Characterizing pp and p-Pb collisions using very forward energy and underlying event activity with ALICE

Detectors used in the analysis:
- Inner Tracking System (ITS)
- Time Projection Chamber (TPC)
- VZERO scintillator hodoscopes
- Zero Degree Calorimeters (ZDC)

Based on paper
ALICE Collaboration, arXiv 2107.10757
The energy carried by neutrons emitted from the Pb nucleus (slow neutrons) measured in neutron ZDC:

- linearly increases with centrality at different $\sqrt{s}$
- scales with number of collisions, $N_{\text{coll}}$

The energy coming from the p fragmentation measured in neutron ZDC:

- decreases with the centrality of the collisions
- scales with $1/N_{\text{coll}}$ up to very peripheral events

C. Oppedisano, Very forward energy and underlying event activity, QM2022
Very forward energy in p-p collisions: asymmetry

Forward and backward energies carried by neutrons in neutron ZDC are correlated at high energies

Forward and backward energies carried by protons in proton ZDC do not show correlation, as observed at lower energies [1]

Very forward energy vs. midrapidity multiplicity in pp collisions

ALICE Simulation
pp $\sqrt{s} = 13$ TeV

ALICE $\sqrt{s} = 13$ TeV

Forward energy decreases with increasing particle multiplicity at midrapidity

PYTHIA6 Perugia2011, PYTHIA8 Monash and EPOS-LHC predictions describe the overall pattern, but are not able to quantitatively reproduce experimental results in multiplicity bins.

inverse dependence of very forward energy as a function of the number of MPIs in PYTHIA models
Very forward energy vs. leading $p_T$ particle in pp collisions

For leading $p_T > 5$ GeV/c at midrapidity very forward energies normalised to MB value saturate

Very forward energy (separation in rapidity) shows a complementary behaviour to that observed for transverse charged particle multiplicity

UE measurements (separation in azimuthal angle) large transverse multiplicity selects central pp collisions with a large number of MPIs