New results on Φ-pair production in proton-proton collisions at $\sqrt{s}$=7TeV with the ALICE detector

Nicola Rubini on behalf of the ALICE Collaboration

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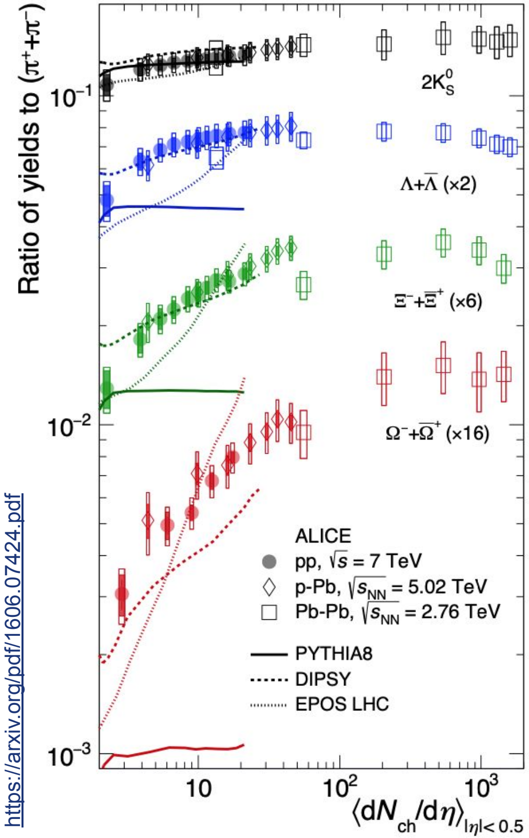
Physics motivation



https://arxiv.org/pdf/1606.07424.pdf

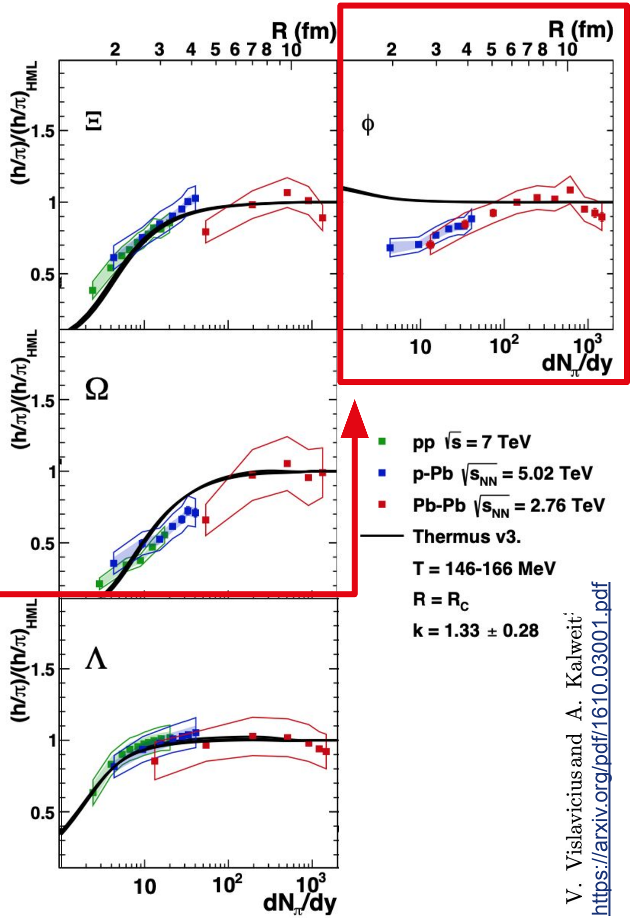
The ratio to pions increases with the multiplicity of an event, with a smooth transition between collision systems

Strangeness enhancement is an increase observed in the ratio of strange hadrons to pions in high multiplicity pp collisions and heavy-ion collisions with respect to minimum bias pp collisions.

In this context, the Φ meson proves to be a probe of choice: being a $s\bar{s}$ bound state it is only sensitive to strangeness production

A hint the Φ meson could help disentangle the nature of strangeness production and enhancement can be seen by the disagreement with the canonical model prediction, an otherwise successful model

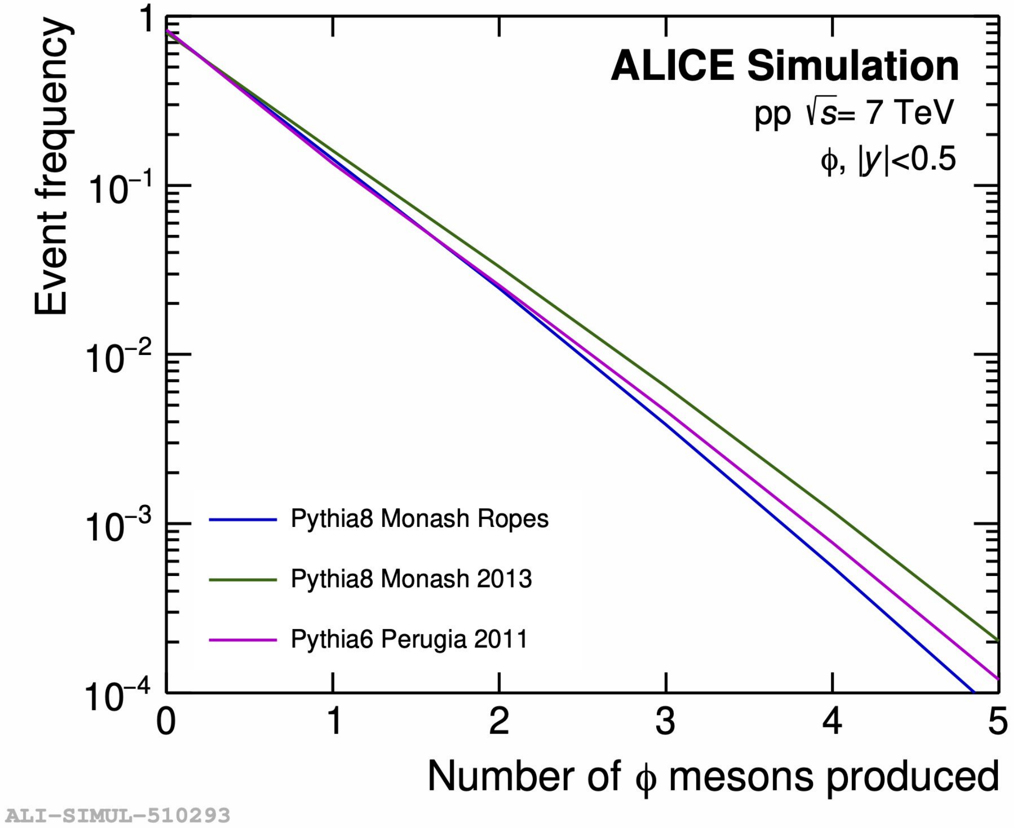
Probing its production statistics can then help better disentangle the inner workings of this phenomenon by discriminating microscopic production models



V. Vislavicius and A. Kalweit https://arxiv.org/pdf/1610.03001.pdf

Physics motivation

The measurement of the Φ-meson pair yield gives access to the variance of the n Φ-meson production probability



$\langle Y_\phi \rangle$ Inclusive ϕ meson production

$\langle Y_{\phi\phi} \rangle$ Inclusive ϕ-meson pairs production (NEW!)

$$\mu_\phi = \langle Y_\phi \rangle$$

Average yield of produced ϕ-meson

$$\sigma^2_\phi = 2\langle Y_{\phi\phi} \rangle + \langle Y_\phi \rangle - \langle Y_\phi \rangle^2$$

NEW!

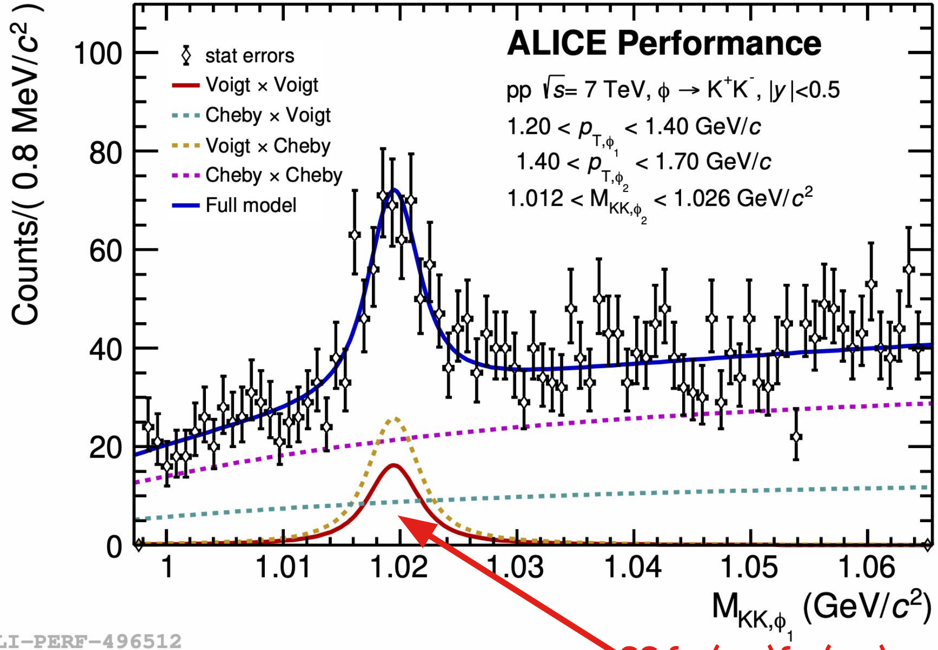
Variance of produced ϕ mesons

$$\gamma_\phi = \frac{\sigma^2_\phi}{\mu_\phi} - 1 = 2\frac{\langle Y_{\phi\phi} \rangle}{\langle Y_\phi \rangle} - \langle Y_\phi \rangle$$

NEW!

New way to characterise production

Analysis technique



We fit the histogram with a 4-components function, derived from the 1D analysis:

$f_{1D}(m_1) = S_1 f_{sig}(m_1) + B_1 f_{bkg}(m_1)$

$f_{2D}(m_1,m_2) = f_{1D}(m_1) \times f_{1D}(m_2)$

SS $f_{sig}(m_1)f_{sig}(m_2)$ +

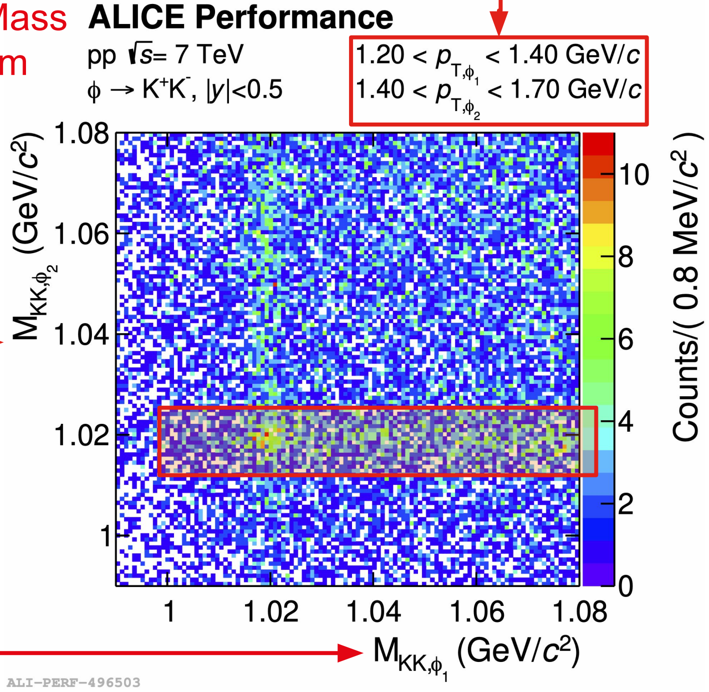
BS $f_{bkg}(m_1)f_{sig}(m_2)$ +

SB $f_{sig}(m_1)f_{bkg}(m_2)$ +

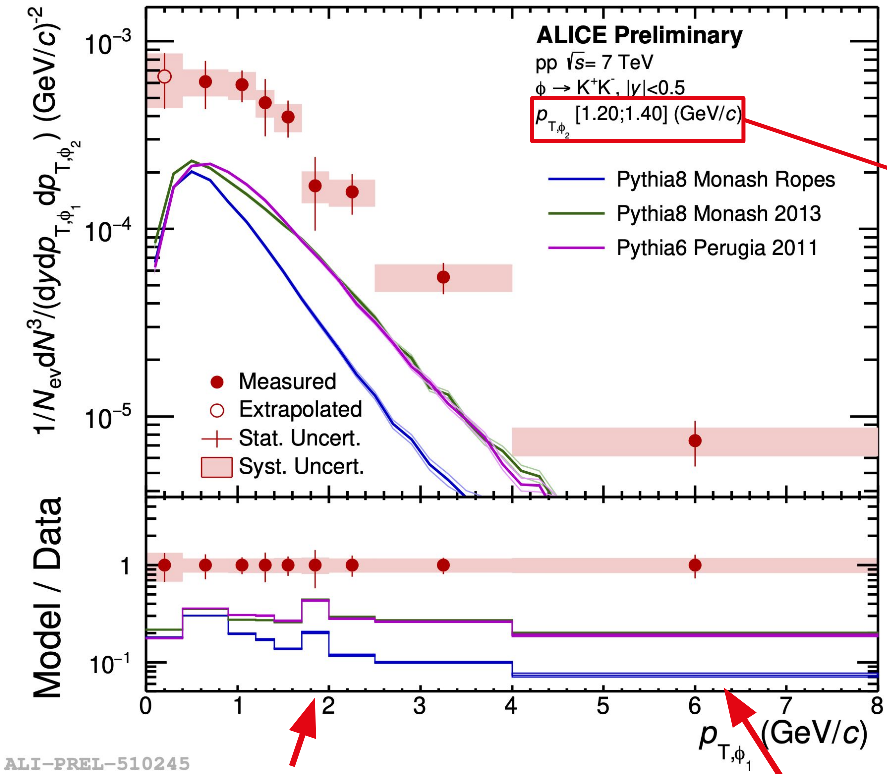
BB $f_{bkg}(m_1)f_{bkg}(m_2)$

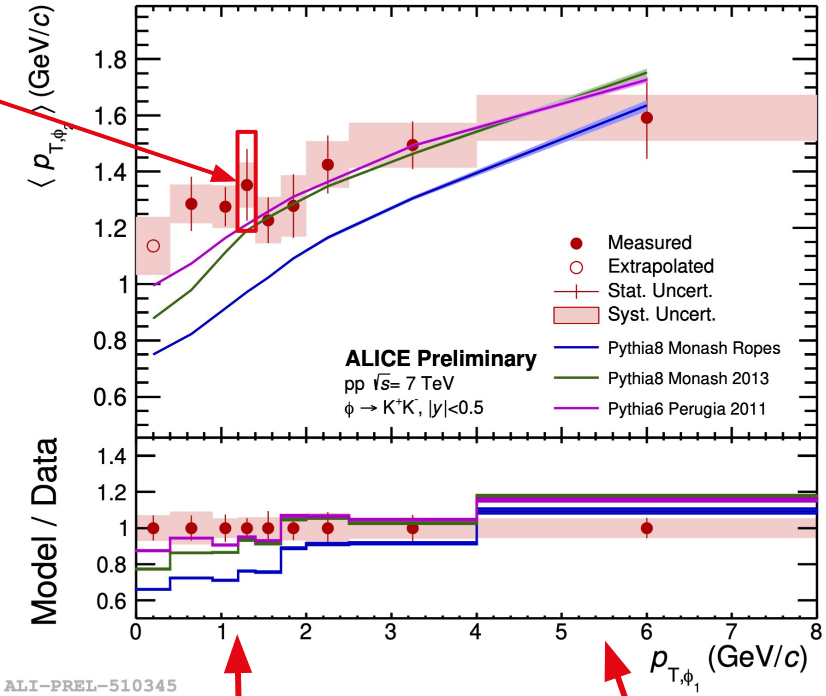
Two Φ-meson candidates are paired in a 2D Invariant Mass histogram

The analysis is p_T differential with spectra of Φ-meson pairs



Results





Conditional spectra describe how a Φ meson (Φ_1) behaves when produced together with a second Φ meson (Φ_2) of a given p_T

Different Pythia tunes tend to underestimate the conditional Φ-meson production yield

Rope tune of Pythia has a softer spectrum

Mean p_T for conditional spectra indicates Pythia models generally reproduce spectra shape

Summary

1. **Y**ields are themselves underestimated by all Pythia models, nevertheless the enhancement w.r.t. Poissonian distribution is comparable and compatible with measurements, hinting the underlying mechanism might be correct
2. **D**ifferent Pythia tunes yield different results, making the measurement a tool for model discrimination

Prospects

1. **S**tatistical uncertainty still is a limiting factor, more datasets will be included
2. **M**easurements in p-Pb collisions will give room for a higher multiplicity reach in small systems
3. **R**un 3 high statics pp data will further improve the precision of the measurement