Low Cost Neutron and Muon Detectors for Soil Moisture Monitoring

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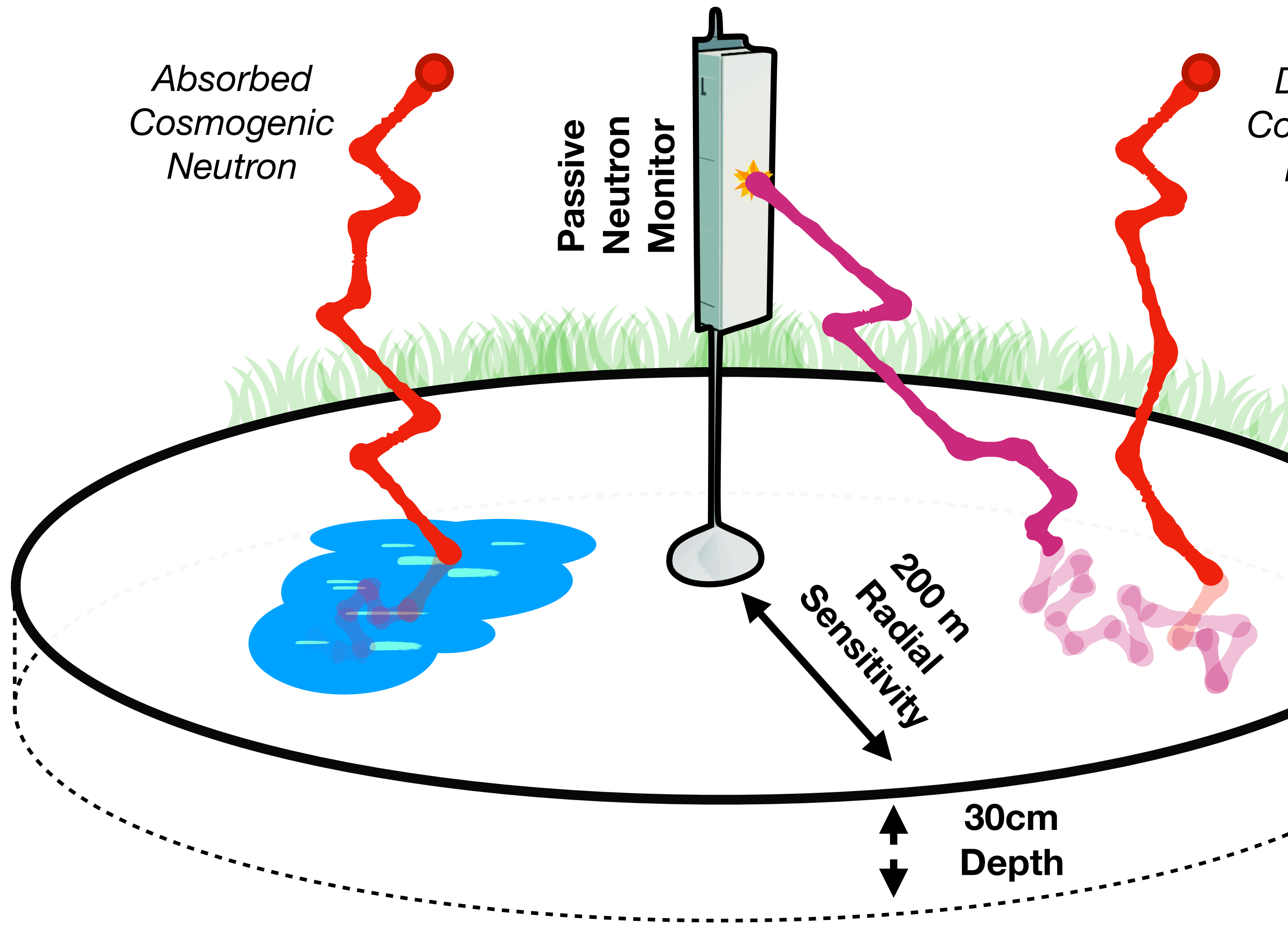Geoptic Infrastructure Investigations Ltd[c]

Cosmic Ray Neutron Sensing

Absorbed Cosmogenic Neutron

Passive Neutron Monitor

Detected Cosmogenic Neutron

200 m Radial Sensitivity

30cm Depth

$$VWC = \left(\frac{0.0869}{f_p f_c \frac{N}{N_0} - 0.1236} - 0.1236 \right)$$

N - Measured Neutron Counting Rate
(hourly integrations)

N_0 - Dry Counting Rate
(Max detector rate estimated from field calibration)

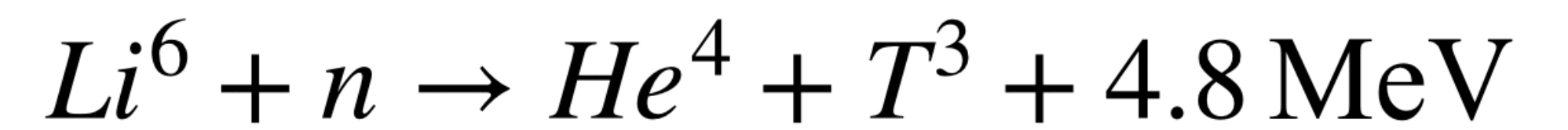**f_p - Local environmental conditions correction**
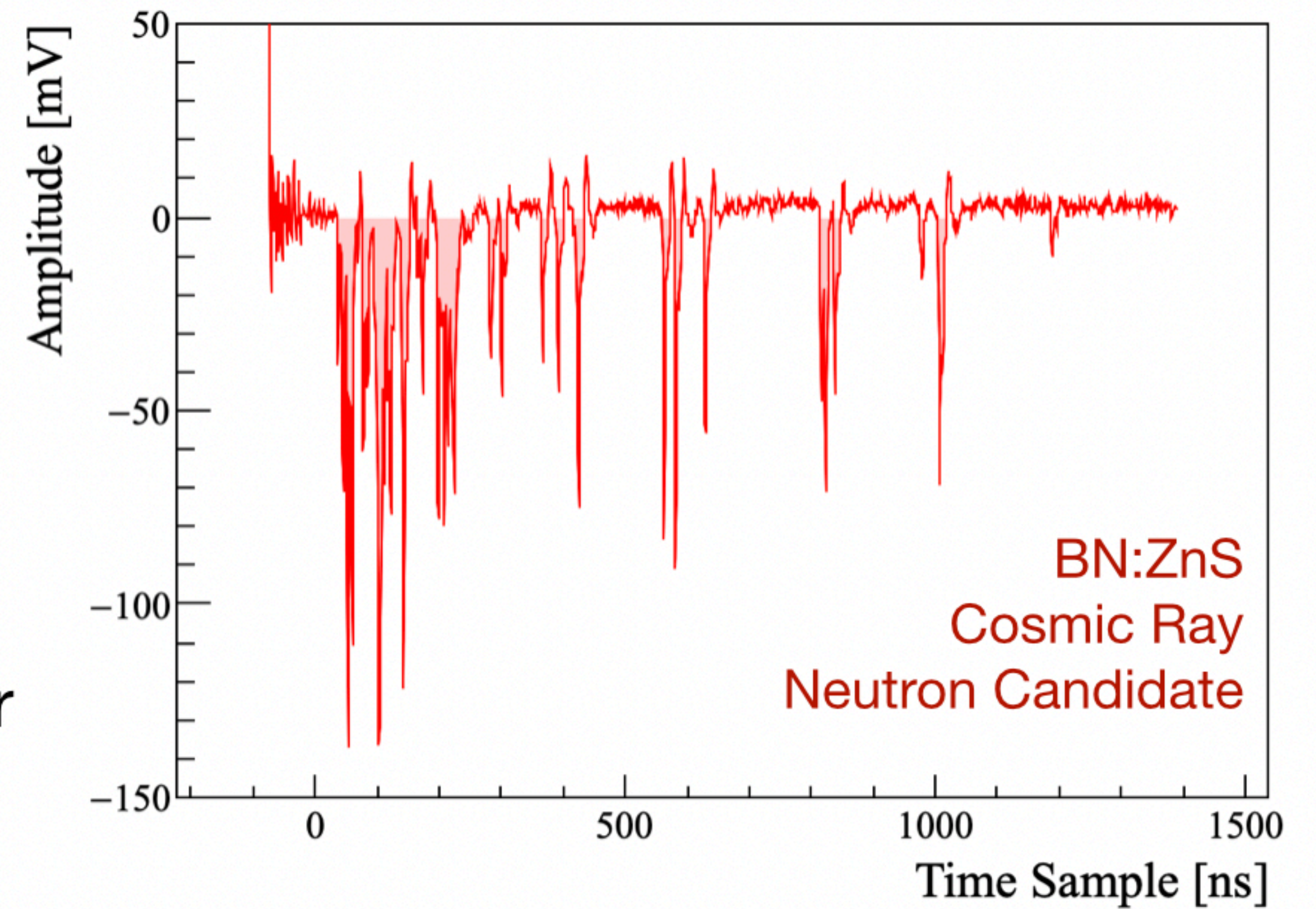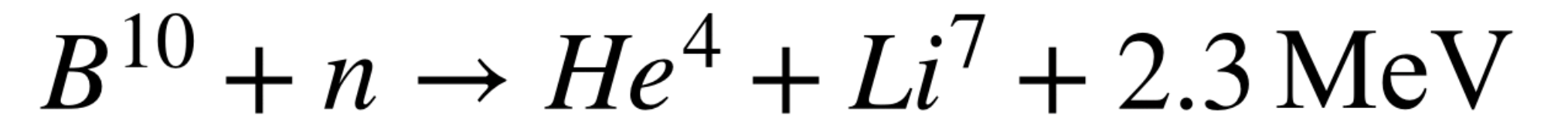(derived from pressure, temperature, humidity)

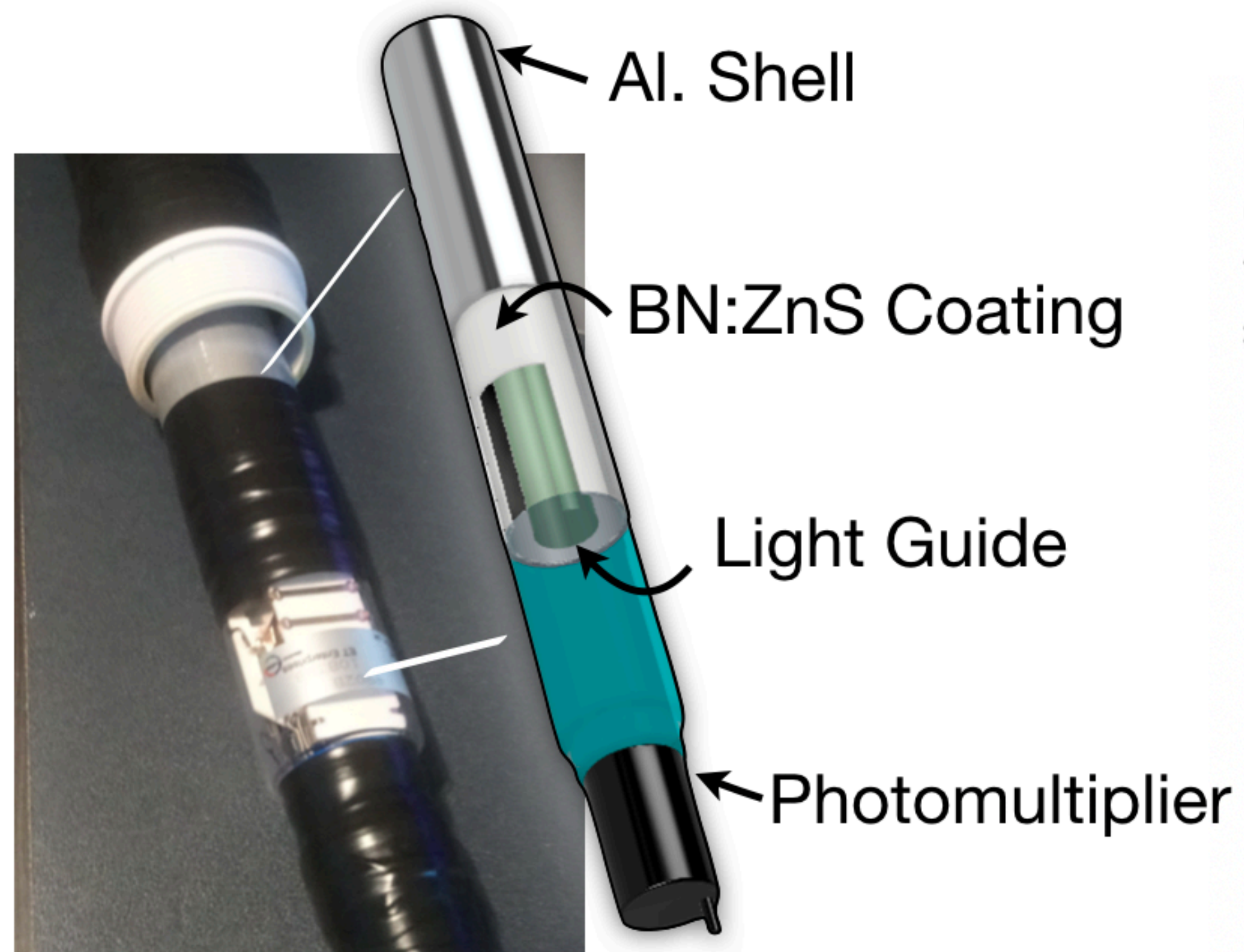**f_c - High energy cosmic ray intensity correction**
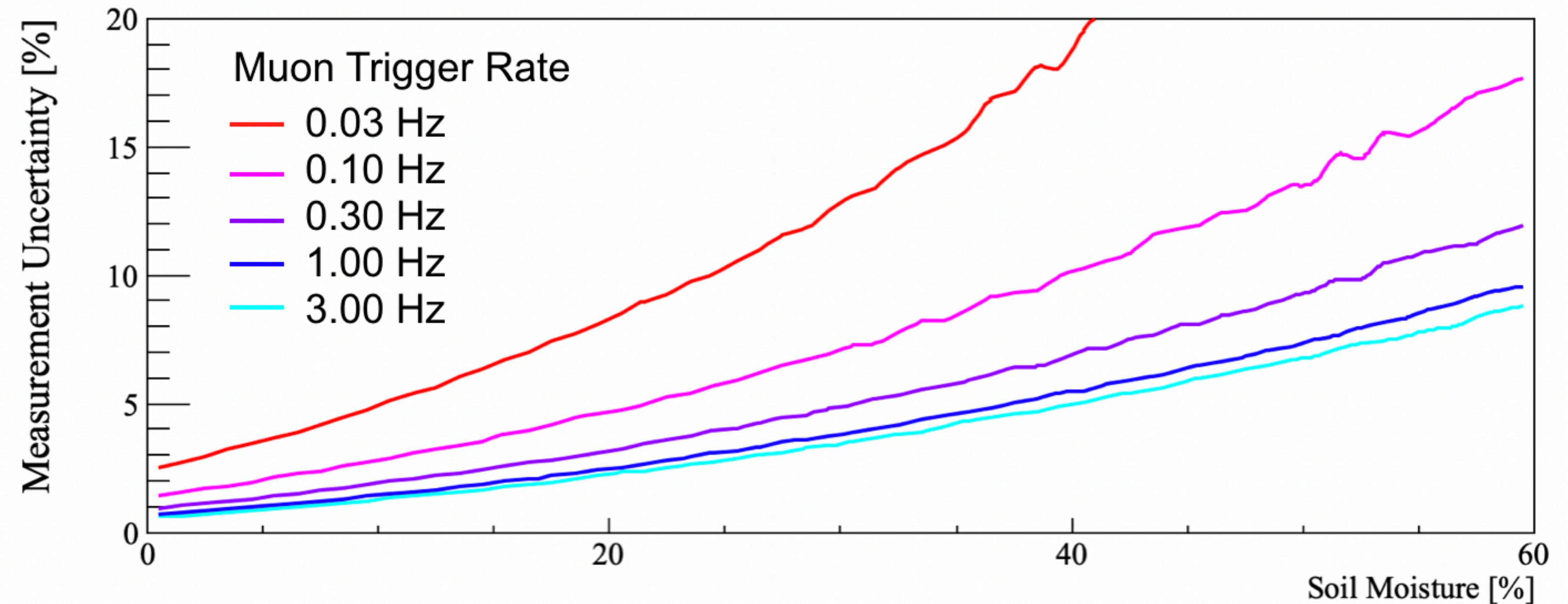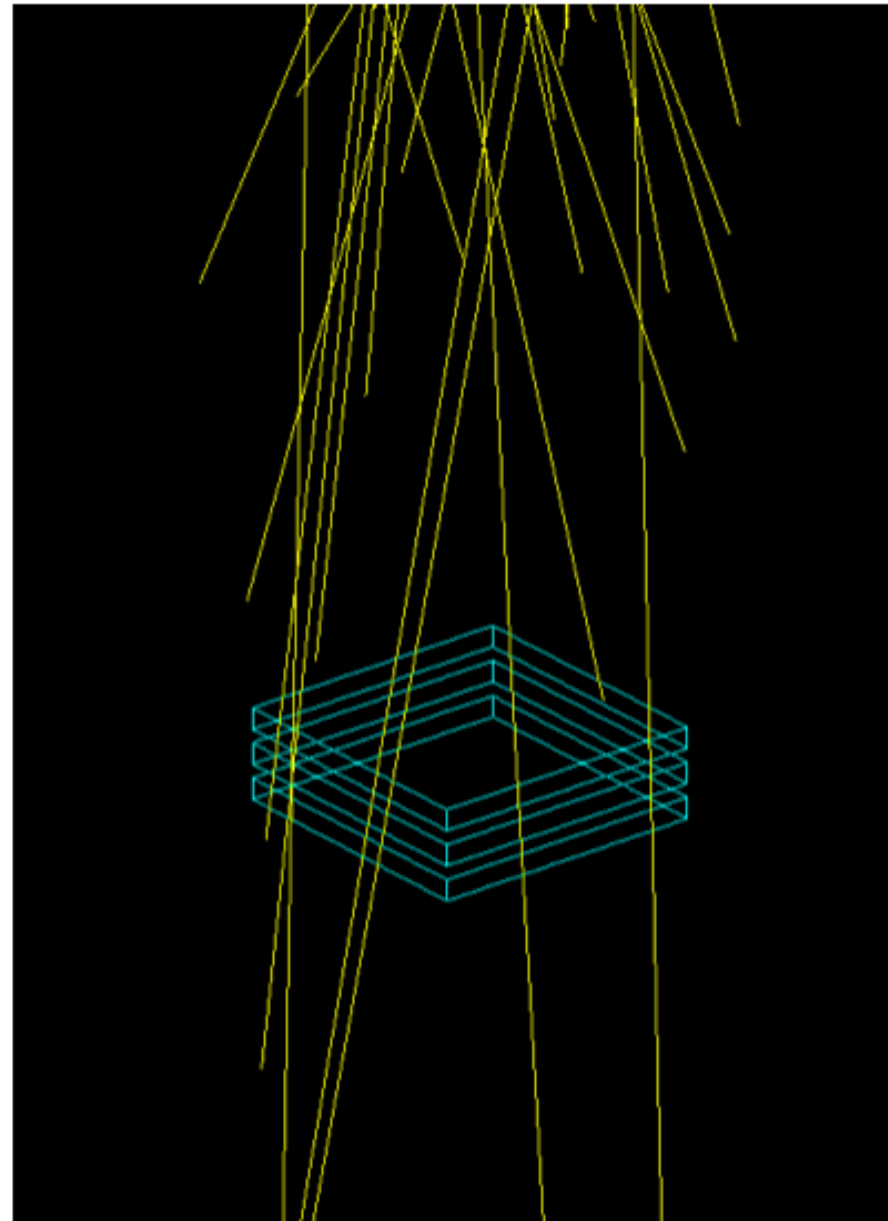(derived from Jungfraujoch neutron monitor database)

IoT Scintillator Detectors

$$Li^6 + n \rightarrow He^4 + T^3 + 4.8 \, \text{MeV}$$

Low Cost Neutron Detectors

$$B^{10} + n \rightarrow He^4 + Li^7 + 2.3\,\text{MeV}$$

Al. Shell

BN:ZnS Coating

Light Guide

Photomultiplier

BN:ZnS
Cosmic Ray
Neutron Candidate

Self Contained Detection Systems

- Developing IoT-enabled cosmogenic neutron detectors for smart soil moisture monitoring.

- Lithium based scintillator detectors showing good efficiency/cost compared to traditional BF3 or He^3 based systems. Boron based scintillator expected to reduce costs further.