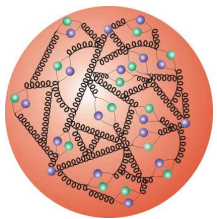
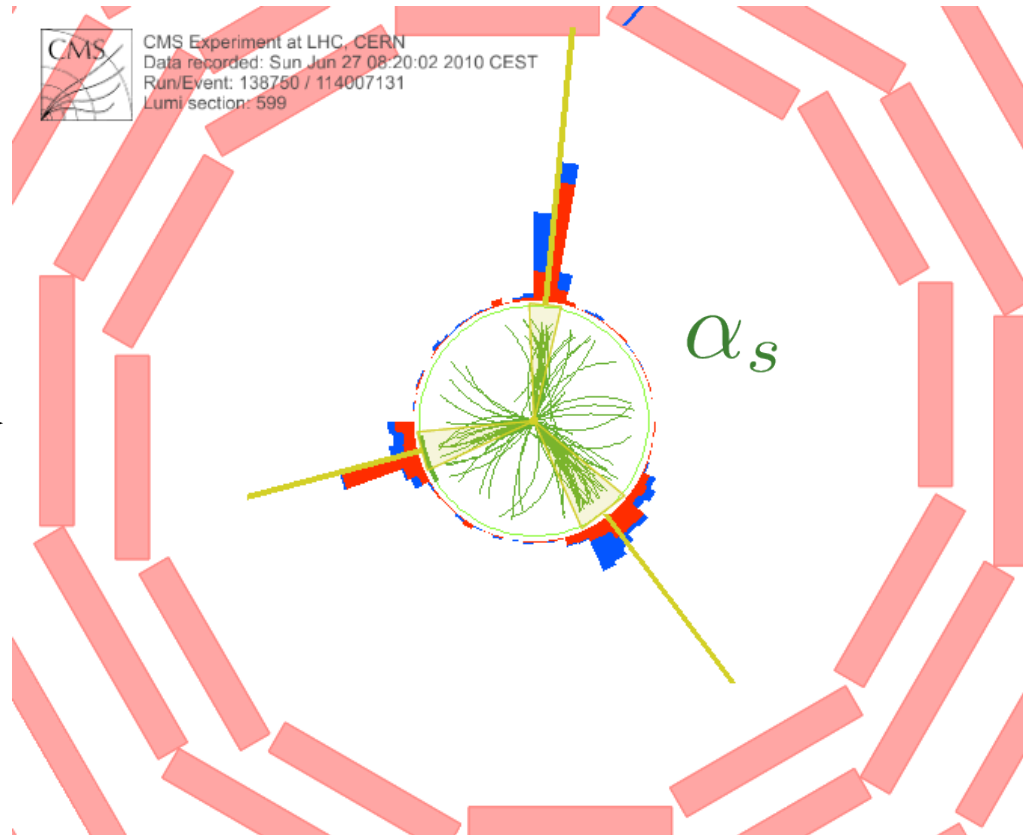


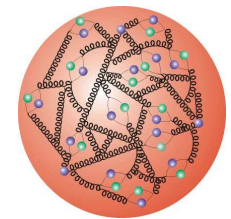


Proton Structure Analysis

Jets at CMS



Proton Structure (PDF)



Proton Structure (PDF)

GEFÖRDERT VOM



Bundesministerium für Bildung und Forschung

Klaus Rabbertz, KIT





Inclusive Jets/Dijets

Agreement with predictions of **QCD** at NLO over many orders of magnitude in cross section and up to 2 TeV in p_T , 4 TeV in M_{JJ} .

Perspectives:

Inclusive jet p_T beyond 2 TeV (2012) + NNLO + EWK

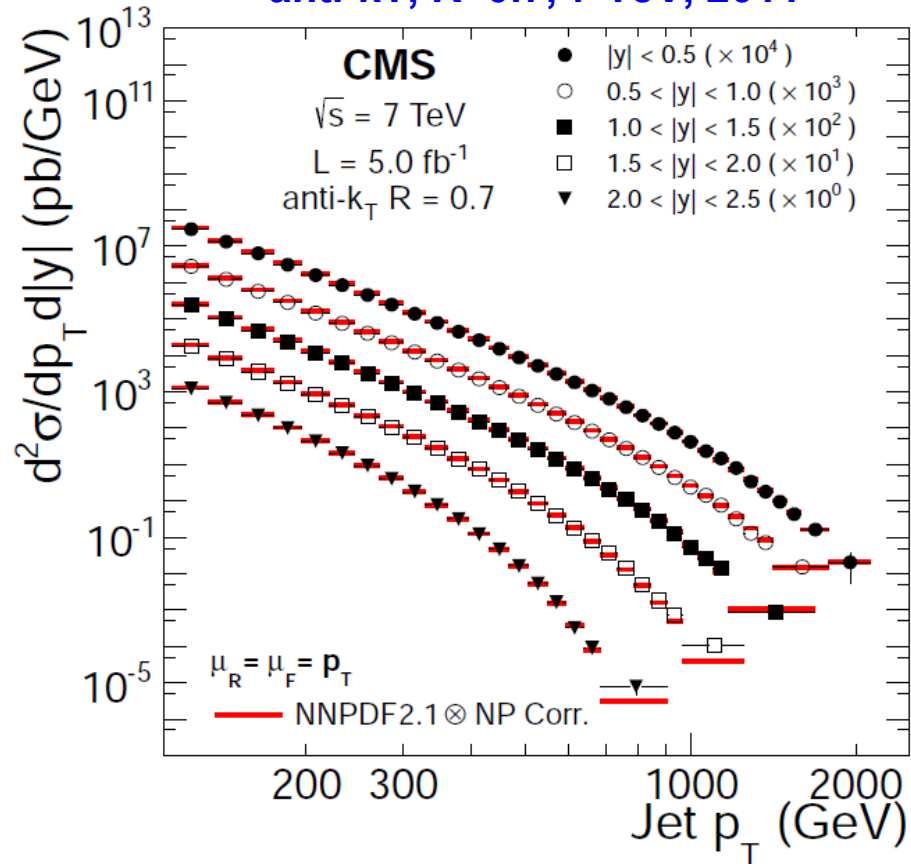
→ strong coupling α_s at highest scales

→ gluon at high x → impact on PDF uncertainty of ggH

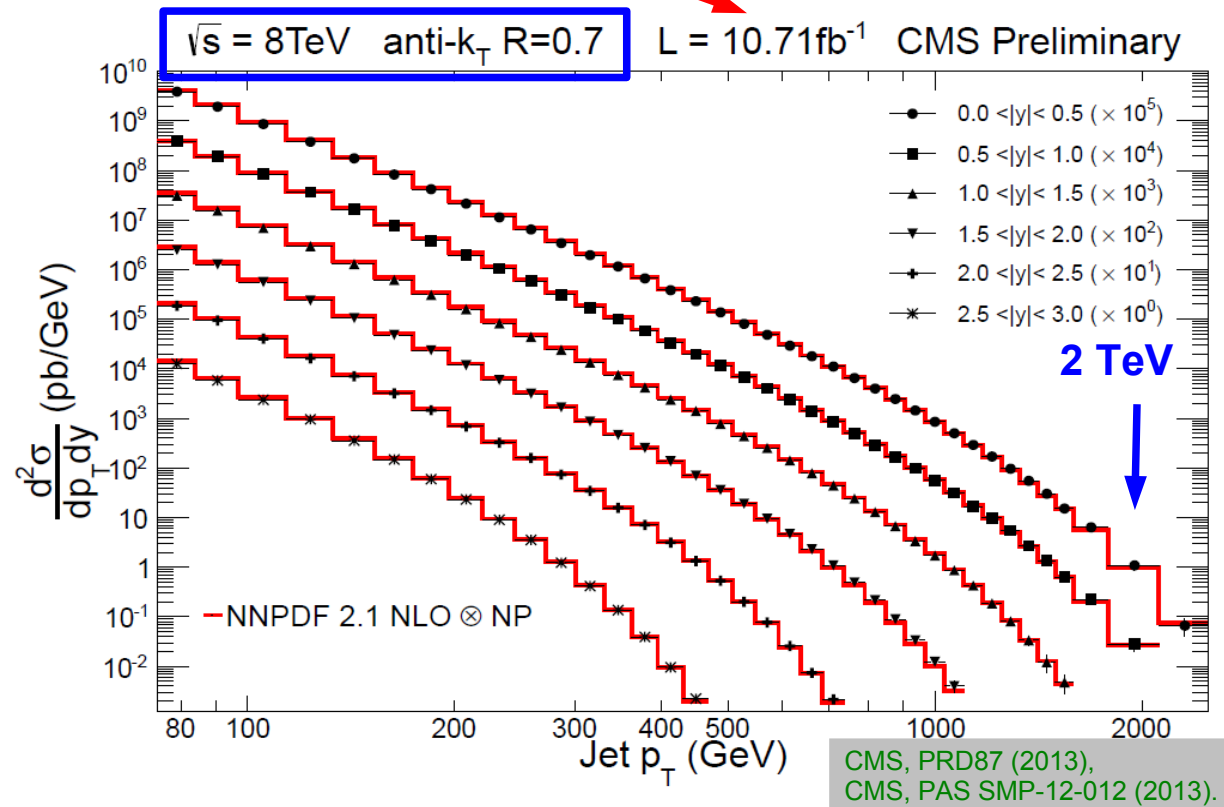
$$\frac{d^2\sigma}{dp_T dy} \propto \alpha_s^2$$

$$\frac{d^2\sigma}{dM_{JJ} dy_{max}} \propto \alpha_s^2$$

anti- k_T , $R=0.7$, 7 TeV, 2011



Half of 2012 luminosity!





Jet Cross Section Ratios

Perspectives:

- Ratios for diff. jet sizes → emphasizes effects of showering and hadronization
- Ratios for diff. E_{CMS} → test beyond fixed order theory, MC tuning
- Ratios for diff. jet mult. → red. uncertainties → α_s

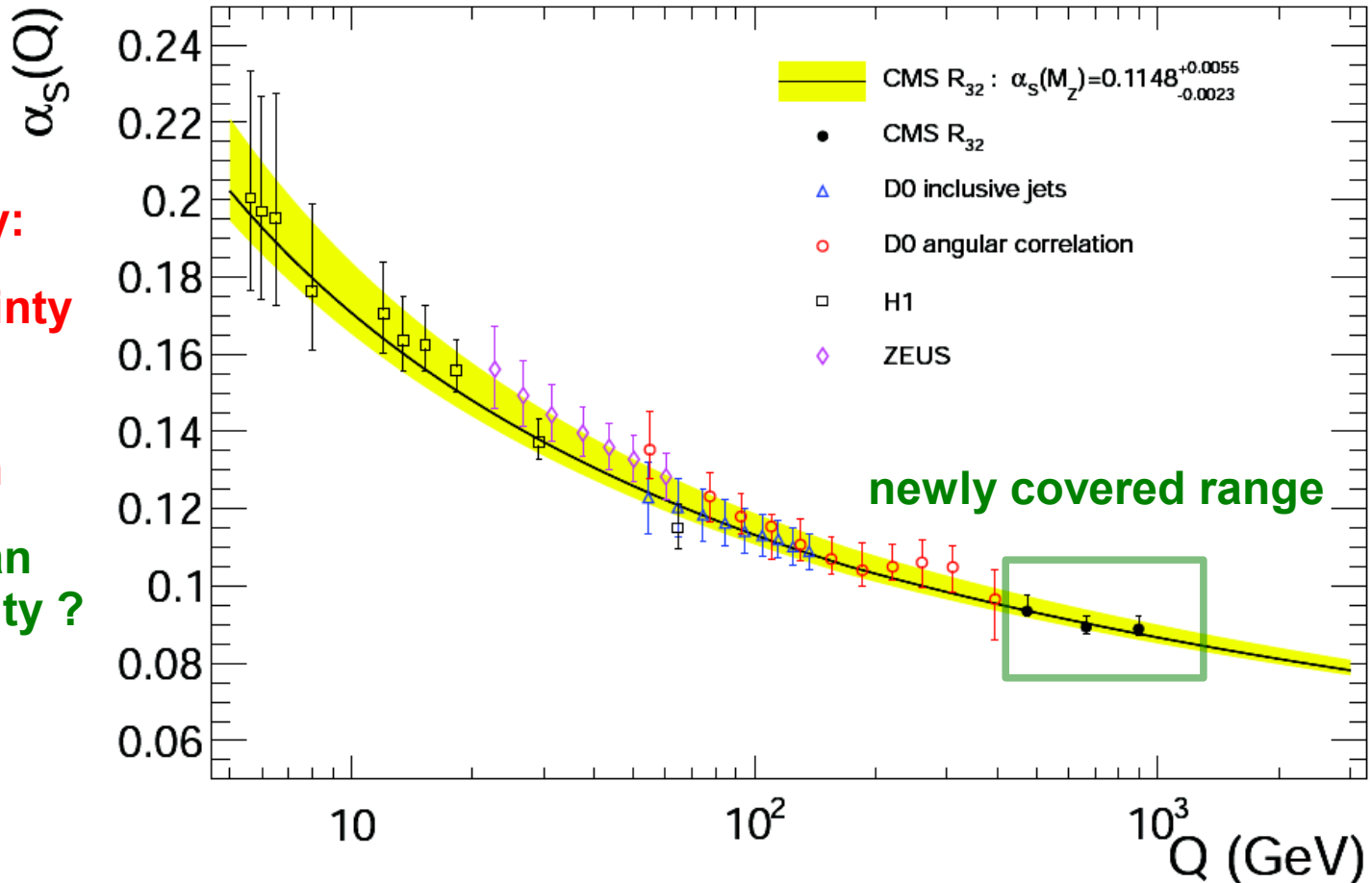
ALICE, arXiv:1301.3475

ATLAS, CONF-2012-128

CMS-PAPER-QCD-11-003

R₃₂:

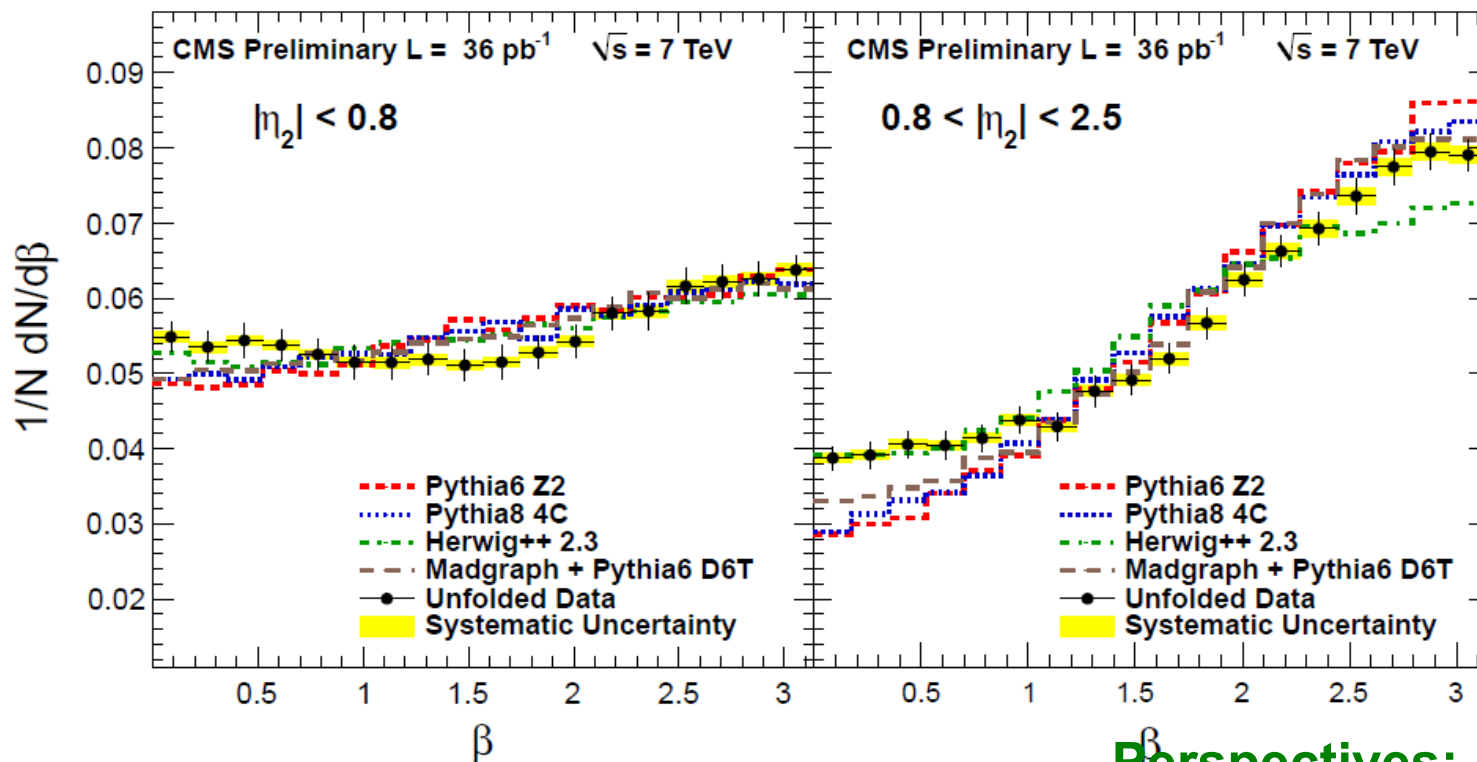
- Small exp. Uncertainty
- Dominated by th. Uncertainty:
 - ➔ asymmetric scale uncertainty
 - ➔ PDF uncertainty
- No hope for 3-jet NNLO soon
- Maybe NLO + matched PS can help reduce theory uncertainty ?
- ➔ Work to be done ...



Other Multi-Jet Observables

β observable, rel. to orientation of third jet emission

→ test color coherence
→ MC tuning



CMS, PAS SMP-12-010 (2013).

Rel. obs.: Count 3rd jet emissions in cone

3-jet mass

Ratio R_{43}

Azimuthal decorrelation

Event Shapes

Other multi-jet observables

Perspectives:

→ $R_{\Delta R}$ → measure α_s (NLO)

→ PDFs, α_s (NLO)

→ α_s (NLO)

→ ISR

→ MC tuning, test resummation

→ MC tuning, QCD gauge structure ?

D0, arXiv:1207.4957

D0, PLB704 (2011)

CDF;D0;ATLAS;CMS

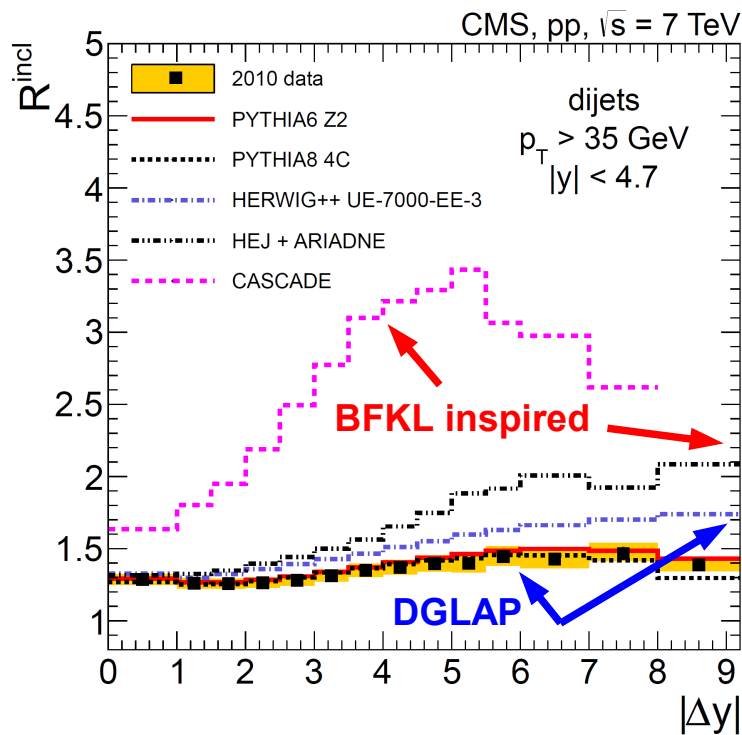
CDF;ATLAS;CMS



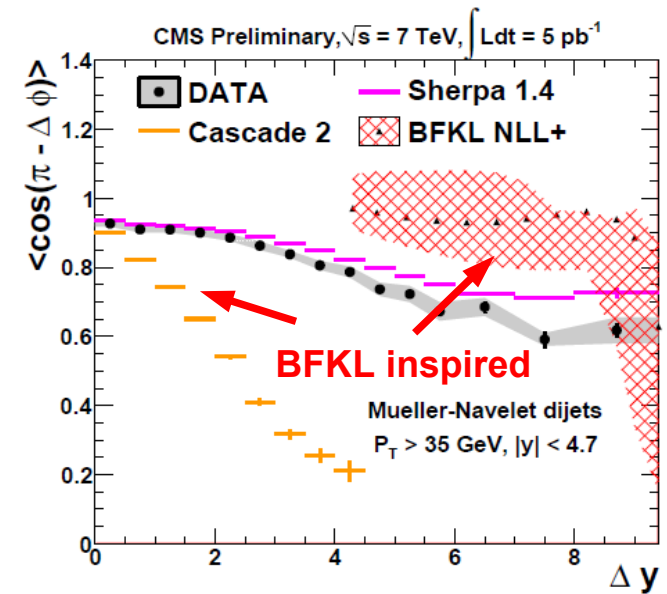
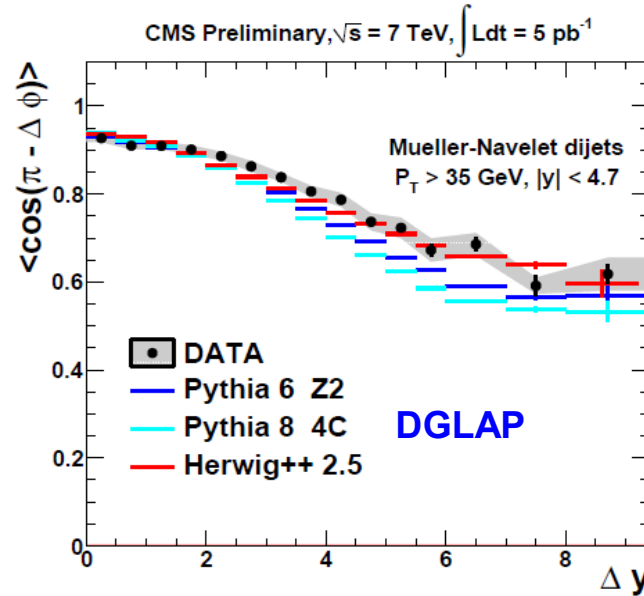
Dijets separated in Rapidity

Quantities sensitive to potential deviations from DGLAP evolution at small x
Some MC event generators run into problems ... but also BFKL inspired ones!
Large y coverage needed, also useful for WBF tagging jets.

All possible dijet pair distances over leading dijet pair distance



First Fourier coefficient of angular decorrelation between Muller-Navelet jets
(average cosine of angular difference from π)





Outlook for SM Measurements

- Nice possibilities for combined LHC data to improve gluon knowledge:
 - ➔ Inclusive jets (soon NNLO), Z+jet pT (NNLO ?), ttbar production (NNLO)
 - ➔ **Reduce gluon PDF uncertainty on Higgs production (ggH)!**
- Measure the strong coupling α_s at highest scales (jets)
- Measure M_{top} (ttbar)



Backup Slides

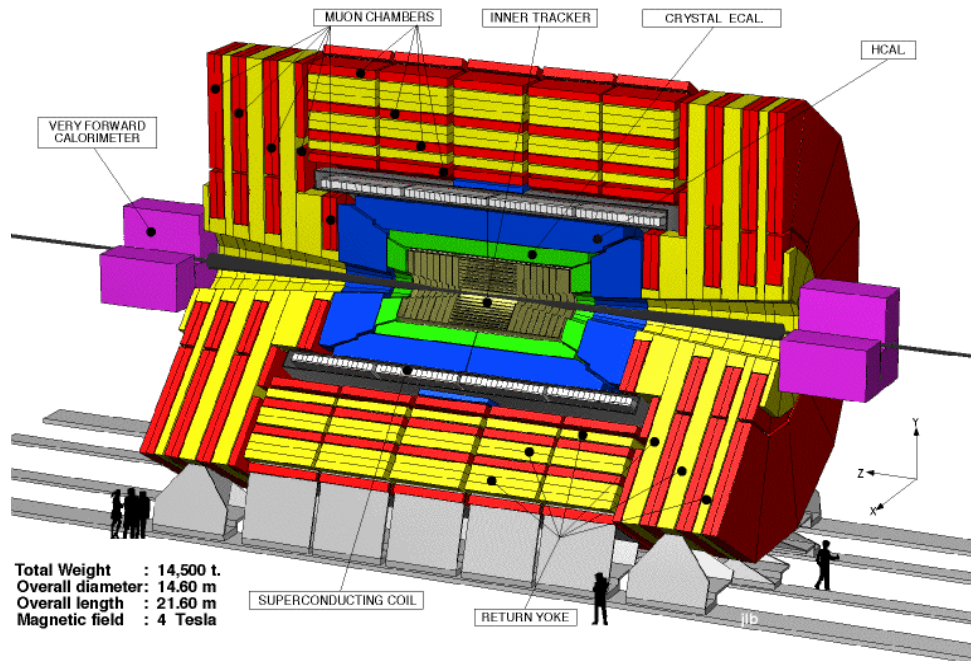


LHC and CMS

LHC: Collisions of Pb-Pb, p-Pb and p-p (23/fb)
 $E_{\text{cms}} = 0.9, 2.36, 2.76, 7, 8 \text{ TeV}$
 peak inst. lumi almost $8 \times 10^{33} \text{ cm}^{-2}\text{s}^{-1}$

CMS global features:

Silicon trackers: Up to $|\eta| = 2.5$
Calorimetry: Up to $|\eta| \sim 5.0$
Muon chambers: Up to $|\eta| = 2.4$
Jet energy scale: 1 – 3 % prec.



Main jet algos:
 Anti-k_T
 R=0.5 or 0.7

Pile-up effect

