Measurements of low-mass dielectrons in pp collisions at $\sqrt{s} = 13$ TeV with ALICE *

I. Vorobyev[†1,2], *A. Chauvin*[1,2], *T. Dahms*[1,2], *A. Dashi*[1,2], *and O. Vazquez Doce*[1,2]

[1]Excellence Cluster Universe, Technische Universität München, Garching, Germany; [2]Physik Department, Technische Universität München, Garching, Germany

The hot and dense system created in ultra-relativistic heavy ion collisions is believed to be a deconfined state of quarks and gluons. Electromagnetic probes such as electron-positron pairs are a unique tool to investigate the whole space-time evolution of such a system. In proton-proton collisions, measurements of dielectron production serve as important vacuum reference to quantify modifications observed in heavy ion collisions. Measurements of low-mass dielectrons could also shed light on the underlying physics processes in those proton-proton collisions with high charged-particle multiplicities.

The current analysis focuses on a comparison of raw dielectron mass spectra in minimum bias events and in events collected with a trigger on high charged-particle multiplicities. To this purpose, the ratio of properly normalised dielectron spectra in high multiplicity (HM) and minimum bias (MB) events is calculated:

$$\frac{\langle N_{\mathrm{ch}}(\mathrm{MB})\rangle}{\langle N_{\mathrm{ch}}(\mathrm{HM})\rangle} \times \frac{1/N_{\mathrm{HM}}\, \mathrm{d}N_{\mathrm{ee}}/\mathrm{d}m_{\mathrm{ee}}|_{\mathrm{HM}}}{1/N_{\mathrm{MB}}\, \mathrm{d}N_{\mathrm{ee}}/\mathrm{d}m_{\mathrm{ee}}|_{\mathrm{MB}}}, \qquad (1)$$

where $\langle N_{\mathrm{ch}}\rangle$ is the average charged particle multiplicity and N_{HM} (N_{MB}) is the number of recorded high-multiplicity (minimum bias) events.

The dielectron analysis is performed in the central barrel spectrometer of ALICE [1]. Event selection for both multiplicity classes is based on the information from the V0 detectors. Charged particle tracks are reconstructed with the help of the central barrel tracking detectors ($|\eta| < 0.8$) : the Inner Tracking System and the Time Projection Chamber (TPC). Specific energy loss in the TPC and time-of-flight information from the TOF detector are used for electron identification.

Electron and positron candidates from the same event are combined to pairs forming the unlike-sign spectrum. The combinatorial background is estimated via the geometric mean of like-sign pairs within the same event. Conversions of real photons in the detector material (e.g. beam pipe and support structures) are removed from the raw signal by their orientation relative to the magnetic filed.

A cocktail of several dielectron sources is used to estimate the expected ratio (1) as a function of the invariant mass. For the light flavour part, the different hadronic sources of dielectrons via Dalitz or two-body decays are taken into account using a fast Monte-Carlo simulation. Simulations of high-multiplicity events are based on measurements of ratios of charged-particle p_{T} distributions as a function of multiplicity [2].

The contribution of correlated semileptonic decays of open charm and bottom mesons is estimated with PYTHIA simulation. For the multiplicity dependence, the results on D-meson production as a function of multiplicity [3] bracket the expectation for the ratio (1) between 1 and 2.5.

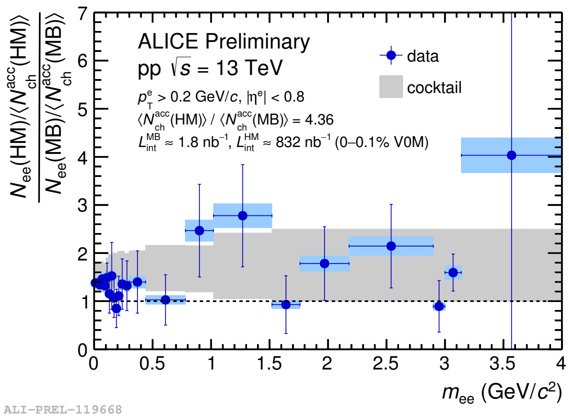

Figure 1: Ratio of dielectron spectra scaled with charged particle multiplicity.

In Fig. 1 the results for the ratio of the dielectron spectra in high multiplicity over minimum bias events scaled by multiplicity factor $\langle N_{\mathrm{ch}}\rangle|_{\mathrm{HM}}/\langle N_{\mathrm{ch}}\rangle|_{\mathrm{MB}}$ = 4.36 are shown. The data are in agreement with the expected deviation from a perfect multiplicity scaling over almost the full investigated mass range of 0–4 GeV/c^2. Beyond $\approx$0.2 GeV/c^2 the data are also consistent with unity, i.e. multiplicity scaling. Higher precision data are necessary to investigate possible modifications of dielectron spectrum in more details. For this purpose, approximately 5 times more proton-proton data from 2016 will be analysed, and the reduction of systematic uncertainties as well as improvements in cocktail calculations are expected.

References

[1] ALICE Collaboration, JINST **3** (2008) 08002.

[2] ALICE Collaboration, Phys. Lett. B **753**, 319 (2016)

[3] ALICE Collaboration, JHEP **09**, 148 (2015)

* Work supported by the DFG cluster of excellence ”Origin and Structure of the Universe”.

† ivan.vorobyev@tum.de