Contribution ID: **513** Type: **Oral**

# Measurement of two- and multi-particle azimuthal correlations in small collision systems with the ATLAS detector

*Tuesday, 7 February 2017 11:20 (20 minutes)*

ATLAS measurements of two-particle correlations in $\Delta\phi$ and $\Delta\eta$ and multi-particle azimuthal correlations using four, six and eight-particle cumulants are presented for $pp$, $p$+Pb and low multiplicity Pb+Pb collisions.

For the two-particle correlations, a template fitting procedure is used to subtract the dijet contribution and to extract the genuine
long-range ridge correlations. In all collision systems, the ridge correlations are shown to be present even in events with a low
multiplicity of produced particles, implying that the long-range correlations are not unique to rare high-multiplicity events. The
properties of the correlation are shown to exhibit only a weak energy dependence and are remarkably similar to that observed in $p$+Pb collisions. Another new aspect of this talk is a detailed study of ridge properties in collisions containing hard processes,
characterized by large four-momentum transfer. This may help answering the question whether the ridge arises from hard or semi-hard processes, or if it is the result of mechanisms unrelated to the initial hardness scale.

In order to assess the collective nature of multi-particle production, the correlation measurements are extended to include azimuthal
correlations measured using multiparticle cumulants. The presented measurements of multi-particle cumulants $c_2\{2\text{–}8\}$ confirm the evidence for collective phenomena in $p$+Pb and low-multiplicity Pb+Pb collisions. However, for $pp$ collisions, the measurements of cumulants do not yet provide clear evidence for collectivity as they are susceptible to event-by-event multiplicity fluctuations. In order to address this, results from a new modified cumulant method which suppress both the contribution of multiplicity fluctuation and non-flow effects are presented.

## Preferred Track

QCD in small systems

## Collaboration

ATLAS

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**Session Classification:** Parallel Session 2.2: QCD in Small Systems (II)

**Track Classification:** QCD in small systems