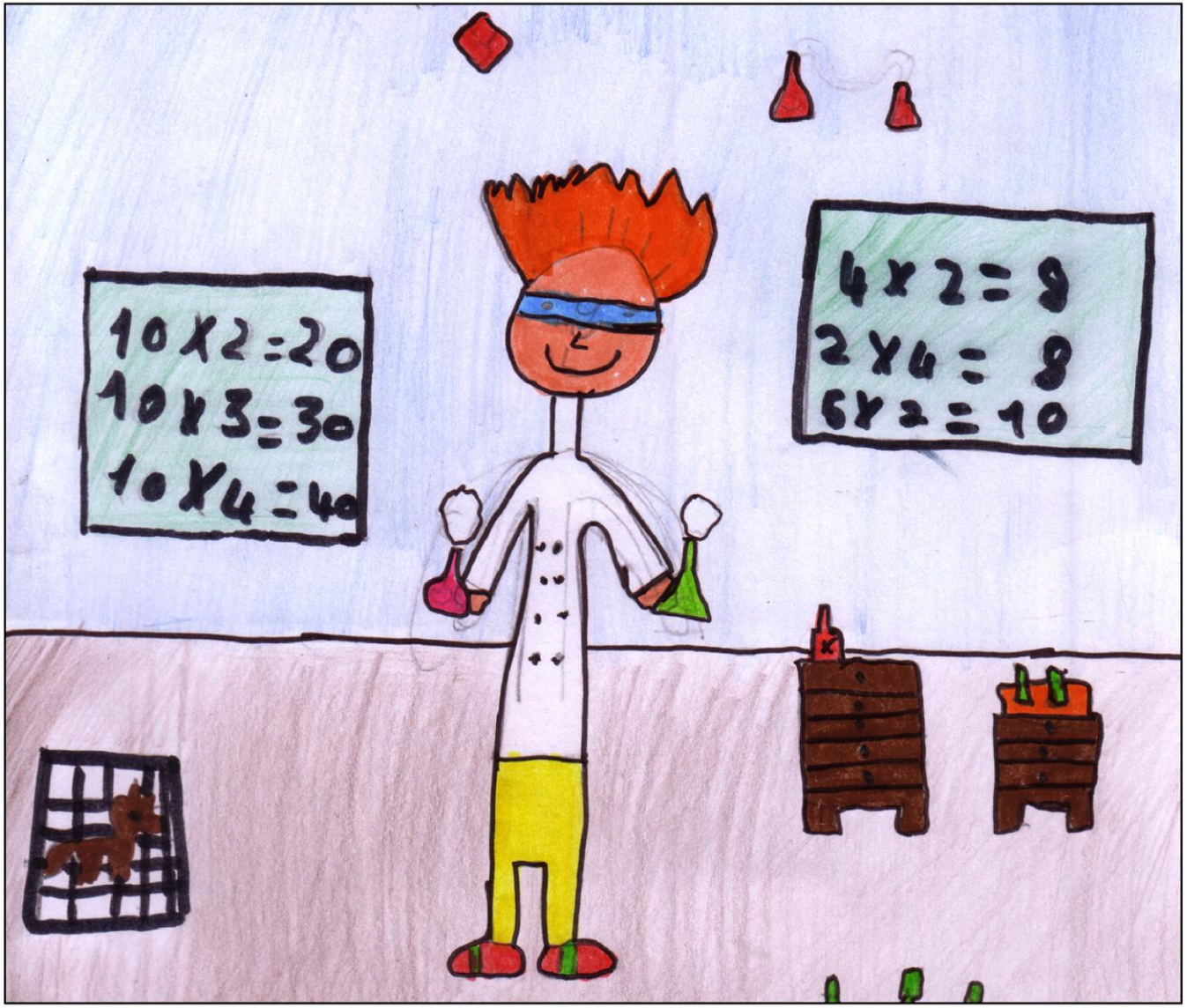


Le travail d'un physicien c'est de trouver les secrets de la Nature.

Chloé

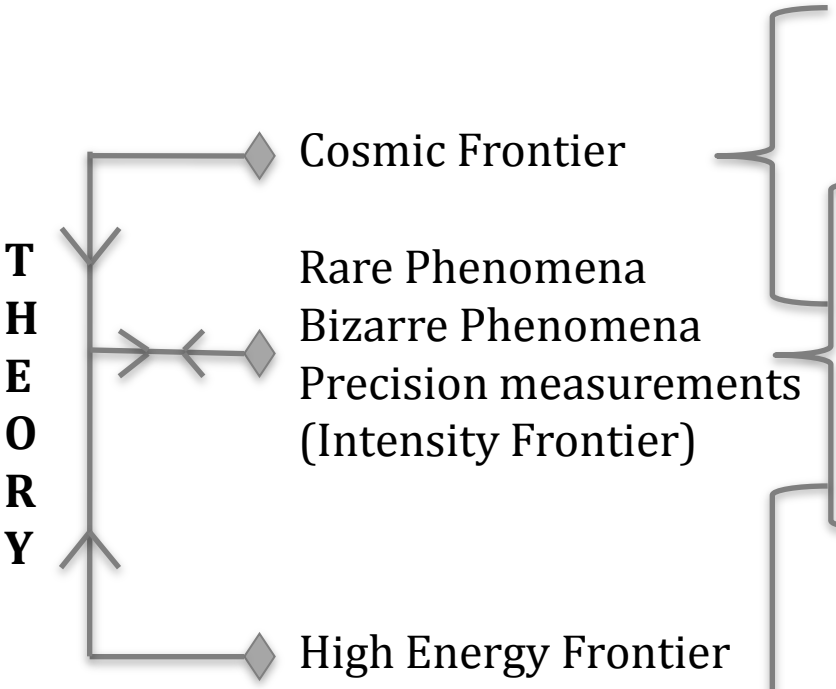
www.cern.ch/dessine-moi-un-physicien

Un physicien est un monsieur qui boit du café toute la journée. *Endrit*



Le physicien réagit tristement quand il rate une expérience. *Alyssa*

HIGHLIGHTS, VISION: Outline



*Cosmology : what is the Universe made of ?

*High Energy Cosmic Rays, new messengers : high energy phenomena in the Universe

*ν properties, p decay : a window towards the highest energies

* ν long Baseline

*edm, g-2, **p size**, μ ->eγ **(PSI)**

***B**, K, c, t decays, CKM, **CP violation**

*W, Z, t production, mass…

*Point like structure

*q, g plasma

*New Physics **(Moment of truth: Tevatron, LHC ?)**

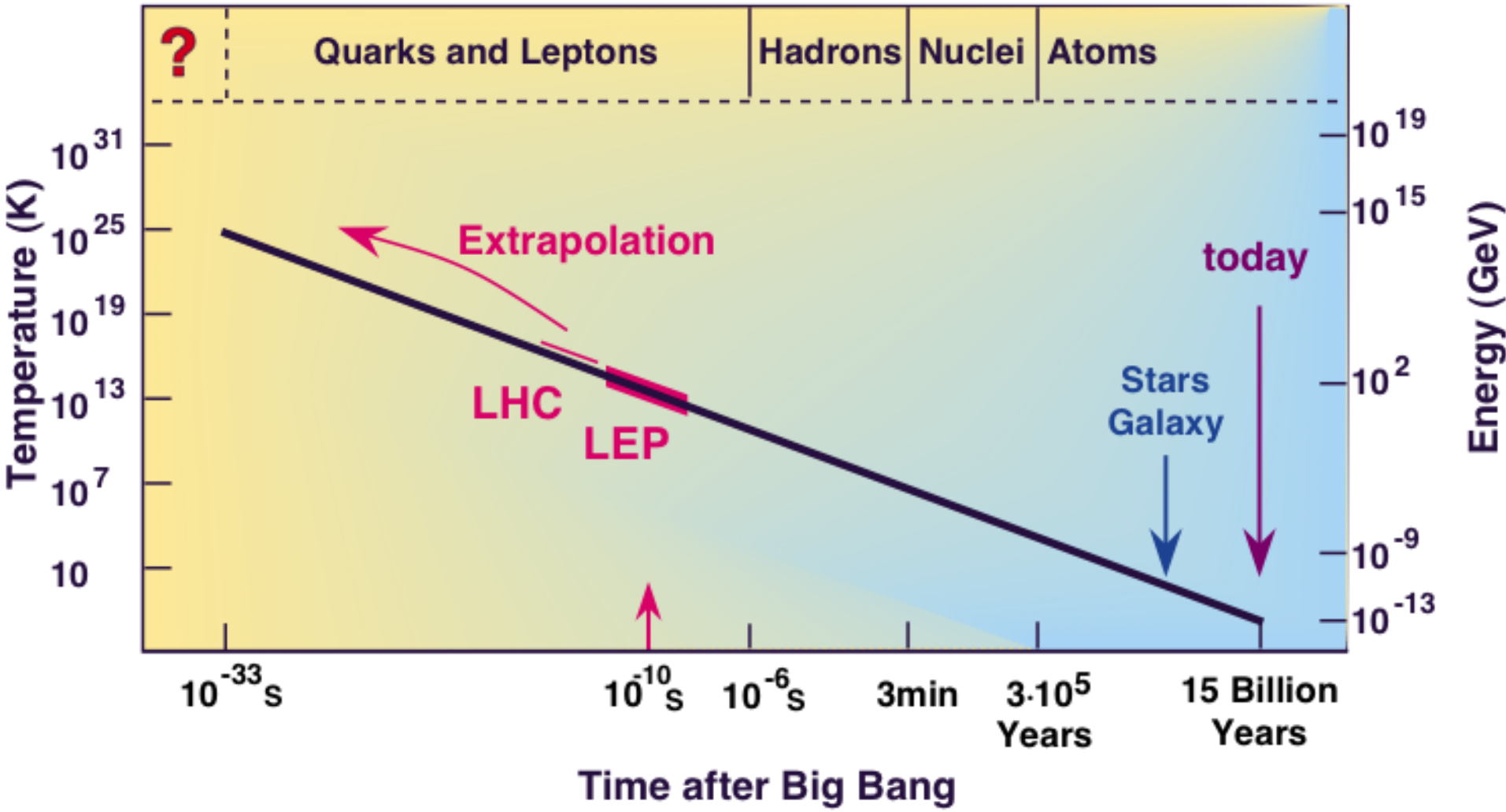
- Higgs or no Higgs

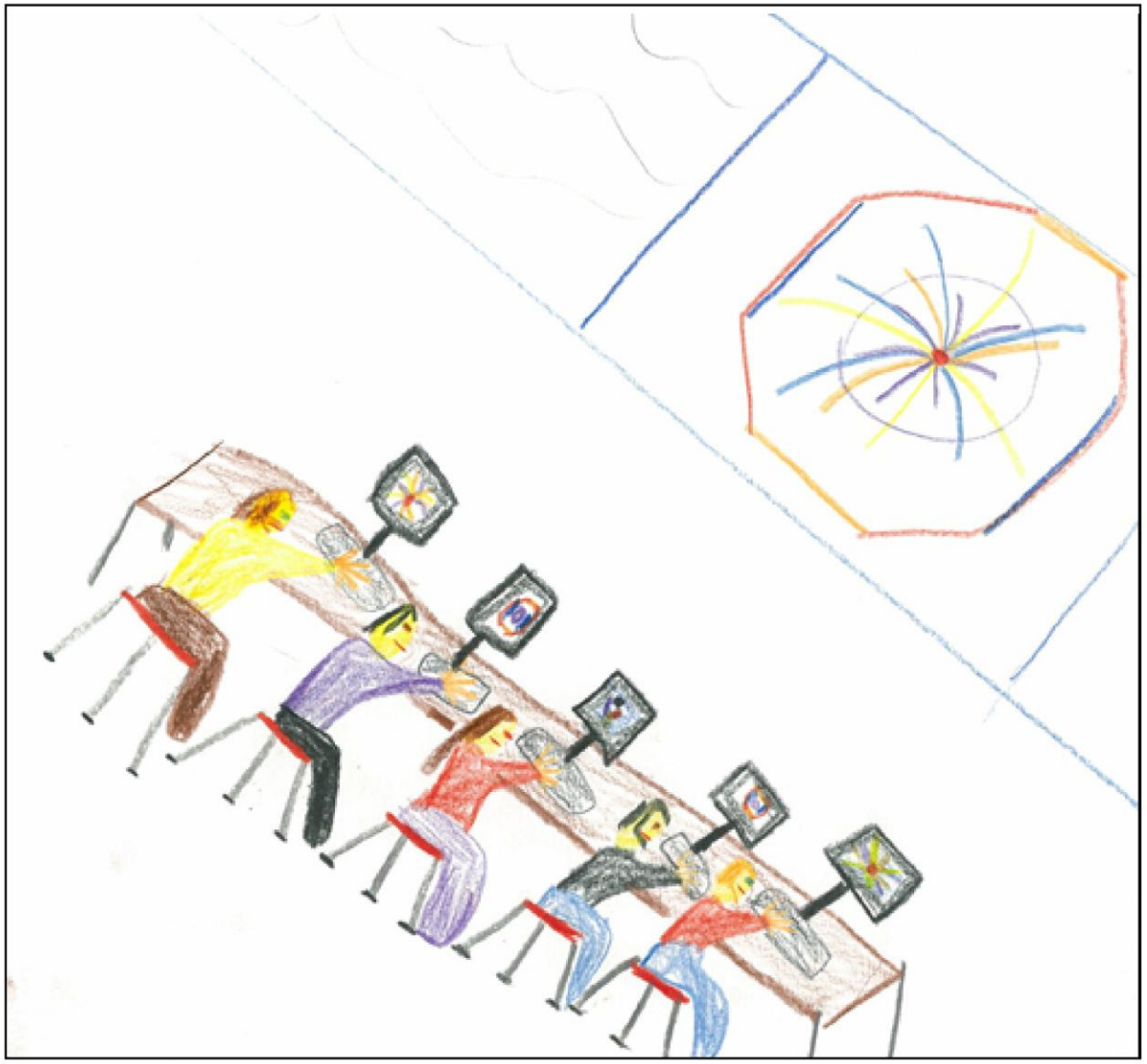
-Susy, Z', …

-Extra dimensions

- Mini black holes…

Evolution of the Universe

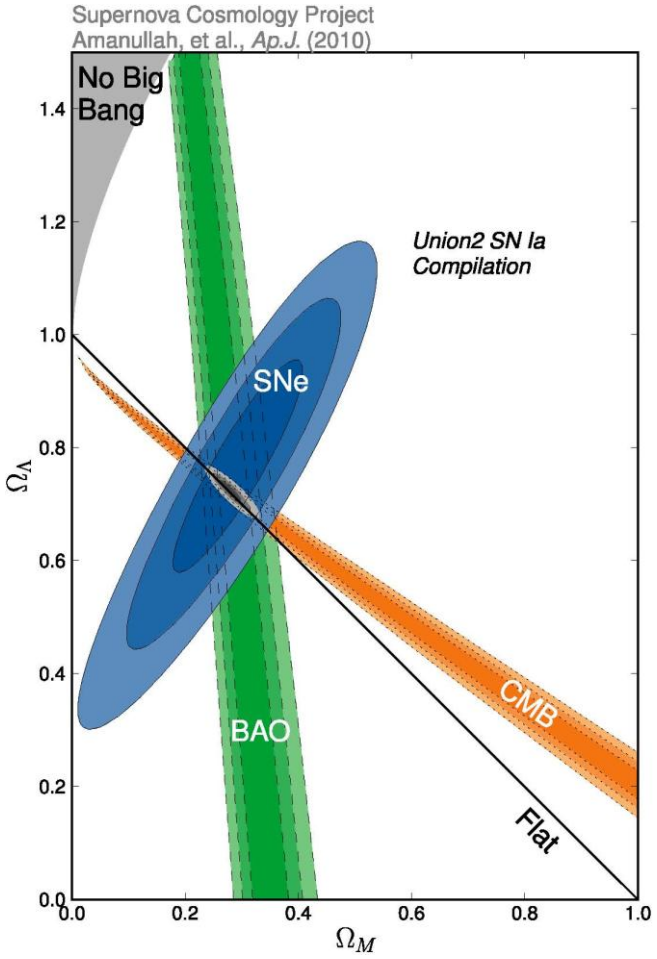


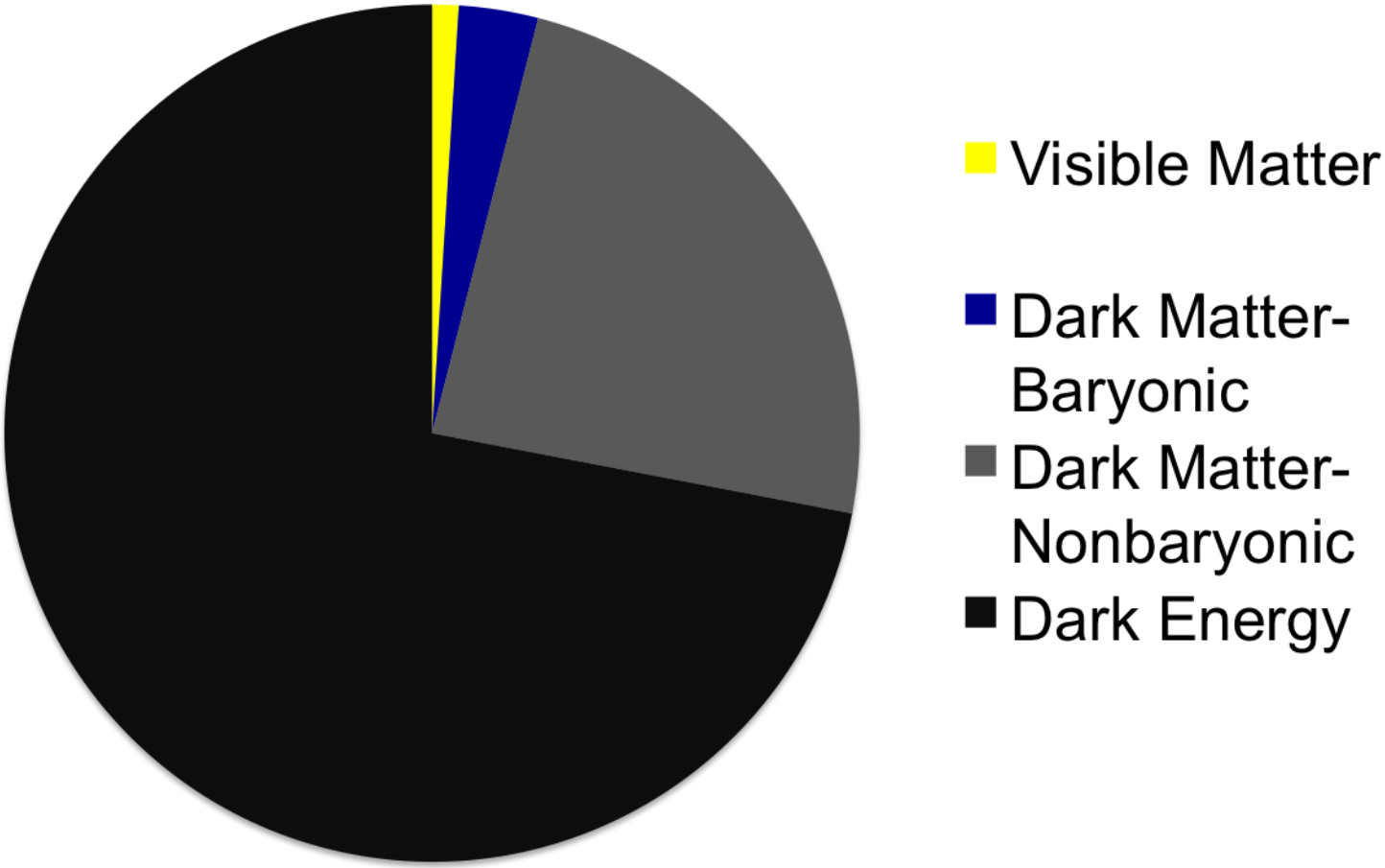


Un physicien est une personne qui fait marcher le LHC
pour savoir à peu près comment était le Big Bang. *Olivier*

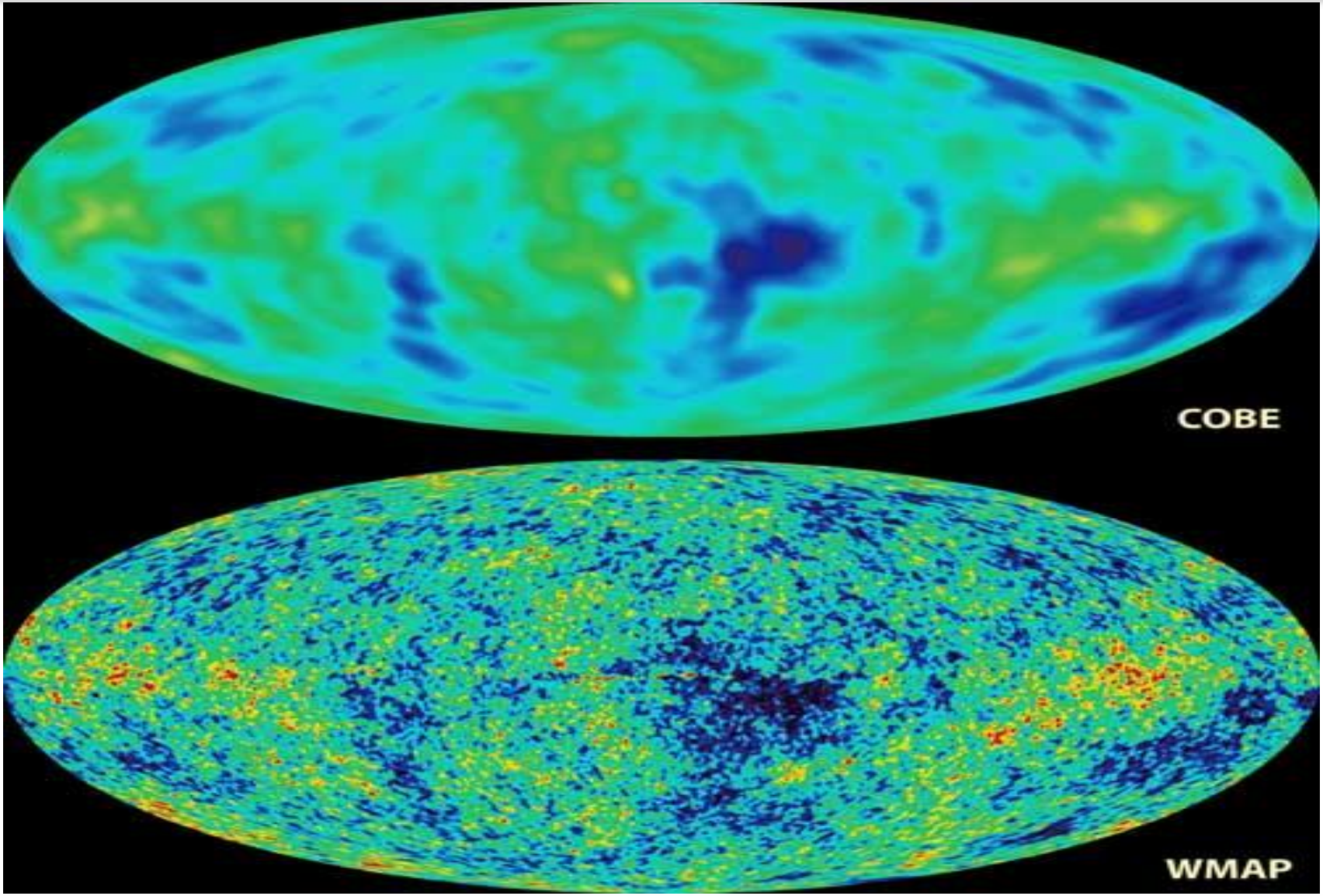
Cosmology Concordance Model:

$\Omega_M + \Omega_\Lambda = 1$ ($\rightarrow$k=0, inflation)

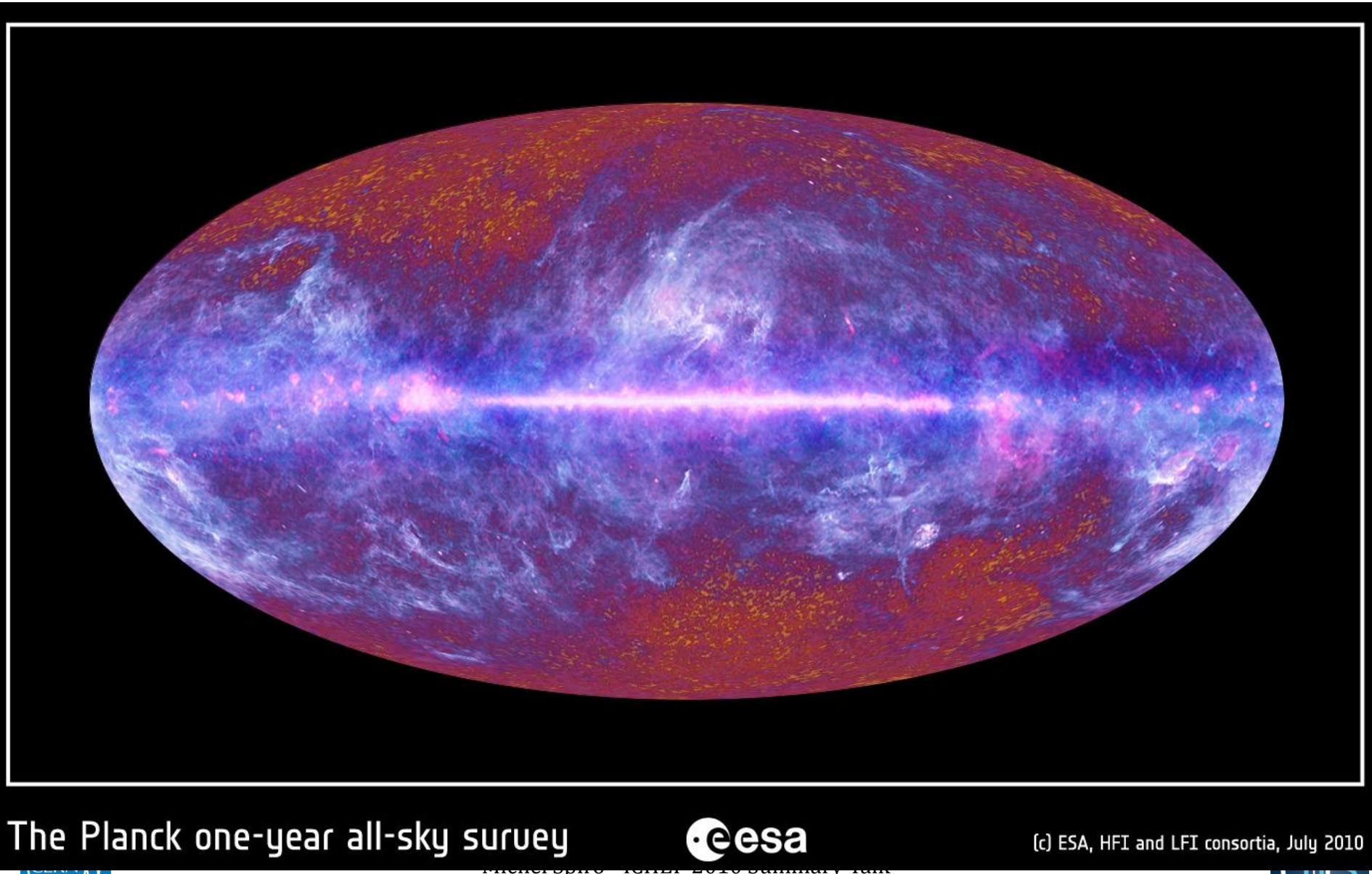



Visible Matter
Dark Matter-Baryonic
Dark Matter-Nonbaryonic
Dark Energy

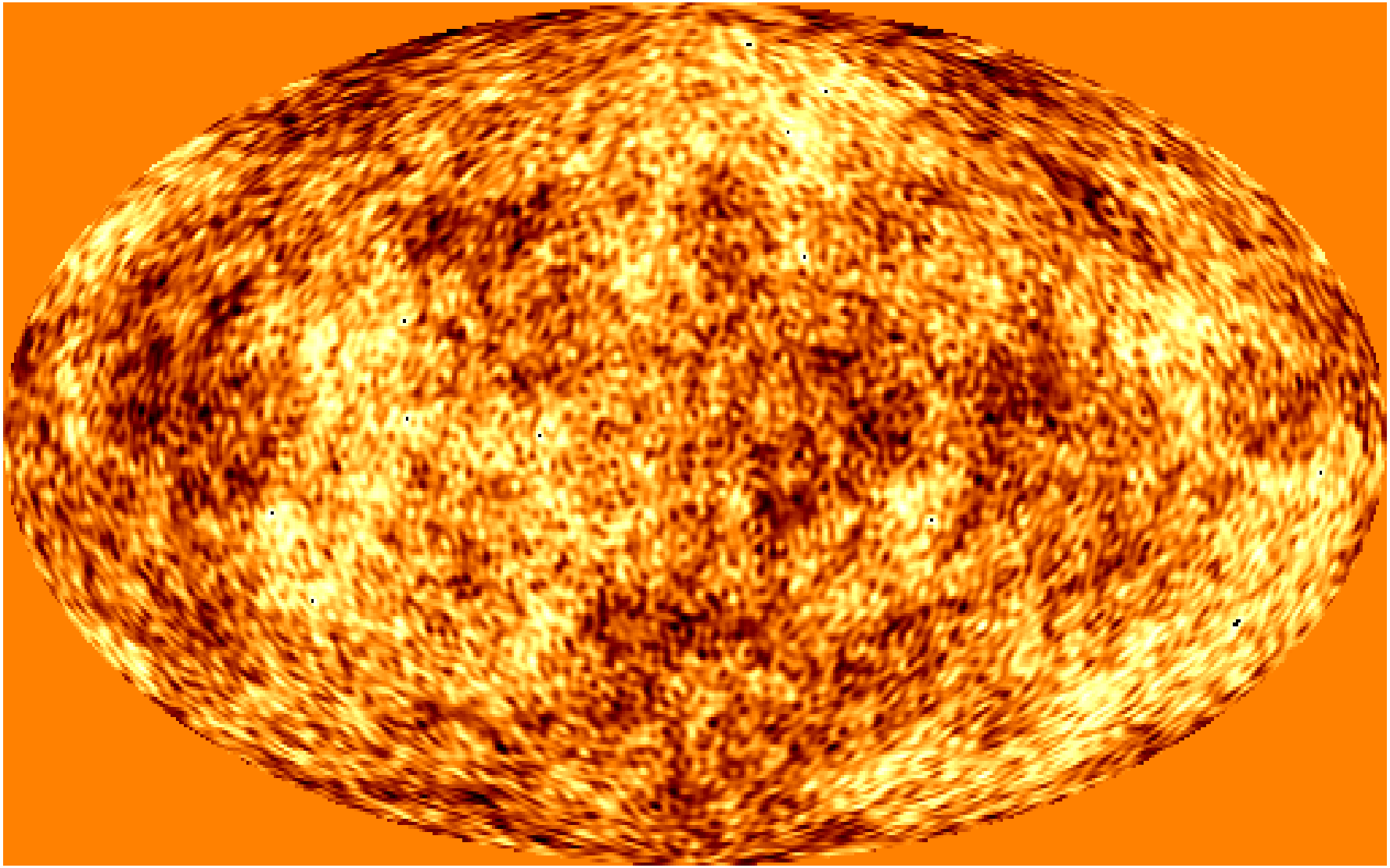
CMB: from COBE to WMAP



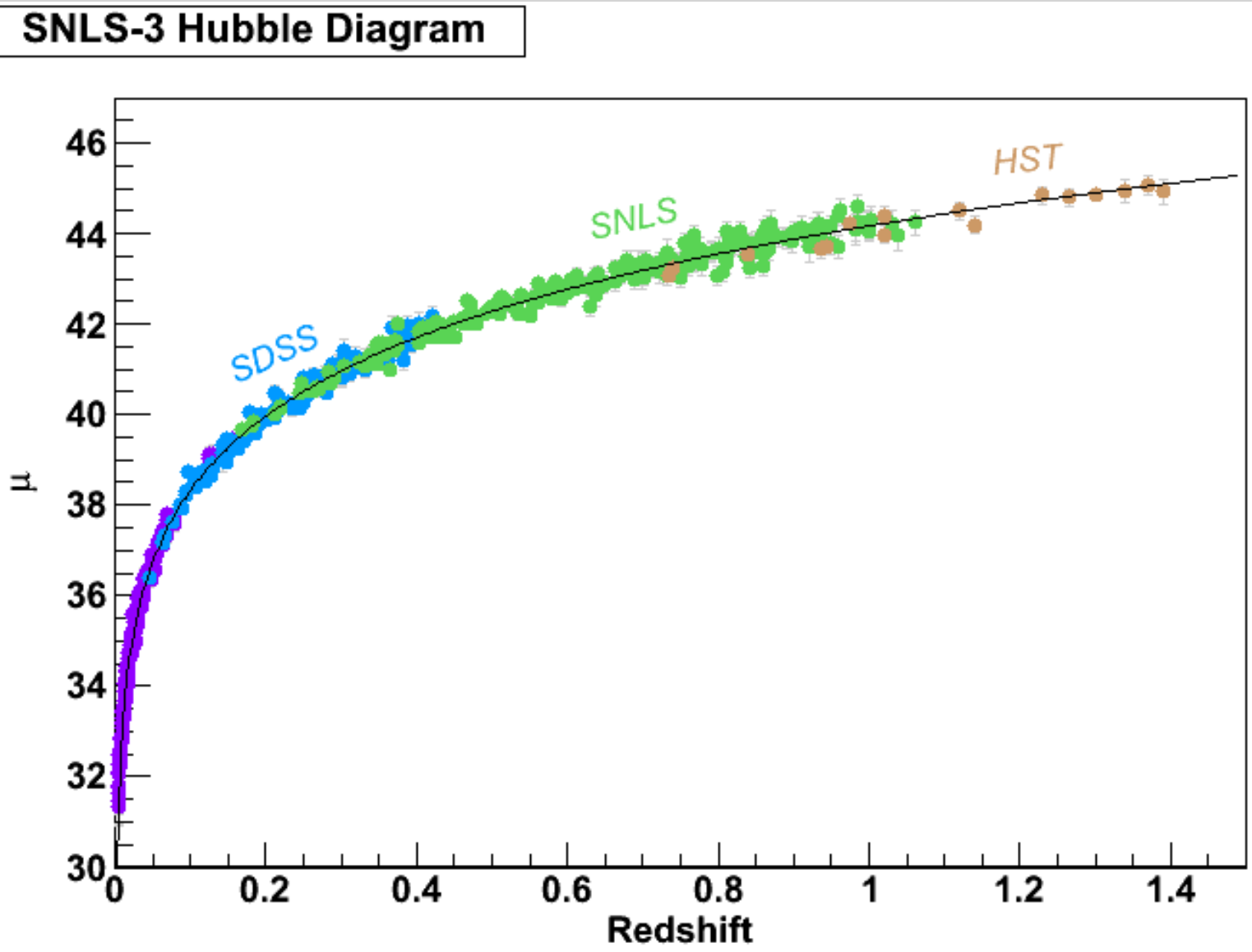
4th Planck Press Release (05/07/2010)



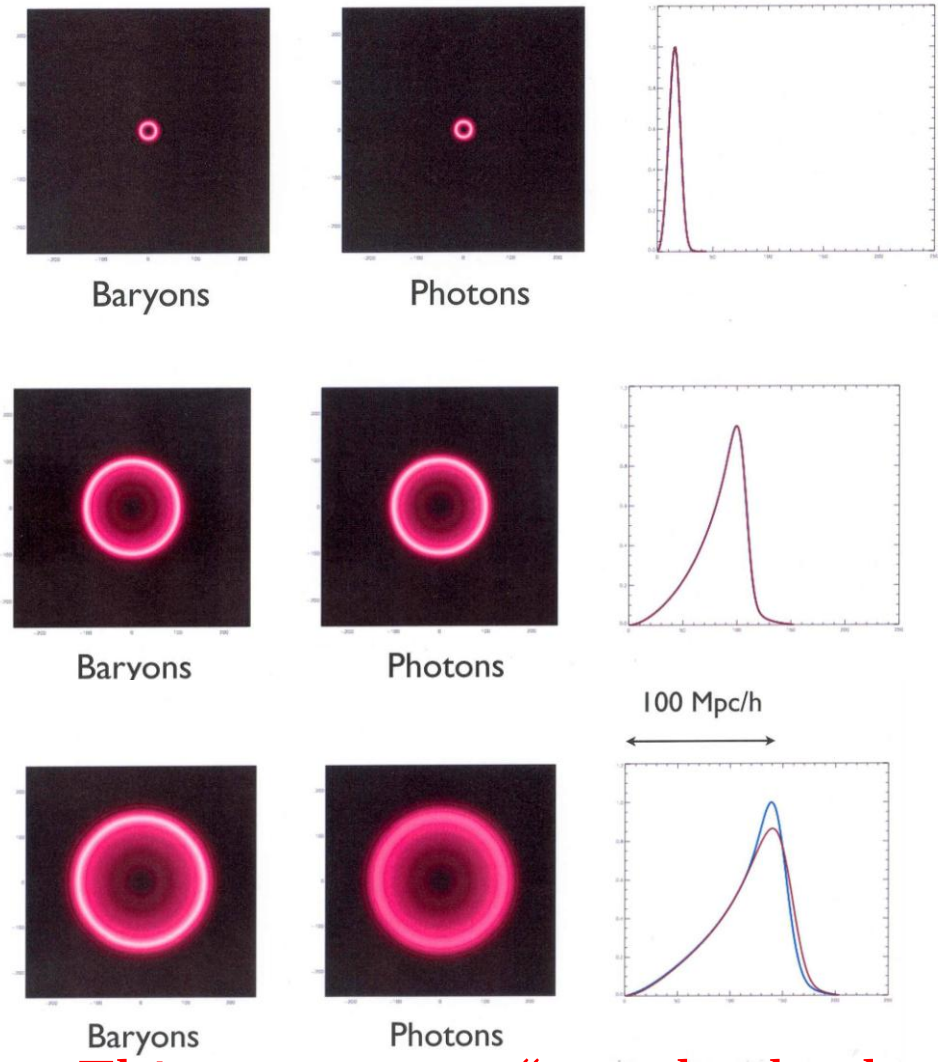
PLANCK final goal



Supernovae standard candles Hubble diagram



BAO: Acoustic wave in the early universe



Soon after end of inflation small density fluctuations start pressure waves

Spherical waves propagate with known velocity $v=c/\sqrt{3}$

Time of decoupling of photons from Matter known from CMB measurements

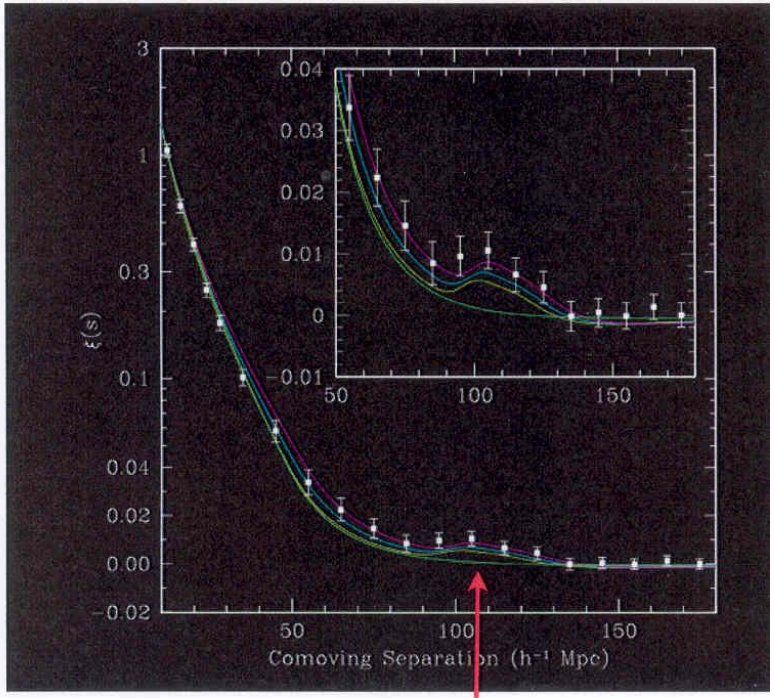
$z = 1089 \pm 1$, $t = 379{,}000 \pm 8{,}000$ years

At decoupling wave stops growing at a radius of

$r_s = 147 \pm 2$ Mpc

This serves as a "standard ruler" imprinted on the Universe

Eisenstein et al. 2005
SDSS spectro-z
40,000 red galaxies
$0.15 < z < 0.40$



ruler length

Dark Energy

The importance of Dark Energy

What do we want to learn about Dark Energy ?

*Is the value of DE random or theory determined (connected to the issue of fine tuning or more generally the anthropic principle which we find also for supersymmetry and the hierarchy scale)?

*Is DE a cosmological constant (vacuum curvature or/and energy?

*Is the DE density constant in time—what is $\mathbf{w_0}$

*Is the DE changing in time—what is $\mathbf{w_a}$

*Is Einsteins General Relativity correct

Parametrize the equation of state of Dark Energy as

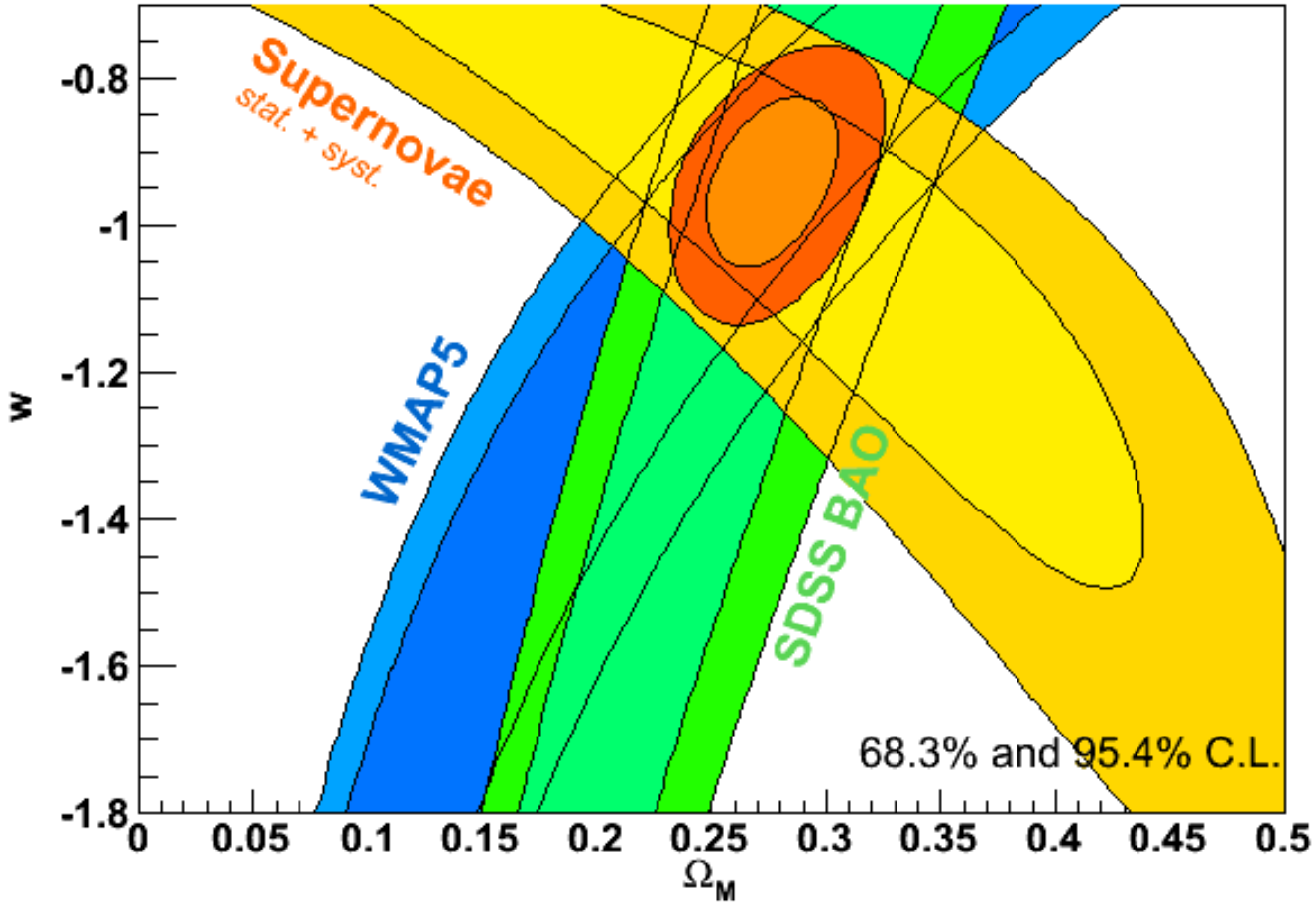
$p / \rho = w$ $\quad w < -\frac{1}{3}$ for an accelerating univ

$w = w_0 + w_a(1 - a)$ where a is the scale factor

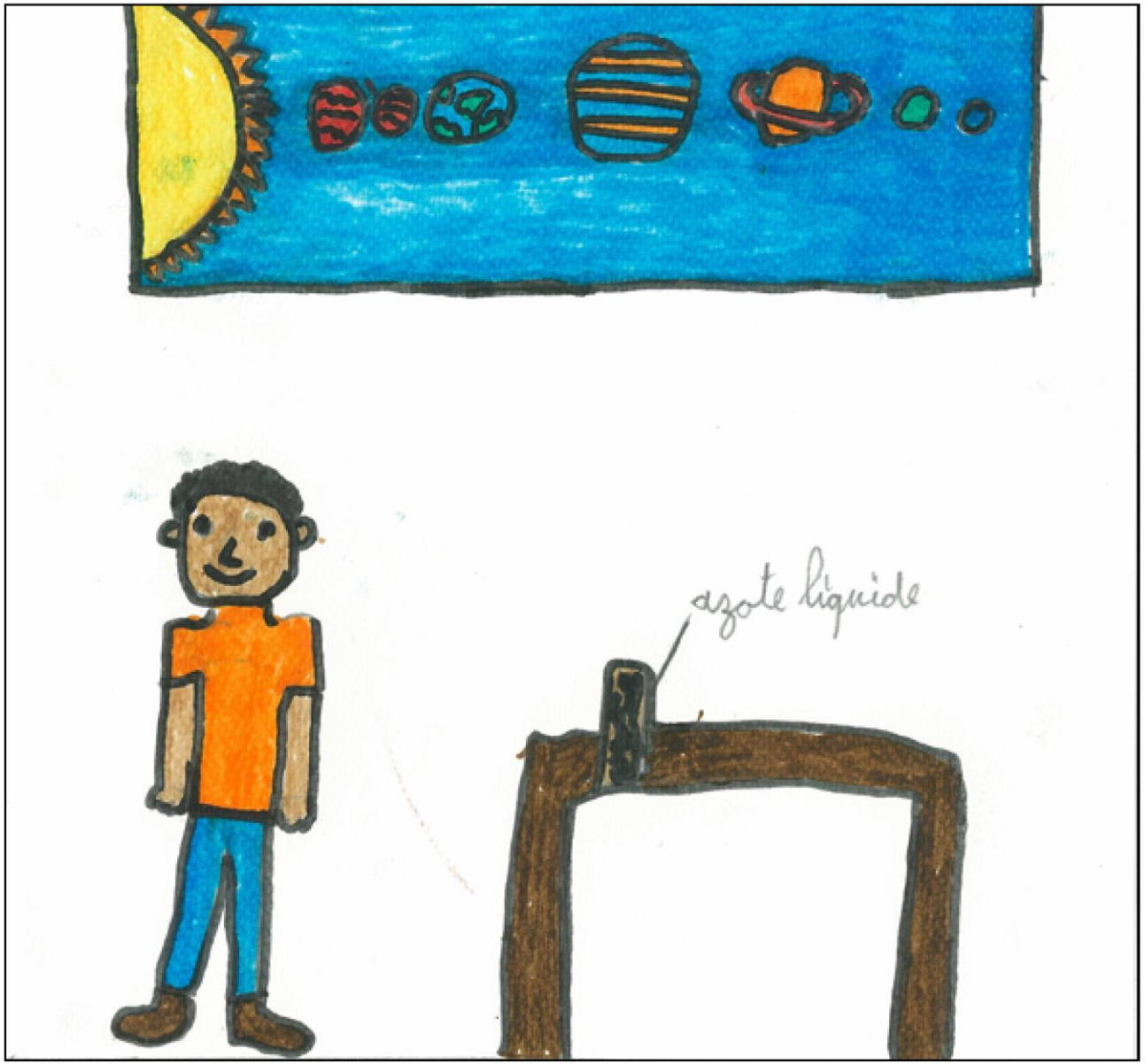
Recall that for the cosmological constant

$w_0 = -1, \quad w_a = 0$

Constraints on w_x



Future is : LSST (ground) and Euclid/Jdem (space)

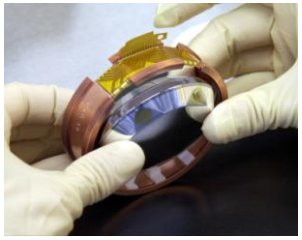


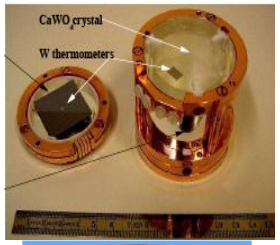
Le physicien est une personne qui étudie l'espace. Amandio

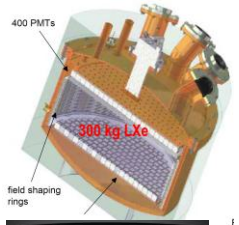
Un physicien recherche plein de choses comme si l'espace a une limite et fait plein de maths pour être intelligent.

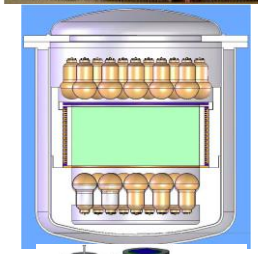
Ysaline

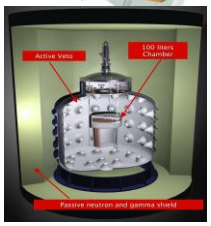
Dark Matter Searches

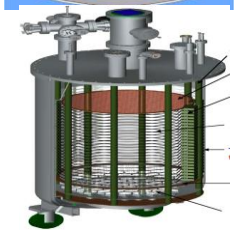




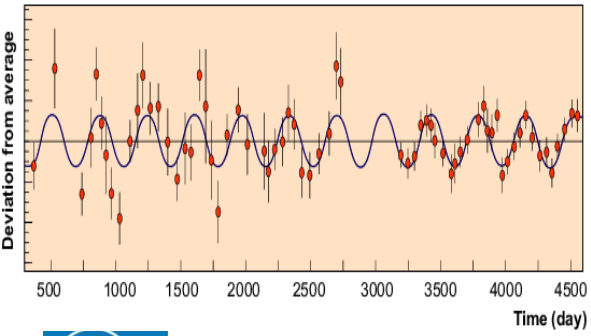








DAMA annual modulation



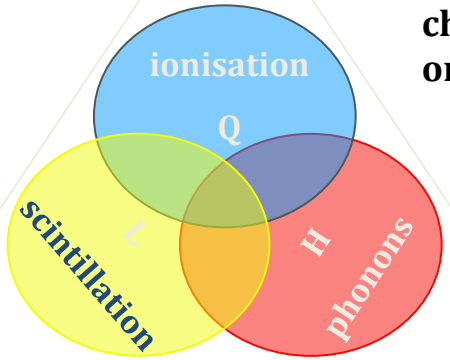
WIMP elastic nuclear recoils deposit < 50keV of energy at a rate 10^{-5} to 1 event/day/kg

PICASSO/SIMPLE
CUPP
DRIFT I, II
GENIUS,

ArDM, WARP,
XENON, ZEPLIN, LUX,

phonons, photons and charge whose relative proportions and /or characteristics depend on dE/dx ⇒ particle type

EDELWEISS, CDMS



DAMA/LIBRA, ANAIS,
ZEPLIN I

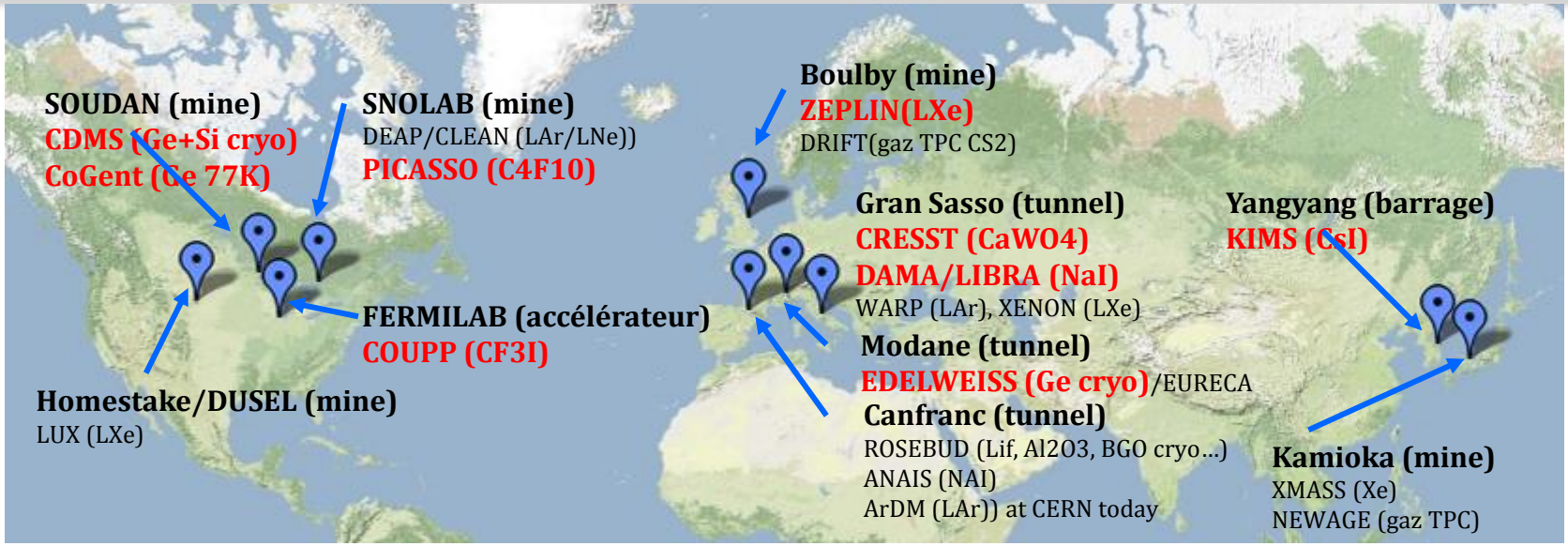
High efficiency particle identification requires compound information and/or large self-shielding mass

CRESST
ROSEBUD,

Originally by T. Sumner

Towards 2 large European consortia + R&D (directive detection)
EDELWEISS, CRESST =>EURECA
Noble liquids => DARWIN

Direct WIMPs search: what's new ?



- **Main new results since 2008:**

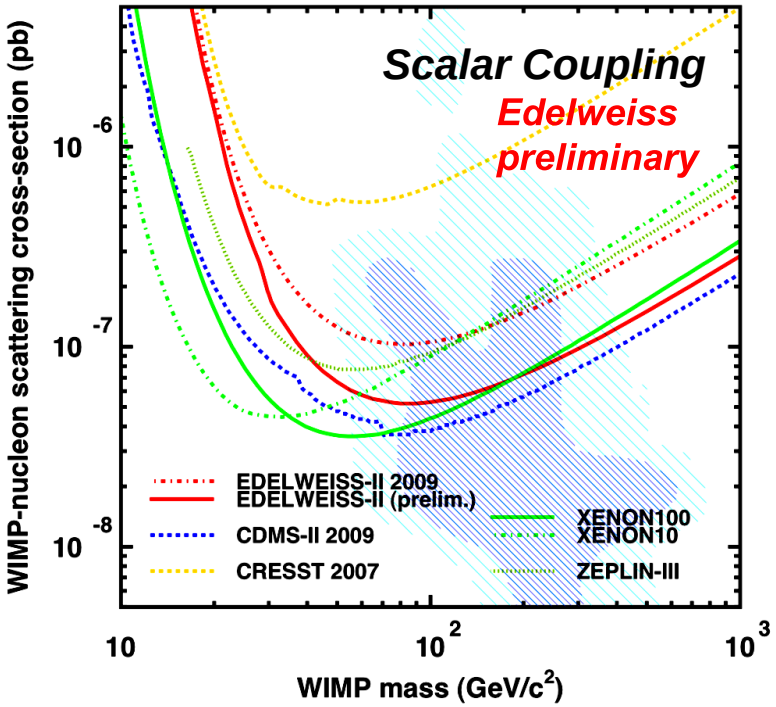
– ***DAMA***	***April 08***	**Solid Scintillator**
– **ZEPLIN III**	**Dec 08**	**Liquified noble gaz**
– **CDMS**	**March 08/ Dec 09**	**Cryogenic (Heat-ionization)**
– **EDELWEISS**	**Dec 09/ July10**	**Cryogenic (Heat-ionization)**
– **PICASSO**	**July 09**	**Metastable droplet**
– **COUPP**	**Fev 08/Fev 10**	**Metastable bubble chamber**
– **CoGeNT**	**June 08/Fev10**	**Ge 77K, low threshold**
– **XENON100**	**March 10**	**Liquified noble gaz**

Leading Direct WIMP searches

CMSSM-motivated search:
Scalar Coupling, Mass>>10 GeV

- **CDMS-II (best sensitivities > 70 GeV)**
- **XENON-100 (x2 wrt XENON-10 so far, best <70 GeV)**
- **EDELWEISS II (x30 with new ID detectors)**

→ Similar sensitivities & still improving
→ SUSY explored down to ~5×10^{-8}pb

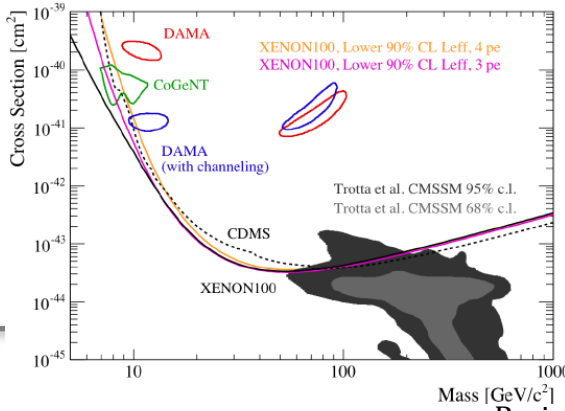


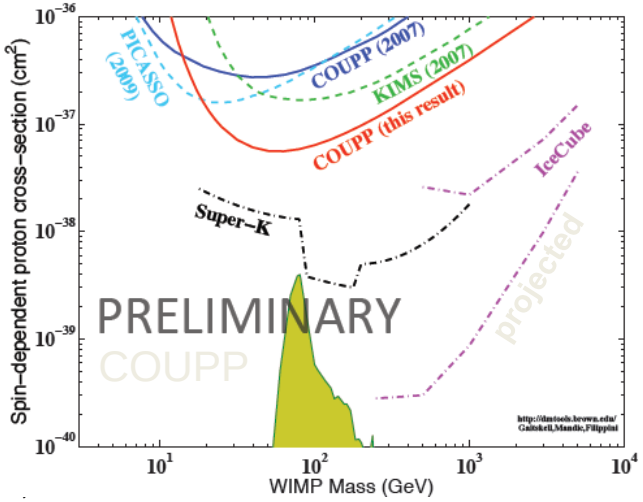
Alternate models:

Axial coupling on neutron **(Xenon-10/-100)** or proton **(COUPP, x6)**
→ Searches still far from SUSY models, indirect detection more competitive in proton case

Masses <10 GeV (**CoGeNT, DAMA, CRESST)**
→ (Contradictory) hints, to be investigated

Scalar Coupling, Low mass



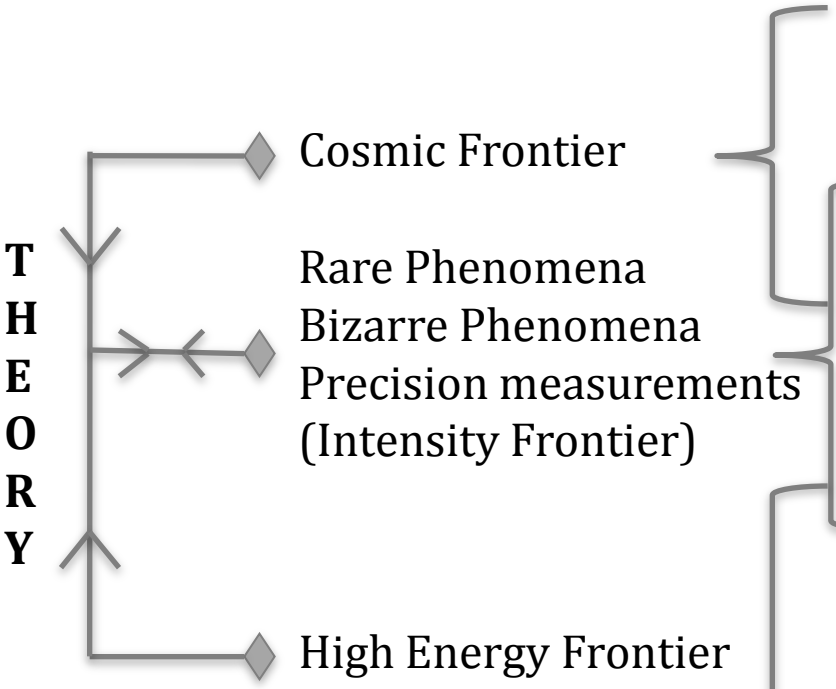


Axial Coupling

Un physicien travaille sur la cryogénie et l'infiniment petit... Il travaille avec beaucoup d'outils dans un grand laboratoire. La physique c'est trop cool !!!

Emma

HIGHLIGHTS, VISION: Outline



*Cosmology : what is the Universe made of ?

*High Energy Cosmic Rays, new messengers : high energy phenomena in the Universe

*ν properties, p decay : a window towards the highest energies

* ν long Baseline

*edm, g-2, **p size**, μ ->eγ **(PSI)**

***B**, K, c, t decays, CKM, **CP violation**

*W, Z, t production, mass…

*Point like structure

*q, g plasma

*New Physics **(Moment of truth: Tevatron, LHC ?)**

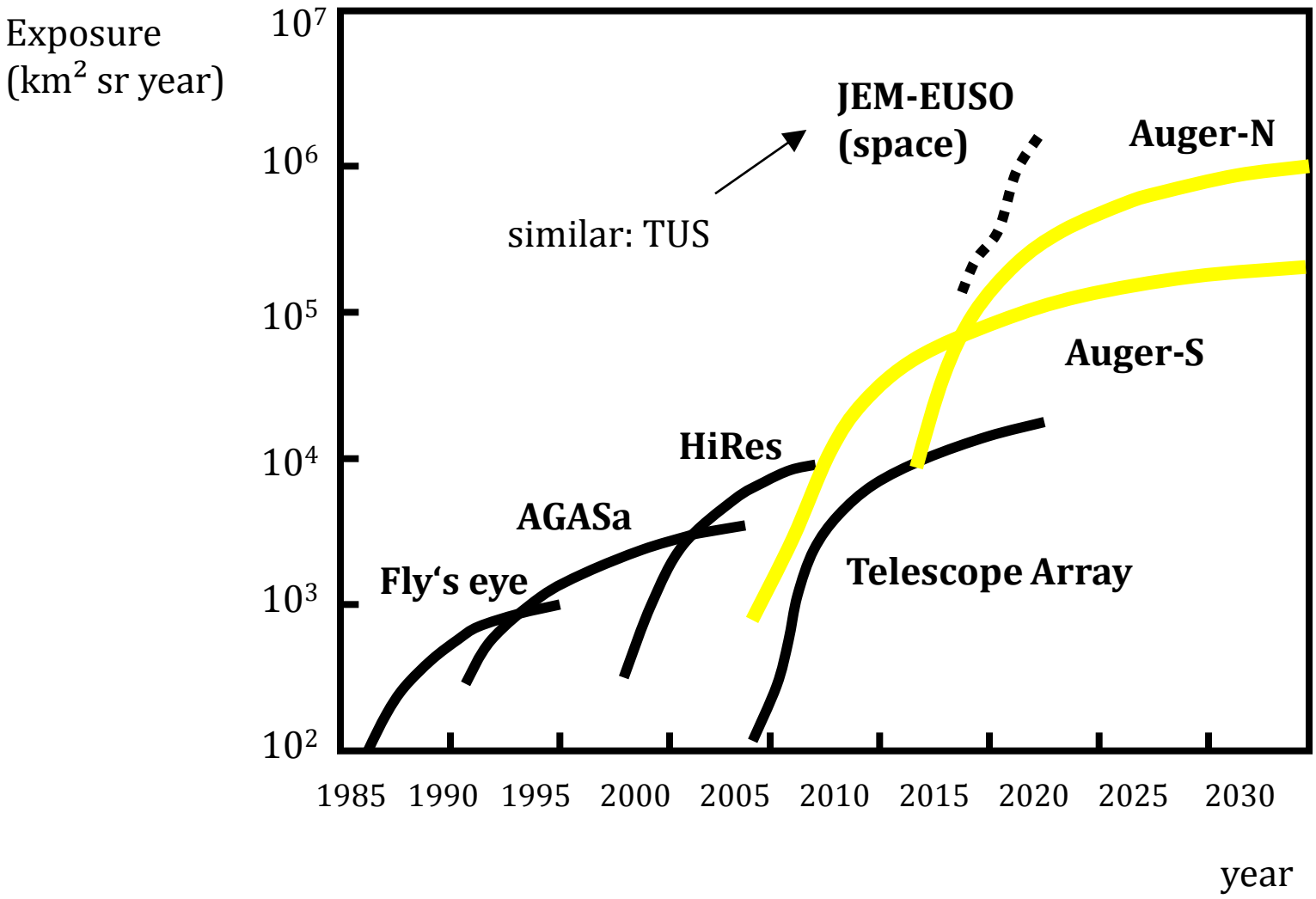
- Higgs or no Higgs

-Susy, Z', …

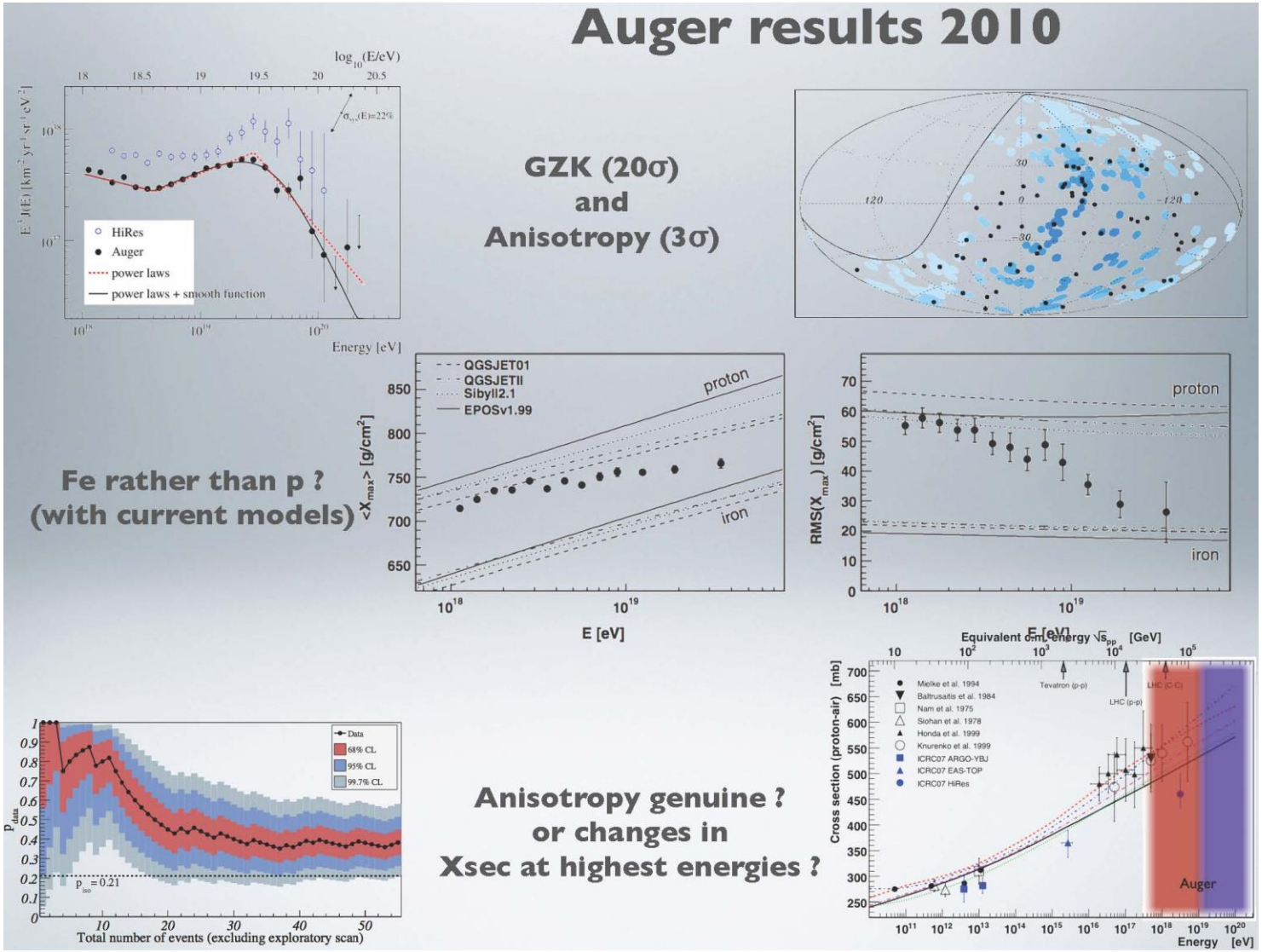
-Extra dimensions

- Mini black holes…

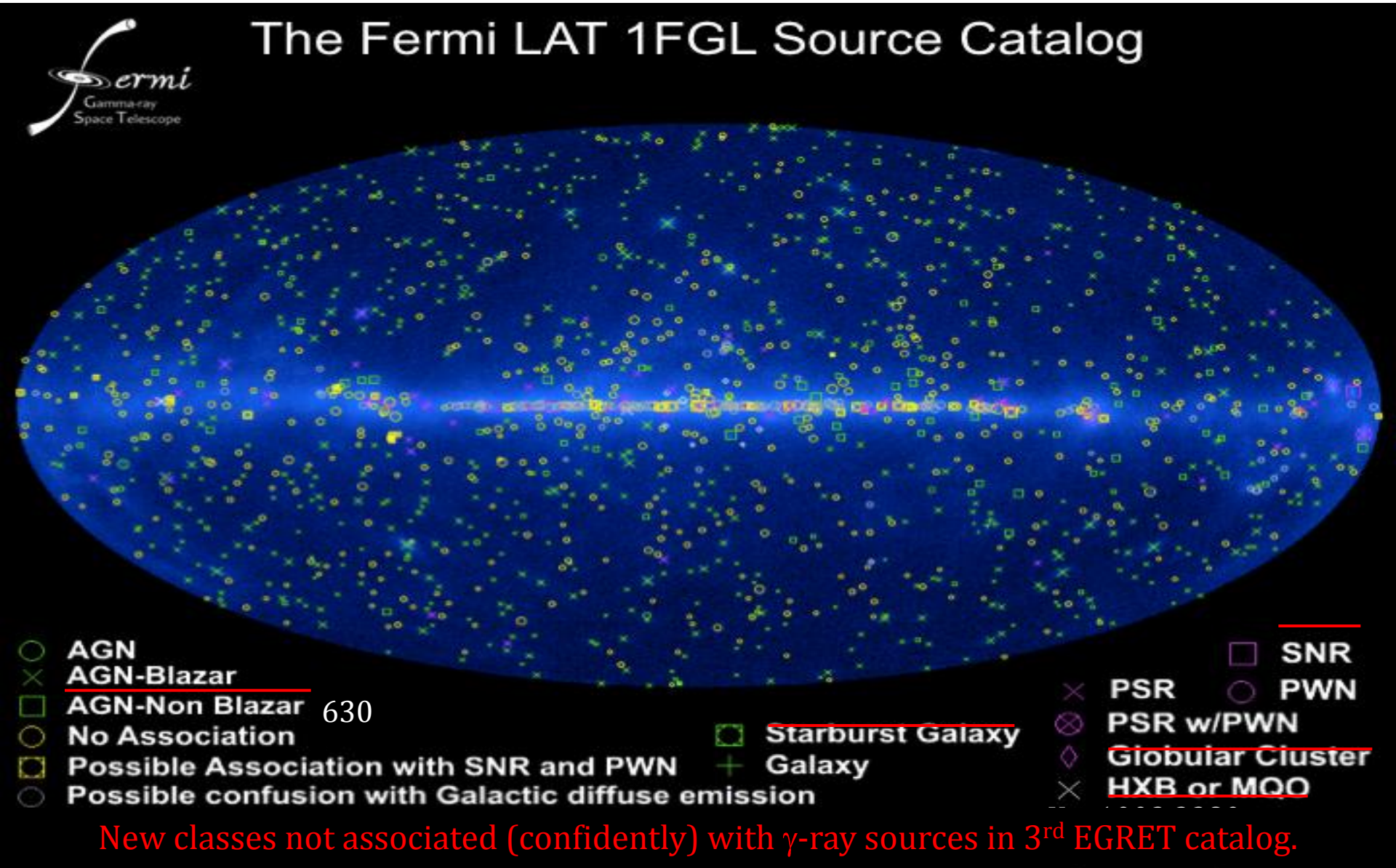
Cosmic Rays: The highest energies



High Energy Cosmic Rays



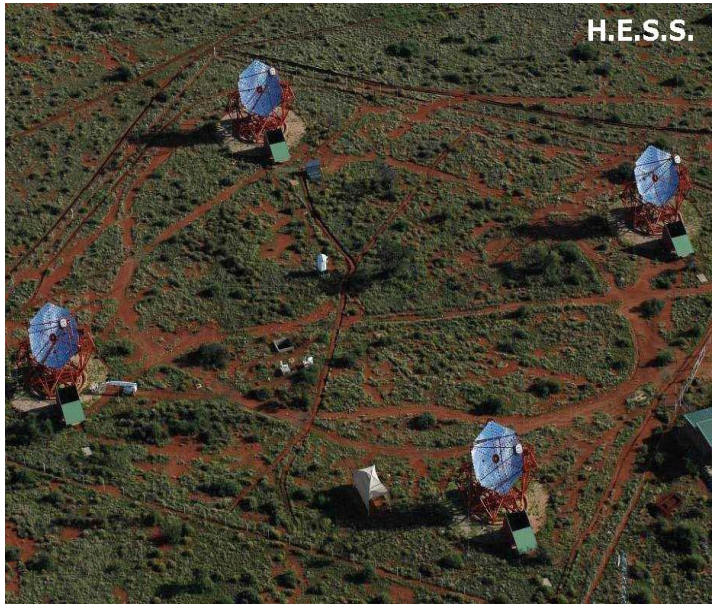
High Energy gamma rays: FERMI GAMMA RAY SPACE OBSERVATORY



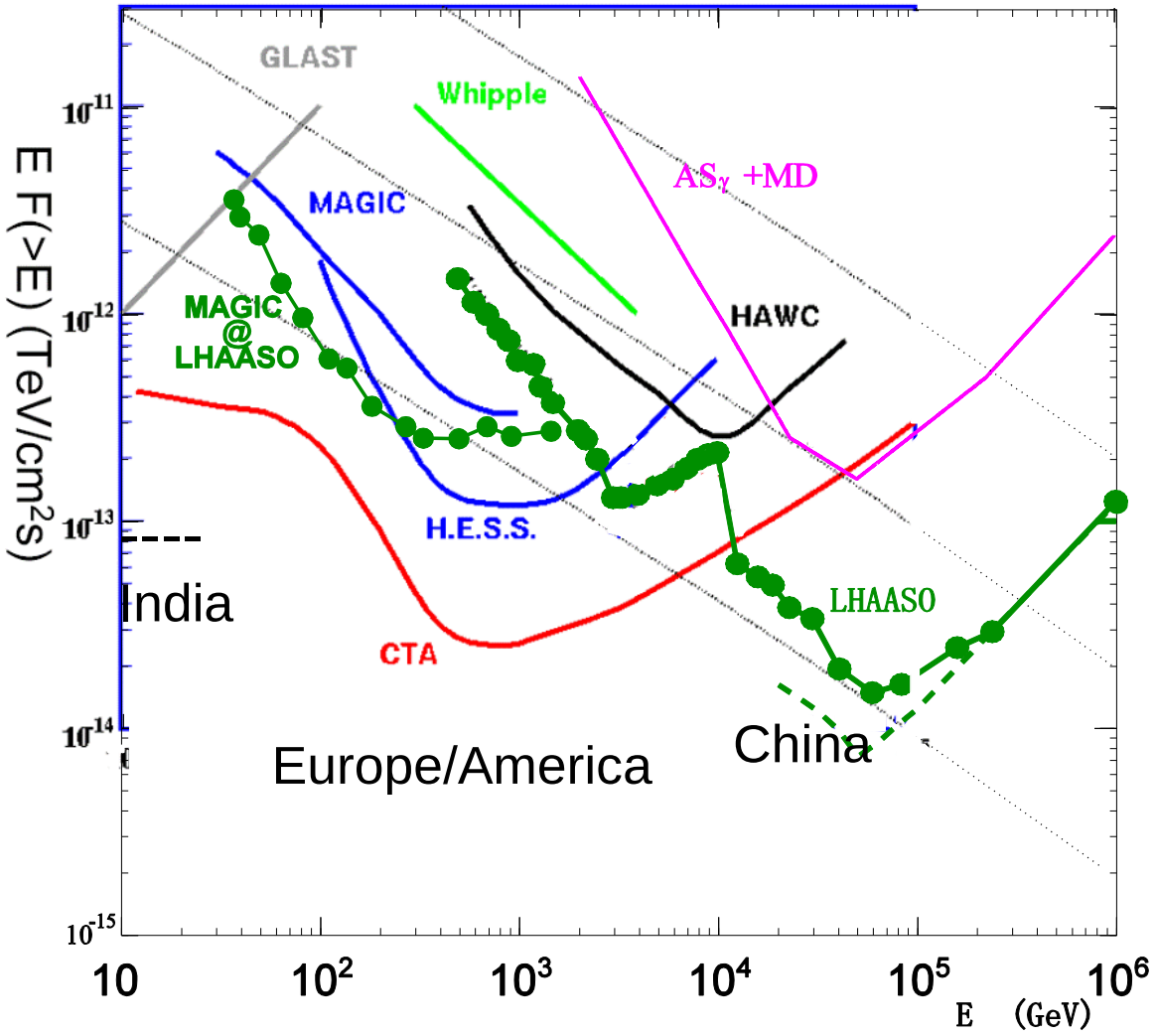
New classes not associated (confidently) with γ-ray sources in 3rd EGRET catalog.

Complemented by Ground Cerenkov Telescope Arrays

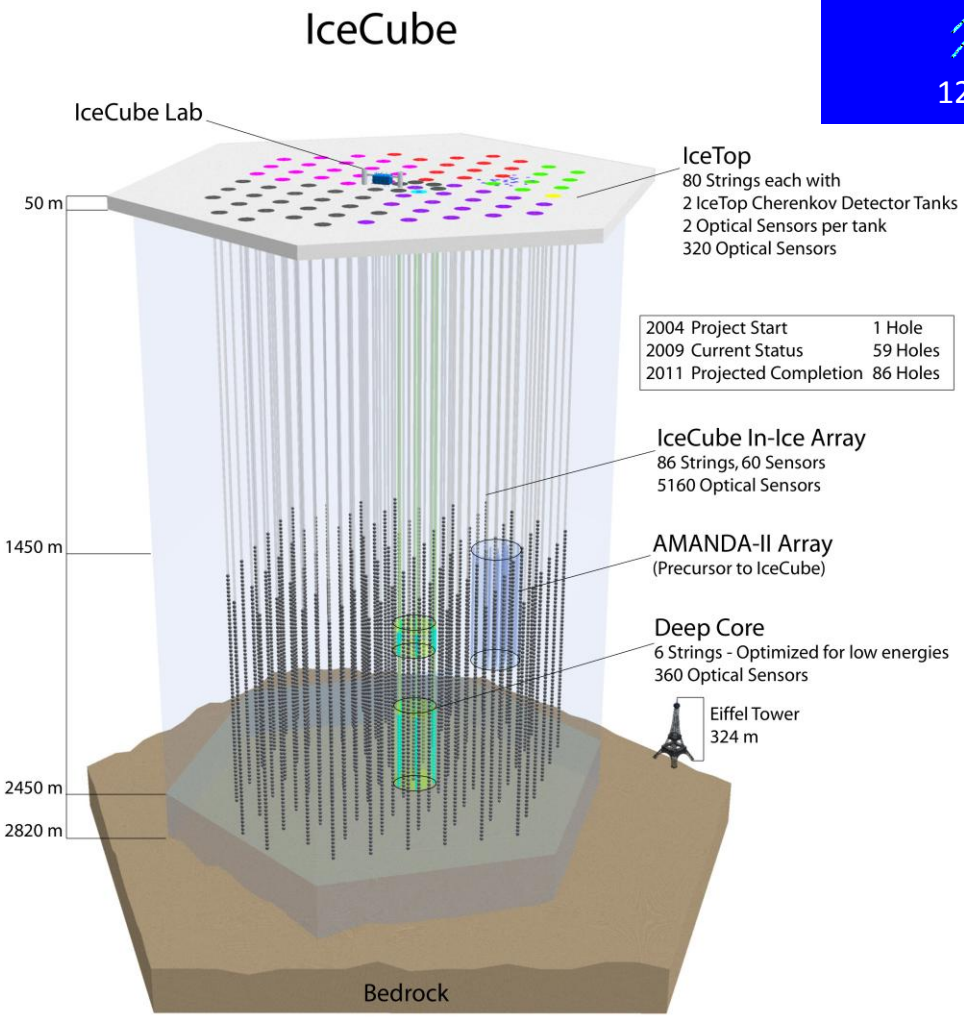
- Look for higher energies on identified sources
- Cut-off energy due to interstellar-galactic UV light
- Origin of high energy gamma rays: star bursts, SNR remnants, Active Galactic Nuclei
- Inverse Compton electromagnetic process (electrons on X rays) or Hadronic (pi0)

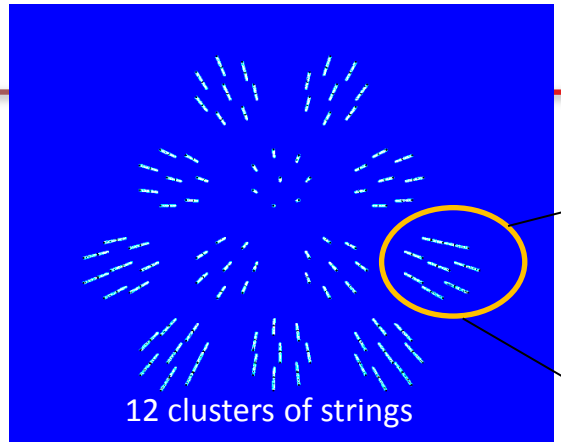


Future….

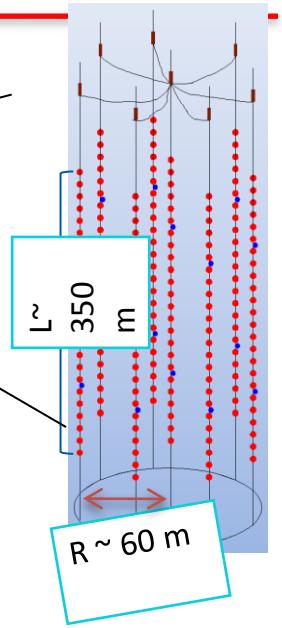

GLAST
Whipple
ASγ +MD
MAGIC
MAGIC
@
LHAASO
HAWC
H.E.S.S.
India
CTA
LHAASO
China
Europe/America
E F(>E) (TeV/cm²s)
E (GeV)
10
10²
10³
10⁴
10⁵
10⁶
10⁻¹¹
10⁻¹²
10⁻¹³
10⁻¹⁴
10⁻¹⁵

Neutrino astronomy: Search for point like sources



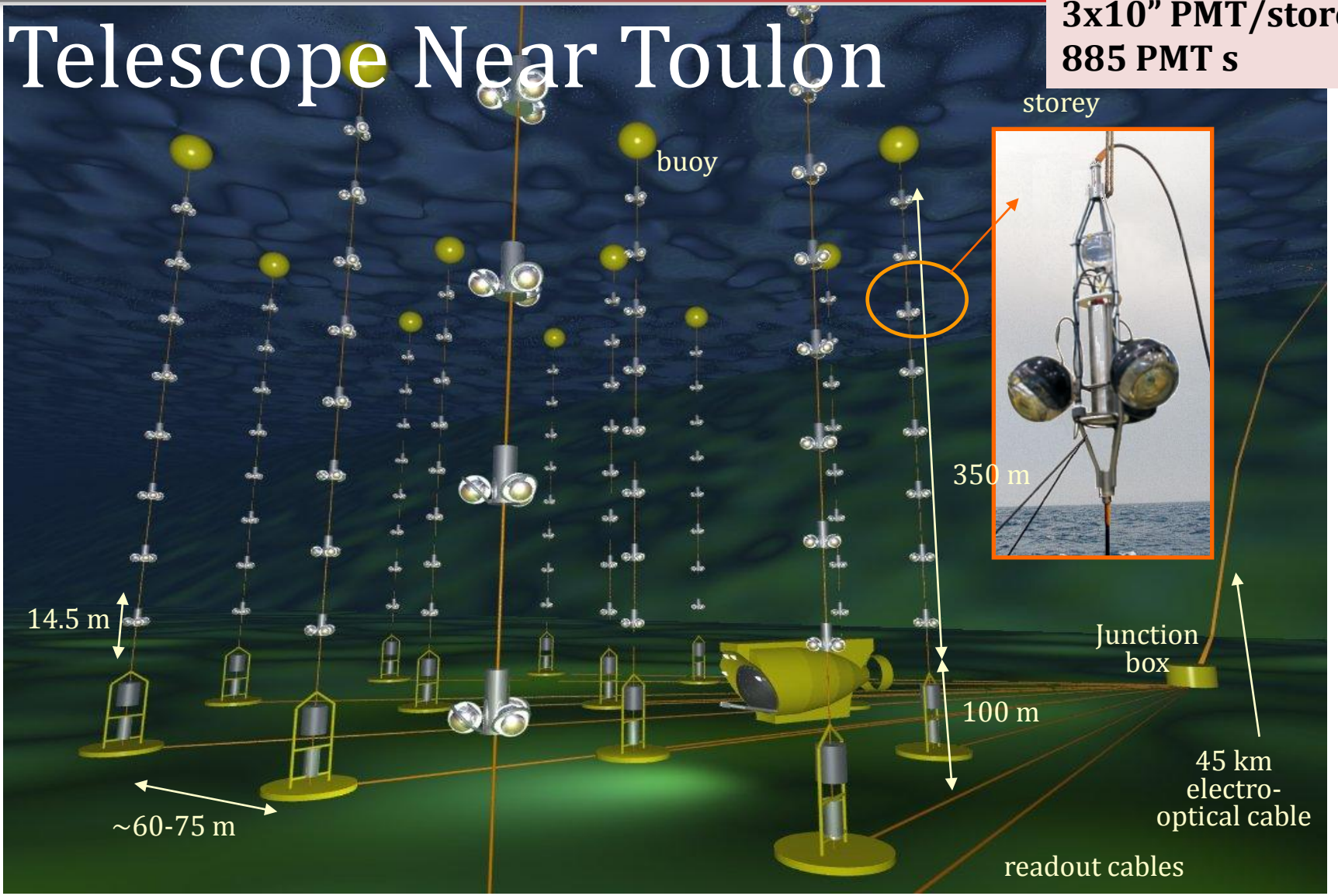


NT1000: top view

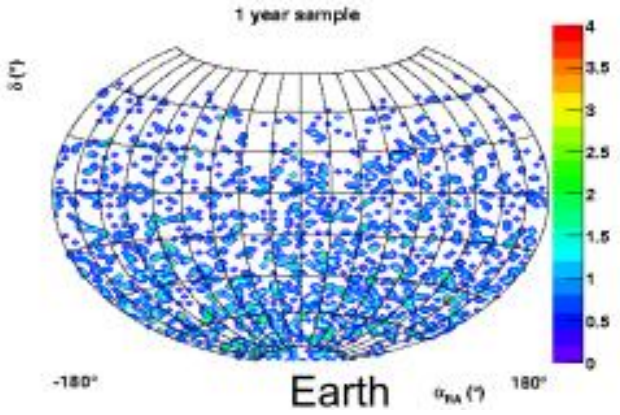


The now running Antares

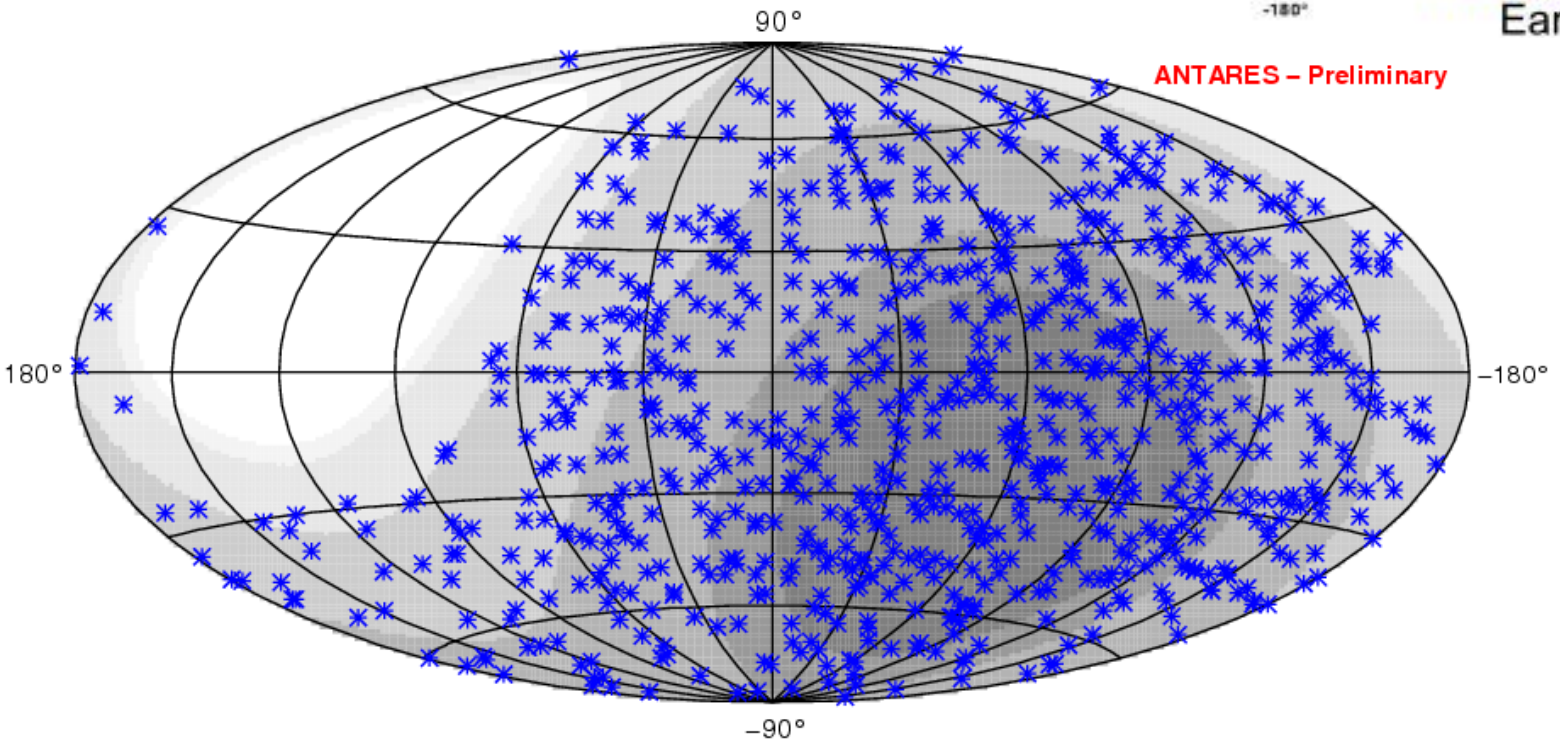
12 detection lines
25 storeys/line
3x10” PMT/storey
885 PMT s



ANTARES first sky map of 1000ν

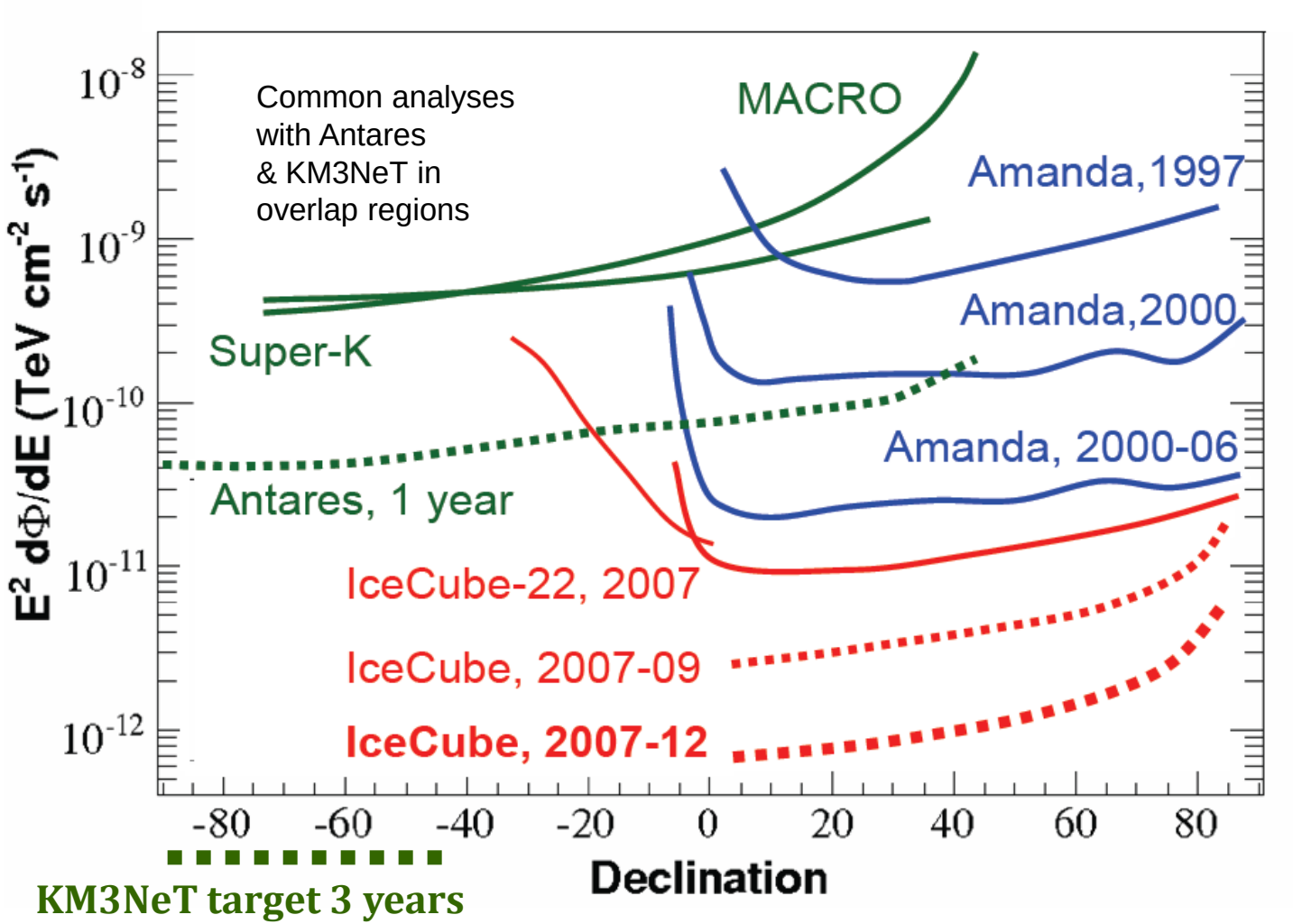


Fast tracking

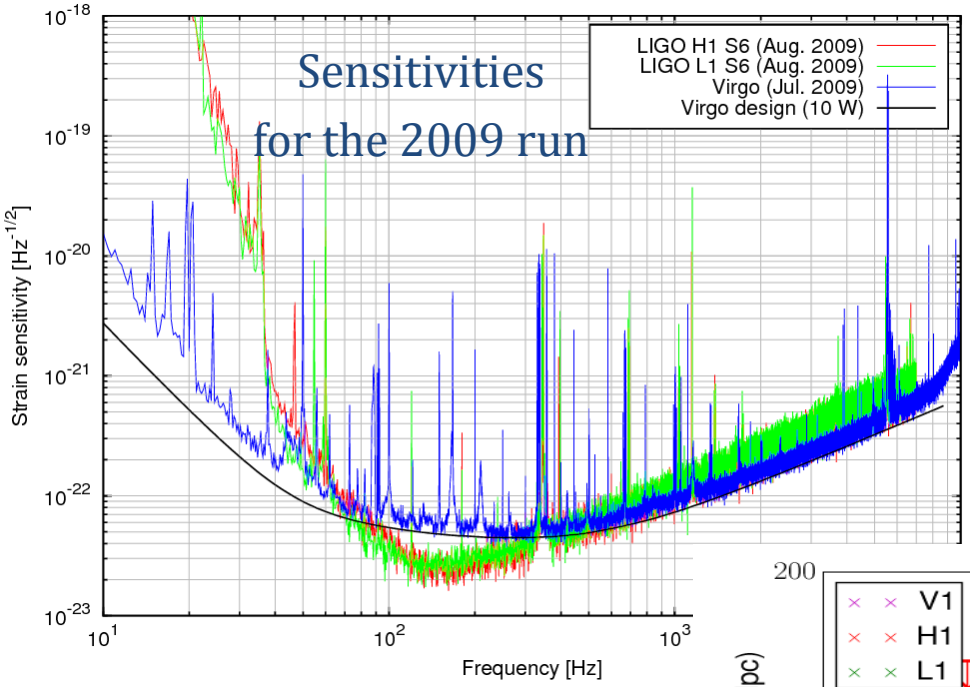


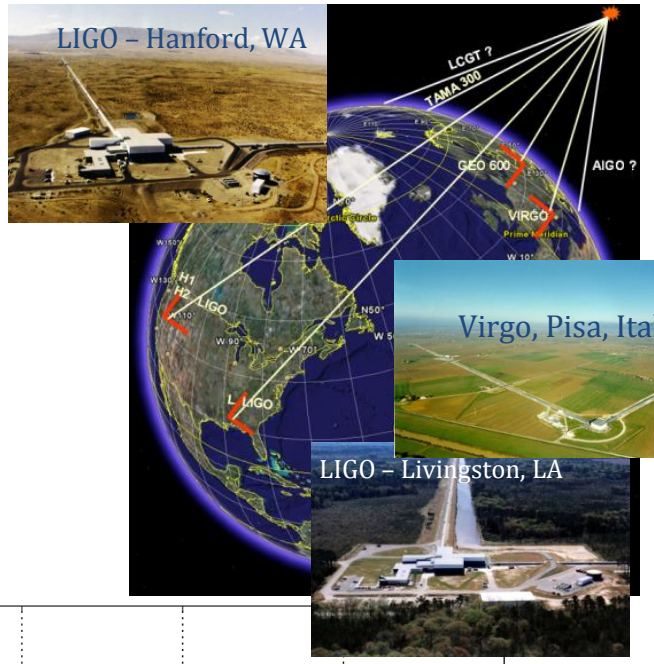
Point Sources: The Progress

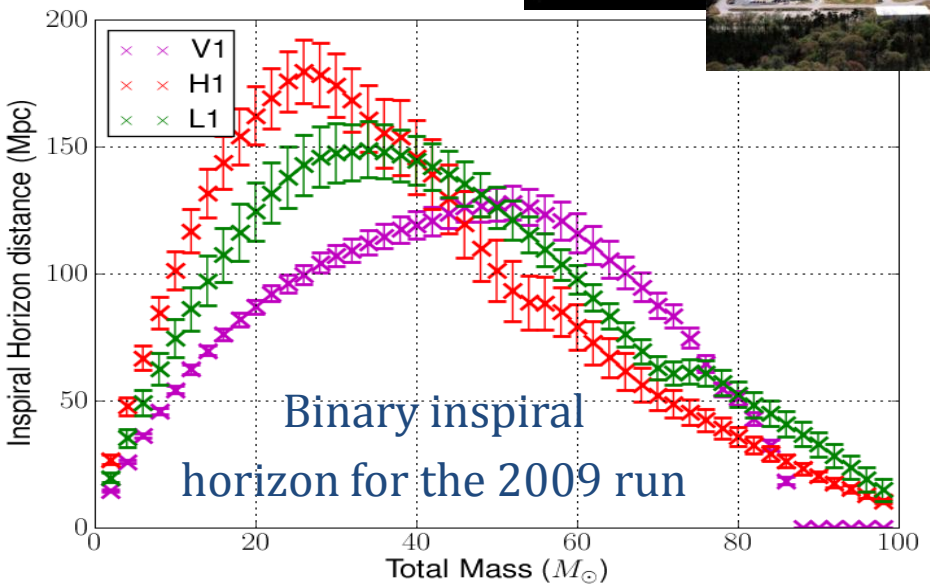
Tremendous progress in sensitivity over last decade



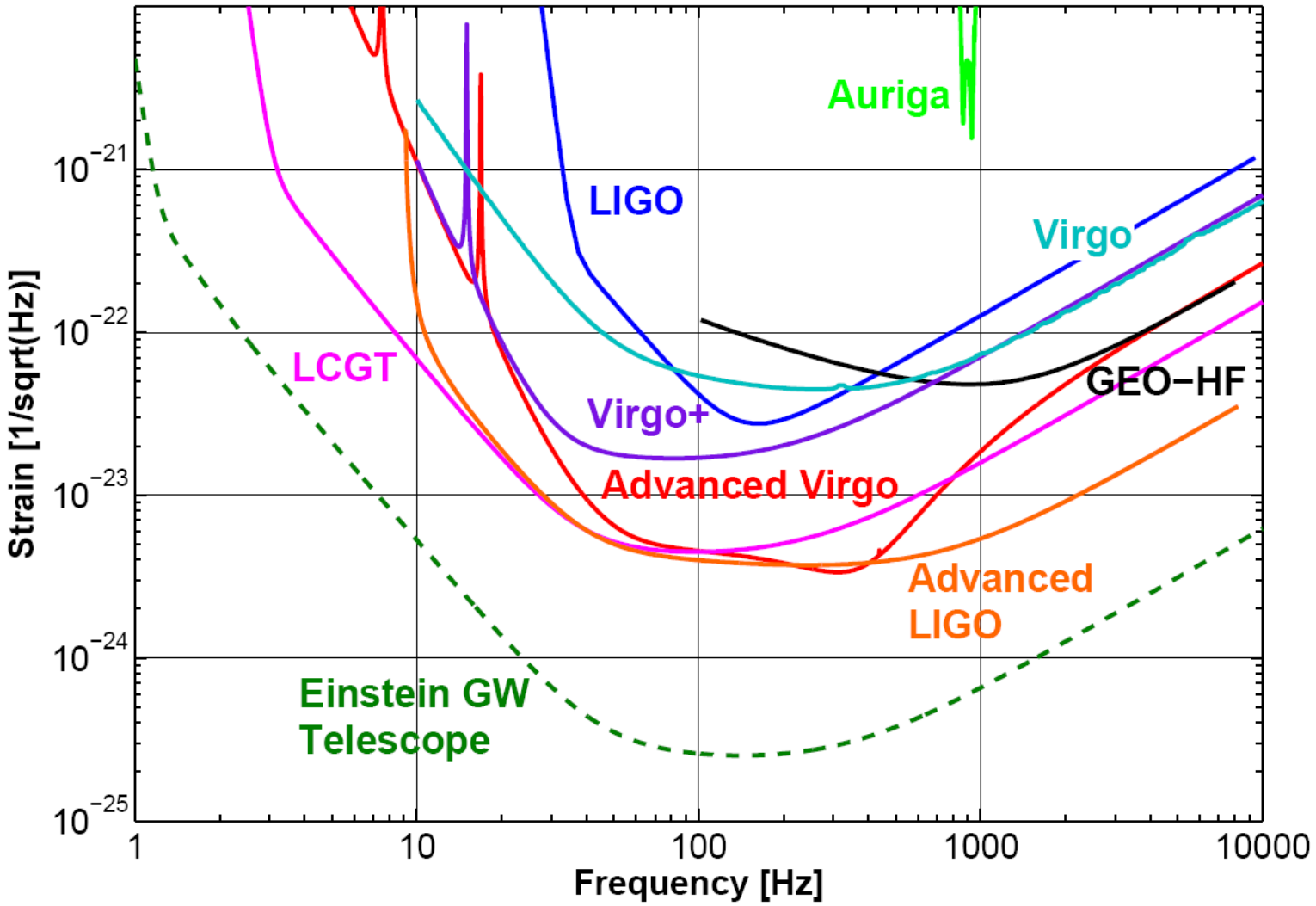
A world wide network of Gravitational Wave Detectors





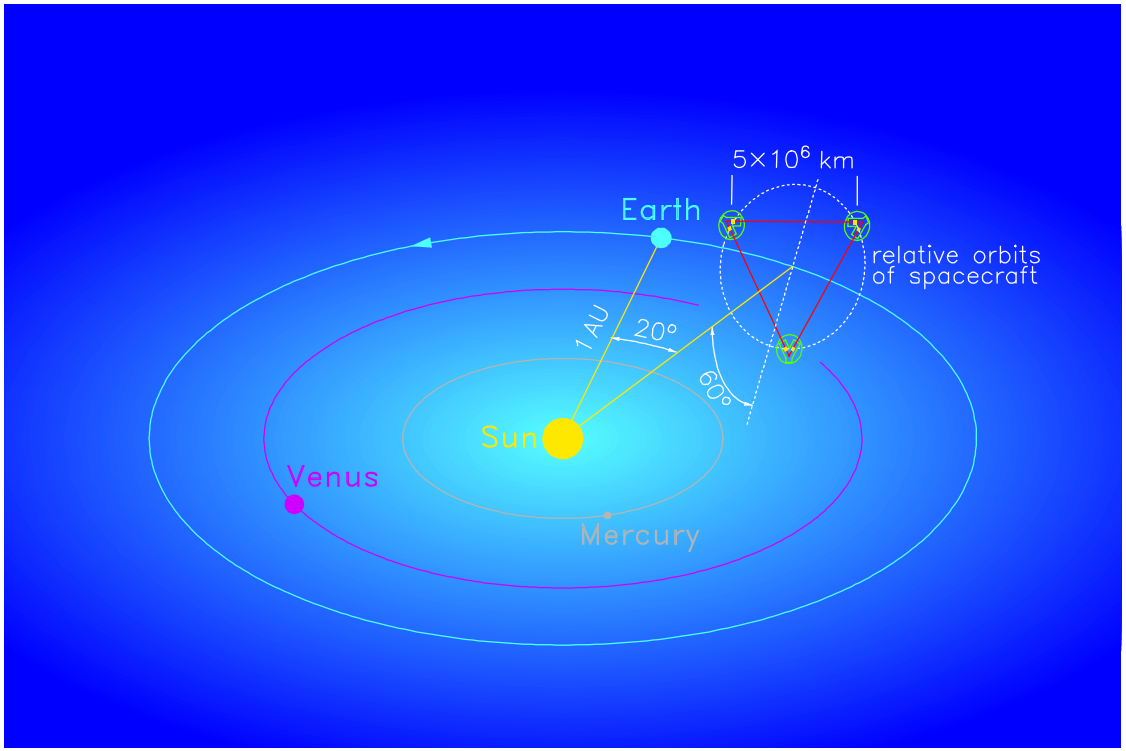


Summary of sensitivities



What Needs to be Done?

- Fly LISA to explore a wealth of black hole physics at low frequency



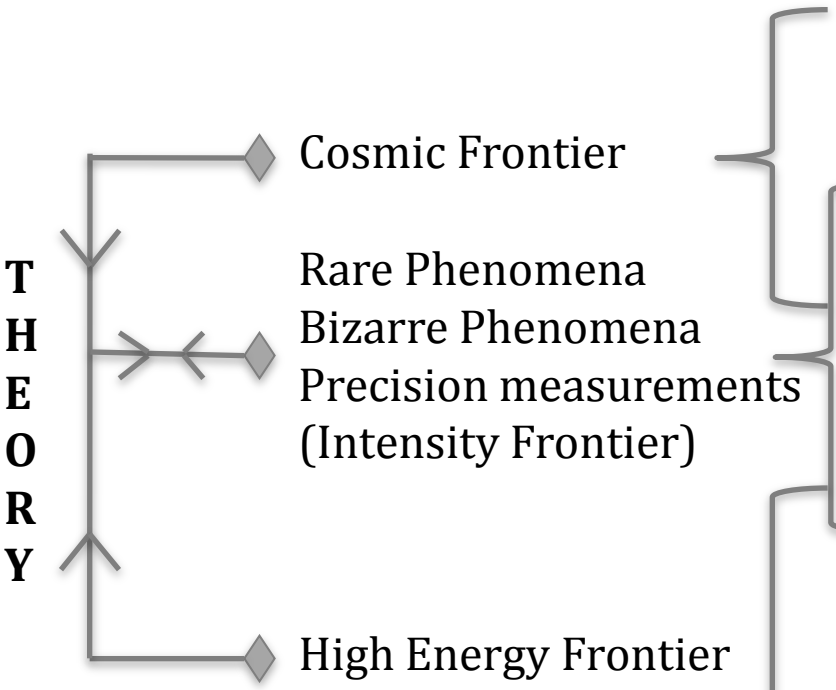
Je crois qu'un physicien est une personne qui essaie de comprendre l'Univers en faisant des expériences.

Alisson

Un physicien est un spécialiste de physique et observe les phénomènes naturels.

Emma

HIGHLIGHTS, VISION: Outline



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*ν properties, p decay : a window towards the highest energies

* ν long Baseline

*edm, g-2, **p size, μ ->eγ (PSI)**

***B**, K, c, t decays, CKM, **CP violation**

*W, Z, t production, mass…

*Point like structure

*q, g plasma

*New Physics **(Moment of truth: Tevatron, LHC ?)**

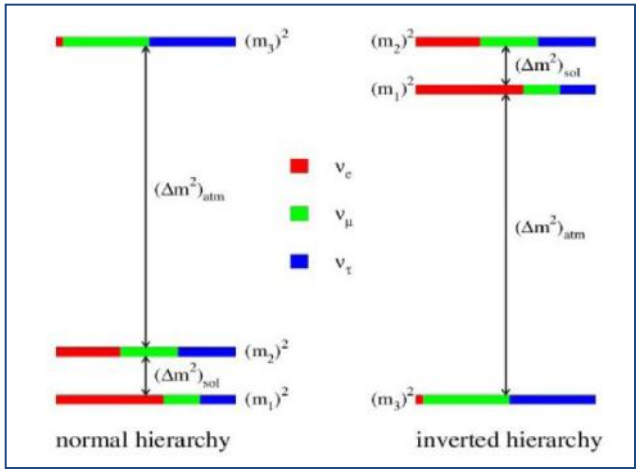
- Higgs or no Higgs

-Susy, Z', …

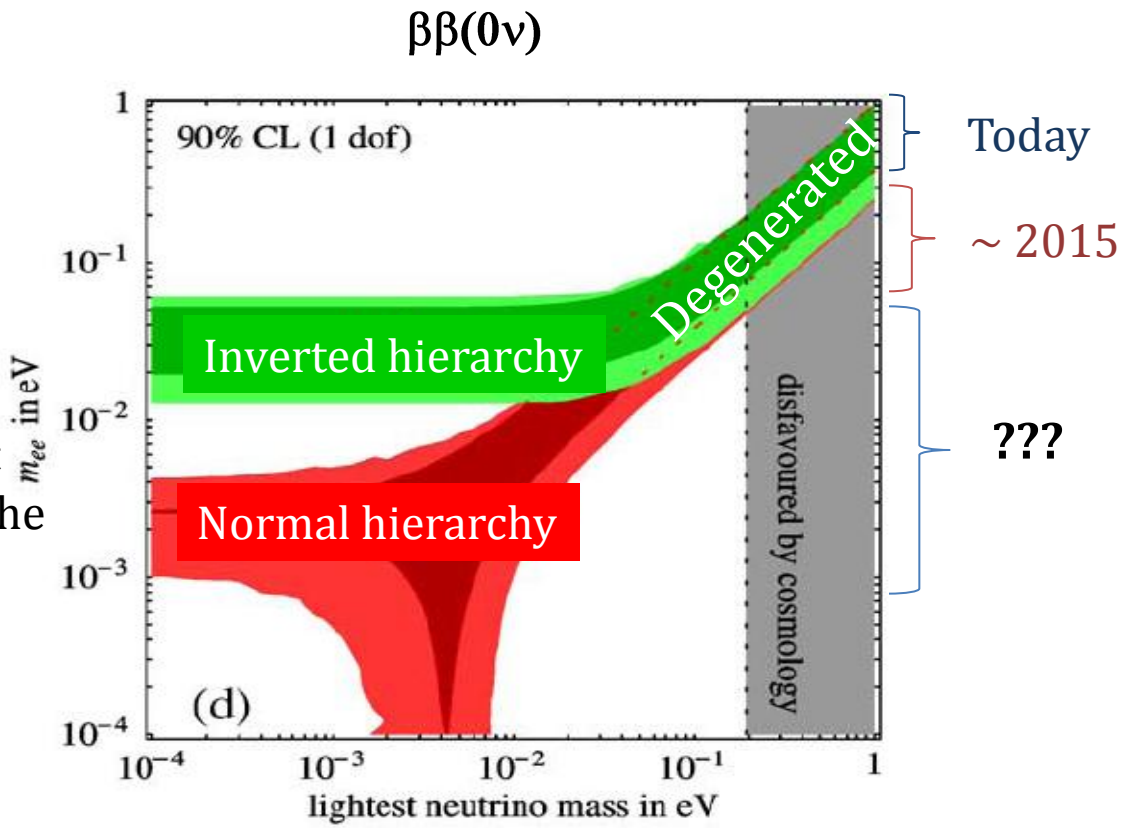
-Extra dimensions

- Mini black holes…

Neutrino mass hierarchy



Need of several 100 kg ββ(0ν) experiments with different Isotopes and techniques to reach the inverted hierarchy scenario



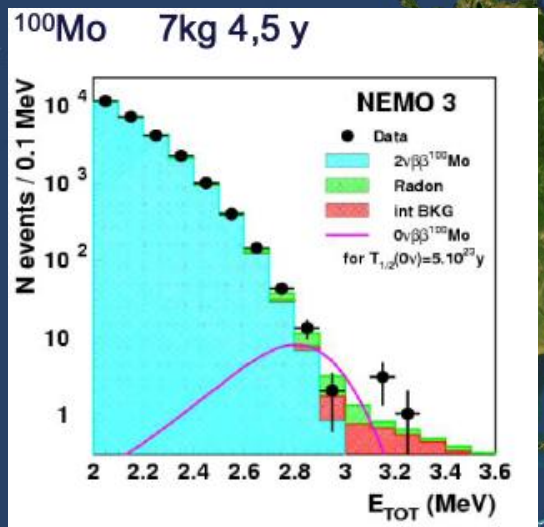
ββ(0ν) : experiments and projects

SNO++

EXO
Majorana

NEMO3/SuperNEMO
Cuoricino/CUORE
GERDA
COBRA
NEXT

CANDLES
KamLAND
DCBA
MOON

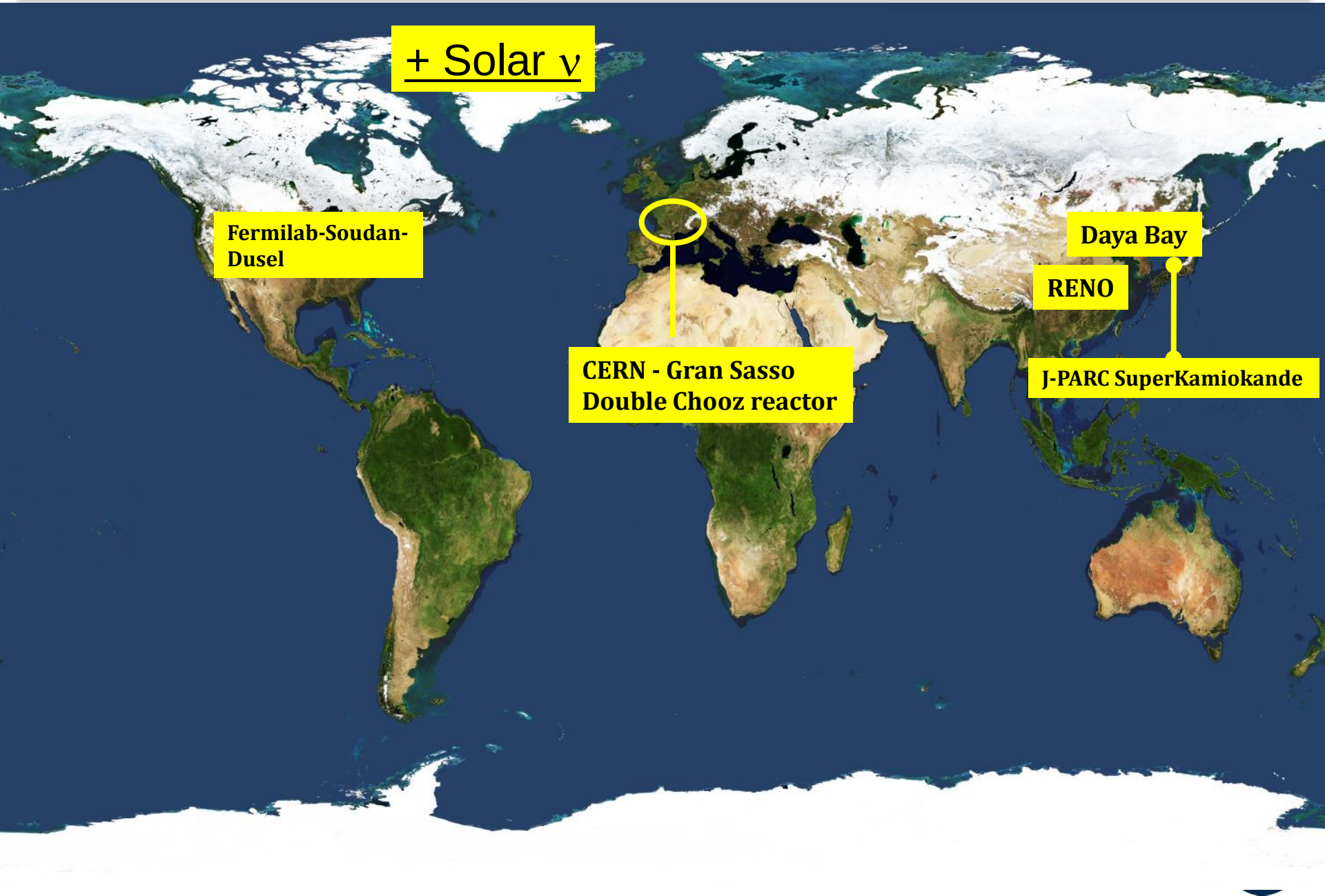


[2.8-3.2] MeV: DATA = 18; MC = 16.4±1.4

$T_{1/2}(0\nu) > 1.0\times10^{24}$ yr 90%CL

$\langle m_\nu \rangle < (0.47 - 0.96)$ eV *

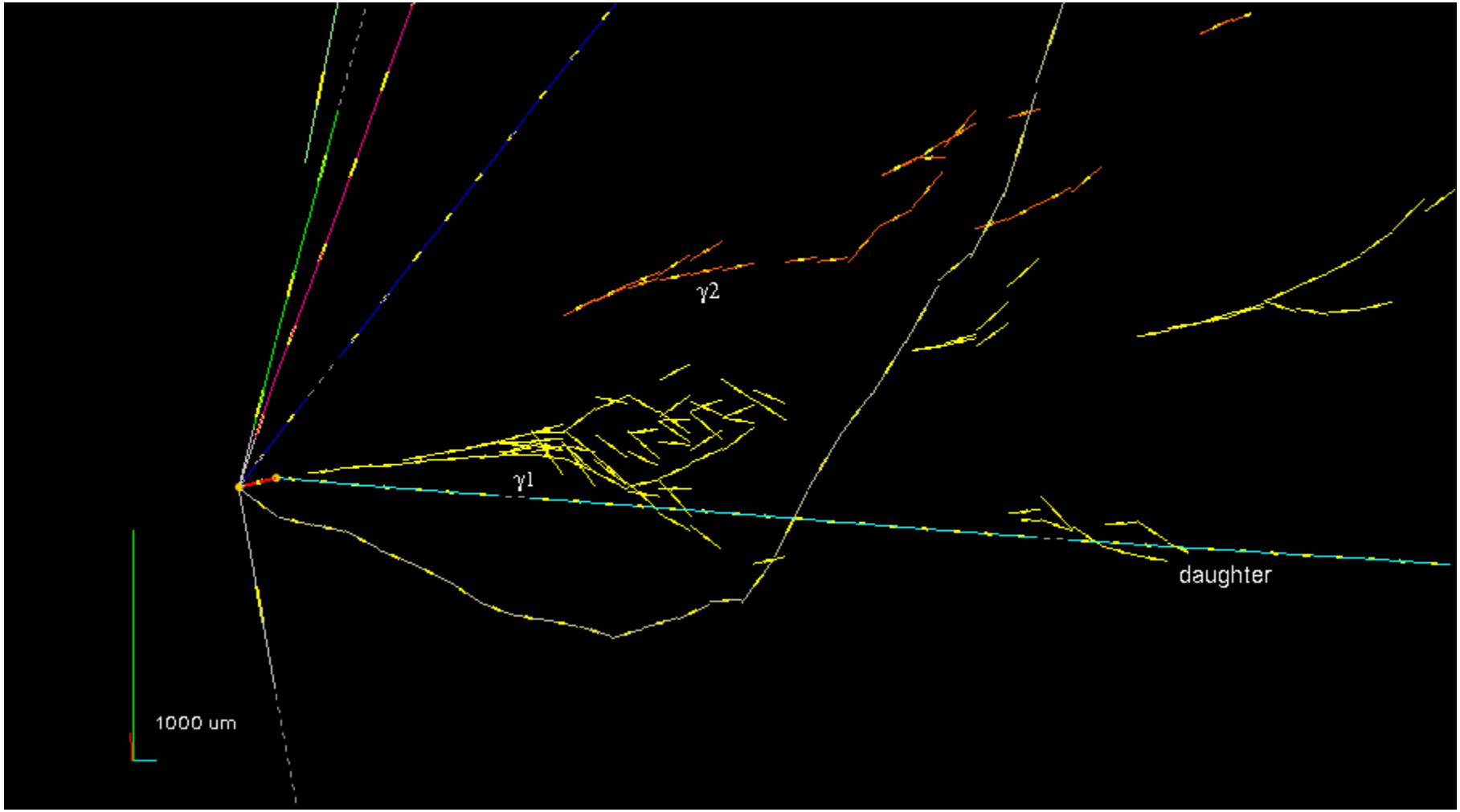
Long Baseline Reactor and Accelerator Neutrino Experiments



Neutrino Long Baseline

- First tau neutrino in OPERA Cern Gran Sasso experiment
- First ICARUS observed events from Cern Gran Sasso experiment
- First T2K observed events J-PARC to Superkamiokande
- Results from MINOS experiment NUMI beam from Fermilab to Soudan

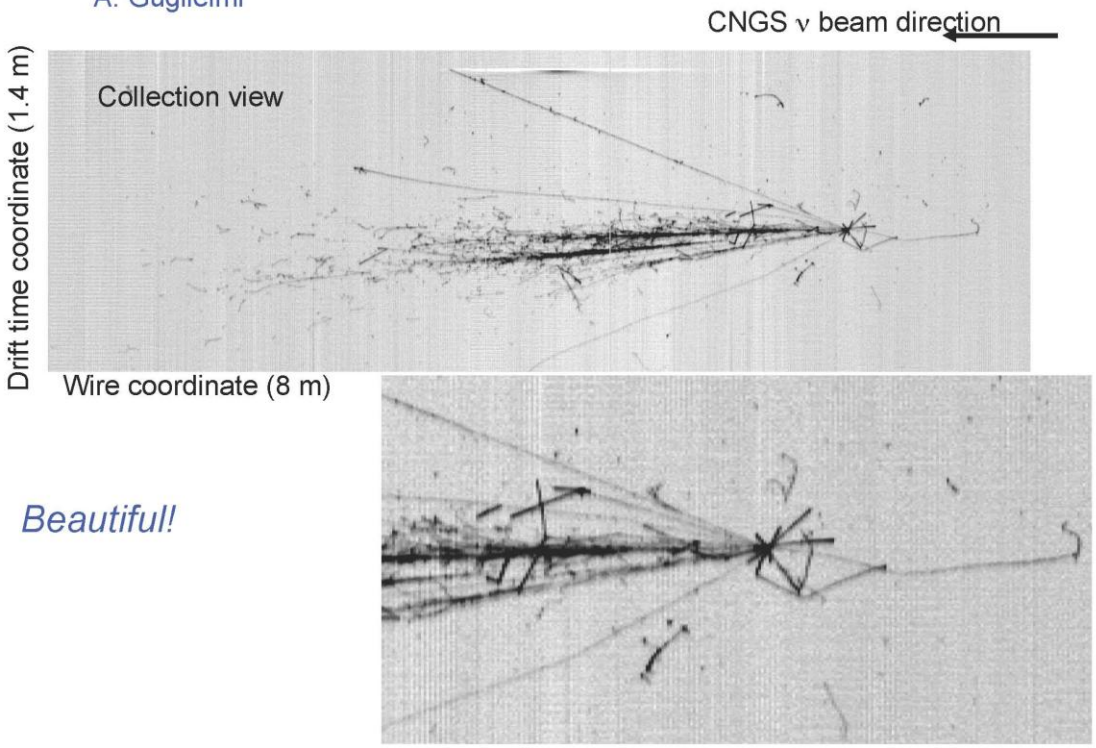
OPERA Tau Event reconstruction



T600 ICARUS could test the LSND/MiniBoone anomaly (Sterile Neutrinos ?)

The second CNGS neutrino interaction in ICARUS T600

A. Guglielmi



Beautiful!

First T2K event Feb 2010

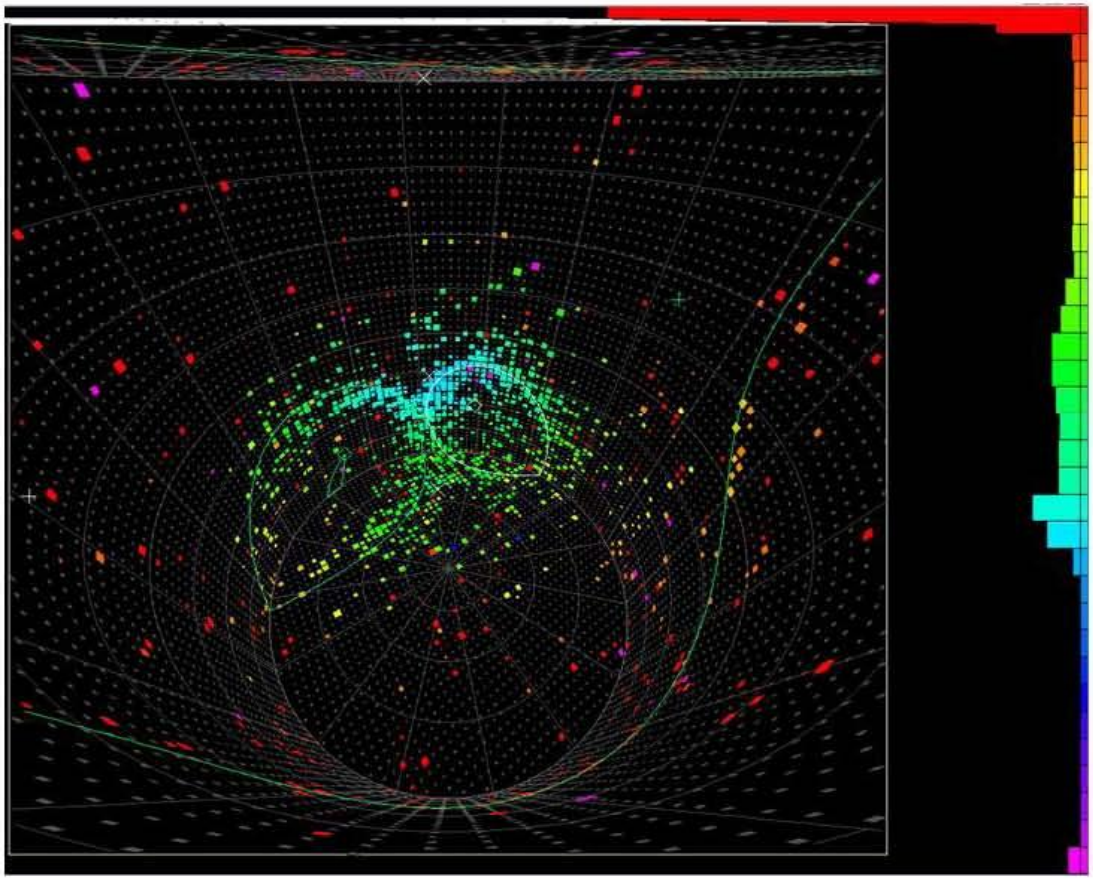


Figure 3 The first T2K event seen in Super-Kamiokande. Each dot is a PMT which has detected light. The two circles of hits indicate that a neutrino has probably produced a particle called a π^0, perfectly in time with the arrival of a pulse of neutrinos from J-PARC. Another faint circle

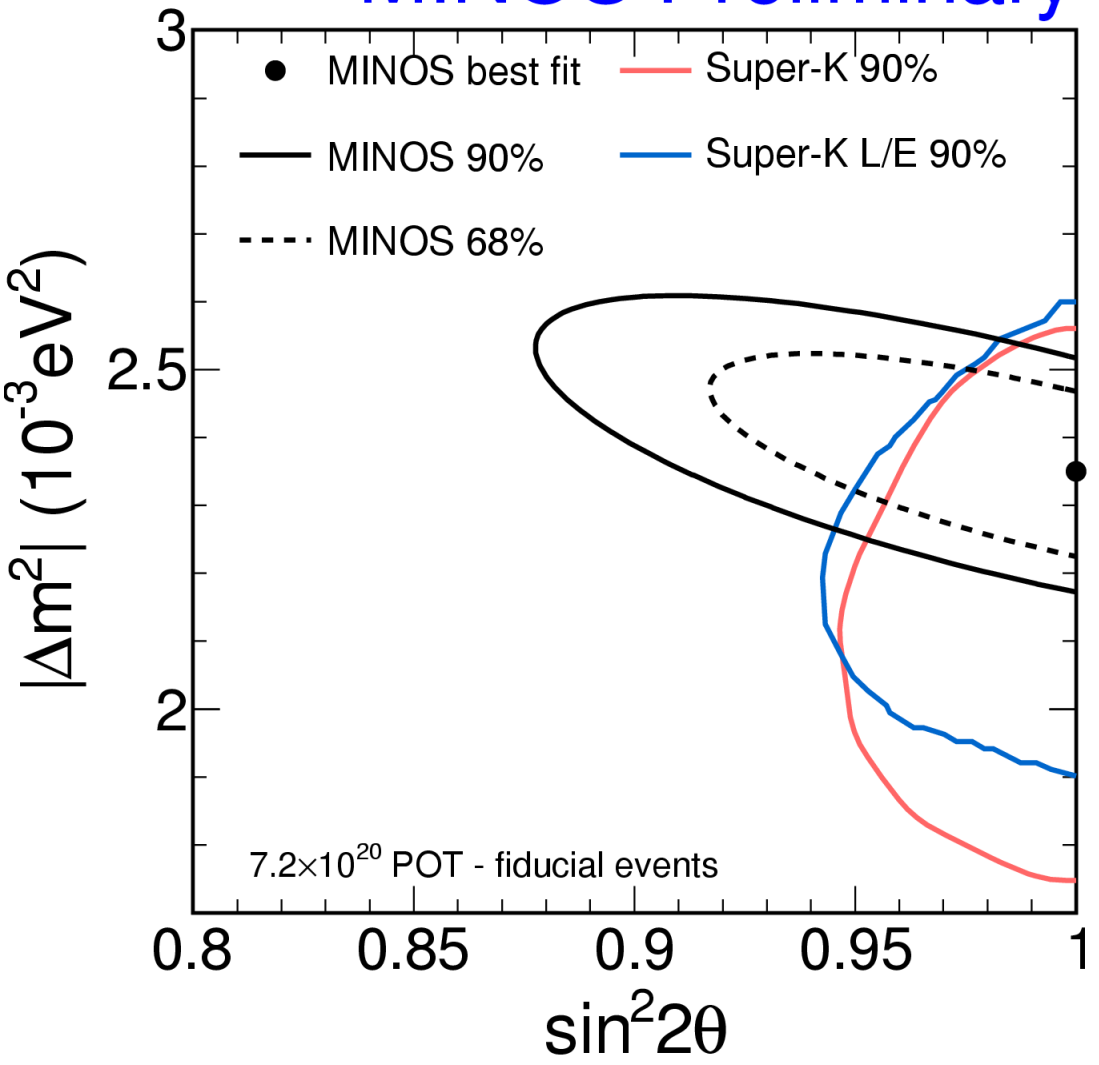
Allowed region

$$\left|\Delta m^2\right| = 2.35^{+0.11}_{-0.08} \times 10^{-3}\,\mathrm{eV}^2$$

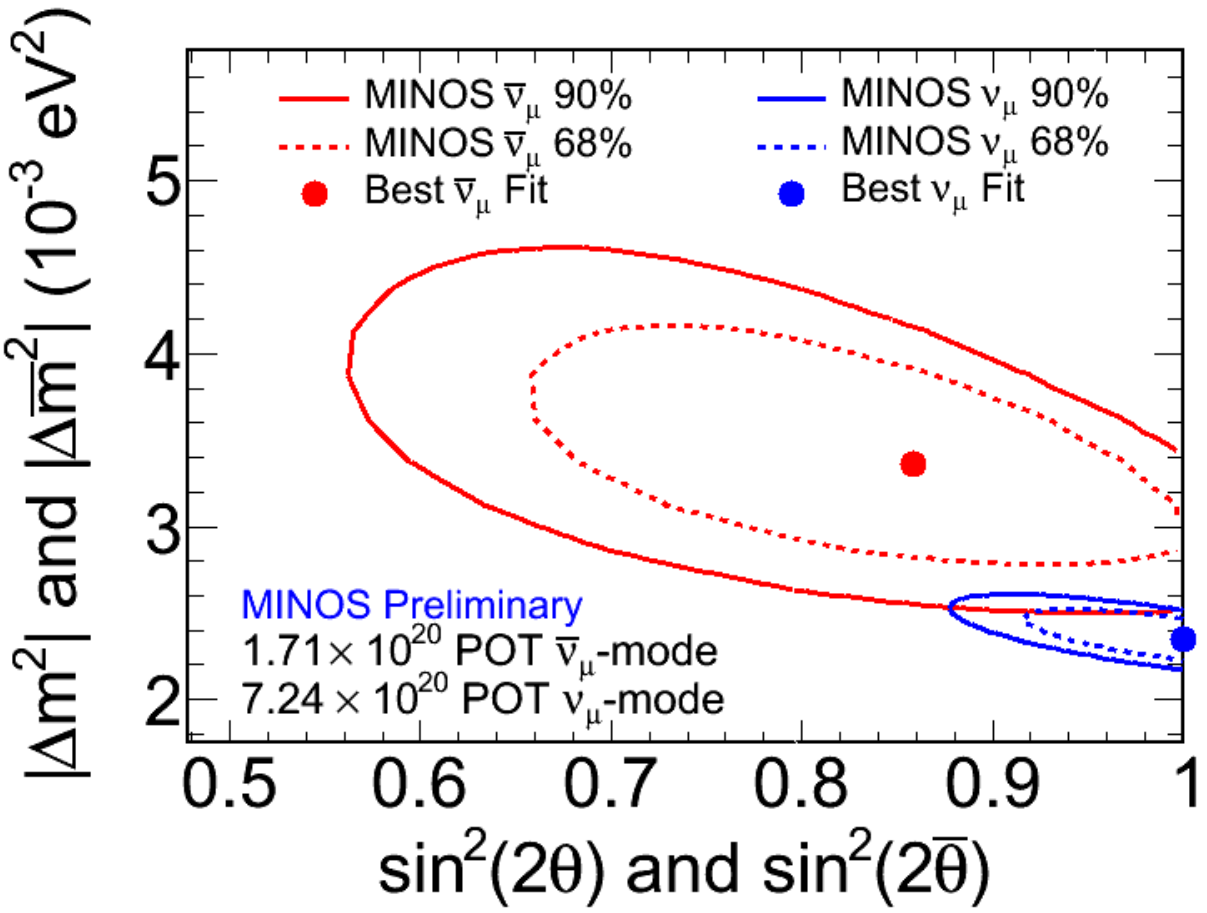
$$\sin^2(2\theta) > 0.91\ (90\%\ \mathrm{C.L.})$$

Contour includes effects of dominant systematic uncertainties

- normalization
- NC background
- shower energy
- track energy



ν_μ oscillation parameters



- Contours include the effects of systematic uncertainties

ν_e appearance results

for $\delta_{CP} = 0, \sin^2(2\theta_{23}) = 1,$

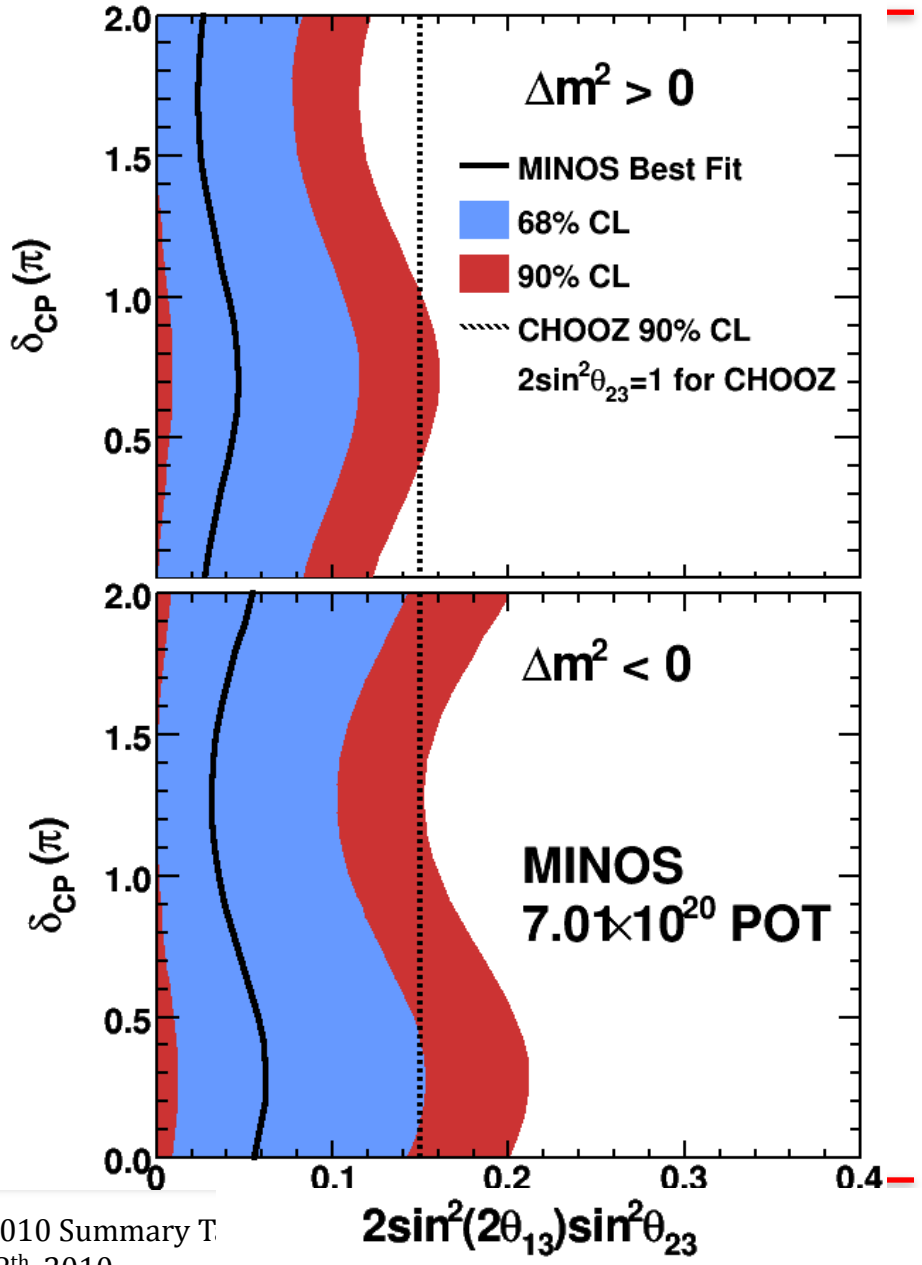
$\left|\Delta m^2_{32}\right| = 2.43 \times 10^{-3}$ eV^2:

$\sin^2(2\theta_{13}) < 0.12$ normal hierarchy

$\sin^2(2\theta_{13}) < 0.20$ inverted hierarchy

at 90% C.L.

See poster by J. Evans & L. Whitehead



Future for Neutrino Long Baseline

- More statistics (Opera, Icarus, Minos, T2K)
- Start of reactor experiments (Double Chooz, Daya Bay, RENO)
- Ongoing construction of the NOvA project at FERMILAB
- Very ambitious Project X at Fermilab, coupled to K, edm, g-2, DUSEL Megaton detector. High intensity frontier: a way to neutrino factory and muon collider
- J-Parc, T2K, Hyperkamiokande: a way to combine neutrino physics, astronomy and proton decay (historical way shown by IMB (US) and Kamiokande (Japan)

- **Long baseline neutrino oscillation experiments:**

Driven by a high-power proton source with proton energies between 3 and 120 GeV that would produce intense neutrino beams directed toward massive detectors at a distant deep underground laboratory.

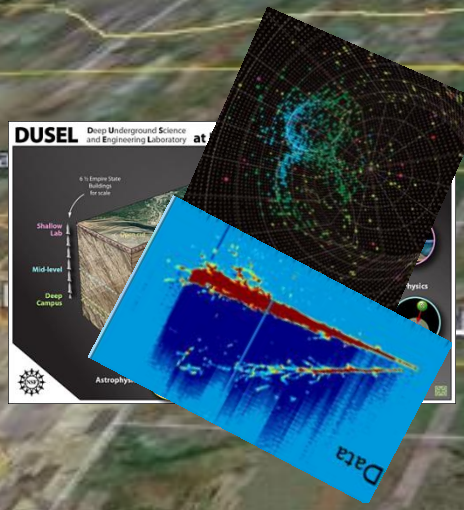
- **Kaon, muon, nuclei & neutron precision experiments driven by high intensity proton beams running simultaneously with the neutrino program:**

These could include world leading experiments searching for muon-to-electron conversion, nuclear and neutron electron dipole moments (edms), and world-leading precision measurements of ultra-rare kaon decays.

- **Platform for evolution to a Neutrino Factory and Muon Collider**

Detailed Discussion: Project X website

Long Baseline Neutrino Experiment



New Neutrino Beam at Fermilab…

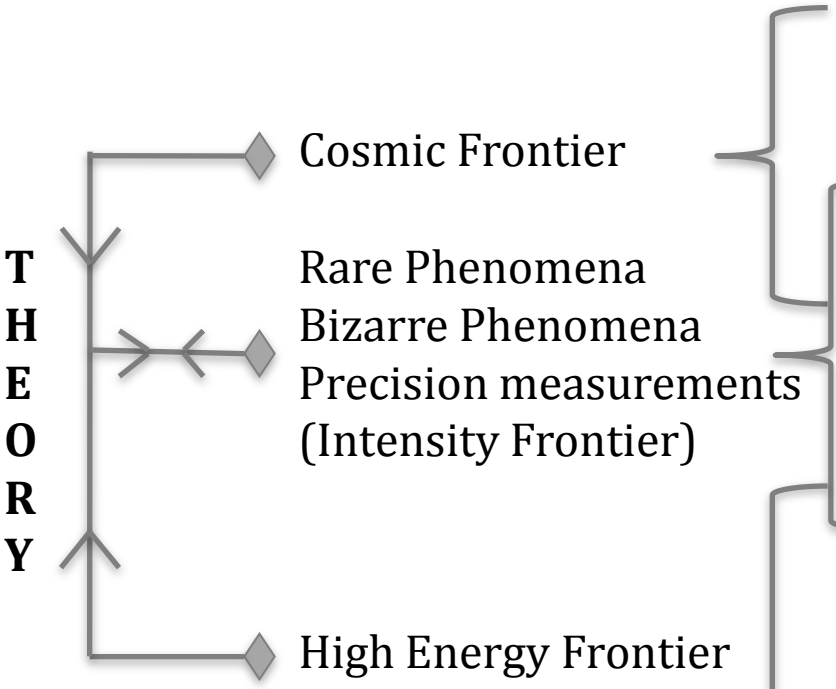
…Directed towards NSF's proposed DUSEL

Precision Near Detector on the Fermilab site

100 kT fiducial volume Water Cherenkov Far Detector

17 kT fiducial volume Liquid Argon TPC Far Detector

HIGHLIGHTS, VISION: Outline



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*Point like structure

*q, g plasma

*New Physics **(Moment of truth: Tevatron, LHC ?)**

- Higgs or no Higgs

-Susy, Z', …

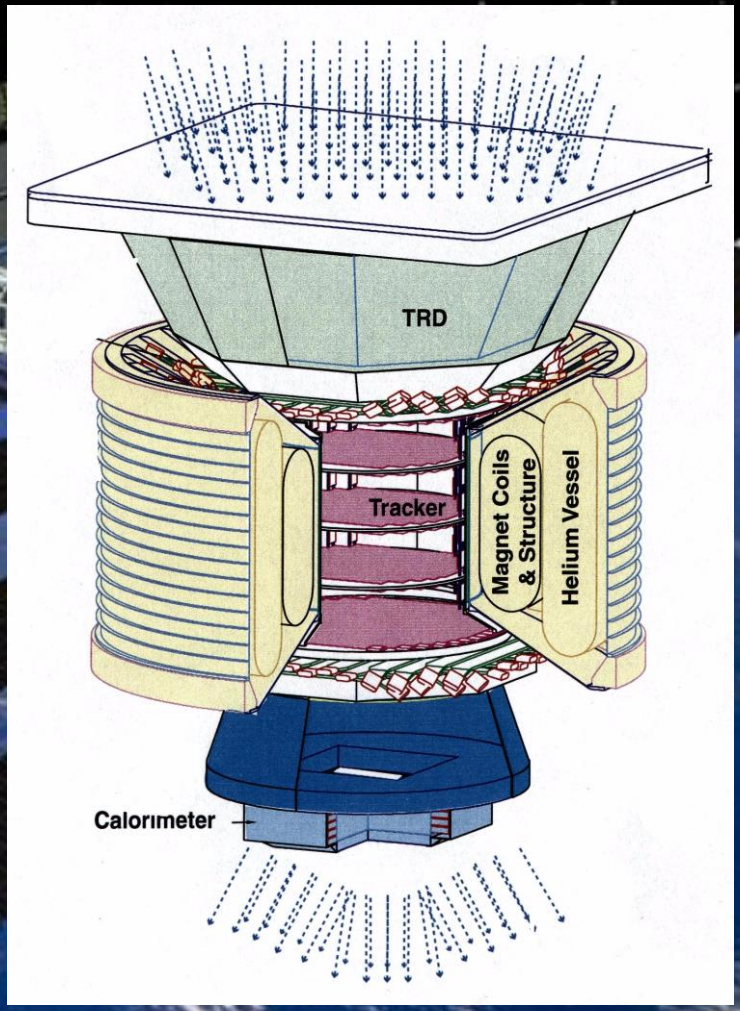
-Extra dimensions

- Mini black holes…

CP Violation, the issue of antimatter in the Universe

- Where has all antimatter gone?
- CP violation and CKM matrix (Babar and Belle legacy)
- Intriguing results in B_s sector
- Looking forward for **LHCb and SuperB**

AMS-02

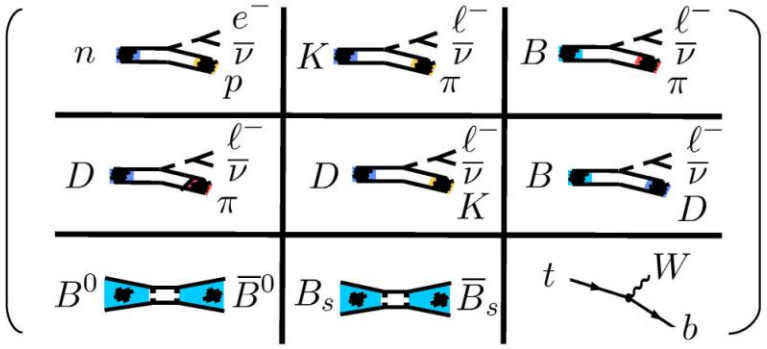


Spectacular, controversial results from PAMELA

Launch end 2010

CKM

$$V_{CKM} = \begin{pmatrix} V_{ud} & V_{us} & V_{ub} \\ V_{cd} & V_{cs} & V_{cb} \\ V_{td} & V_{ts} & V_{tb} \end{pmatrix} =$$



CKM Matrix: BELLE and BABAR LEGACY

KM ansatz: tested to be dominant source of CPV at the EW scale

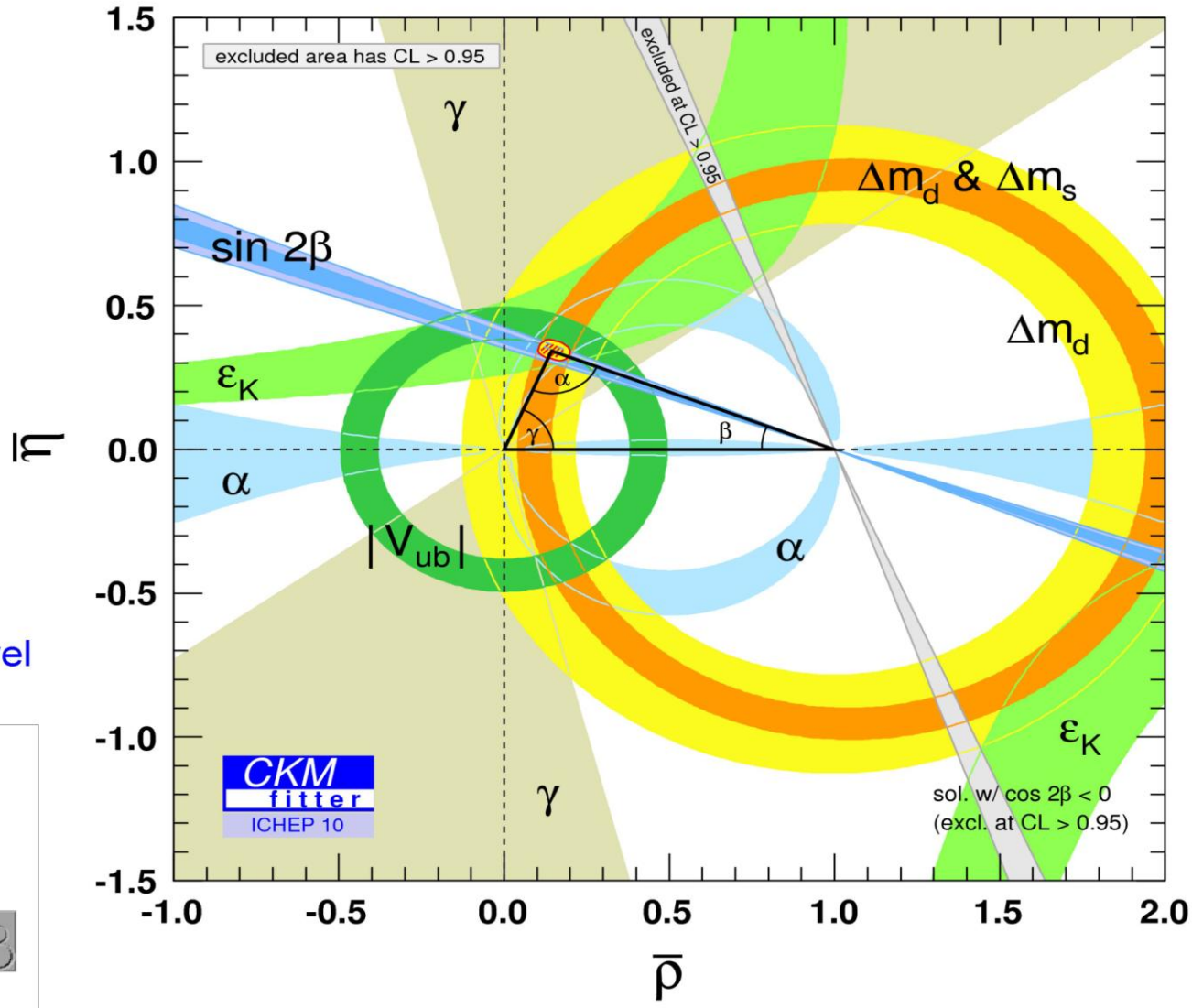
Inputs (theor. uncer. under control (LQCD)):

A, λ: $|V_{ud}|$, $|V_{us}|$, $|V_{cb}|$

$(\bar{\rho}, \bar{\eta})$:

- $|V_{ub}|$
- $B \rightarrow \tau\nu$
- γ
- Δm_d
- Δm_d & Δm_s
- $|\varepsilon_K|$
- sin2β
- α

Overall consistency at 2σ level



BABAR May '99-Apr '08

BELLE May '99-Jun '10

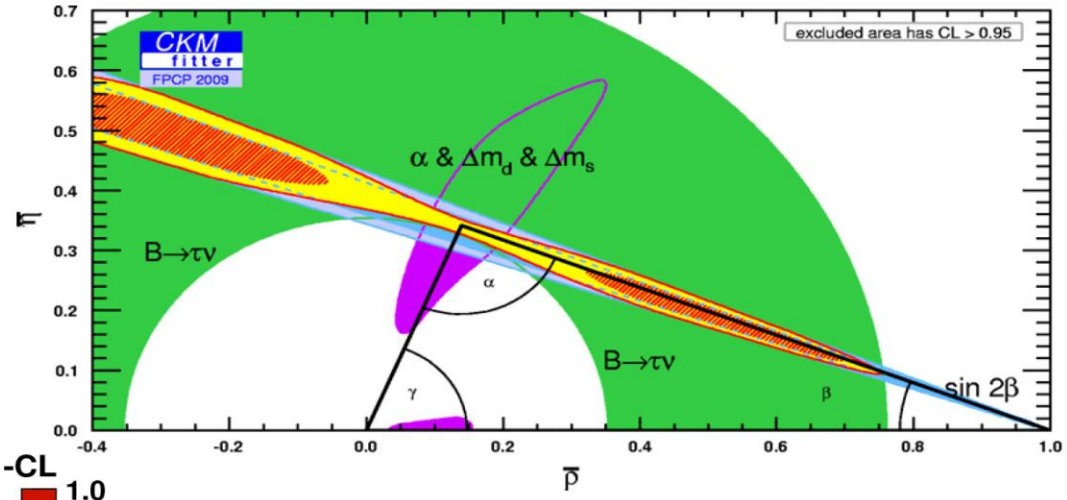
KTEV Kaons at the Tevatron

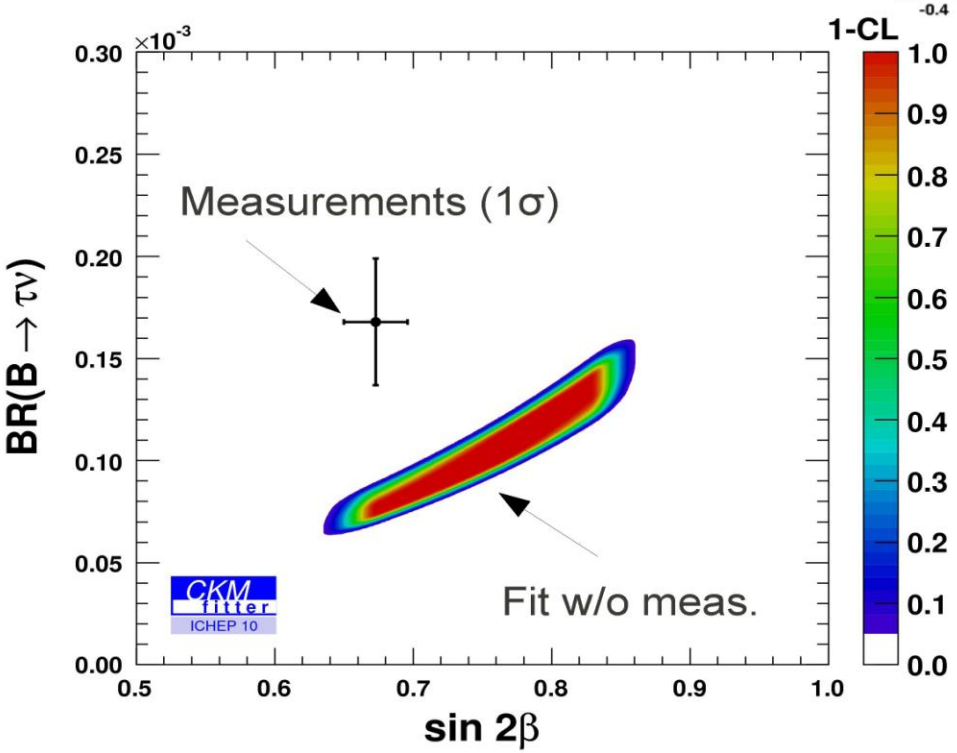
HFAG LQCD …

Tensions: a case for SuperB factories in Japan or/and Italy

Sin2β and B→τν discrepancies

- The combination sin2β and B →τν favors 2 solutions in contradictions with other inputs.
- One cannot accommodate both inputs simultaneously in the global fit.





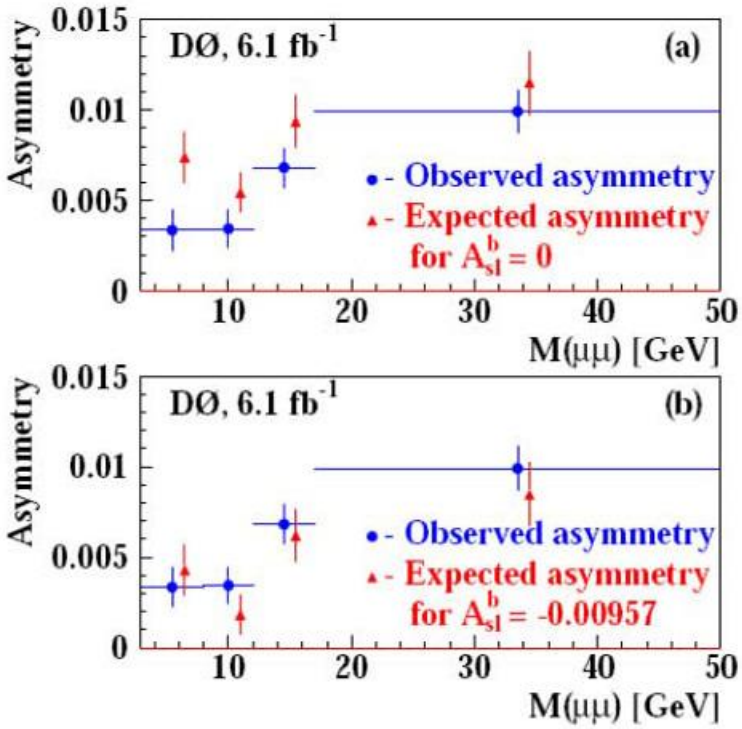
Non-trivial correlation of indirect constraints on sin2β and B →τν.

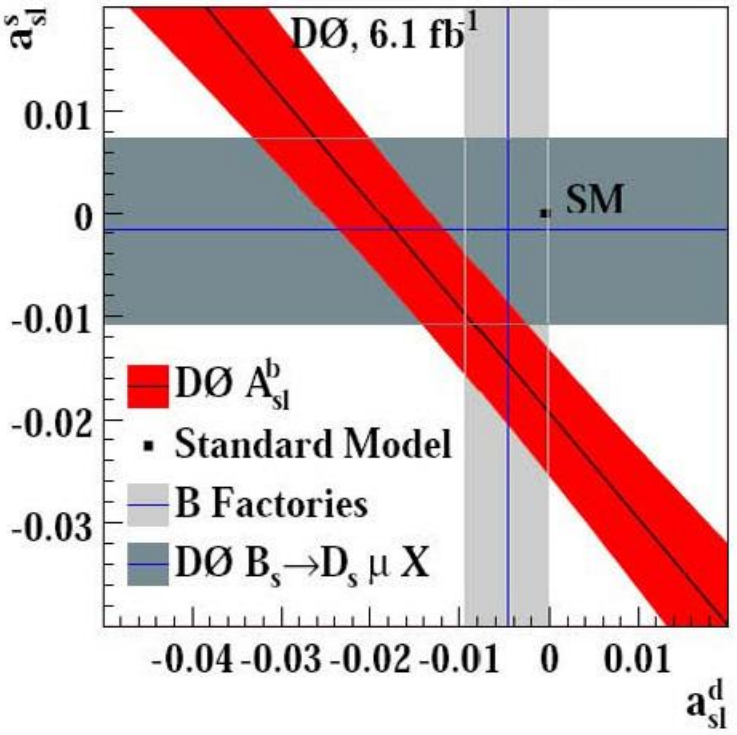
The low value of the prediction of B →τν is mainly driven by the measured value of sin2β

Sources of discrepancies:
1) Measurements (stat. fluctuations)?
2) Lattice estimate of f_B?
3) New Physics in B→τν and/or sin2β?

D0 3σ charge asymmetry effect B_s in μμ

Hoeneisen (D0)

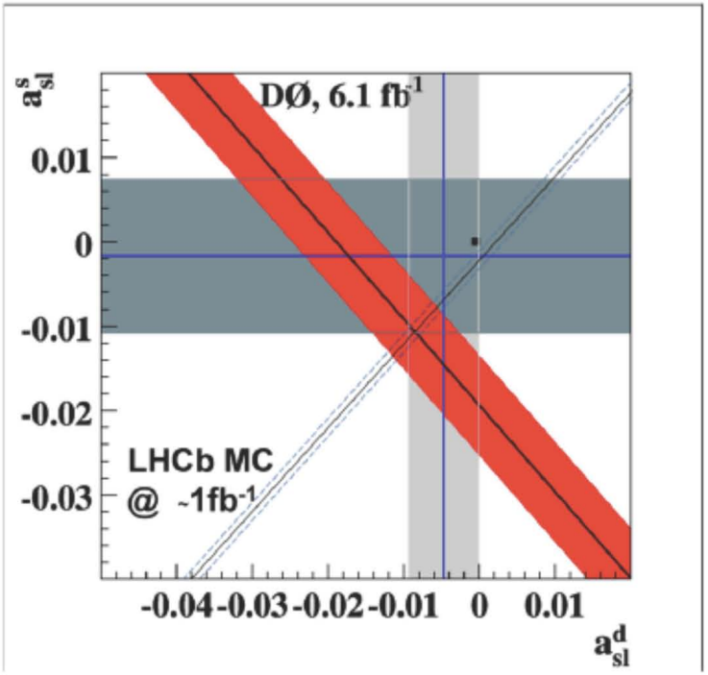




LHCb 2010-2011

$\Delta A_{fs} = (a_{fs}(B_s) - a_{fs}(B_d)) / 2$ @ LHCb
using semileptonic decays $B_{d,s} \rightarrow D\mu\nu$

- Provide constrain "orthogonal" to recent D^0 measurement
- With 100 pb^{-1} expect statistical precision similar to that of D0



2 to 1 standard deviation from SM in D0 and CDF

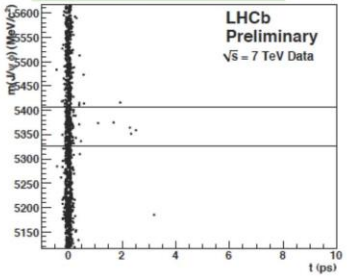
LHCb events

CPV in $B_s \rightarrow J/\psi\phi$

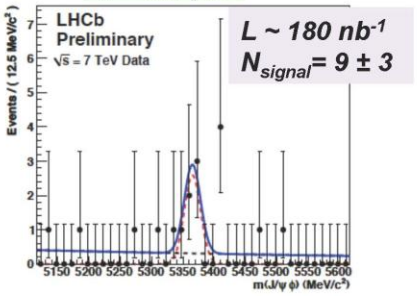
$\phi_s^{J/\psi\phi} = -2\beta_s$ *is very small and precisely predicted in SM*

→ *Very sensitive to NP !!!*

$B_s \rightarrow J/\psi\phi$
$M(J/\psi\phi)$ vs t(ps)



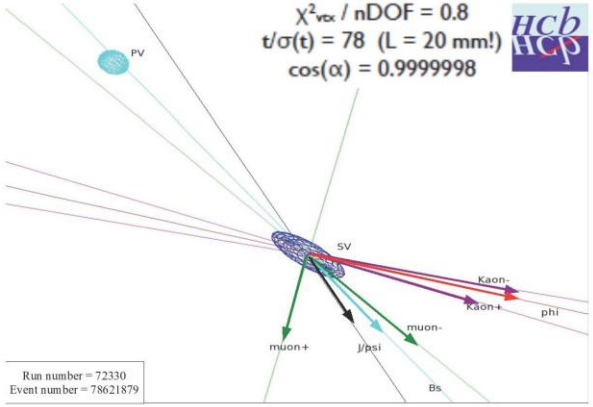
$t > 0.3$ ps



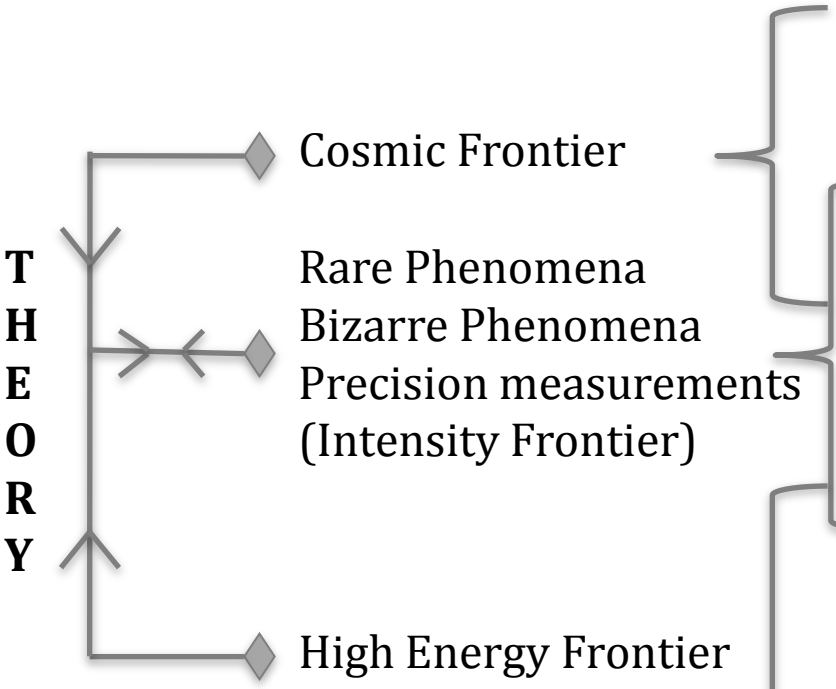
Number of signal events as expected

m(μμ) = 3072 MeV/c²
m(KK) = 1020 MeV/c²
m(μμKK) = 5343 MeV/c²

χ^2_{vtx} / nDOF = 0.8
$t/\sigma(t)$ = 78 (L = 20 mm!)
cos(α) = 0.9999998



HIGHLIGHTS, VISION: Outline



*Cosmology : what is the Universe made of ?

*High Energy Cosmic Rays, new messengers : high energy phenomena in the Universe

*ν properties, p decay : a window towards the highest energies

* ν long Baseline

***edm, g-2, p size, μ ->eγ (PSI)**

***B**, K, c, t decays, CKM, **CP violation**

*W, Z, t production, mass…

*Point like structure

*q, g plasma

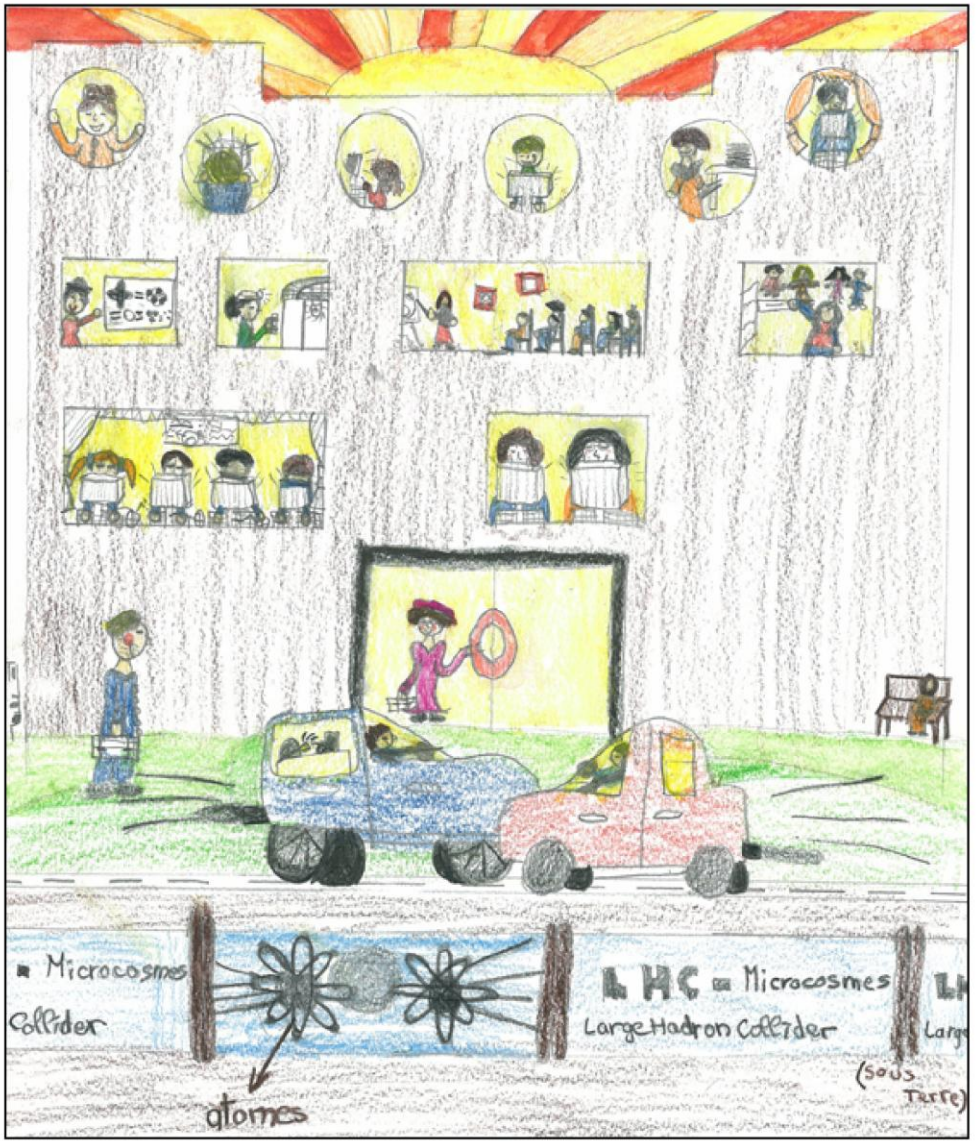
*New Physics **(Moment of truth: Tevatron, LHC ?)**

- Higgs or no Higgs

-Susy, Z', …

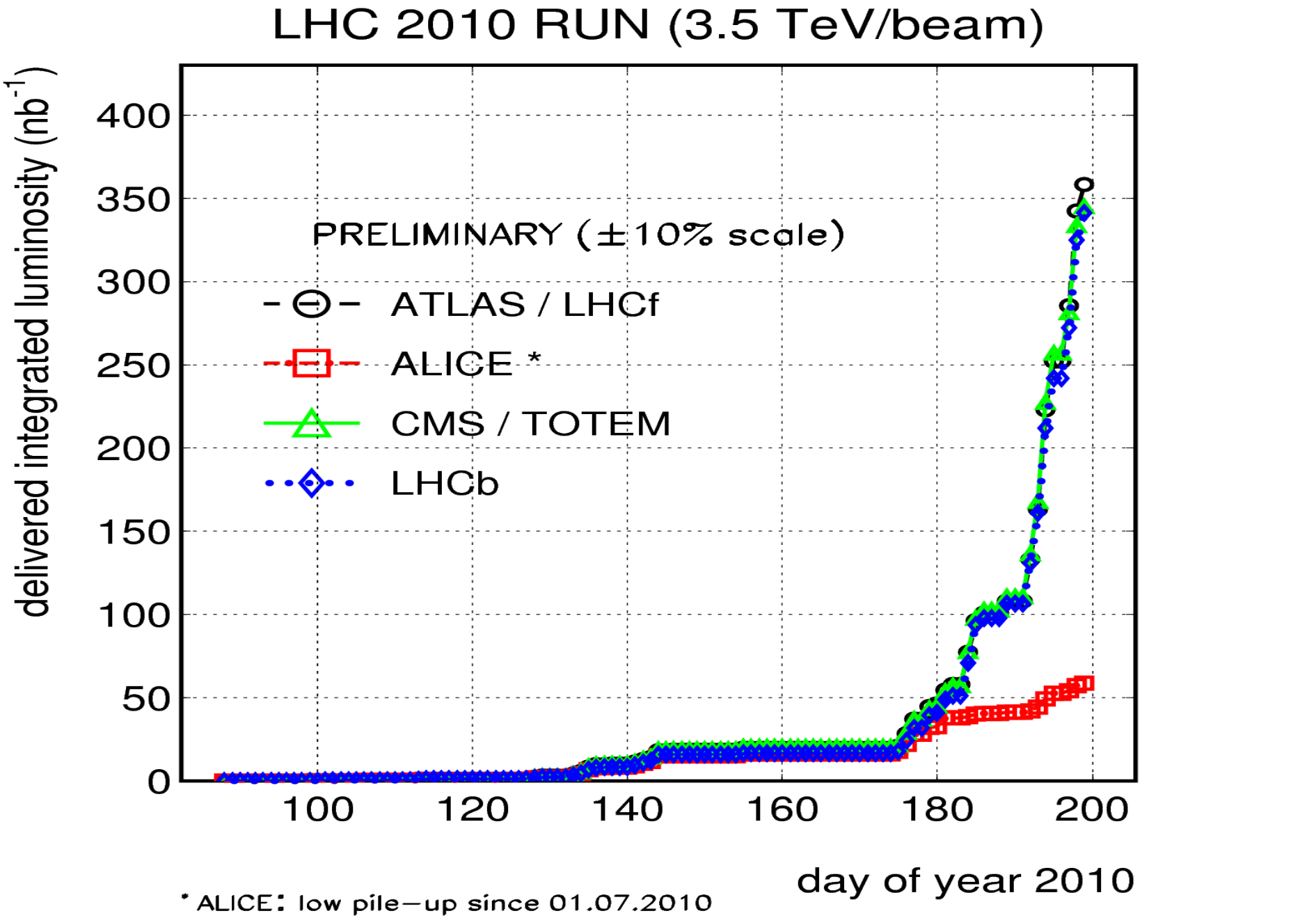
-Extra dimensions

- Mini black holes…



Un physicien veut explorer les secrets de la Nature. Sous terre, il y a le LHC, un grand tunnel où les atomes font des collisions. *Isabel*

2010/07/19 11.54



Summary of Luminosity Evolution 2010

Event	β*	Nb	Ib	Itot	MJ	MJ Factor	Nc	Peak luminosity	Date
1	10	2	1.00E+10	2.0E+10	0.0113	0.0000	1	8.9E+26	30 March 2010
2	10	2	2.00E+10	4.0E+10	0.0226	2.0000	1	3.6E+27	02 April 2010
3	2	2	2.00E+10	4.0E+10	0.0226	1.0000	1	1.8E+28	10 April 2010
4	2	4	2.00E+10	8.0E+10	0.0452	2.0000	2	3.6E+28	19 April 2010
5	2	6	2.00E+10	1.2E+11	0.0678	1.5000	4	7.1E+28	15 May 2010
6	2	13	2.60E+10	3.4E+11	0.1910	2.8167	8	2.4E+29	22 May 2010
7	3.5	3	1.10E+11	3.3E+11	0.1865	0.9763	2	6.1E+29	26 June 2010
8	3.5	6	1.00E+11	6.0E+11	0.3391	1.8182	4	1.0E+30	02 July 2010
9	3.5	8	9.00E+10	7.2E+11	0.4069	1.2000	6	1.2E+30	12 July 2010
10	3.5	13	9.00E+10	1.2E+12	0.6612	1.6250	8	1.6E+30	15 July 2010

Decided Scenario 2010-2011

Following the technical discussions in Chamonix (Jan 2010) the CERN management and the LHC experiments decided

- **Run at 3.5 TeV/beam up to a integrated luminosity of at least $1fb^{-1}$.**
- **Then consolidate the whole machine for 7TeV/beam (during a shutdown in 2012)**
- **From 2013 onwards LHC will be capable of maximum energies and luminosities**

Some highlights

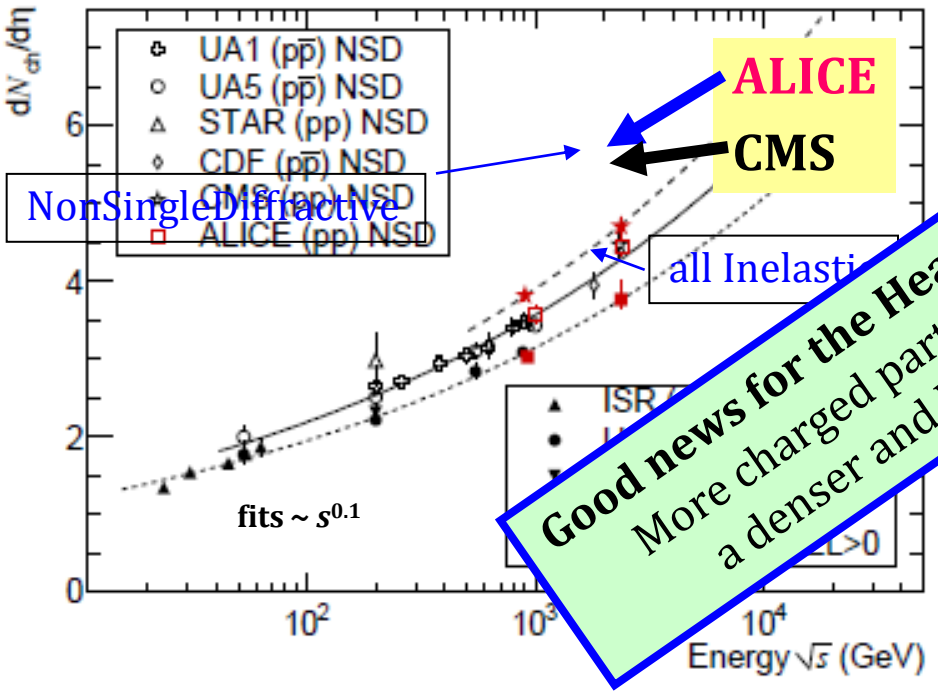
- High rapidity plateau: gluon gluon collider?
- Rediscovery of all Standard Model particles: K, π, p, Λ, 1000 Ω, 1000 W,100 Z, 10 top
- Use data from less than a week!!!
- 100 papers
- Measurements of jets, di jets, soon α_s already competitive with Tevatron
- However uncertainties on luminosity and jet energy scale to be improved

dN_{ch}/dh versus $\sqrt{(s)}$

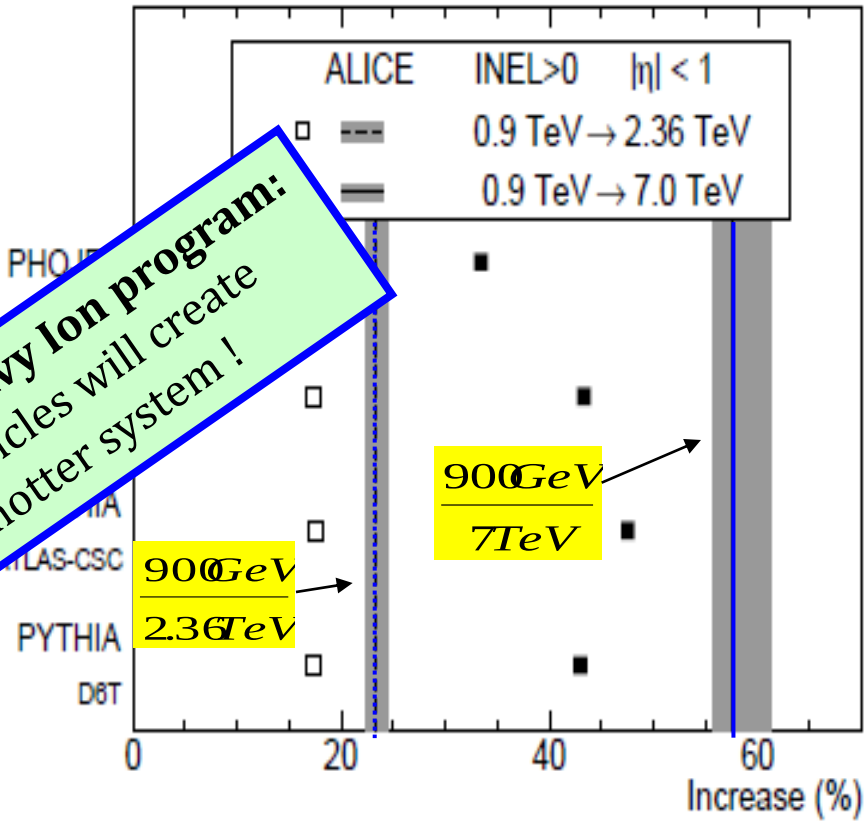
dN_{ch}/dh versus $\sqrt{s}$

Relative increase in dN_{ch}/dh

Inelastic $N_{ch} \geq 1$ in $|h|<1$



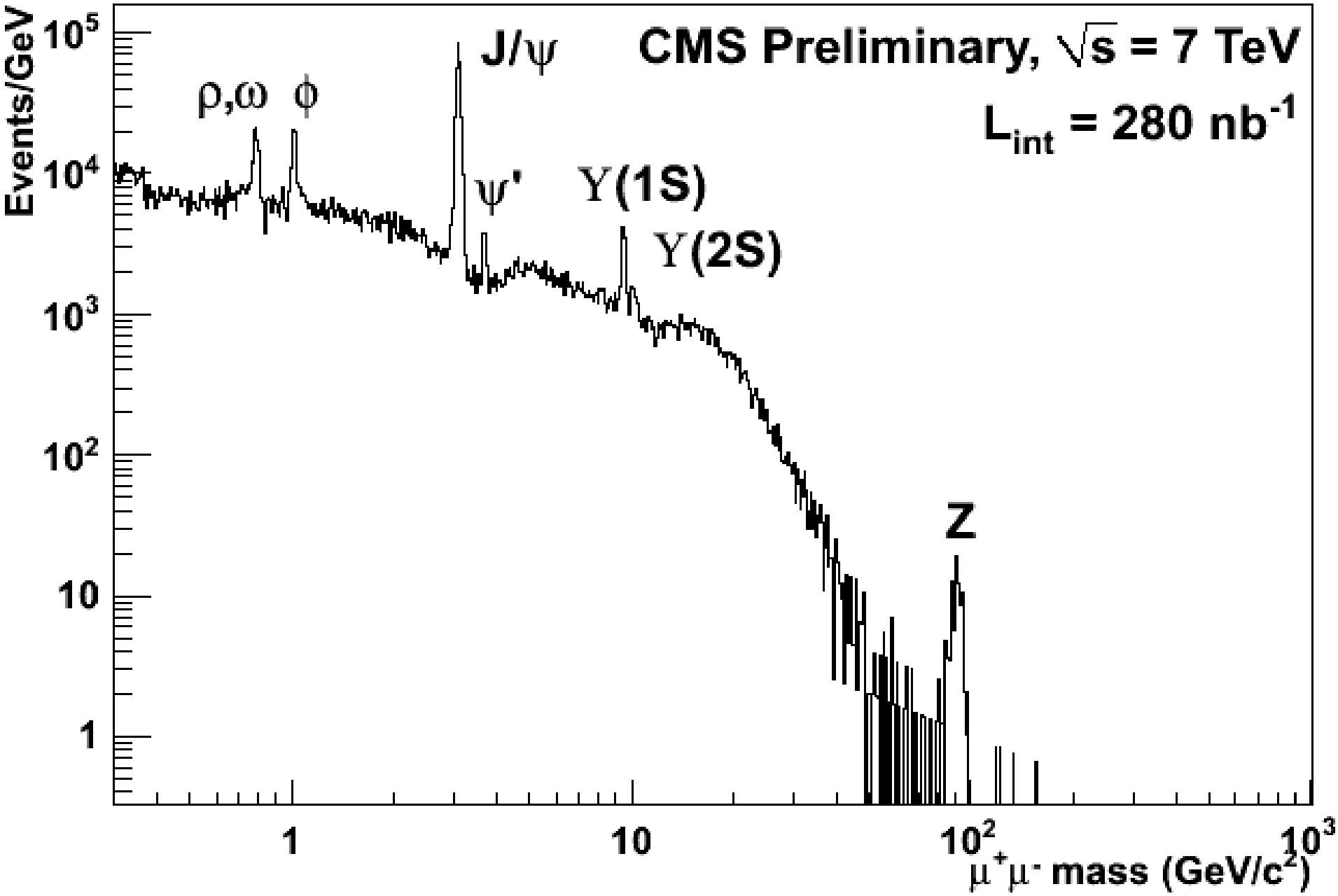
Good news for the Heavy Ion program:
More charged particles will create a denser and hotter system !



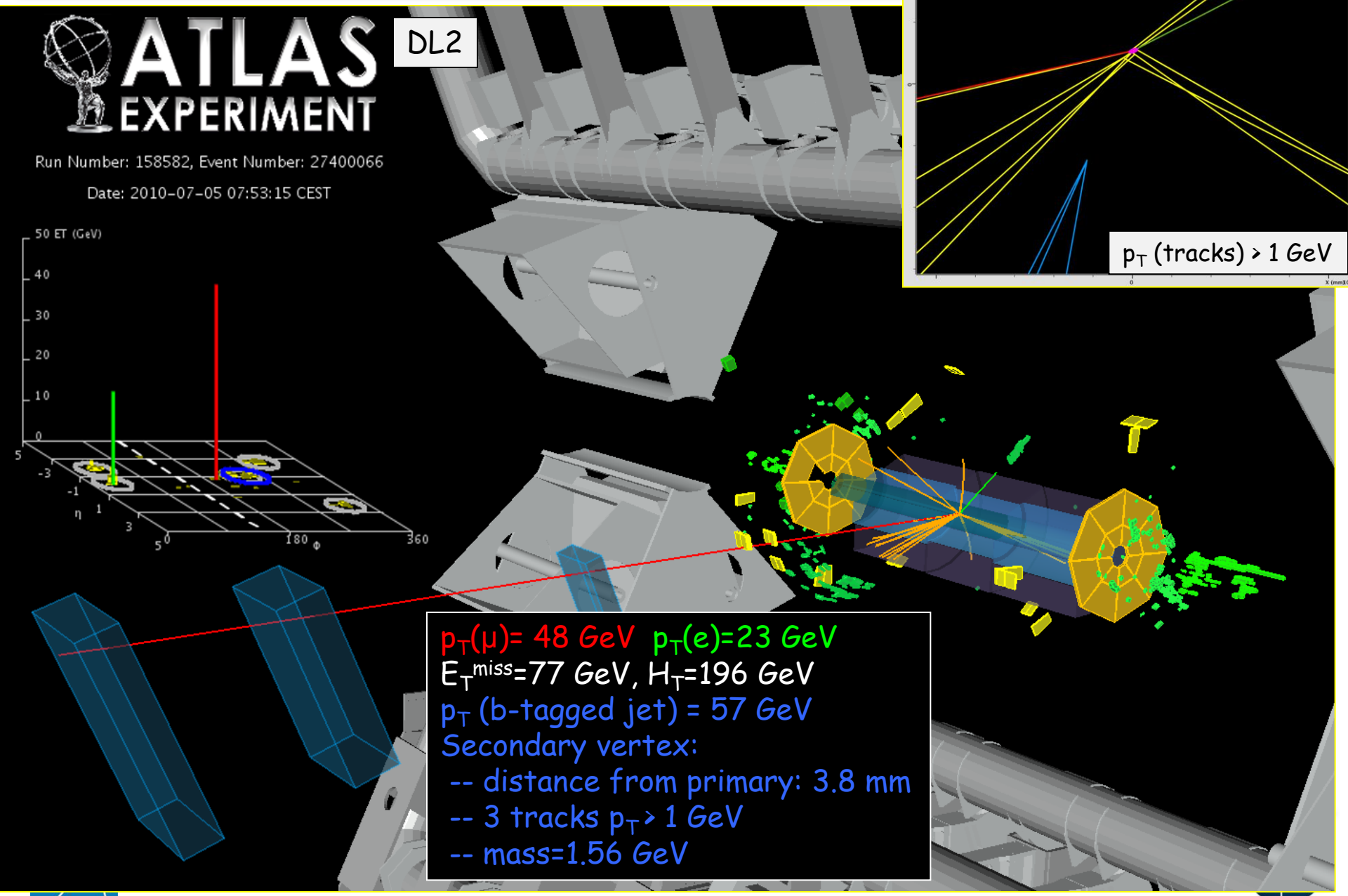
Results:

- dN_{ch}/dh well described by power law $(\sqrt{s})^{0.2}$
- increase with energy significantly stronger in data than MC's
- Alice & CMS agree to within 1 s (< 3%)

Here is the Compact Muon Solenoid

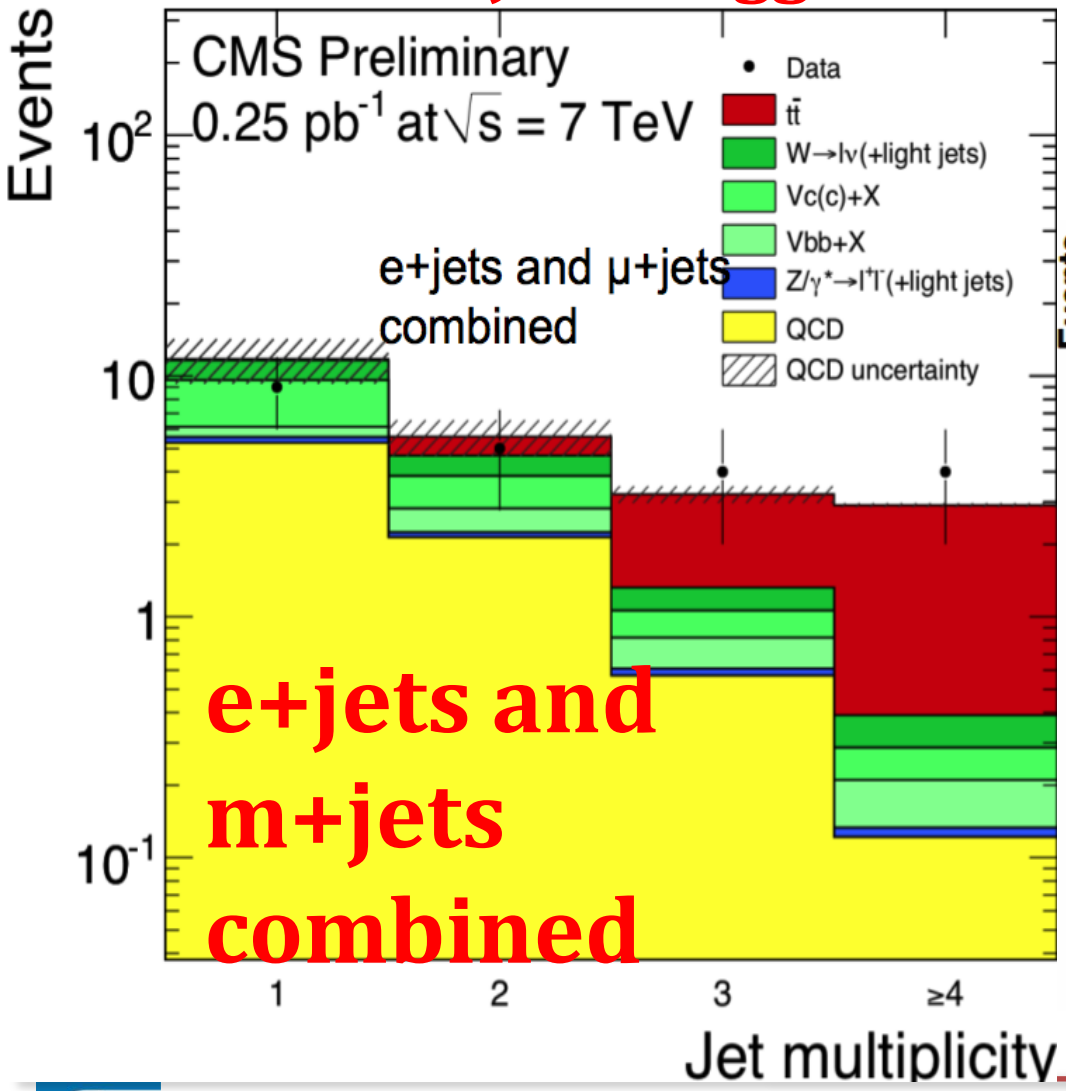


eμ candidate

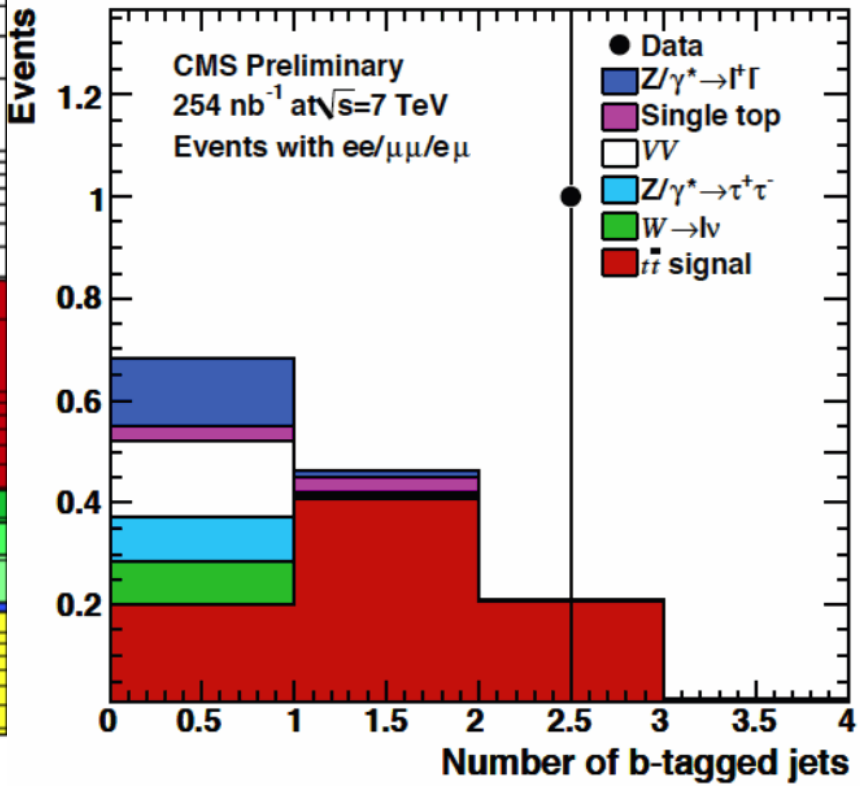


The top signal region is getting populated

At least 1jet b-tagged

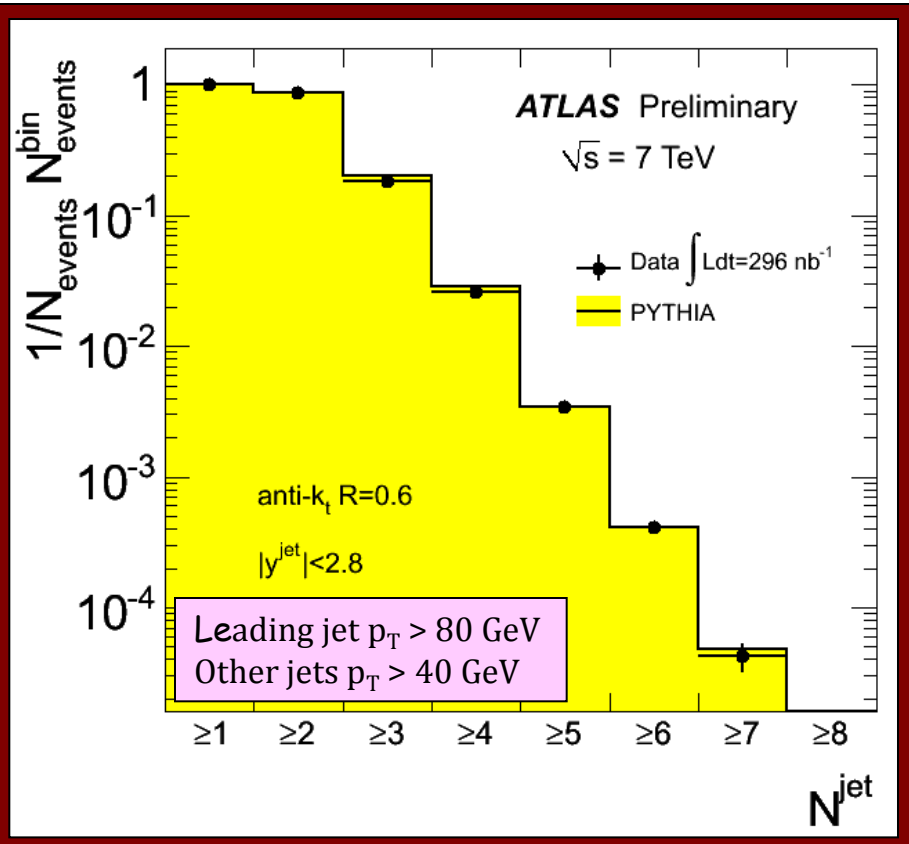


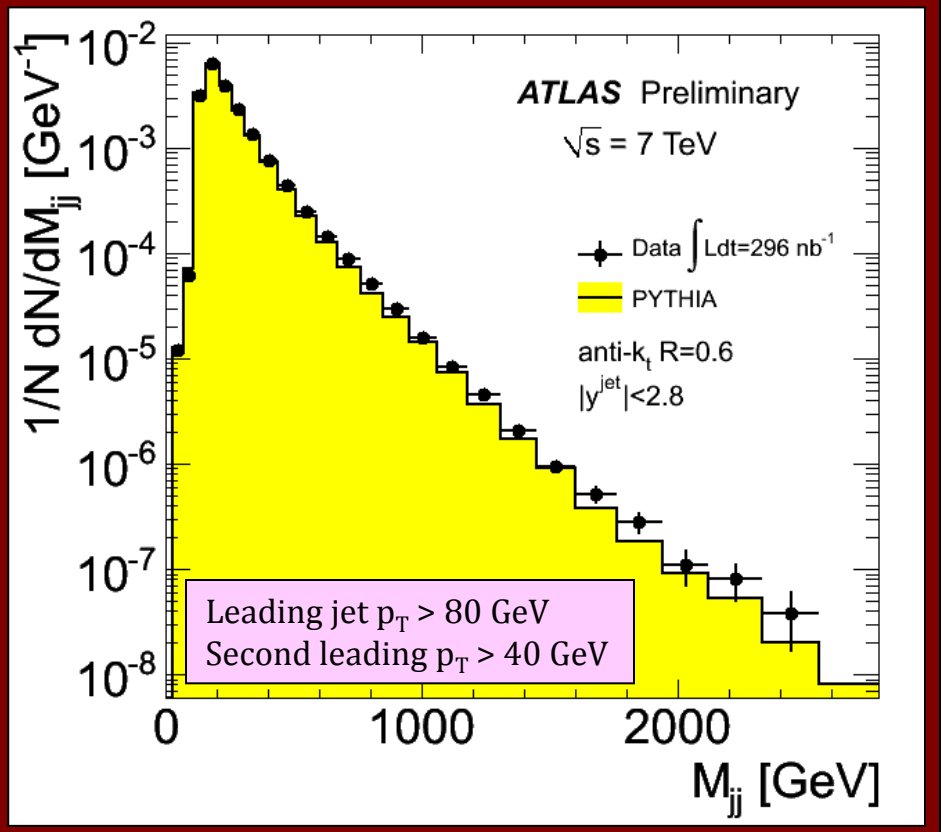
ee+jets/me+jets/mm+jets



Jets physics

Full data sample





Shape comparisons between data and parton-shower MC (distributions normalized to unity)

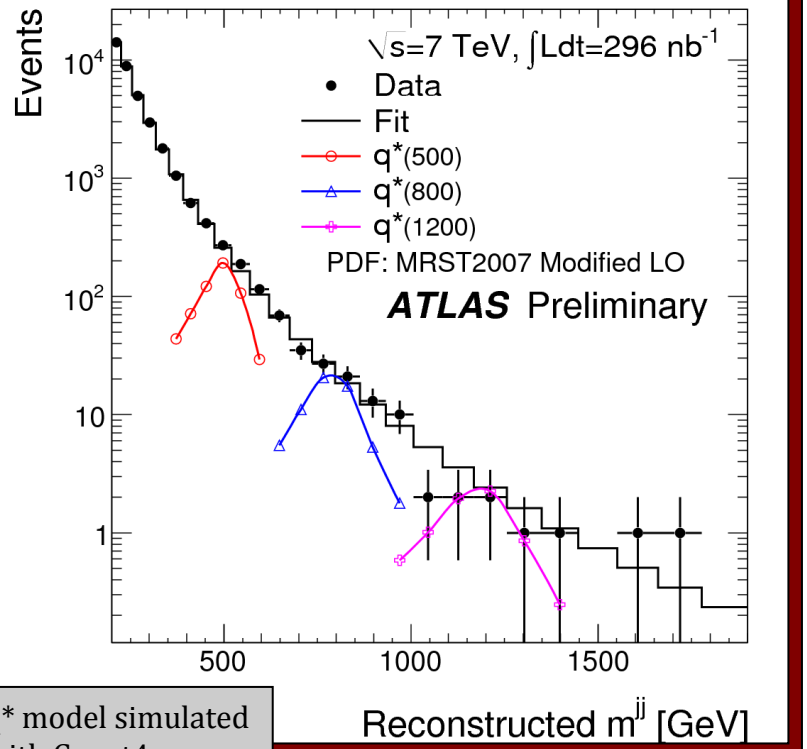
Searches for excited quarks: q*→ jj

Full data sample analysed

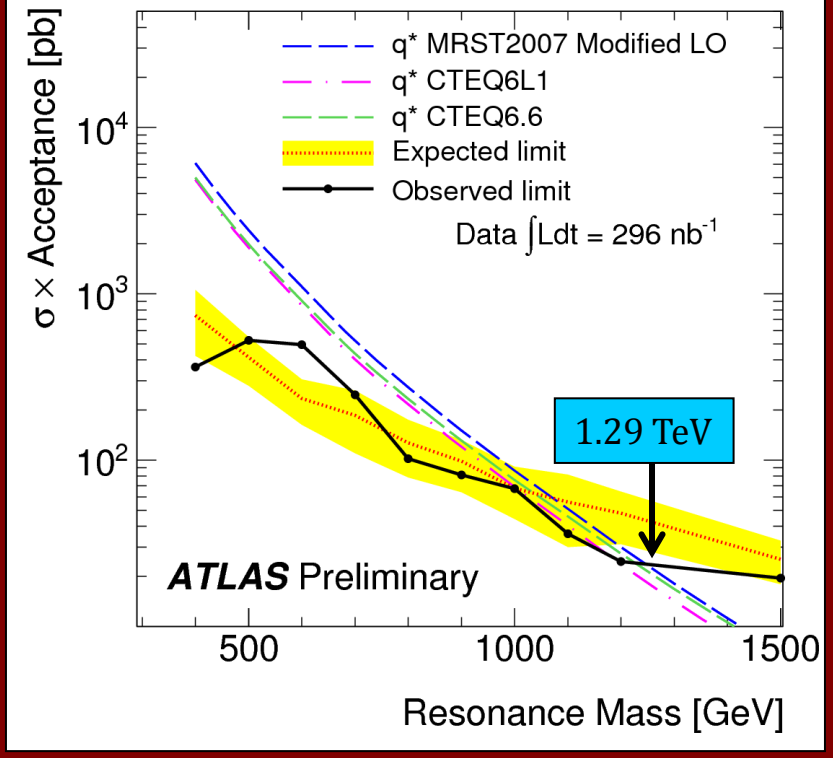
Looked for di-jet resonance in the measured M(jj) distribution
→ spectrum compatible with a smooth monotonic function → no bumps

→ 0.4 < M (q*) < 1.29 TeV excluded at 95% C.L.

Latest published limit:
CDF: 260 < M (q*) < 870 GeV



q* model simulated with Geant4

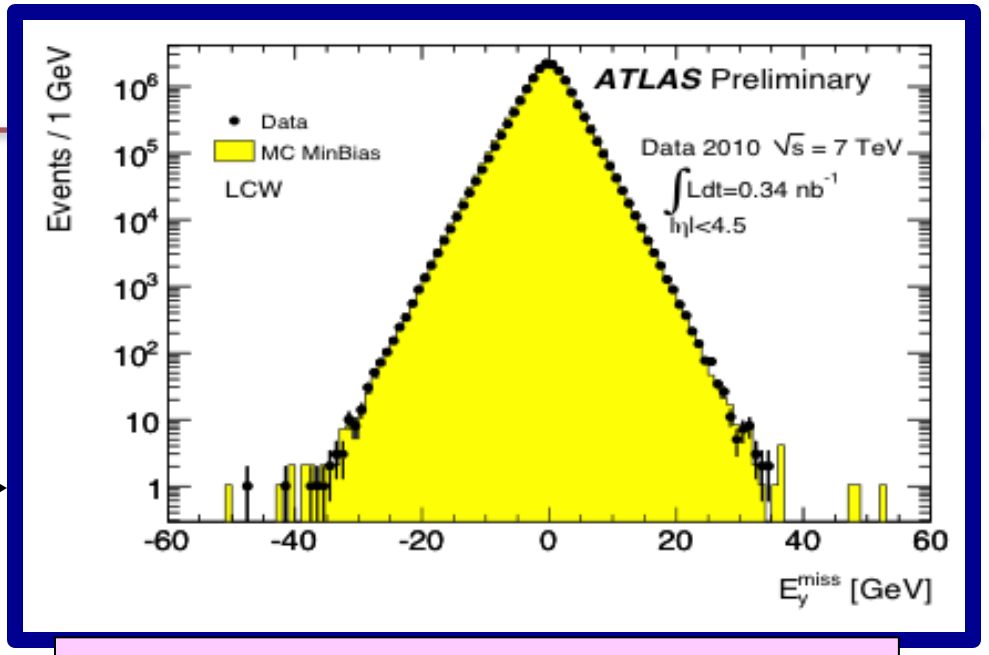


- Experimental systematic uncertainties included: luminosity, JES (dominant), background fit, ..
- Impact of different PDF sets studied → with CTEQ6L1: 0.4 < M (q*) < 1.18 TeV

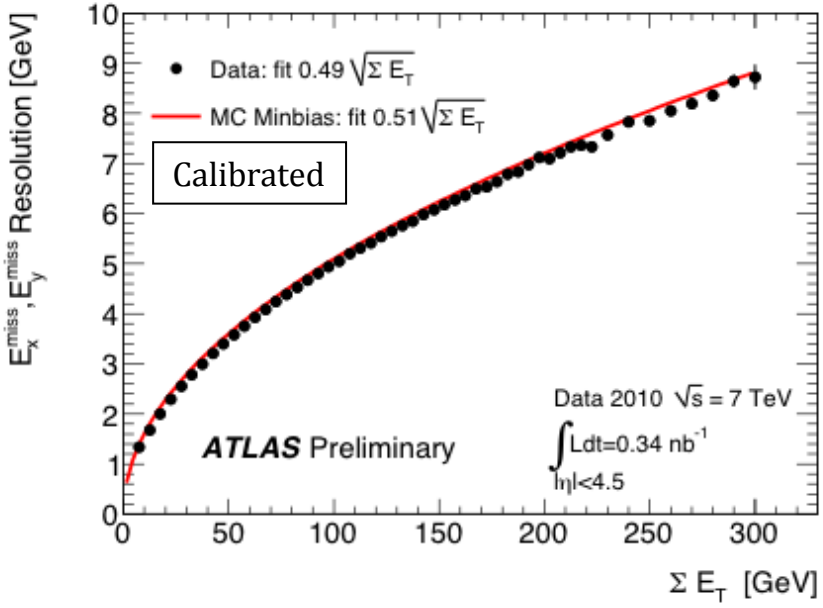
Missing transverse energy in the calorimeters

Sensitive to calorimeter performance (noise, coherent noise, dead cells, mis-calibrations, cracks, etc.), and cosmics and beam-related backgrounds

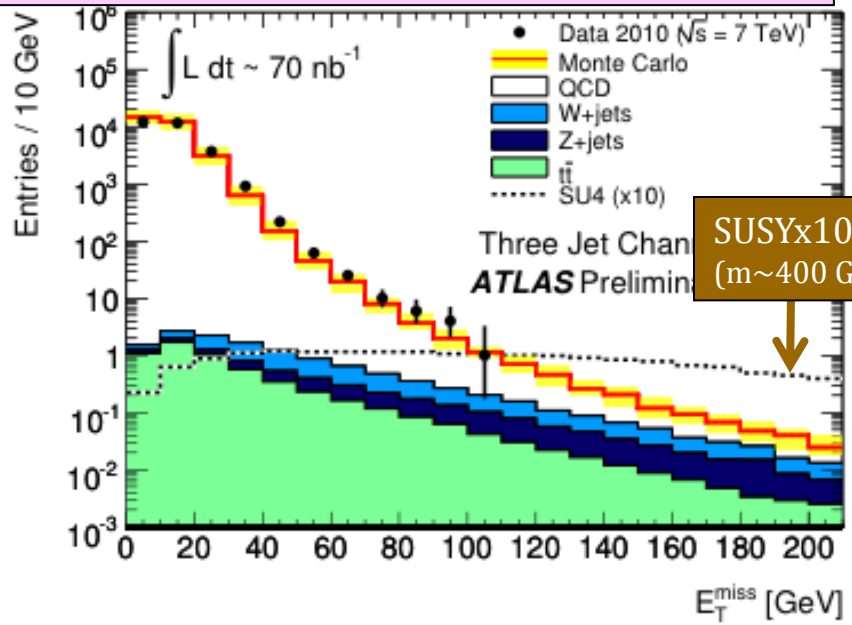
Calibrated E_T^{miss} from minimum-bias events



Measured over ~ full calorimeter coverage (360^0 in φ, $|\eta| < 4.5$, ~ 200k cells)



E_T^{miss} spectrum from SUSY searches: events with ≥ 3 high-p_T jets, p_T (j1) > 70 GeV



Discovery Potential at LHC 1 fb^{-1}

3.5 TeV (end 2011 or beginning 2012)

- HIGGS competitive with the Tevatron
- Z': extend by a factor 2 the Tevatron potential
- SUSY from 400 GeV (Tevatron) to 800 GeV exclusions or discoveries
- Extra dimensions, mini black holes (extend by factor 2 the Tevatron limits (or discovery)

Tevatron running

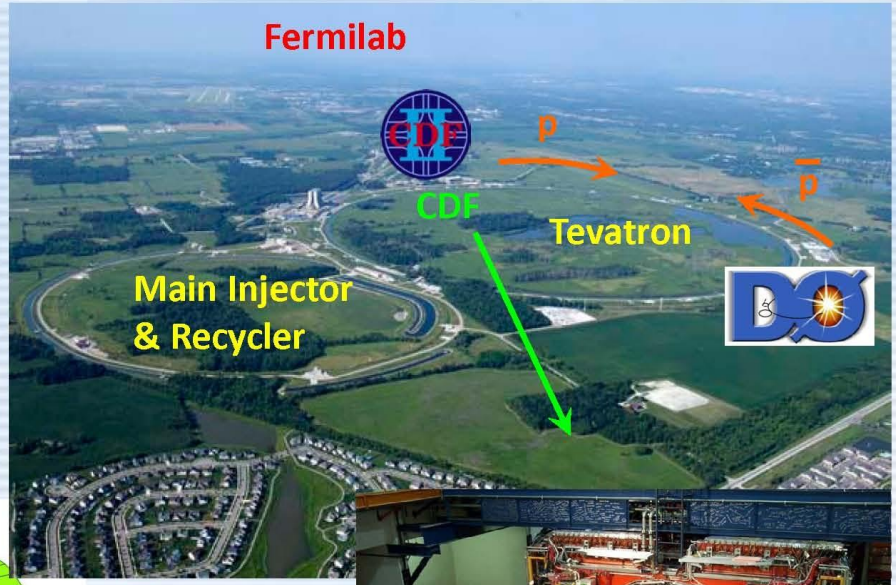
Tevatron and CDF

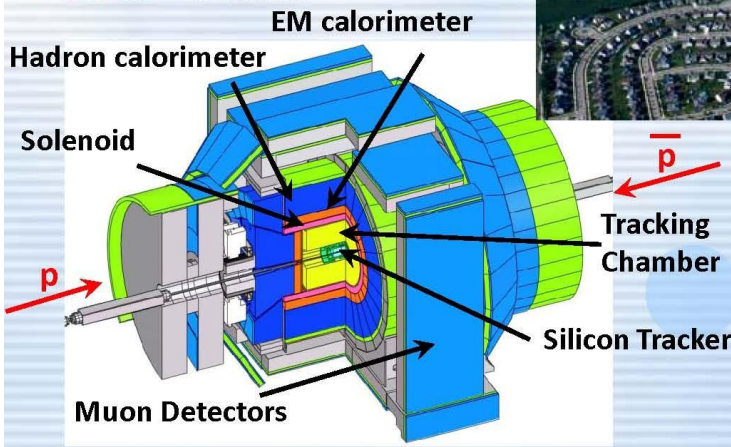
Tevatron

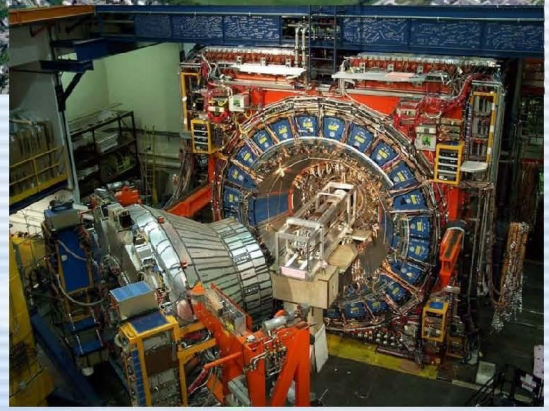
- Proton-antiproton collisions at $\sqrt{S} = 1.96\,\mathrm{TeV}$
- > 9.0 fb^{-1} delivered

CDF

- One of the general purpose detectors
- Currently, CDF has recorded > 7.5 fb^{-1} of data.



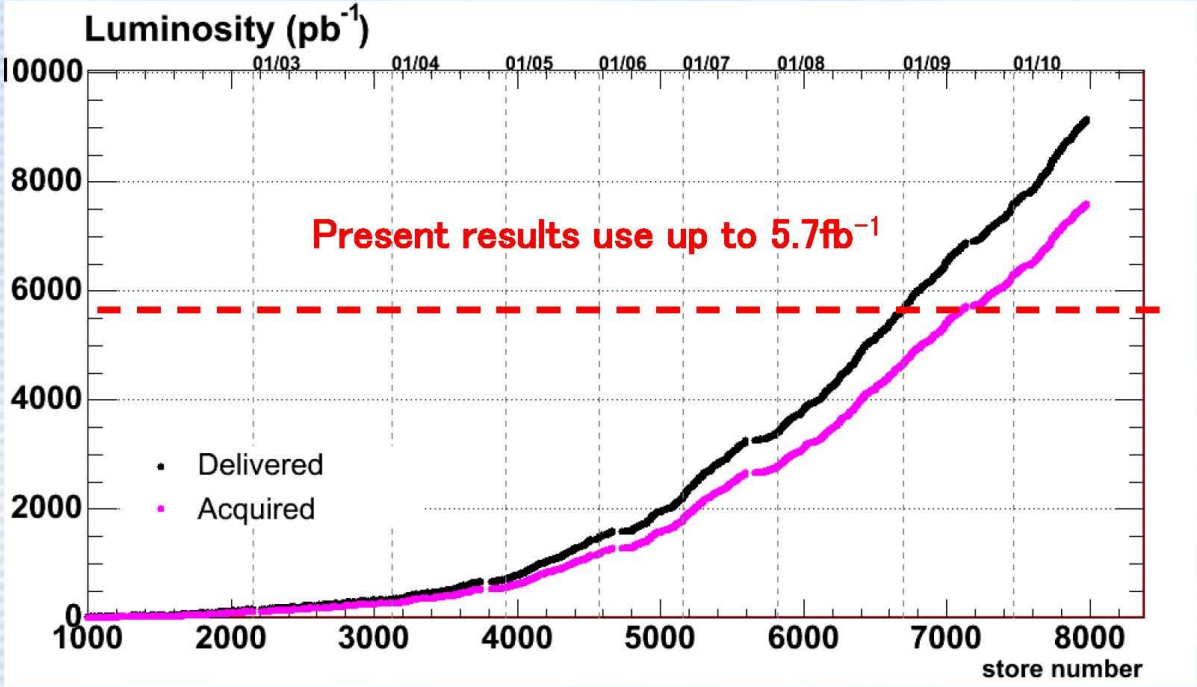




ICHEP 2010, July 22 Y. NAGAI (Univ. of Tsukuba) 4

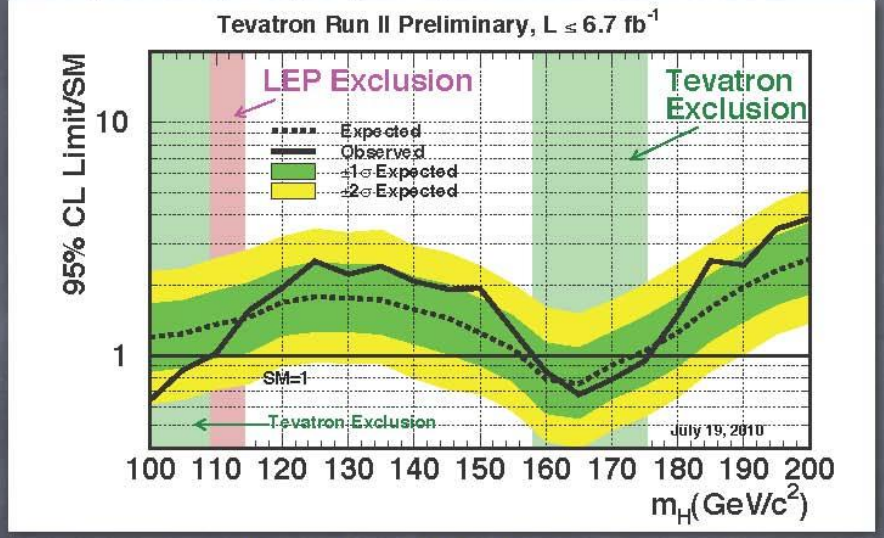
End 2011: 10fb^{-1}, end 2014: 20 fb^{-1}?

Luminosity



Approaching the moment of truth

Conclusions



- Higgs has no place to hide !
  - Squeezing allowed mass from both sides
    - 95% CL Exclusion 158 < m_H < 175 GeV (about expected)
    - Limit 1.5*SM @ 115 GeV
- BSM searches : consistent with SM
  - 2 sigma is largest discrepancy in CDF MSSM H→bb (so far)

Ben Kilminster, ICHEP 2010 38

$\Delta\sigma$ th?

New studies under way (HL-LHC)

- High Gradient/Large Aperture Quads, with B_{peak} 13-15 T. **(Nb_3Sn)**

–Higher field quadrupoles translate in higher gradient/shorter length **or larger aperture/same length or a mix.**

– US-LARP engaged to produce proof by 2013.

–β^* as small as 22 cm are possible with a factor ~2.5 **in luminosity by itself,** if coupled with a mechanism to compensate the geometrical reduction

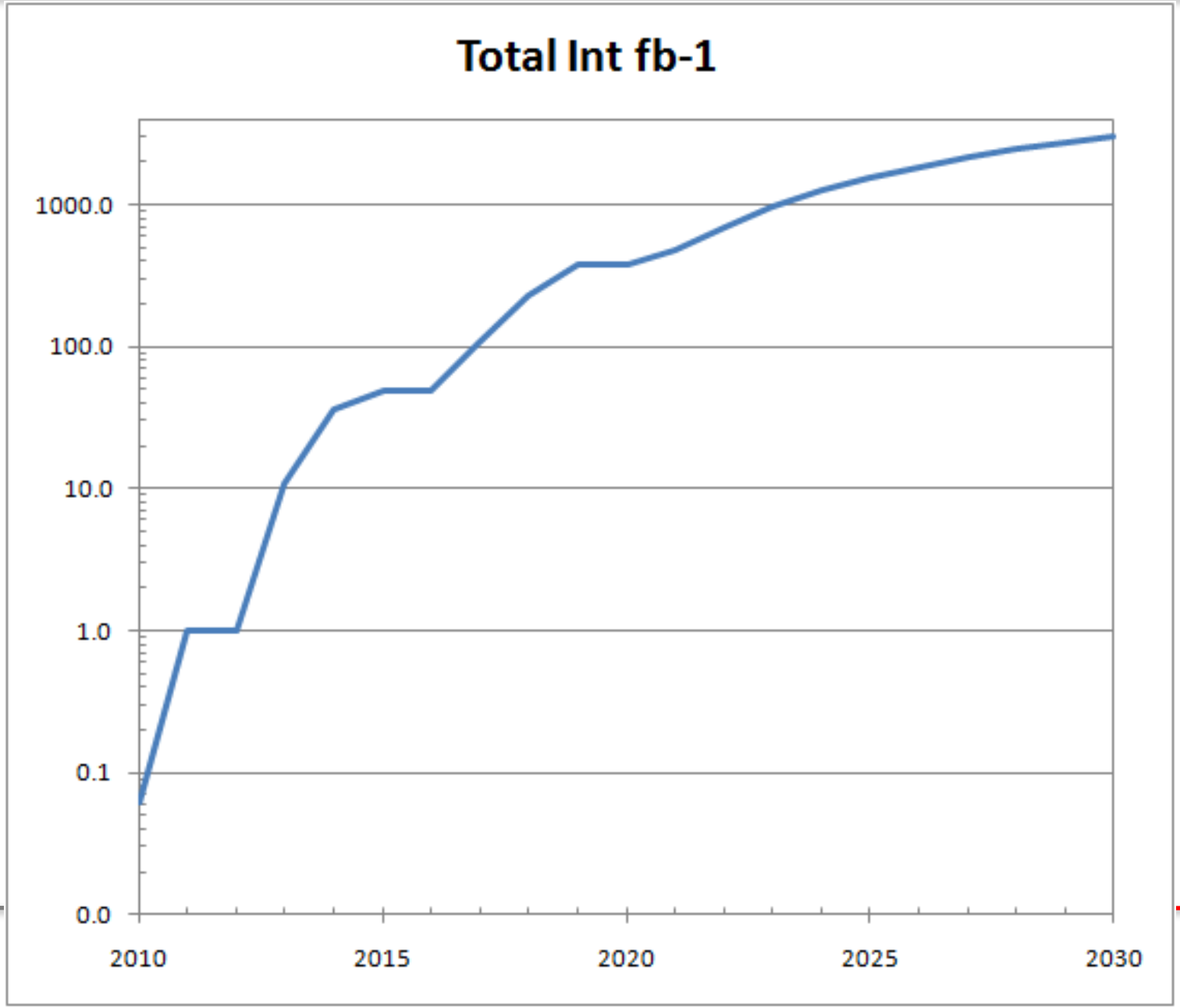
- Crab Cavities**: this is the best candidate for exploiting small β^***

–However it should be underlined that today Crab Cavities are not validated for LHC , not even conceptually: the issue of machine protection will be addressed with priority

New studies under way (HL-LHC)

- SC links to replace at the surface elecronic equipment today in the tunnel and exposed to high radiation
- New Cryoplants in IP1 & IP5: for power AND to make independent Arc- IR:
- Upgrades in the injector chain (LINAC4, PS Booster, PS, SPS)

Preliminary Long Term Predictions

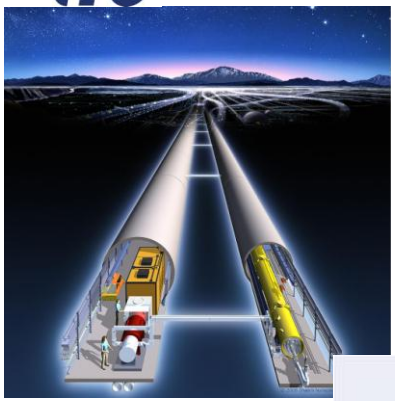


32 TeV HE-LHC!!! – main issues and R&D

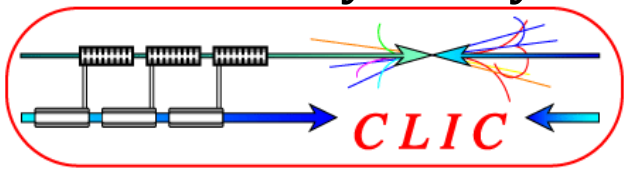
- high-field 20-T dipole magnets based on Nb_3Sn, Nb_3Al, and HTS
- high-gradient quadrupole magnets for arc and IR
- fast cycling SC magnets for 1-TeV injector
- emittance control in regime of strong SR damping and IBS
- cryogenic handling of SR heat load (first analysis; looks manageable)
- dynamic vacuum

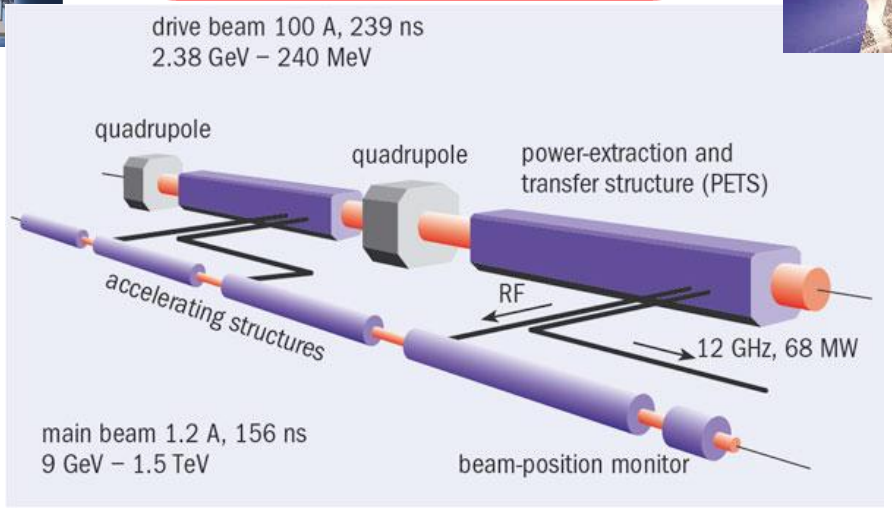
Vision for next machine (2030 ?)

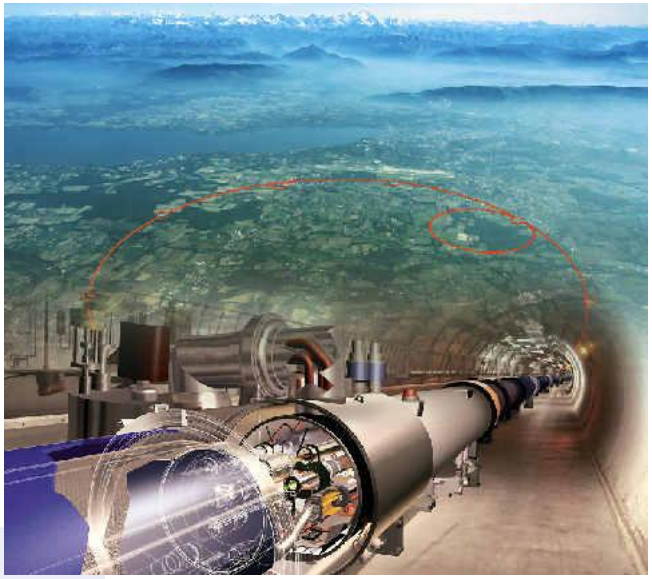
e+e- 500 GeV
Mature



e+e- 3 TeV
Feasibility Study

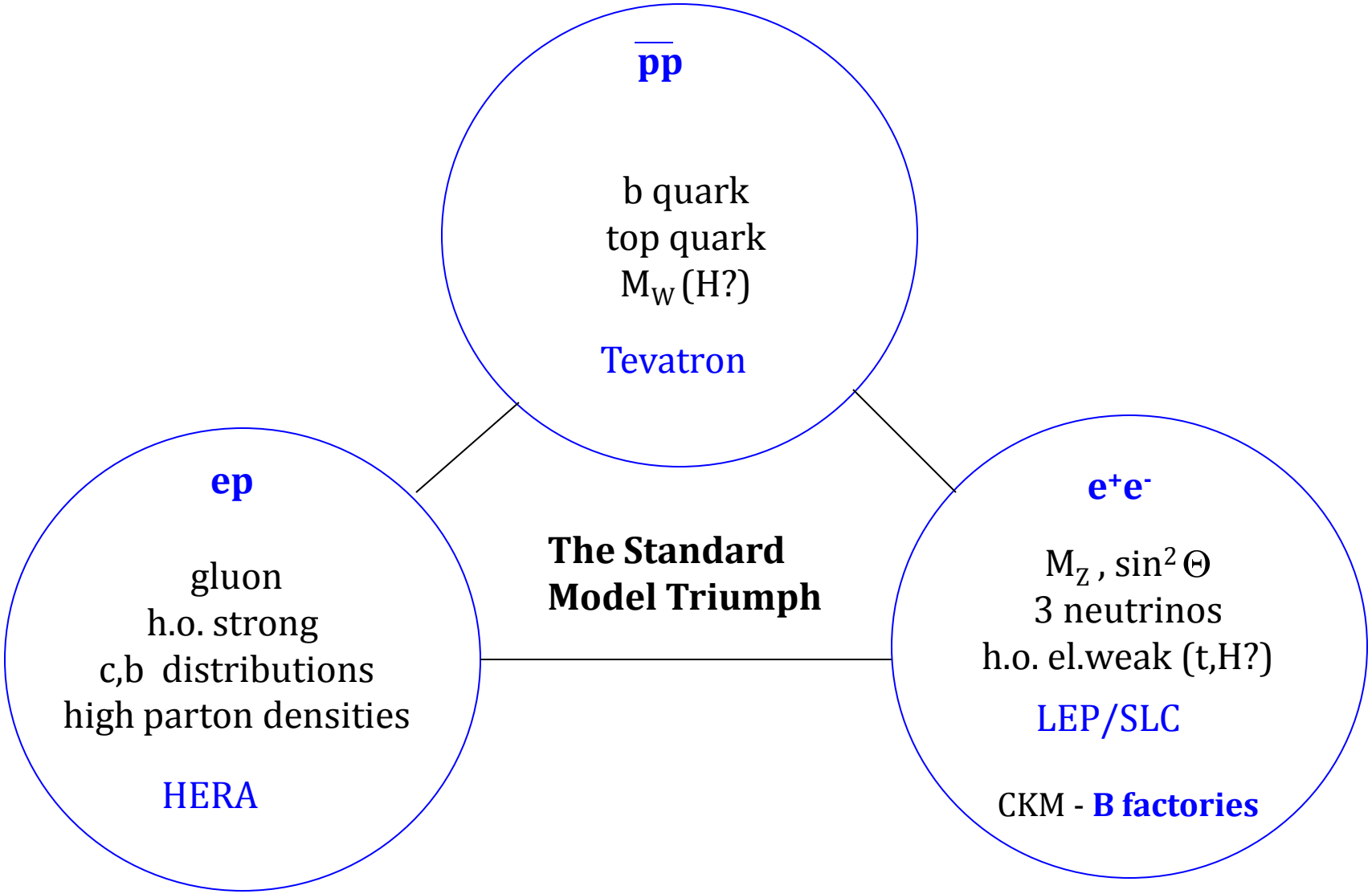




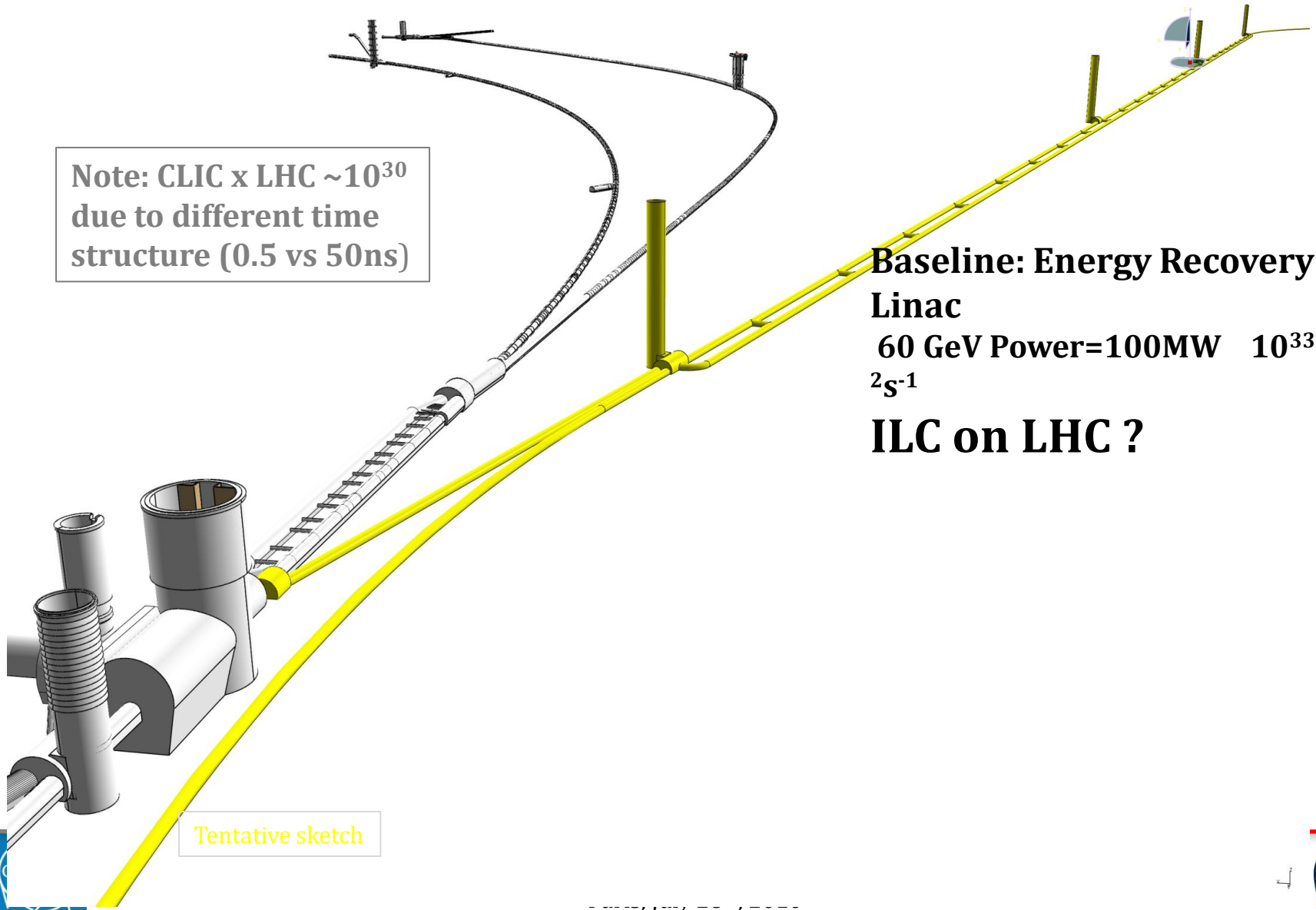


High Energy LHC
≥ 30 TeV
New Idea

The Fermi Scale [1985-2012]



ep Linac-Ring configuration



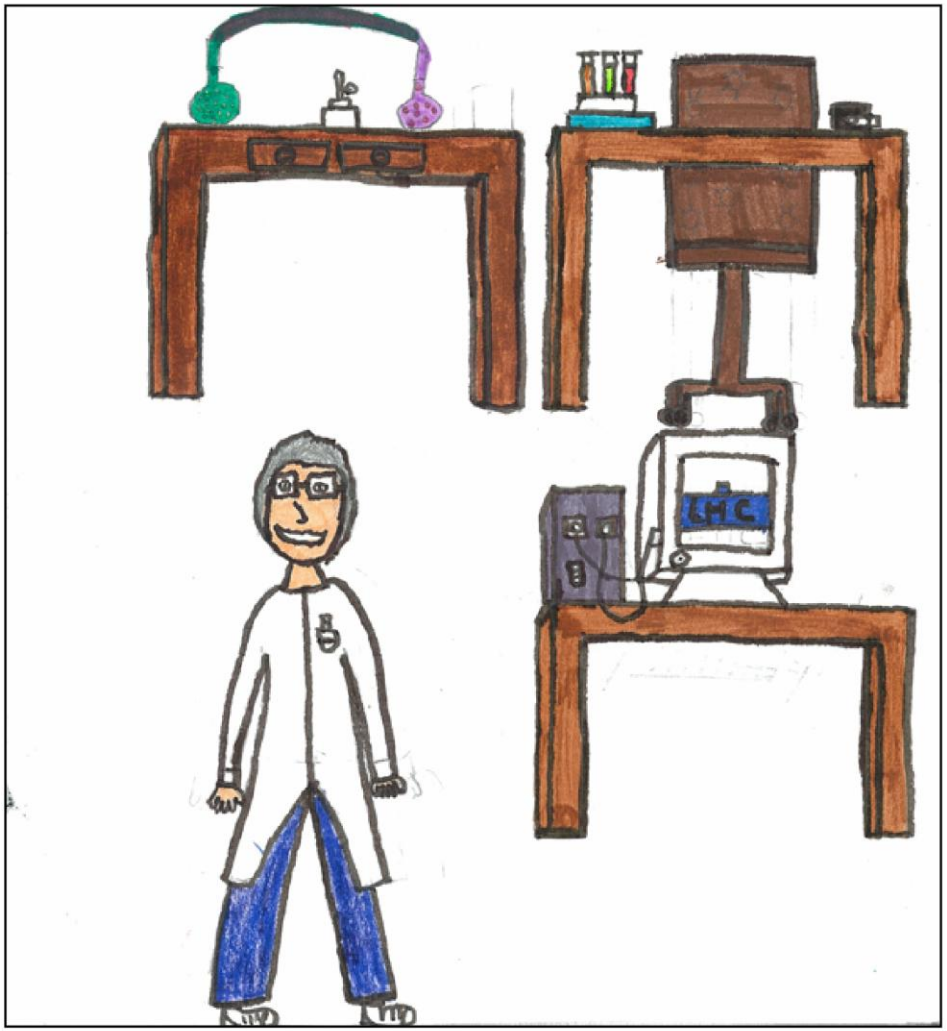
Note: CLIC x LHC ~10^{30} due to different time structure (0.5 vs 50ns)

Baseline: Energy Recovery Linac

60 GeV Power=100MW $10^{33}cm^{-2}s^{-1}$

ILC on LHC ?

Tentative sketch



Un physicien est une personne qui examine des choses, comme le noyau. Dans le noyau, il y a des protons et des neutrons, et dans les protons et les neutrons, il y a des quarks. Mais pas que ça ! Il y a encore plein de choses.

Lieke

Further in time…

Muon Collider Conceptual Layout

Project X
Accelerate hydrogen ions to 8 GeV using SRF technology.

Compressor Ring
Reduce size of beam.

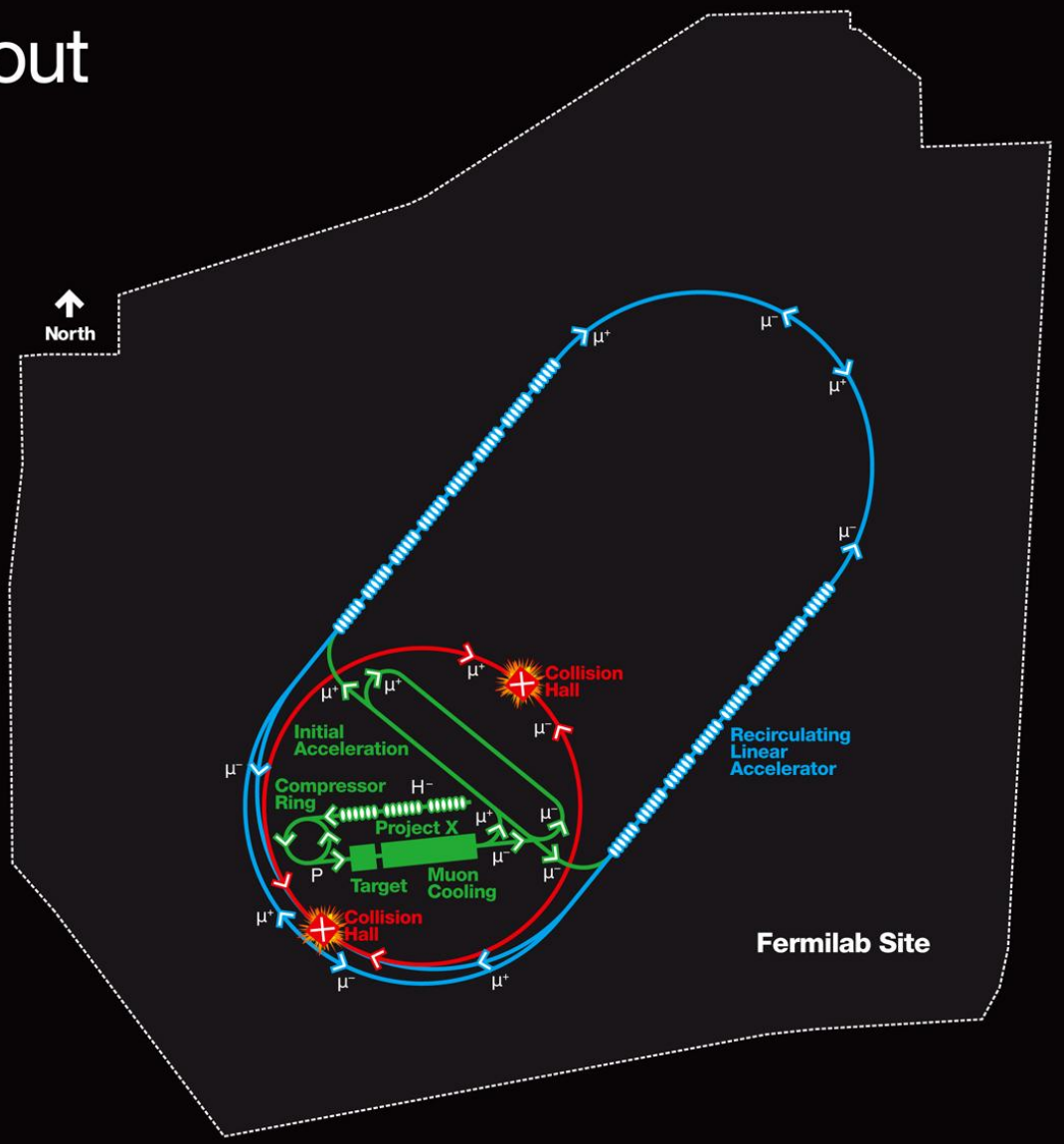
Target
Collisions lead to muons with energy of about 200 MeV.

Muon Capture and Cooling
Capture, bunch and cool muons to create a tight beam.

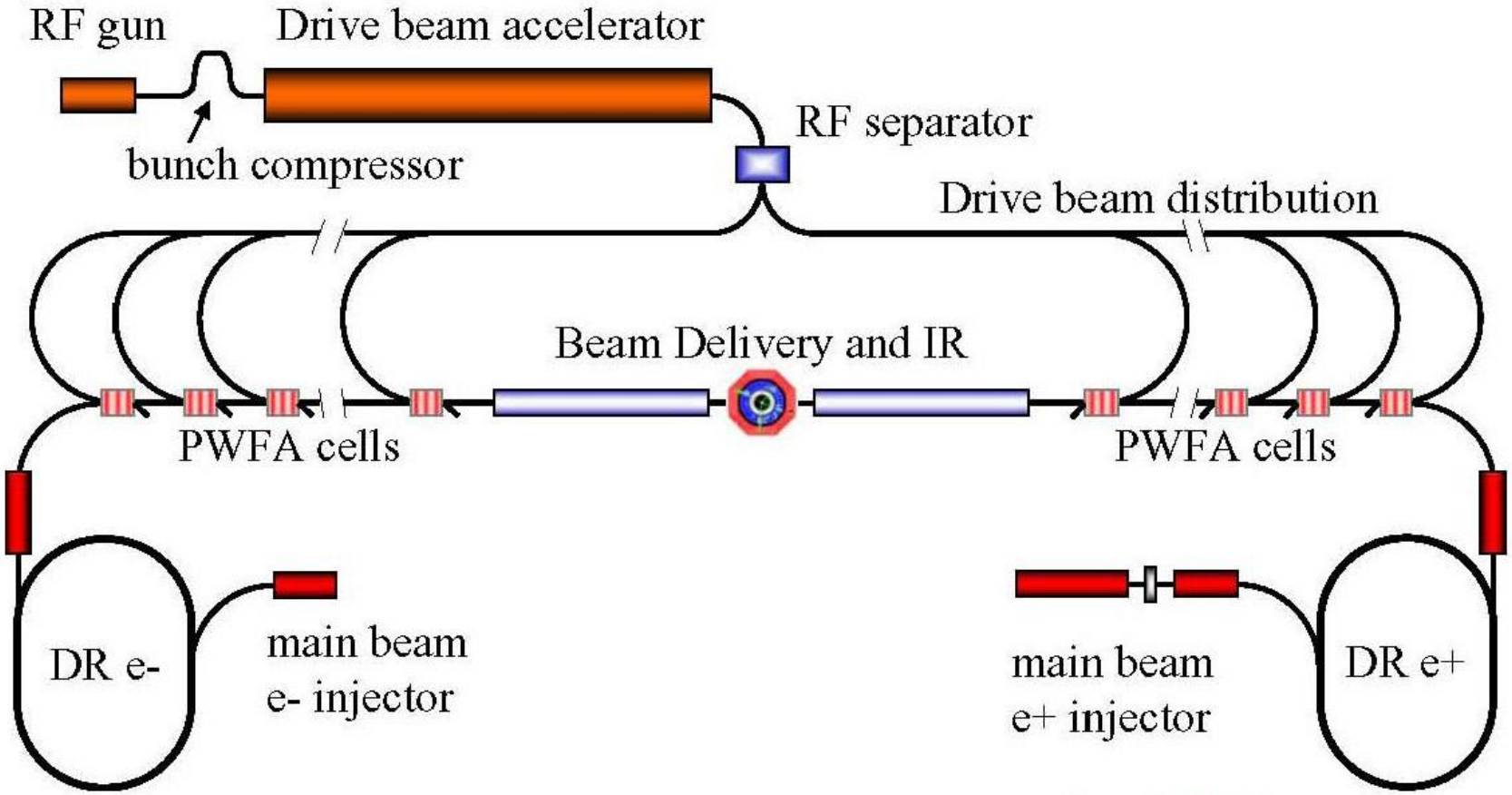
Initial Acceleration
In a dozen turns, accelerate muons to 20 GeV.

Recirculating Linear Accelerator
In a number of turns, accelerate muons up to 2 TeV using SRF technology.

Collider Ring
Bring positive and negative muons into collision at two locations 100 meters underground.



Even further : particle or laser plasma acceleration



Un physicien recherche des machines pour le futur, exemple une machine pour la téléportation.

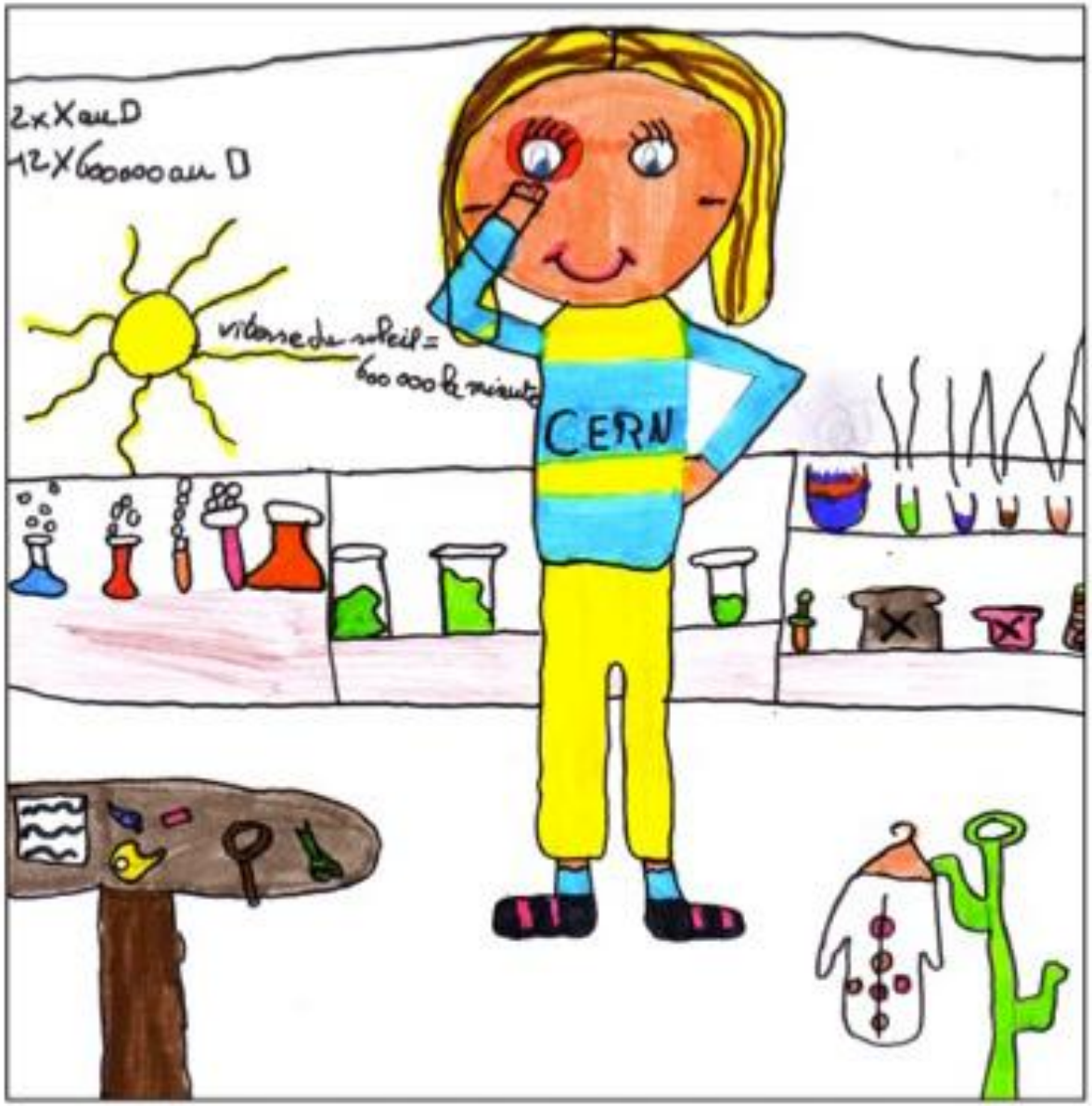
Alban

FALC: Funding Agencies for Large Colliders

- FALC serves as a venue for funding agencies to communicate with one another information about their programs, program plans, and issues related to future large particle physics projects.
- The exchange of information serves to frame discussions of future multi-lateral projects and ensure governments are prepared for productive negotiations.
- Increased recognition of FALC so as to ensure governments are fully aware of its work.
- NB. CERN is open now to become also a global forum place

Meeting of FALC at Fermilab in 2006

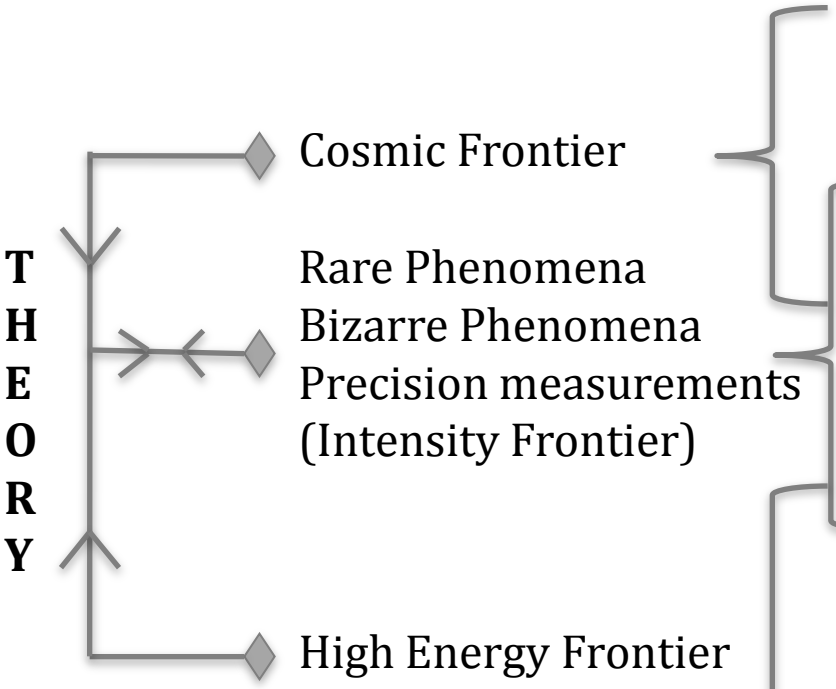
Meeting of FALC at Tata Institute in Mumbai in 2010



Un physicien travaille avec des physiciens d'autres pays.

Lorena

HIGHLIGHTS, VISION: Outline



*Cosmology : what is the Universe made of ?

*High Energy Cosmic Rays, new messengers : high energy phenomena in the Universe

*ν properties, p decay : a window towards the highest energies

* ν long Baseline

*edm, g-2, **p size, μ ->eγ (PSI)**

***B**, K, c, t decays, CKM, **CP violation**

***W, Z, t production, mass…

*Point like structure

*q, g plasma

*New Physics **(Moment of truth: Tevatron, LHC ?)**

- Higgs or no Higgs

-Susy, Z', …

-Extra dimensions

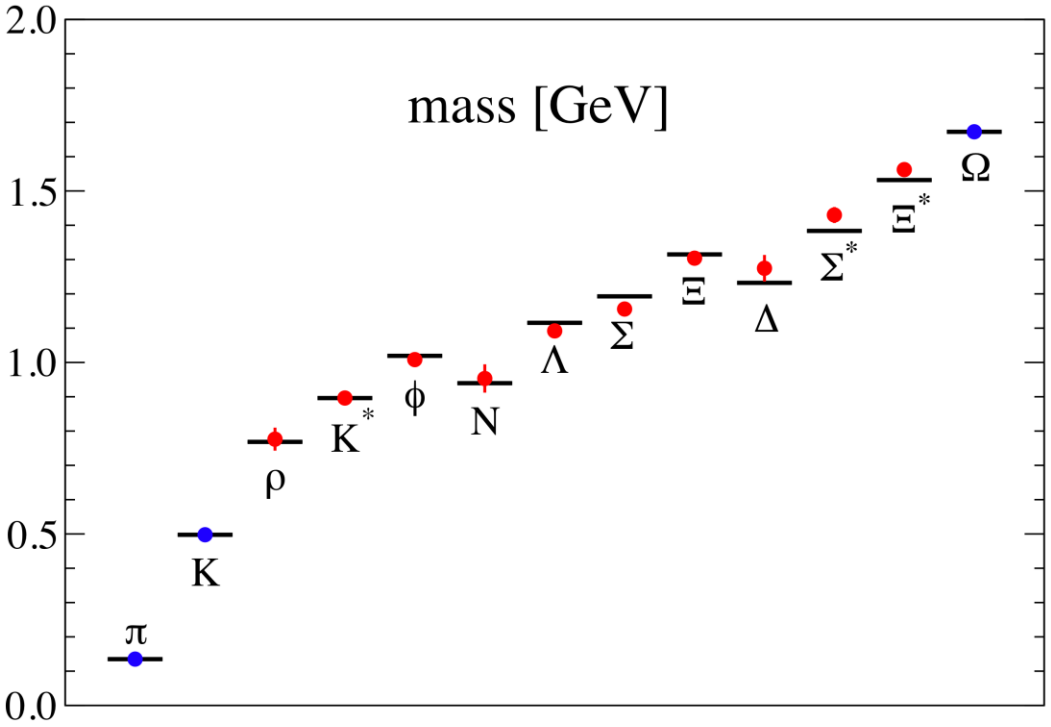
- Mini black holes…

Theory

- Lattice theory: spectra, quark gluon plasma..
- Ongoing developments on Gravity (Effective theory, quantization)
- Black Holes
- Inflation, chaotic inflation…
- Strings…

Hadron Spectrum in 2+1 Flavor lattice QCD

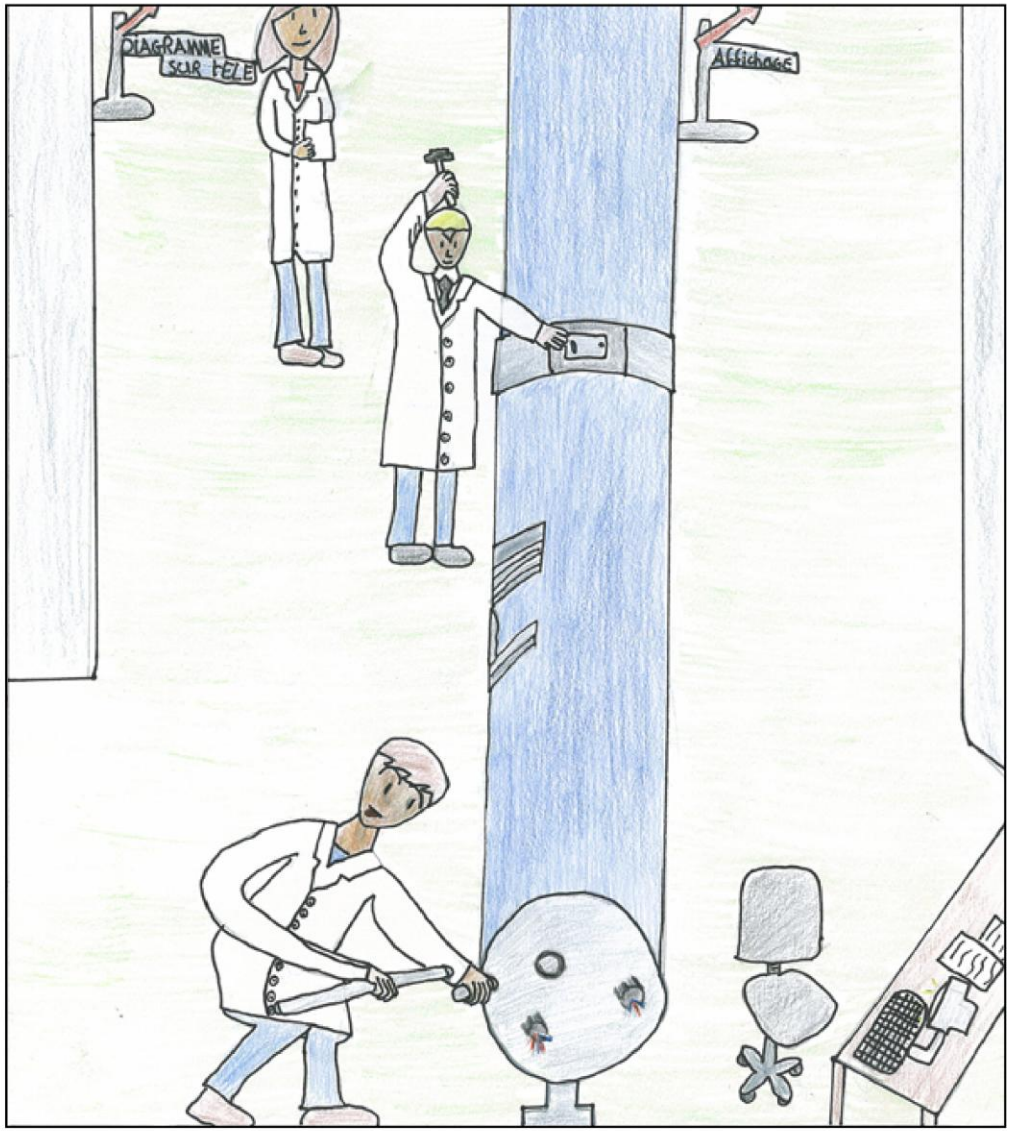
physical input m_π, m_K, $m_\Omega \Rightarrow m_u=m_d$, m_s, a



PACS-CS 09

consistent within 2∼3% error bars

similar results are obtained by other groups
MILC, RBC/UKQCD, BMW, ...

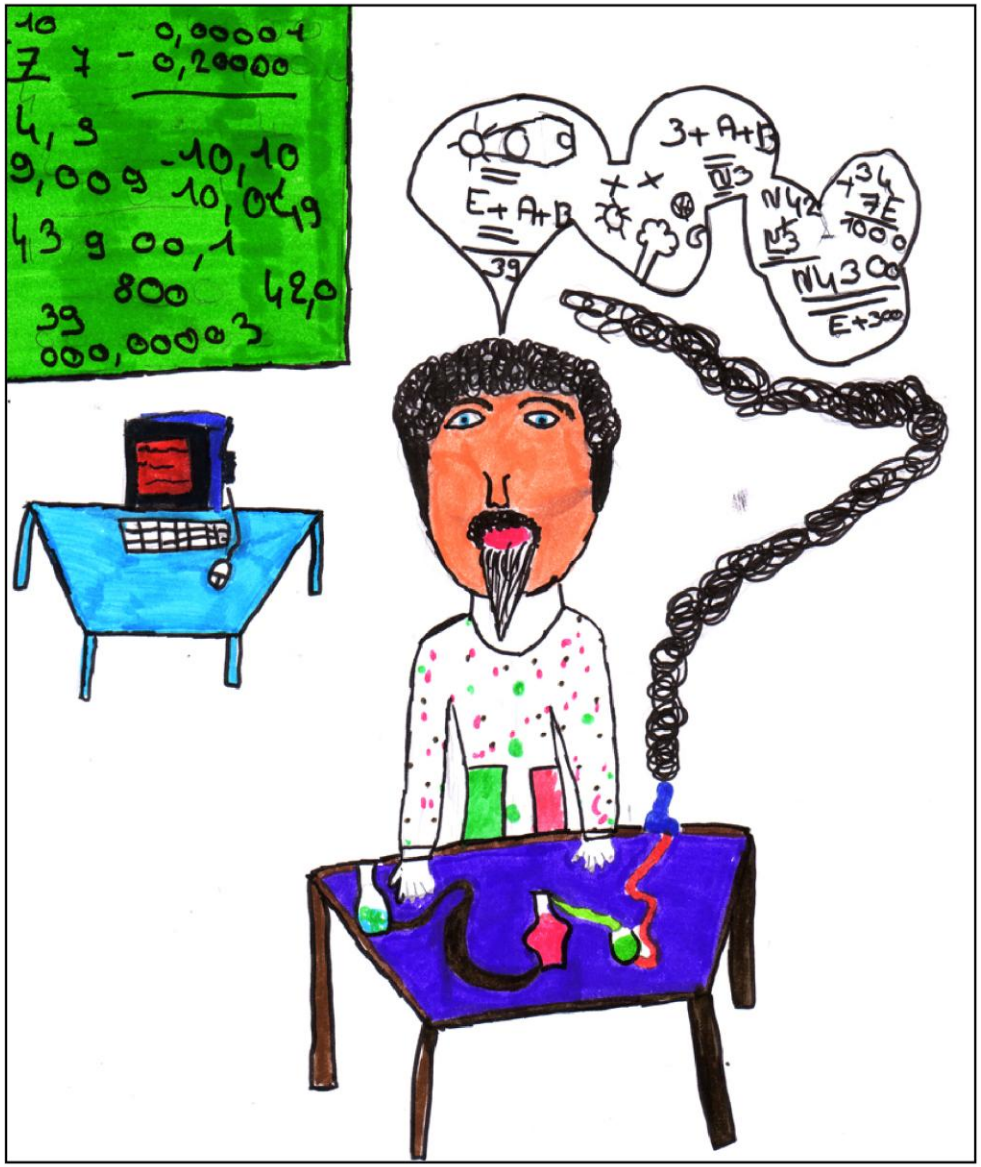


Le physicien fait des expériences pour mieux connaître l'Univers et il essaie même de faire des petits trous noirs.

Jessica

Un physicien est un scientifique qui cherche à faire apparaître un portail tridimensionnel entre deux dimensions parallèles.

Nicolas



Un physicien fait des milliers de calculs et cherche ce qu'il y a après l'espace. *Lise*

Dessine-moi un physicien

Un physicien cherche le pourquoi du pourquoi.

Clément

www.cern.ch/dessine-moi-un-physicien

THANK YOU

- The organizers (special mention to Guy Wormser)
- The contributors (I stole many slides from the contributors to this conference: they will recognize themselves)
- The remaining audience for their patience
- Sorry for being unfair to many of you..
- Sorry for showing you 100 slides in 30 mn
- Thanks to Sarodia for helping me!!