Missing beauty of proton-proton interactions

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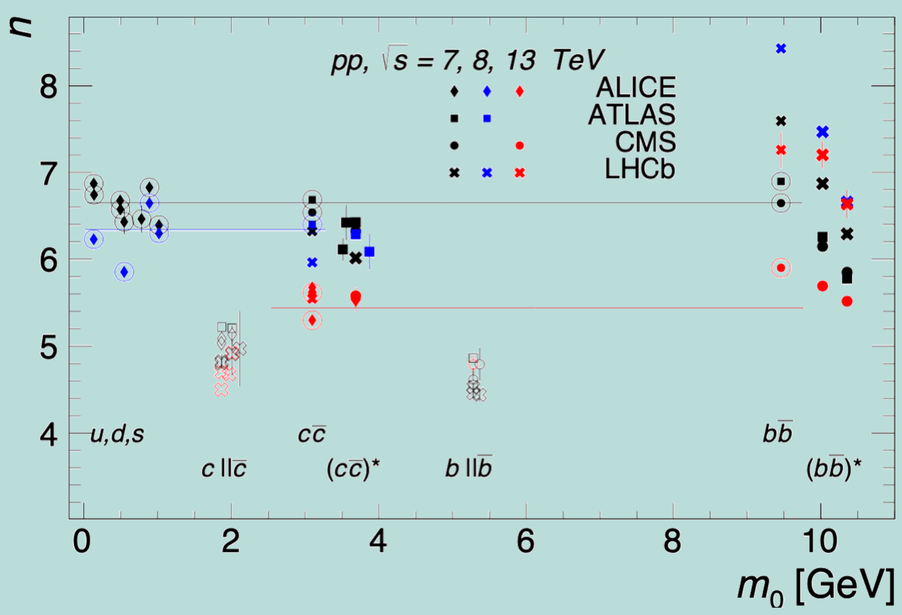
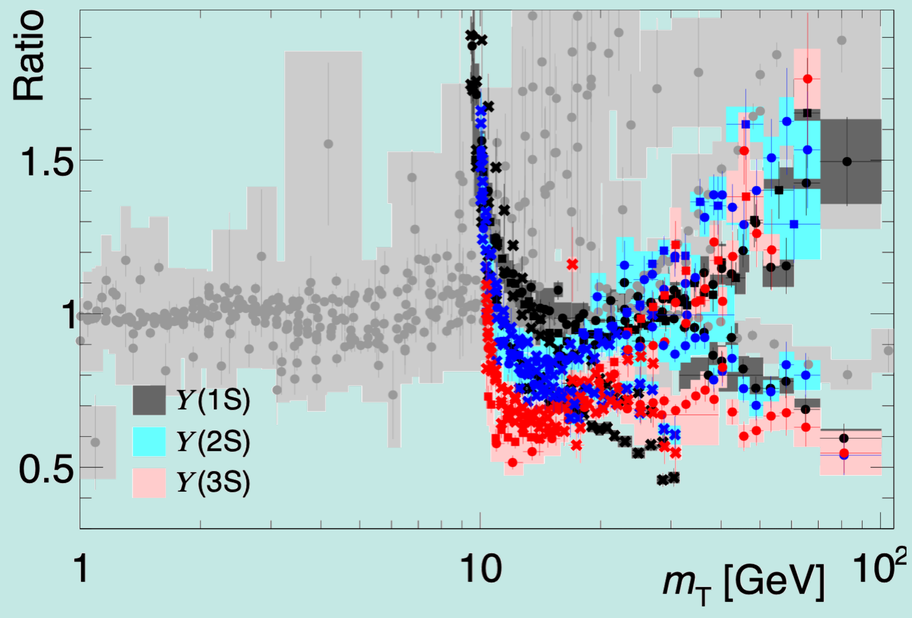
The $b\bar{b}$ states measured at the LHC have significantly different p_T distributions. This is surprising since, from the first principle, particles with the same quark content and close masses should have similar kinematic properties. The m_T-scaling assumption estimates deviations between the Y(nS) states due to shifts in their masses. The study reveals significant differences with the measured data, such that the cross-section of Y(2S) is 1.6 times fewer and Y(3S) is 2.4 times fewer than the mass shifts can explain it. This may have a direct connection to the correlations observed between the Y(nS) states production and the number of charged particles in the underlying event in pp collisions at the LHC.

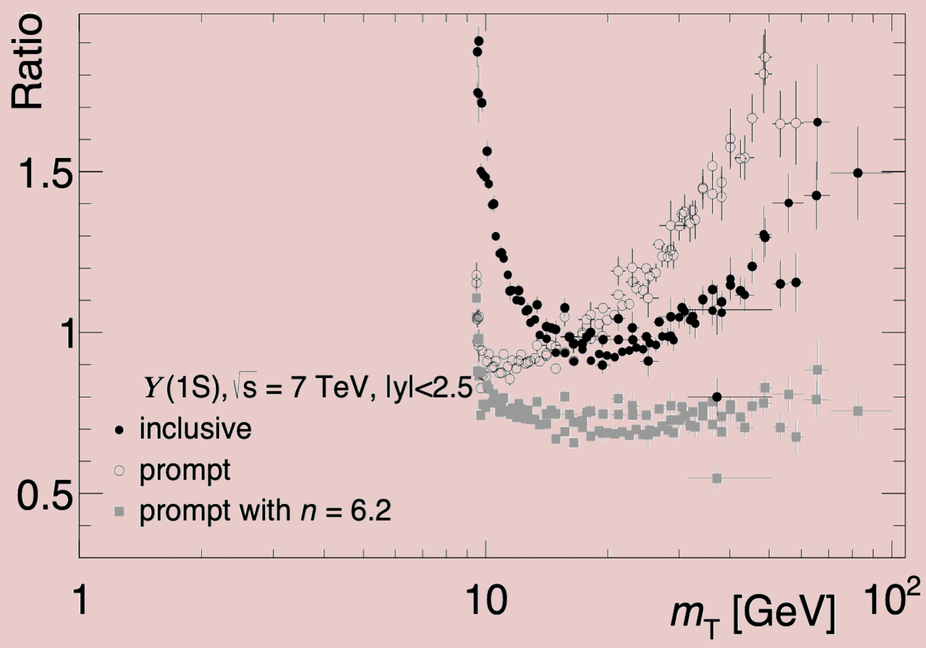


3 energies
18 mesons
4 experiments
72 data samples
1509 c.s. points
327 ratio points

$$\frac{\mathrm{d}\sigma}{\mathrm{d}m_{\mathrm{T}}} \propto \left(1+\frac{m_{\mathrm{T}}}{nT}\right)^{-n}$$

$n = 6.65, 6.34, 5.44$
$T = 254$ MeV



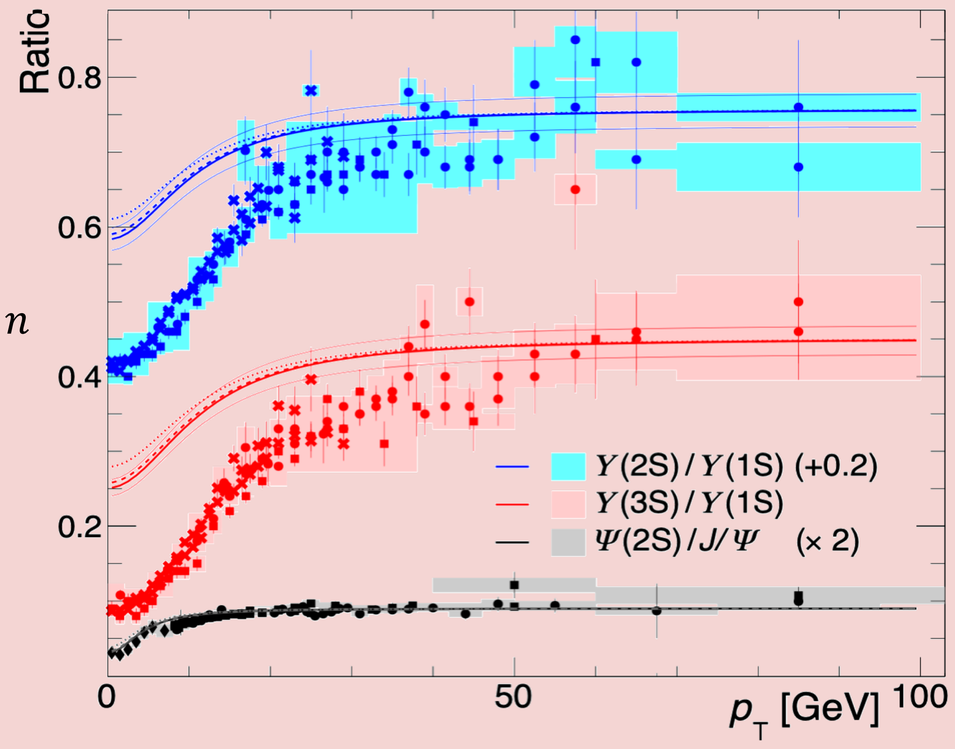


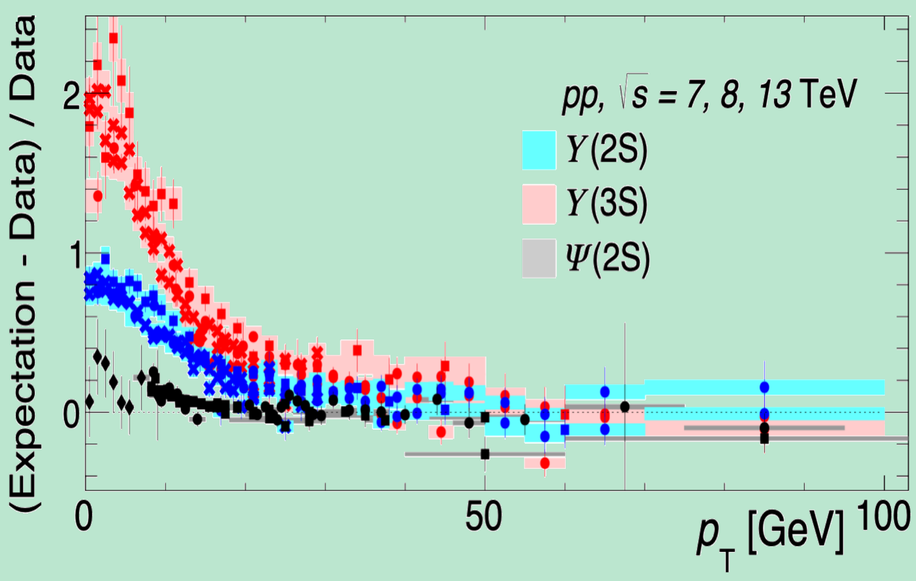
`Horns' are due to $\chi_b(mP) \to \Upsilon(nS)$

$$\frac{min}{max} = 1 - \frac{\Delta m}{nT + m} n$$

$\Delta m/m = 0.9/9.4$

~10% changes in n make no difference





Missing cross section
$\Upsilon(2S) \to \times 1.6$
$\Upsilon(3S) \to \times 2.4$

Can this be a coincidence?

Missing tracks in UE
$\Upsilon(2S) \to$ up to 12%
$\Upsilon(3S) \to$ up to 17%