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Performance and upgrade plans of the ALICE Photon Spectrometer

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PHOS is a highly granulated precision spectrometer, one of the two electromagnetic calorimeters of ALICE (A Large Ion Collider Experiment) at the LHC. It is based on scintillating PbWO₄ crystals and is dedicated to the precise measurements of spectra, collective flow and correlations of thermal and prompt direct photons, and of neutral mesons in ultra-relativistic nuclear collisions at LHC energies. PHOS participated in LHC Run 1 (2009-2013) and Run 2 (2015-2018), during which a large amount of physical data were collected in pp, p-Pb and Pb-Pb collisions.

The choice of active material with small Molière radius allows PHOS to operate in a high-multiplicity environment and to reconstruct neutral pions by two-photon decays up to very high transverse momenta ~ 60 GeV/c. In order to increase the light yield of the crystals and reduce electronic noise, PHOS is cooled down and kept at a constant temperature of -25°C . This resulted in excellent energy and position resolutions. Dedicated L0 and L1 triggers were used to increase collected integrated luminosity during data taking.

We will present an overview of the PHOS performance during Runs 1 and 2 and plans for an upgrade for LHC Run 4 (currently expected for 2025-2027) and beyond. PHOS upgrade is ongoing and covers the following three aspects: front-end cards (FEC) using modern components to improve timing resolution and operation reliability; photodetectors to increase sensitivity to low-energy photons and to improve timing resolution; mechanical structure of modules to ease access to FEC and improve operation reliability. The physics program of the upgraded PHOS will also be discussed.

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