Measurement of low-mass dielectrons in inelastic and high-multiplicity pp collisions at $\sqrt{s} = 13$ TeV with ALICE

Ivan Vorobyev* for the ALICE Collaboration

Motivation

Low-mass dielectrons - penetrating probe to study the system created in high-energy heavy-ion collisions
- Produced during all stages of collision
- Unaffected by strong interactions
- Why proton–proton collisions?
- Medium-free reference
- Heavy-flavour production cross sections

Rejection of photon conversions:

Low-mass dielectrons in high-energy heavy-ion collisions

Penetrating Low-mass dielectrons

New (or heavy ion like) phenomena in high-multiplicity pp events? [1]

- Production / destruction of p meson
- Thermal radiation in small system
- Understanding of Multiple Parton Interactions
- $dK_d$: produce a ratio of dielectron spectra in high-multiplicity (HM) over inelastic (INEL) events

Pair Analysis

- Signal calculation: $S = N_{++} - B$
- Combinatorial background from geometric mean of like-sign pairs from same event: $B = R \times 2 \sqrt{N_{++} \times N_{--}}$
- Relative acceptance correction factor from mixed events:
  \[ R = \frac{N_{++}^{\text{MIX}}}{2 \sqrt{N_{++}^{\text{MIX}} \times N_{--}^{\text{MIX}}} \times 2 \sqrt{N_{++} \times N_{--}}} \]

Rejection of photon conversions:
- Pair orientation relative to the magnetic field
- No ITS clusters shared with other tracks

Central barrel detectors (2π coverage, $|\eta| < 0.8$

Inner Tracking System
- Collision vertex reconstruction
- Tracking
- Time Projection Chamber
- Tracking
- Particle Identification
- Time Of Flight
- Particle Identification
- V0 scintillators

Experimental Setup

- V0A: 2.8 < $\eta$ < 5.1, V0C: -3.7 < $\eta$ < -1.7
- Min.-bias trigger: coincidence of V0A & V0C signals
- HM trigger: coincidence of V0A & V0C signals, threshold on V0M amplitude (0.036% of INEL events

Cocktail of hadronic sources

- Light-flavour (LF) cocktail calculations based on ALICE measurements
  - $h\eta$ at 13 TeV, $h\eta$ at 7 TeV
  - PYTHIA 8 (Monash 2013) for $p/\pi$ and $\omega/\pi$ ratios (good description of data [5,6])
  - $\eta$ scaling for other hadrons ($\eta$ and $\phi$)
- Heavy-flavour (HF) contribution from PYTHIA 6 (Perugia 2011) simulation of open charm and beauty production
- Input for high-multiplicity cocktail calculations:
  - LF: modification of $p_t$ spectrum of charged particles in events with higher multiplicities [7]
  - HF: multiplicity dependent production of D meson [8] and inclusive J/$\psi$ [9] in pp at $\sqrt{s} = 7$ TeV
- Same enhancement for beauty is assumed as for open charm [8, 10]

Results

Good description of dielectron production in inelastic pp collisions with cocktail expectations

Ratio of dielectron spectra in HM over INEL events scaled with $dN_{ee}/d\eta$(HM) / $dN_{ee}/d\eta$(INEL): $= 6.27 \pm 0.22$

- Good agreement with cocktail expectations over whole measured $m_{ee}$ and $p_{T,ee}$ range—see no modifications beyond established ones [6 - 8]

- Light-flavour sources (in particular $\eta$ and $\eta'$): same multiplicity dependence as a function of $m_{ee}$

- Agreement at high $p_{T,ee}$ confirms assumption that beauty scales with multiplicity similarly to open charm

Further results: heavy-flavour production cross sections [A. Dashi, poster ID 879] and direct photons [O. Vazquez, poster ID 880]

References

[4] ALICE Collaboration, Measurement of $p$ and $\eta$ meson production in pp collisions at $\sqrt{s} = 0.9$ TeV and $\sqrt{s} = 7$ TeV”, PLB 717 (2012) 162
[10] F. Fionda, poster at this conference (poster ID 291)