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Macroscopic Geo-Magnetic Radiation Model; Polarization effects and finite volume calculations

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An ultra-high-energy cosmic ray (UHECR) colliding with the Earth's atmosphere gives rise to an Extensive Air Shower (EAS). Due to different charge separation mechanisms within the thin shower front coherent electromagnetic radiation will be emitted within the radio frequency range. A small deviation of the index of refraction from unity will give rise to Cherenkov radiation up to distances of 100 meters from the shower core and therefore has to be included in a complete description of the radio emission from an EAS. Interference between the different radiation mechanisms, in combination with different polarization behavior will reflect in a lateral distribution function (LDF) depending on the orientation of the observer and a non-trivial fall-off of the radio signal as function of distance to the shower core.

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