ICRC

The Astroparticle Physics Conference

34th International Cosmic Ray Conference
July 30 - August 6, 2015
The Hague, The Netherlands

Contribution ID: **549**   Type: **Oral contribution**

Multi-scale and multi-frequency studies of cosmic ray air shower radio signals at the CODALEMA site

Monday, August 3, 2015 11:00 AM (15 minutes)

Since 2003, the Nançay Radio Observatory hosts the CODALEMA experiment, dedicated to the radio detection of cosmic ray induced extensive air showers. After several instrumental upgrades, CODALEMA is now composed of:
- 57 self-triggering radio detection stations working in the 20-250 MHz band, spread over 1 km^2;
- an array of 13 scintillators acting as a particle detector;
- a compact array of 10 cabled antennas, triggered by the particle detector, to test the capabilities of a phased antenna cluster to cleverly select air shower events.
In addition, CODALEMA supports the EXTASIS project, aiming at detecting the low-frequency signal produced by the sudden deceleration of the air shower particles hitting the ground. Beside these dedicated arrays, the Nançay site will host the NenuFAR radio telescope (recognized as a SKA pathfinder), made of 1824 dual crossed-polarization antennas similar to the CODALEMA ones. All these arrays present different antenna density and extent, and could be operated in a joint mode to record simultaneously the radio signal coming from an air shower. Therefore, the upgraded CODALEMA facilities could offer a complete description of the air shower induced electric field at small, medium and large scale, and over an unique and very wide frequency band (from ˜2 to ˜250 MHz). The use of multi-band detectors combined with composite trigger algorithms could help boosting the radio detection technique as a candidate for a further very large cosmic ray observatory, or in the frame of a large radio telescope such as SKA. We describe the current instrumental set-up and the last results obtained, together with the prospective developments of the radio detection technique.

Collaboration

– not specified –

Registration number following "ICRC2015-I/"

494

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Session Classification: Parallel CR12 Radio

Track Classification: CR-EX