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Latest results from the searches for ultra-high-energy photons at the Pierre Auger Observatory

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The Pierre Auger Observatory is the most sensitive detector to primary photons with energies above 0.2 EeV providing unprecedented exposure to ultra-high-energy (UHE) cosmic rays and specifically to UHE photons. The Pierre Auger Observatory measures extensive air showers using a hybrid technique that combines a fluorescence detector (FD) with a ground array of particle detectors (SD). The signatures of a photon-induced air shower are a larger atmospheric depth of the shower maximum (X_{max}) and a steeper lateral distribution function, along with a lower number of muons with respect to the bulk of hadron-induced background. Using observables measured by the FD and SD, various photon searches in different energy bands are performed. These efforts have produced some of the most stringent upper limits on the diffuse fluxes of UHE photons. These limits place significant constraints on current models for the origin of UHE cosmic rays, highlighting the leading role of the Observatory in multimessenger astronomy at the highest energies.

In this contribution, an overview of current activities related to the search for UHE photons is shown, using more than 15 years of data from the Pierre Auger Observatory. The latest results of the searches for diffuse fluxes of photons will be presented, as well as follow-up searches for UHE photons in association with transient events, such as gravitational wave events, will be summarized. Future perspectives, in light of the ongoing AugerPrime detector upgrade, will also be discussed, which aim to further enhance the Observatory's sensitivity to photons at the highest energies.

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