Top quark mass - introduction

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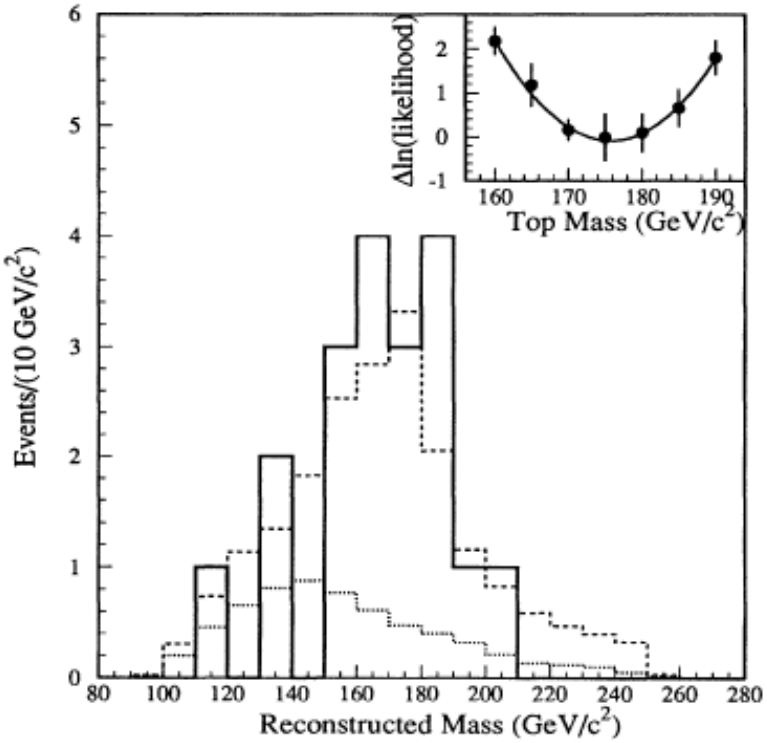
Top mass workshop

Valencia, May ‘24



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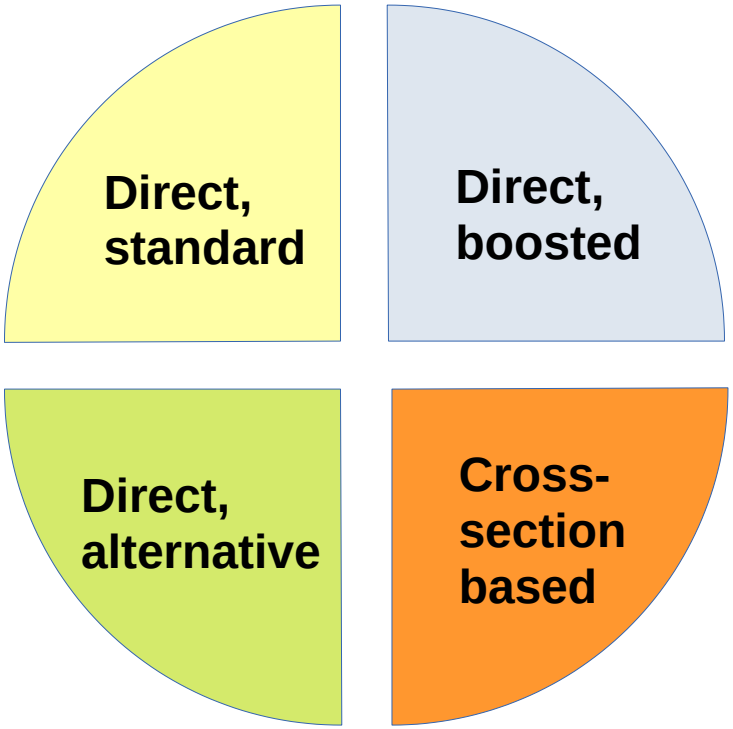
Existing mass measurements landscape



Uncertainty for the best single measurements in each category

Direct (standard) ~ 400 MeV
Direct (alternative) ~ 800 MeV
Direct (boosted) ~ 800 MeV
Diff. cross-section-based ~ 800 MeV

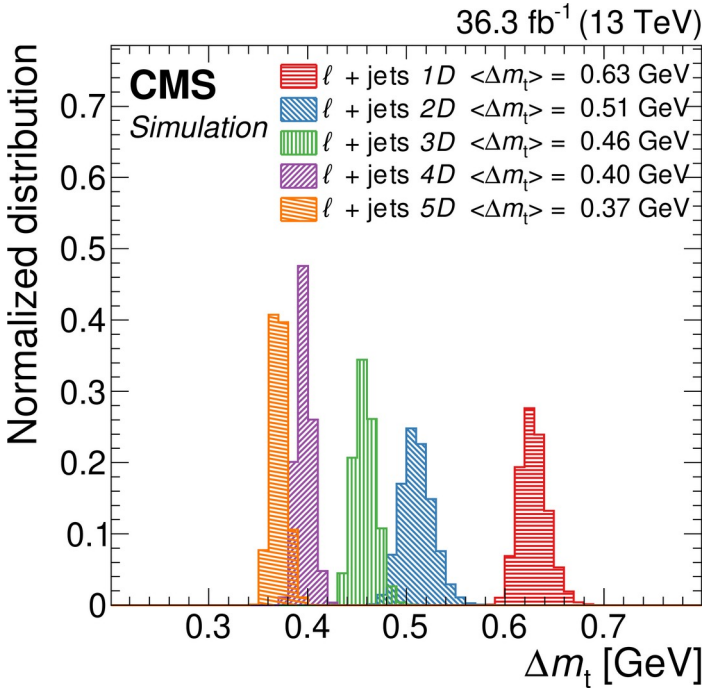
Direct mass measurements

CMS top mass with PL fit,
l+jets, 36/fb at 13 TeV

m_t = 171.8 ± 0.4 (total)

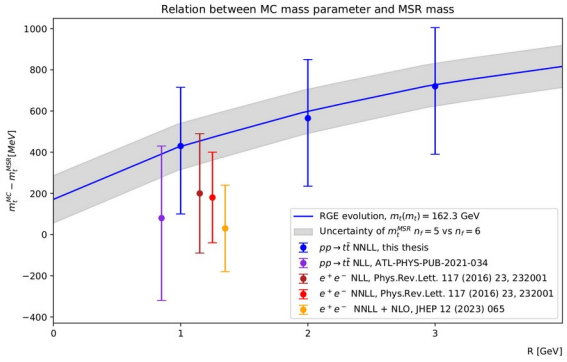
Aggressive use of PL fit can reduce uncertainty to ~380 MeV

[arXiv:2302.1967]



Improve the nominal MC and uncertainty model to ensure robust results

Perform measurements in range of topologies, Including boosted top quark production



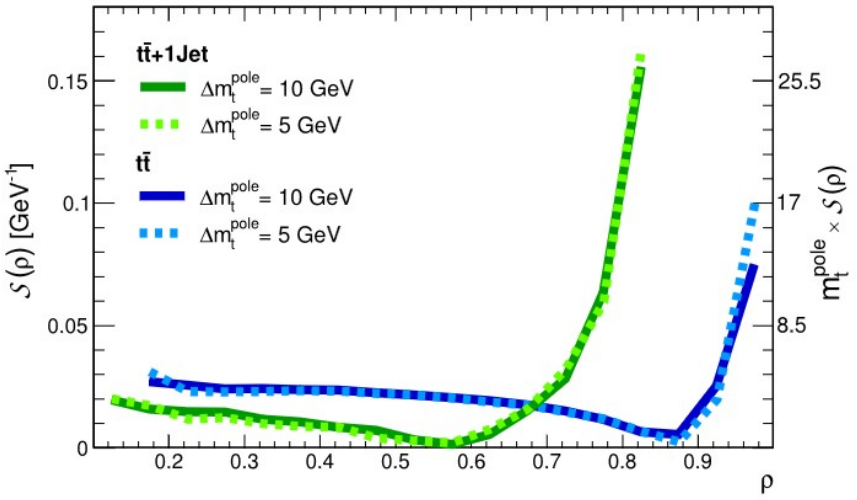
Improve the understanding of MC generators and provide a robust interpretation of the MC mass parameter in a field-theoretical mass scheme
[Seminar André Hoang, https://indico.ific.uv.es/event/7584/, talk Naseem Bouchhar]

Measurements from differential cross section

The heart of this meeting

Measurements from differential cross section:

- offer flexible interpretation and include an estimate of the theory uncertainty
- can be updated as soon as better theory becomes available
  [talks by Sven Moch, Malgorzata Worek, Simon Badger]
- can avoid/cross-check the correction to “parton-level” stable top quarks
  [talk by Andrej Saibel]
- full run 2 analyses in progress in both ATLAS and CMS
  [talks by Ana, Luis and Alberto]

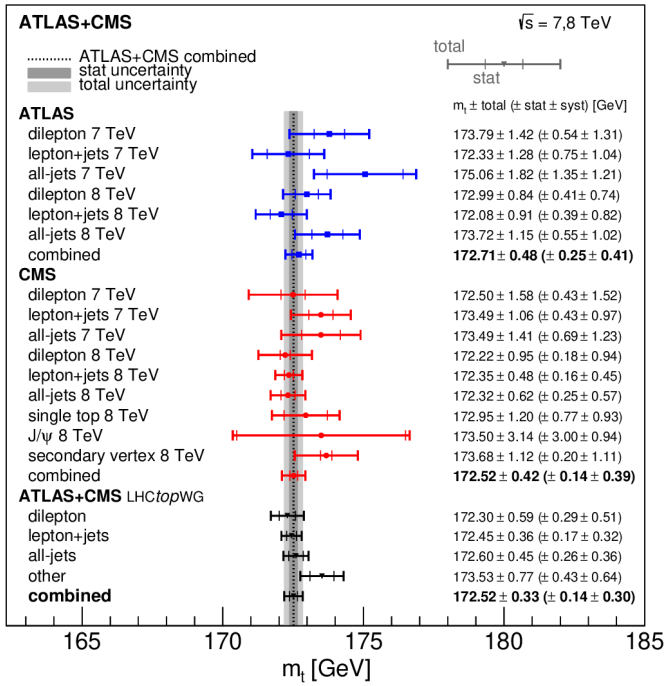


The power of combinations

ATLAS+CMS run 1 combination

Multiple (15!) direct measurements
using different techniques

Combination yields 330 MeV uncertainty,
with best measurement of ~600 MeV (link)

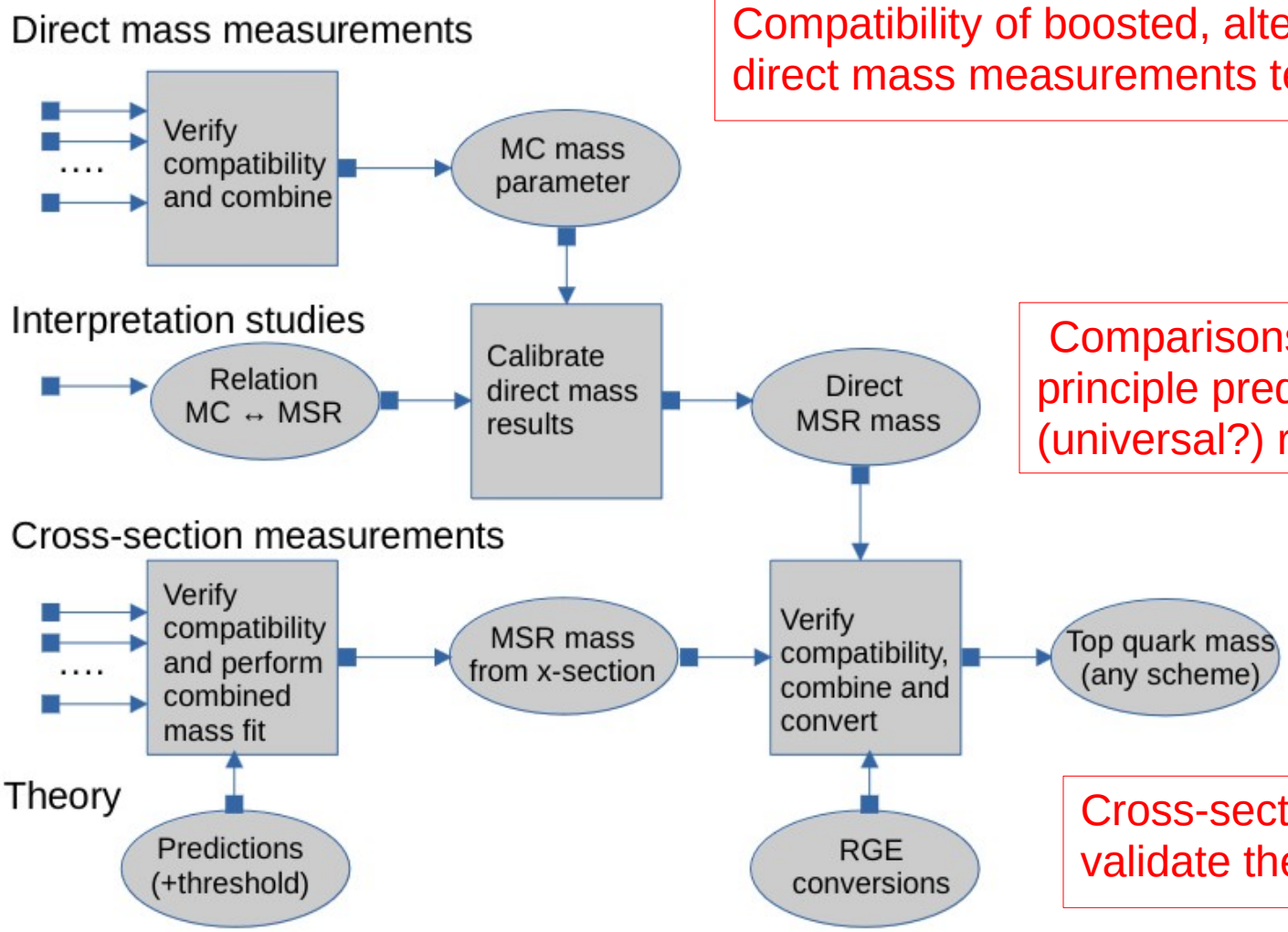


- average is dominated by “standard” template methods,
- alternative results provide “robustness” and reduce the total uncertainty

	ATLAS						CMS								
	2011 (7 TeV)			2012 (8 TeV)			2011 (7 TeV)			2012 (8 TeV)					
	dil	lj	aj	dil	lj	aj	dil	lj	aj	dil	lj	aj	t	J/ψ	vtx
Pull	+0.93	−0.15	+1.43	+0.61	−0.51	+1.09	−0.01	+0.96	+0.71	−0.33	−0.47	−0.37	+0.38	+0.31	+1.08
Weight	−0.02	+0.07	+0.00	+0.16	+0.17	+0.03	−0.08	−0.01	+0.03	+0.12	+0.34	+0.12	−0.03	+0.01	+0.08

Develop combined fit for ATLAS+CMS tt+jet-based measurements before the measurements are finalized
[talks by Sasha Zenaiev, Matteo, Sebastian and Davide]
Improve b-JES as the dominant systematic [talk by Miguel Jimenez]

Top mass master plan



Compatibility of boosted, alternative and standard direct mass measurements tests MC description

Comparisons of MC and first-principle predictions yield (universal?) relation $m_t^{MC} \leftrightarrow m_t^{MSR}$

Cross-section based results validate the interpretation

Summary

Top quark mass is to be determined with a comprehensive program

→ precision depends on hard work (JES + generators + B/D production/decay)

→ combinations across methods are complex, but will ultimately be needed

Practical information for Wednesday's program:

- sandwiches here in the "delegación" at 13:30
- seminar by André Hoang in IFIC's seminar room at 16:30
- dinner at "El Tap (calle Roteros 9) at 21:00

All other sessions here in the "bajocubierta" room