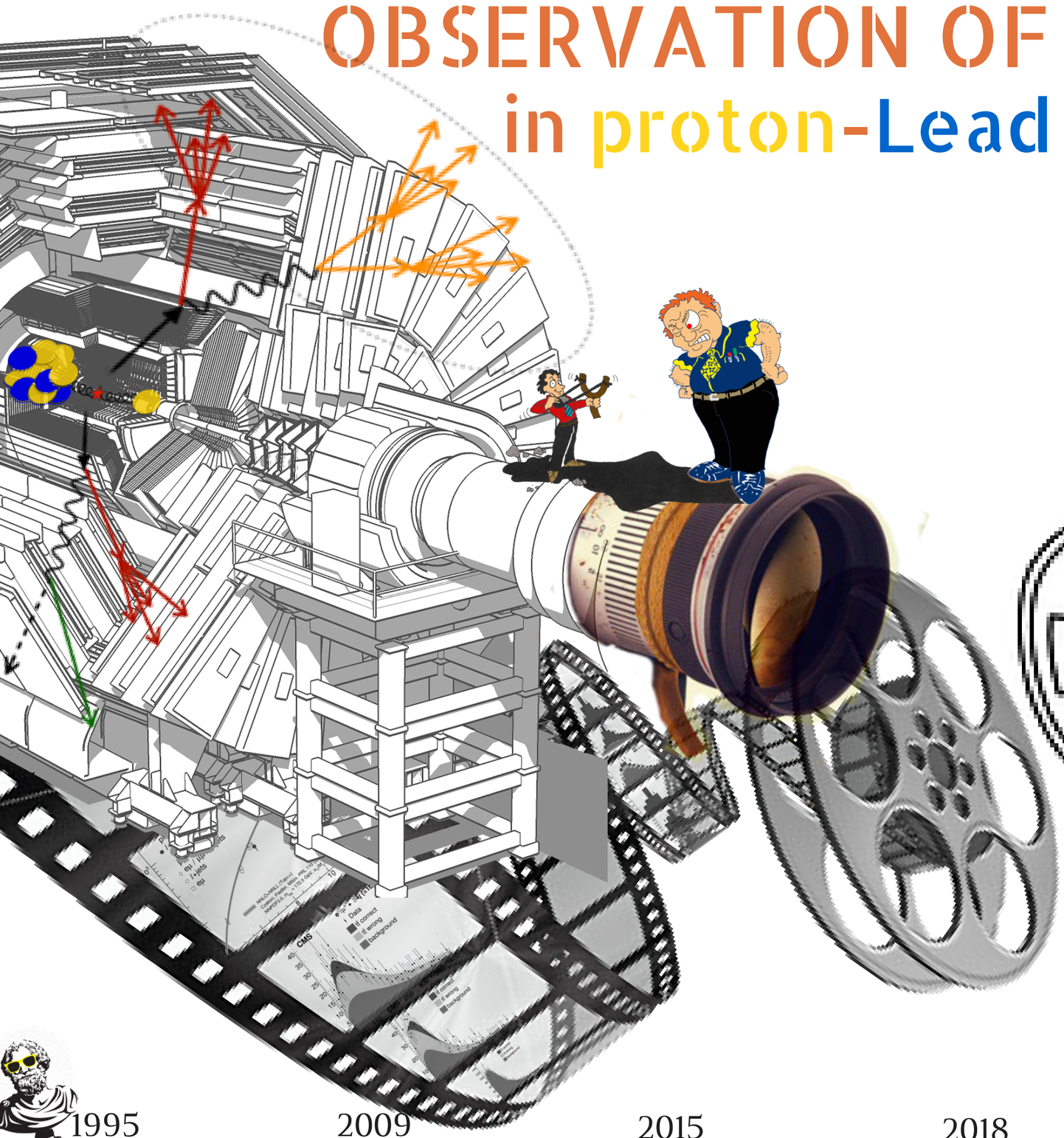
OBSERVATION OF TOP QUARK in proton-Lead collisions



1995 — *Top at Tevatron*

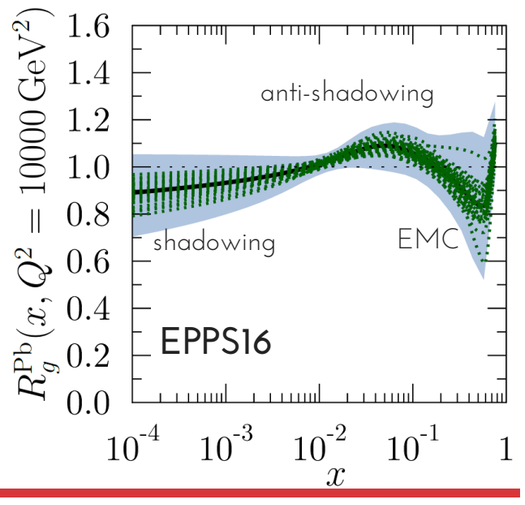
2009 — *Top at LHC (7 TeV)*

2015 — *Top at LHC (5 TeV)*

2018 — *Top in hot QCD (Expected)*

In pPb collisions ? Not a typo ?

In November 2016, the LHC delivered **proton-Lead** (pPb) collisions at $\sqrt{s}$ = 8.16 TeV. This is a unique opportunity to verify the **pQCD** prediction of the top pair-production (tt), providing complementary constraints on the **large-x gluon PDF**. Such a measurement further serves as a reference for measuring top quark in **PbPb** collisions.

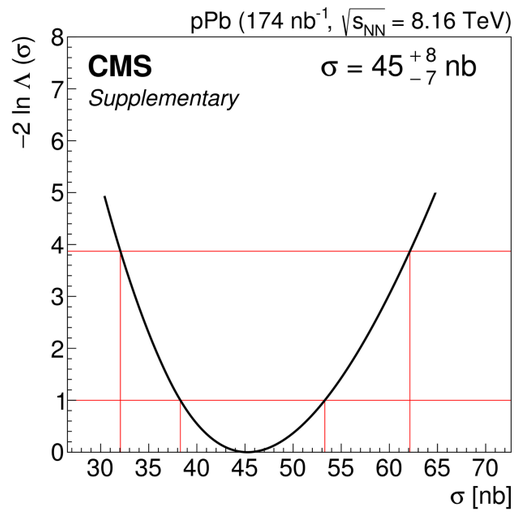


How you extracted the signal ?

The background contribution is parameterized from **dedicated** event samples, while the scale is determined from **a combined fit** including signal-enriched regions in the l+jets channel. The tt signal is separately considered for **fully** and **partially** reconstructed W boson candidates and is taken from a **NLO** MC simulation interfaced to state-of-the-art nuclear PDFs.

Is the signal significant ?

The total number of observed events is **710±130**, and the background-only hypothesis is excluded at **>5σ** level **including all** systematic uncertainties as nuisance parameters with Gaussian priors. To further examine the hypothesis that the selected data are consistent with tt production, **a proxy** of the top quark mass is defined by pairing the highest scored b jet with the W boson candidate.



And, with what precision ?

Experimental uncertainties include **b tagging**, **trigger** and **lepton** efficiencies, plus **jet energy scale** and **resolution**. Theoretical ones involve **QCD scales**, and free- and bound-proton **PDFs**.

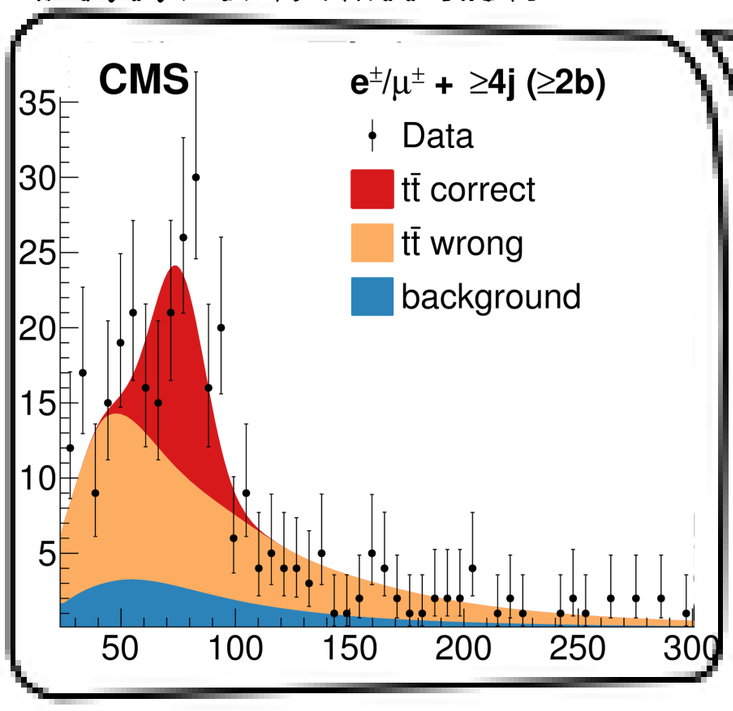
Experimental	• 13/4/4 %
Luminosity	• 5 %
Background	• 7 %
Theoretical	• 4 %
Total systematic	• 18(23)% in μ(e)+jets
Statistical Precision	• 7%
Total	• 17%

CMS Collaboration. PRL 119, 242001 (2017)
Observation of Top Quark Production in Proton-Nucleus Collisions

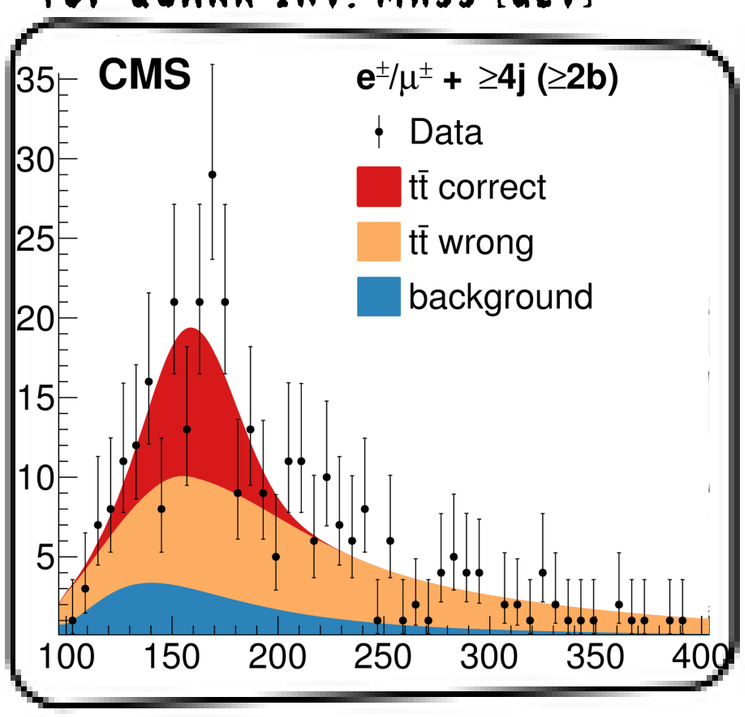
SELECTION — SIGNAL

- High Level Trigger
- ≡1 high pT lepton (μ or e)
- ≥4 anti-kt clustered jets
- ≥1 b tagged jet

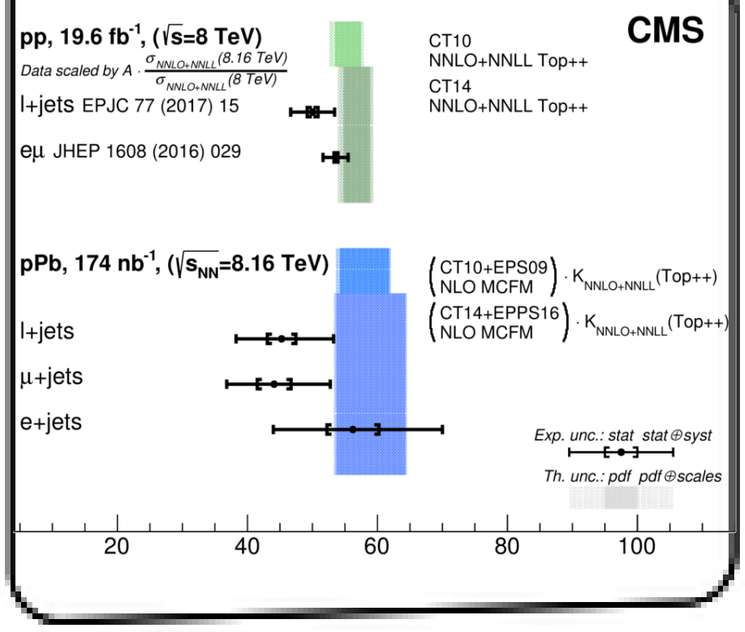
W BOSON INV. MASS [GEV]



TOP QUARK INV. MASS [GEV]



CROSS SECTION IN PP, PPB [NB]



L=174NB-1

Result

$\sigma_{tt} = 45 \pm 8$ nb

in-line with theory