



SAHAL YACOOB

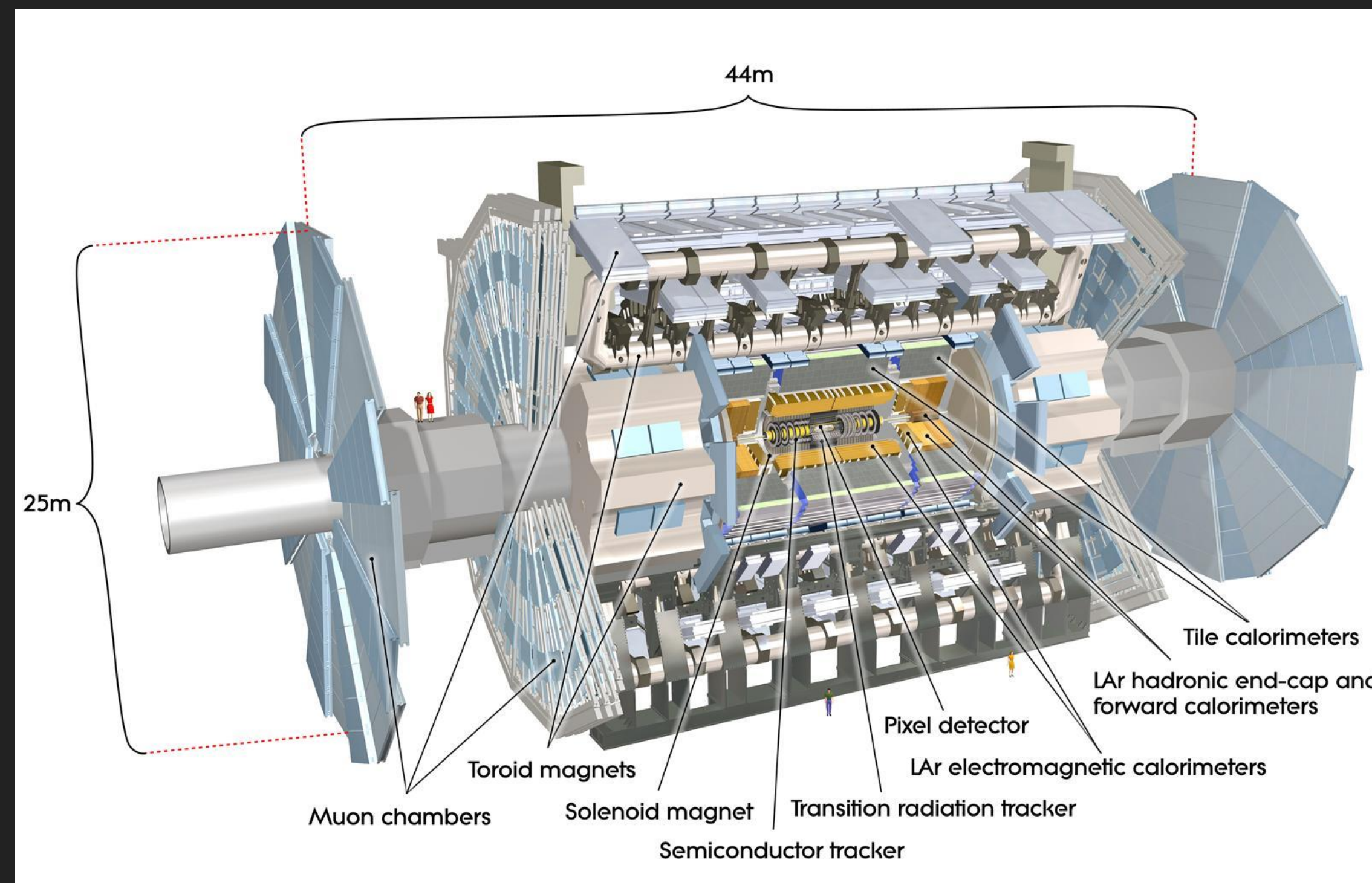
ATLAS@UCT



UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

WHAT IS ATLAS ?

- ▶ The ATLAS experiment at CERN is a Multi-purpose particle Physics detector and collaboration which collect and analyse data from high energy proton and nuclear collisions produced by the Large Hadron Collider



A SHORT HISTORY OF UCT INVOLVEMENT WITH ATLAS

- ▶ Started by Andrew Hamilton in 2011 (no longer an ATLAS member)
- ▶ Sahal Yacoob joined in 2015
- ▶ James Keaveney joined in 2019

A relatively small group
Currently top quark cross-sections
group co-convenor



Andrew



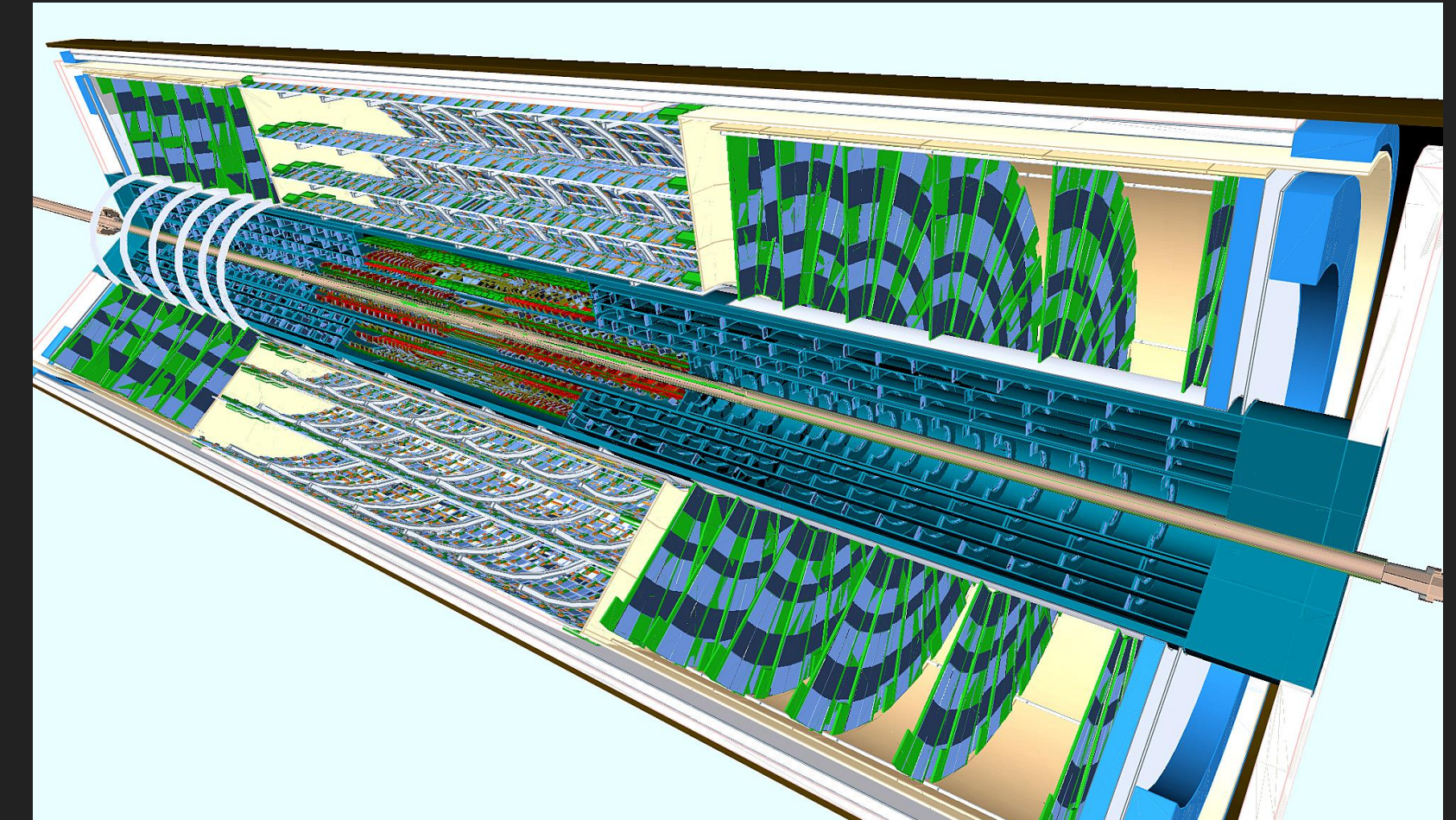
Sahal



James

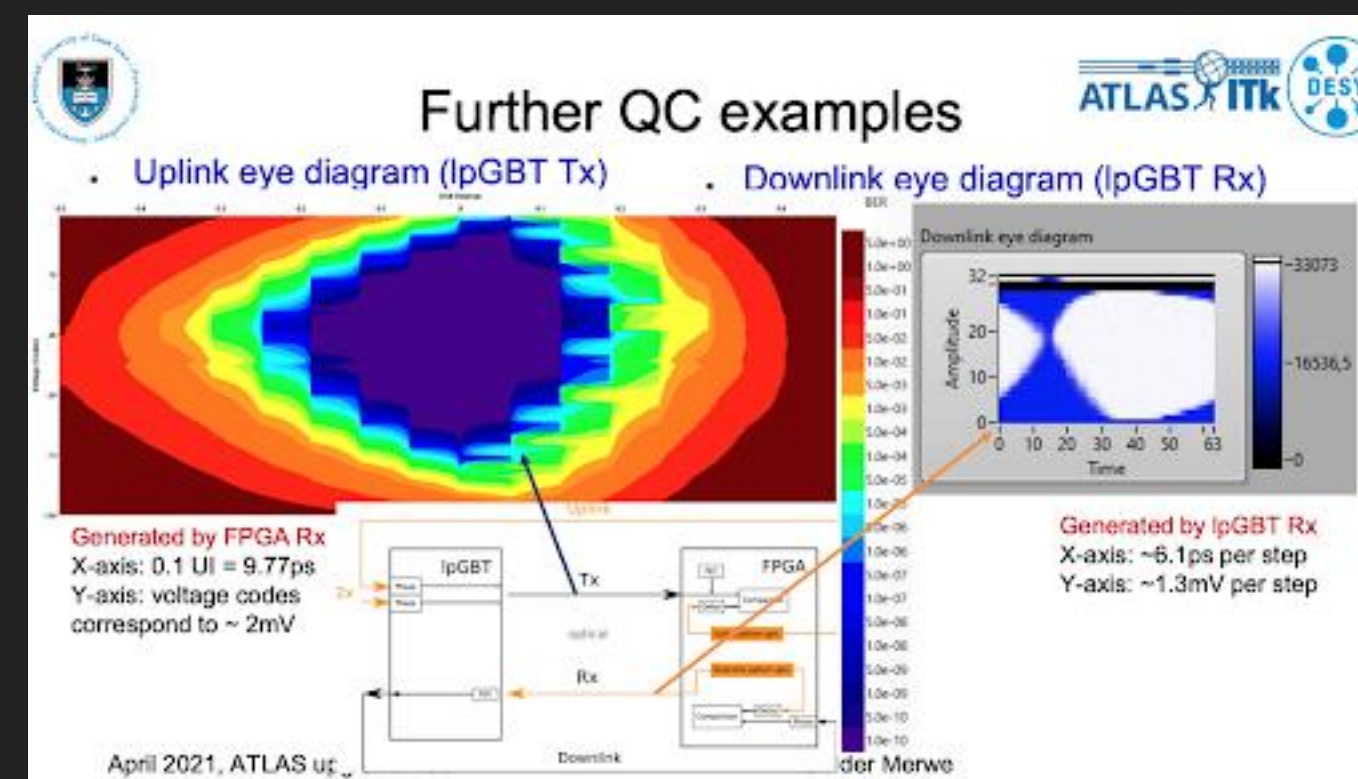
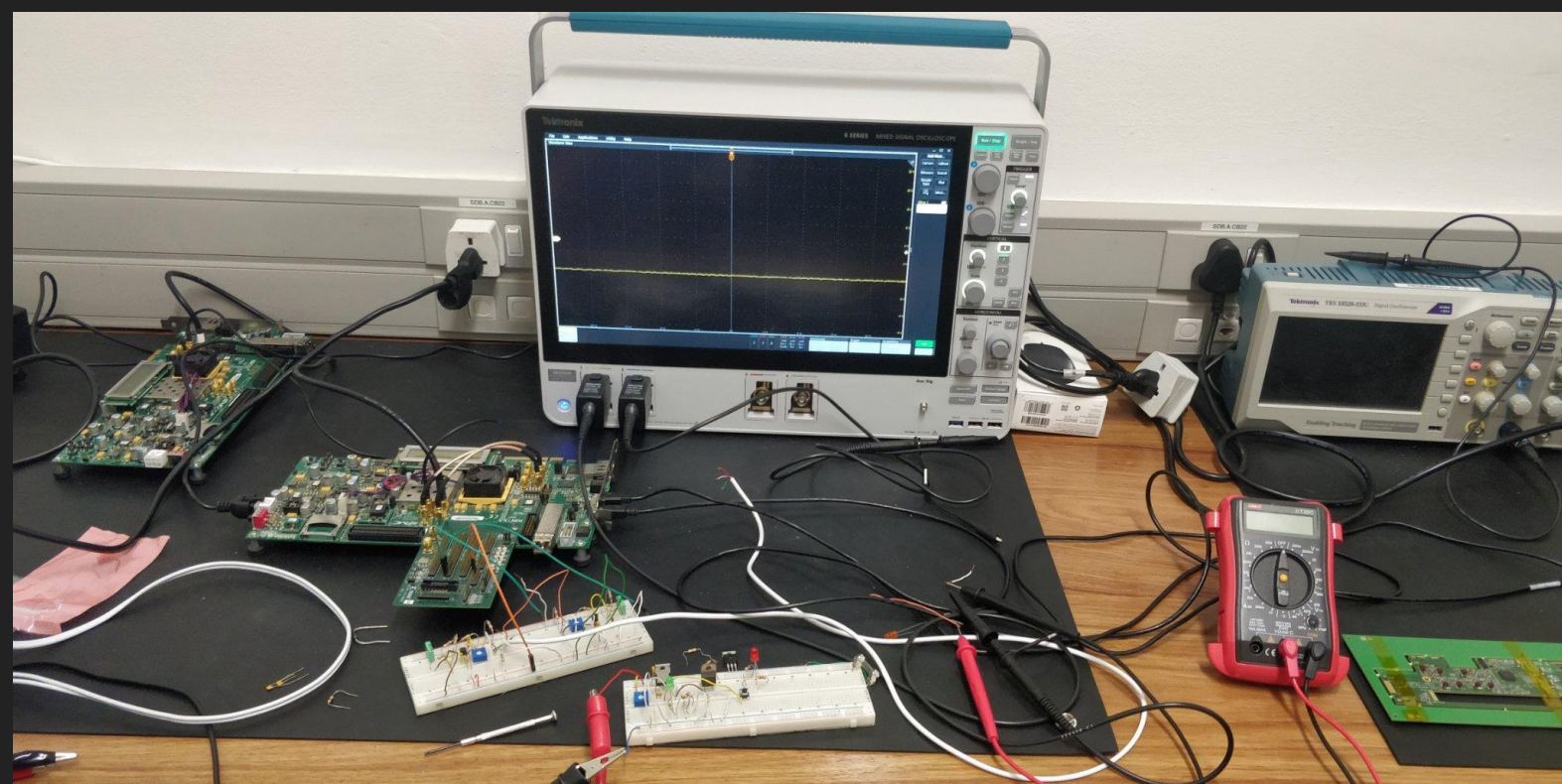
SILICON DETECTOR DEVELOPMENT

- ▶ SCT
 - ▶ Data acquisition development
- ▶ ITk
 - ▶ Evaporative cooling development
 - ▶ Material Description in simulation and related studies
 - ▶ QC for readout electronics – more on next slide
 - ▶ Polymoderator design and procurement



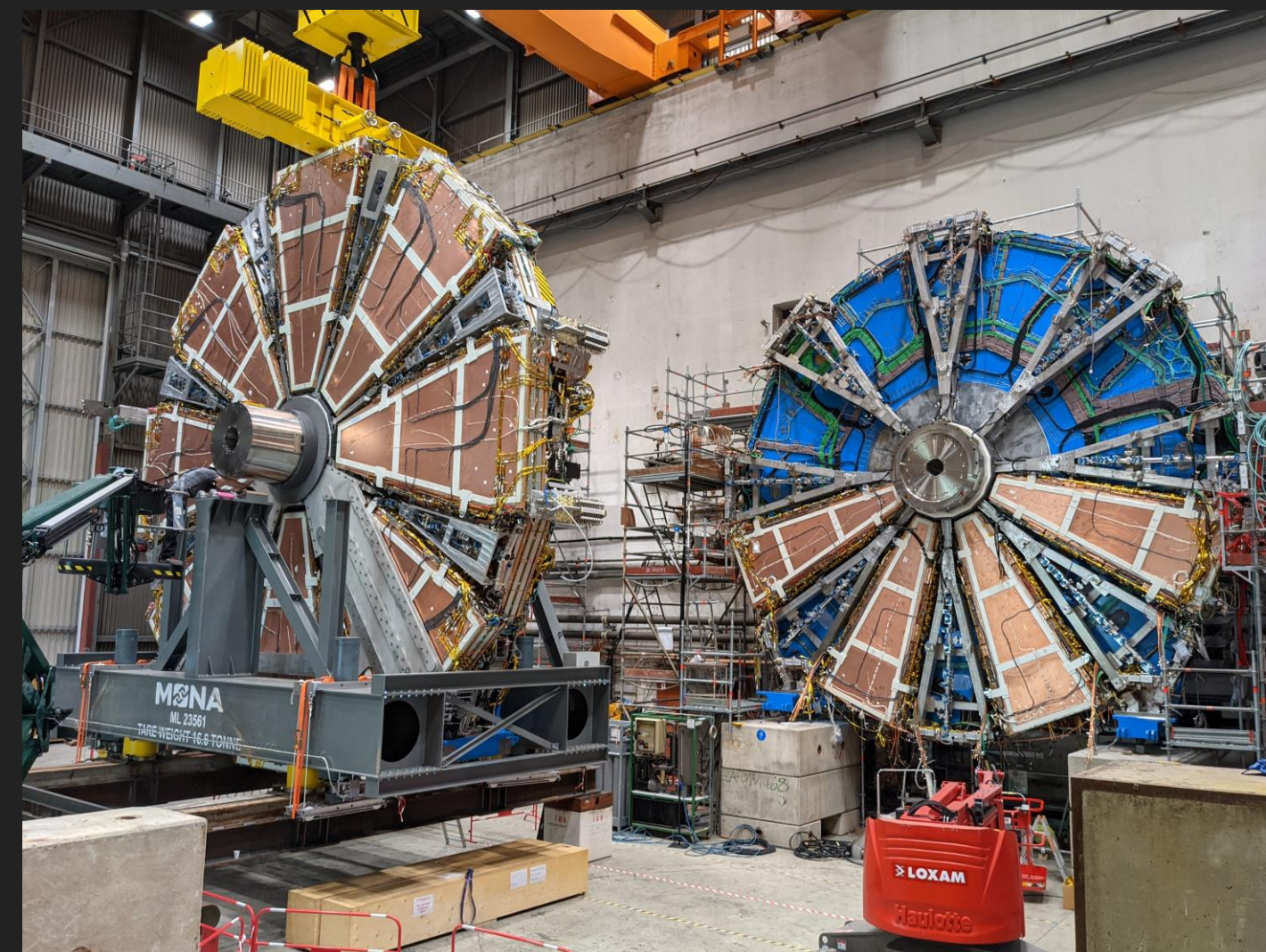
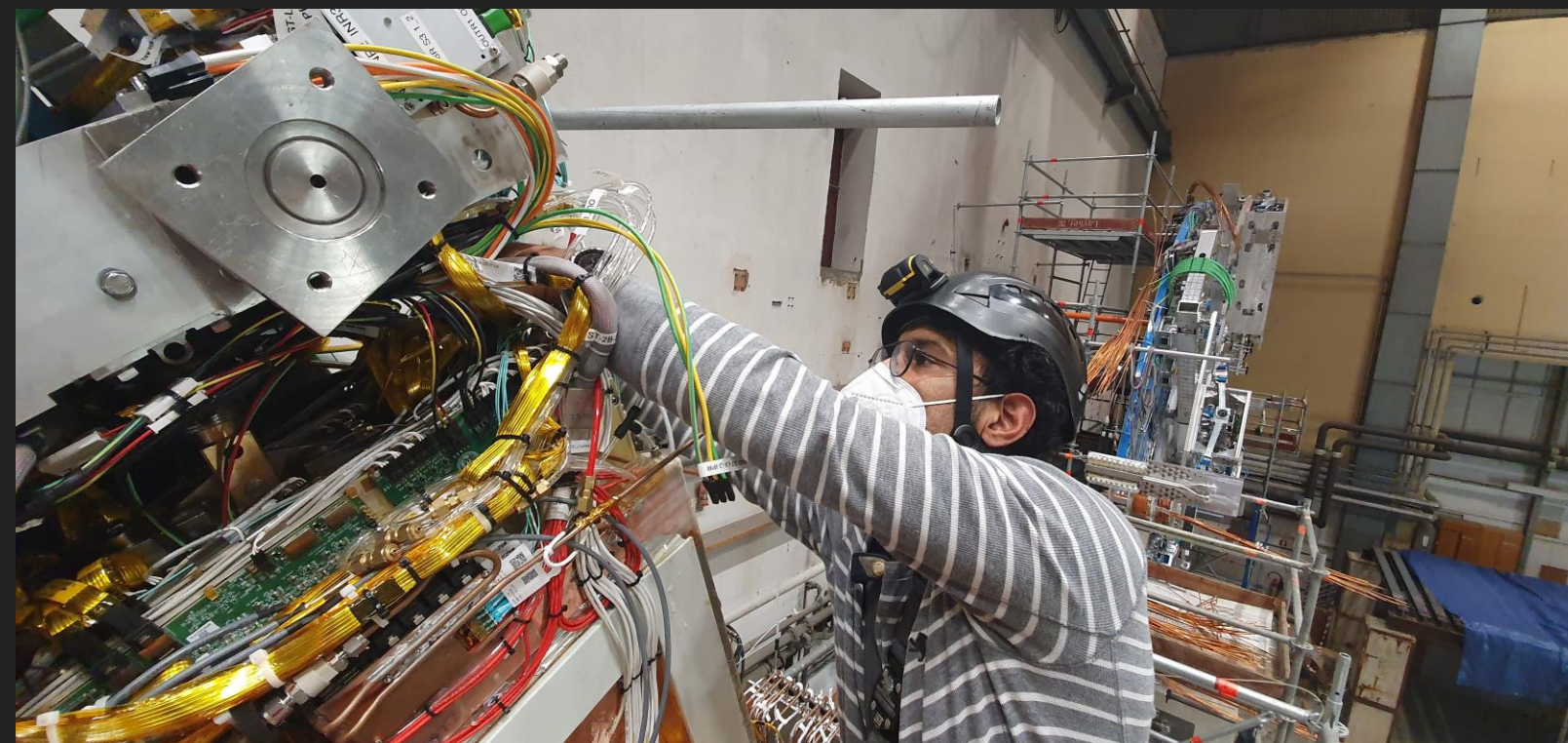
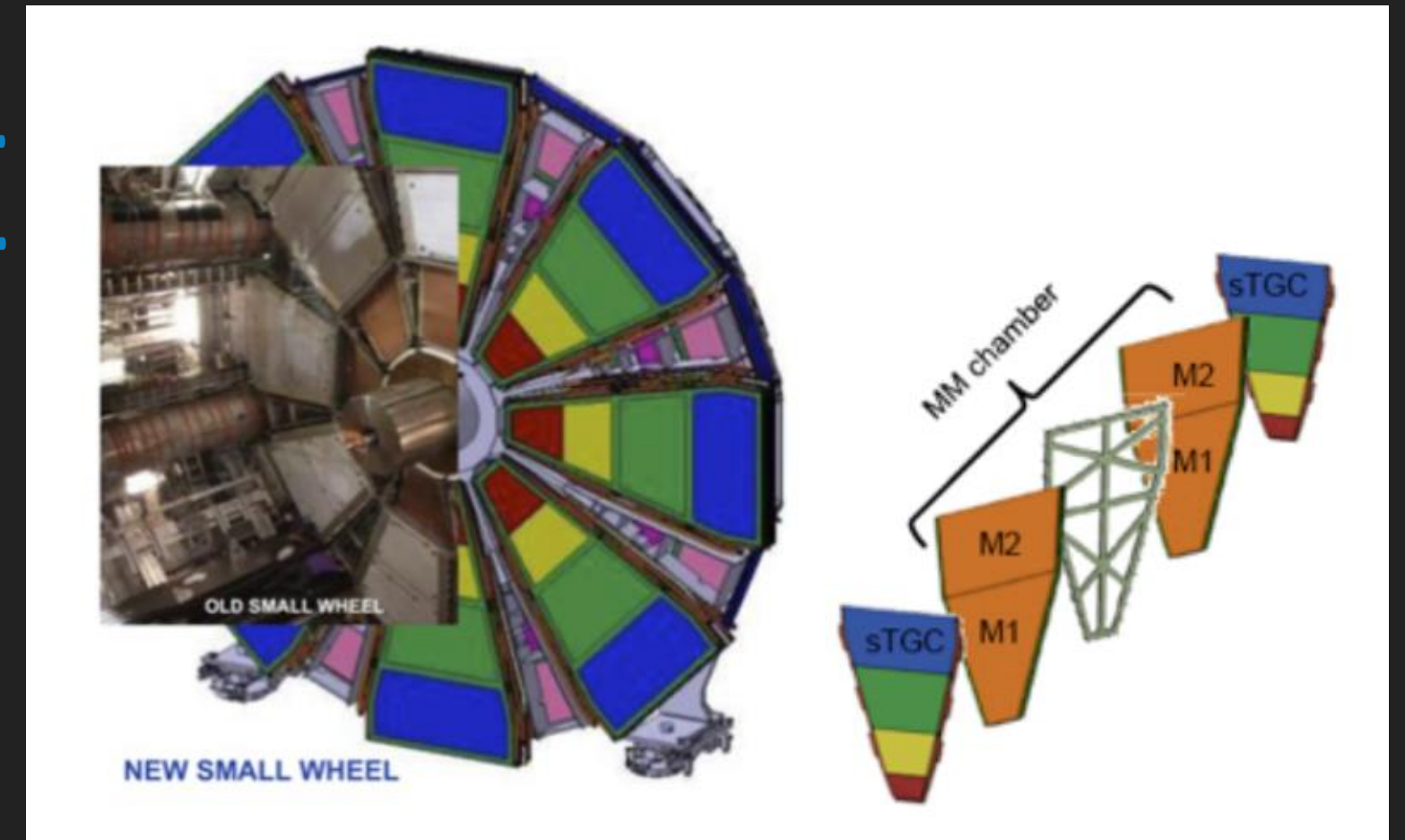
ITK END OF SUBSTRUCTURE (EOS) CARDS

- ▶ Collaborating with DESY to produce and qualify ~2000 EoS cards for ITk
- ▶ EOS prototypes @ UCT, dedicated lab space and equipment (photos) to develop QC procedures
- ▶ Collaborations between UCT physicists and Engineers.



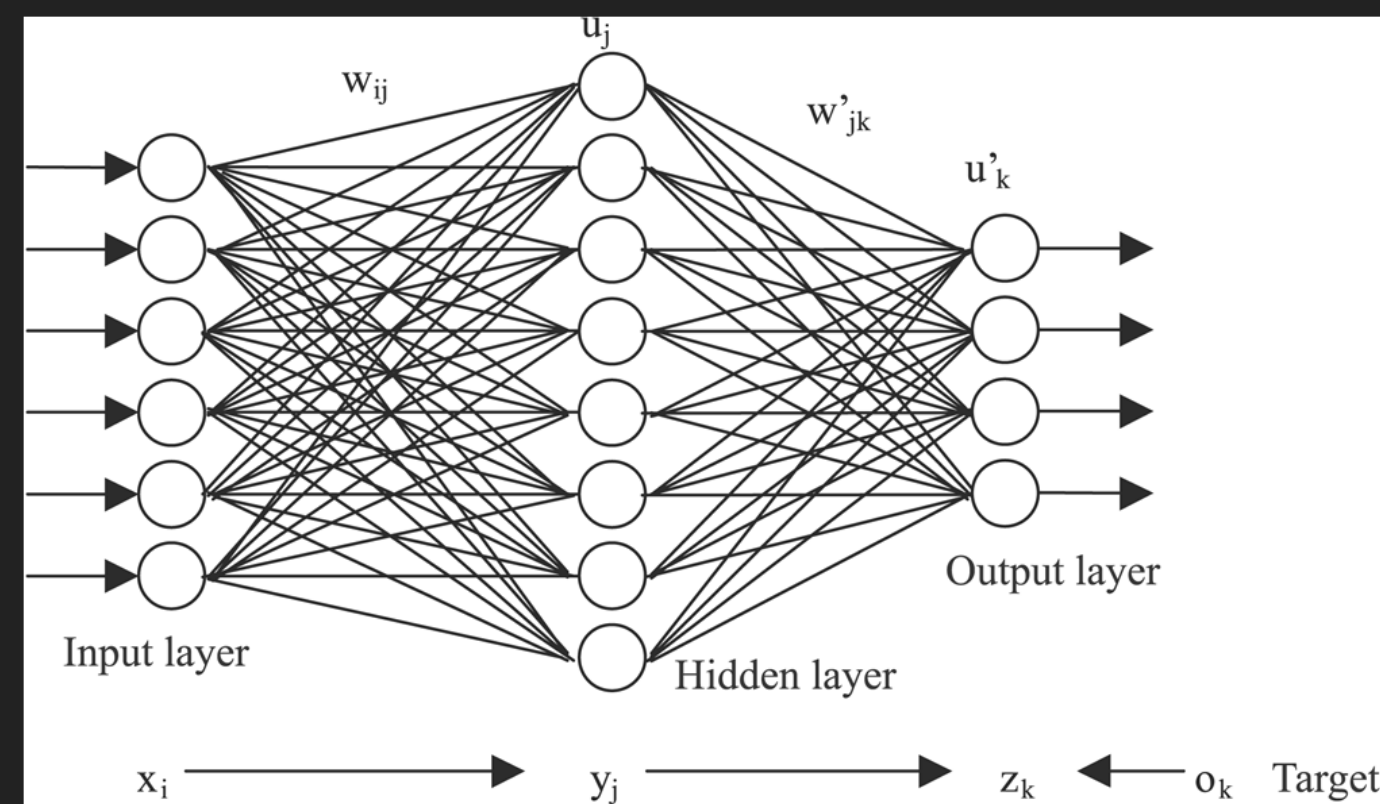
MORE DETECTOR DEVELOPME

- ▶ Muon New Small Wheel
 - ▶ Material description in simulation
 - ▶ Manufacturing and assembly of components and installation tools
 - ▶ Commissioning



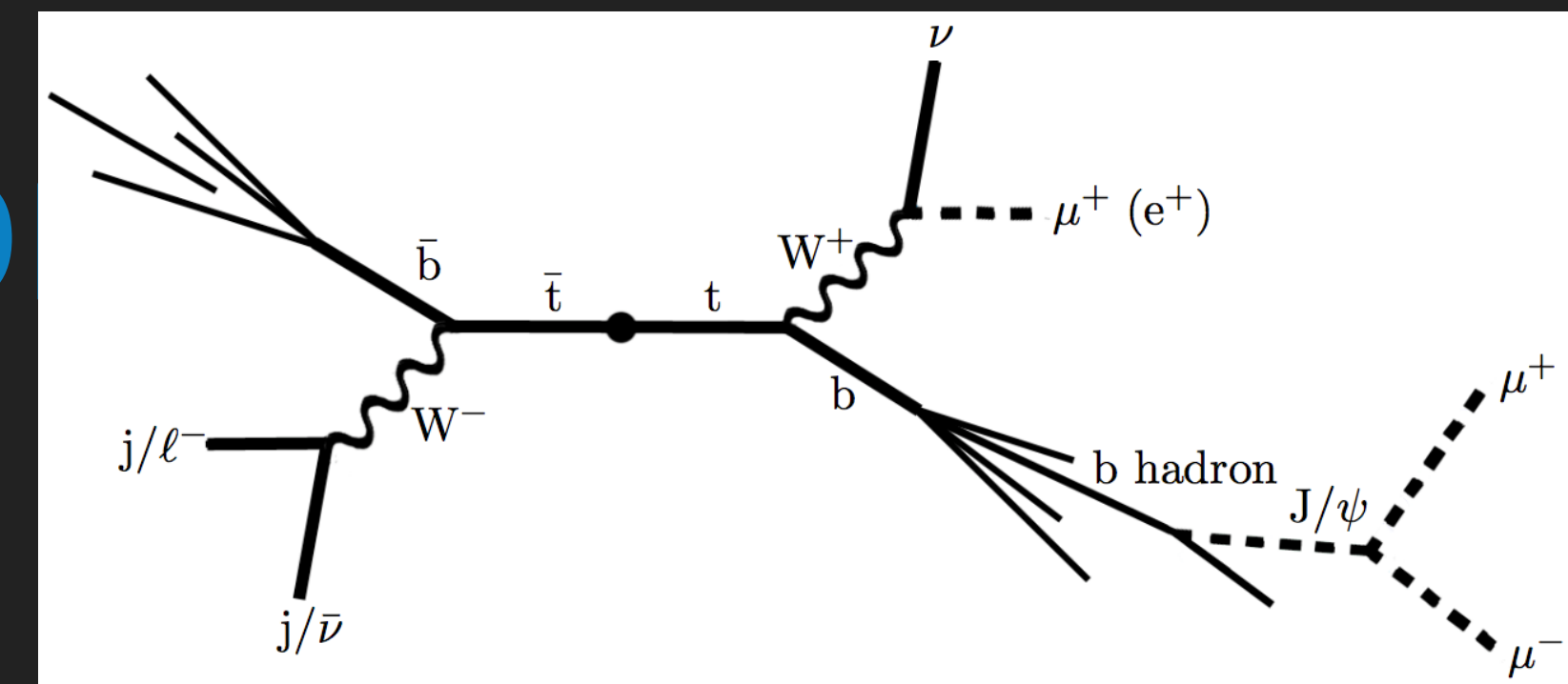
OTHER DATA VALIDATION TASKS

- ▶ Developing a model for missing transverse momentum determination using neural nets
- ▶ Determining the low- p_T muon fake rates
- ▶ Developing an automated online data quality monitoring algorithm (using machine learning)



TOP QUARK MASS USING LEPTO

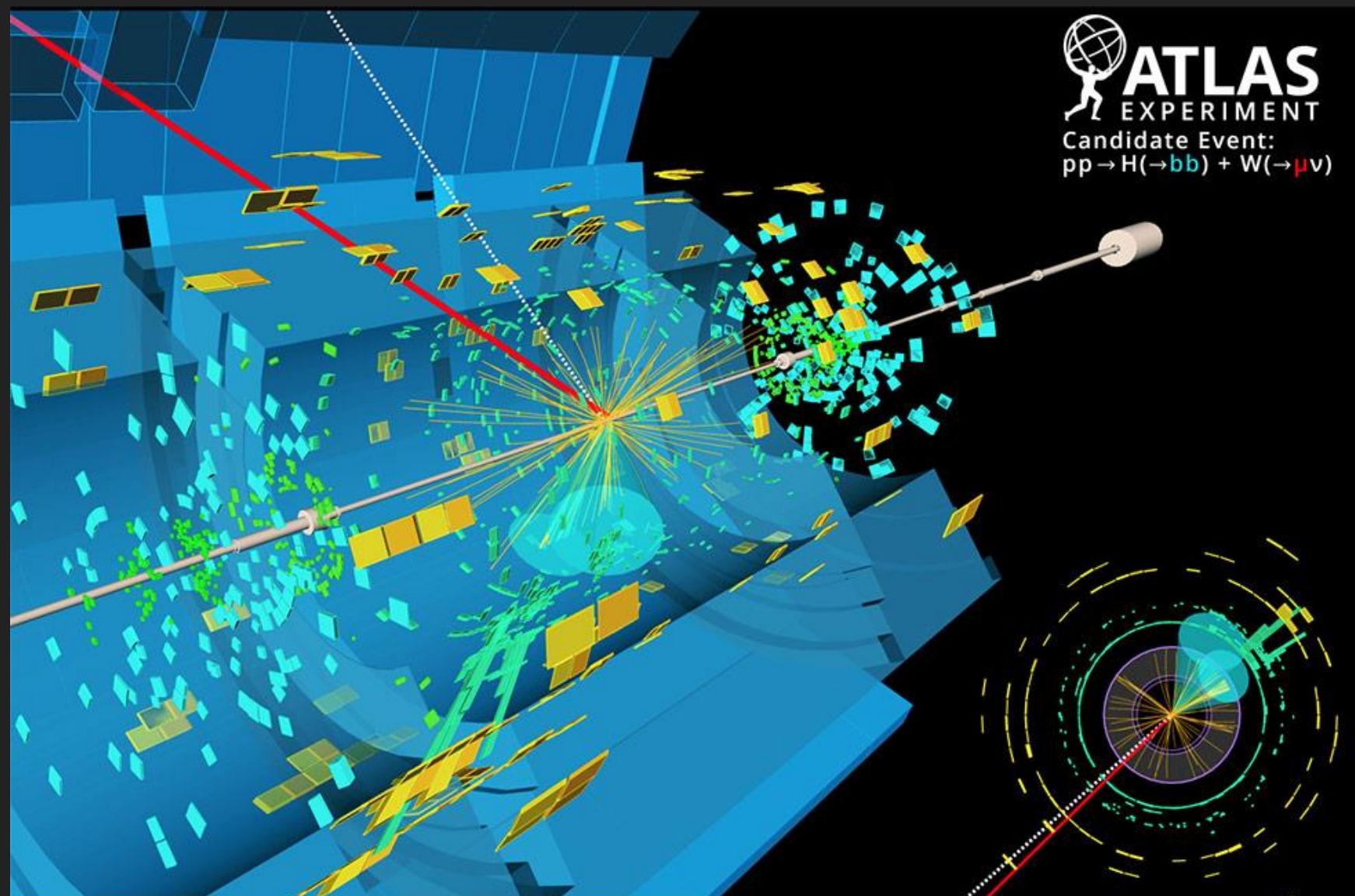
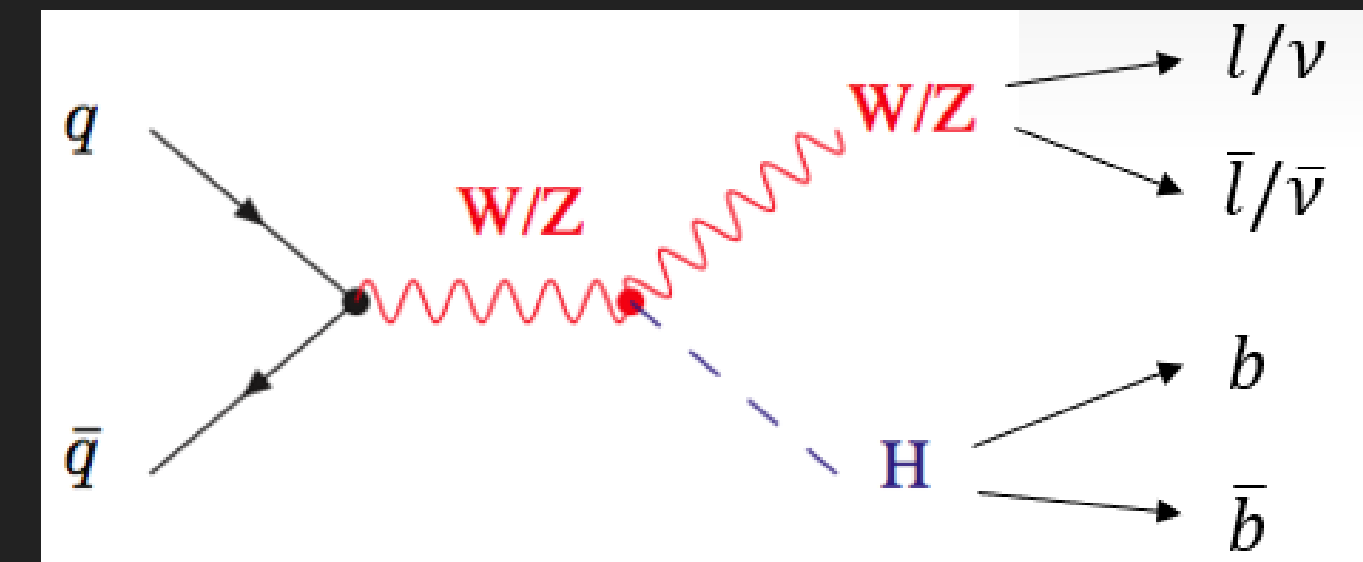
- ▶ Measuring the mass of the top quark
 - ▶ Current PDG value: $m_t = 172.9 \pm 0.4 \text{ GeV}$
- ▶ Precision measurement of m_t , m_W , and m_H combine to form a precision test of the SM
- ▶ Important for SM determination of stability of the vacuum
- ▶ Method should be competitive with large LHC run 3 datasets



Not Yet Public

MEASURING HIGGS PRODUCTION

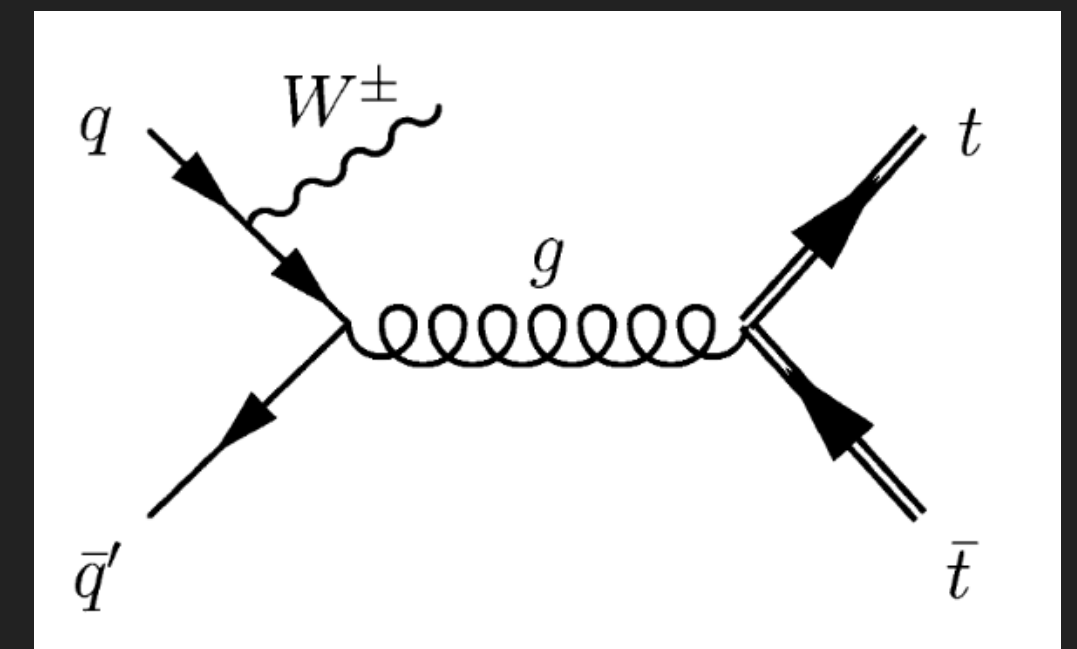
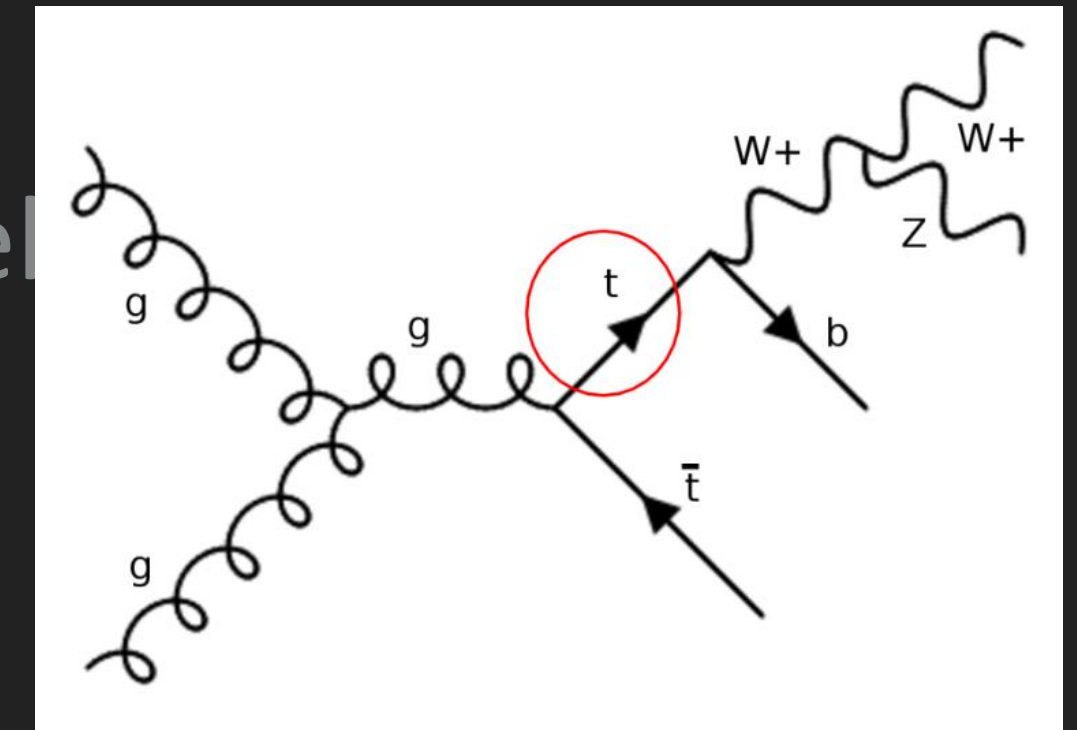
- ▶ Higgs boson production in association with a W/Z boson, with the Higgs decaying to two bottom quarks.



- ▶ Best way to directly measure Higgs boson's ElectroWeak couplings as part of understanding the Higgs.

NEW PHYSICS VIA TOP EW COUPLINGS

- ▶ tWZ cross section: UCT-led analysis on course to place a novel constraint on a previously unexplored process.
- ▶ Leptonic Charge asymmetry in ttW production
 - ▶ collaboration between UCT and IFIC Valencia on previously unexplored observable sensitive to new physics
- ▶ Phenomenological work on the top quark EFT to support and inspire these measurements (arXiv:2107.01053)



WORK BY GRADUATED STUDENTS

- ▶ TWZ production cross section
 - ▶ Tetra and tri-lepton channels
- ▶ Same-sign WW production cross section
- ▶ tH(bb) feasibility study
- ▶ Exclusive dimuon production cross-section
- ▶ QCD backgrounds to W-boson measurements
- ▶ Running ATLAS software on ARM processors
- ▶ Study of susceptibility of EOS cards to SEUs using neutron sources at UCT

STUDENTS

- ▶ Students Graduated:
 - ▶ 16 MSc (including engineers)
 - ▶ Most continued in academia
 - ▶ 1 PhD
 - ▶ Currently a post-doc on ATLAS
- ▶ Current Students
 - ▶ 4 MSc
 - ▶ 3 PhD



OUTREACH AND INCLUSION

- ▶ Hosted Particle Physics Masterclasses with High Schools
- ▶ Support for the Beamlines for Schools program
- ▶ Working with the International Particle Physics Outreach Group in expanding Particle Physics to new countries
- ▶ Working within ATLAS and in Particle Physics generally to improve Diversity and Inclusion

IN SUMMARY

- ▶ Due to the funding available from the SA-CERN program we have been active within the ATLAS collaboration in all aspects:
 - ▶ Detector development, simulation, operations, commissioning, and construction
 - ▶ Interesting and intellectually challenging physics analyses
 - ▶ Exposing students to world-class research and an international network
 - ▶ Impactful on ATLAS and locally --- a good win win

