

Disclaimer: this is not a summary talk,
too many good talks at this Conference !!

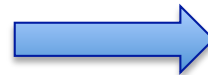
The 2nd IMP meeting on LHC Physics
Tehran, 7th - 11th September 2013

Conclusions

Roberto Tenchini
INFN Pisa

The first IPM meeting was not long ago 2009 → 2013

Esfahan



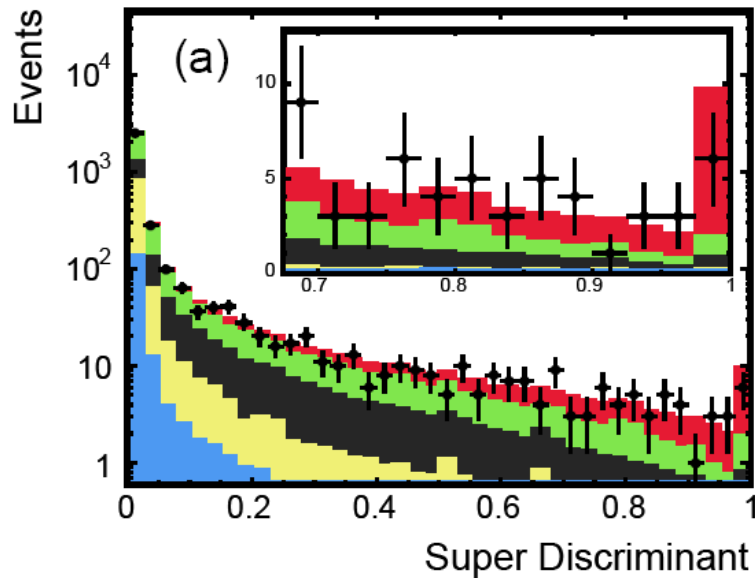
Tehran



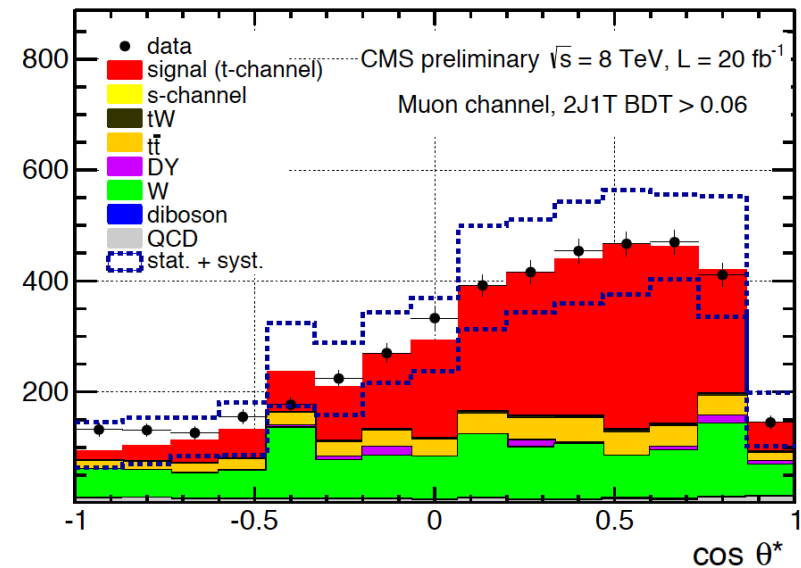
Impressive progress in 4 years

Example - single top production

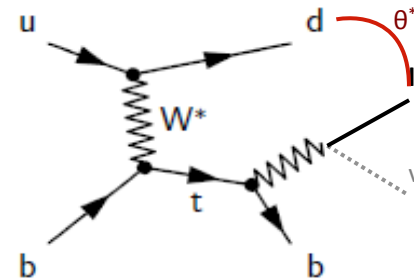
2009: first observation (CDF)



2013: detailed studies of single top properties



More information in A. Jafari's talk



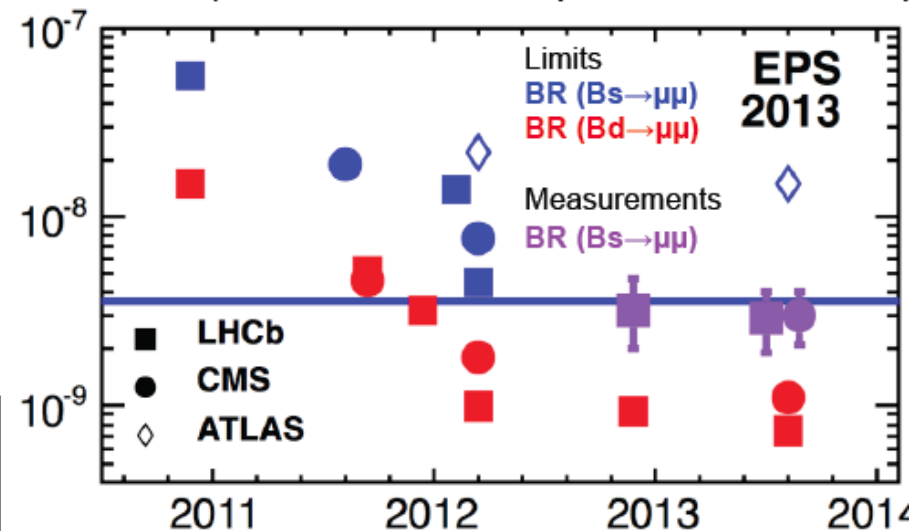
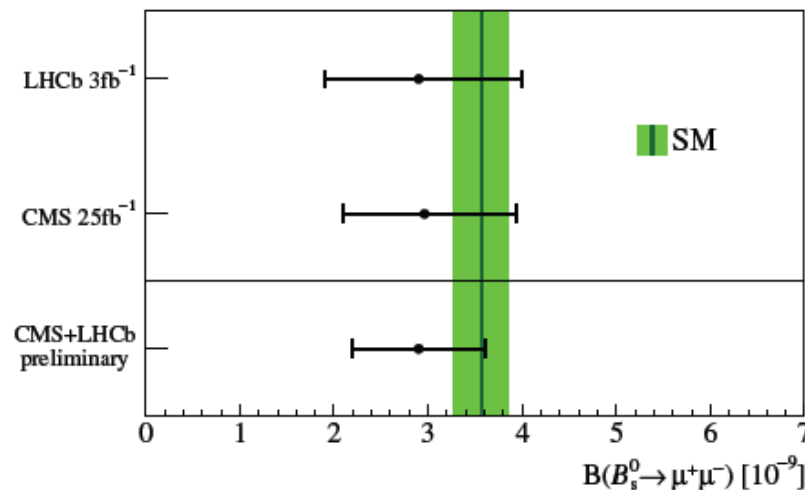
We have detected very rare (and very relevant !) decays

- CMS measurements using 25 fb⁻¹ data

$$\text{BR}(B_s \rightarrow \mu\mu) = \left(3.0_{-0.9}^{+1.0}\right) \times 10^{-9} \text{ statistics dominated, } 4.3 \sigma \text{ significance}$$

$$\text{BR}(B_d \rightarrow \mu\mu) < 1.1 \times 10^{-9} @ 95\% \text{ CL}$$

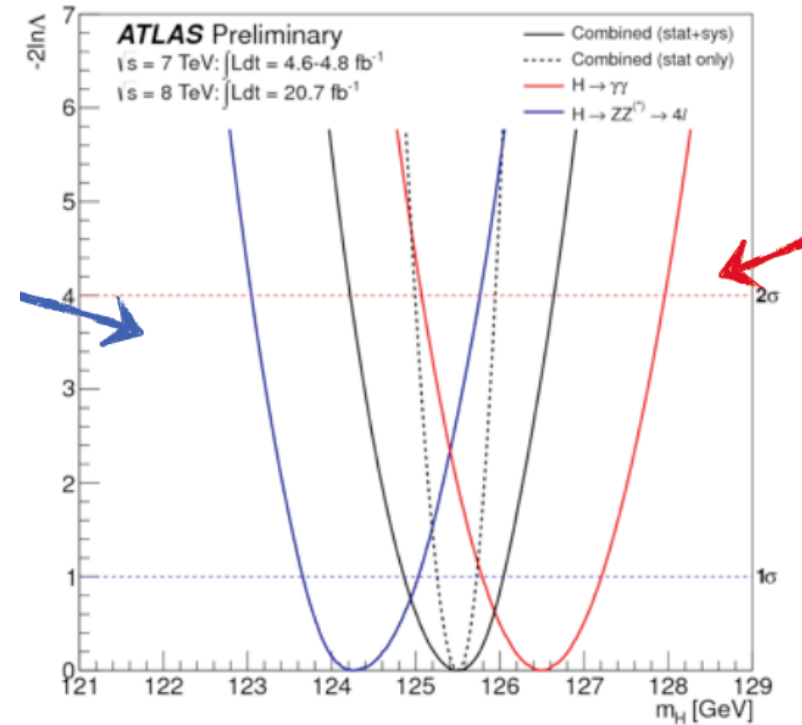
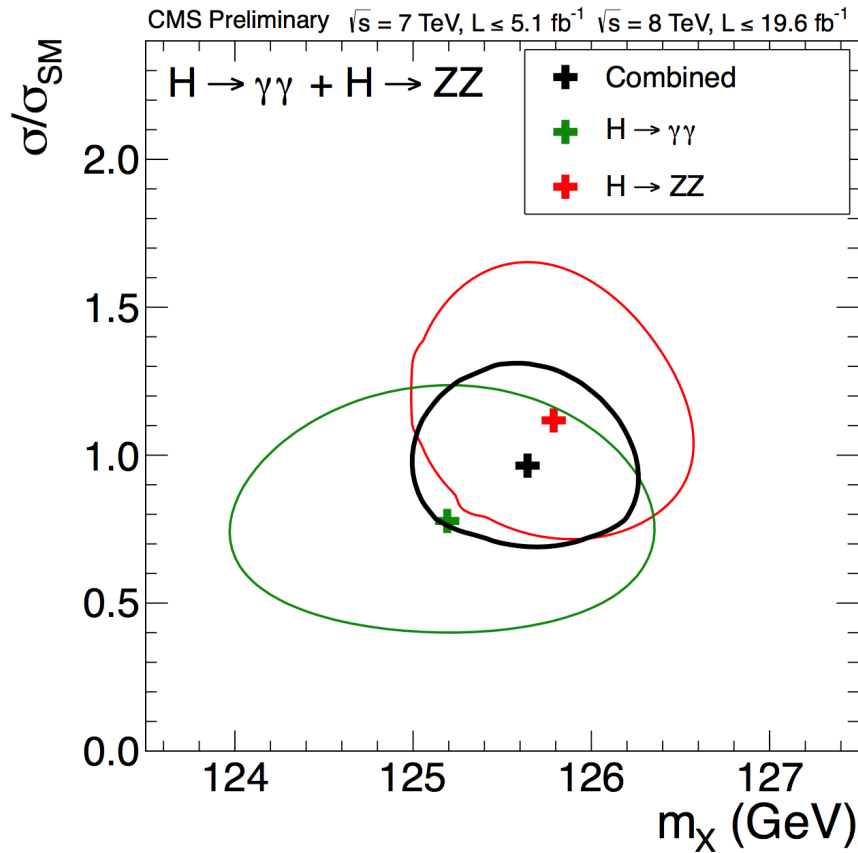
- LHCb + CMS combined measurement: accounting for correlations



$$\text{BR}^{\langle\tau\rangle}(B_s \rightarrow \mu^+\mu^-) = (2.9 \pm 0.7) \times 10^{-9}$$

Consistent with SM expectations!

Discovered H and measured properties



Combined mass: $m_H = 125.5 \pm 0.2(\text{stat})^{+0.5}_{-0.6}(\text{sys}) \text{ GeV}$
 Mass difference 2.4σ (p-value 1.5%).

$$m_H = 125.7 \pm 0.3(\text{stat}) \pm 0.3(\text{syst}) \text{ GeV}$$

$$= 125.7 \pm 0.4 \text{ GeV}$$

Witnessed (Won!) a Nobel Prize



We have probed hot and dense matter

$$R_{AA} = \frac{\sigma_{pp}^{inel} \frac{d^2 N_{AA}}{dp_T d\eta}}{\langle N_{coll} \rangle \frac{d^2 \sigma_{pp}}{dp_T d\eta}} = \frac{\text{Rate in PbPb}}{\text{Rate expected from pp}}$$

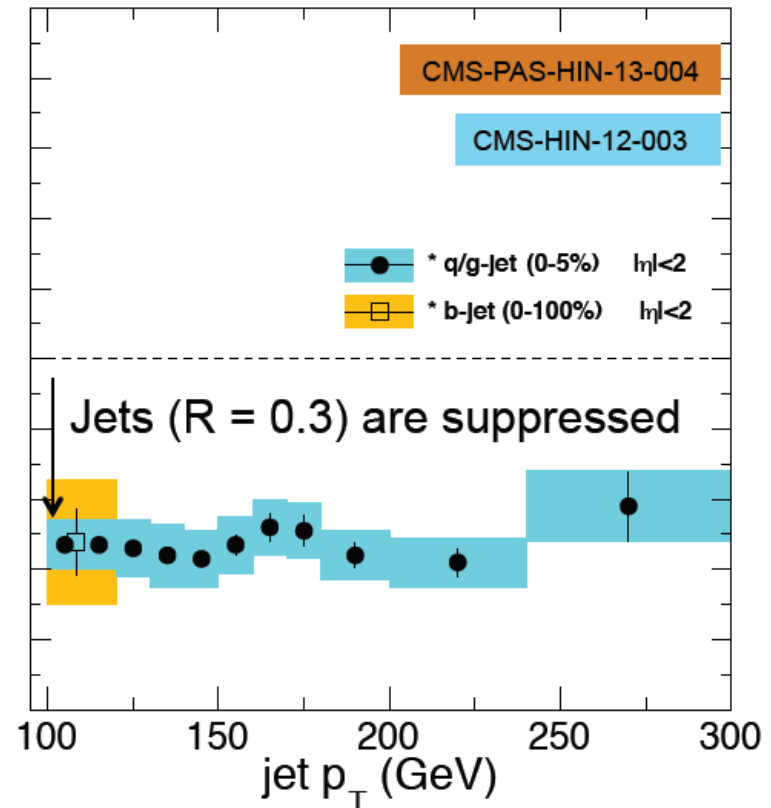
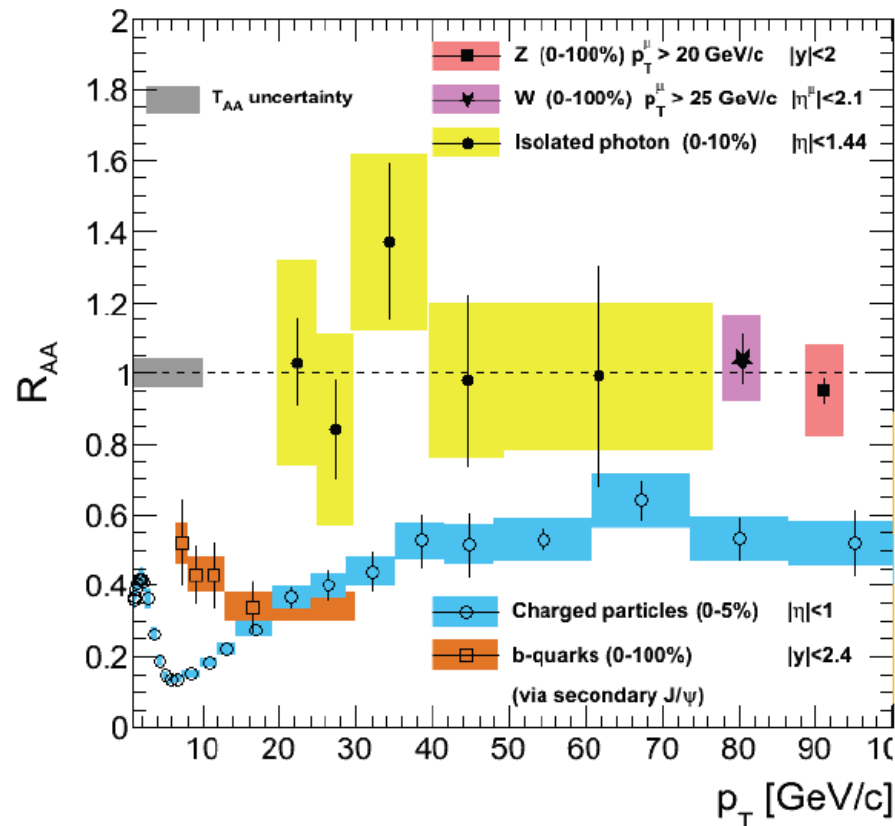
PLB 710 (2012) 256

JHEP 05 (2012) 063

EPJC 72 (2012) 1945

PLB 715 (2012) 66

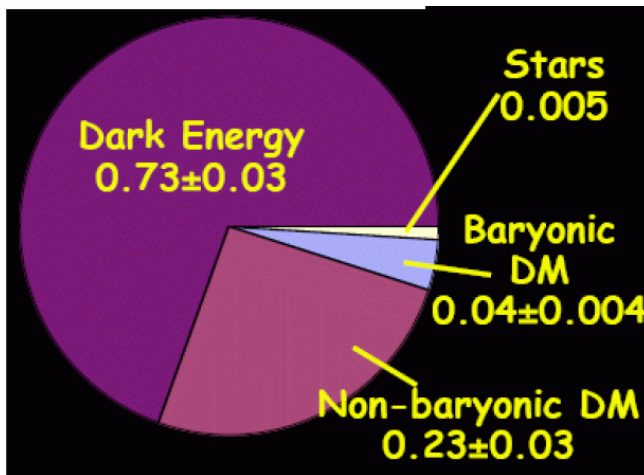
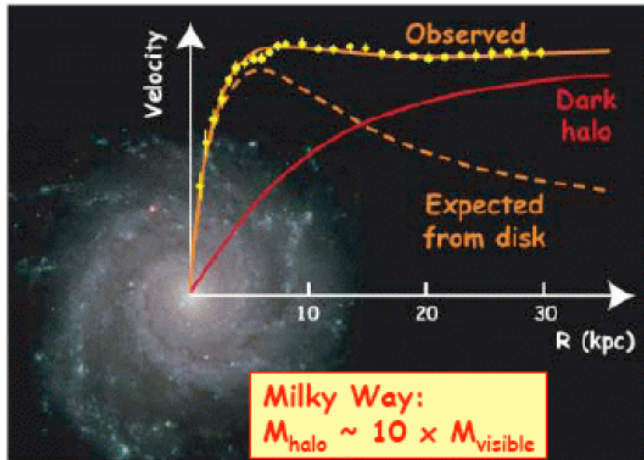
PRL 106 (2011) 212301



WHAT'S NEXT ? WHAT'S BEHIND THE PEAK ?



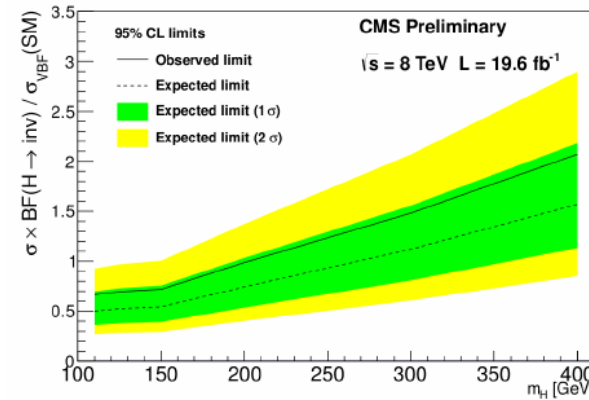
LHC and Dark Matter



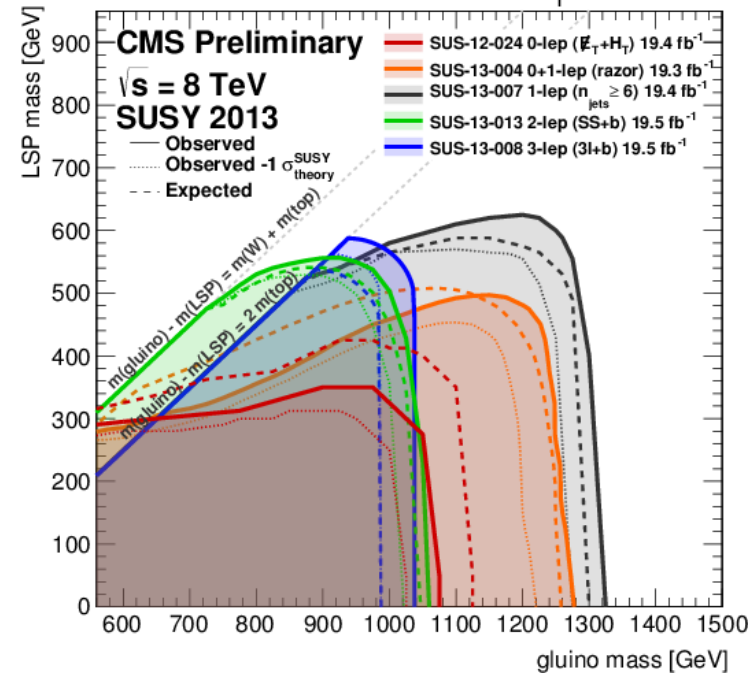
More information in A. Nikitenko's talk

Sezen Sekmen

Upper limit on BR(H→invisible) in VBF analysis

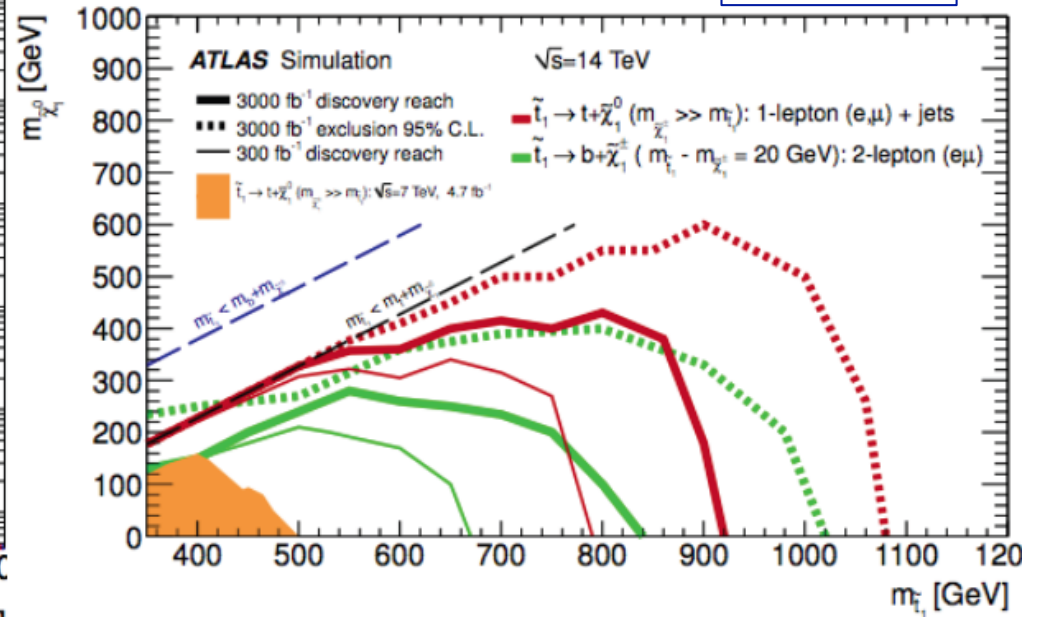
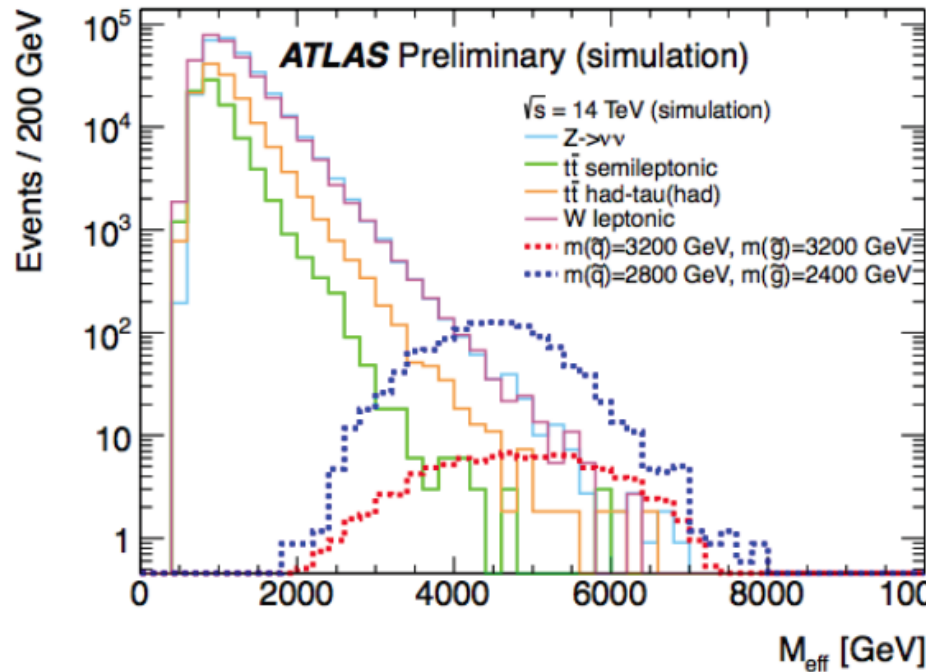


$\tilde{g}\text{-}\tilde{g}$ production, $\tilde{g} \rightarrow t \bar{t} \tilde{\chi}_1^0$



Never give up, we have 14TeV

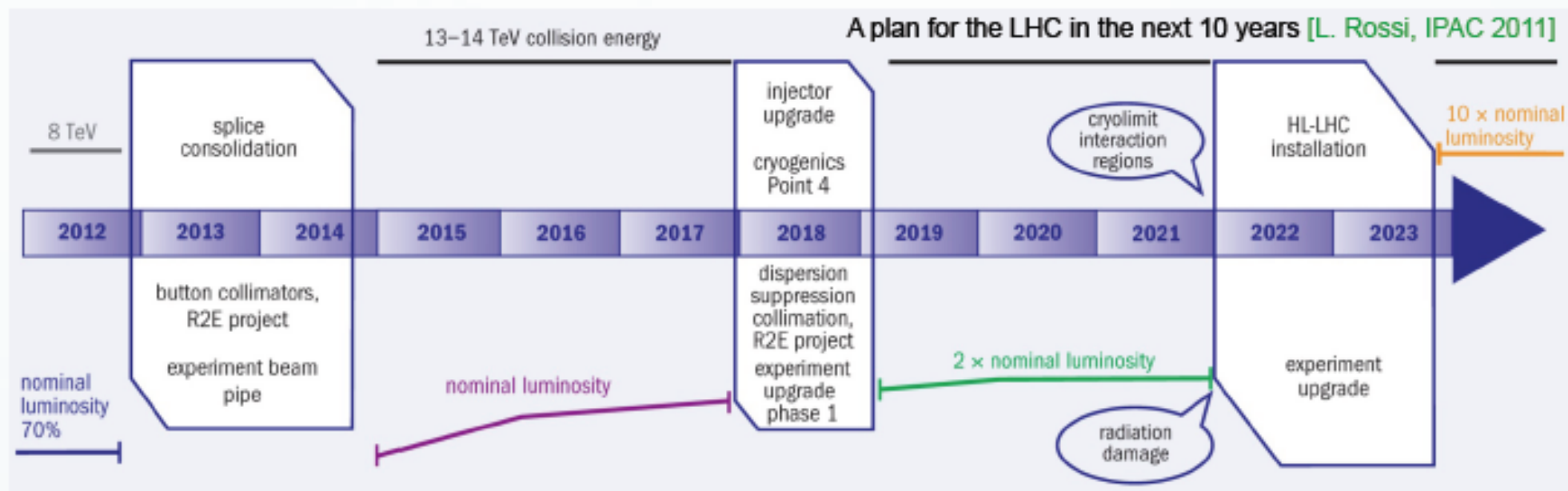
Shoji Asai



We can cover gluino/squark upto $\sim 3\text{TeV}$
stop 600-700 GeV

- 1) Boost up EW gaugino direct production,
- 2) Understand BG at high end
- 3) degenerate case

The HL-LHC



Pixel Upgrade
"phase 1"

Ful Tracker Upgrade
"phase 2"

The challenge for the detector upgrades (example from the Tracker but the concepts are general)

➤ Radiation hardness

⊙ Ultimate integrated luminosity considered $\sim 3000 \text{ fb}^{-1}$

★ To be compared with original $\sim 500 \text{ fb}^{-1}$

➤ Granularity

⊙ Resolve ~ 140 (and up to 200) collisions per bunch crossing, with $\sim \%$ occupancy

❖ The original design figure for the present Tracker was 25!

★ Requires much shorter strips!

Substantially higher channel count!

➤ Improve tracking performance

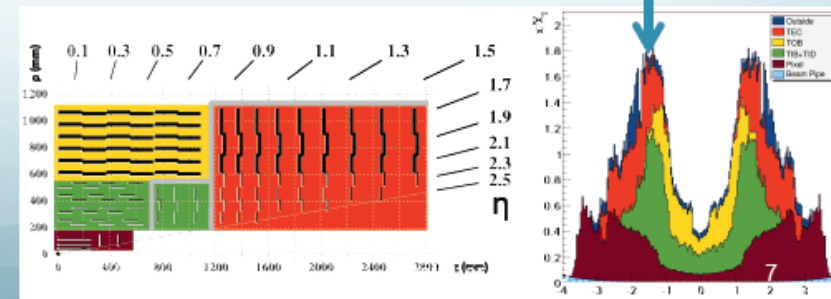
⊙ Improve performance @ low p_T

⊙ Reduce rates of nuclear interactions, γ conversions, bremsstrahlung...

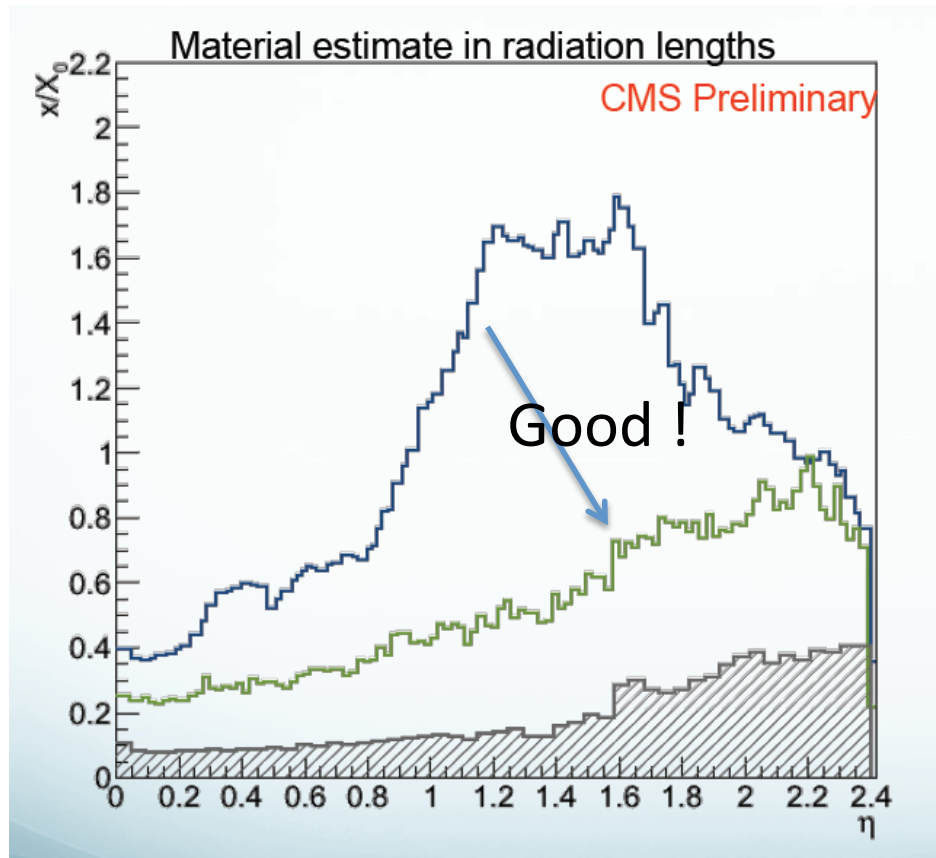
★ Reduce material in the tracking volume

⊙ Improve performance @ high p_T

★ Reduce average pitch



Upgrades: improving on all aspects

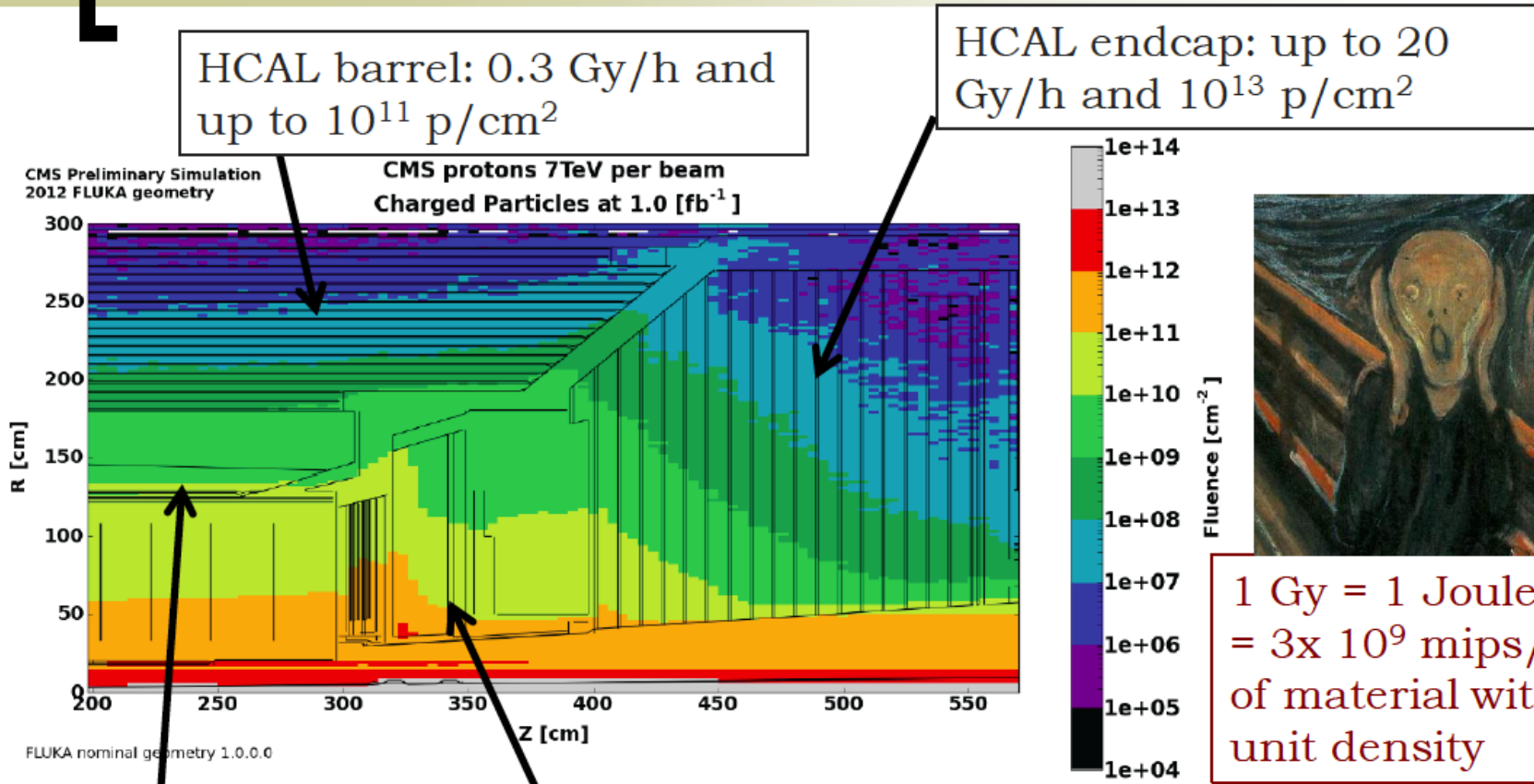


Duccio Abbaneo



Upgrade: the challenge of forward calorimetry

Radiation Environment

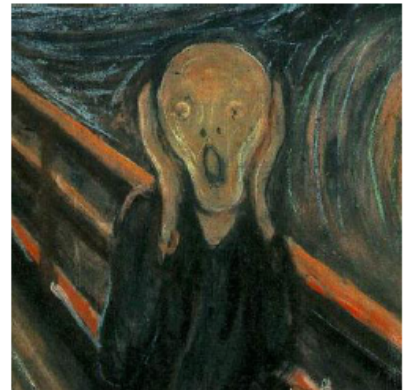


HCAL barrel: 0.3 Gy/h and up to 10¹¹ p/cm²

HCAL endcap: up to 20 Gy/h and 10¹³ p/cm²

ECAL barrel: 3 Gy/h and 2x10¹² p/cm²

ECAL endcap at η=2.6: 65 Gy/h and 2x10¹⁴ p/cm²



1 Gy = 1 Joule/kg
= 3x 10⁹ mips/cm²
of material with unit density

Upgrade: the Trigger challenge

Data taking scenarios

- 2012

- collision energy 8 TeV
- peak instantaneous luminosity $7.5e33 \text{ cm}^{-2}\text{s}^{-1}$ @ 50 ns

- post-LS1

- collision energy 13 TeV
- peak instantaneous luminosity $1.6e34 \text{ cm}^{-2}\text{s}^{-1}$ @ 25 ns
or $1e34 \text{ cm}^{-2}\text{s}^{-1}$ @ 50 ns

expected **trigger rate**
roughly "2012" x4

- Phase 2 - HL-LHC

- collision energy 14 TeV
- peak instantaneous luminosity $5e34 \text{ cm}^{-2}\text{s}^{-1}$ @ 25 ns

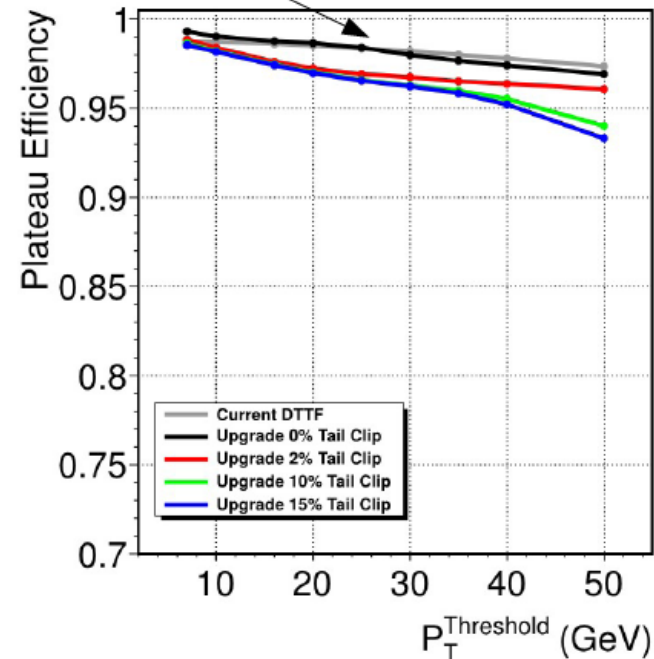
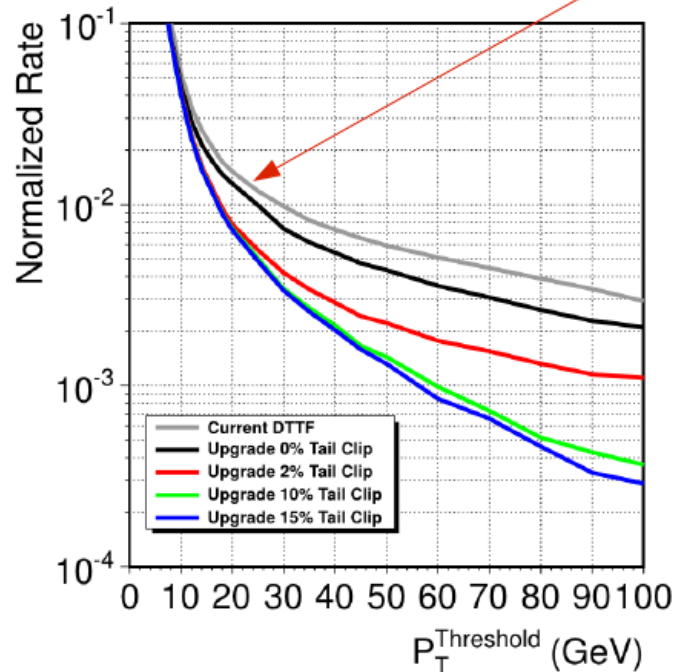
expected **trigger rate**
roughly "2012" x12 or more

–
plus pile-up dependency

Upgrade: the Trigger challenge

Example → Muon L1 Trigger

rate reduction by a **factor 2 ~ 3**, with a **similar** efficiency



new muon p_T assignment (bigger LUTs, post-processing)

Conclusions

- We had 4 unbelievable years at LHC ...
- ... **we just got a Nobel prize 😊** ...
- ... however we have still to find New Physics
 - **“mission not YET accomplished”**
- A successful Detector Upgrade program is crucial to continue our adventure !!

Thanks !

