



Water Management using Smart Radiation Sensors

18-19th July, Online Workshop



Natural
Environment
Research Council



SÃO PAULO RESEARCH FOUNDATION



Universidade Federal do ABC



Universidade de São Paulo



University of
BRISTOL



UNIVERSITÄT
HEIDELBERG
ZUKUNFT
SEIT 1386

STYX NEUTRONICA



Durham
University

<https://conference.ippp.dur.ac.uk/event/smartwater/>

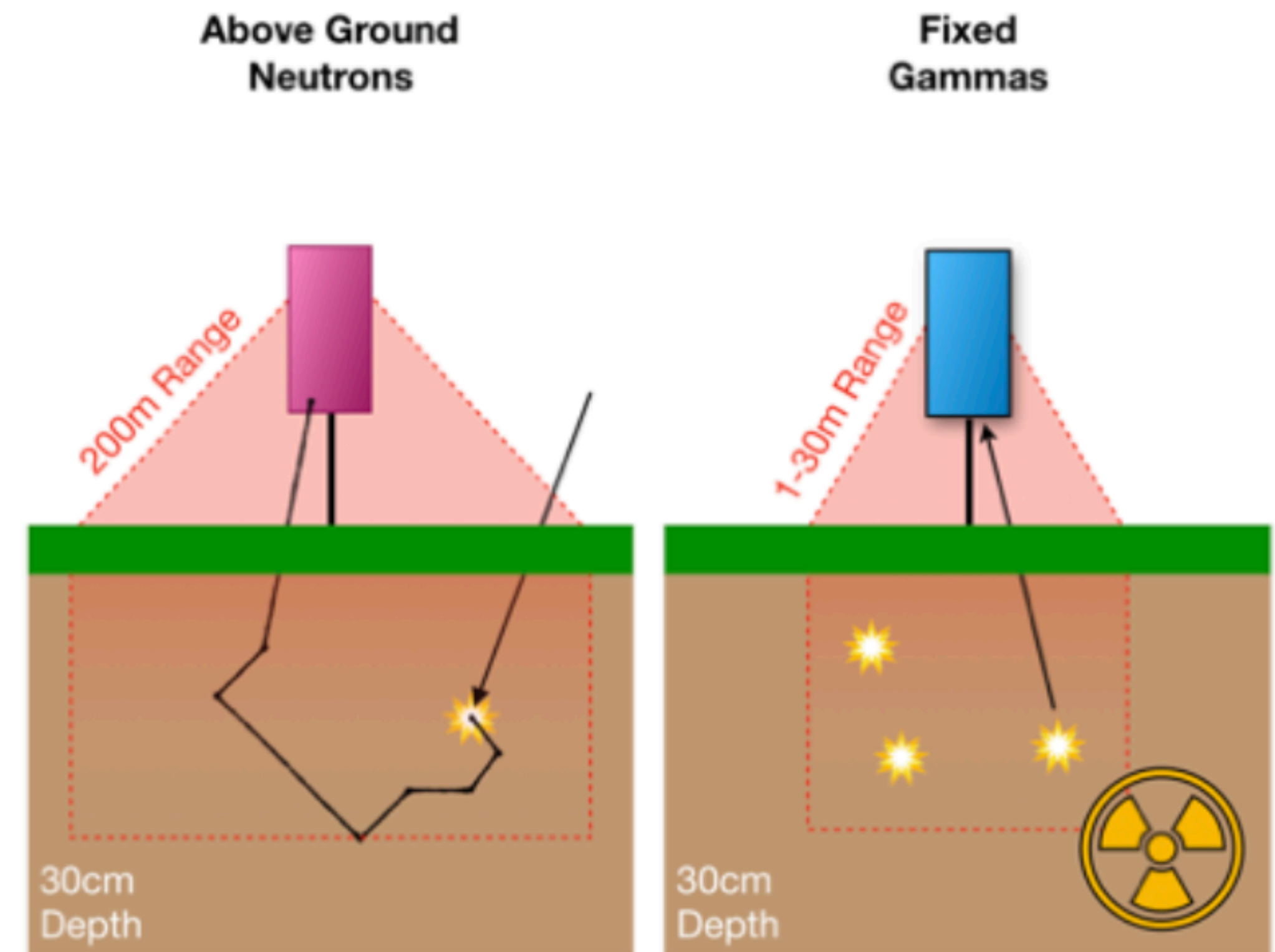
Starting at 13:30 BST

Introduction, P. Stowell



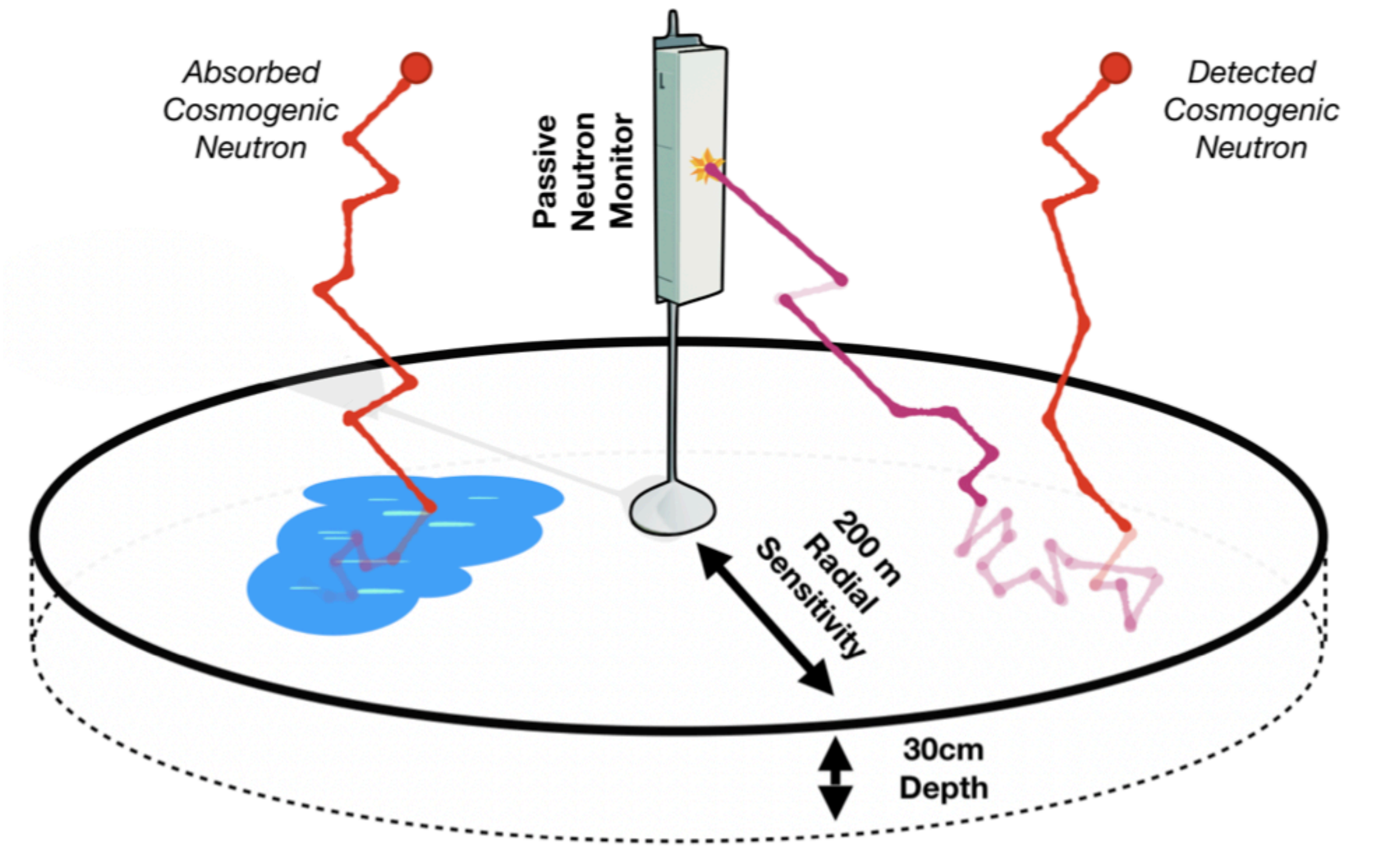
Introduction

- First of a set of workshops funded by a NERC-FAPESP research grant “COSMIC-SWAMP”.
- **Looking at integration of cosmic-ray sensors into internet-of-things irrigation management networks.**
- Workshop now mostly aimed at the cosmic ray neutron sensing technique.
- Interested in how different passive IoT radiation sensing techniques can be applied.



Radiation Sensing (Neutron)

- Cosmic ray neutron sensing exploits an inverse correlation between neutron rate and local hydrogen content to infer soil moisture.
- **Neutrons entering/produced-in the soil interact strongly with hydrogen** and are absorbed before reaching a detector.
- Non-invasive sensing technique with a large area footprint good for sensing at a typical field scale.



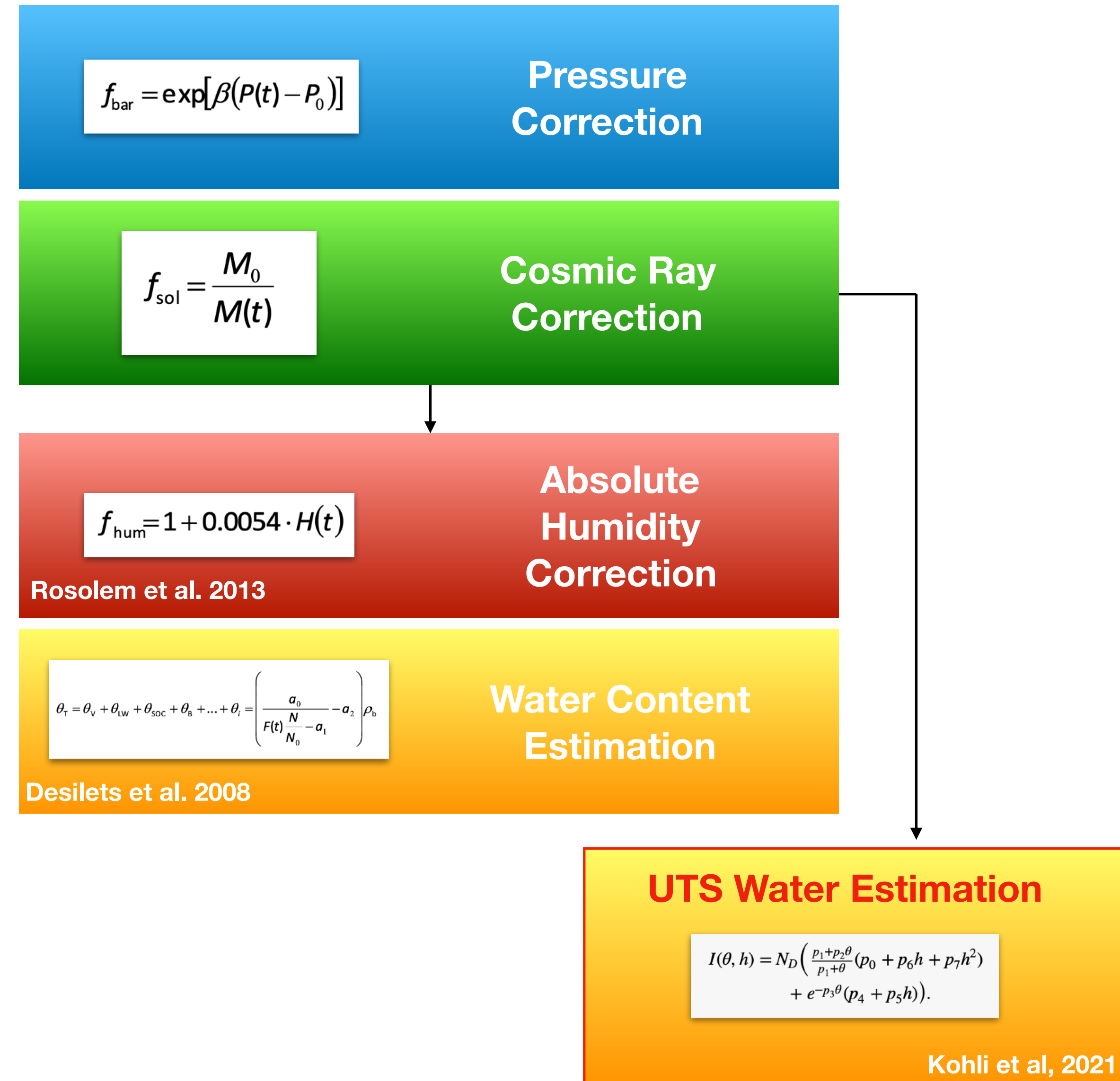
Total water content

$$\theta_T = \left(\frac{a_0}{F(t) \frac{N}{N_0} - a_1} - a_2 \right) \rho_b$$

N observed neutrons
N₀ Neutrons over dry soil
F correction factors
a_i model parameters

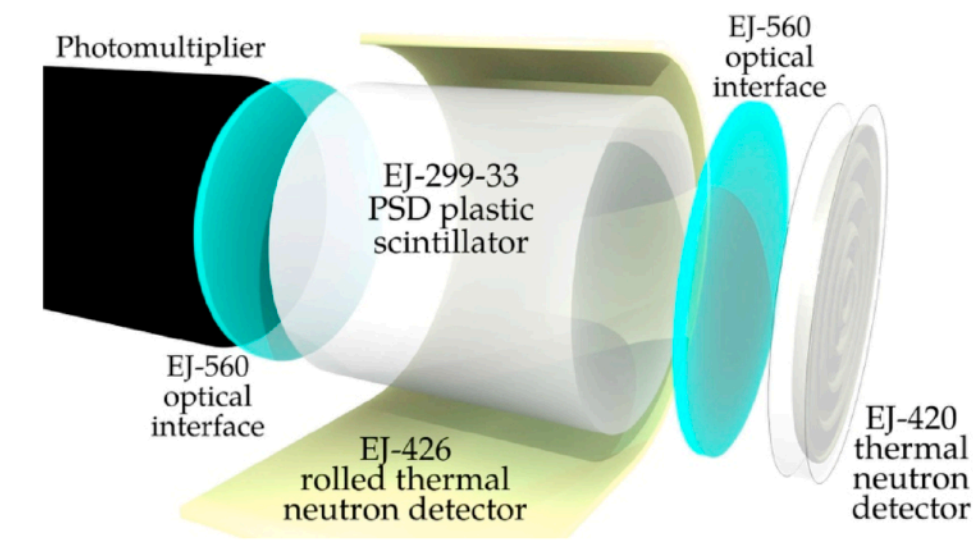
Radiation Sensing (Corrections)

- Several **correction functions needed to convert raw neutron counting rate to soil moisture.**
- Field is continuously evolving due to improvements in both detectors and simulations.
- Data throughput of a single sensor is still relatively low. Suitable for low power data transfer.



Neutron Sensing (Innovations)

- Lots of groups exploring the possibility of alternative neutron sensing instrumentation.
- Reductions in cost or addition of new capabilities compared to traditional BF3/He3 systems.
- Aiming to support the integration of these sensors into larger Internet-of-Things (IoT) networks through software tools.
- **Open source IoT services** that include standardised data formatting, most up to date corrections functions, automatic data analyses and forecasting.



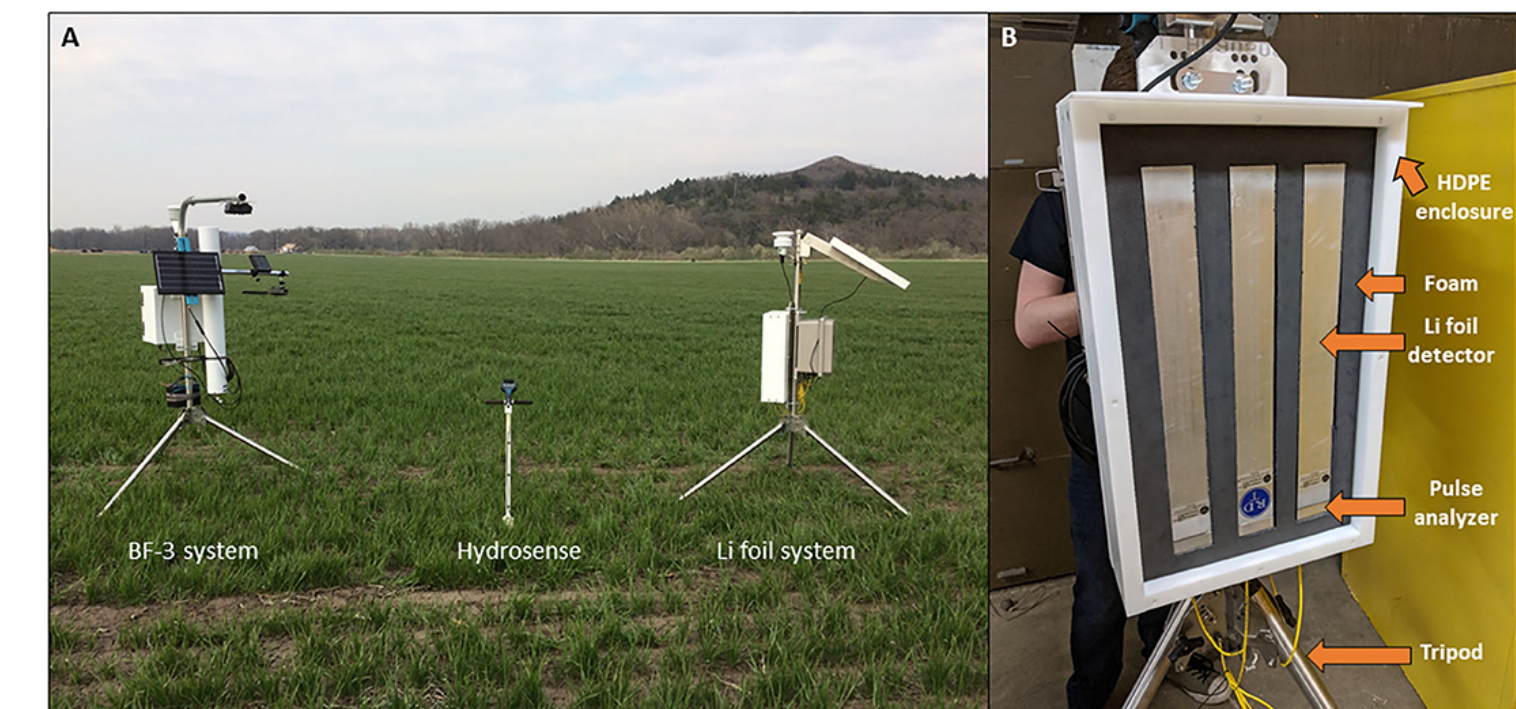
FinApp



Durham University



StyxNeutronica



RDT Ltd

Agenda

- Some nice talks lined up covering applications of CRNS, new sensors, soil health and monitoring, and IoT networks.
- Final session will show COSMIC-SWAMP progress and open floor for discussion.

Day 1

1 - Welcome: Introduction (0)	Patrick Stowell
2 - Day 1 : Introduction to Radiation Sensing (01.01)	Patrick Stowell 13:30 - 14:00
3 - Day 1 : Cosmic Ray Sensor Networks (01.02)	Patrick Stowell 14:00 - 15:00
Coffee Break	
4 - Day 1 : Radiation Sensors (01.03)	15:10 - 16:00
10 - Day 1 : Understanding the Soil (01.04)	Patrick Stowell 16:00 - 17:00

Day 2

Day 2 : Software Tutorial: URANOS (02.01)	Patrick Stowell 10:00 - 11:00
Day 2 : Software Tutorial: CRSPY Tutorial (02.01)	Patrick Stowell 11:00 - 12:00
Day 2 : Software Tutorial: CORNY Neutron Processing Tool Usage (02.01)	12:00 - 12:30
Lunch	12:30 - 14:00
Day 2 : IoT Sensors (02.02)	Patrick Stowell 14:00 - 15:00
Coffee Break	15:00 - 15:10
Day 2 : COSMIC-SWAMP (02.03)	Patrick Stowell 15:10 - 16:00
Discussion and Workshop Close	Patrick Stowell 16:00 - 16:30

Software Tutorial

- Files for the software tutorial have been placed here (Link on the workshop page):
<https://gitlab.com/patrickstowell/cosmic-swamp-workshop-2022/-/tree/main>
- Grab the complete tutorial zip file from here:
<https://gitlab.com/patrickstowell/cosmic-swamp-workshop-2022/-/archive/main/cosmic-swamp-workshop-2022-main.zip>
- Quickest way to run the code is through docker. Several examples are included for Windows and Linux:
 - Run URANOS simulation through docker with GUI/noGUI
 - Run URANOS analysis through Jupyter notebook (docker option available)
 - Run CRSPY analysis through Jupyter notebook (docker option available)
- If you are familiar with docker, you can do
 - `docker run -it --rm -p 8888:8888 johnpatrickstowell/uranos_tutorial`
 - `docker run -it --rm -v $PWD:/uranos/workdir/ -w /uranos/workdir/ johnpatrickstowell/uranos-ubuntu bash /runuranos noGUI Uranos.cfg -platform offscreen`
 - `docker run -it -p 8888:8888 johnpatrickstowell/crspy_tutorial`

House-keeping

- Presenters are welcome to share their own screen when giving their talk. Please enter your full name when joining so we can make you a co-host when presenting.
- Please raise your hand at the end of the session using zooms reactions panel to ask a question or type your questions in the chat window.
- Talk slots are 20 minutes long (15+5). If you can please hang around in the break before your session so we can check you can share your screen.
- Please message john.p.stowell@durham.ac.uk, cak@ufabc.edu.br, or rafael.Rosolem@bristol.ac.uk if you have issues connecting.
- **Most importantly, stay cool!**

