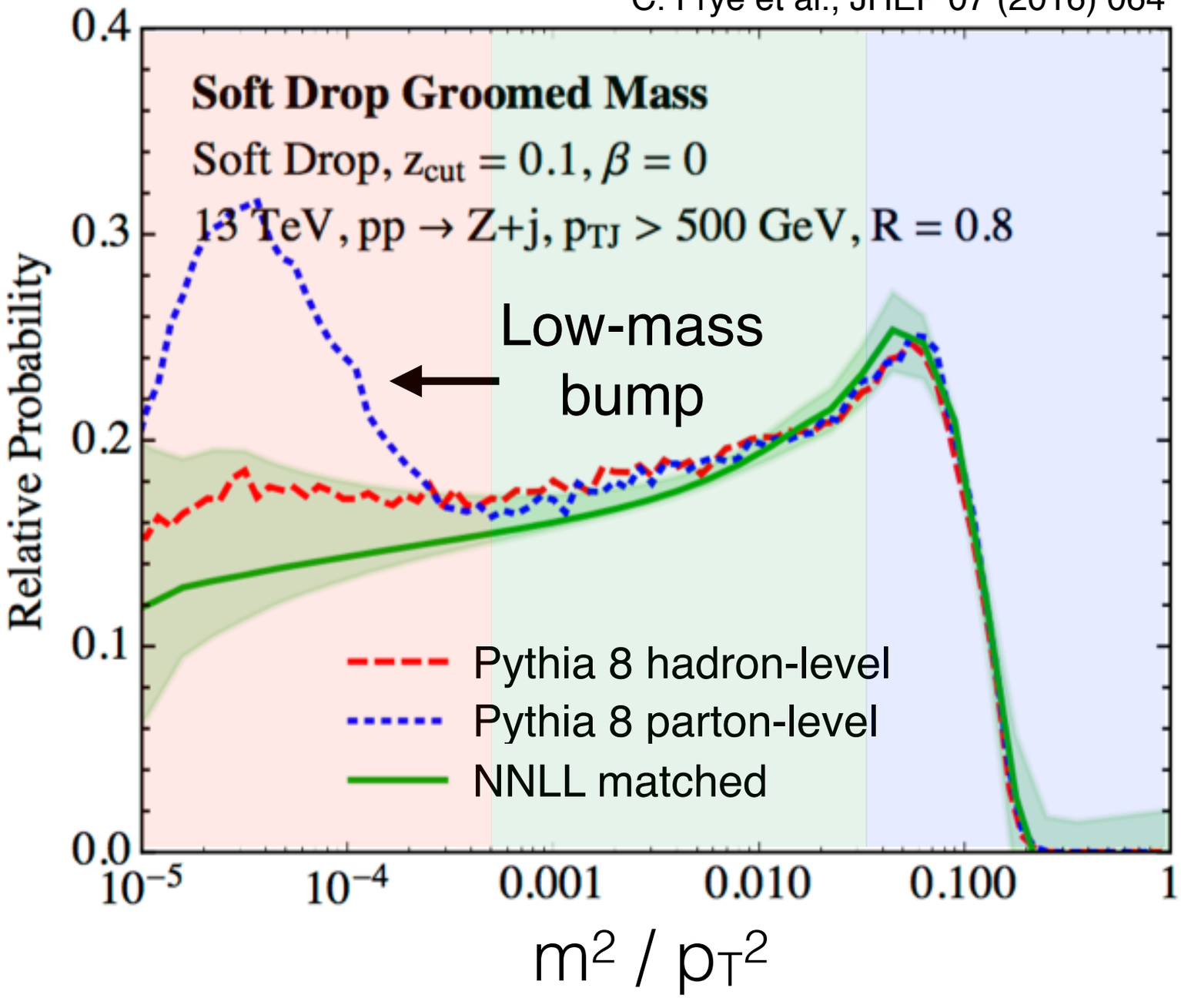
$O(\Lambda_{QCD})$: The low mass bump

C. Frye et al., JHEP 07 (2016) 064



ATLAS measurement: Phys. Rev. Lett. 121 (2018) 092001

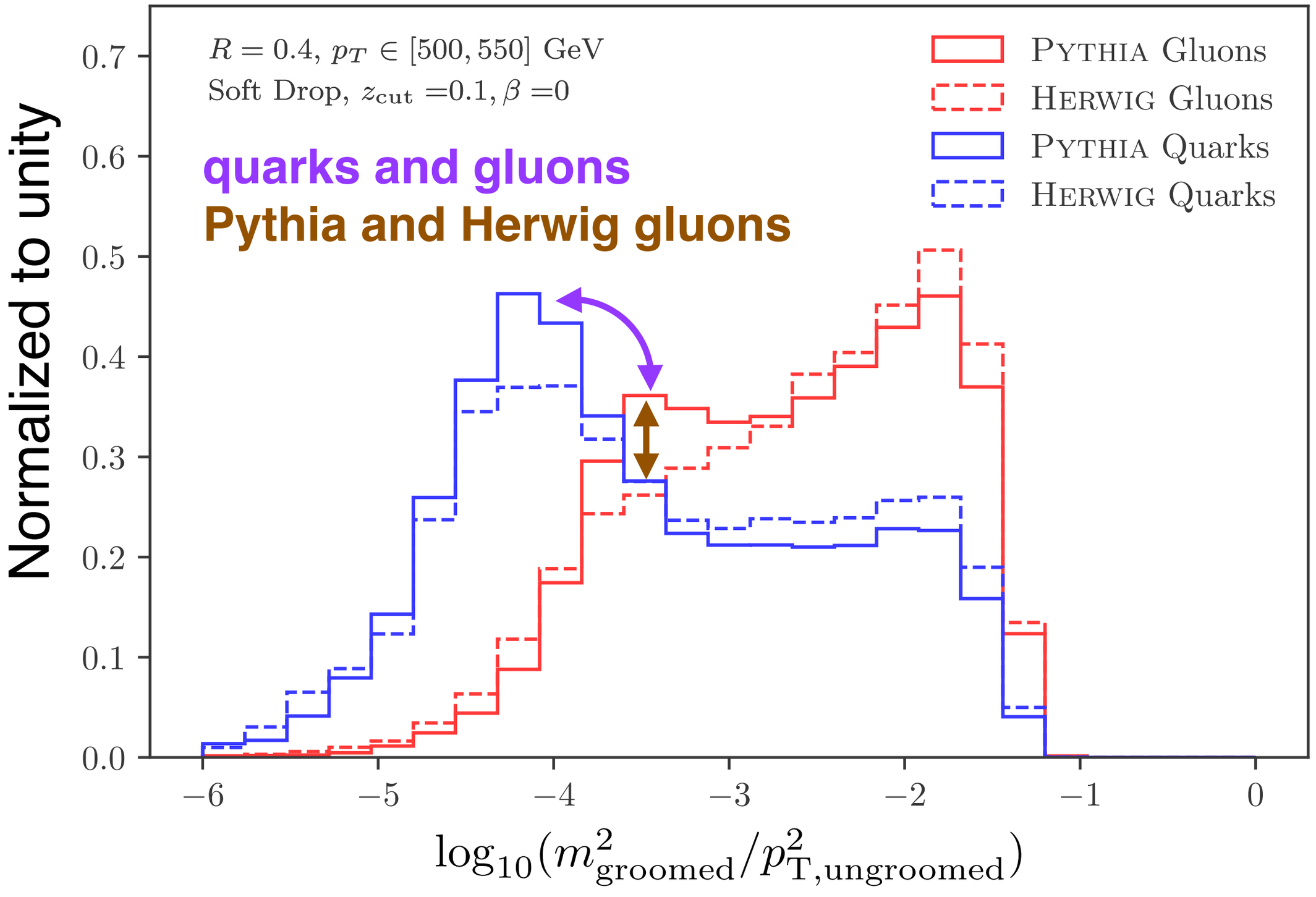
CMS measurement: JHEP 11 (2018) 113

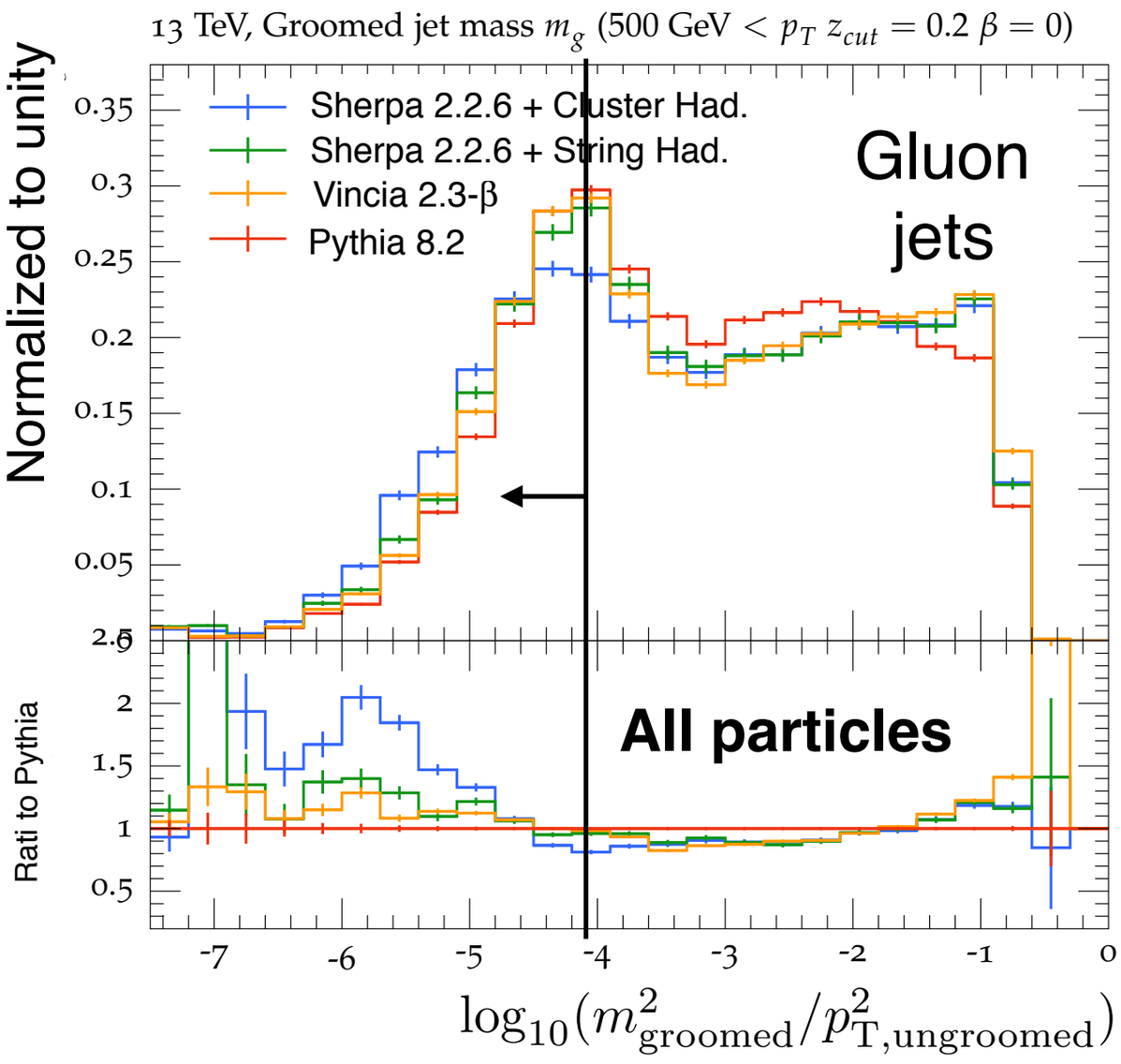
Soft drop grooming parametrically separates **non-perturbative**, **resummation**, and **fixed-order** sensitive regions.

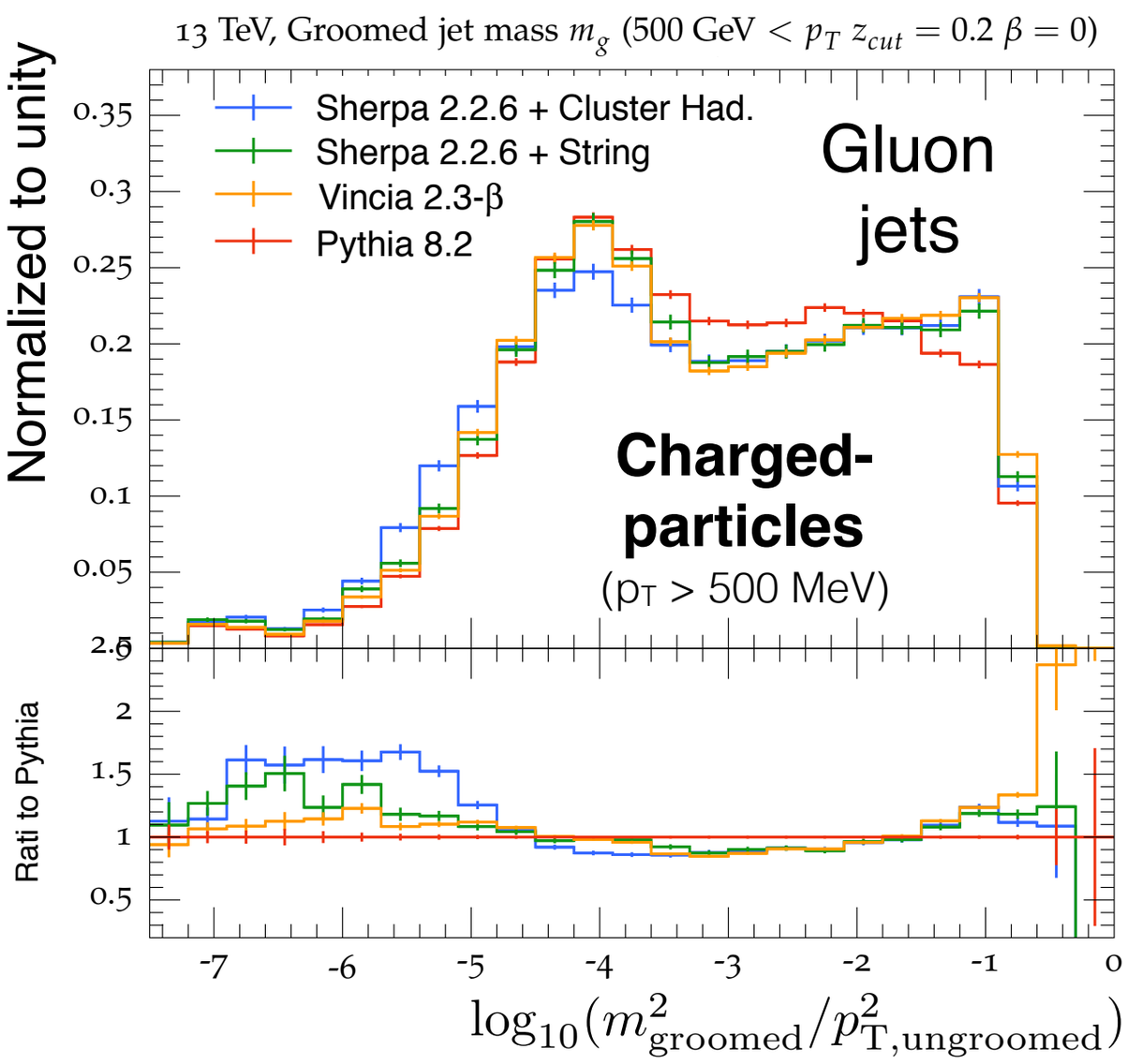
Question:

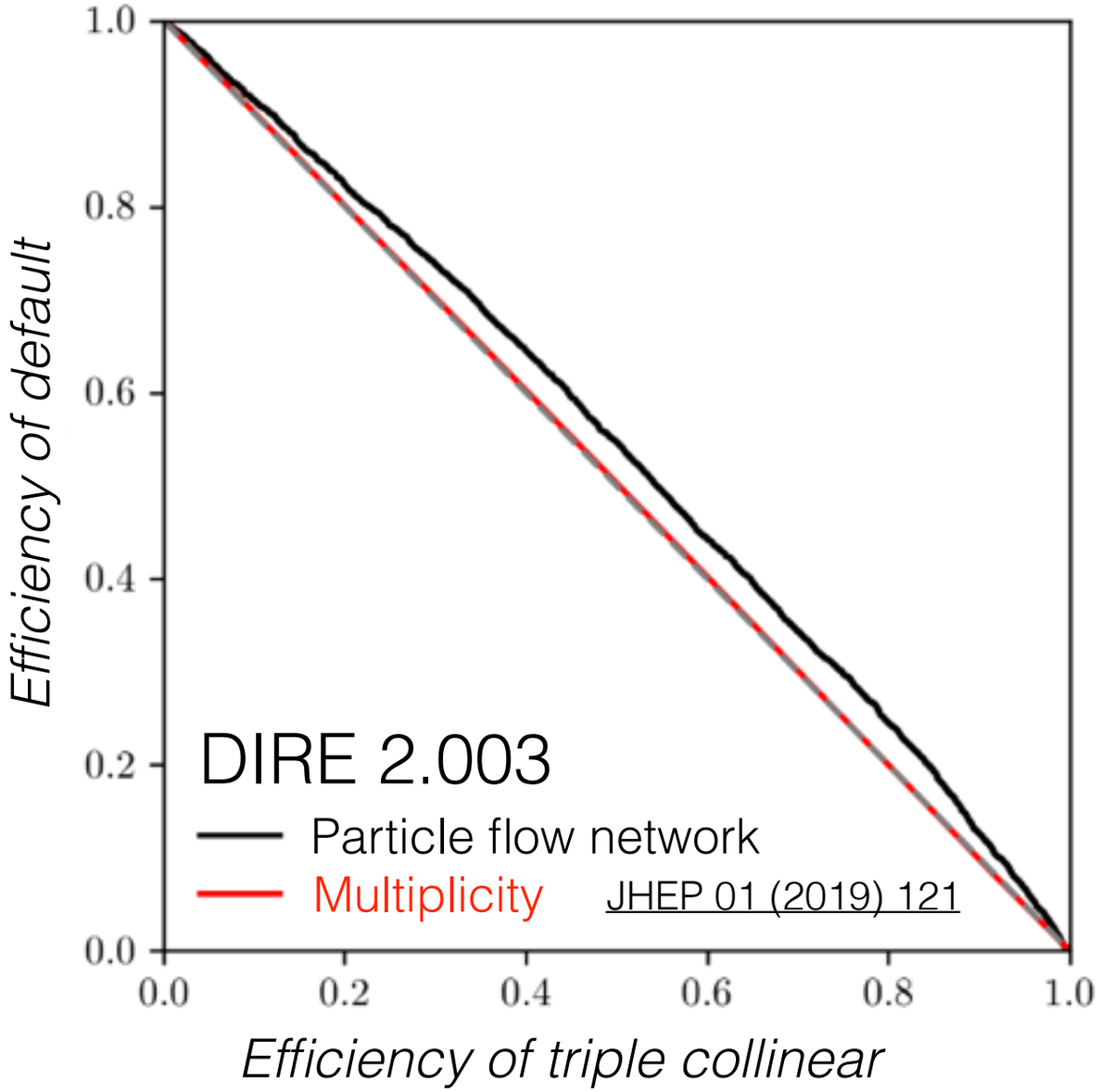
Can we use this for tuning NP at the LHC?

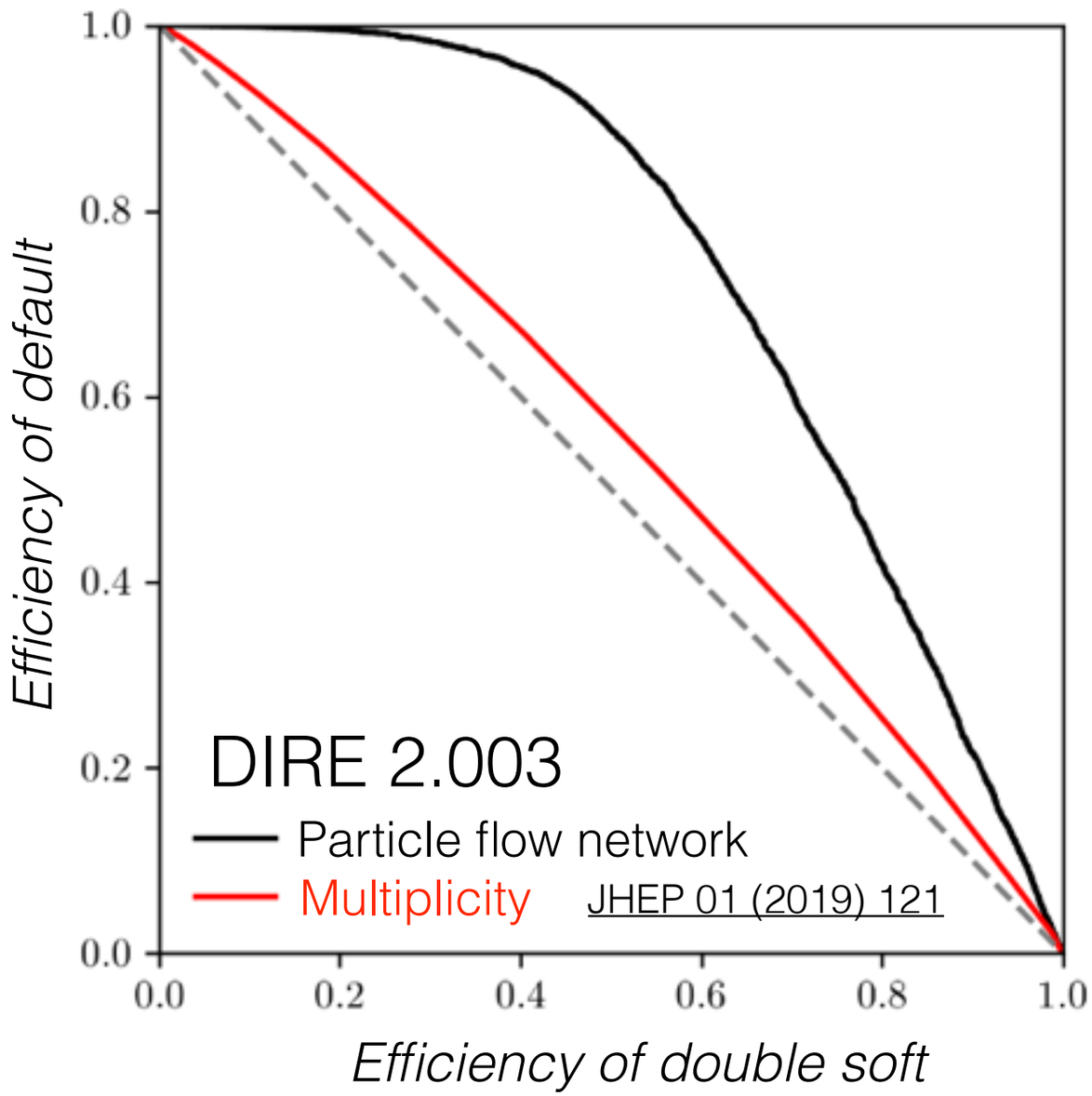
For analytic work on the NP region, see A. Pathak et al.


$R = 0.4$, $p_T \in [500, 550]$ GeV
Soft Drop, $z_{\rm cut}$ =0.1, β =0
quarks and gluons
Pythia and Herwig gluons
Pythia Gluons
Herwig Gluons
Pythia Quarks
Herwig Quarks
Normalized to unity
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
−6
−5
−4
−3
−2
−1
0
$\log_{10}(m^2_{\rm groomed}/p^2_{\rm T,ungroomed})$


13 TeV, Groomed jet mass m_g (500 GeV < p_T $z_{cut} = 0.2$ $\beta = 0$)
Normalized to unity
Sherpa 2.2.6 + Cluster Had.
Sherpa 2.2.6 + String Had.
Vincia 2.3-β
Pythia 8.2
Gluon jets
All particles
Rati to Pythia
$\log_{10}(m^2_{\mathrm{groomed}}/p^2_{\mathrm{T,ungroomed}})$


13 TeV, Groomed jet mass m_g (500 GeV < p_T $z_{cut} = 0.2$ $\beta = 0$)
Normalized to unity
Sherpa 2.2.6 + Cluster Had.
Sherpa 2.2.6 + String
Vincia 2.3-β
Pythia 8.2
Gluon jets
Charged-particles
(p_T > 500 MeV)
Rati to Pythia
$\log_{10}(m^2_{\mathrm{groomed}}/p^2_{\mathrm{T,ungroomed}})$


1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Efficiency of default
DIRE 2.003
Particle flow network
Multiplicity
JHEP 01 (2019) 121
Efficiency of triple collinear

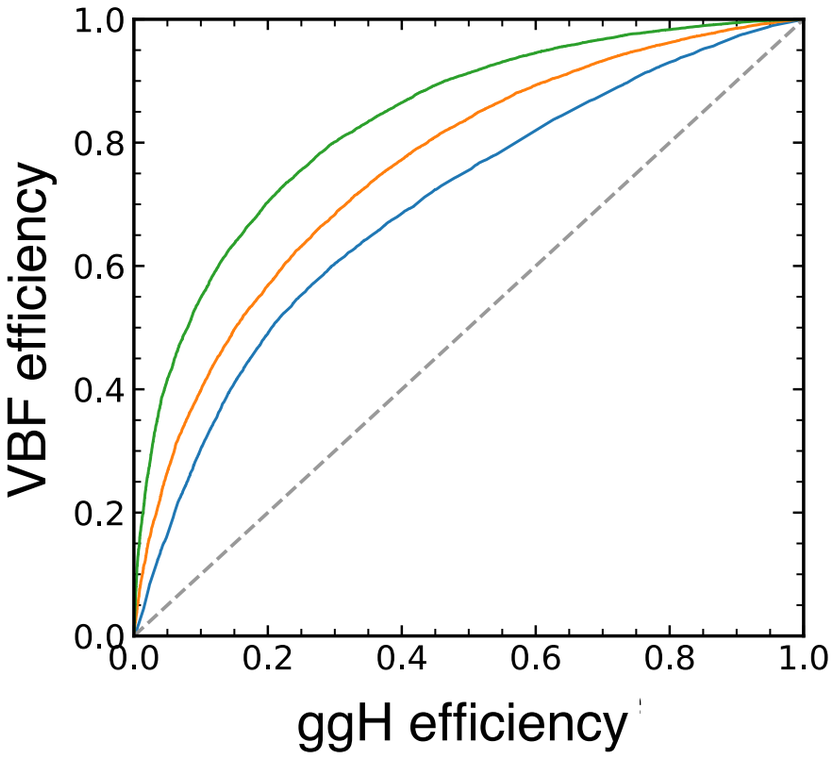

1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
Efficiency of default
DIRE 2.003
Particle flow network
Multiplicity
JHEP 01 (2019) 121
Efficiency of double soft

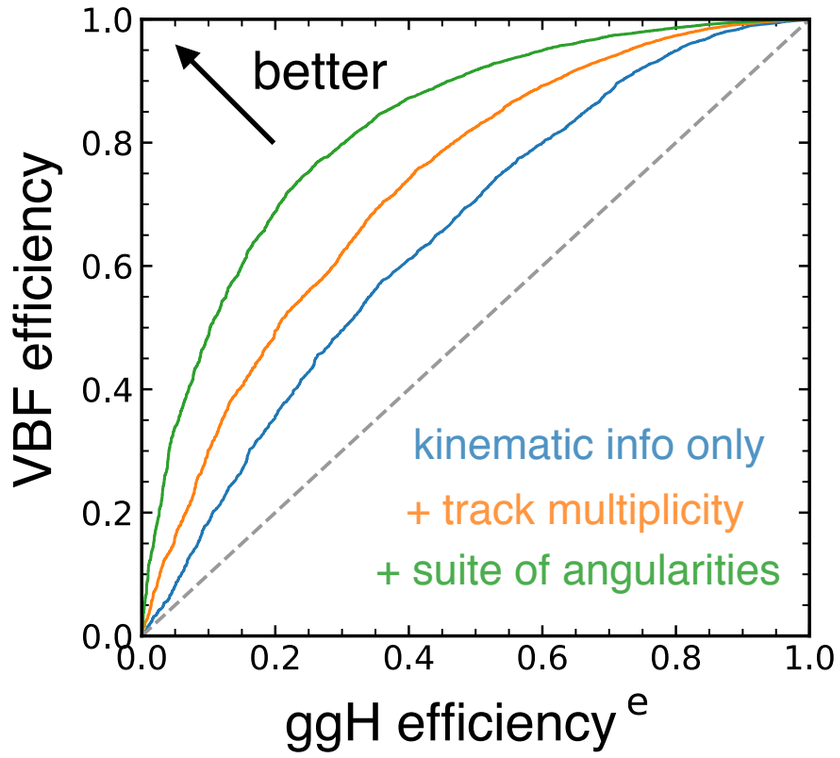
O(10+ GeV): VBF

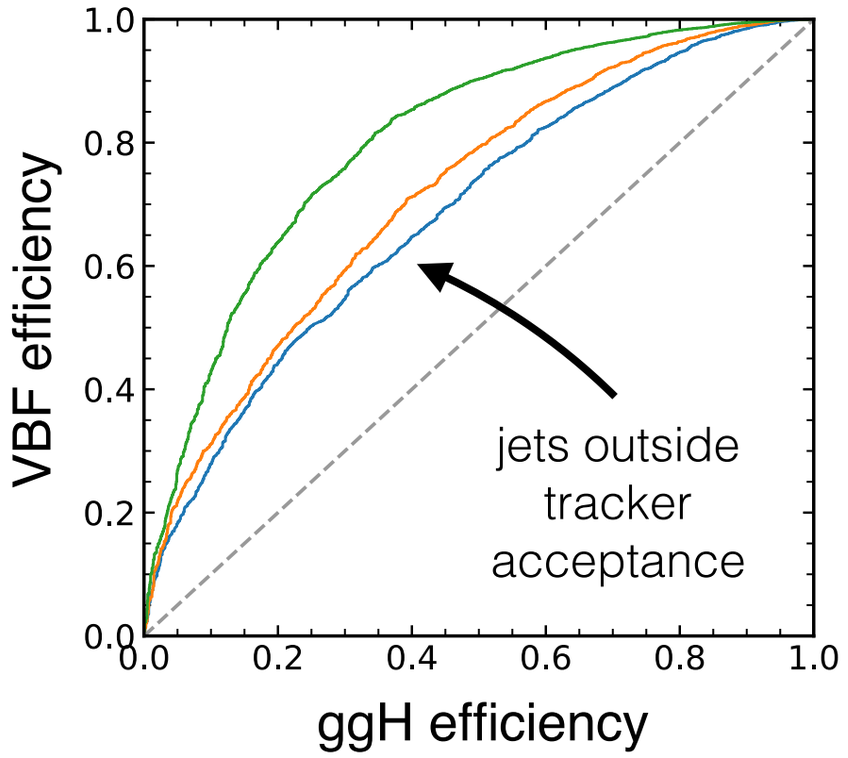
Case study: can q/g tagging help disentangle VBF from ggH?

At high m_{jj}, jets from ggH are also quark-like - biggest gains expected at lower mass.

m_{jj} 350 GeV → 700 GeV



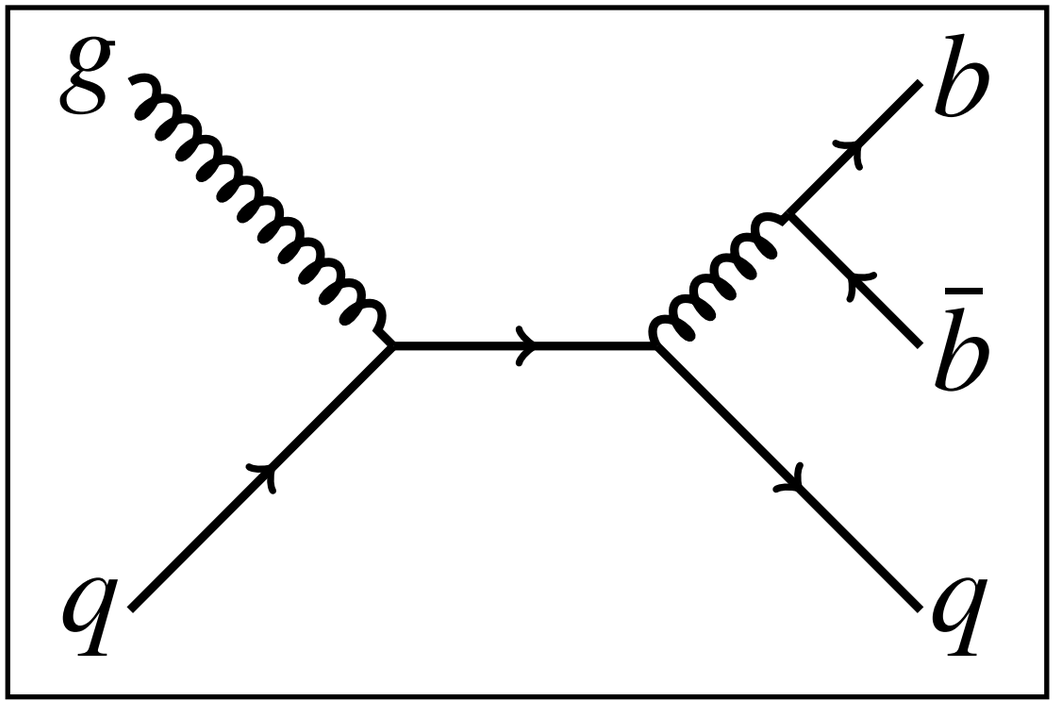




Non-trivial gains seem possible!

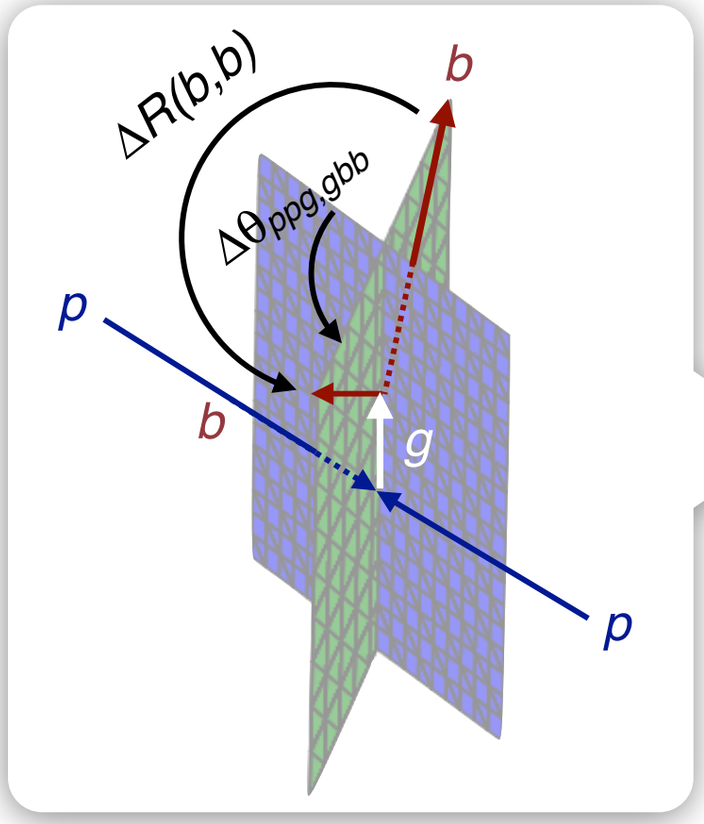
…for the **proceedings**: signal versus background, modeling, etc.

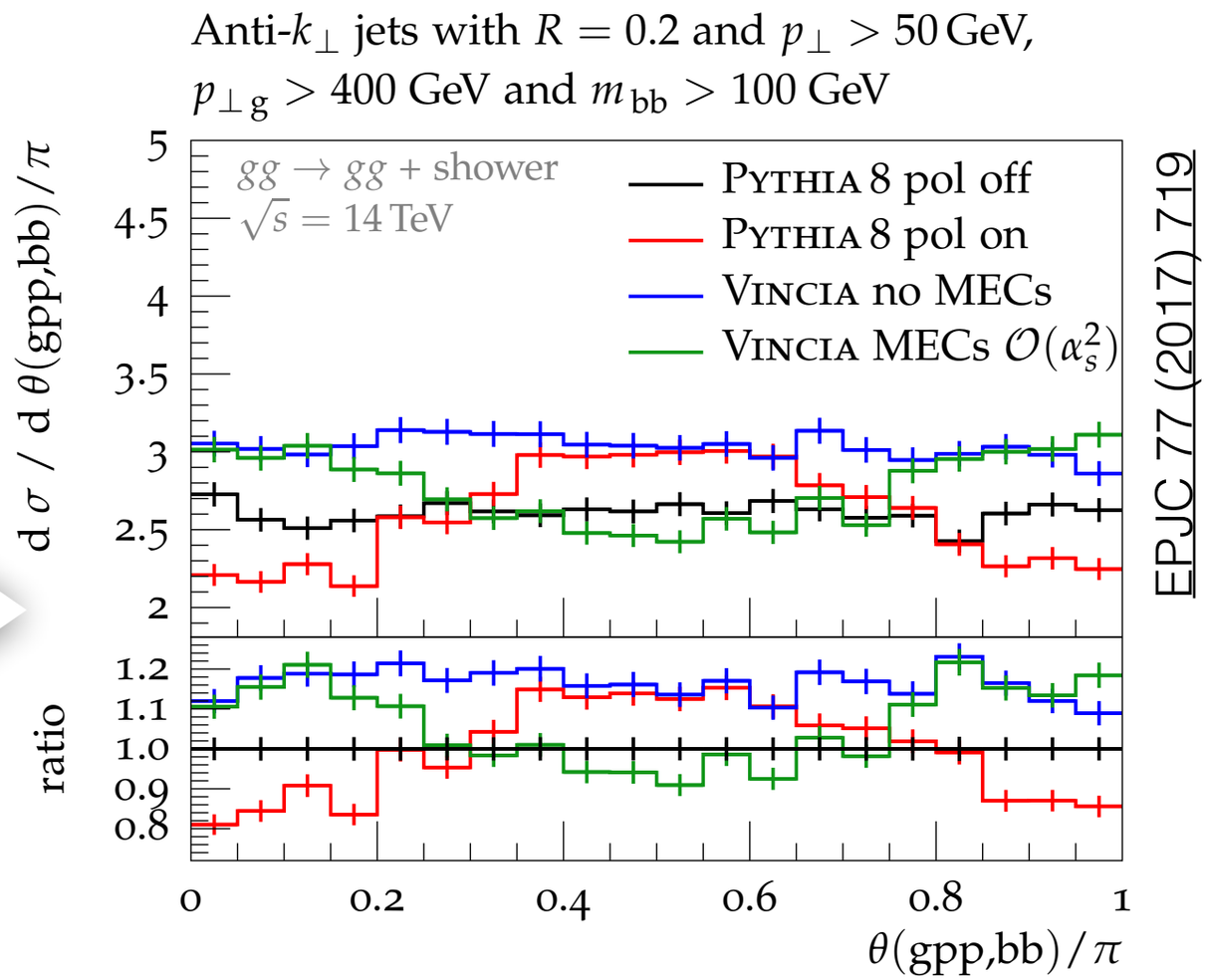
O(100 GeV): g → bb



g → bb provides a unique opportunity to directly probe the (polarized) gluon fragmentation function

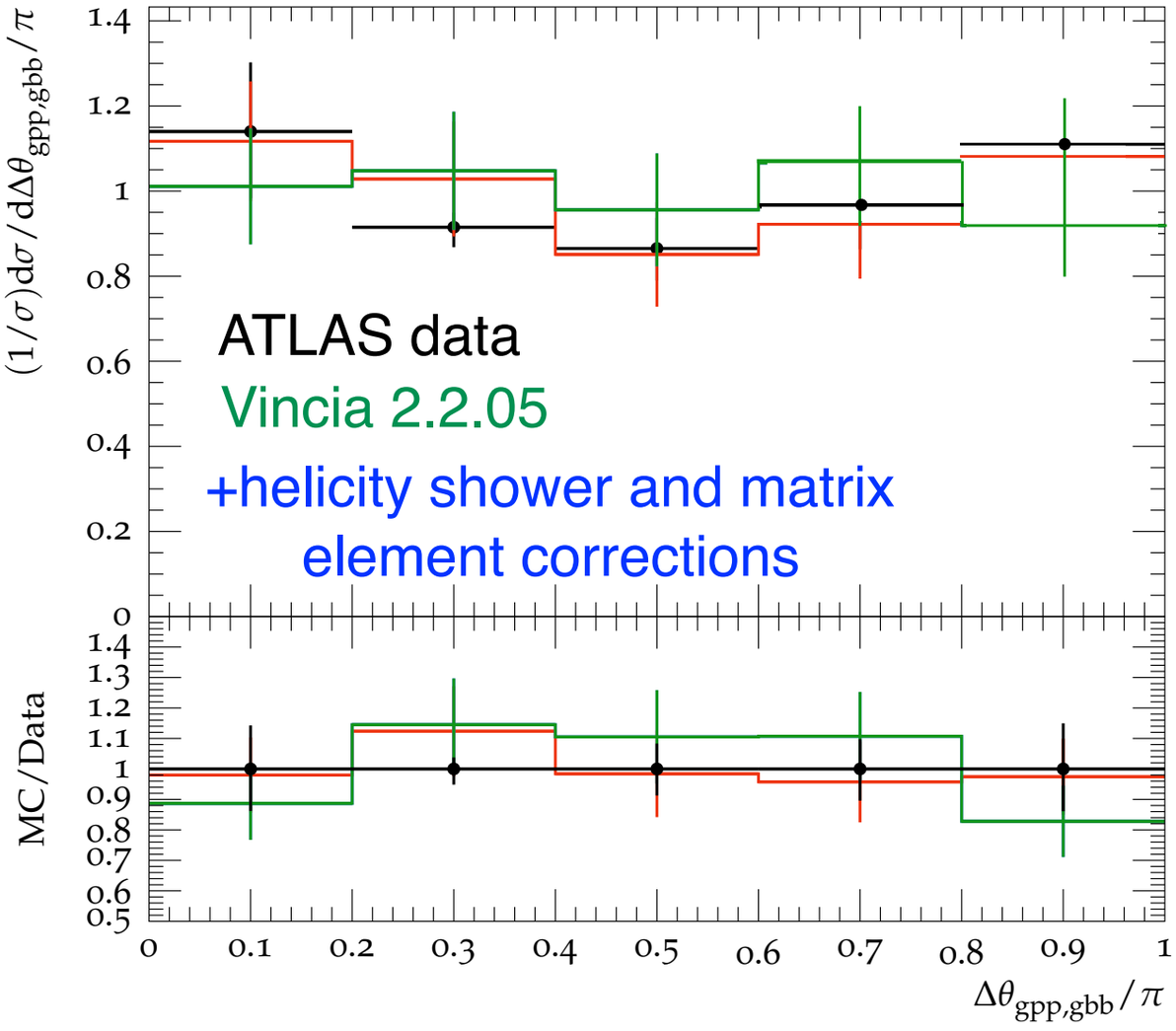
state-of-the-art seemed strange - what does data say?

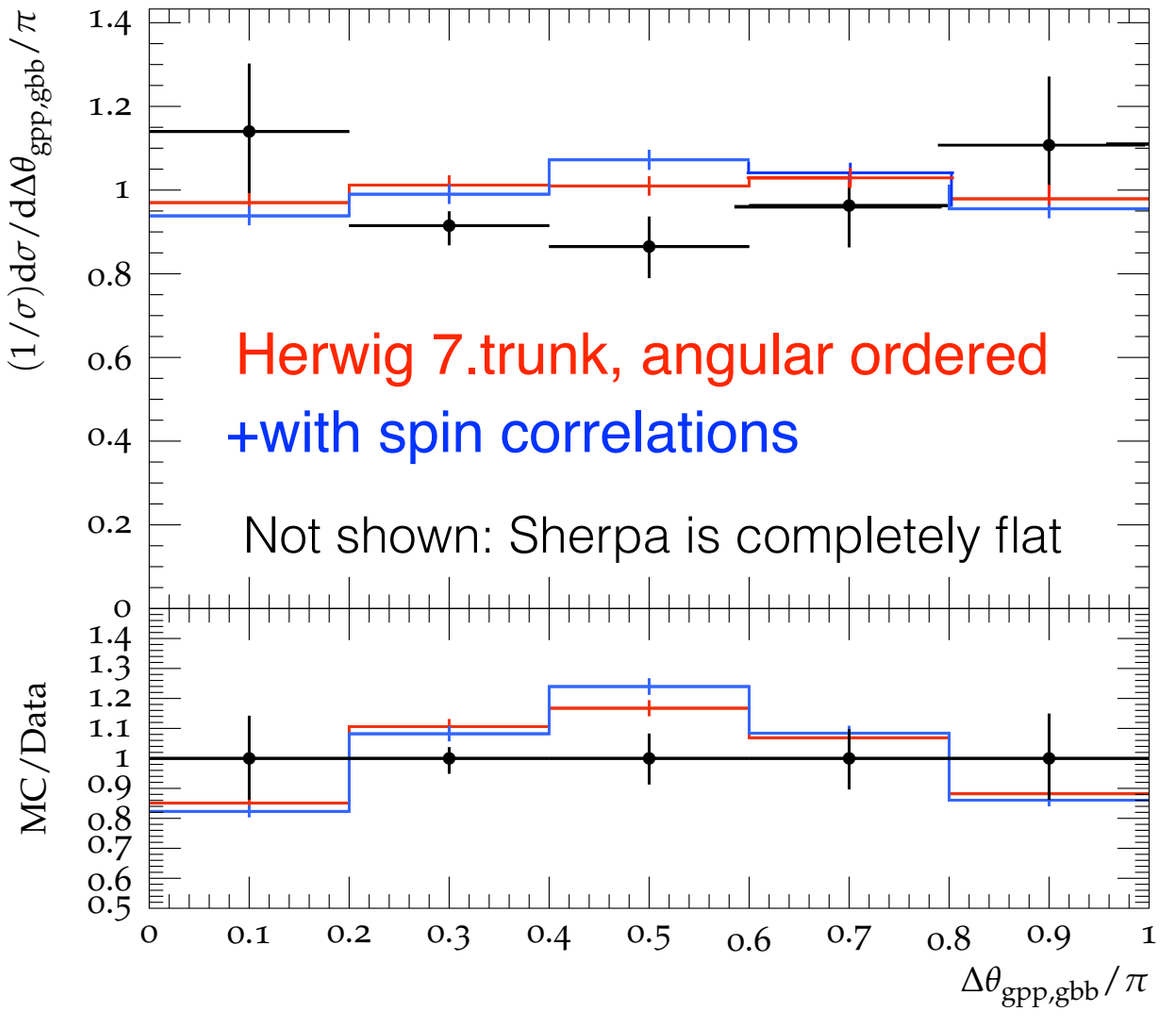




O(100 GeV): g → bb

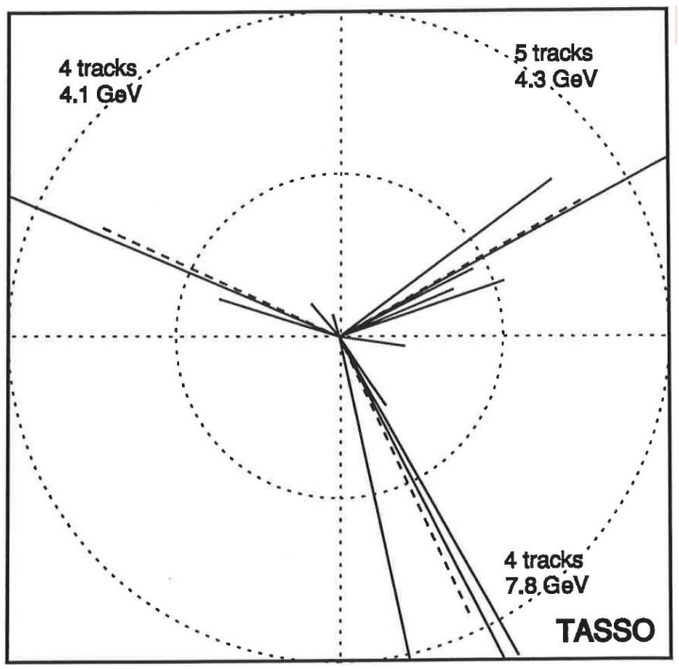
Data = Phys. Rev. D 99, 052004 (2019)

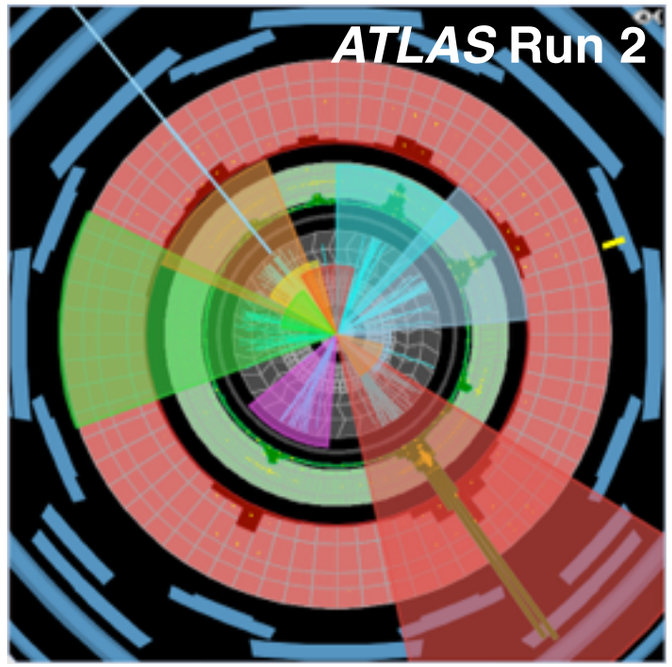




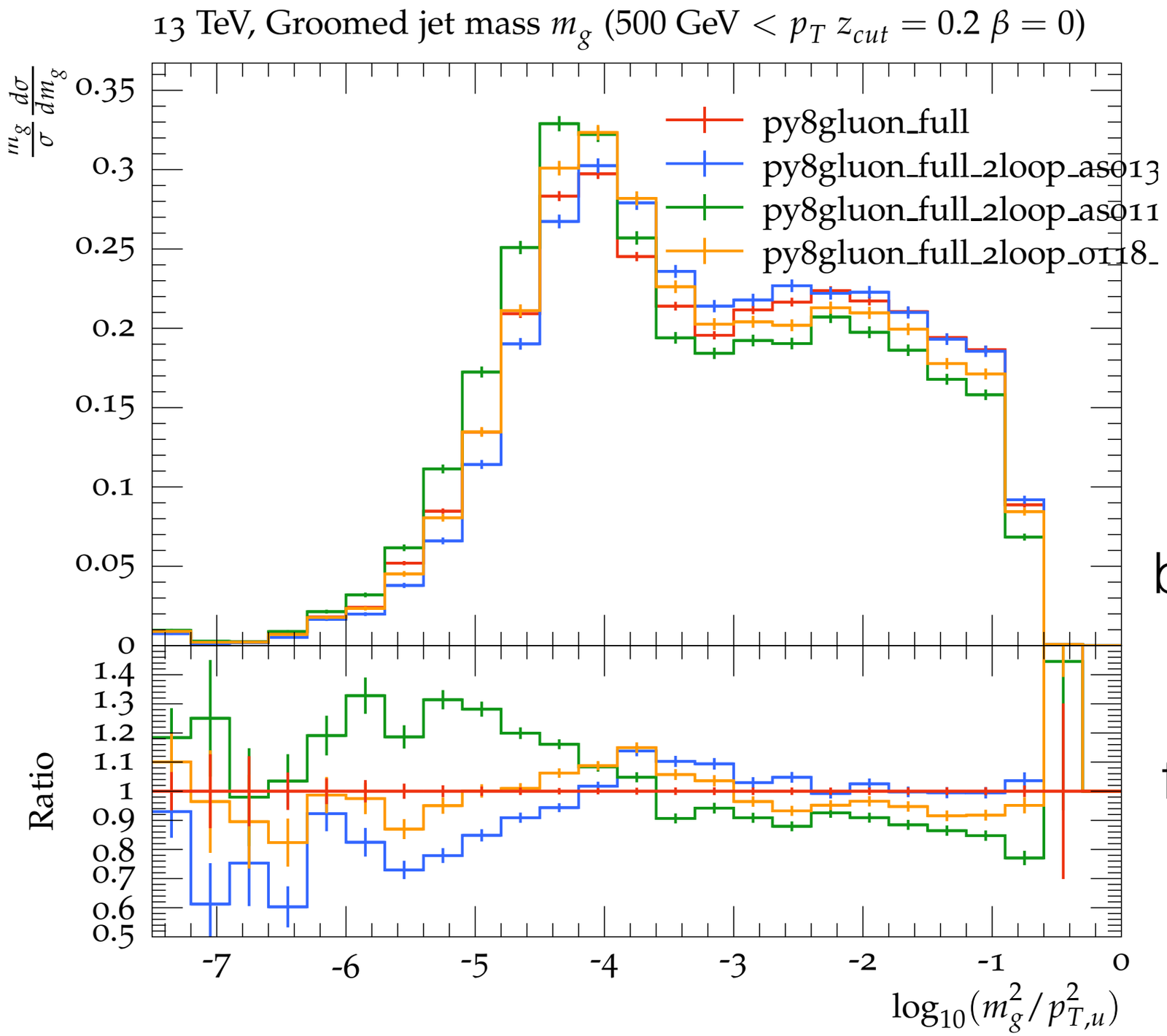
Low-stats indication: Vincia + ME corrections w/ helicity shower show same trend as data - prediction confirmed!

Joyeux anniversaire gluons!





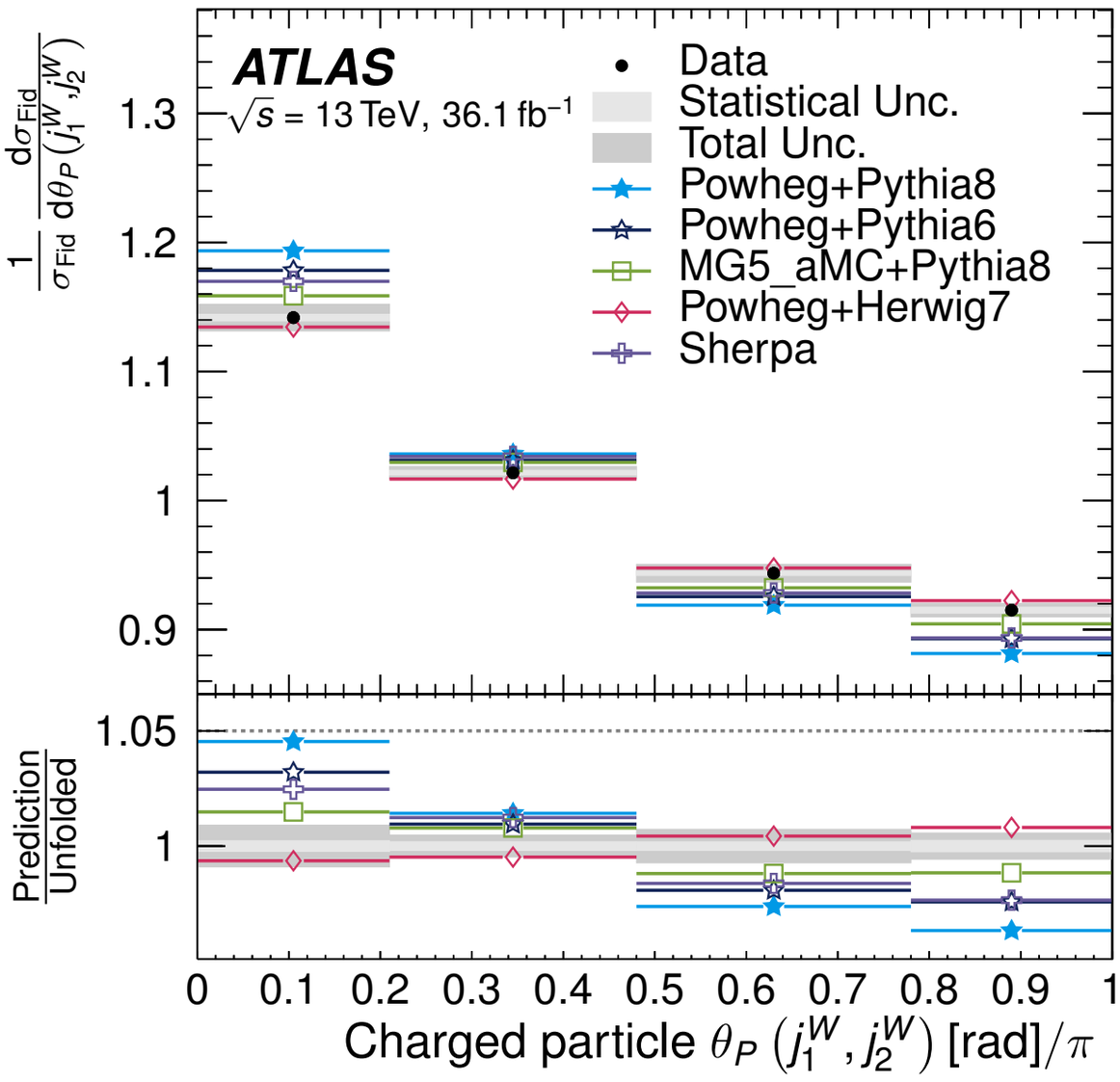
$O(\Lambda_{QCD})$: The low mass bump

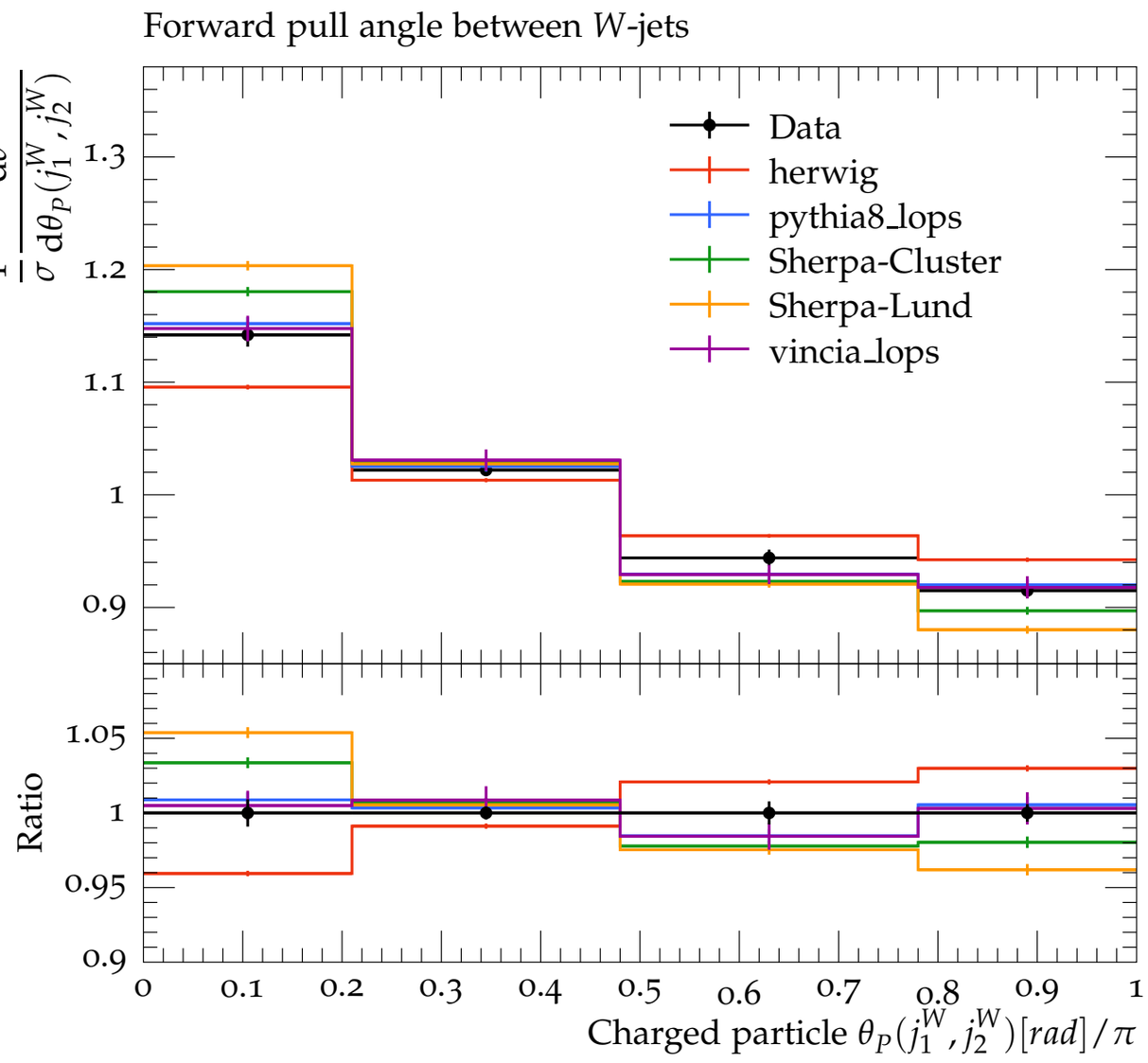


Important interplay between α_S and NP region: with (re)tuning, potentially (first?) observable at LHC for NP studies a la p227 in LH2015 proceedings.

O(10 GeV): Jet Pull

Eur. Phys. J. C 78 (2018) 847





O(10 GeV): Jet Pull

Eur. Phys. J. C 78 (2018) 847