

# FWF project: "Dielectron production in nuclear collisions"

(Elisa Meninno, Daniel Samitz)

goal: measure temperature of thermal radiation in Pb-Pb collisions from invariant mass spectrum of dielectrons

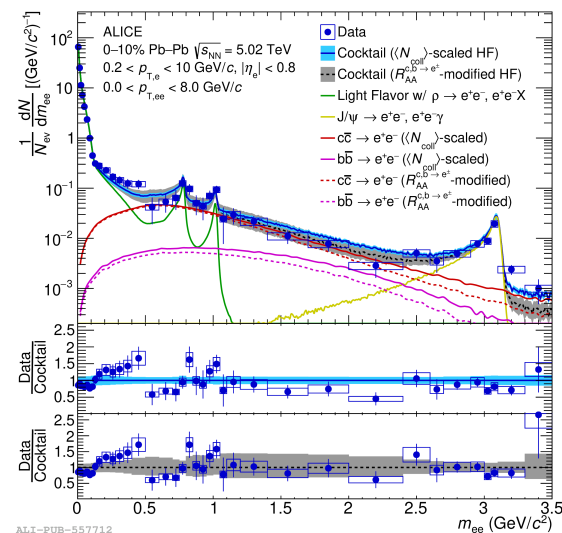
specific approach: use ML techniques for background subtraction and electron identification

so far: already promising tests on Run3 Pb-Pb data (poster@ICHEP2024)

current work: implement code to run ML models in PWG-EM workflows (PWG-EM code still evolving a lot, only recently gave up using PWG-DQ code and switched to our own new framework)

Lc production in pp (currently not working on that)

Hadronization models for Herwig (currently not working on that)



**Machine learning approach for studying dielectrons in LHC Run 3 data with ALICE**  
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**Electromagnetic probes**

- Photons and light nuclei experience no strong interactions
- Photons of light flavor ( $LF$ ) mesons ( $\pi, \eta, \omega, \rho, \dots$ )
- Electromagnetic decays of correlated heavy flavor ( $HF$ ) hadrons
- Thermal radiation  $e^+e^-$  ( $m_{ee} < m_{\rho} < m_{\omega}$ )
- Allows to measure temperature of QGP

**Electron identification with boosted decision trees**

- Goal to achieve high purity of electron sample while maintaining good efficiency
- Fast approach to particle identification (PID)
- Use energy loss in Time Projection Chamber (TPC) and Time-of-flight measurements (TOF) to distinguish electrons from other hadron species
- Use information from TPC, TOF and other detectors (ITS, muon spectrometer and high-level variables)
- PID using BDTs can significantly reduce background while preserving signal efficiency

**Separation of prompt vs. non-prompt dielectrons**

- Electrons from radiative decays of correlated  $BF$  hadrons are main background to thermal radiation from QGP in the dielectron mass range  $1.1 \text{ GeV}/c^2 < m_{ee} < 2.7 \text{ GeV}/c^2$
- Run 1.2.2 it was shown that distance of closest approach (DCA) to vertex in transverse plane can be used to discriminate prompt electrons from pairs originating from  $BF$  hadron decays [2]
- $DCA_{xy} = \sqrt{(DCA_x)^2 + (DCA_y)^2}$
- Dielectrons from  $BF$  hadron decays have larger DCA
- Transverse size:  $r_{\perp} \sim 150 - 300 \mu\text{m}$
- Transverse size:  $r_{\perp} \sim 400 \mu\text{m}$
- Significant TPC to track with comparable resolution in a cylinder allows use of 3-dimensional DCA

**Summary & outlook**

- Measurement of low mass dielectrons allows to measure temperature of QGP in thermal radiation
- Large background from  $BF$  decays makes good signal from radiational separation mandatory
- ML improvement with BDTs over DCA based approach seems possible
- Transverse plane cut to further reduce background
- Significant ALICE detector & Run 3 before writing published
- ML techniques allow promising improvements in dielectron prompt and non-prompt separation
- ML techniques allow promising improvements in dielectron identification and non-prompt background rejection

ALICE logo and logos of OAW, FWF, and SMU are present at the bottom.

## PWG-EM: PAG LMee

- Responsible for code for cocktail simulation:
  - LF cocktail: costume generator for LF mesons (ported from AliRoot/AliPhysics)
  - HF cocktail: Pythia 8 + forced decays
  - plus cocktail analysis tasks
- PAG coordinator since March 2024
- Next LMee workshop in Vienna: 27 Nov – 29 Nov @ ÖAW Campus Bäckerstraße