The Pierre Auger Observatory

- 1660 water Cherenkov detector stations, spread out over 3000 km² (Surface Detector, SD)
- 27 fluorescence telescopes (Fluorescence Detector, FD)
- Taking data since 2004, currently undergoing a major detector upgrade (AugerPrime)
  - Plastic scintillators on top of each SD station
  - Radio upgrade
  - Main goal: enhance composition sensitivity

\[ E_{\text{cal}} = \int \frac{dE}{dX} \, dX \]

\[ \sigma_{X_{\text{max}}} \leq 20 \, \text{g/cm}^2 \]
\[ \Delta_{\text{sys}} \leq 10 \, \text{g/cm}^2 \]

\[ E_{\text{surface}} = f(S_{1000}, \theta) \]

M. Niechciol (University of Siegen) for the Pierre Auger Collaboration, 6 October 2020
Ultra-high-energy (UHE) photons at Auger: (some) scientific goals

- Pose constraints on the origin of UHE cosmic rays and the properties of their sources in conventional bottom-up models: expected flux of cosmogenic (GZK) photons depends on e.g. primary composition and source properties.

- Constrain exotic top-down models for the origin of UHECRs: Super-heavy dark matter (SHDM) provides a link between cosmology and astroparticle physics, relating the expected flux of UHE photons to the lifetime-and-mass parameter space of SHDM particles.

- Test new-physics scenarios, e.g. Lorentz invariance violation.

![Diagram showing constraints on the mass and lifetime of SHDM particles](image_url)

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M. Niechciol (University of Siegen) for the Pierre Auger Collaboration, 6 October 2020

Auger Letters of Interest related to UHE photons:
SNOWMASS21-CF7_CF3-NF4_NF0_Jaime_Alvarez-Muniz-140
SNOWMASS21-CF1_CF7-203