

# Circular polarization of radio emission from air showers in thundercloud conditions.

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When a high-energy cosmic-ray particle enters the upper layer of the atmosphere, it generates many secondary high-energy particles and forms a cosmic-ray-induced air shower. In the leading plasma of this shower electric currents are induced that emit electromagnetic radiation. These radio waves can be detected with LOw-Frequency ARray (LOFAR) radio telescope. Events have been collected under fair-weather conditions as well as under atmospheric conditions where thunderstorms occur.

For the events under the fair weather conditions the emission process is well understood by present models. For the events measured under the thunderstorm conditions, we observe large differences in intensity, linear polarization and circular polarization from the fair-weather events. This can be explained by the effects of atmospheric electric fields in thunderclouds. Therefore, measuring the intensity and polarization of radio emission from cosmic ray extensive air showers during the thunderstorm conditions provides a new tool to probe the atmospheric electric fields present in thunderclouds.

## Summary

**Author:** TRINH, Gia (KVI - CART, University of Groningen)

**Co-authors:** Dr NELLES, Anna (University of California Irvine); BONARDI, Antonio (IMAPP - Radboud University Nijmegen); CORSTANJE, Arthur (Radboud University Nijmegen); RUTJES, C. (CWI, University of Amsterdam); FALCKE, H. (Radboud University Nijmegen); ENRIQUEZ, J. E. (Radboud University Nijmegen); HÖRANDEL, Jörg (Ru Nijmegen/Nikhef); RACHEN, Jörg Paul (IMAPP / Radboud University Nijmegen); MULREY, Katie (Vrije Universiteit Brussel); Dr ROSSETTO, Laura; SCHOLTEN, Olaf (KVI-CART, Univ. of Groningen); MITRA, P. (Vrije Universiteit Brussel); SCHELLART, Pim (R); TER VEEN, Sander (ASTRON); THOUDAM, Satyendra (Radboud University); BUITINK, Stijn (Vrije Universiteit Brussel (VUB)); Dr WINCHEN, Tobias (Vrije Universiteit Brussel); EBERT, Ute (CWI, Univeristy of Amsterdam)

**Presenter:** TRINH, Gia (KVI - CART, University of Groningen)

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