

2015 highlights from the CMS experiment

CMS Experiment at LHC, CERN
Data recorded: Sat Aug 22 04:13:48 2015 CEST
Run/Event: 254833 / 1268846022
Lumi section: 846



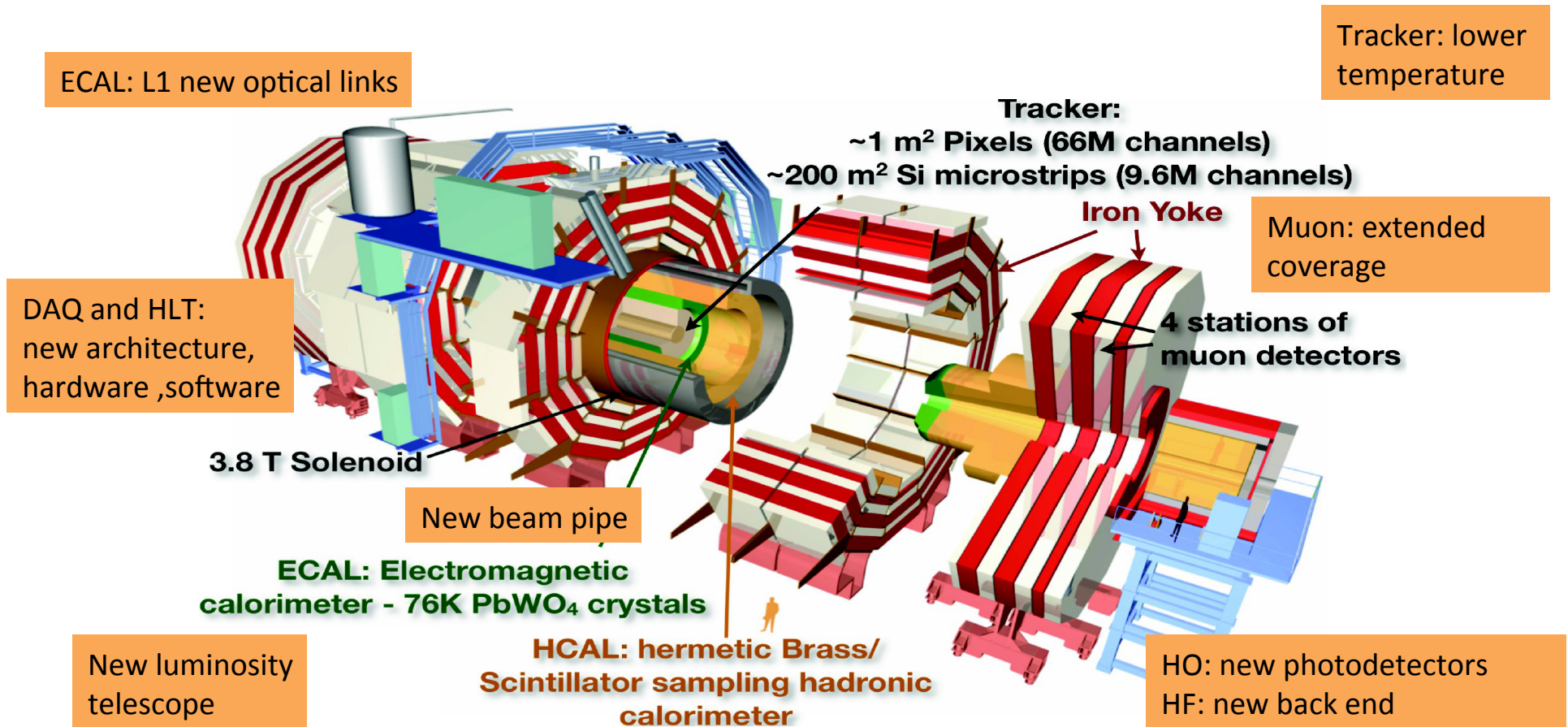
Electron 1,
pt = 1278.63
eta = -1.312
phi = 0.420

Electron 0,
pt = 1256.20
eta = -0.239
phi = -2.741



Mariarosaria D'Alfonso (CERN)
On behalf of the CMS Collaboration

CMS detector in Run2

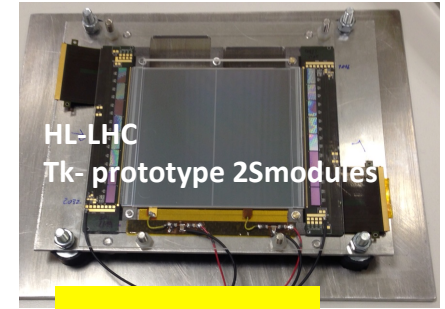
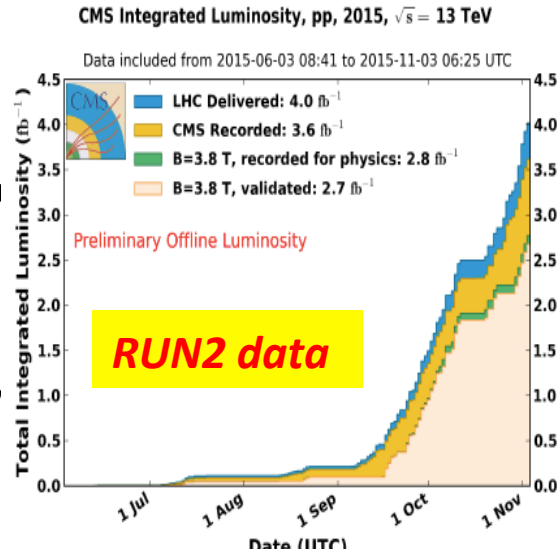


All sub-detector operating with active detector fraction higher than Run1
Excellent availability of the CMS detector during Run2 (>97%)

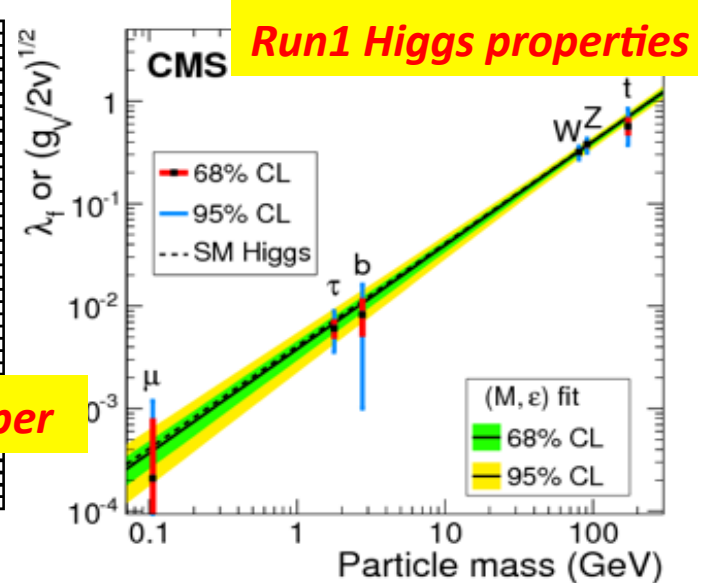
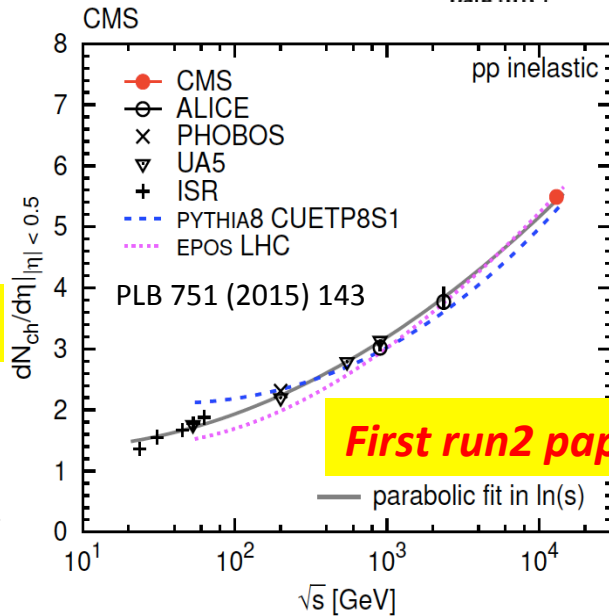
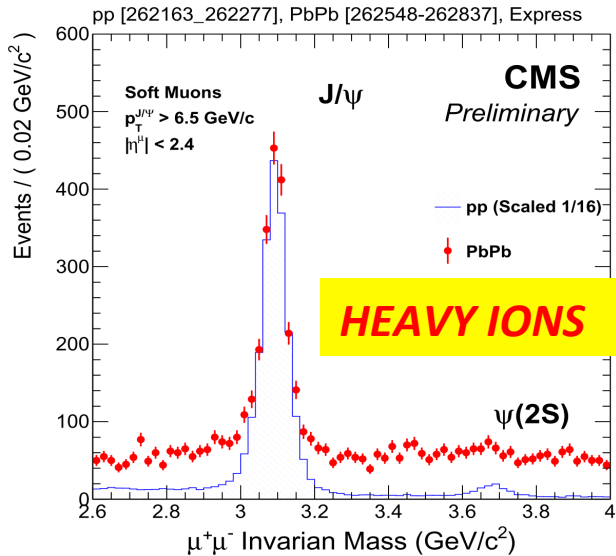
1700 physicists, 700 students, 950 engineers/technicians, 180 institutions from 43 countries to make all pieces of this complex scientific instrument work all together

2015: The busiest of times

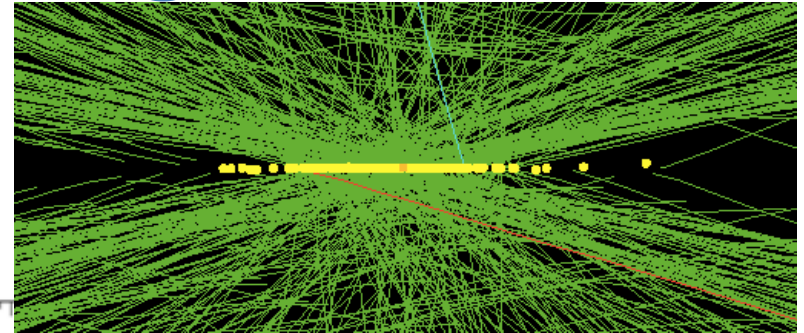
Running with proton and heavy ion beams, analyzing Run II data, publishing Run I data, and upgrading...



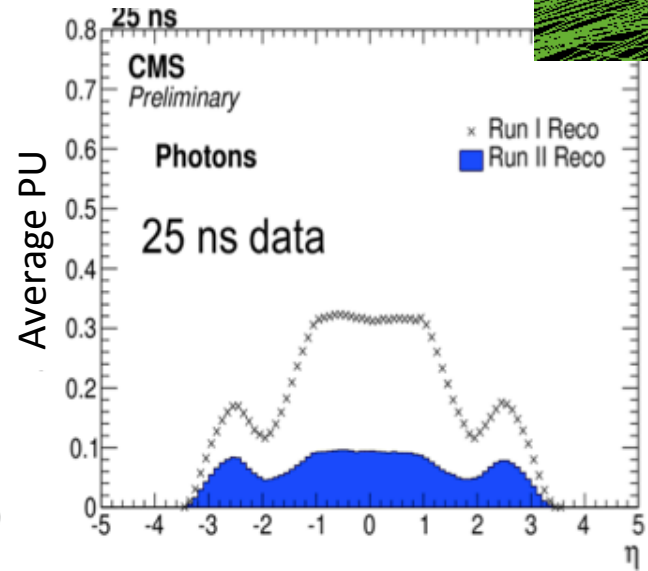
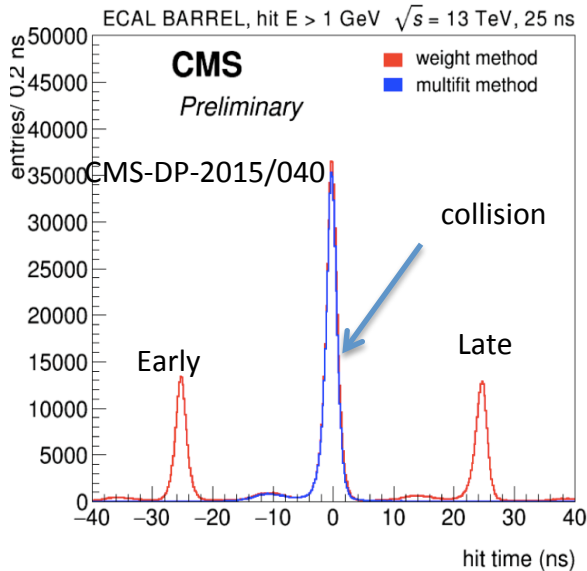
Upgrading



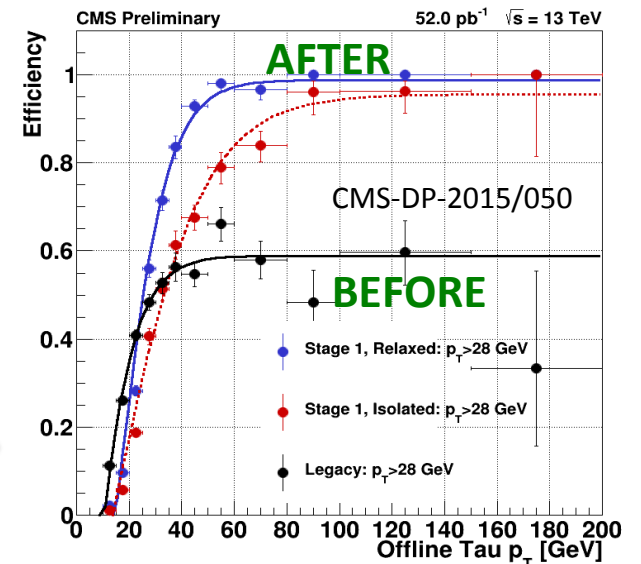
Record the interesting collision



New challenge with 25ns:
Use of calorimeter timing to achieve better out-of-time PU rejection



Important improvement in trigger: PU subtraction in the algorithms and larger collection efficiency.



Detector calibration

CMS Preliminary

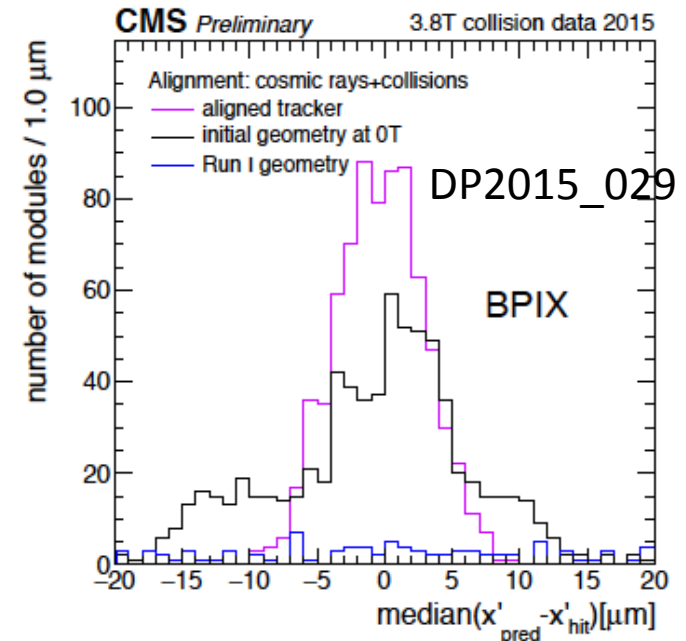
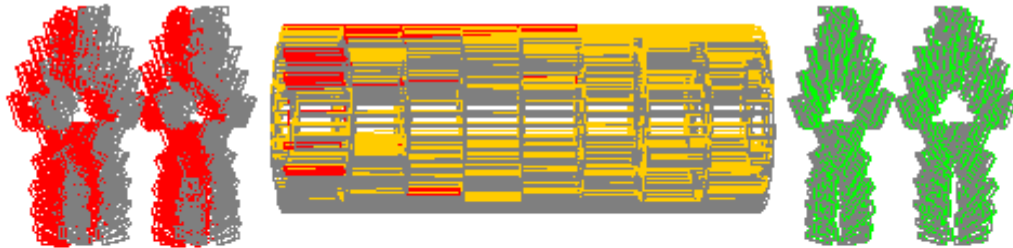
Alignment: cosmic rays + 0T collisions

Run II vs. Run I geometry, shift x 5

> 4 mm

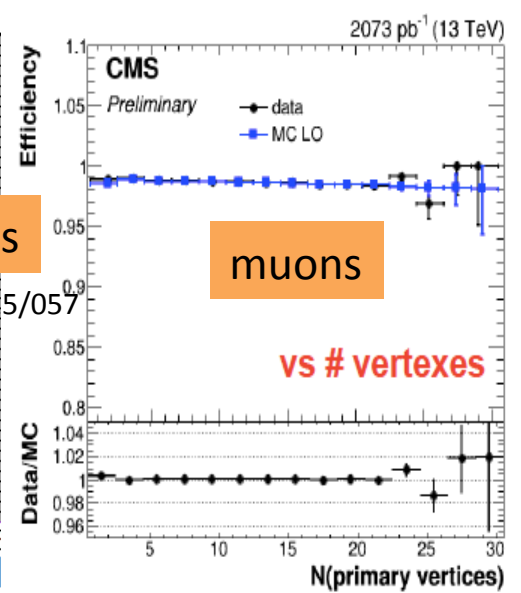
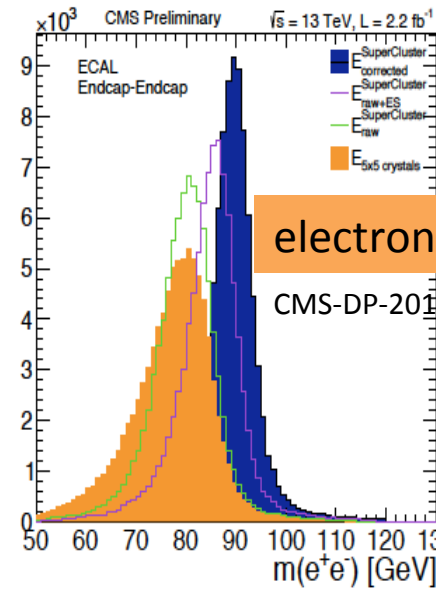
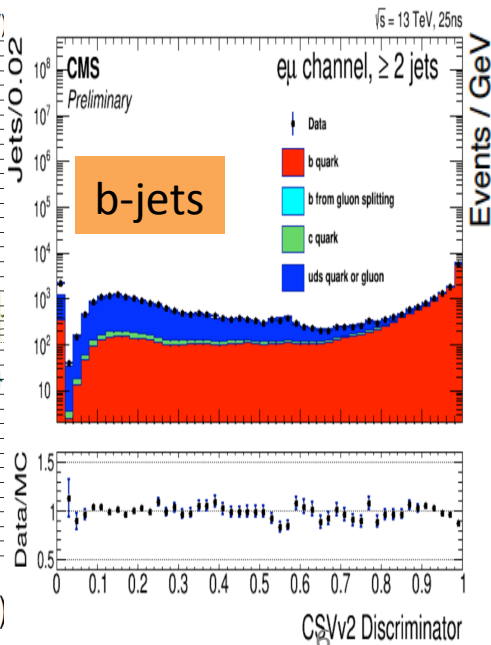
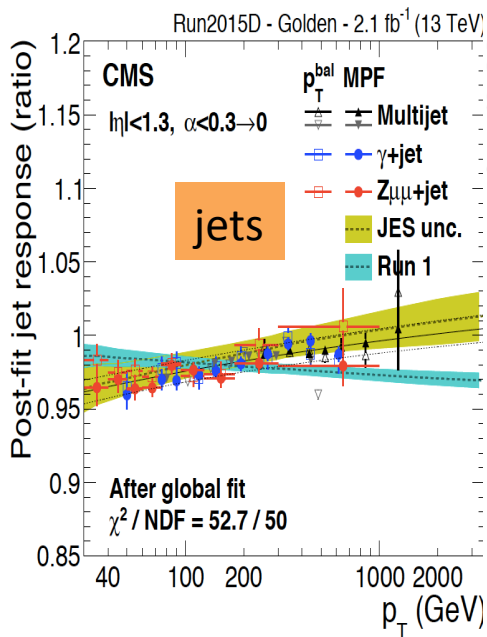
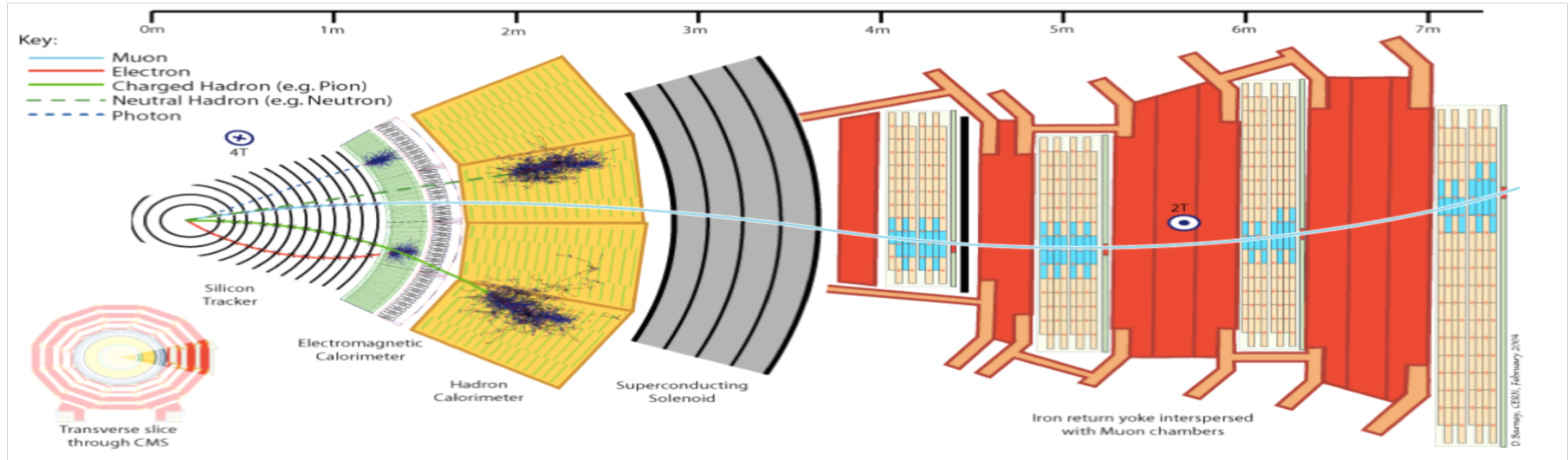
2 mm - 4 mm

< 2 mm



Excellent alignment precision at the module level
~1-2 M cosmics and initial 20 M tracks from collisions:
changes from run1 expected due to magnetic field cycles,
operation of the detector, new tracker temperature

Visible Physics Objects



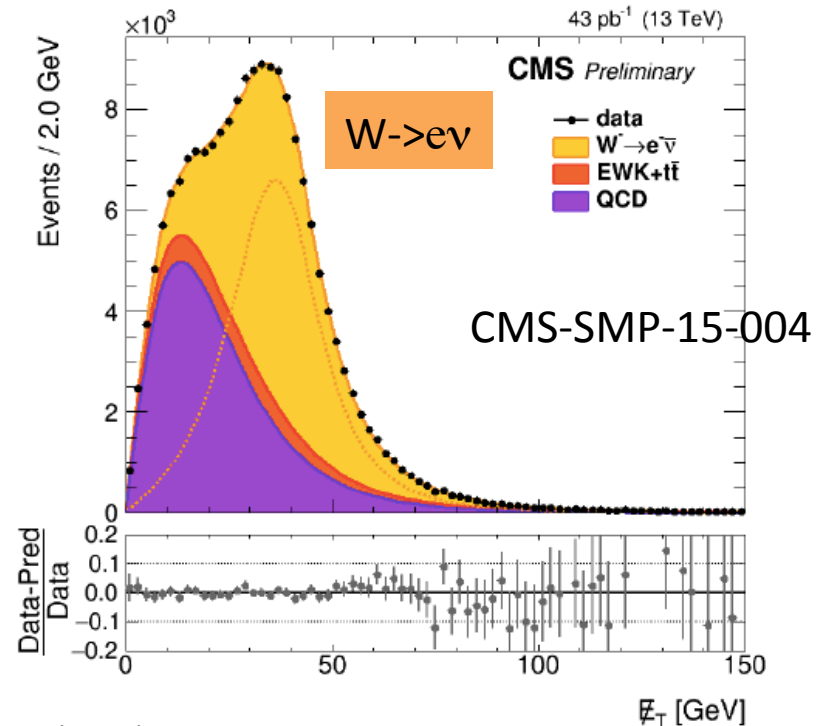
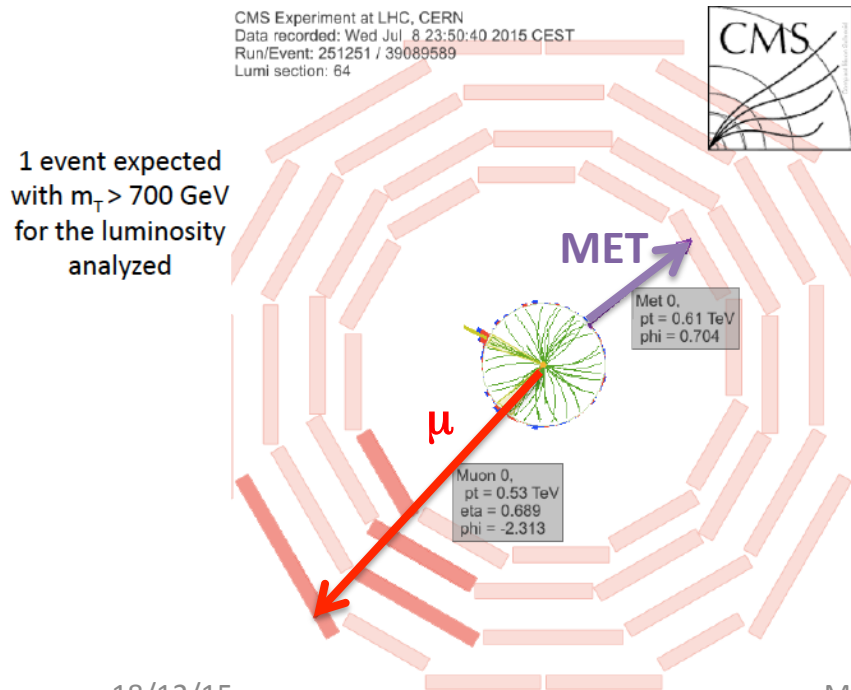
Missing energy

Made out of all the rest of the particles that do not add up momentum wise in the transverse plane

sensitive to all the changes in machine/detector/reconstruction.

→ Excellent response from CMS overall

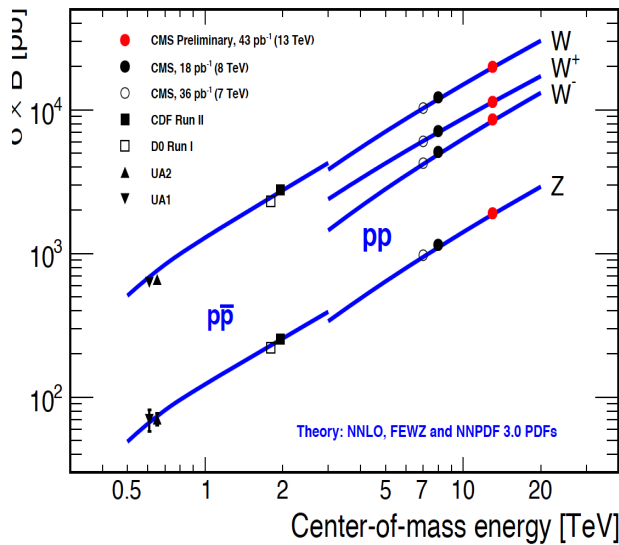
→ Key variable for the searches relying for undetectable particles



LHC: W/Z/TOP standard candles

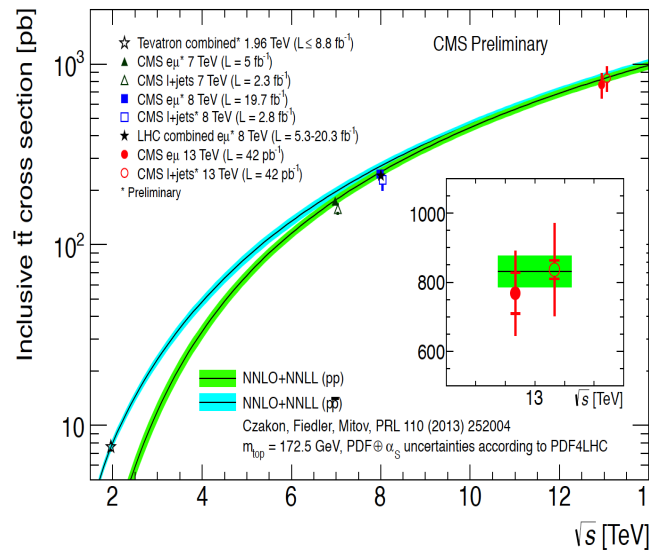
First objective:
rediscover the known particles ...

CMS-SMP-15-004

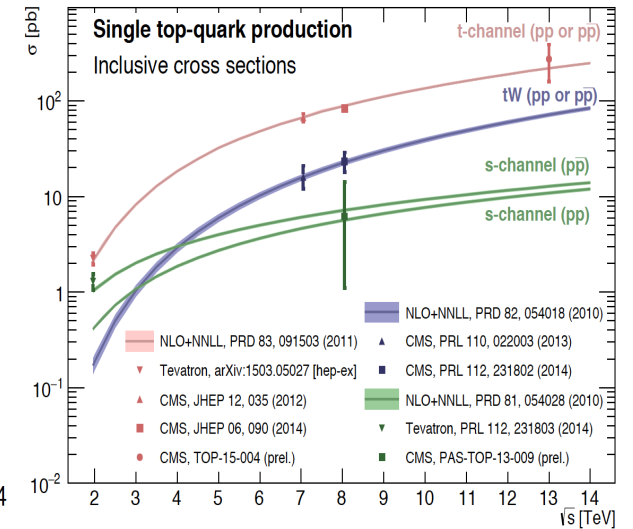


CMS-TOP-15-003

Submitted to Phys. Rev. Lett.

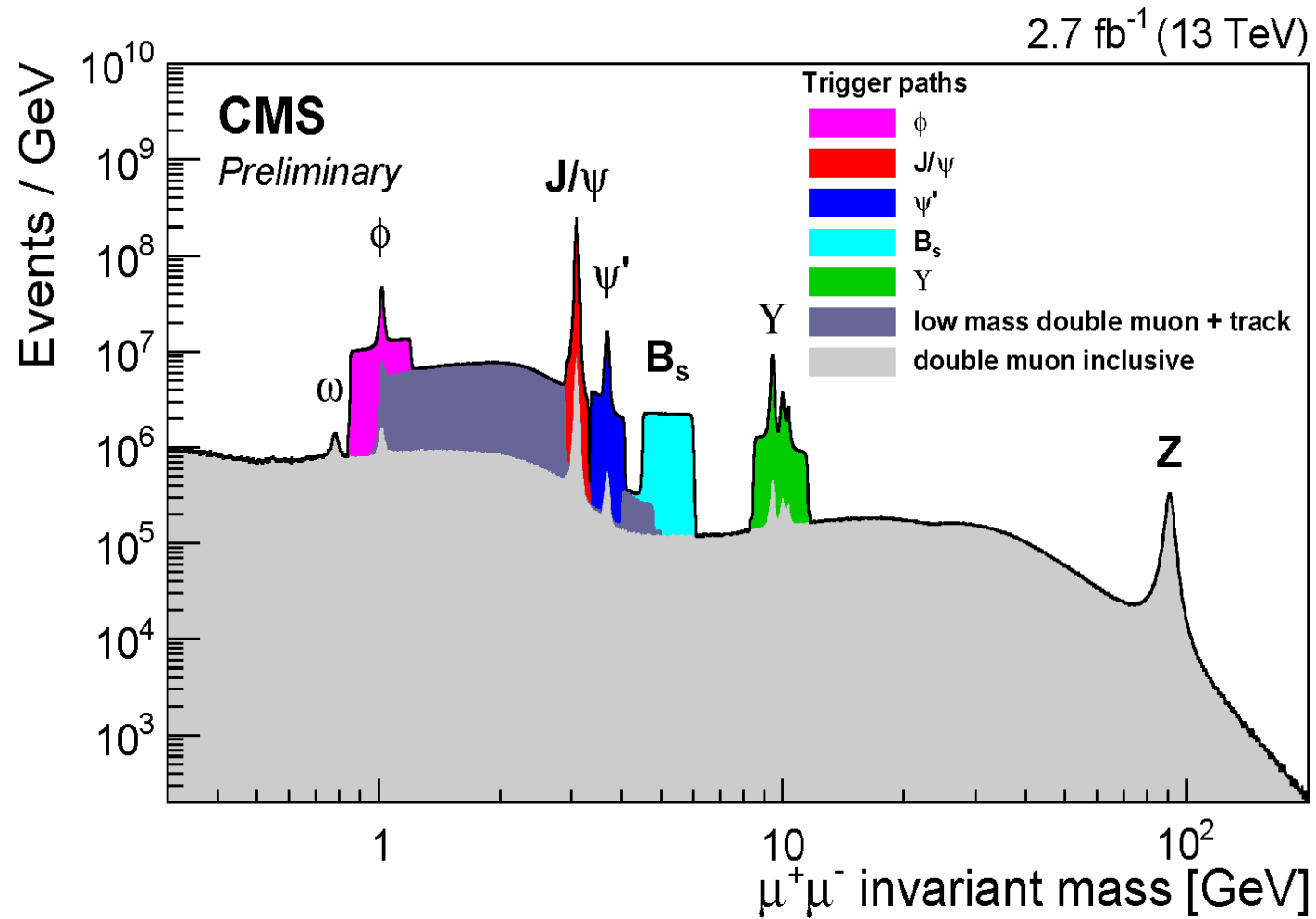


CMS-TOP-15-004

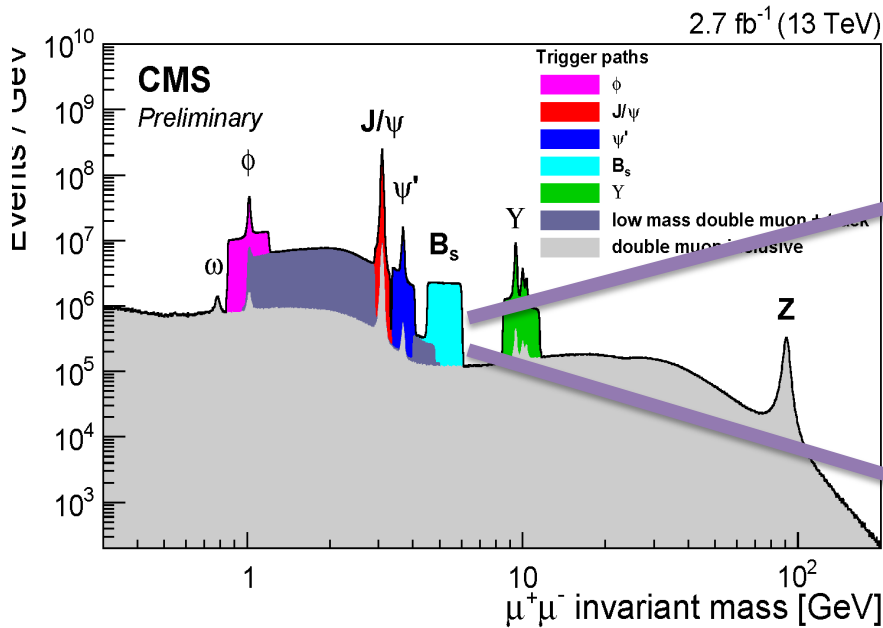


Predicted increase of cross sections with centre-of-mass energy confirmed by measurements

Measured particles



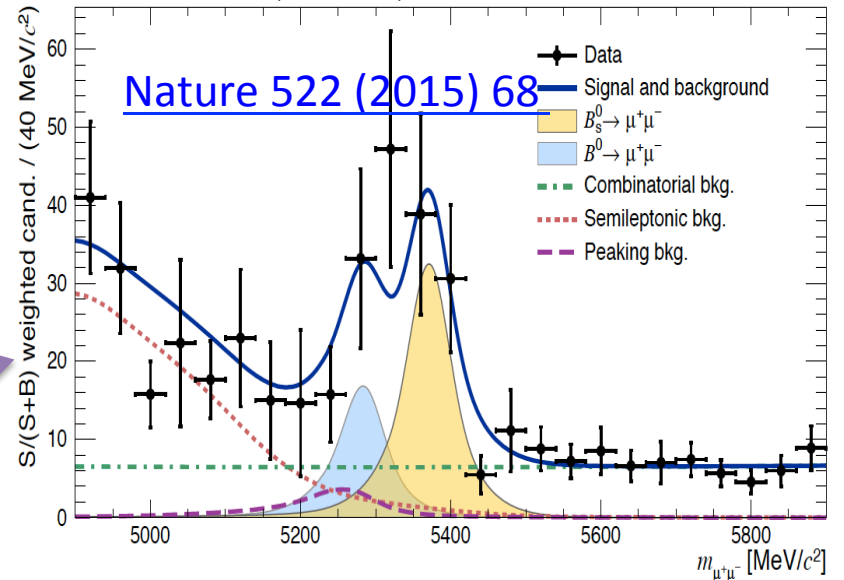
Towards new particles



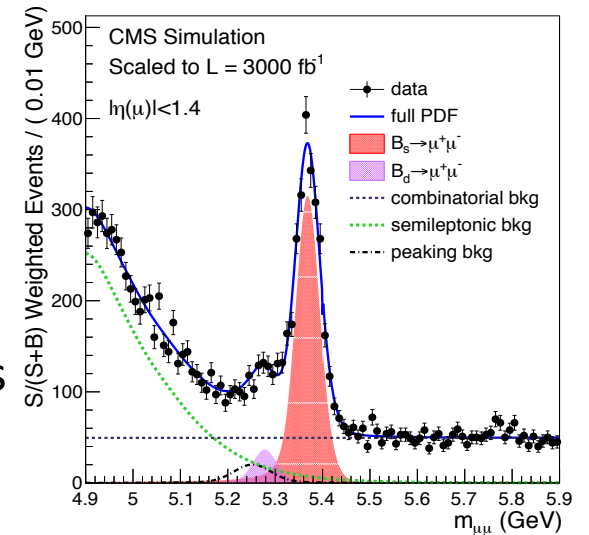
RUN1

HL-LHC simulation

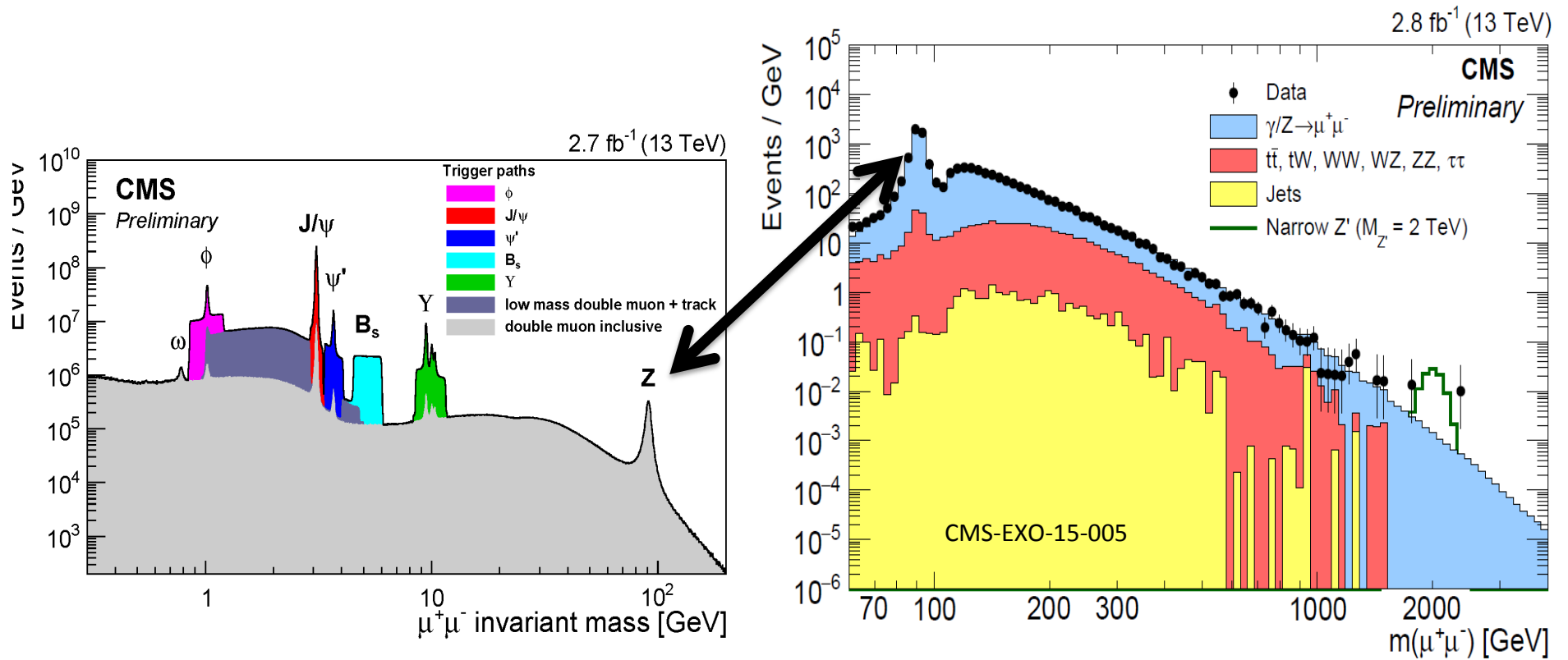
CMS and LHCb (LHC run I)



... for the HL-LHC extend the knowledge on the rare decays



Towards new particles

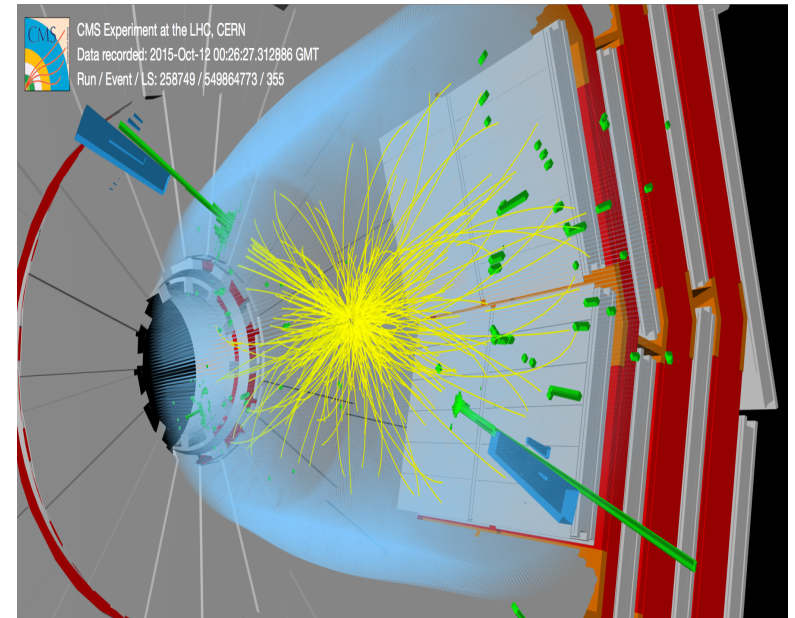


In Run2 we are exploring the TeV scale

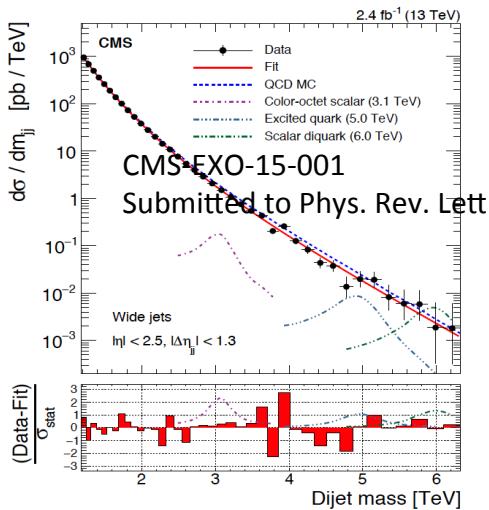
Searches for high mass resonances

Nature has been kind to us regarding the Higgs boson, continue our detective work searching for a resonance over a smooth falling spectrum.

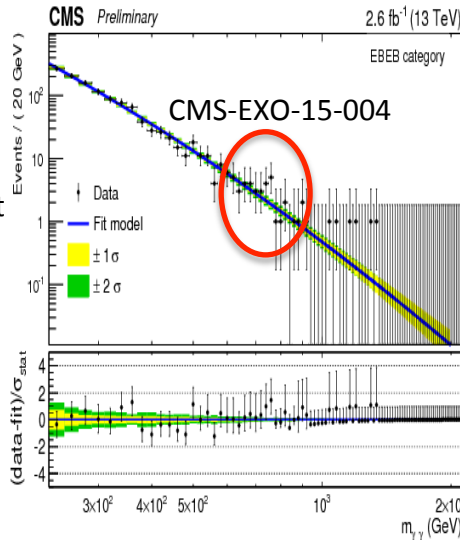
Thanks to the increase of the LHC collision energy, now possible to probe higher \sqrt{s}



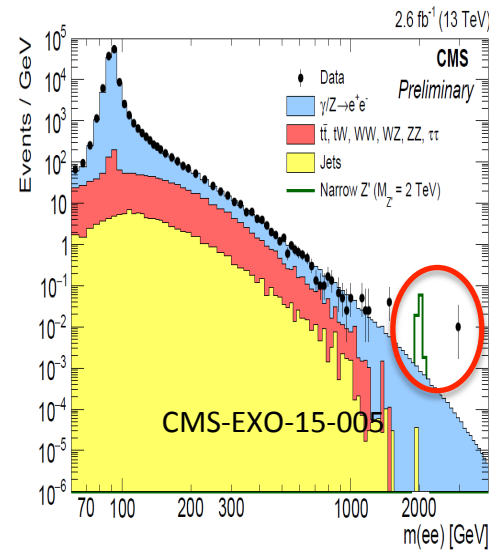
X → Di-Jets



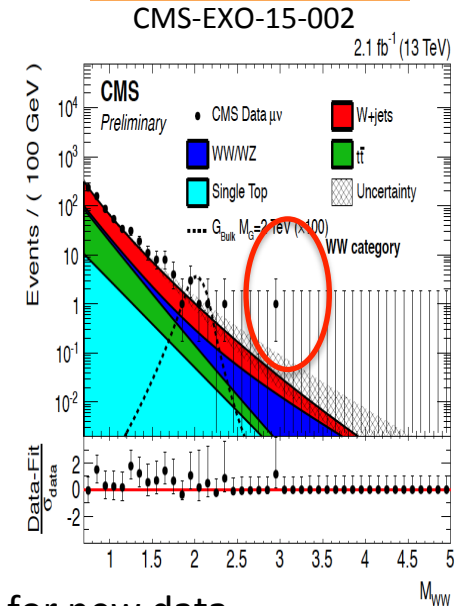
X → Di-Photons



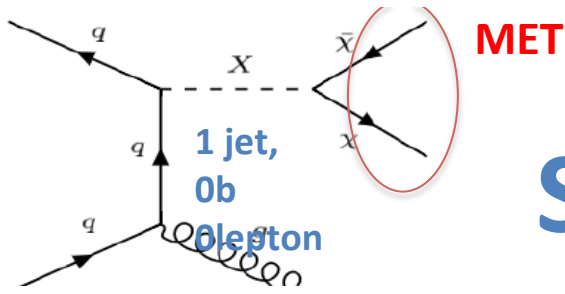
X → Di-Electrons



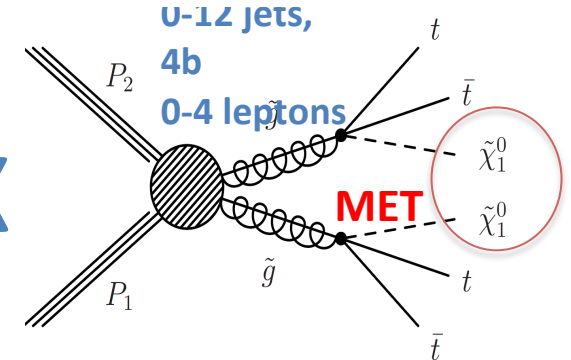
X → Di-Bosons



Small, local excess found: no evidence for such a resonances is observed, looking for new data.



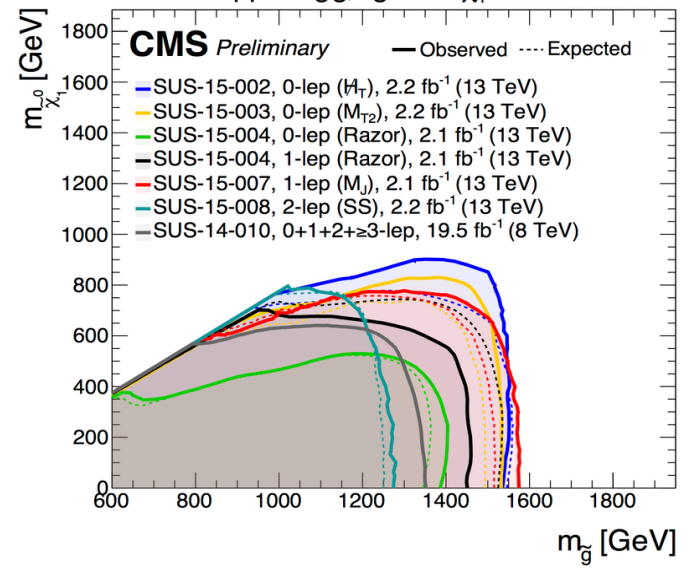
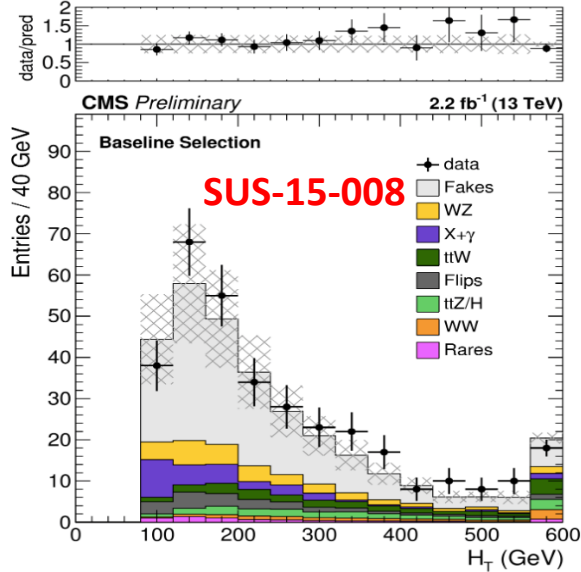
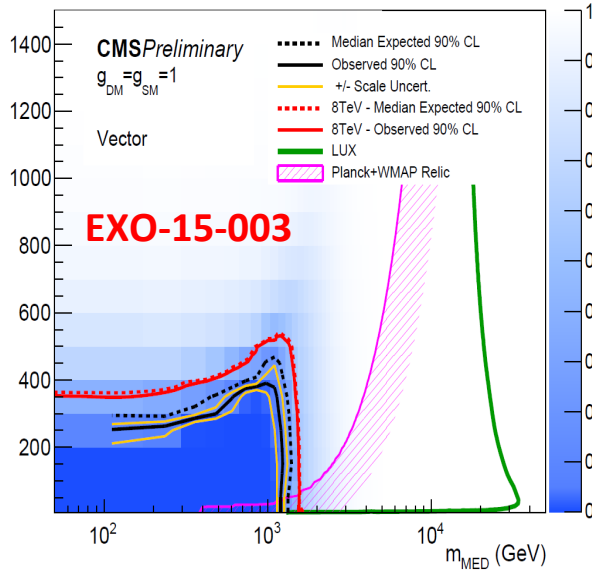
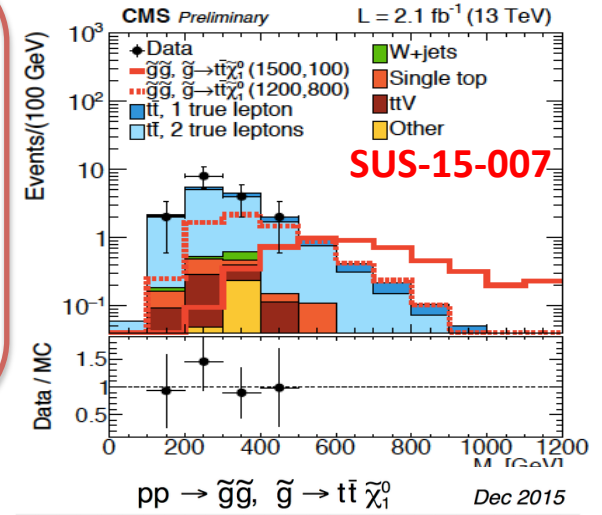
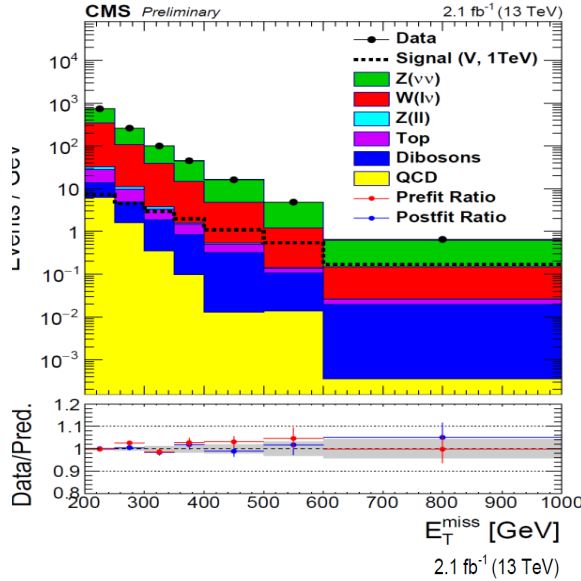
Searches MET+X



Search for DarkMatter in the tails of Missing Energy accompanied by

- one or many jets,
- one or more b jets,
- with one or a pair of leptons same/ opposite sign or multiple

Backgrounds predicted from data



Summary

*Excellent availability of the LHC to maximize delivered luminosity to the experiments! **Thanks, LHC !***

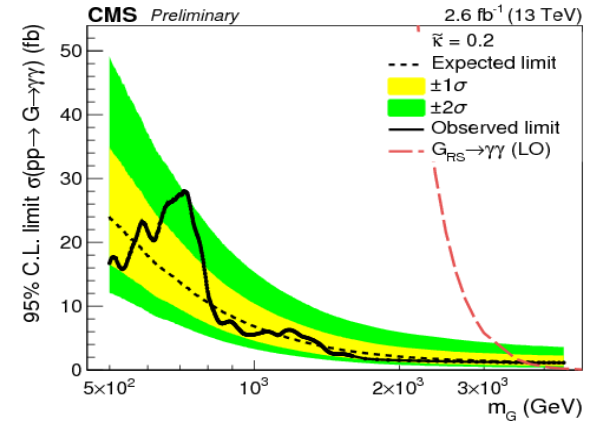
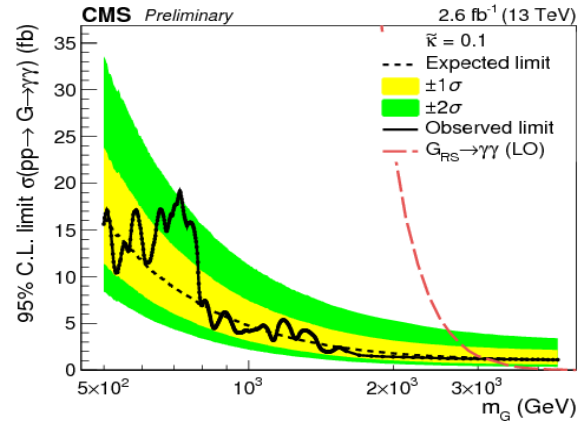
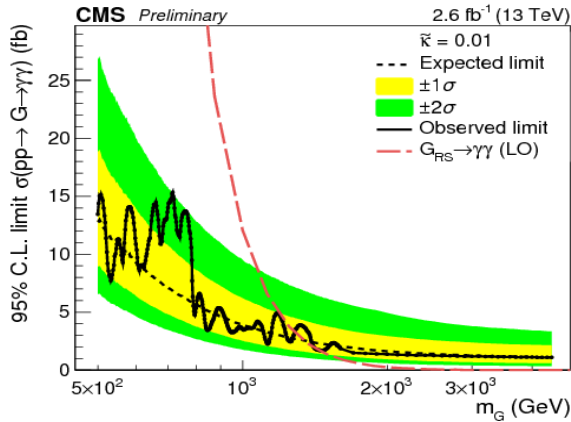


2015: a successful year for CMS on different fronts:
running with proton and heavy ion beams, analyzing Run II data, publishing Run I Data, and upgrading

- Excellent performance of the CMS detector
- Measured the SM production at higher energies
- Searches for new Physics covered new phase space:
Resonances, Dark Matter, SUSYlike Exotics or models,

Looking forward to 2016 !

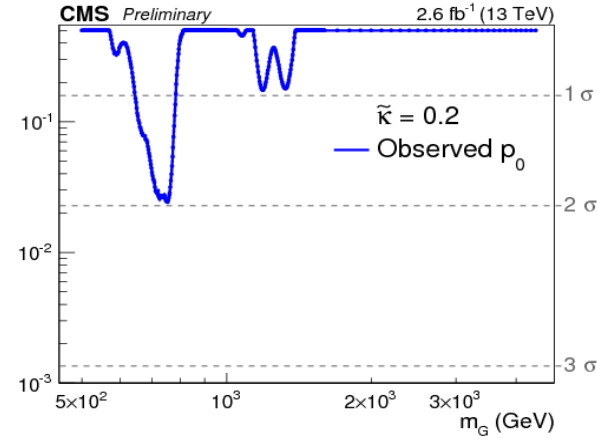
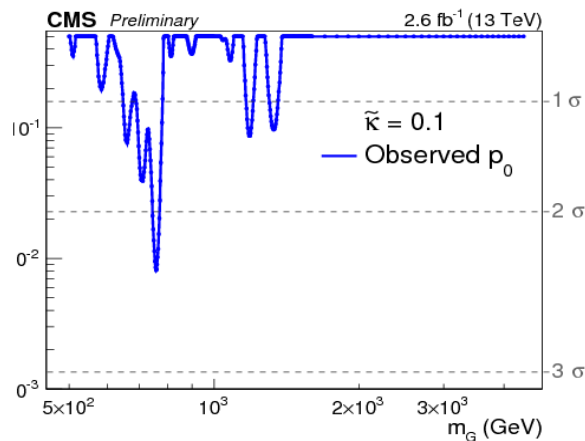
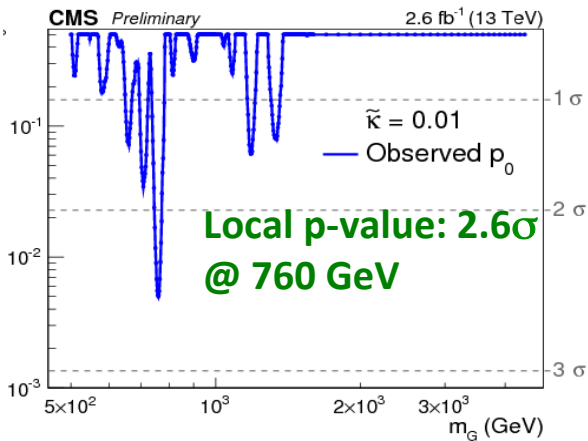
Combined limits and p-values



Narrow Width



Wide (6%) Width



Including LEE (0.5 - 4.5 TeV; narrow width), global p-value < 1.2σ