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Cosmic-Ray Neutron Detectors for Soil Moisture Monitoring

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Primary cosmic rays are high-energy particles that enter the Earth's atmosphere via the heliosphere, which generate cascades of secondary cosmic-ray particles when interacting with atmospheric atoms. These secondary cosmic-rays interact inversely with hydrogen atoms in soil moisture, providing a non-invasive method for monitoring moisture levels. Continuous measurements of neutron flux in soil can establish predictive models for heatwaves, droughts, and floods that significantly impact South Africa's agricultural sector. This study employs a cosmic-ray neutron sensor (CRNS) probe equipped with a Boron trifluoride (BF₃) detector positioned 1-2 m above ground that is capable of measuring soil moisture across a footprint of approximately 20 hectares width and up to 0.3 m depth. We detail the calibration process relating measured neutron intensity to volumetric water content, validated against gravimetric soil sampling and point sensor data, which will assist in precision agriculture that can enhance water resource management in diverse agricultural landscapes across South Africa.

Presenter: DUMONT, Aimee**Session Classification:** Astrophysics & Space Science