Sommario di HEP 2013 Stoccolma 18-24 07 2013

Agenda Plenarie

14:30 - 16:20 Joint ECFA-EPS session - open to all

Chairs: Paris Sphicas, Manfred Krammer

Location: Stockholm University Campus (Aula Magna

14:30 **EPS-HEPP Board** *10'*
Speaker: Paris Sphicas (CERN/Athens)

14:40 **ECFA** *10'*
Speaker: Manfred Krammer (HEPHY/Vienna
Material: Slides Video

14:50 **The Update of the European Strategy**
Speaker: Tatsuya Nakada (Ecole Polytechni
Material: Slides Video

15:10 **Q&A** *10'*

15:20 **The CERN program** *20'*
Speaker: Rolf Heuer (CERN)
Material: Slides Video

15:40 **Q&A** *10'*

15:50 **The ILC program in Japan** *20'*
Speaker: Sachio Komamimya (Tokyo)
Material: Slides Video

16:10 **Q&A** *10'*

16:20 - 16:50 Coffee

16:50 - 19:00 Joint ECFA-EPS session - open to all

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013 Stockholm (17-24 July 2013)

16:50 **The ongoing strategy discussion in th**
Speakers: Andrew James Lankford (Univers
(University of California Irvine (U
Material: Slides

17:10 **Q&A** *10'*

17:20 **Neutrino program: the future** *20'*
Speaker: Andre Rubbia (Eidgenoessische Te
Material: Slides

17:40 **Q&A** *10'*

17:50 **Accelerator R&D for future machines**
Speaker: Leonid Rivkin (Paul Scherrer Insti
Material: Slides

Monday, 22 July 2013

09:00 - 11:00 Ceremony & Introduction
Convener: Paris Sphicas (CERN/Athens)
09:00 **Welcome from the Local Organizers** 4'
Speakers: Bengt Lund-Jensen (KTH Royal In
University)
Material: Slides
09:04 **Welcome from the Dean of Faculty of S**
Speaker: Anders Karlhede (Stockholm Univer
09:12 **Welcome from the Dean of the School**
Speaker: Leif Kari (KTH)
09:20 **EPS HEPP prize award and talks by rec**
09:55 **Cocconi prize award and talks by recip**
10:20 **Gribov, Young Physicist and Outreach**
10:30 **Ancestry of a New Boson** *30'*
Speaker: Peter Higgs (Edinburgh)
Material: Video

11:00 - 11:30 Coffee break

11:30 - 13:00 Higgs Session
Convener: Prof. Yves Sirois (Ecole Polytechnique (FR))
11:30 **Higgs bosons in the Standard Model an**
Speaker: Greg Landsberg (Brown University
Material: Slides
12:00 **Properties of the new boson** *30'*
Speaker: Fabio Cerutti (Lawrence Berkeley N
Material: Slides Video
12:30 **The scalar sector of the SM and beyond**
Speaker: Christophe Grojean (ICREA/IFAE ar
Material: Slides

13:00 - 14:30 Lunch

14:30 - 16:00 Standard Model
Convener: Zoltan Laszlo Trocsanyi (University of Debr
14:30 **Standard Model theory for collider phy**
Speaker: Daniel de Florian (Universidad de B
Material: Slides Video
15:00 **Electroweak physics** *30'*
Speaker: Jan Stark (LPSC Grenoble)
Material: Slides Video
15:30 **Top physics** *30'*
Speaker: Sara Kristina Strandberg (Stockhol

2013 Stockholm (17-24 July 2013)

Material: Slides Video

16:00 - 16:30 Coffee

16:30 - 18:00 AdS/FT and heavy ions
Convener: Barbara Erazmus (CERN/SUBATECH)
16:30 **AdS/CFT and applications** *30'*
Speaker: Romuald Janik (Cracow)
Material: Slides Video
17:00 **Heavy ions: flavour production** *30'*
Speaker: Silvia Masciocchi (GSI Darmstadt (
Material: Slides Video
17:30 **Heavy ions: jets and correlations** *30'*
Speaker: Gabor Veres (CERN)
Material: Slides Video

Tuesday, 23 July 2013

09:00 - 19:00 Plenary 2
Conveners: Roger Barlow (University of Manchester (GB)), V
(Instituto Superior Tecnico (PT)), Bob Van Eijk (
Location: Stockholm University Campus (Aula Magna)
09:00 **Dark matter: theory** *30'*
Speaker: Geraldine Servant (ICREA Barcelona)
Material: Slides Video
09:30 **Dark matter: direct searches for WIMPs** *30'*
Speaker: Laura Baudis (University of Zurich)
Material: Slides
10:00 **Indirect searches for dark matter** *30'*
Speaker: Sylvie Rosier-Lees (LAPP)
Material: Slides Video
10:30 **Cosmic rays and neutrinos** *30'*
Speaker: Elisa Resconi (TUM)
Material: Slides Video
11:00 **Coffee and poster session II** *30'* ( )
11:30 **Cosmology: theory** *30'*
Speaker: Mikhail Shaposhnikov (EPFL)
Material: Slides Video
12:00 **Cosmology: experiment** *30'*
Speaker: Olivier Perdereau (LAL)
Material: Slides Video
12:30 **QCD Lattice** *30'*
Speaker: Prof. Christopher Sachrajda (University o
Material: Slides Video
13:00 **Lunch** *1h30'* ( )
14:30 **Detector R&D** *30'*
Speaker: Francesco Forti (Pisa)
Material: Slides Video
15:00 **LHC, HL-LHC and beyond** *30'*
Speaker: Mike Lamont (CERN)
Material: Slides
15:30 **Accelerator R&D** *30'*
Speaker: Ralph Assmann (DESY)
Material: Slides Video
16:00 **Coffee break** *30'* ( )
16:30 **Neutrino mixing: results from non-accelera**
Speaker: Yifang Wang (IHEP Beijing)
Material: Slides Video

3 Stockholm (17-24 July 2013) https

17:00 **Neutrino mixing: results from accelerator e**
Speaker: Atsuko Ichikawa (Kyoto)
Material: Slides Video
17:30 **Neutrinos: masses** *30'*
Speaker: Oliviero Cremonesi (INFN Milano Bicocca)
Material: Slides Video

19:15 - 23:00 Conference Dinner at Vasa Museum
Conference Dinner at Vasa Museum
Location:

Wednesday, 24 July 2013

09:00 - 19:00 Plenary 3
Conveners: Prof. Paula Eerola (University of Helsinki (FI)), Teresa Rodrigo (Universidad de Cantabria (ES)),
Daniel Wyler (ITP Zurich), Thomas Lohse (Humboldt-Universitaet zu Berlin (DE))
09:00 **Scattering amplitudes in Quantum Field Theory** *30'*
Speaker: Zvi Bern (UCLA)
Material: Slides Video
09:30 **QCD experiment (includes W/Z+jets)** *30'*
Speaker: Konstantinos Kousouris (CERN)
Material: Slides Video
10:00 **Flavour physics: experiment** *30'*
Speaker: Stephanie Hansmann-Menzemer (Heidelberg)
Material: Slides Video
10:30 **Flavour physics: theory** *30'*
Speaker: Jernej Kamenik (JSI Ljubljana)
Material: Slides Video
11:00 Coffee break *30'* ( )
11:30 **Announcement of Elsevier Poster Prizes** *5'*
11:35 **Charged lepton flavor and dipole moments** *30'*
Speaker: Klaus Kirch (ETHZ / PSI)
Material: Slides Video
12:05 **Searches for new resonances from BSM** *30'*
Speaker: Fabienne Ledroit (LPSC Grenoble)
Material: Slides Video
12:35 **Non-resonant and unusual BSM signatures** *30'*
Speaker: Freya Blekman (VUB)
Material: Slides Video
13:05 Lunch *1h25'* (Stockholm University Campus)
14:30 **Searches for SUSY** *30'*
Speaker: Oliver Buchmueller (Imperial College)
Material: Slides Video
15:00 **Naturalness after LHC-7 and LHC-8** *30'*
Speaker: Gian Giudice (CERN)
Material: Paper Slides Video
15:30 **Probing EWSB and future Higgs physics** *30'*
Speaker: Roberto Contino (Rome)
Material: Slides Video
16:00 Coffee break *30'* ( )
16:30 **Highlights from EPS HEP 2013** *30'*
Speaker: Sergio Bertolucci (CERN)
Material: Slides Video
17:00 **Outlook** *30'*
Speaker: Gerard 't Hooft (Utrecht)
Material: Video

Agenda Odierna

Modello Standard

- HIGGS
- TOP
- ZW, etc

BSM : alta energia

BSM : alta precisione

- Leptoni (carichi)
- Adroni (b)

Neutrini

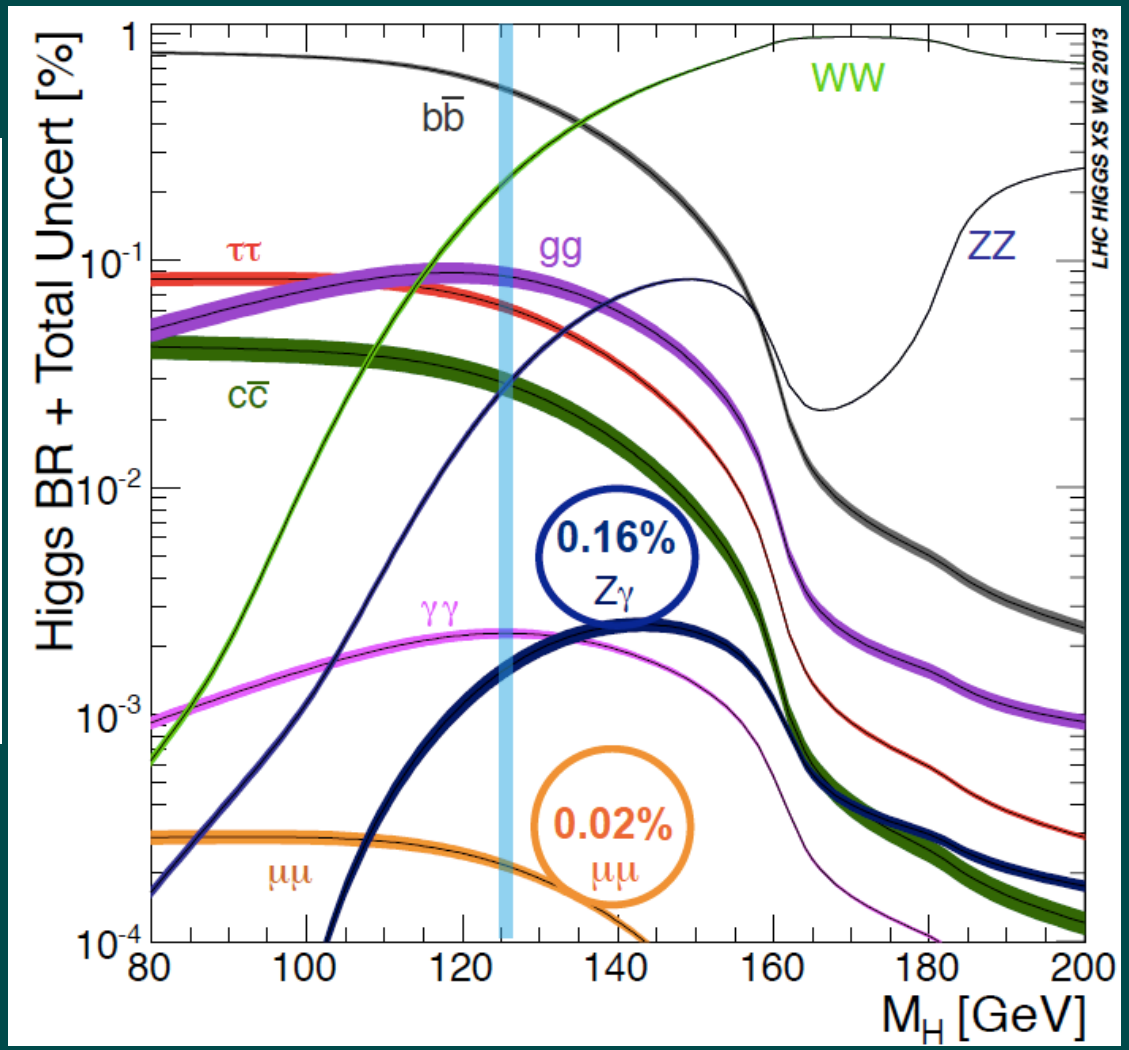
- masse
- oscillazioni

Prospettive

- medio e lungo termine
- dentro e fuori Europa

HIGGS (Landsberg, Cerutti, Grosjean)

- The "big five":
  - H(bb) - 57%
  - H(WW) - 22%
  - H(ττ) - 6.2%
  - H(ZZ) - 2.8%
  - H(γγ) - 0.23%



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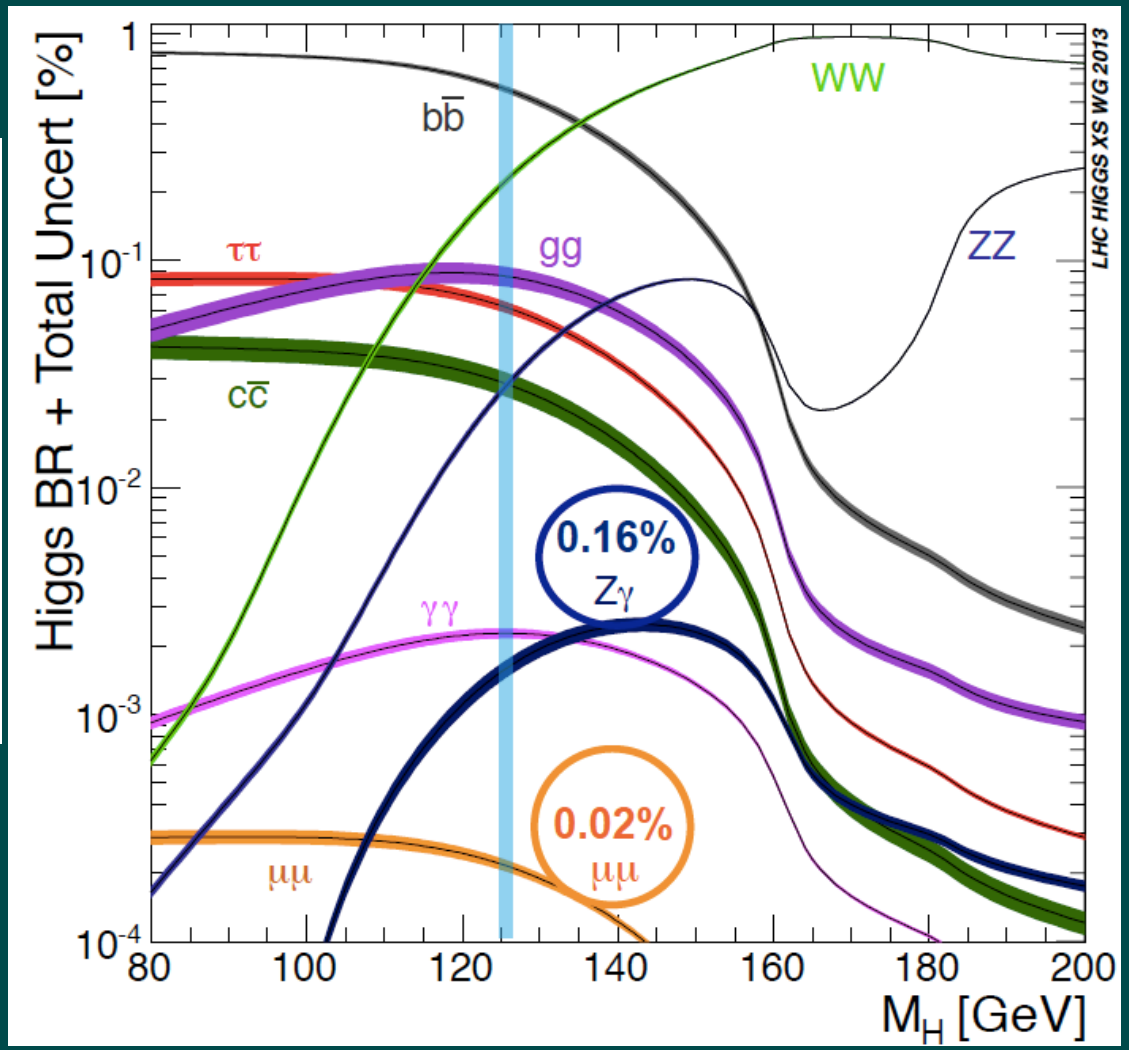
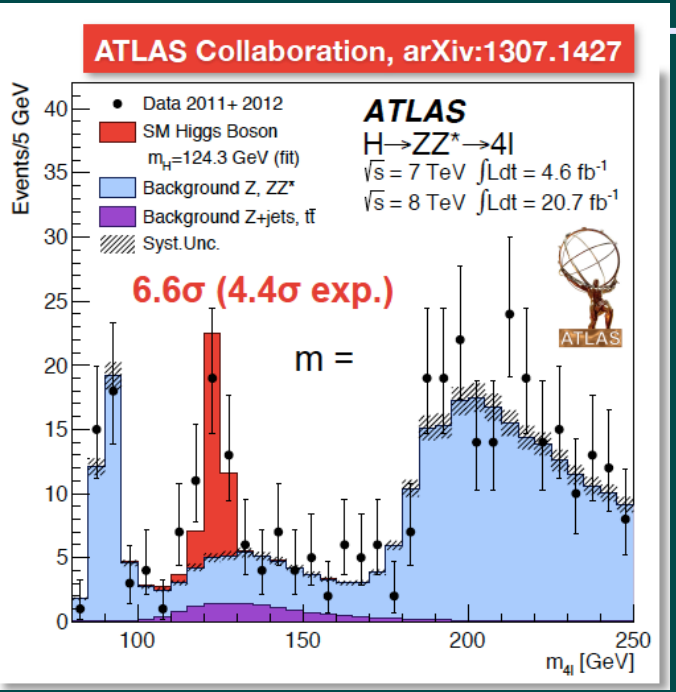
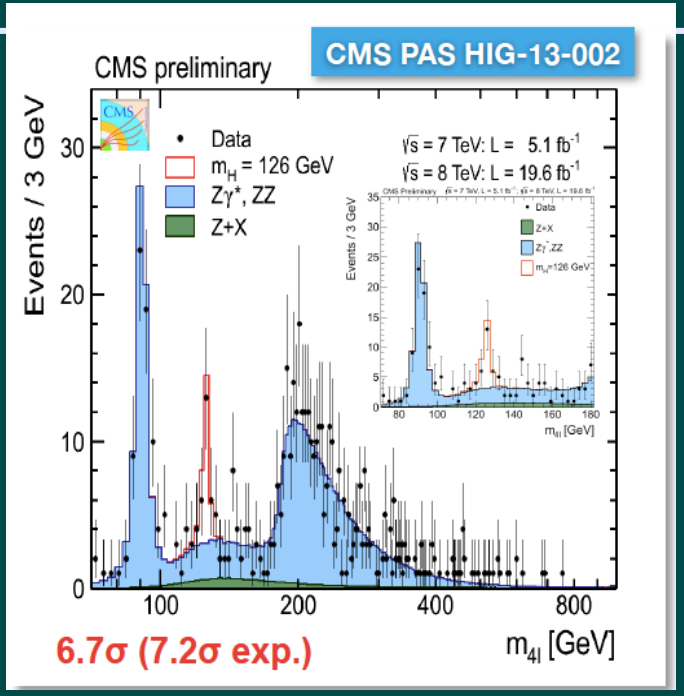
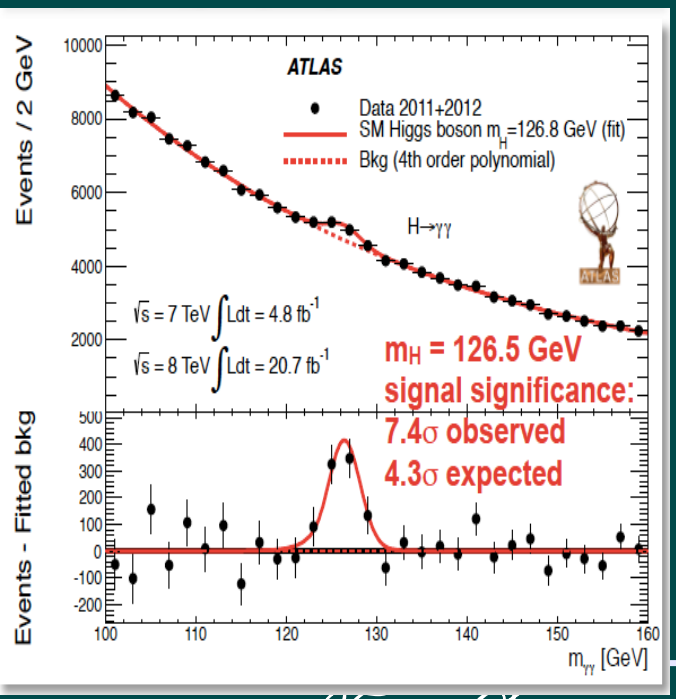
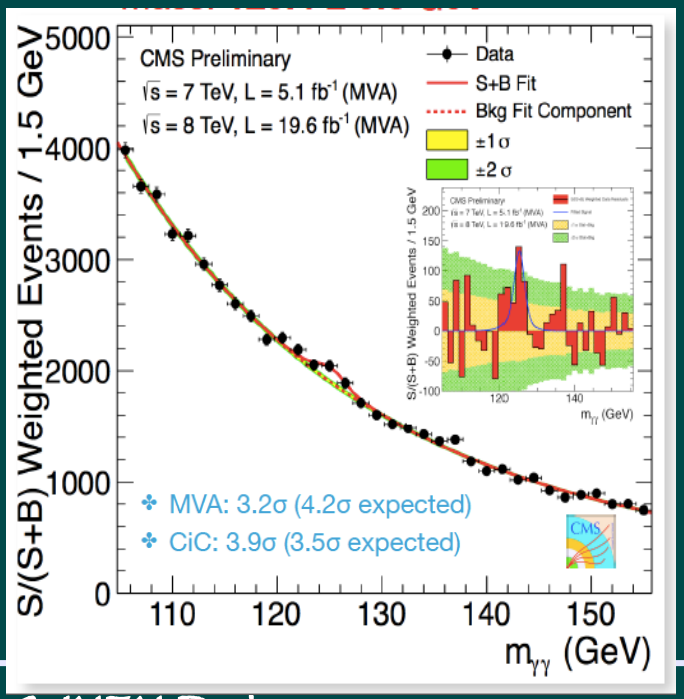


H -> ZZ, γγ


ATLAS Collaboration, arXiv:1307.1427
ATLAS
H→ZZ*→4l
√s = 7 TeV ∫Ldt = 4.6 fb-1
√s = 8 TeV ∫Ldt = 20.7 fb-1
Data 2011+ 2012
SM Higgs Boson
mH=124.3 GeV (fit)
Background Z, ZZ*
Background Z+jets, tt̄
Syst.Unc.
6.6σ (4.4σ exp.)
m =
Events/5 GeV
m4l [GeV]

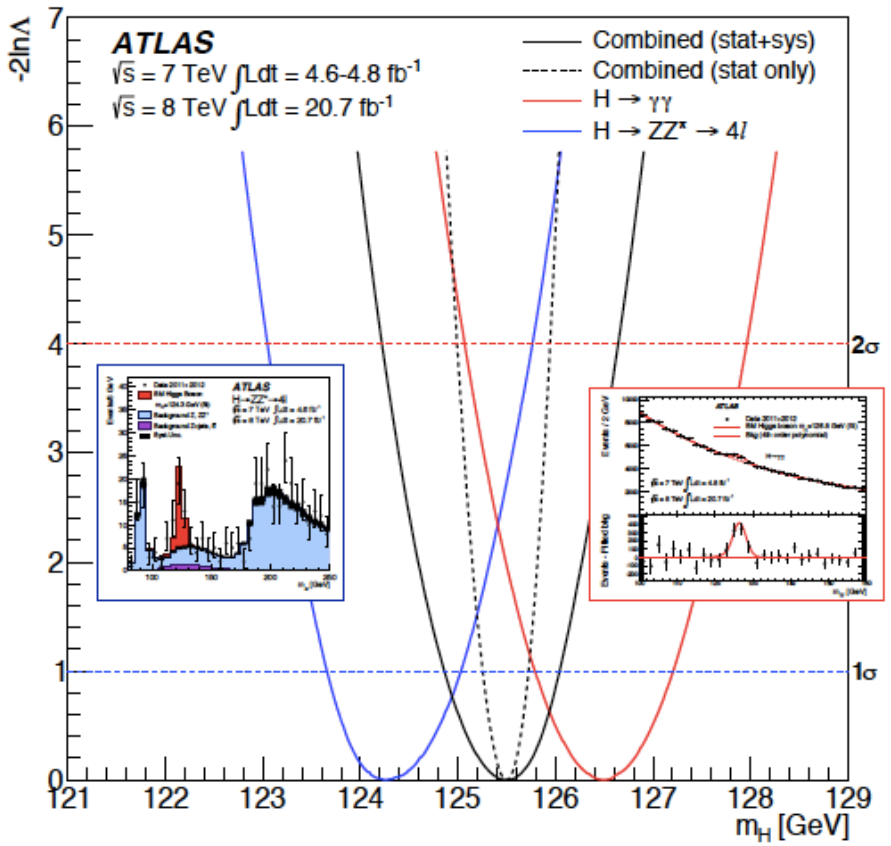

CMS preliminary
CMS PAS HIG-13-002
Data
mH = 126 GeV
Zγ*, ZZ
Z+X
√s = 7 TeV: L = 5.1 fb-1
√s = 8 TeV: L = 19.6 fb-1
6.7σ (7.2σ exp.)
Events / 3 GeV
m4l [GeV]

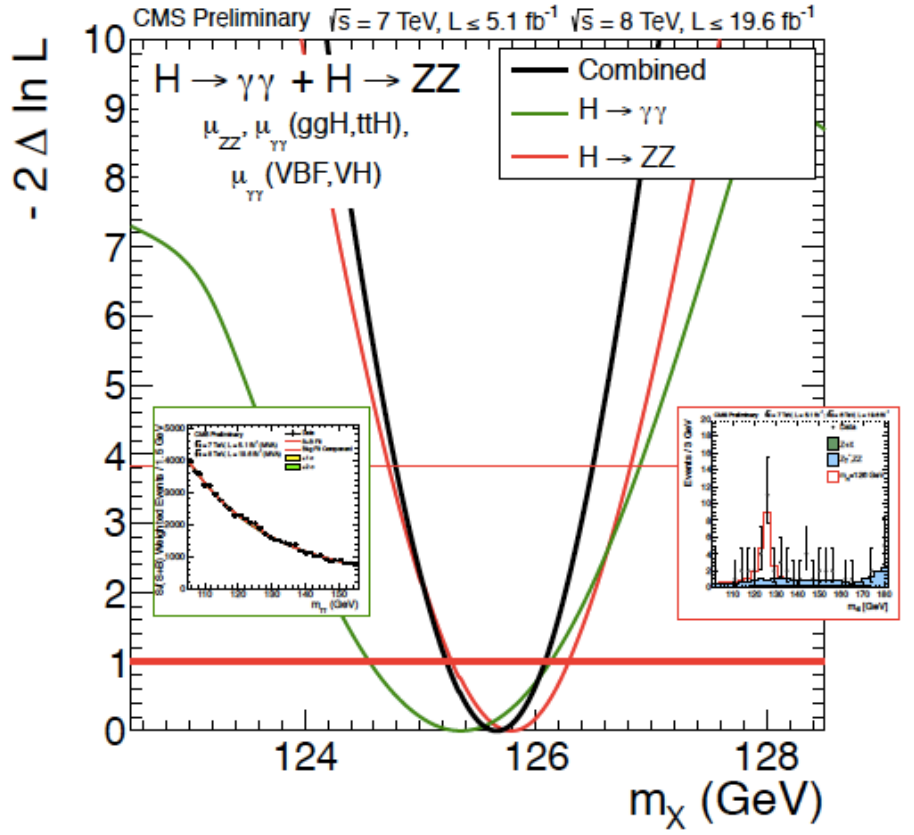

ATLAS
Data 2011+2012
SM Higgs boson mH=126.8 GeV (fit)
Bkg (4th order polynomial)
H→γγ
√s = 7 TeV ∫Ldt = 4.8 fb-1
√s = 8 TeV ∫Ldt = 20.7 fb-1
mH = 126.5 GeV
signal significance:
7.4σ observed
4.3σ expected
Events / 2 GeV
Events - Fitted bkg
mγγ [GeV]


CMS Preliminary
√s = 7 TeV, L = 5.1 fb-1 (MVA)
√s = 8 TeV, L = 19.6 fb-1 (MVA)
Data
S+B Fit
Bkg Fit Component
±1σ
±2σ
MVA: 3.2σ (4.2σ expected)
CiC: 3.9σ (3.5σ expected)
S/(S+B) Weighted Events / 1.5 GeV
mγγ (GeV)

Massa e Larghezza

Measured from γγ and ZZ*(4ℓ) mass spectra: needed to predict σ×BR





ATLAS: $M_H = 125.5 \pm 0.2_{stat} \pm 0.6_{sys}$ GeV

CMS: $M_H = 125.7 \pm 0.3_{stat} \pm 0.3_{sys}$ GeV

New

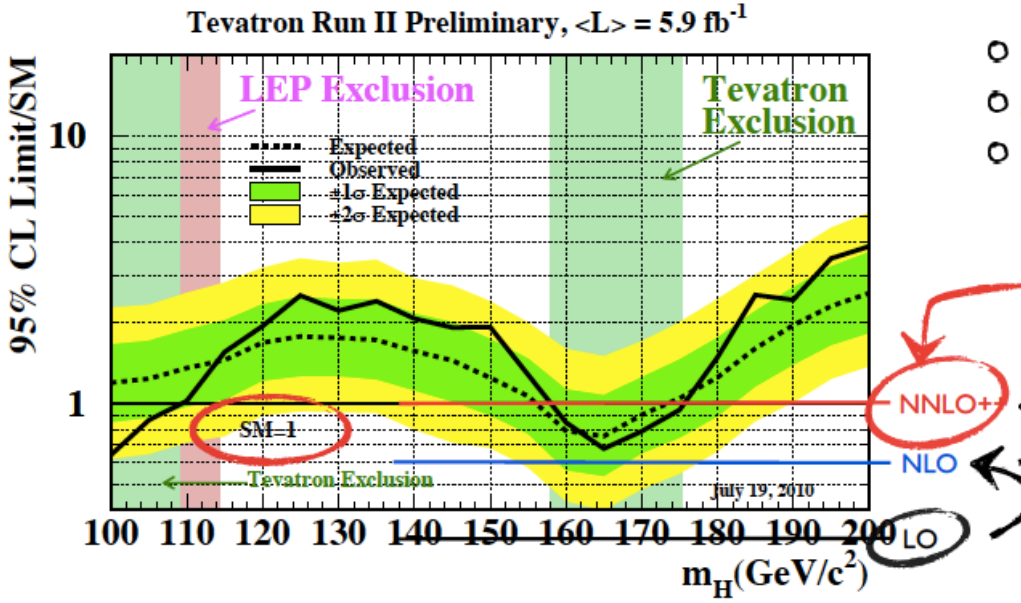
From γγ: $\Gamma_H < 6.9$ GeV at 95% CL (direct)

Now what?

"The experiment worked better than expected and the analysis uncovered a very difficult to find signal"

the words of a string theorist

Why did it work better than expected?



- Hard work from experimentalists
- Luck with a positive fluctuation
- Hard work from the theorists too

higher precision in theory calculation makes it easier to find the Higgs than initially thought

K-factor ≈ 1.25

K-factor ≈ 2

R. Harlander, talk @ LHCP'13

Christophe Grojean — The scalar sector of the SM and beyond — 4 — EPS-HEP, 22nd July 2013

Now what?

"The experiment worked better than expected and the analysis uncovered a very difficult to find signal"

the words of a string theorist

The Higgs has access to EW coupled New Physics
which is less constrained by direct searches than strongly coupled NP

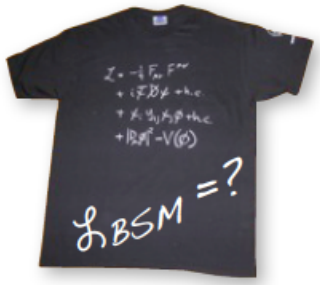
1 Higgs properties

J^{PC}

Important & nice to see progresses but "this question carries a similar potential for surprise as a football game between Brazil and Tonga" Resonaances

2 Higgs couplings

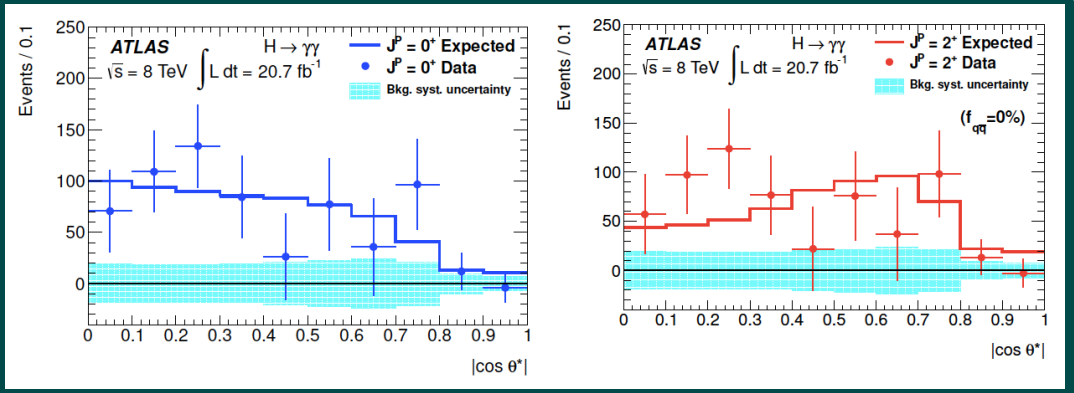
3 BSM implications



Christophe Grojean The scalar sector of the SM and beyond 10 EPS-HEP, 22nd July 2013

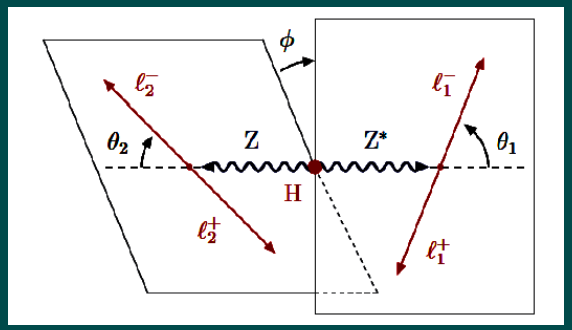
H: J^P

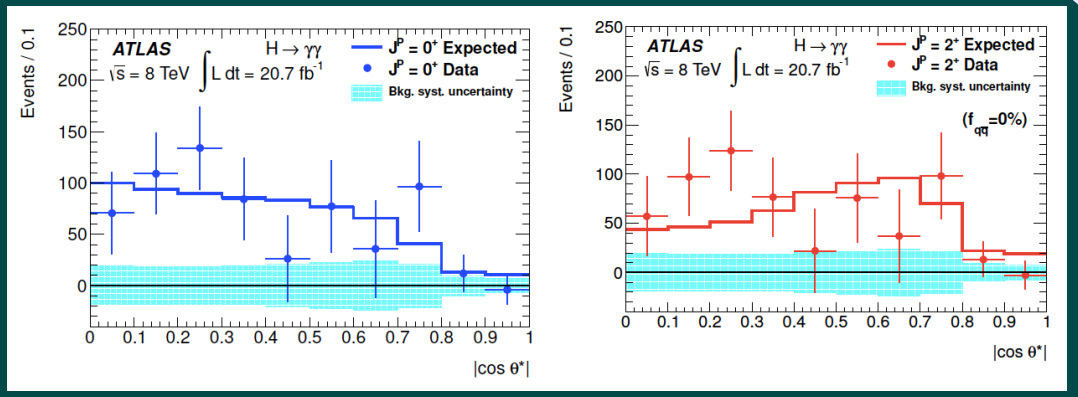
- H -> gg : cosθ in Collins-Sopper r.f.

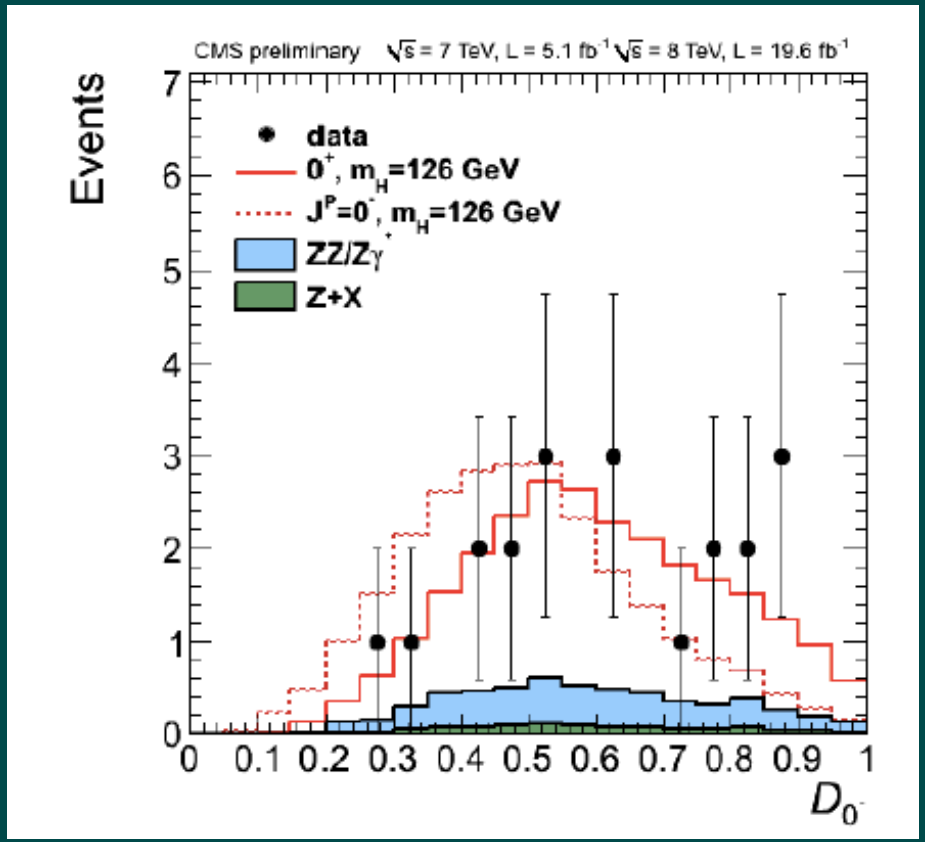


H: J^P

- H -> gg : cosθ in Collins-Sopper r.f.
- H ->ZZ -> 4ℓ : MVA







H: J^P

- H -> gg : cosθ in Collins-Sopper r.f.
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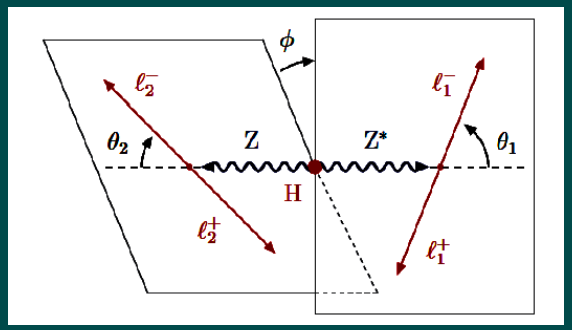
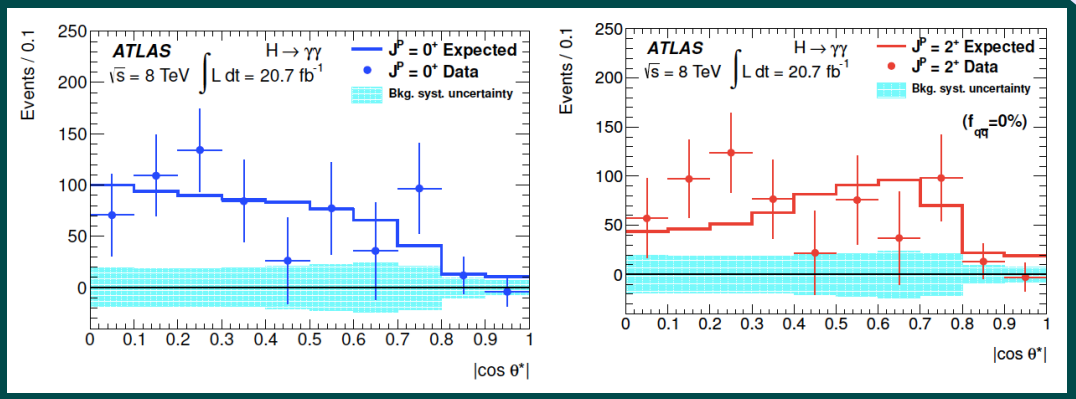
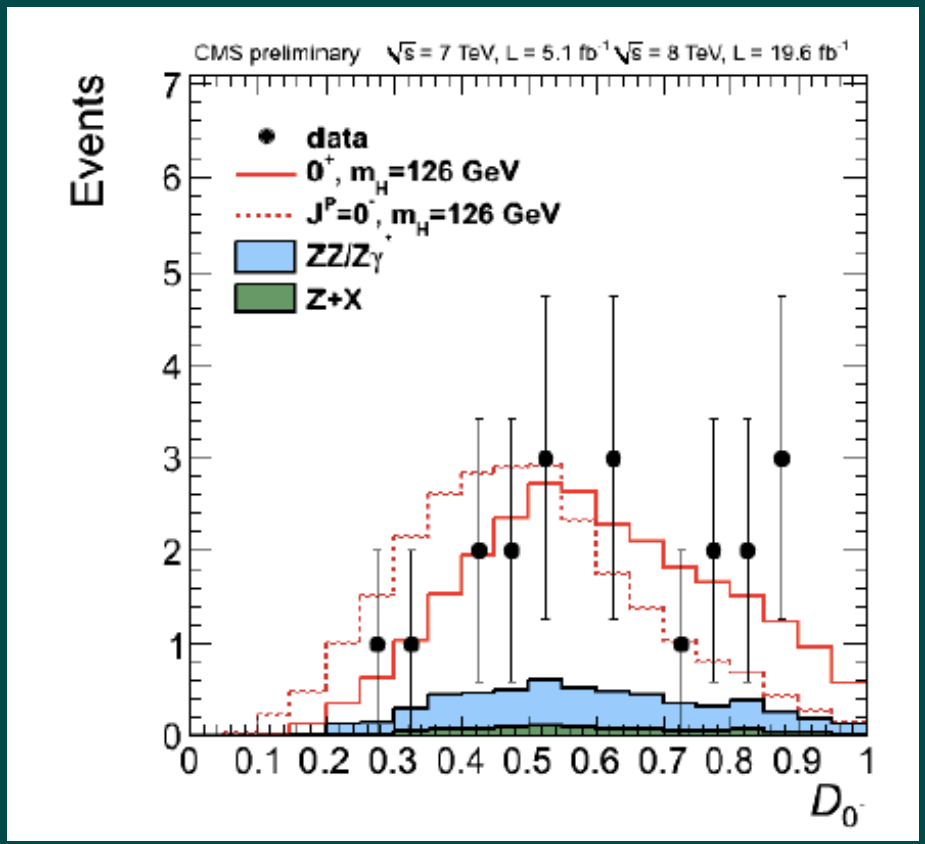
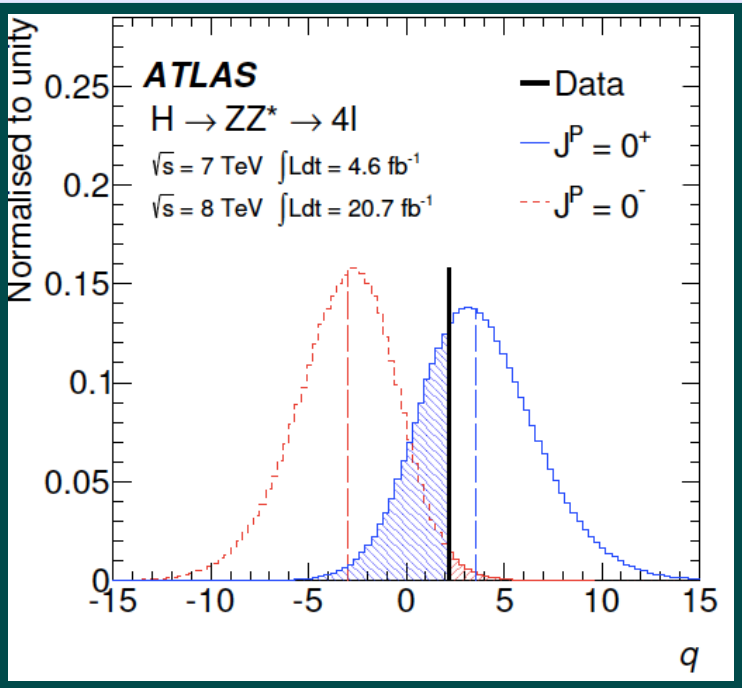


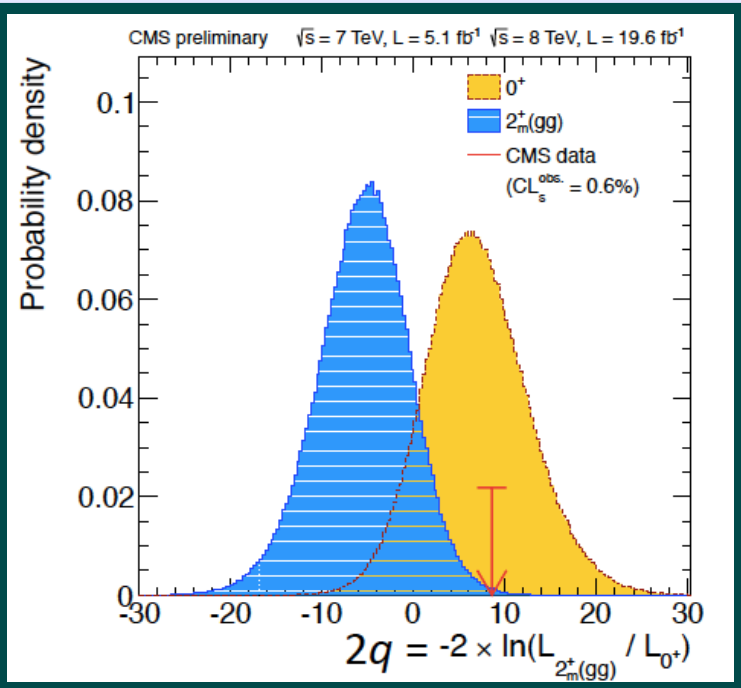
- Usato solo ZZ
- test SM (0^+) vs altre ipotesi (0^-, 1^+,1^-,2^+,2^-)

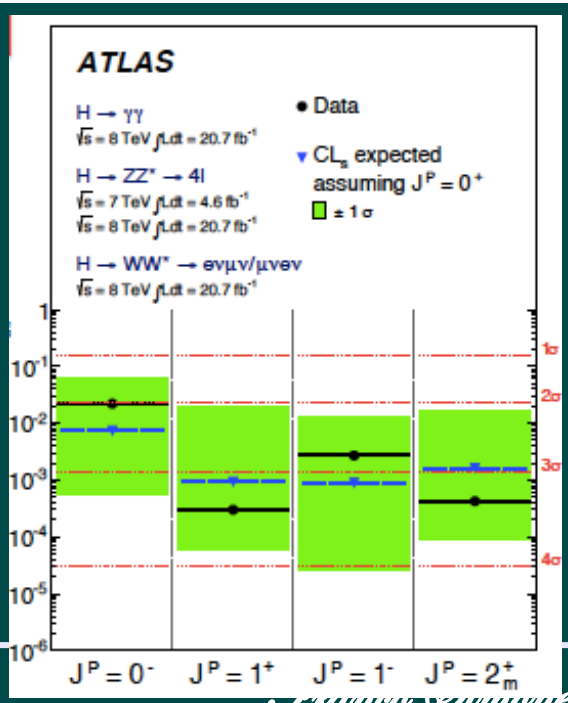




$J^P(H): 0^+$!







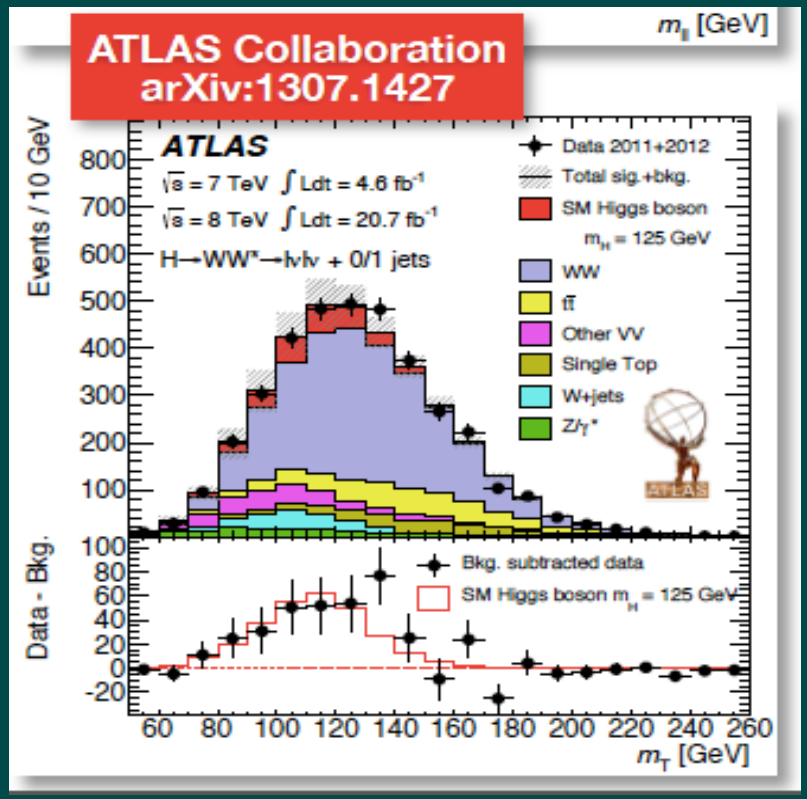
ATLAS and CMS: *"bosonic"* decay modes

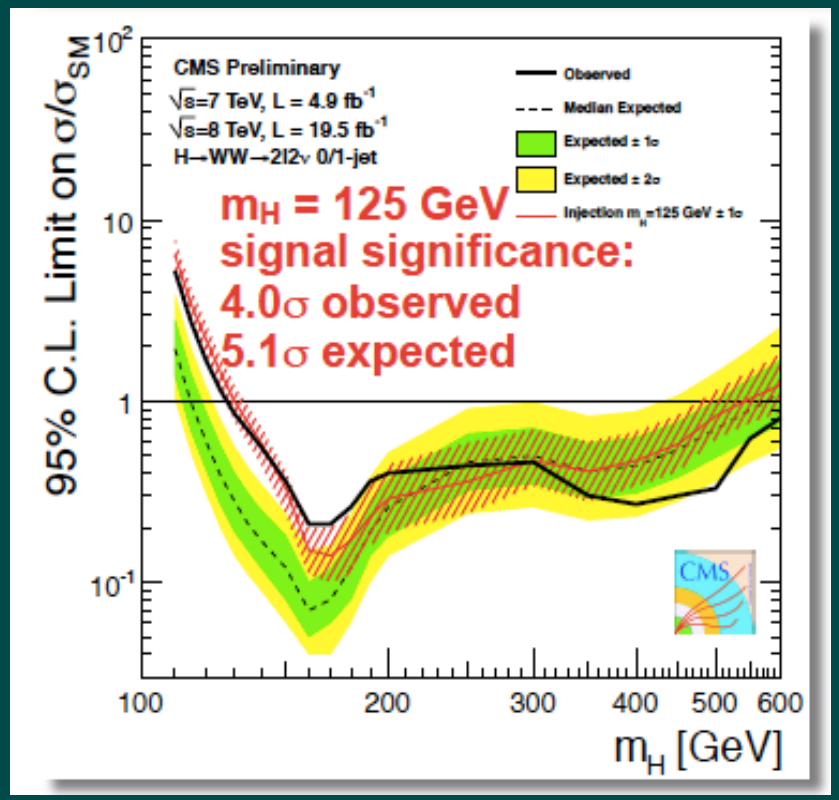
Strongly favor J^P = 0^+ SM quantum numbers

All alternative J^P models tested:

Excluded @ >95% CL

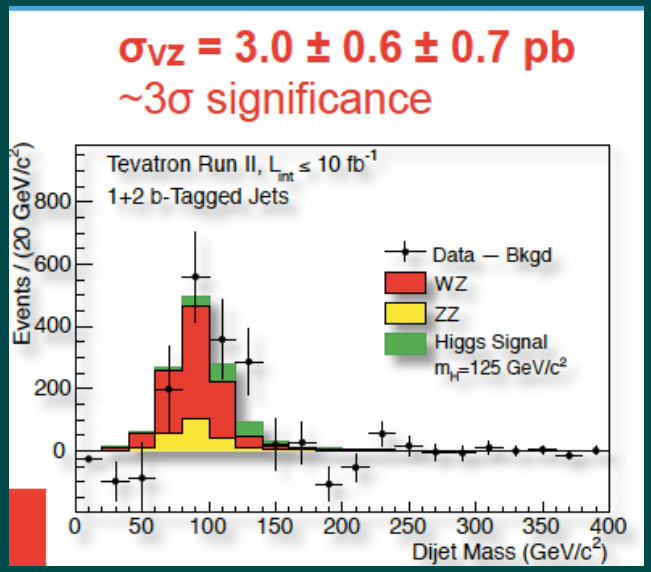
Accoppiamenti: H->WW

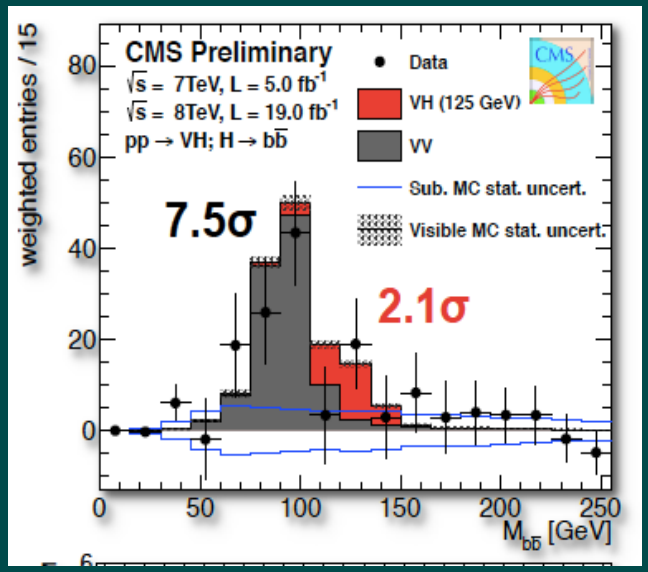




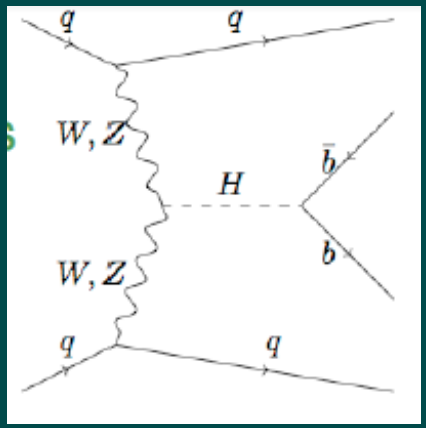
Accoppiamenti : H -> bb

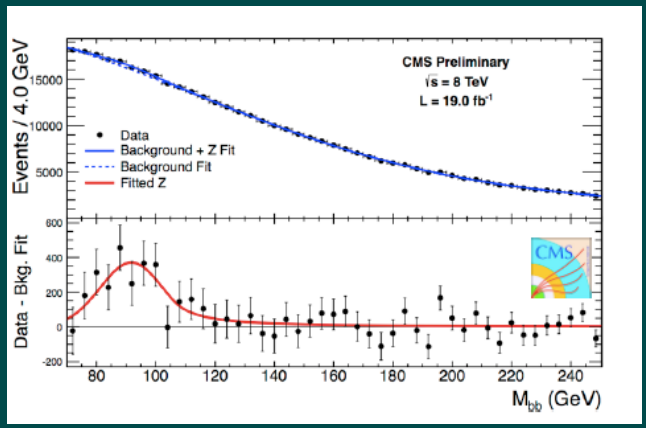
- beauty : in associazione VH(bb) (background)





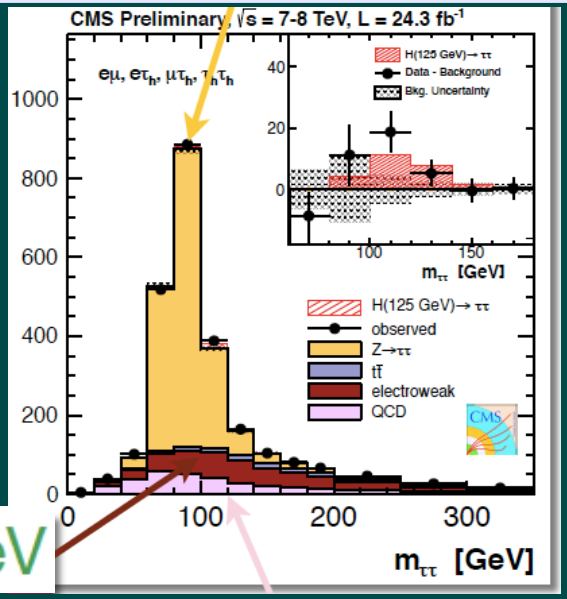
- ... anche VBF H(bb)





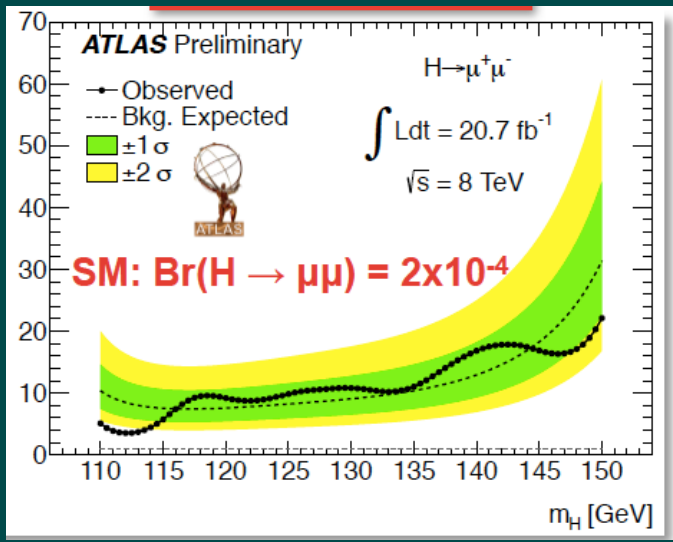
Accoppiamenti : H -> ℓℓ

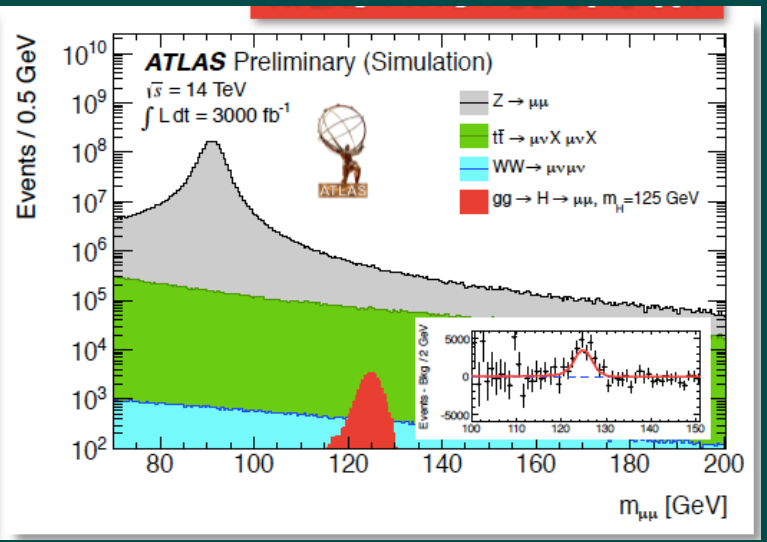
- CMS : H-> ττ (μμ,μe,ee, ℓh, hh)



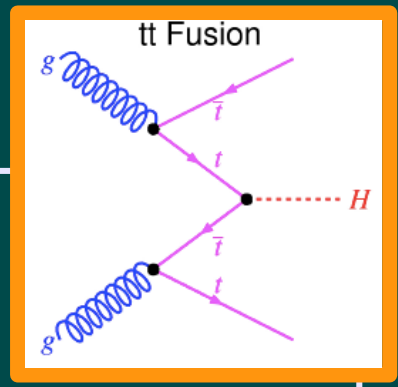
2.9σ (2.6σ exp.) for m_H = 125 GeV

- ATLAS : H-> μμ

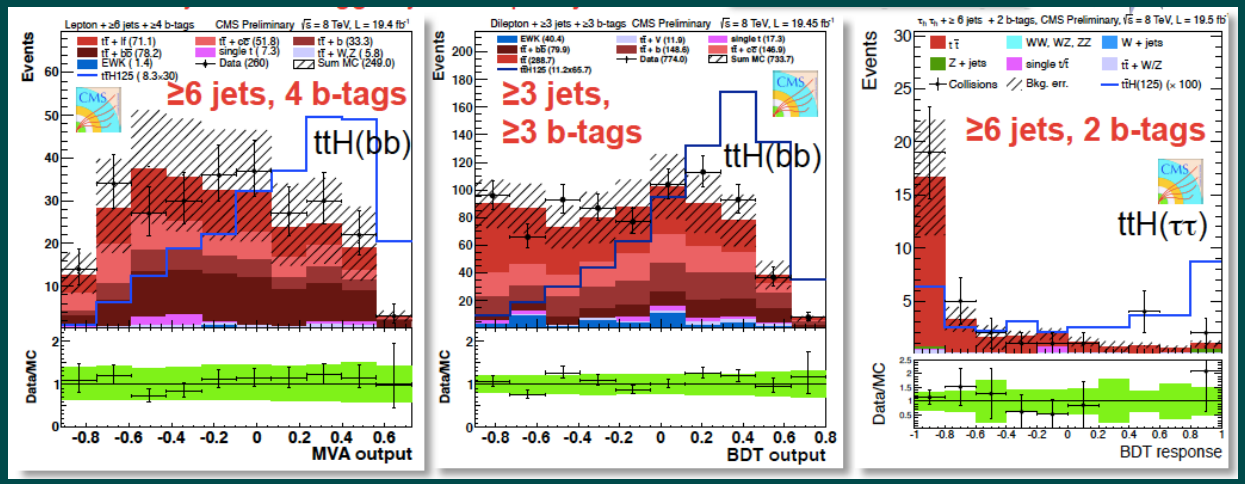




Accoppiamenti : H <-> tt



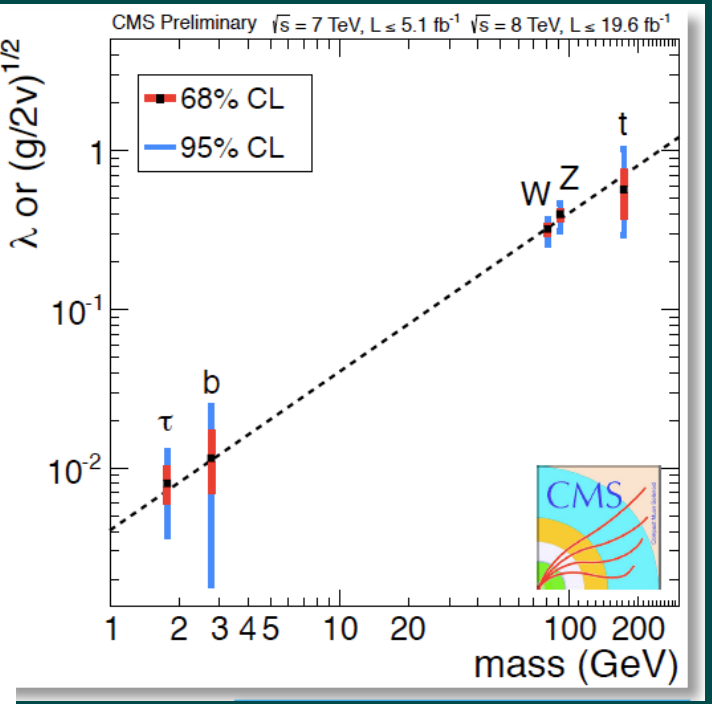
- Ricerca la produzione associata ttH(bb,ττ,ψψ)
- b-tagging + Analisi Multivariate (BDT,MVA)



$$\mu = \frac{\sigma(\mathrm{OBS})}{\sigma(\mathrm{SM})} \begin{cases} < 3.4 & \mathrm{CMS} \\ < 5.3 & \mathrm{ATLAS}(\gamma\gamma) \end{cases}$$

Sommario Higgs

- Tutto compatibile col MS
- ... ma precisione ancora grossolana (> 10%)



- Seen beyond any doubts in three bosonic channels
- Looks more and more like the SM Higgs boson
- No evidence for non-SM decays yet
- No evidence for additional Higgs bosons at higher or lower mass so far

NOW WHAT ?

Now what?

"The experiment worked better than expected and the analysis uncovered a very difficult to find signal"

the words of a string theorist

Great success...

...but the experimentalists haven't found what the BSM theorists told them they will find in addition to the Higgs boson:
no susy, no BH, no extra dimensions, nothing ...

Have the theorists been lying for so many years?

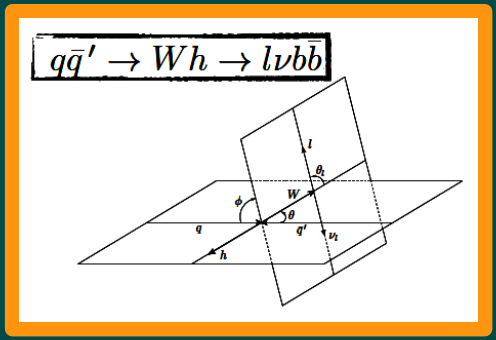
Have the exp's been too naive to believe the th's?

HEP future:

exploration/discovery era or consolidation/measurement era?

Prospettive (Grosjean)

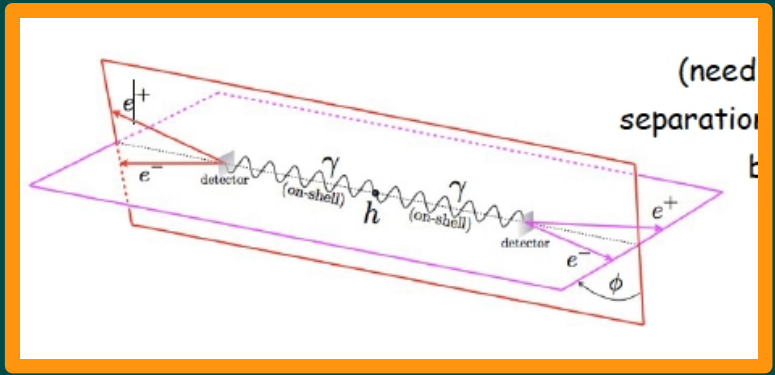
- Diminuire gli errori (ovvio), in particolare ttH (o 1% !)
- Distribuzioni differenziali (p_T, η) per misurtare dinamicamente i contributi dei diversi meccanismi di produzione -> Th. o(N^3LL)
- Violazione di CP . Componenti CP -pari negli stati finali:



the asymmetry in the variable

$$\vec{l} \cdot (\vec{h} \times \vec{q})$$

is linear in ~~CP~~ coefficient



Misura la polarizzazione dei γ da angolo tra le due coppie di e da conversione

Ottimo per CMS

TOP

- *Differential cross sections for top-pair and single-top production*, KIDONAKIS, Nikolaos
- *Search for Single-Top Production in ep Collisions at HERA*, ANTONELLI, Stefano
- *Top quark mass measurements at and above threshold in e+e- collisions at Linear Colliders*, ROLOFF, Philipp
- *A precise determination of top quark electroweak couplings at the ILC operating at 500 GeV*, POESCHL, Roman
- *Measurement of the single top quark production cross section in pp collisions with the ATLAS detector*, KRASZNAHORKAY, Attila
- *Measurement of differential cross sections in top pair production in pp collisions with the ATLAS detector*, GARBERSON, Ford
- *Measurement of intrinsic top quark properties (top mass, charge, top and W polarisation, and search for FCNC in top decays) with the ATLAS detector*, MASETTI, Lucia
- *Top quark pair properties (spin correlations, charge asymmetry and complex final states) with the ATLAS detector*, MIJOVIC, Liza
- *t tbar b bbar production at NLO accuracy matched with parton shower*, TROCSANYI, Zoltan Laszlo
- *Measurement of the charge asymmetry in top quark pair production at the Tevatron*, DEMINA, Regina
- *Inclusive and differential top quark production at the Tevatron*, SORIN, Maria Veronica
- *Single top quark production cross section at the Tevatron*, GARCIA-BELLIDO ALVAREZ DE MIRANDA, Aran
- *Measurement of the top quark mass at the Tevatron*, PETERS, Reinhild
- *Top quark properties studies at the Tevatron*, LEONE, Sandra
- *Measurement of the inclusive top quark pair cross section in pp collisions at 7 and 8 TeV with the CMS detector*, MAES, Michael
- *Measurement of differential cross sections in top pair production in pp collisions with the CMS detector*, SYMONDS, Philip Hugh
- *Measurements of the production properties of top quark pairs in pp collisions (includes charge asymmetry and spin correlations) with the CMS detector*, DORLAND, Tyler Mc Millan
- *Measurement of the properties of top quarks in decays (top quark and W polarization, top quark charge and couplings) with the CMS detector*, SENGHI SOARES, Mara
- *CMS Measurements of the Top Quark Mass*, STADIE, Hartmut
- *New approaches in determining the mass of the top quark: alternative techniques and differential measurements*, BLYWEERT, Stijn
- *Measurement of t-channel single top quark production in pp collisions with the CMS detector*, IORIO, Alberto Orso Maria
- *Measurement of single top production in the tW-channel in pp collisions and search for FCNC with the CMS detector*, BENELLI, Gabriele
- *Top Decays with Flavor Changing Neutral Higgs Interactions at the LHC*, KAO, Chung
- *Probing for the t→ch decay at the LHC*, HOU, George Wei-Shu
- *Four-loop on-shell integrals: MSbar – on-shell relation and g-2*, MARQUARD, Peter
- *NNLO top quark pair production*, FIEDLER, Paul
- *NLO merging in tt+jets*, SCHOENHERR, Marek
- *Top-quark Pair Production in a Running Mass Scheme*, DOWLING, Matthew
- *Measurement of the inclusive top quark pair cross section in pp collisions at 7 and 8 TeV with the ATLAS detector*, HENRICHS, Anna
- *Top quark mass measurements in ATLAS*, COMPOSTELLA, Gabriele
- *TOPLHCWG: combinations of top measurements at the LHC*, CRISTINZIANI, Markus

TOP Properties

- Sezione d'urto tt

8 TeV results:

ATLAS ℓ+j: $232 \pm 2(\text{stat}) \pm 31(\text{syst}) \pm 9(\text{lumi})$ pb

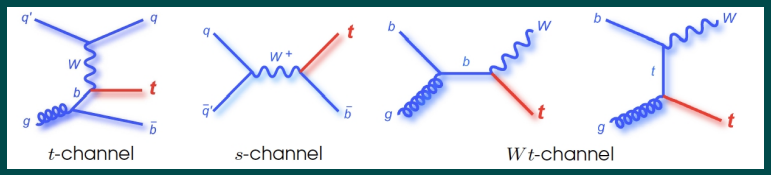
CMS $\ell\ell$: $227 \pm 3(\text{stat}) \pm 10(\text{syst}) \pm 10(\text{lumi})$ pb

CMS ℓ+j: $228 \pm 9(\text{stat})^{+29}_{-26}(\text{syst}) \pm 10(\text{lumi})$ pb

Total uncertainty (CMS $\ell\ell$): 6.3%

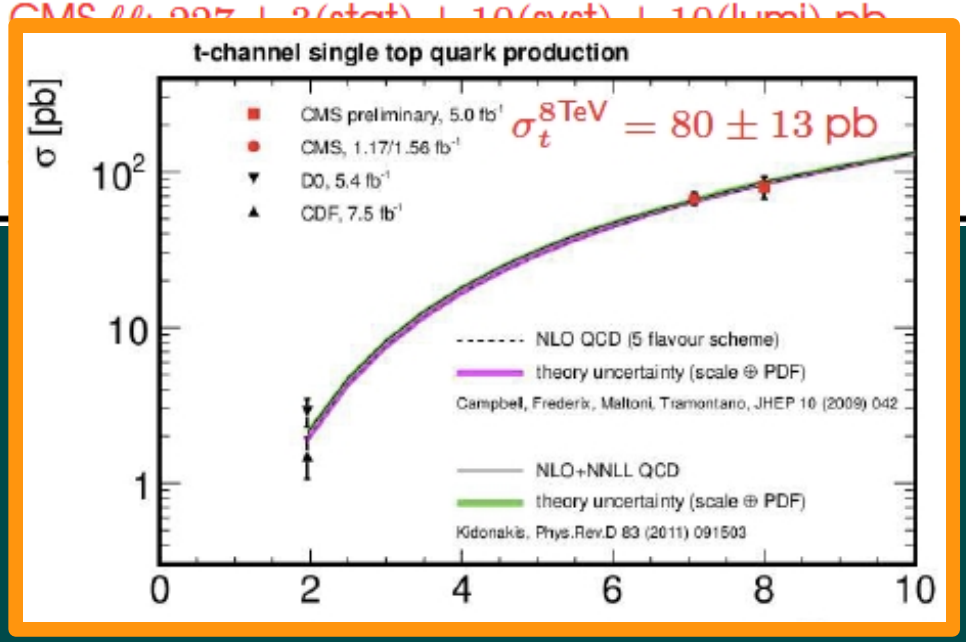
TOP Properties

- Sezione d'urto tt
- Sezione d'urto top singolo



8 TeV results:

ATLAS ℓ+j: $232 \pm 2(\text{stat}) \pm 31(\text{syst}) \pm 9(\text{lumi})$ pb

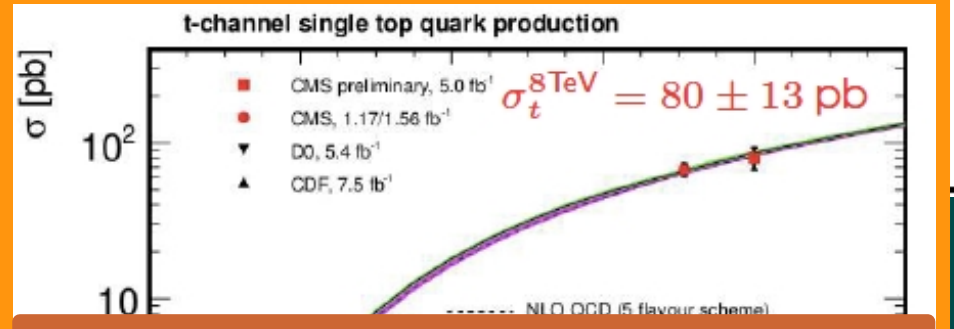


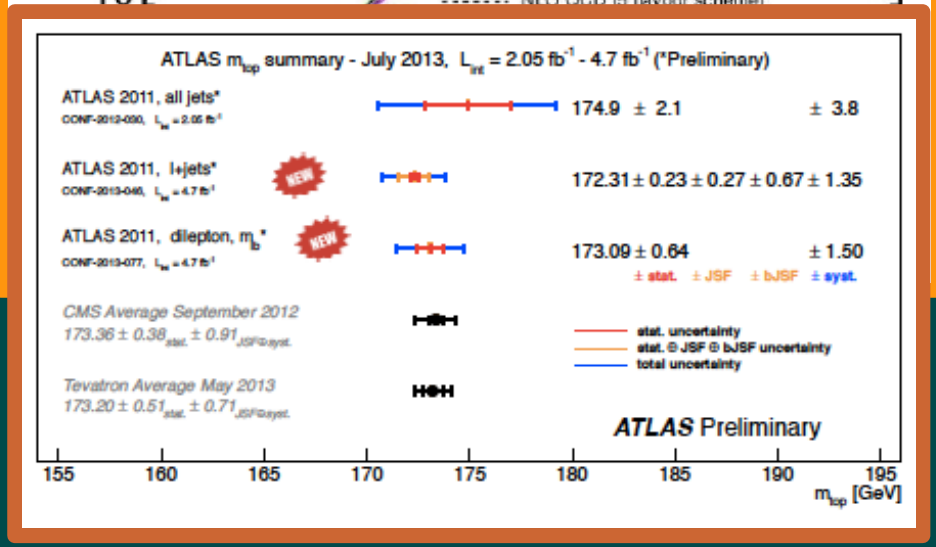
TOP Properties

- Sezione d'urto tt
- Sezione d'urto top singolo
- Massa

8 TeV results:

ATLAS ℓ+j: $232 \pm 2(\text{stat}) \pm 31(\text{syst}) \pm 9(\text{lumi})$ pb





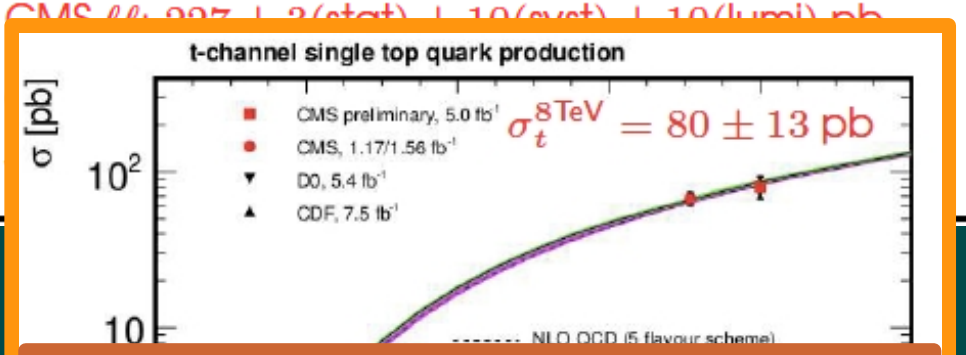
TOP Properties

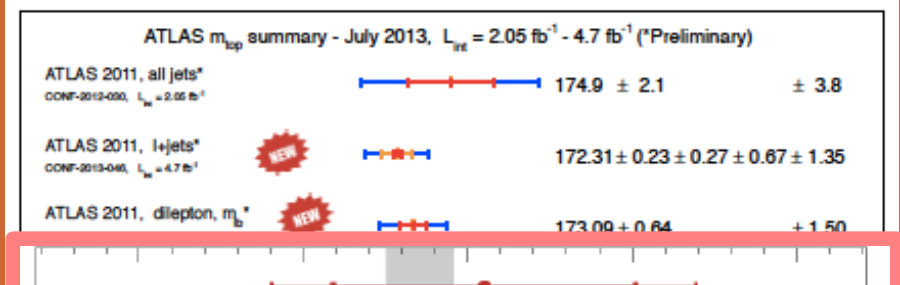
- Sezione d'urto tt
- Sezione d'urto top singolo
- Massa

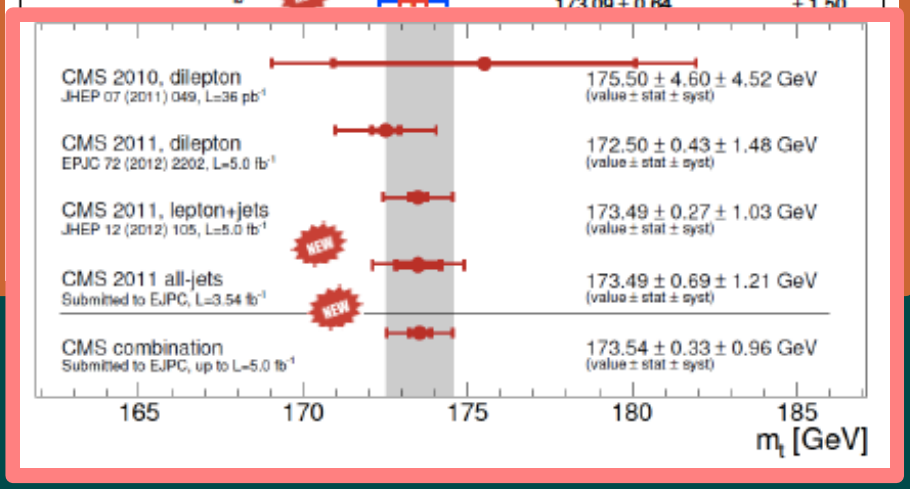
173.2 ± 0.51 ± 0.71	Tevatron
172.3 ± 0.23 ± 1.33	ATLAS
173.5 ± 0.33 ± 0.96	CMS

8 TeV results:

ATLAS ℓ+j: $232 \pm 2(\text{stat}) \pm 31(\text{syst}) \pm 9(\text{lumi})$ pb







TOP Properties

- Sezione d'urto tt
- Sezione d'urto top singolo
- Massa

  $173.2 \pm 0.51 \pm 0.71$ Tevatron

  $172.3 \pm 0.23 \pm 1.33$ ATLAS

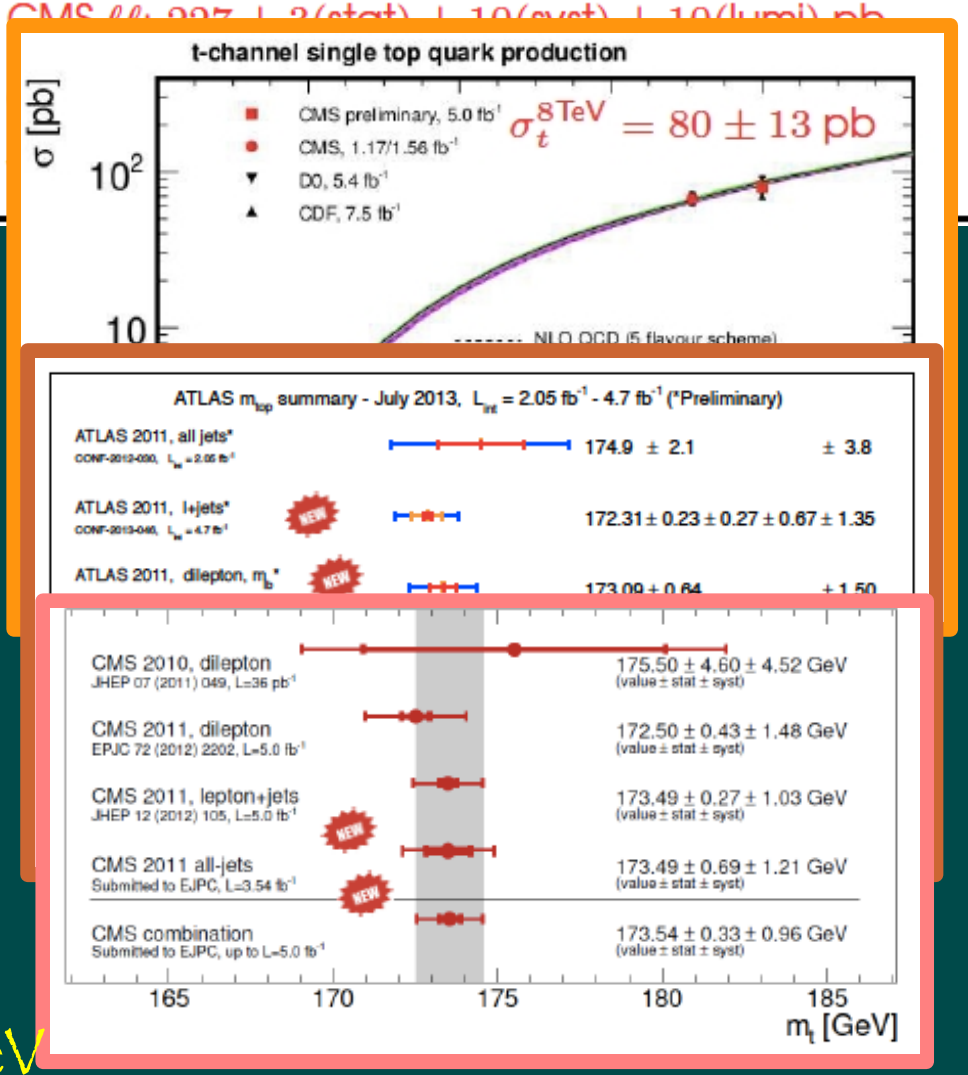
  $173.5 \pm 0.33 \pm 0.96$ CMS

- Test CPT (CMS) :

  $m_t - m_{\bar{t}} = -272 \pm 196 \pm 122$ MeV

8 TeV results:

ATLAS ℓ+j: $232 \pm 2(\text{stat}) \pm 31(\text{syst}) \pm 9(\text{lumi})$ pb

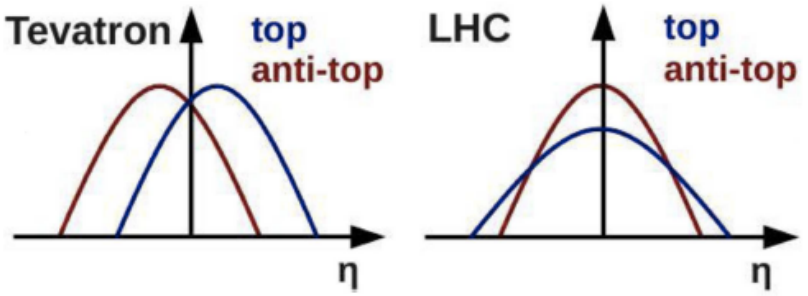


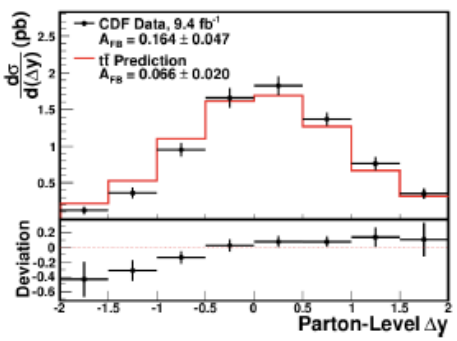
TOP : Anomalie ?

- ~~FCNC~~, Spin ~~Correlations~~, Polarizzazione ...
- Asymmetria di carica avanti – indietro :

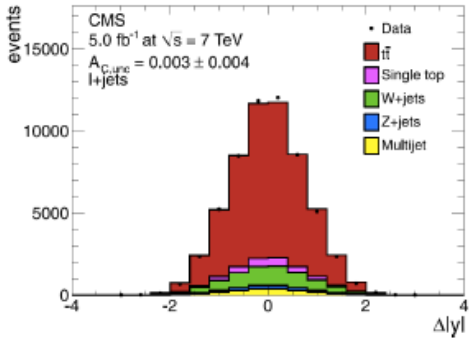
$$A_{FB}^{t\bar{t}} = \frac{N(\Delta y > 0) - N(\Delta y < 0)}{N(\Delta y > 0) + N(\Delta y < 0)}$$
with $\Delta y = y_t - y_{\bar{t}}$

$$A_C^{t\bar{t}} = \frac{N(\Delta|y| > 0) - N(\Delta|y| < 0)}{N(\Delta|y| > 0) + N(\Delta|y| < 0)}$$
with $\Delta|y| = |y_t| - |y_{\bar{t}}|$

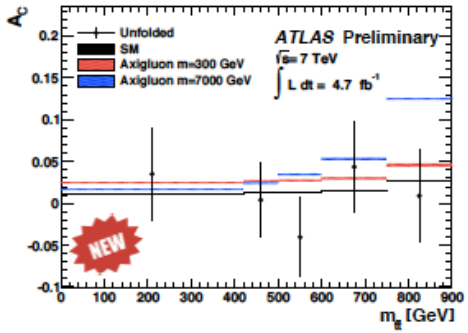




Phys. Rev. D 87 092002 (2013)



Phys. Lett. B 717, 129 (2012)

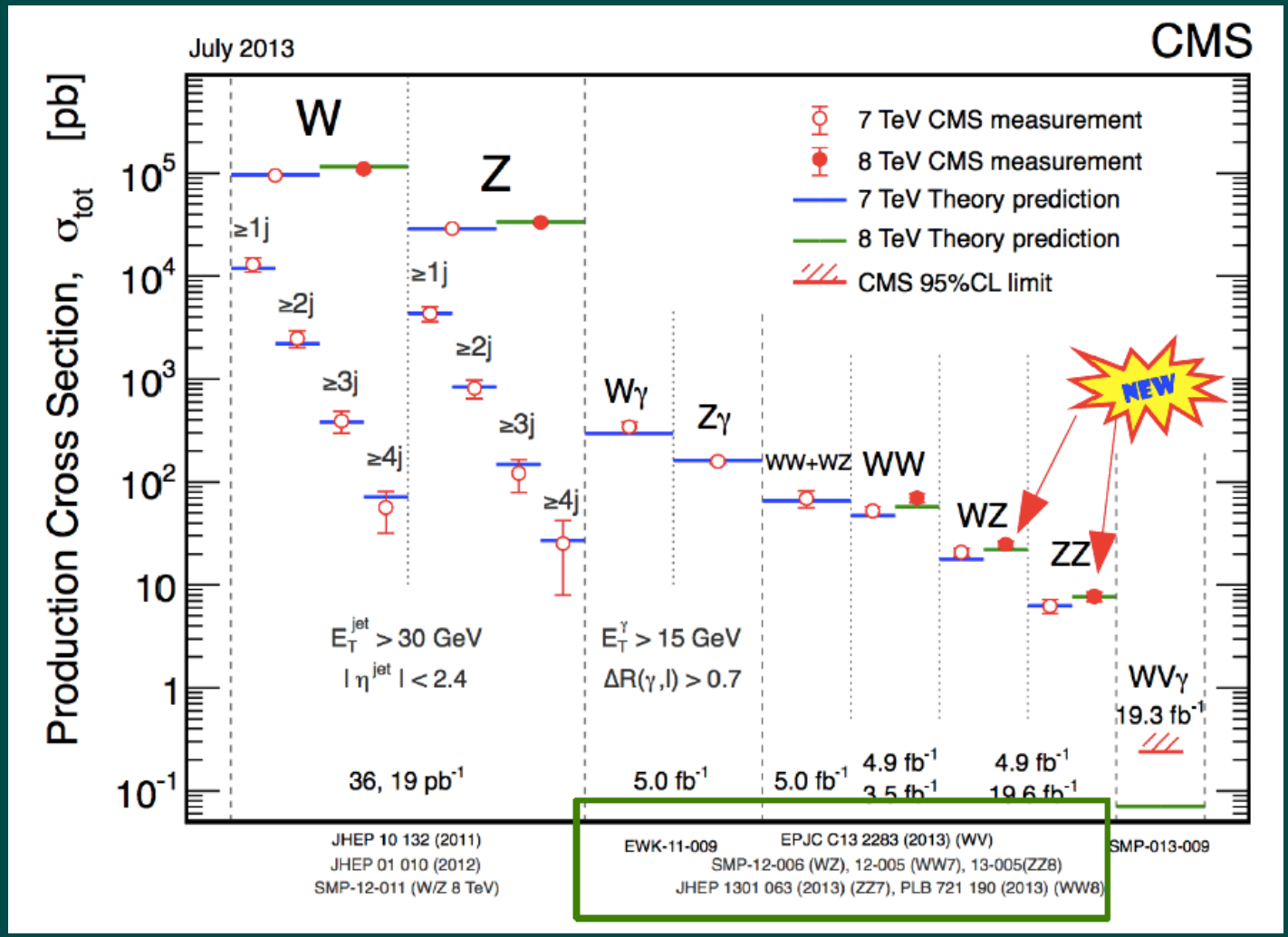


ATLAS-CONF-2013-078

- Tevatron $A_{FB}^{t\bar{t}}$ measurements in tension with SM at $\sim 2.5\sigma$.
- LHC $A_C^{t\bar{t}}$ measurements consistent with SM.

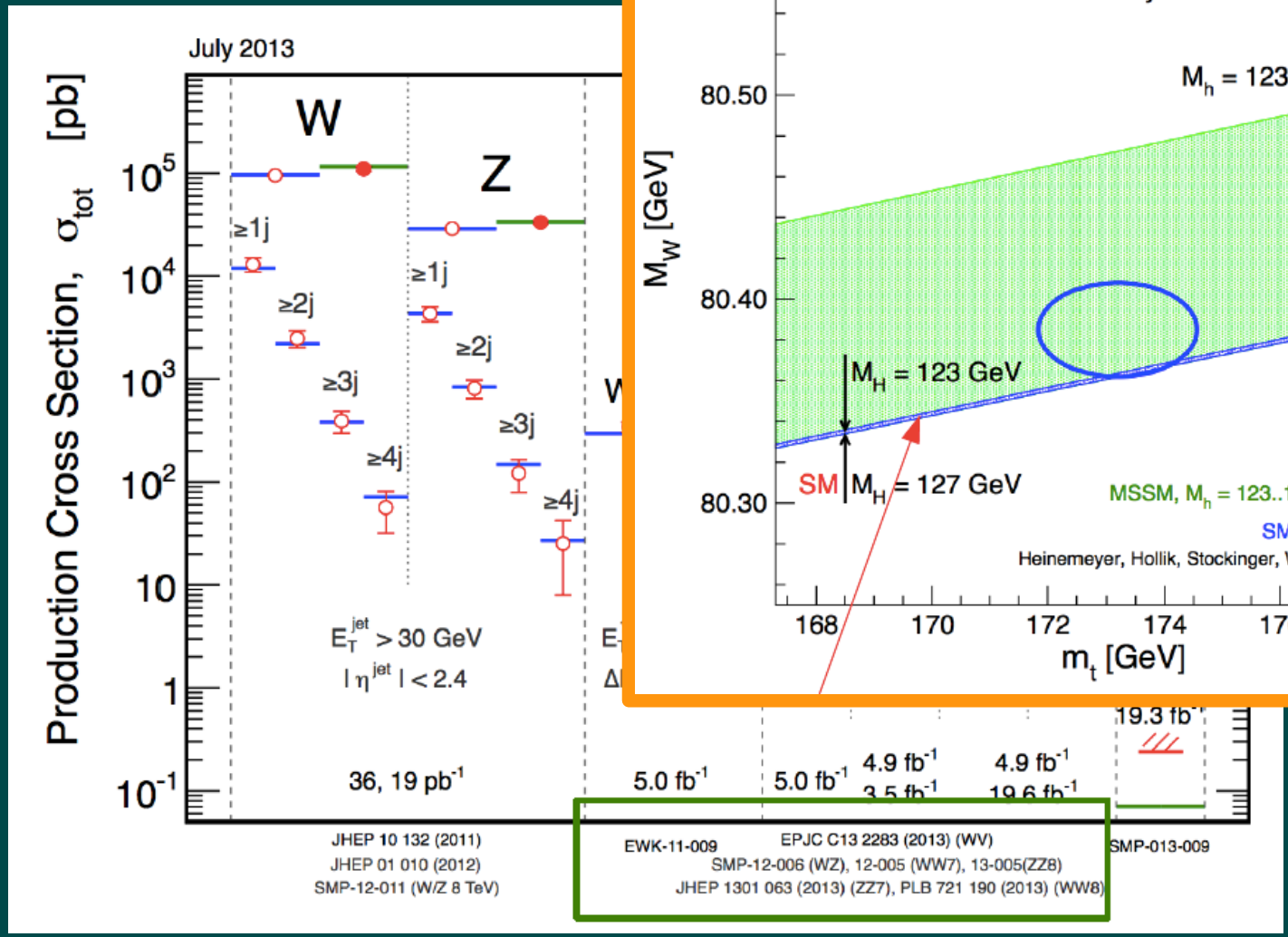
Standard Model

- ... in ottima salute ...

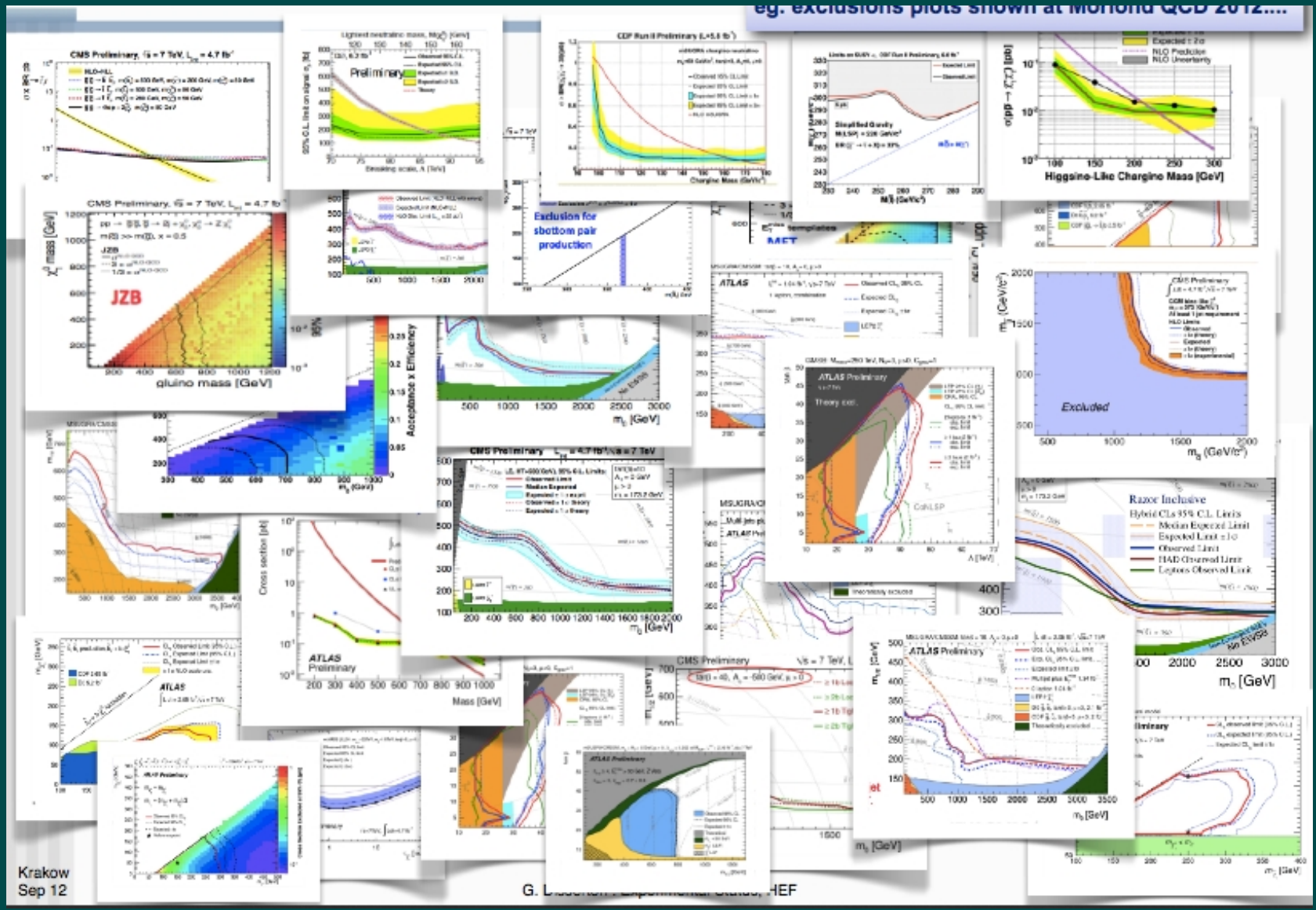


Standard Model

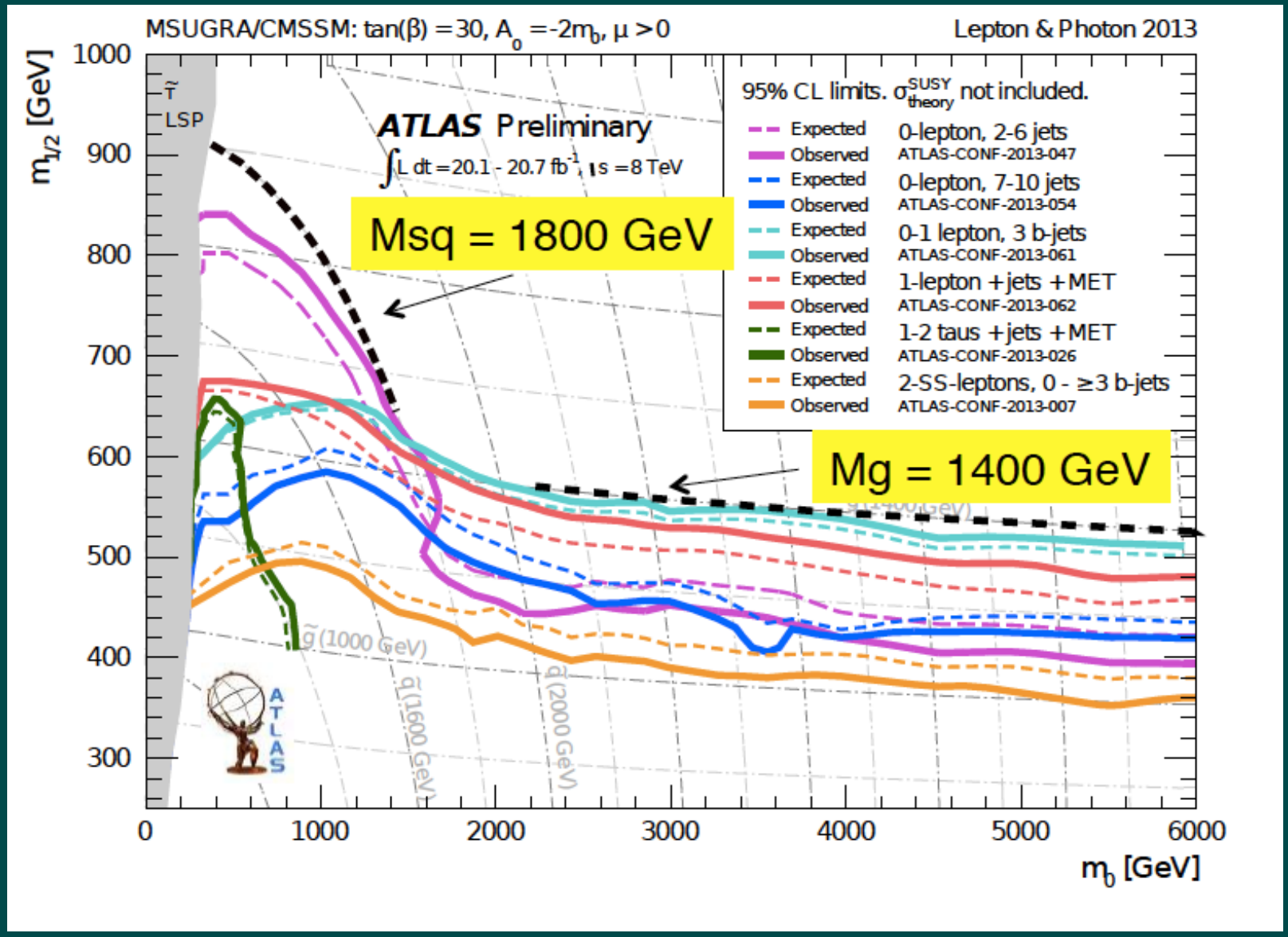
- ... in ottima salute ...



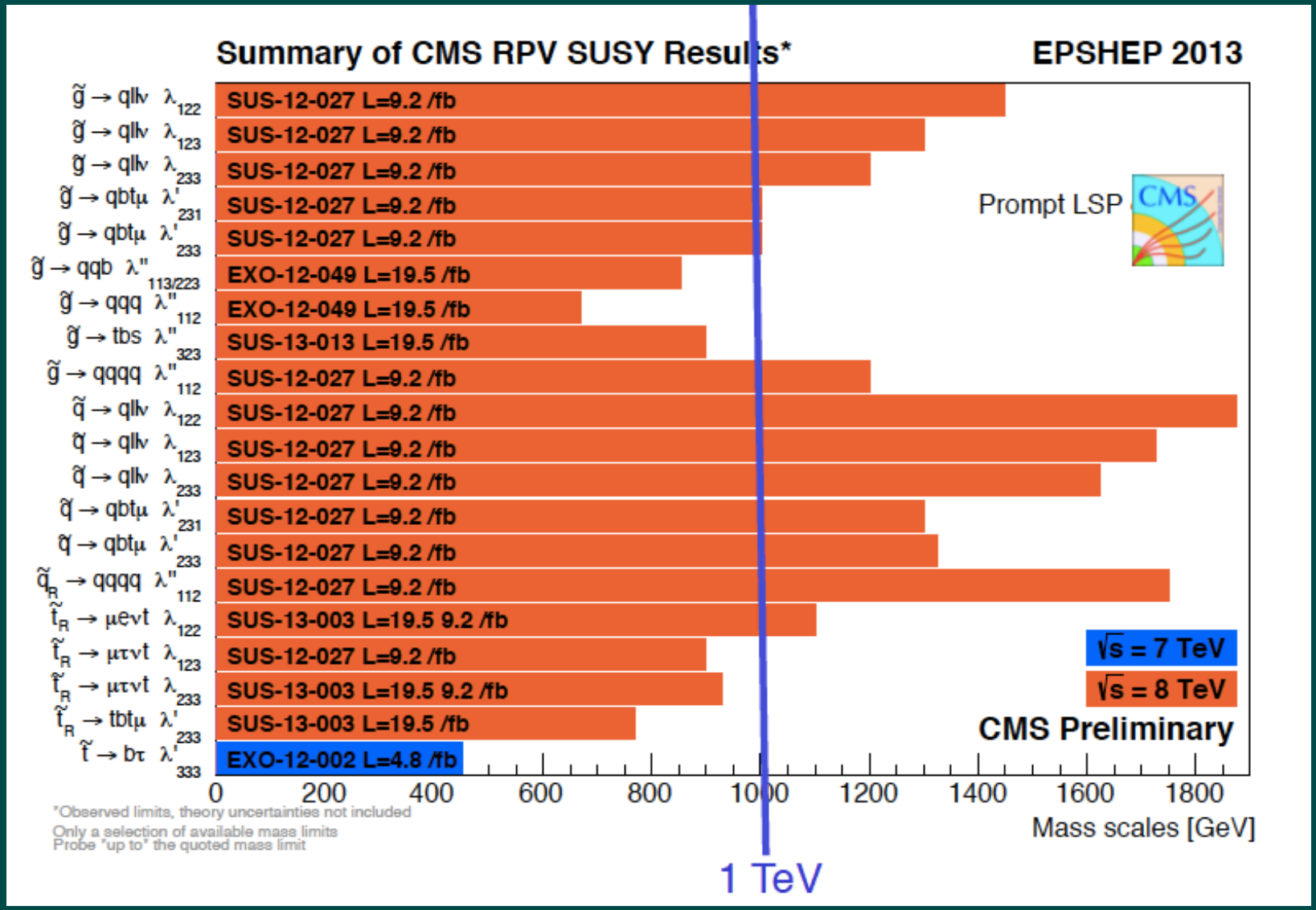
"We have searched ... (Dissertori, Krakow 2012)



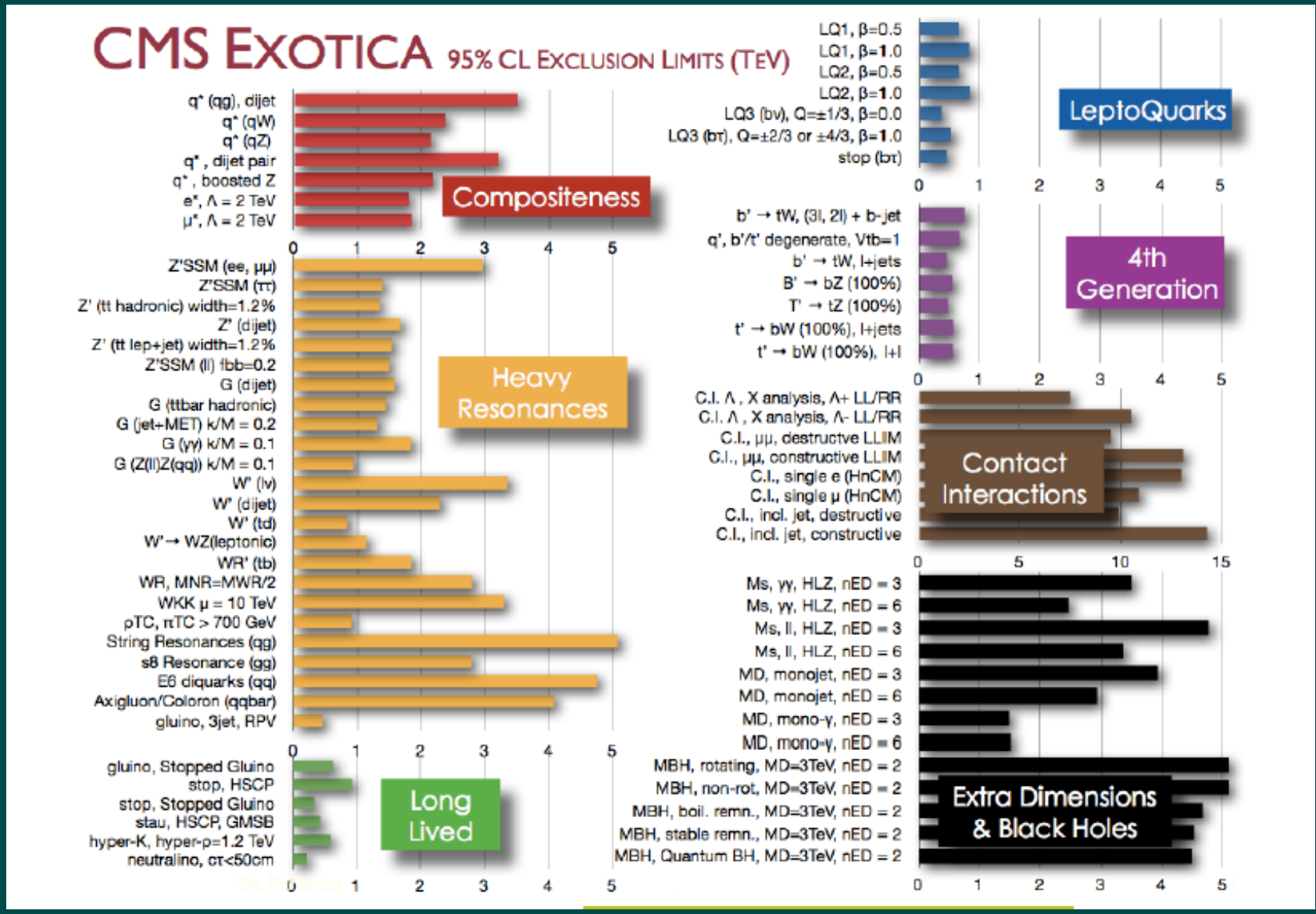
... SuSy (RP) ...


MSUGRA/CMSSM: tan(β) = 30, A0 = -2m0, μ > 0
Lepton & Photon 2013
ATLAS Preliminary
∫L dt = 20.1 - 20.7 fb-1, √s = 8 TeV
95% CL limits. σSUSY theory not included.
Expected 0-lepton, 2-6 jets
Observed ATLAS-CONF-2013-047
Expected 0-lepton, 7-10 jets
Observed ATLAS-CONF-2013-054
Expected 0-1 lepton, 3 b-jets
Observed ATLAS-CONF-2013-061
Expected 1-lepton +jets +MET
Observed ATLAS-CONF-2013-062
Expected 1-2 taus +jets +MET
Observed ATLAS-CONF-2013-026
Expected 2-SS-leptons, 0 - ≥3 b-jets
Observed ATLAS-CONF-2013-007
Msq = 1800 GeV
Mg = 1400 GeV
g̃ (1000 GeV)
q̃ (1600 GeV)
q̃ (2000 GeV)
χ̃1 LSP
m1/2 [GeV]
m0 [GeV]
1000
900
800
700
600
500
400
300
0
1000
2000
3000
4000
5000
6000

... SuSy (non RP) ...


Summary of CMS RPV SUSY Results*
EPSHEP 2013
$\tilde{g} \to qll\nu\ \lambda_{122}$ SUS-12-027 L=9.2 /fb
$\tilde{g} \to qll\nu\ \lambda_{123}$ SUS-12-027 L=9.2 /fb
$\tilde{g} \to qll\nu\ \lambda_{233}$ SUS-12-027 L=9.2 /fb
$\tilde{g} \to qbt\mu\ \lambda'_{231}$ SUS-12-027 L=9.2 /fb
$\tilde{g} \to qbt\mu\ \lambda'_{233}$ SUS-12-027 L=9.2 /fb
$\tilde{g} \to qqb\ \lambda''_{113/223}$ EXO-12-049 L=19.5 /fb
$\tilde{g} \to qqq\ \lambda''_{112}$ EXO-12-049 L=19.5 /fb
$\tilde{g} \to tbs\ \lambda''_{323}$ SUS-13-013 L=19.5 /fb
$\tilde{g} \to qqqq\ \lambda''_{112}$ SUS-12-027 L=9.2 /fb
$\tilde{q} \to qll\nu\ \lambda_{122}$ SUS-12-027 L=9.2 /fb
$\tilde{q} \to qll\nu\ \lambda_{123}$ SUS-12-027 L=9.2 /fb
$\tilde{q} \to qll\nu\ \lambda_{233}$ SUS-12-027 L=9.2 /fb
$\tilde{q} \to qbt\mu\ \lambda'_{231}$ SUS-12-027 L=9.2 /fb
$\tilde{q} \to qbt\mu\ \lambda'_{233}$ SUS-12-027 L=9.2 /fb
$\tilde{q}_R \to qqqq\ \lambda''_{112}$ SUS-12-027 L=9.2 /fb
$\tilde{t}_R \to \mu e\nu t\ \lambda_{122}$ SUS-13-003 L=19.5 9.2 /fb
$\tilde{t}_R \to \mu\tau\nu t\ \lambda_{123}$ SUS-12-027 L=9.2 /fb
$\tilde{t}_R \to \mu\tau\nu t\ \lambda_{233}$ SUS-13-003 L=19.5 9.2 /fb
$\tilde{t}_R \to tbt\mu\ \lambda'_{233}$ SUS-13-003 L=19.5 /fb
$\tilde{t} \to b\tau\ \lambda'_{333}$ EXO-12-002 L=4.8 /fb
Prompt LSP
CMS
√s = 7 TeV
√s = 8 TeV
CMS Preliminary
0 200 400 600 800 1000 1200 1400 1600 1800
Mass scales [GeV]
1 TeV
*Observed limits, theory uncertainties not included
Only a selection of available mass limits
Probe "up to" the quoted mass limit

... ed Esot(er)ici

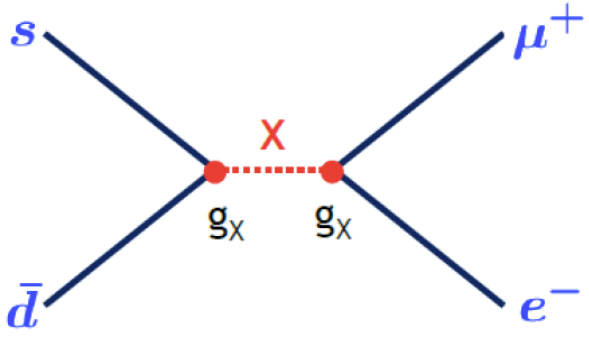


Flavor Leptonico

- Ricerca di processi rari, soppressi nel MS
- Esplorazione per via indiretta di scale inacessibili a LHC:

High NP mass scales accessible for tree-level contributions

Example: $K_L \to \mu^+ e^-$



Dimensional argument:

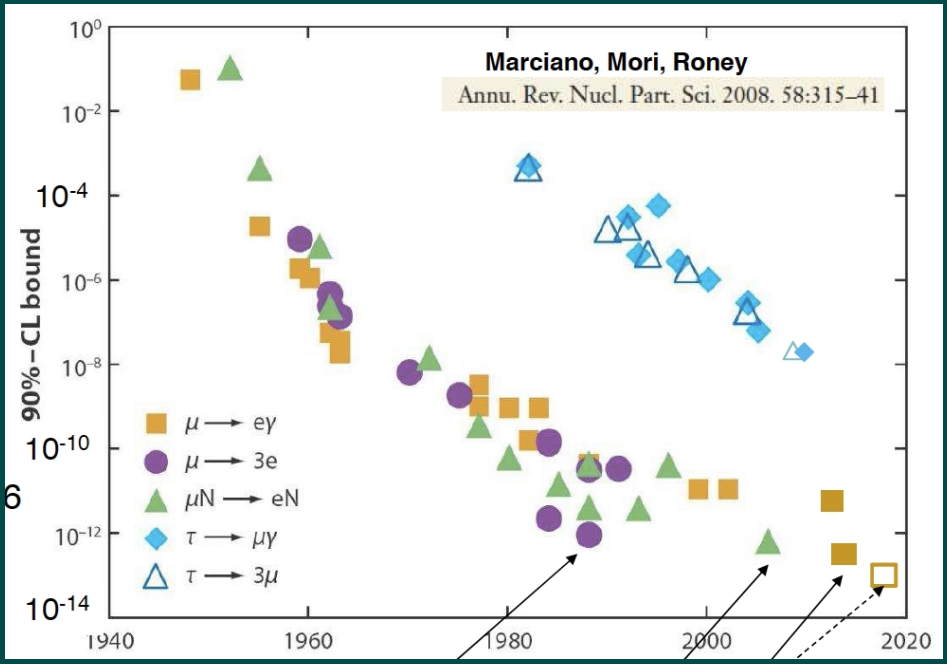
$$\frac{\Gamma_X}{\Gamma_{SM}} \sim \left(\frac{g_X}{g_W} \cdot \frac{M_W}{M_X}\right)^4$$

For $g_X \approx g_W$ and $\mathcal{B} \sim 10^{-12}$,

$$M_X \sim 100 \text{ TeV}$$

Flavor Leptonico

- Ricerca di processi rari, soppressi nel MS
- Esplorazione per via indiretta di scale inacessibili a LHC
- Presente : solo limiti al LFV. Anomalia a ~ 5σ in g_μ-2



Flavor Leptonico

- Ricerca di processi rari, soppressi nel MS
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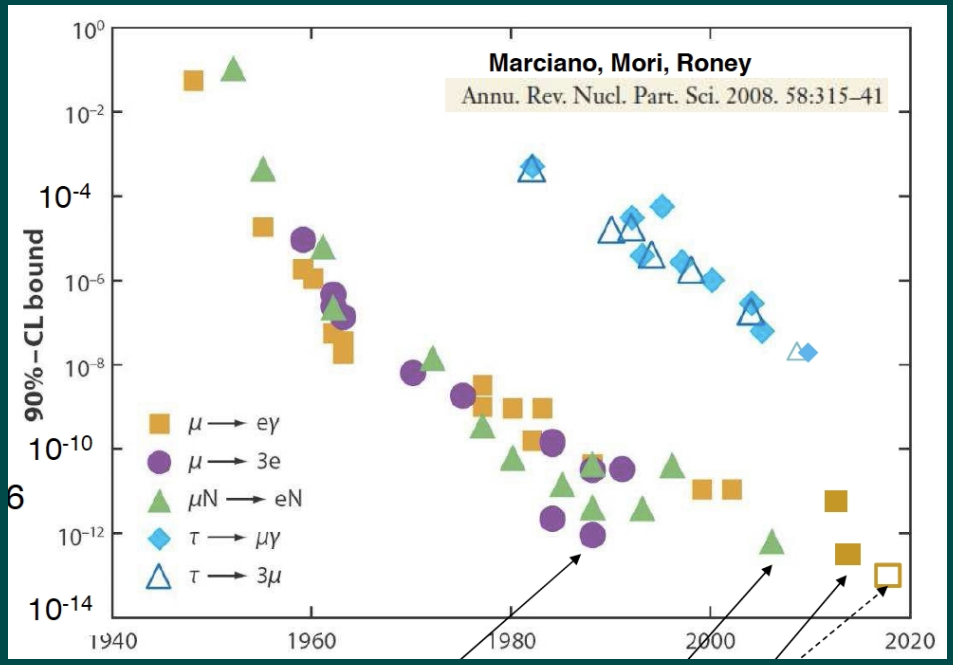
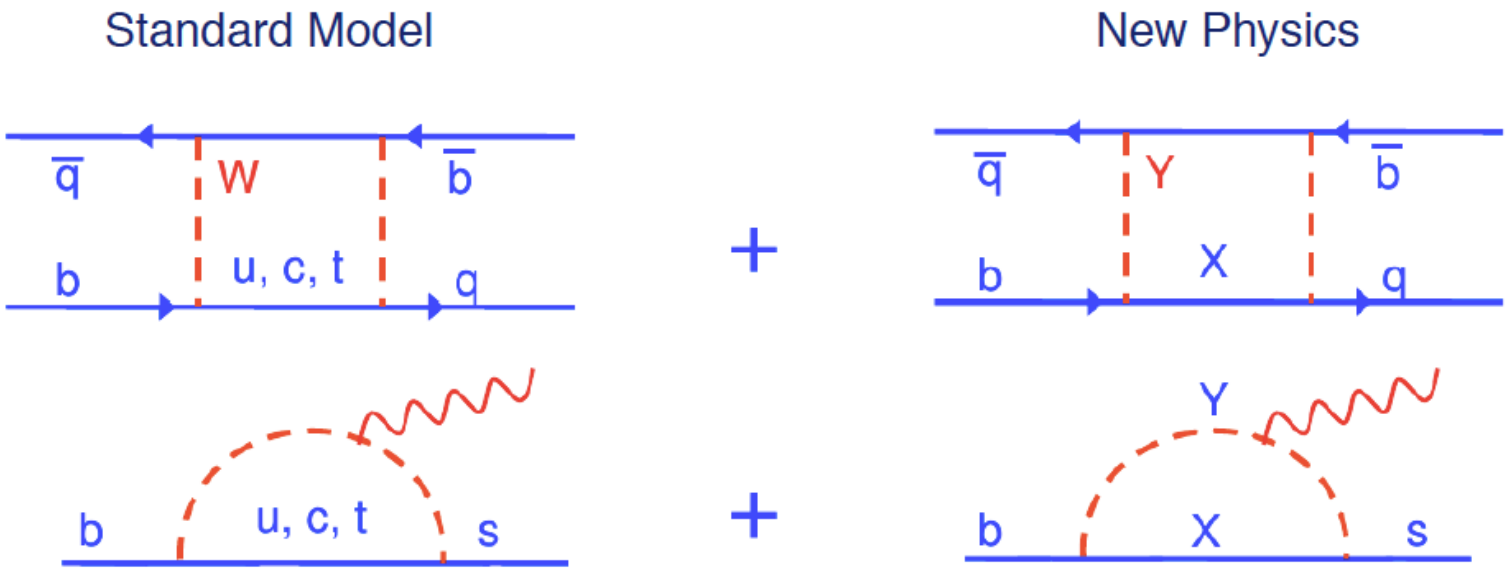


Futuro :

- MEG Upgrade ~ 5 10^{-14} (< 2018)
- μ–>3e (PSI) ~ 5 10^{-17} (>2018)
- μN->eN (FNAL) ~ 6 10^{-17} (>2020)
- τ –>μγ, lll (Belle2) (>2018)
- g_μ-2 @ FNAL

Flavor Adroni : (soprattutto B)

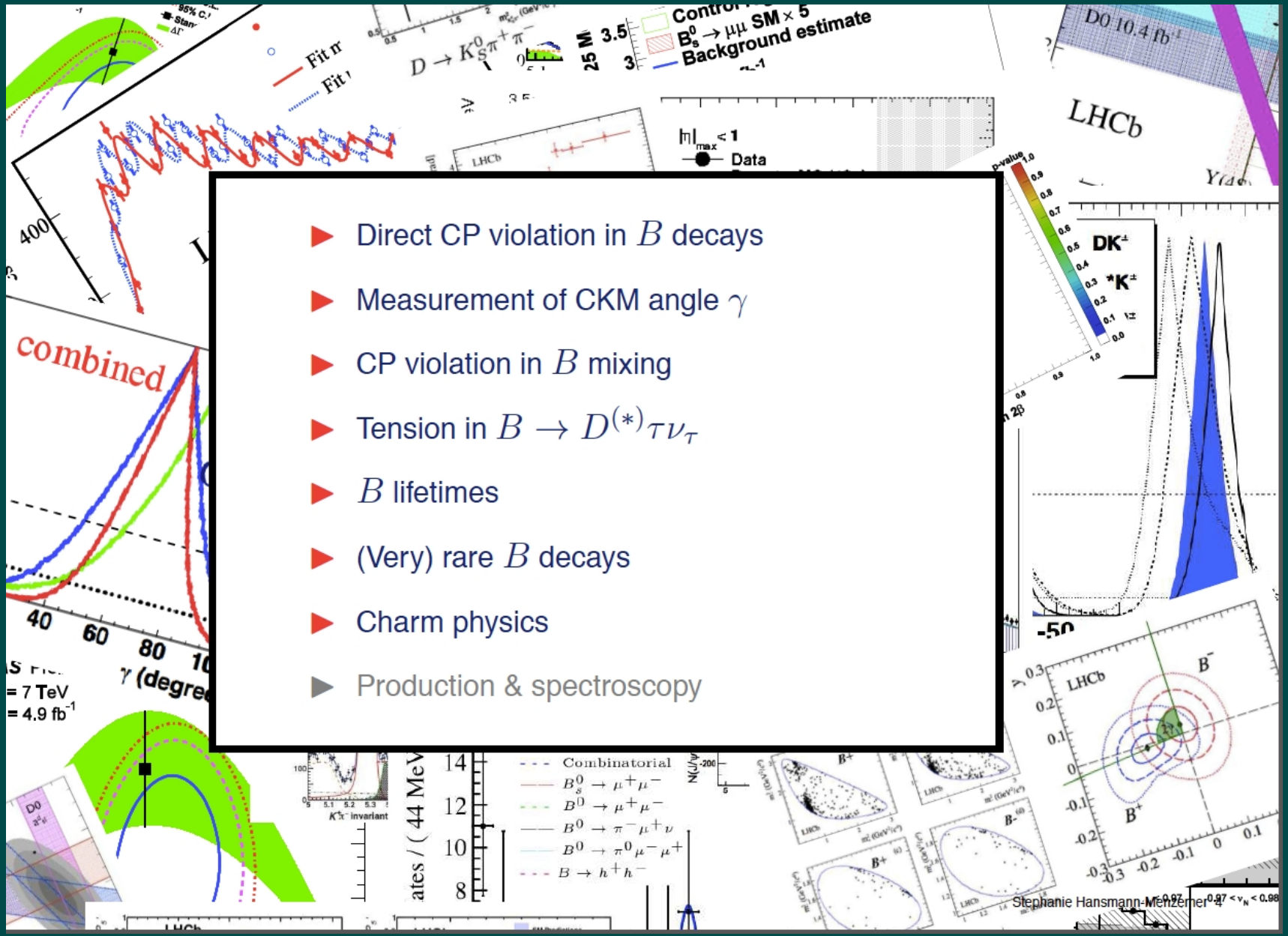
New Physics are corrections to Standard Model processes:



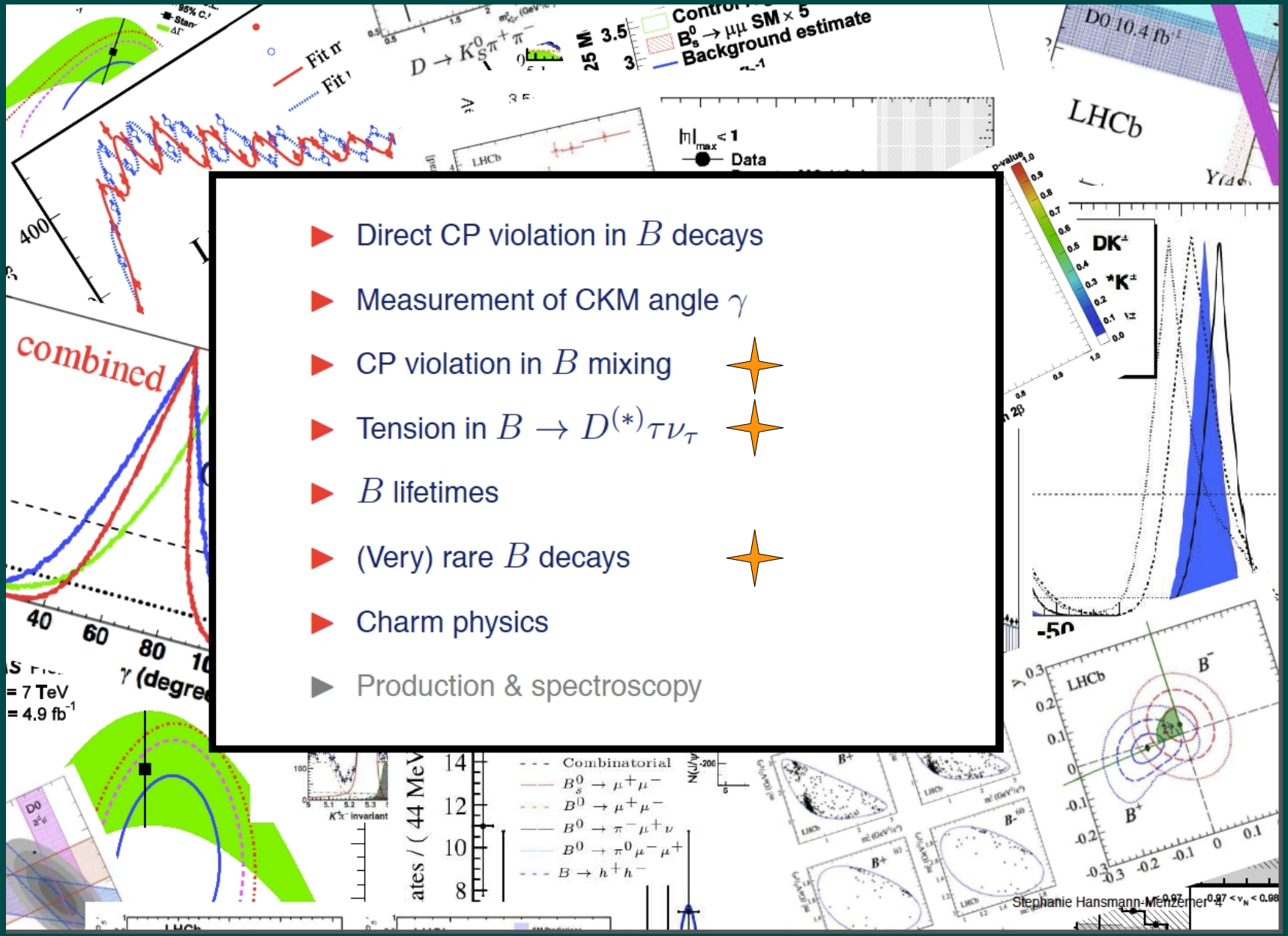
$$\mathcal{A}_{BSM} = \mathcal{A}_0 \left(\frac{C_{SM}}{m_W^2} + \frac{C_{NP}}{\lambda_{NP}^2} \right)$$

What is the scale of λ_{NP}? How much different are C_{NP} and C_{SM}?

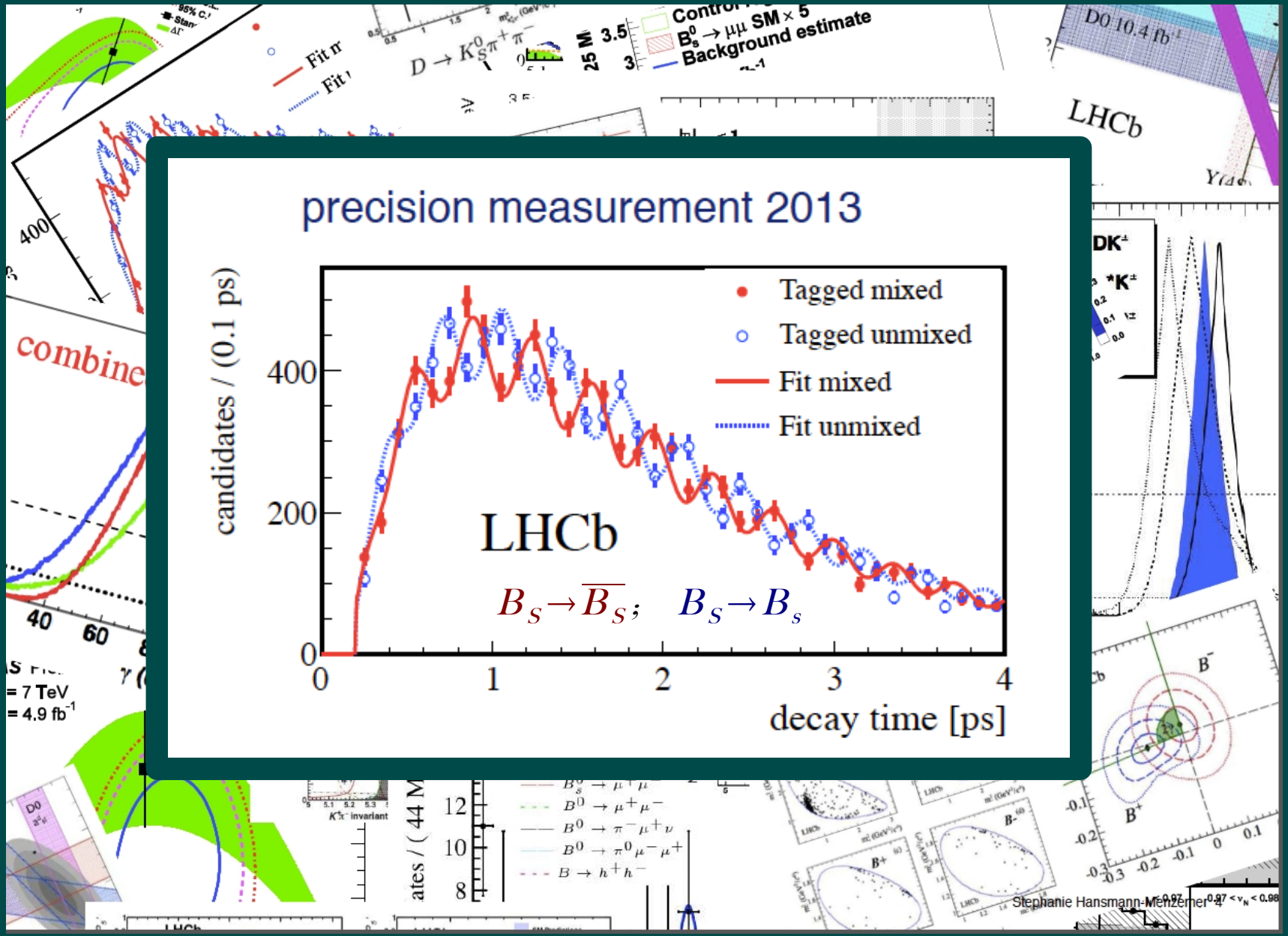
Flavor Adroni : topics



Flavor Adroni : highlights



Oscillazione B_s

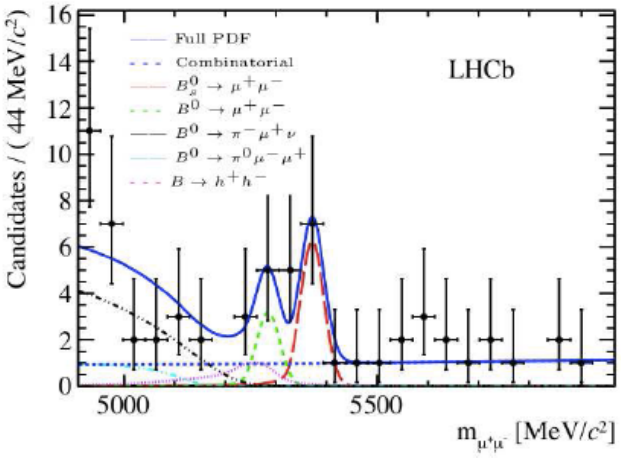


Flavor highlight : $B_s \to \mu\mu$

- 2.1 → 3.0 fb^{-1}
- more variables in BDT

- 5.0 → 25 fb^{-1}
- cut base selection → BDT
- new & improved variables (PID)

expected sensitivity: 3.7 → 5.0 σ



new @ EPS2013

arXiv:1307.5024

$BR(B_s \to \mu^+\mu^-) = (2.9\ ^{+1.1}_{-1.0}(\text{stat})\ ^{+0.3}_{-0.1}(\text{syst})) \times 10^{-9}$

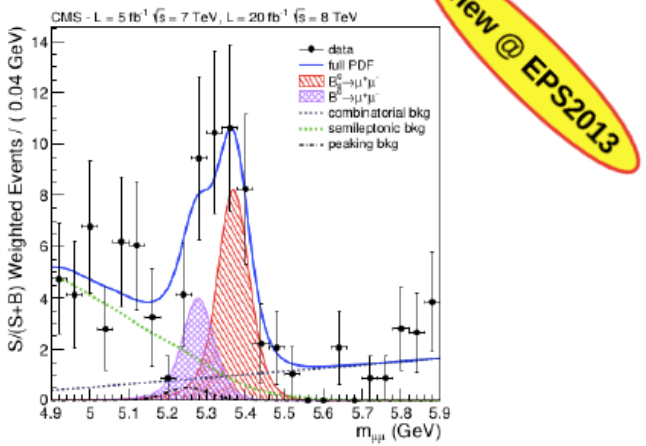
→ 4 σ

$BR(B^0 \to \mu^+\mu^-) < 7.4 \times 10^{-10}$ at 95% CL

$BR(B^0 \to \mu^+\mu^-) = (3.7\ ^{+2.4}_{-2.1}(\text{stat})\ ^{+0.6}_{-0.4}(\text{syst})) \times 10^{-10}$

→ 2.0 σ

expected sensitivity: 4.8 σ



new @ EPS2013

arXiv:1307.5025

$BR(B_s \to \mu^+\mu^-) = 3.0\ ^{+1.0}_{-0.9} \times 10^{-9}$

→ 4.3 σ

$BR(B^0 \to \mu^+\mu^-) < 1.1 \times 10^{-9}$ at 95% CL

$BR(B^0 \to \mu^+\mu^-) = 3.5\ ^{+2.1}_{-1.8} \times 10^{-10}$

→ 2.0 σ

Stephanie Hansmann-Menzemer

Flavor highlight : $B_s \to \mu\mu$

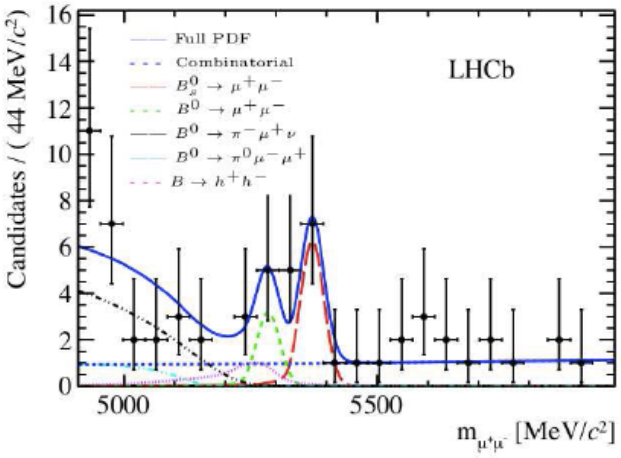
- 2.1 → 3.0 fb^{-1}
- more variables in BDT

LHCb

- 5.0 → 25 fb^{-1}
- cut base selection → BDT
- new & improved variables (PID)

CMS

expected sensitivity: 3.7 → 5.0 σ



new @ EPS2013

arXiv:1307.5024

$BR(B_s \to \mu^+\mu^-) = (2.9\ ^{+1.1}_{-1.0}(\text{stat})\ ^{+0.3}_{-0.1}(\text{syst})) \times 10^{-9}$

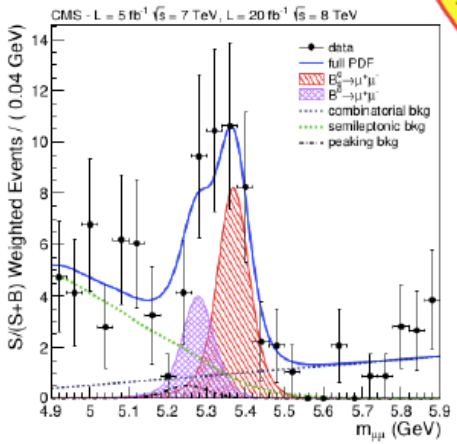
→ 4 σ

$BR(B^0 \to \mu^+\mu^-) < 7.4 \times 10^{-10}$ at 95% CL

$BR(B^0 \to \mu^+\mu^-) = (3.7\ ^{+2.4}_{-2.1}(\text{stat})\ ^{+0.6}_{-0.4}(\text{syst})) \times 10^{-10}$

→ 2.0 σ

expected sensitivity: 4.8 σ



new @ EPS2013

arXiv:1307.5025

$BR(B_s \to \mu^+\mu^-) = 3.0\ ^{+1.0}_{-0.9} \times 10^{-9}$

→ 4.3 σ

$BR(B^0 \to \mu^+\mu^-) < 1.1 \times 10^{-9}$ at 95% CL

$BR(B^0 \to \mu^+\mu^-) = 3.5\ ^{+2.1}_{-1.8} \times 10^{-10}$

→ 2.0 σ

Stephanie Hansmann-Menzemer

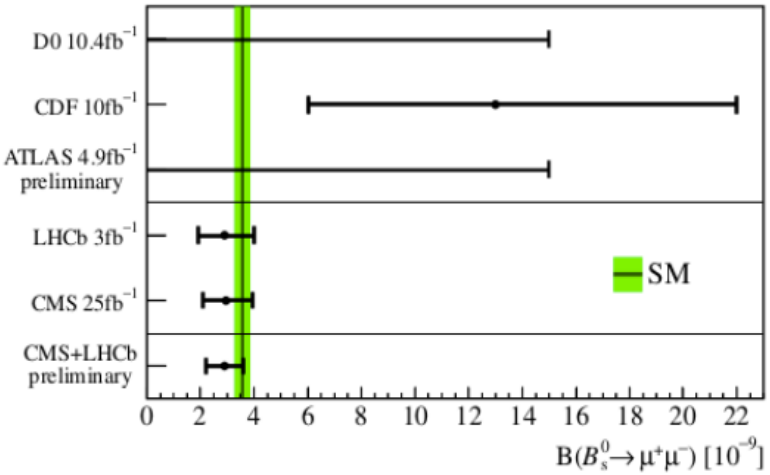
Flavor highlight : $B_s \to \mu\mu$

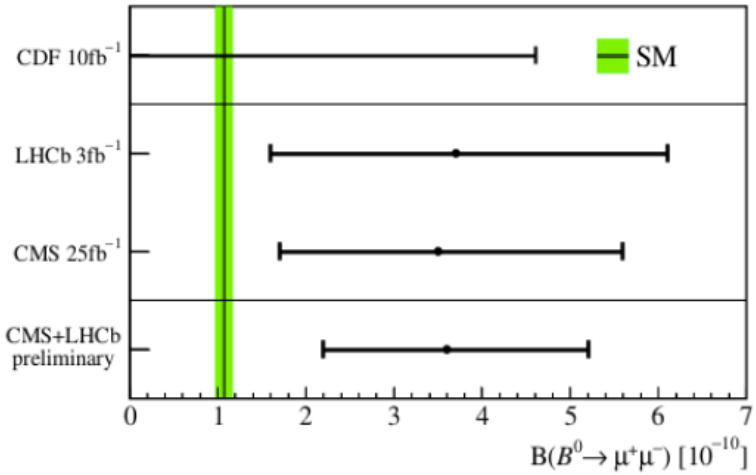
new @ EPS2013

Observation:

$$BR(B_s \to \mu^+\mu^-) = (2.9 \pm 0.7) \times 10^{-9}$$

$$BR(B^0 \to \mu^+\mu^-) = 3.6^{+1.6}_{-1.4} \times 10^{-10}$$





LHCb-CONF-2013-012, CMS-PAS-BPH-13-007

Stephanie Hansmann-Menzemer 26

Flavor highlight : $B_s \to \mu\mu$

new @ EPS2013

Observation:

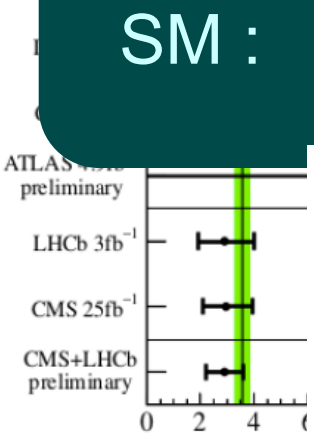
$$BR(B_s \to \mu^+\mu^-) = (2.9 \pm 0.7) \times 10^{-9}$$

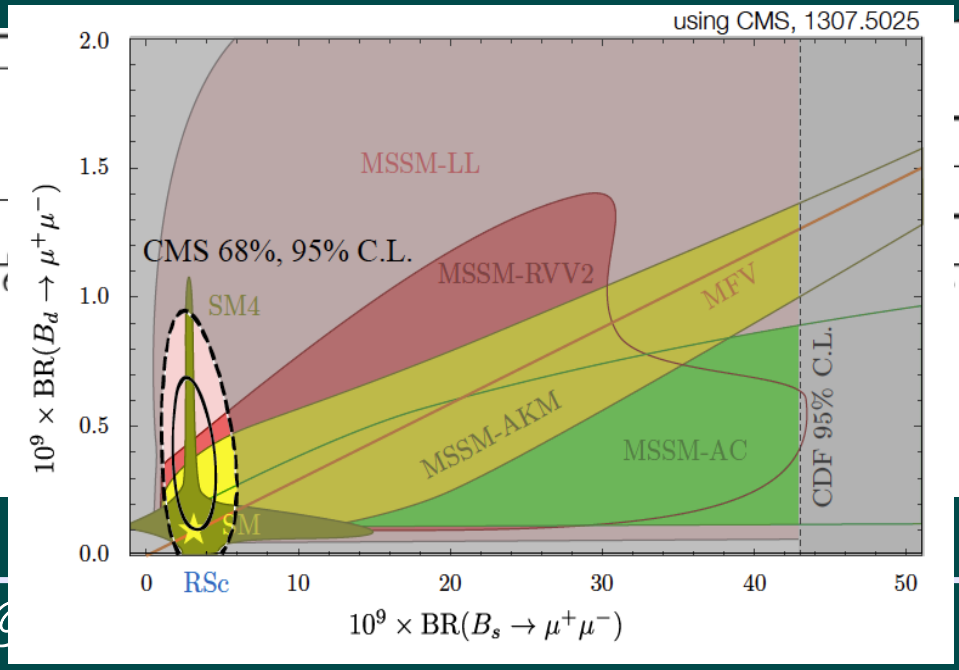
$$BR(B^0 \to \mu^+\mu^-) = 3.6^{+1.6}_{-1.4} \times 10^{-10}$$

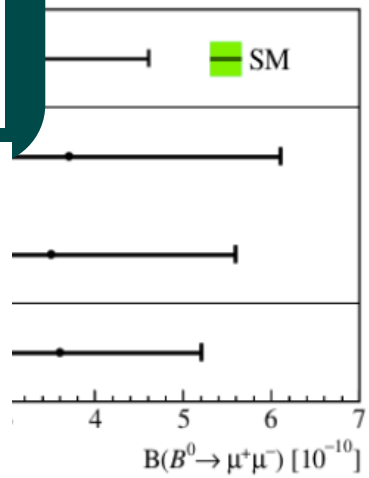
SM :

$$BR(B_s \to \mu^+\mu^-) = 3.34 \pm 0.27 \times 10^{-9}$$

$$BR(B^0 \to \mu^+\mu^-) = 1.07 \pm 0.10 \times 10^{-10}$$







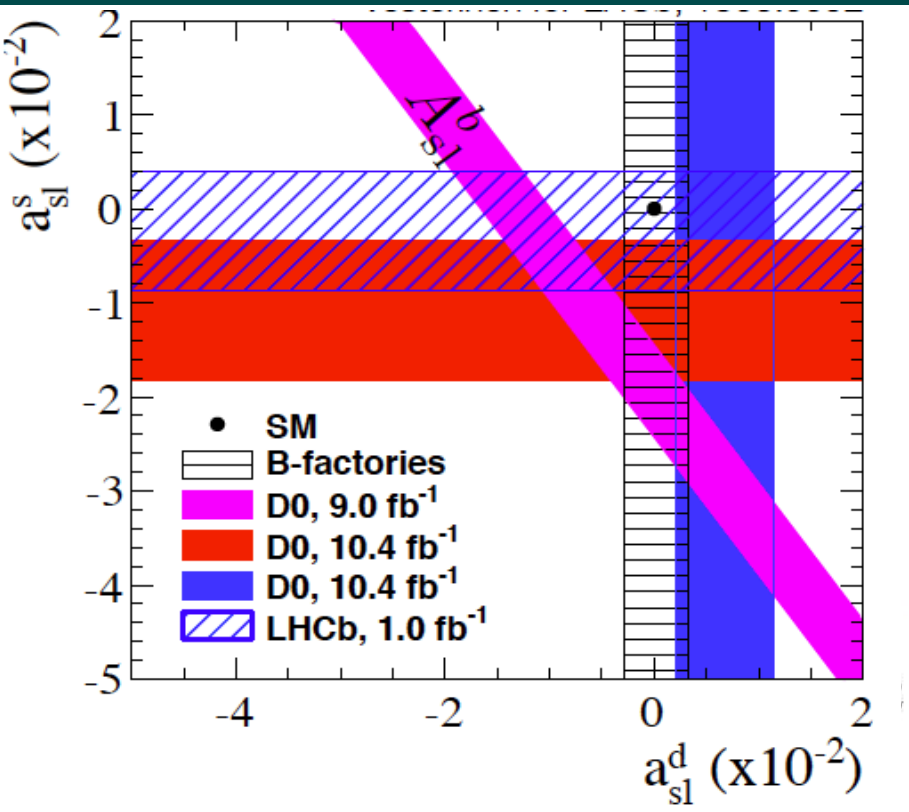
Stephanie Hansmann-Menzemer 26

Anomalie : A_{CP} nel mixing

$P(B \to \bar{B}) \neq P(\bar{B} \to B)$:

$$A = \frac{N(\mu^+\mu^+) - N(\mu^-\mu^-)}{N(\mu^+\mu^+) + N(\mu^-\mu^-)}$$

$D\varnothing$: $A_{CP} = (-0.276 \pm 0.067 \pm 0.063)\%$, 3.9σ *da SM*



$a^s_{sl} = (-0.06 \pm 0.50 \pm 0.36)\%$ B_S

LHCb-PAPER-2013-033-001

single most precise result on a^d_{sl} B_d

using partial reconstructed

$B \to D^* \ell\nu$ + kaon tags:

$a^d_{sl} = (0.06 \pm 0.16^{+0.36}_{-0.32})\%$

Babar: arXiv:1305.1575

PRL 111 101802

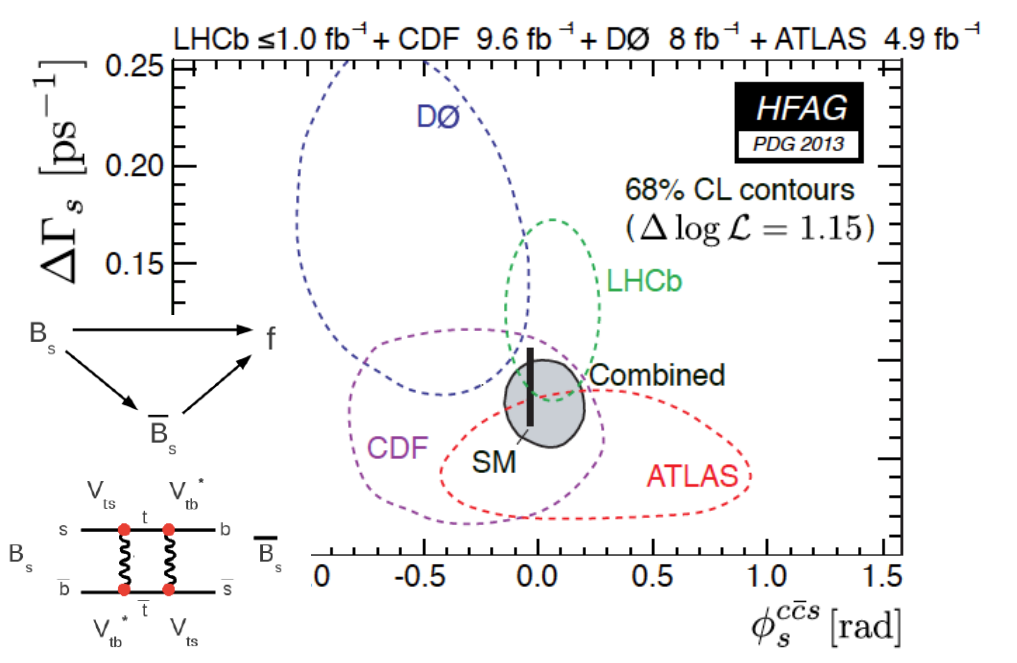
Anomalie : A_{CP} nel mixing

$P(B \to \bar{B}) \neq P(\bar{B} \to B)$:

$$A = \frac{N(\mu^+\mu^+) - N(\mu^-\mu^-)}{N(\mu^+\mu^+) + N(\mu^-\mu^-)}$$

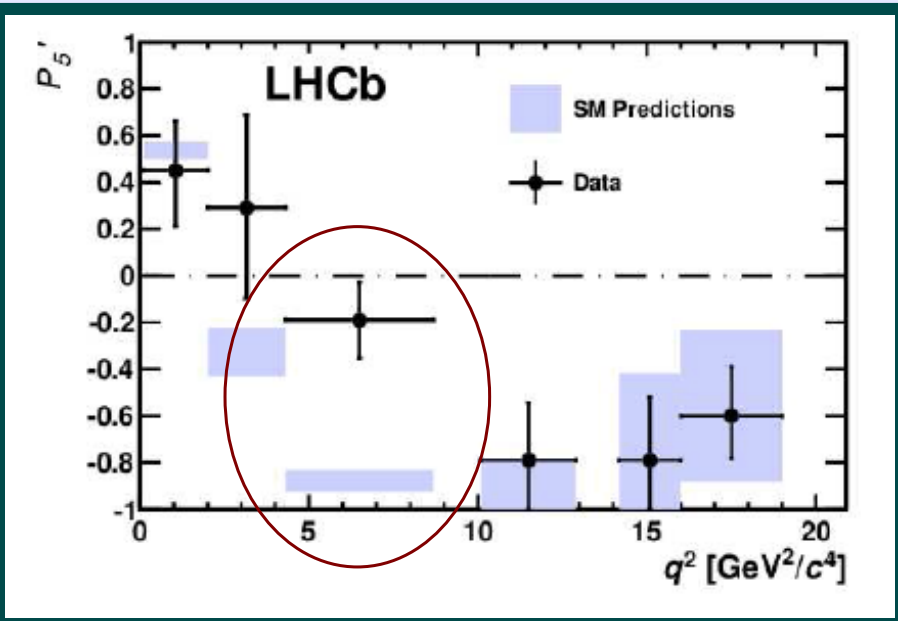
$D\varnothing$: $A_{CP} = (-0.276 \pm 0.067 \pm 0.063)\%$, 3.9σ *da SM*

Non si accomoda facilmente con misure di Φ_s (LHCb)
che viceversa rispettano il MS



Altre Anomalie

- LHCb : B–>K*μμ
  (1 bin anomalo su 24)
  P=0.5%, 3.7σ



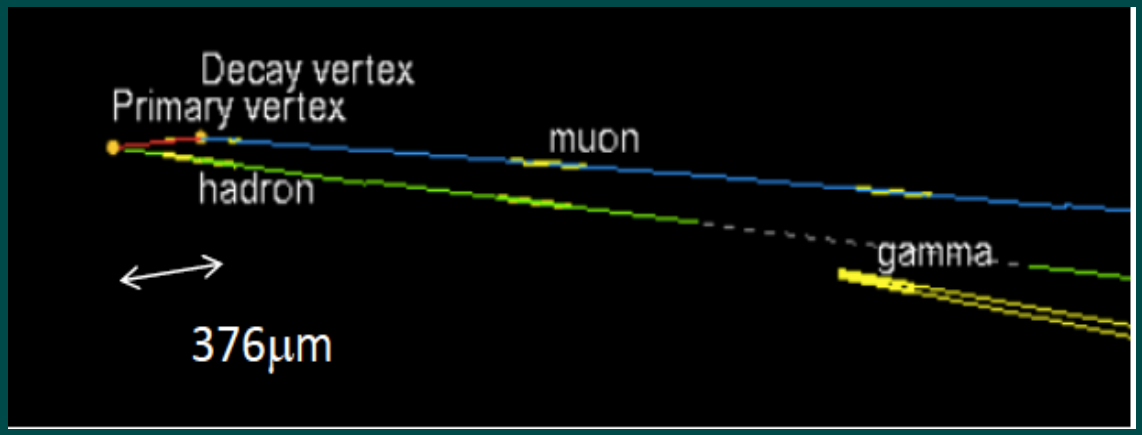
- Belle conferma anomalia (3.3 σ) osservata da Babar (3.4 σ) su :

$$R = \frac{\mathcal{B}(B \to D^{(*)} \tau \nu)}{\mathcal{B}(B \to D^{(*)} \ell \nu)}$$

- Deviazione da MS (combinando) : 4.8 σ

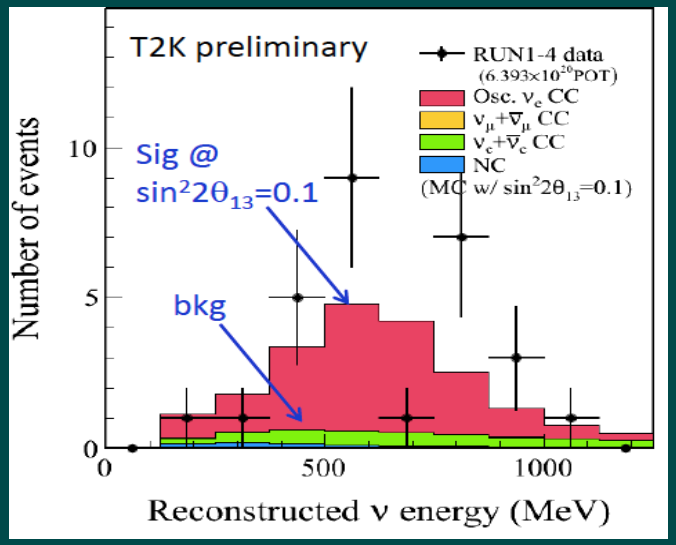
Neutrini : Appearence

- OPERA : $\nu_\mu \rightarrow \nu_\tau$



- III evento ($\tau \rightarrow \mu$, $\tau \rightarrow 3h$, $\tau \rightarrow h$)
- P(back.) ≈ $7\,10^{-4}$
- 3.2 σ significance

- T2K : $\nu_\mu \rightarrow \nu_e$

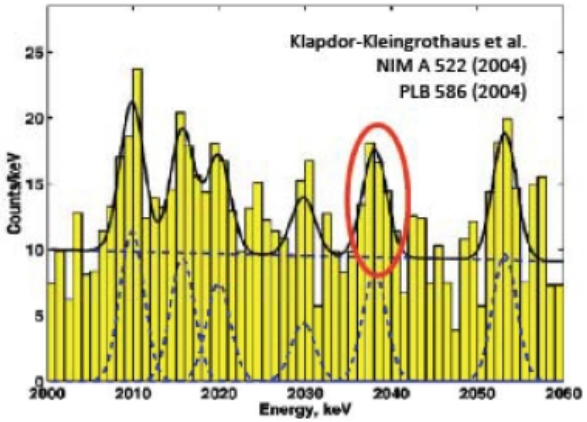


	2012(*)	2013(now)
POT	3.010×10^{20}	6.393×10^{20} (~Apr 12)
Bkgs	3.3 ± 0.4	4.64 ± 0.51
Observed ν_e cand. Events	11	**28**
ν_e app. Significance	3.1σ	**7.5σ**

Neutrini: GERDA

Klapdor-Kleingrothaus et al., NIM A 522 (2004), PLB 586 (2004):

- 71.7 kg year - Bgd 0.17 / (kg yr keV)
- 28.75 ± 6.87 events (bgd:~60)
- Claim: 4.2σ evidence for 0νββ
- reported $T_{1/2}^{0\nu} = 1.19 \times 10^{25}$ yr



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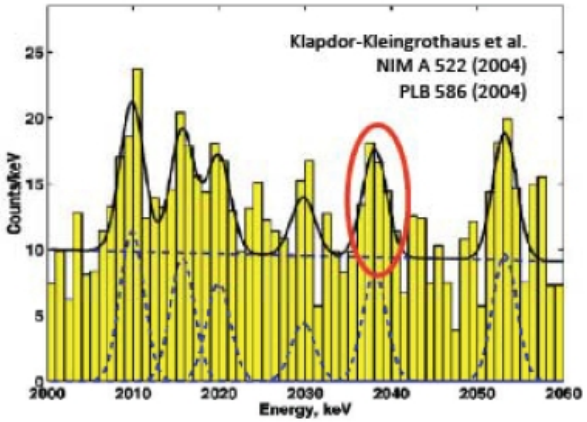

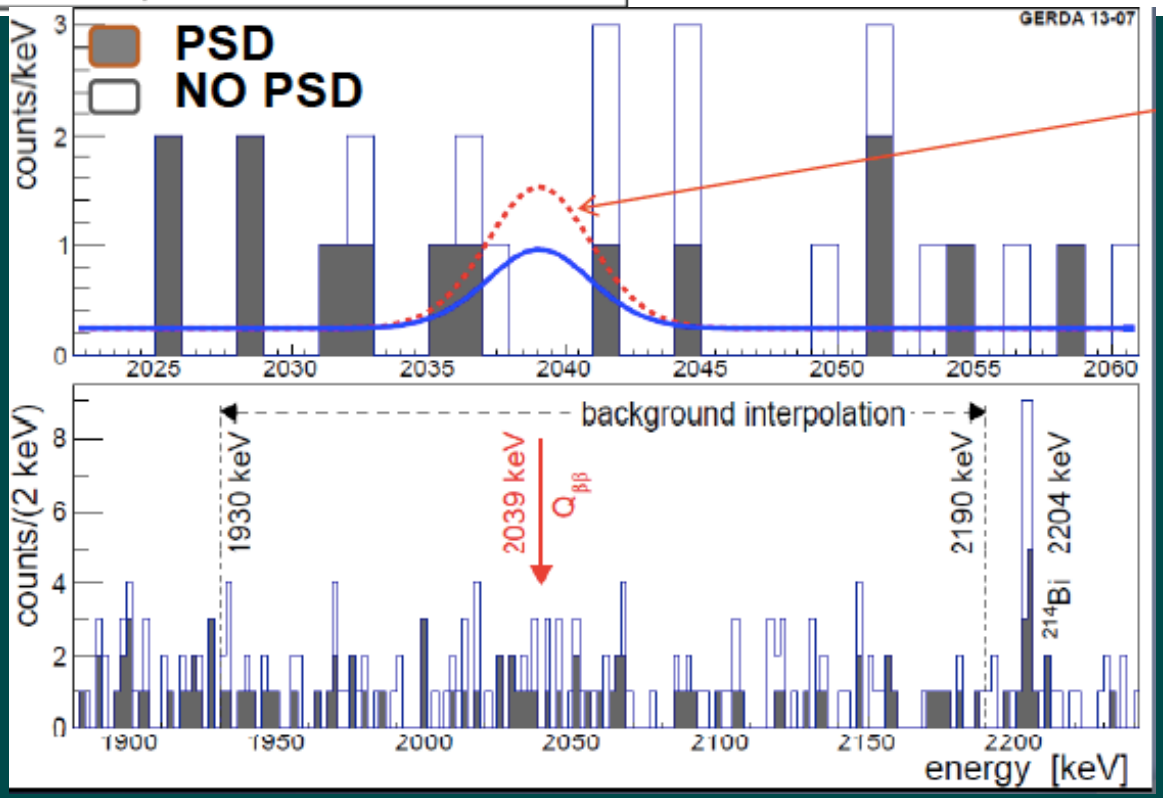

Neutrini: GERDA

Expected Signal (after PSD): 5.9 ± 1.4 cts in ±2σ
Expected Bckgd (after PSD): 2.0 ± 0.3 cts in ±2σ
Observed: 3.0 (0 in ±1σ)

- 71.7 kg year - Bgd 0.17 / (kg yr keV)
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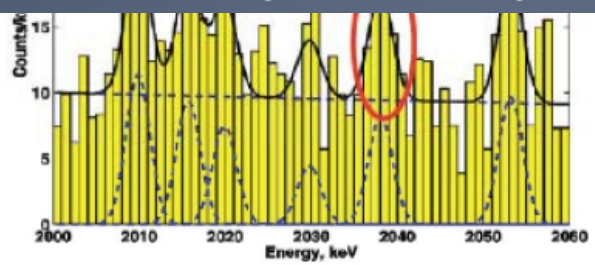

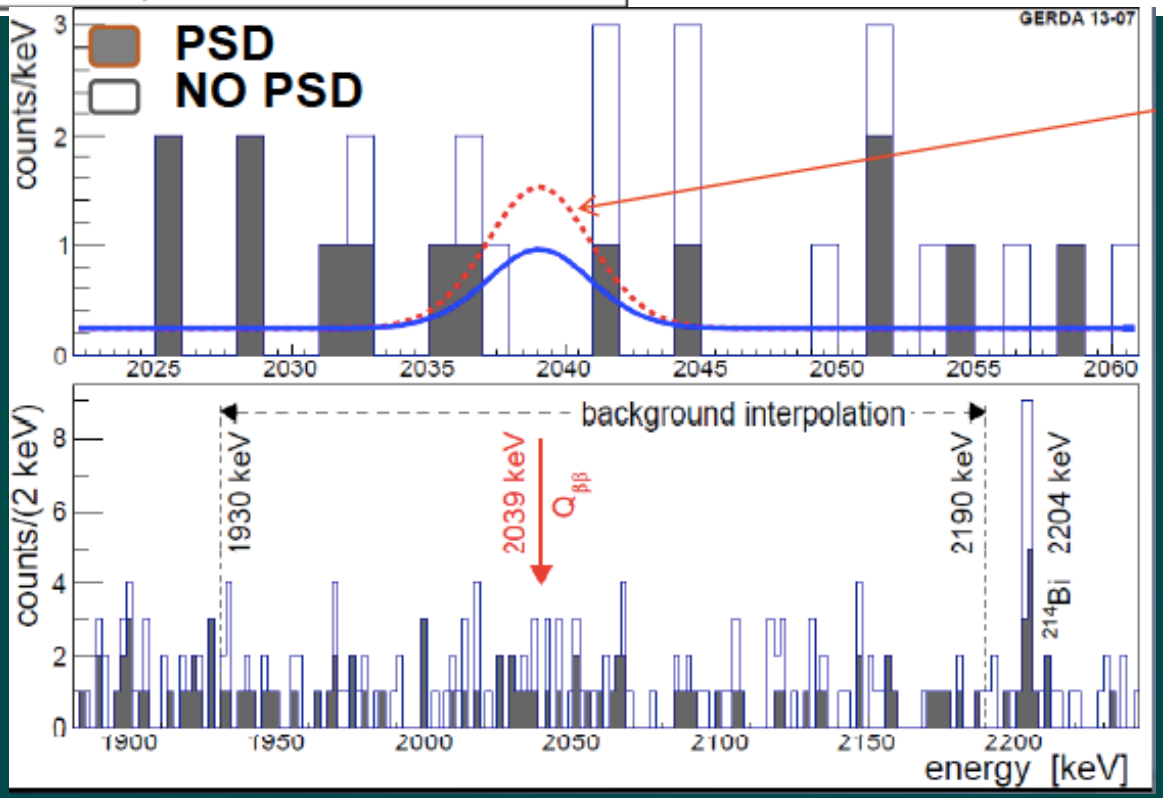

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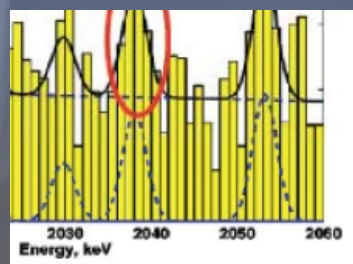
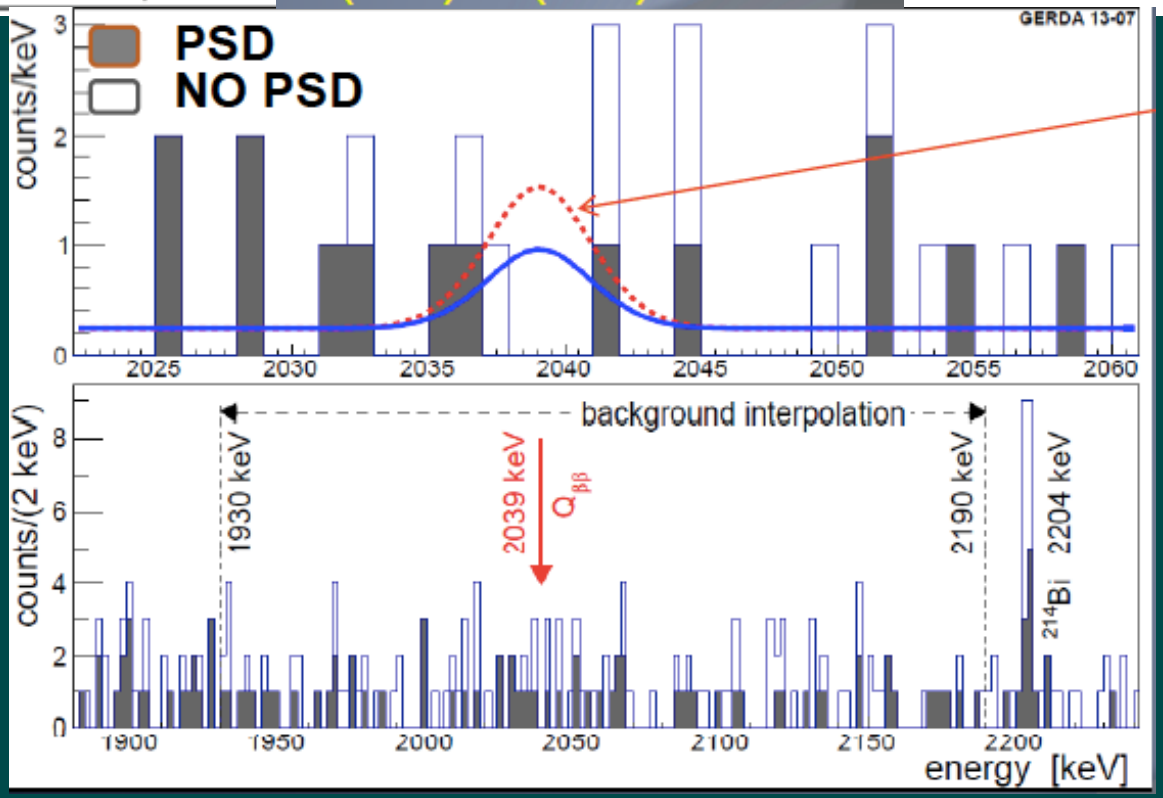
Expected Bckgd (after PSD): 2.0 ± 0.3 cts in ±2σ
Observed: 3.0 (0 in ±1σ)

- 71.7 kg year - Bgd 0.
- 28.75 ± 6.87 events
- Claim: 4.2σ evidence
- reported $T_{1/2}^{0\nu}$ = 1.1

H1: Claimed signal
H0: Background only
Bayes factor
P(H1)/P(H0)=0.024





Sabato 20/07 : Joint ECFA-EPS

14:30 **EPS-HEPP Board** *10'* Sphicas (CERN/Athens)[1]

14:40 **ECFA** *10'* Krammer (HEPHY/Vienna)

14:50 **The Update of the European Strategy for Particle Physics** *20'* Tatsuya Nakada (Ecole Polytechnique Federale de Lausanne (CH))

15:20 **The CERN program** *20'* Rolf Heuer (CERN)

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I Quattro Pilastri della Saggezza Europea

- LHC

  upgrade of the machine and detectors with a view to collecting ten times more data than in the initial design by ~ 2030 ...

- Post-LHC

  CERN should undertake R&D projects for *pp* and e^+e^- High Energy frontier machines... European ambition is energy frontier Physics

- ILC (Japan)

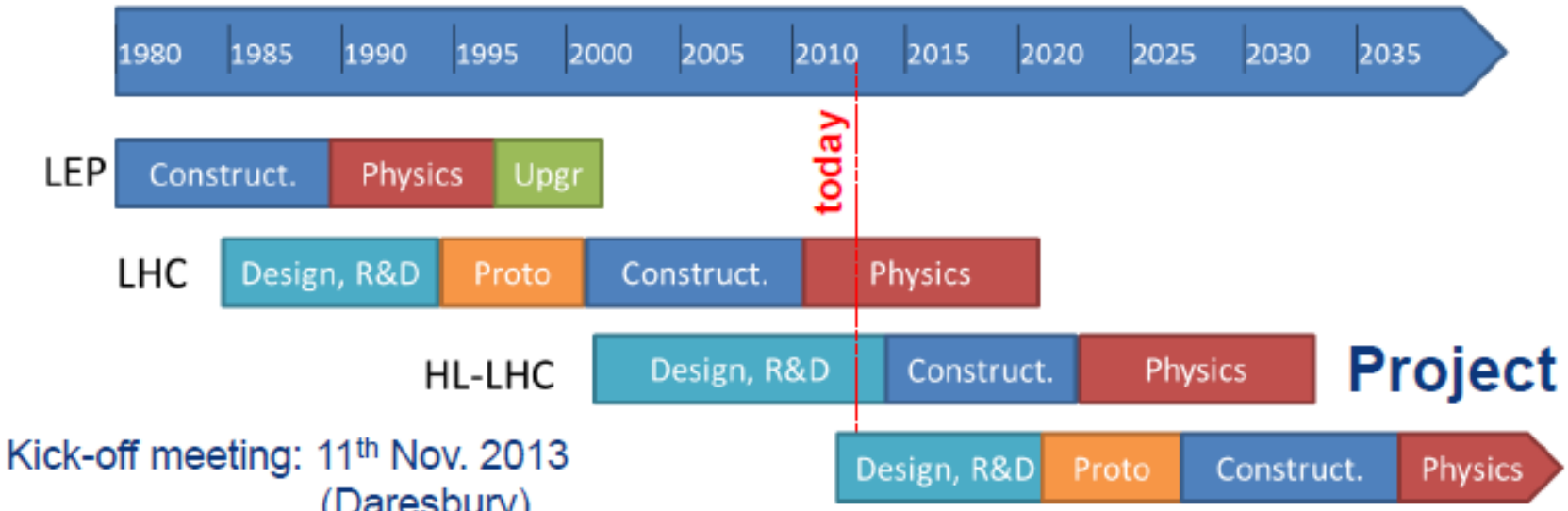
  Europe is not in the position to construct another large accelerator right now ... If the ILC is constructed outside Europe within the LHC lifetime ... a logical conclusion is to contribute

- Long Baseline ν

  Europe should explore the possibility of major participation in leading long-baseline ν projects in US and Japan ...

Heuer : the CERN Program

*"CERN should undertake design studies for accelerator projects in a global context, with emphasis on **proton-proton** and electron- positron **high-energy frontier machines.**"*



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Study : VHE-LHC with TLEP

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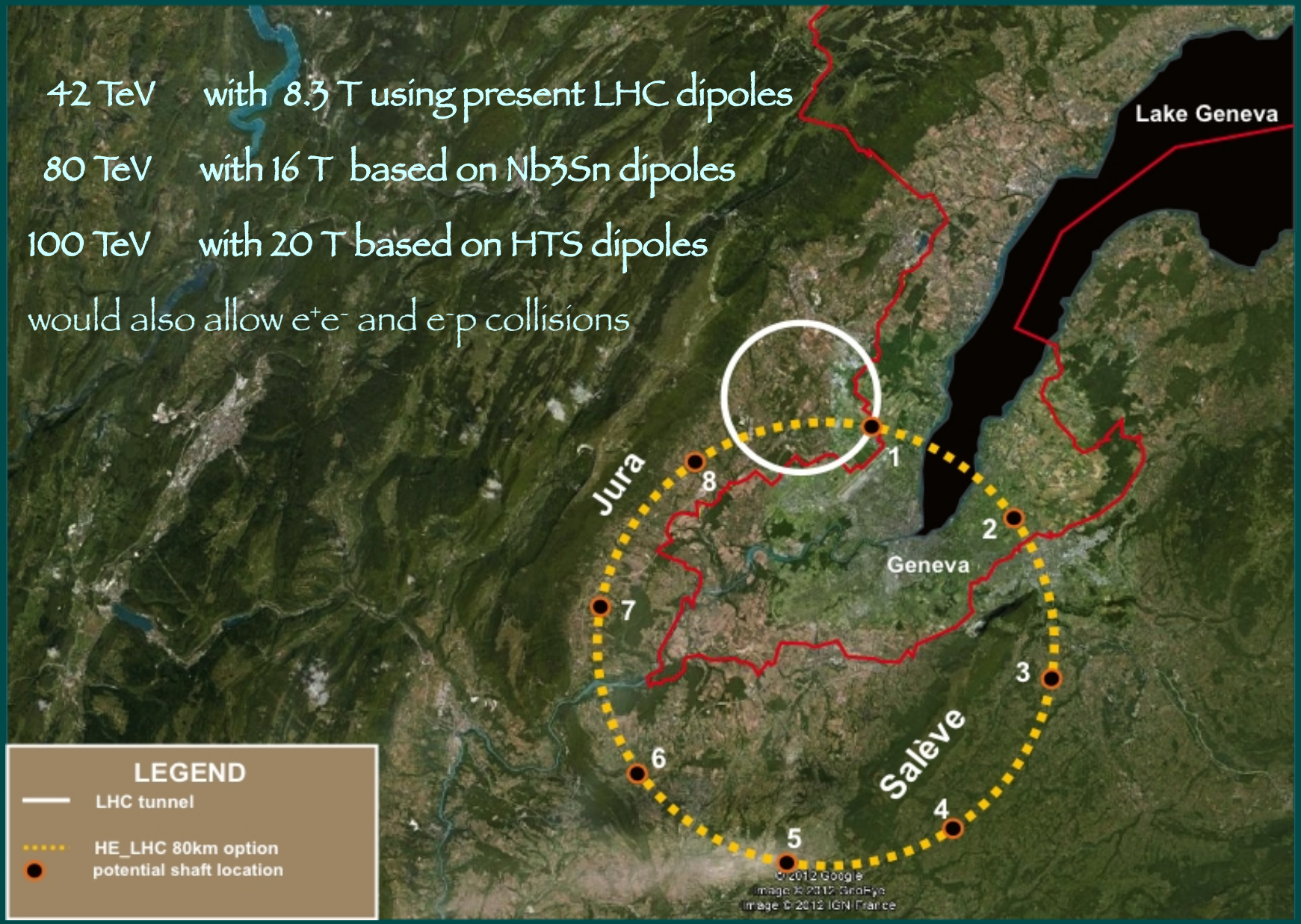
Heuer : VHE LHC



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superceded

【Press release】 *Announcement of the results of the ILC candidate site evaluation in Japan*

The ILC site evaluation committee of Japan has assessed the two candidate sites based on technical and socio-

The Kitaka

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The Kitaka

from *Jiji Press*
6 August 2013

Japan Needs Years to Make Decision on ILC Building: Science Council Panel

-Members of a Science Council of Japan panel agreed in principle on Tuesday that Japan should spend several years to examine the significance of leading the proposed international project to construct a next-generation large-scale particle accelerator.

Snowmass Report: Bedeschi @ CSN1

- DOE definisce disponibilita' per i prossimi 10 anni
  - Ipotesi di bilancio costante per HEP
  - Nuovi progetti devono fittare in 1 G$ su 10 anni
  - Questi fondi devono essere trovati all'interno del budget corrente
- Priorita' da definire per l'estate 2014
  - Comunita' divisa tra LBNE e LHC upgrades/(ILC)
  - **I fondi bastano per LBNE e LHC upgrades ridotti**
    - Riduzione impegno su LHC upgrade avra'un impatto sulla definizione complessiva degli upgrades anche vista la situazione europeea
  - **Contributi a ILC o simili solo da accordi ad alto livello tra USA ed altri stati (e.g. Giappone)**


BACKUP

Update of the European Strategy for HEP (Nakada)

- Calendario :

  - Open Symposium organised by the Preparatory Group in September 2012 in Krakow
  - The draft proposal by the European Strategy Group as out come of the meeting in January 2013 in Erice
  - First Council discussion in March 2013, finalising the agreed draft for the formal approval later
  - Formal adoption by the CERN Council in its special Strategy Session in Brussels in May 2013

- Strategy Paper : preambolo e 17 capitoli

  – Four for selected high priority large scale projects:
  LHC, HE frontier machine R&D, e^+e^- (ILC), long baseline ν

I Quattro Pilastri della Saggezza Europea

- LHC
- CERN Post-LHC accelerator programme
- Japan ILC
- Long baseline neutrino

I quattro pilastri: (1) LHC

"The discovery of the Higgs boson is the start of a major program of work ...

Europe's top priority should be the exploitation of the full potential of the LHC ...

upgrade of the machine and detectors with a view to collecting ten times more data than in the initial design by ~ 2030 ...

Requires major resources in Europe till ~ mid 2020 ... Needs of foreign contributions"

I quattro pilastri: (2) Post-LHC

"Europe needs ... to propose an ambitious post-LHC accelerator project at CERN ... when Physics results from 14 TeV LHC running will be available.

CERN should undertake R&D projects for *pp* and e^+e^- High Energy frontier machines ... in collaboration with national institutes, LABs and universities worldwide.

European ambition is energy frontier Physics

I quattro pilastri: (3) ILC

"There is a strong scientific case for an e^+e^- collider complementary to the LHC ...

The initiative ... from ... Japan is most welcome, and Europe groups are eager to partecipate

Europe is not in the position to construct another large accelerator right now ...

If the ILC is constructed outside Europe within the LHC lifetime ... a logical conclusion is to contribute "

I quattro pilastri: (4) veutrini

"strong scientific case for long baseline ν programme exploring CP violation and the mass hierachy ...

Europe should explore the possibility of major participation in leading long-baseline ν projects in US and Japan ...

optimizing the European contribution for ν programme vis a vie the European ambition of high energy frontier "

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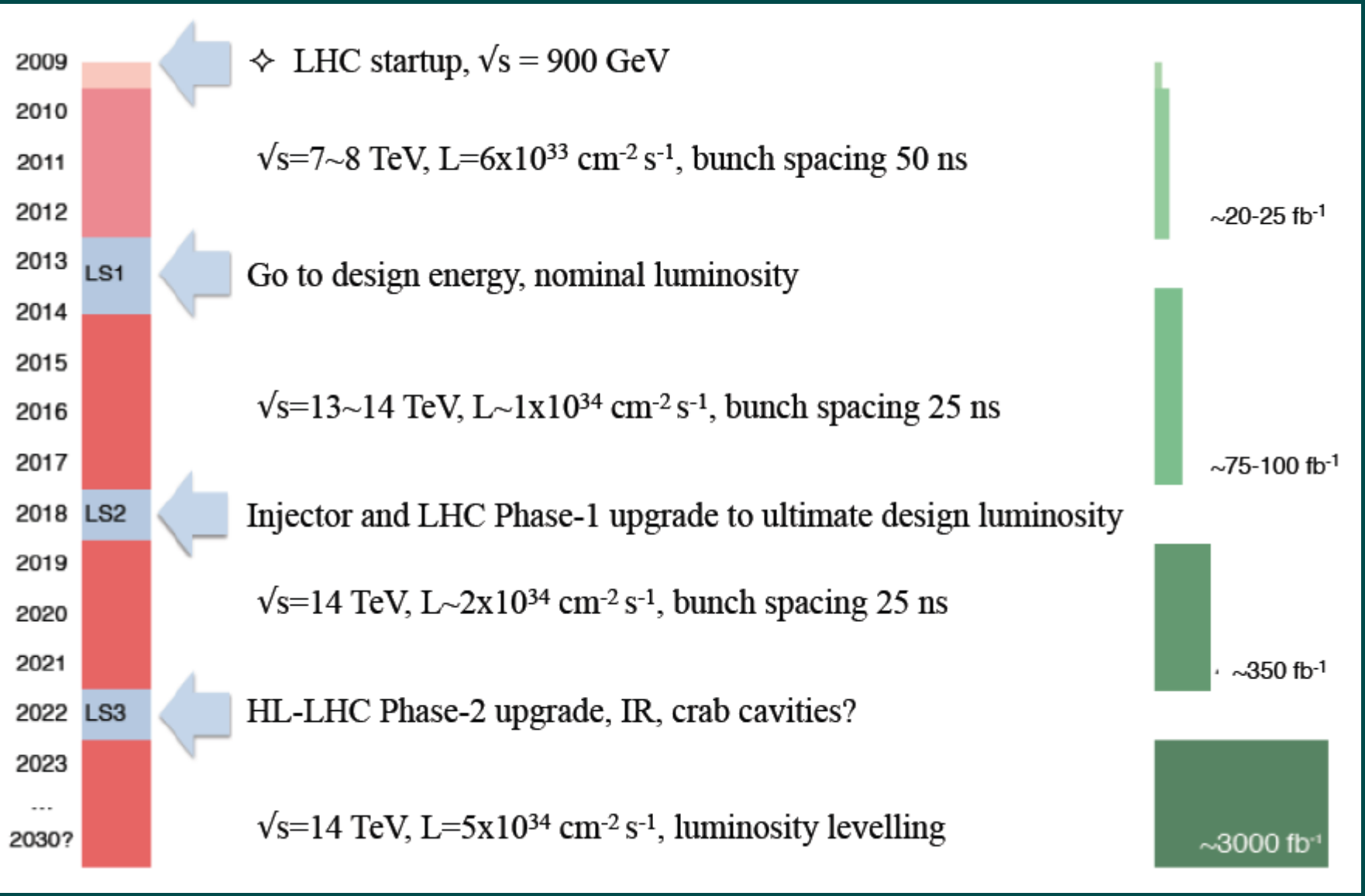
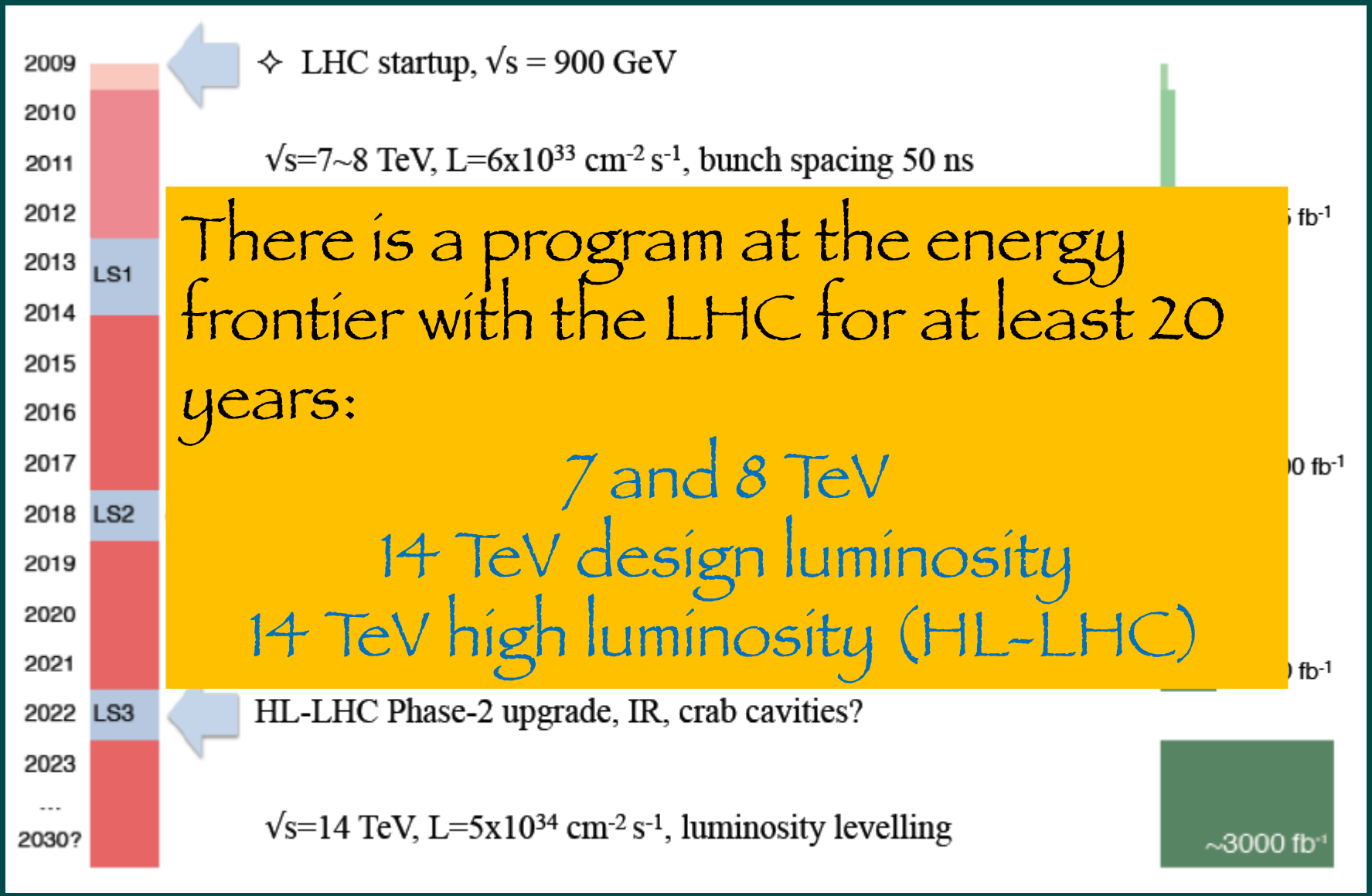
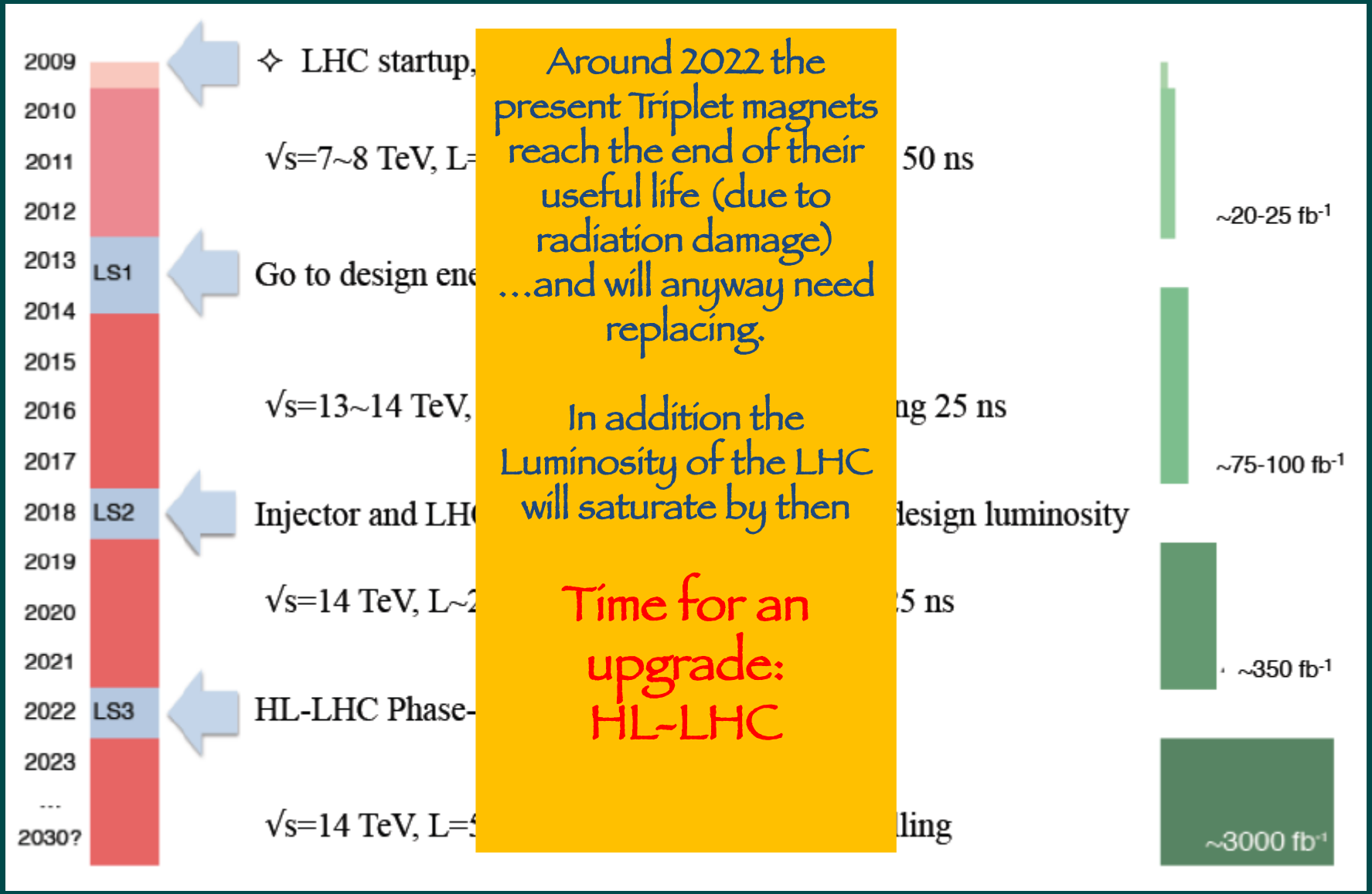
Heuer: LHC programme



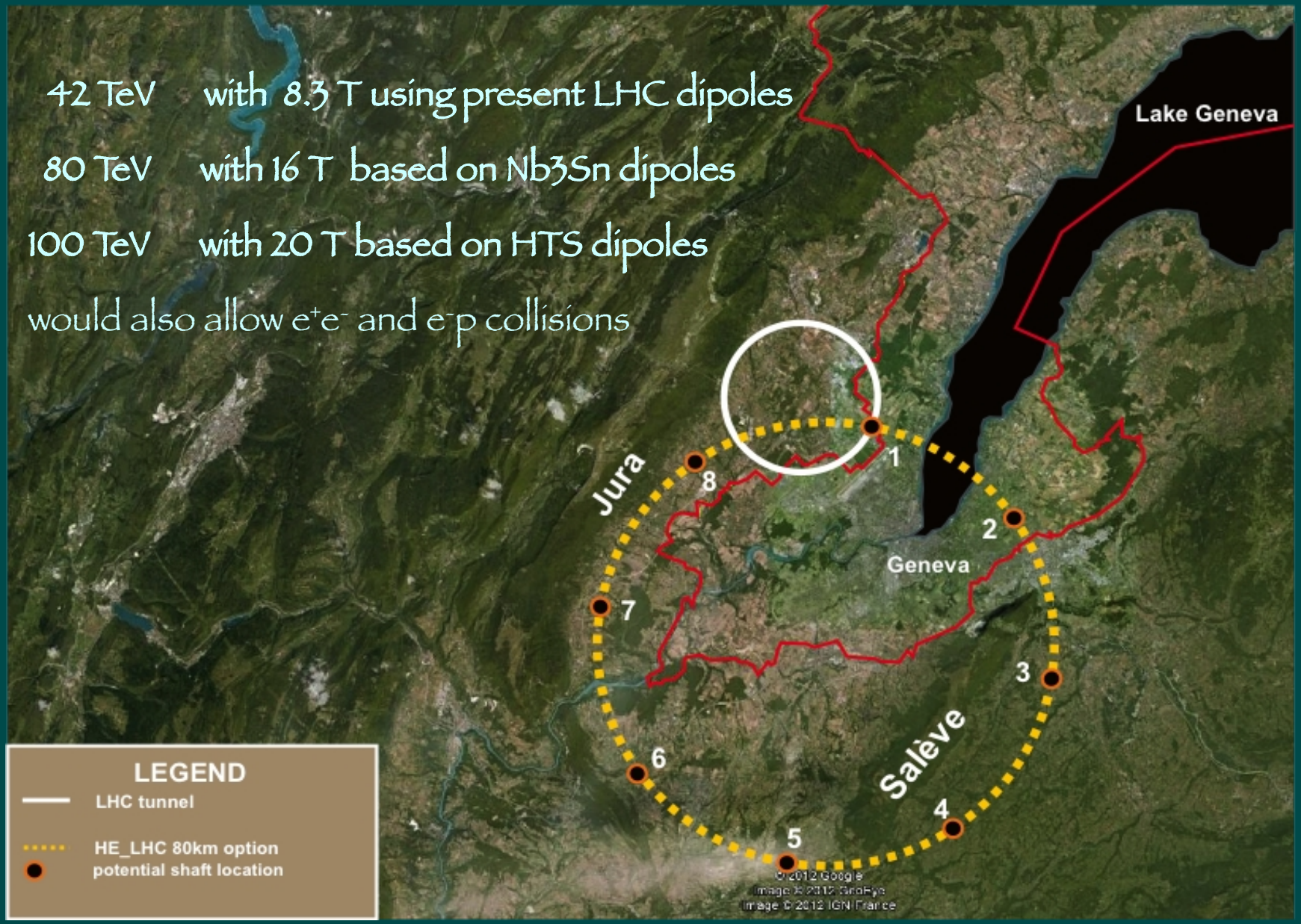
Heuer: LHC programme



Heuer: LHC programme



Heuer : Post – LHC (1) VHE LHC



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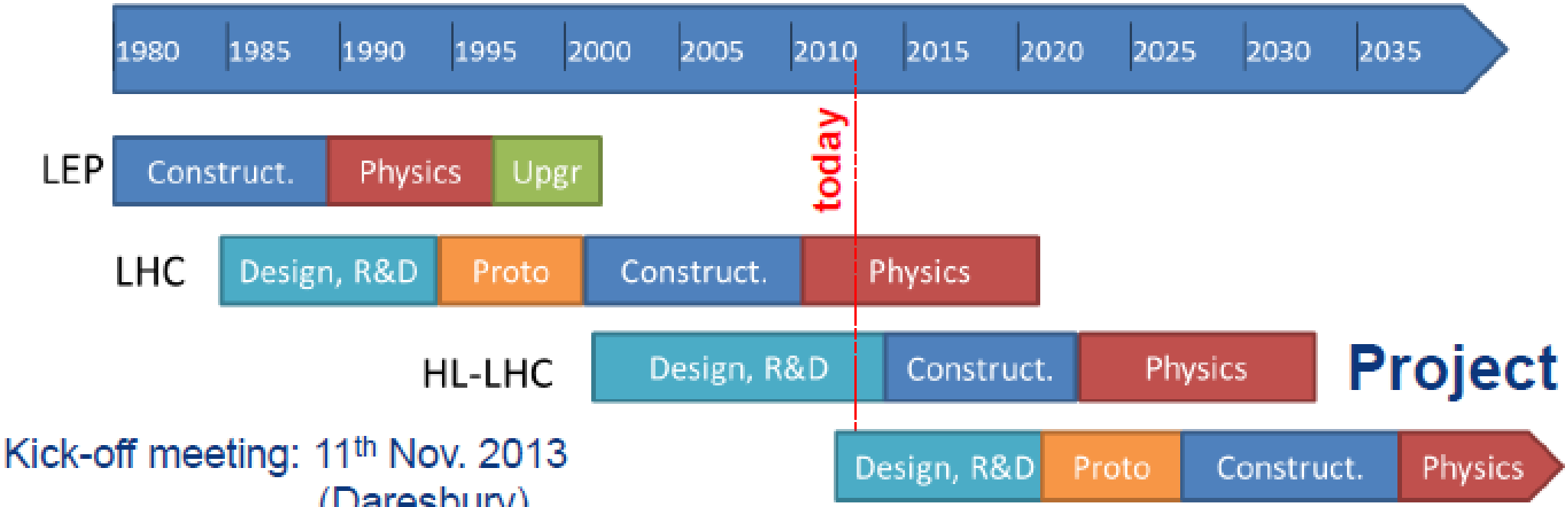

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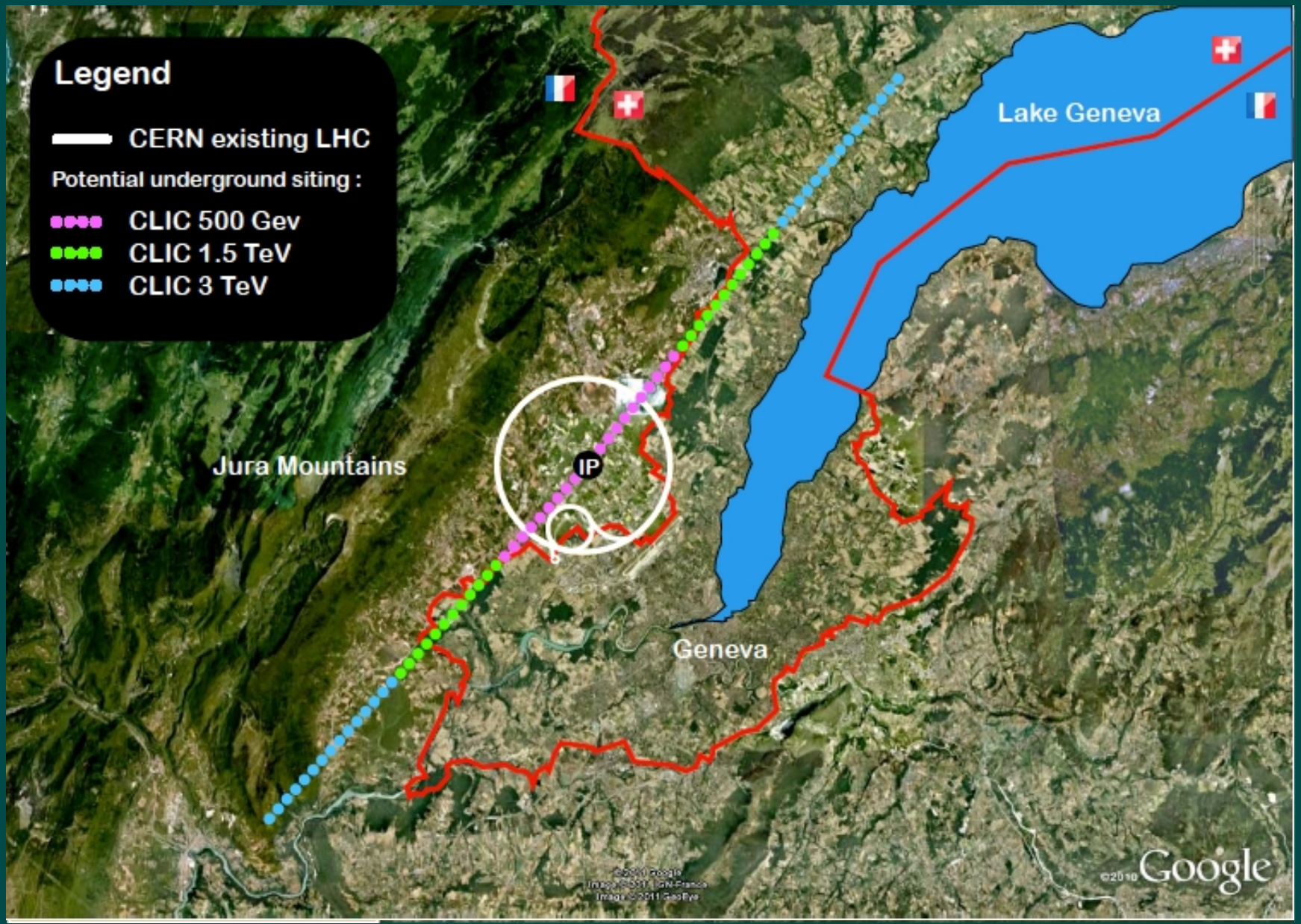
Kick-off meeting: February 2014 (CERN)

Heuer : Post – LHC (2) CLIC



Heuer : altre attivita' @ CERN

- ν-Physics
  - enable large scale detector development and tests for neutrino detectors, e.g. LAGUNA, ICARUS-NESSIE
  - launch study for a neutrino (test) beam in the North Area
- Fixed Target :
  - HIE-Isolde as approved and ongoing
  - AD and ELENA as approved and ongoing;
    - extension for GBAR approved
    - addition of a storage ring under consideration
  - n-TOF (with EAR2) as approved
  - CNGS terminated

Sabato 20/07 : Joint ECFA-EPS

1

14:30 **EPS-HEPP Board** *10'* Sphicas (CERN/Athens)

14:40 **ECFA** *10'* Krammer (HEPHY/Vienna)

14:50 **The Update of the European Strategy for Particle Physics** *20'* Tatsuya Nakada (Ecole Polytechnique Federale de Lausanne (CH))

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Proposal for a Phases Execution of the ILC

- Documento della JAHEP (18/10/2012)

ILC shall be constructed in Japan as a global project based on agreement and participation by the international community.

Scenario : Start with a Higgs Boson Factory ~250 GeV. Upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.

Japan covers 50% of the expenses (construction) of the overall project of a 500 GeV machine. The actual contributions, however, should be left to negotiations among the governments.

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Proposal for a Phases Execution of the ILC

- Dopodiche'

2013 April	ILC Taskforce started in MEXT Japan
2014 May	ECFA LC (DESY, Hamburg)
2013 June	ILC Event TDR Review is completed (Tokyo ⇒Geneva ⇒Chicago)
2013 June-August	In Science Council of Japan ILC Review Committee was formed
2013 July	EPS-HEP 2013 (Stockholm, Sweden)
2013 Summer	A site in Japan will be chosen by scientists (MEXT, Politicians all agree to the process)
2013 Nov. 11-15	LCWS2013 The University of Tokyo

Proposal for a Phases Execution of the ILC

- Schedula ("Very optimistic but not impossible"):

2013 July Site evaluation by scientists will be completed in Japan
2013 fall New organization within Japanese government is expected to be formed and in preparation to bid to host the ILC
2014-15 Intergovernmental negotiation
Linear Collider Collaboration (Lyn Evans and ILC sector) continue to refine the design and organization of the global lab for ILC
2015 International Review of the ILC project (LHC physics @13-14 TeV)

2016 Construction starts (accelerator + detectors)
2026 Commissioning of the ILC machine

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【Press release】 *Announcement of the results of the ILC candidate site evaluation in Japan*

The ILC site evaluation committee of Japan has assessed the two candidate sites based on technical and socio-environmental criteria and unanimously concluded as follows:

The Kitakami site is evaluated to be the best domestic candidate site for the ILC.

ILC戦略会議

ILC Strategy Council Official Website

【Press release】 *Announcement of the results of the ILC candidate site evaluation in Japan*

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The Kitaka

from *Jiji Press*
6 August 2013

Japan Needs Years to Make Decision on ILC Building: Science Council Panel

-Members of a Science Council of Japan panel agreed in principle on Tuesday that Japan should spend several years to examine the significance of leading the proposed international project to construct a next-generation large-scale particle accelerator.

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US Strategy

- Rassegna dei prossimi processi decisionali.

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- Snowmass (29/07 6/08)

Goal: Identify compelling HEP science opportunities over an approximately 20-yr time frame

Not a prioritization, but can make scientific judgments

US Strategy

- Rassegna dei prossimi processi decisionali.

- Snowmass (29/07- 6/08)

Goal: Identify compelling HEP science opportunities over an approximately 20-yr time frame

Not a prioritization, but can make scientific judgments

- P5 (2013-2014) :

- **The P5 process takes the science vision of the community and turns it into a plan that is feasible and executable over a 10-20 year timescale.**

  - **Decide on the project priorities within budget guidance from agencies**
    - in detail for the next 10 years, in broad outline beyond that

Snowmass Report: Bedeschi @ CSN1

- DOE definisce disponibilita' per i prossimi 10 anni
  - Ipotesi di bilancio costante per HEP
  - Nuovi progetti devono fittare in 1 G$ su 10 anni
  - Questi fondi devono essere trovati all'interno del budget corrente
- Priorita' da definire per l'estate 2014
  - Comunita' divisa tra LBNE e LHC upgrades/(ILC)
  - **I fondi bastano per LBNE e LHC upgrades ridotti**
    - Riduzione impegno su LHC upgrade avra'un impatto sulla definizione complessiva degli upgrades anche vista la situazione europeea
  - **Contributi a ILC o simili solo da accordi ad alto livello tra USA ed altri stati (e.g. Giappone)**