DIVISION REPORTS/HIGHLIGHTS IN HIGH ENERGY PARTICLE PHYSICS

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69th Annual Conference of the South African Institute of Physics

SOUTH AFRICAN INSTITUTE OF PHYSICS

INSTITUTE FOR COLLIDER PARTICLE PHYSICS
UNIVERSITY OF THE WITWATERSRAND

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

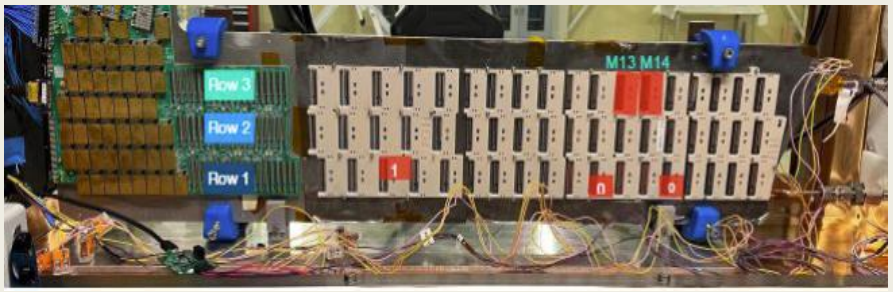
10-July-2025

Rationale of Pillar

- Grow student-training capacity for a new generation of scientists
- Involvement in ATLAS: data analysis, detector upgrades
- CERN provides unparalleled training
- Focus on human capacity & technology transfer to society
- Challenges: students finish their PhDs need support system to prepare them for positions in Academia in South Africa (DHET nGAP)

KPI		Key Performance Indicators					
	Secondary KPI	Actual 2024/25	Planned 2024/25	YTD 2025/26	# Black (ACI)	# Women	# Foreign
Research Outputs							
Peer Reviewed Articles		112	75	12			
Full Length Conference Proceedings		20	20	0			
Human Capacity Development							
Number of Students Supervised	Doctoral	14	15	17	8	3	3
	Masters	32	30	35	23	3	2
	Honours	3	5	10	2	2	-
Number of students graduated	Doctoral	0	4	1	0	0	0
	Masters	4	10	1	1	0	0
Outreach							
Number of interactions		5	5	0			
Membership							
Students		52	45	52	31	6	5
Post-Doctoral Fellows		5	5	5	3	0	0
Scientific/Academic Staff		8	9	11	2	1	6
Technical Staff		3	7	3	0	0	0

HGTD

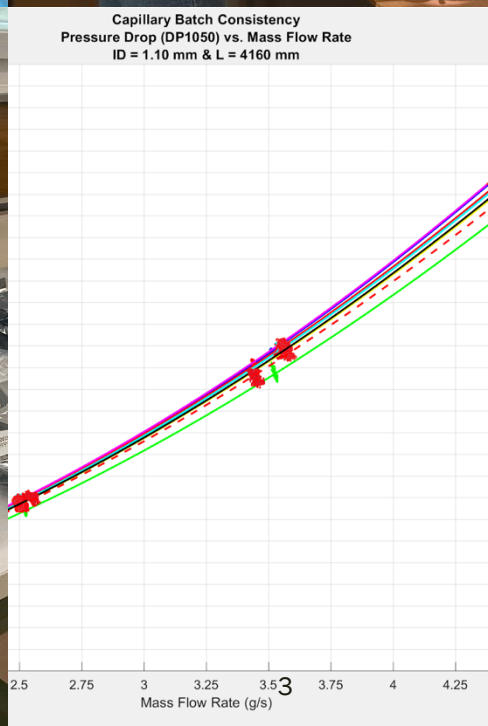


- The Wits/ICPP group joined the HGTD project. It offers a unique opportunity to acquire and develop expertise in high-end silicon detector technology. This includes detector design, Ultra-Fast electronic readout boards as well as custom made data acquisition systems. In addition, LGADs would allow several applications in Medical Physics radiotherapy monitoring and imagery.

- Currently Thabo Lepota (PhD), Katlego Machethe (MSc) and I are active and contributing to some HGTD tasks. Namely the test the performance of a 15x15 LGAD sensor, connected to a Peripheral Electronic Board (PEB) via Flex tails to the FELIX and DAQ systems. Figure below shows parts of the demonstrator configuration.

R&D Highlights: UJ+UNISA+UWC

- Exotic Higgs decays: S → XX → 4l, H → ZdZd → 4l+MET
- EGamma analysis and ElectronID progress
- ITk pixel quality control and logistics
- Cooling system simulations and capillary tests

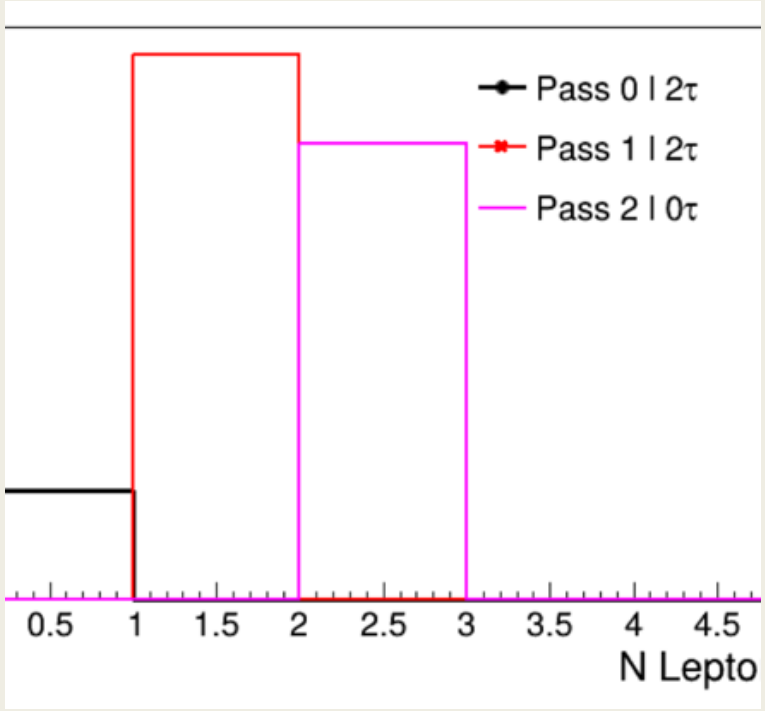


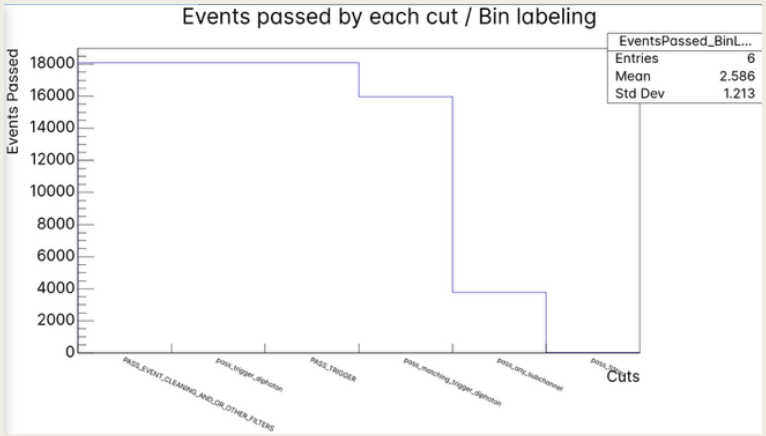
R&D Highlights: UCT-CERN (UCT, AIMS)

- tWZ 4-lepton channel: Analysis leadership & alignment studies
- Top Yukawa: ML-based extraction, systematics evaluated
- Jet Energy Calibration: Significant uncertainty reductions
- Anomaly Detection in Trigger using Variational Autoencoders
- Toponium physics

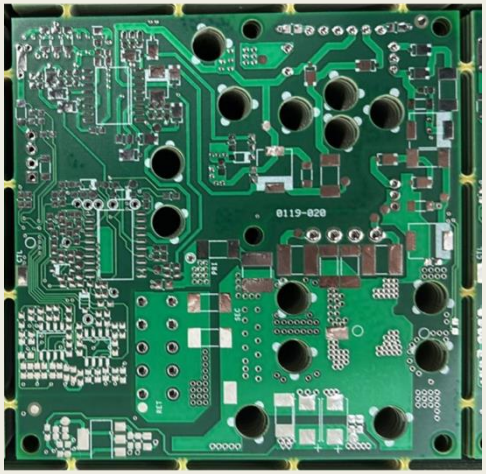
R&D Highlights: Wits, ITL, UniZulu, SU

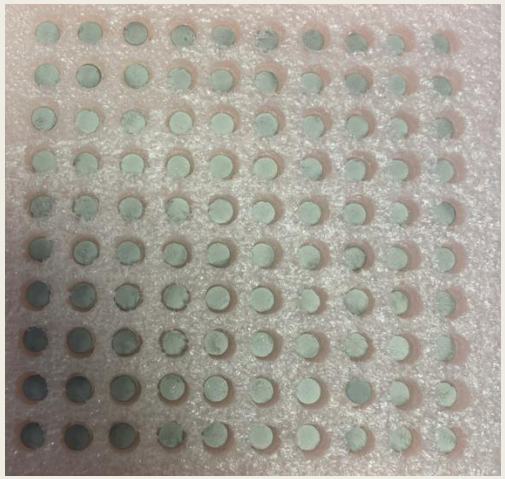
- yy+lepton analysis: Software & MC production ongoing
- Luminosity Transfer Study using TileCal & LUCID
- HGTD: Involvement in timing detector development & testing
- Cooling and condensation mitigation system under design
- Pixel digitization and signal calibration (Dr. Buckton)
- Strip digitization software and ABCStar validation (Dr. Nkadimeng)

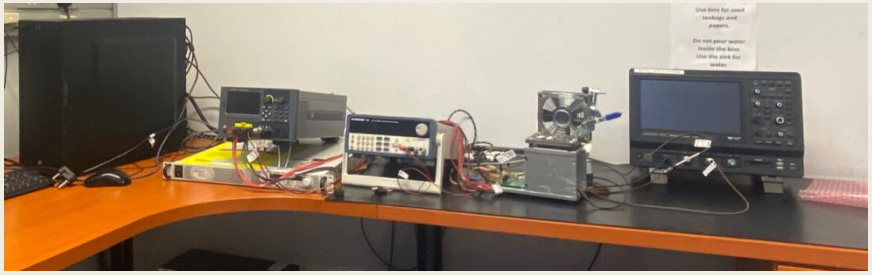


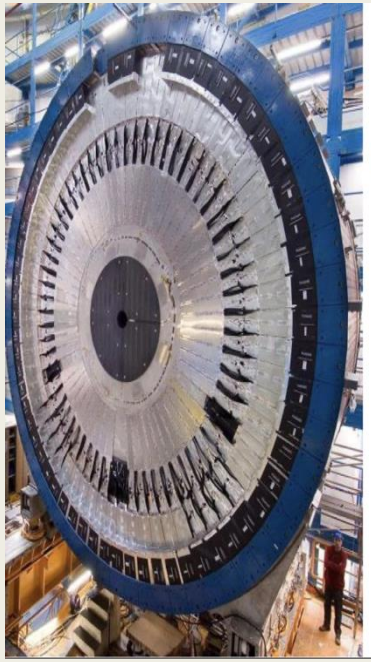


R&D Highlights: Wits, ITL, UniZulu, SU









South Africa's Contribution to the Upgrade of the ATLAS Hadronic Tile-Calorimeter Low-Voltage Power Supply for the HL-LHC

ATLAS Collaboration Week 16-20 June 2025

Thabo Pilusa, Vongani Chabalala, Sanele Gumede, Lungisani Phakathi, Chuene Mosomane, Donald Ngobeni, Roger Van Rensburg, Ryan Mckenzie, Edward Nkadimeng, Bruce Mellado, Mukesh Kumar

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NRF National Research Foundation

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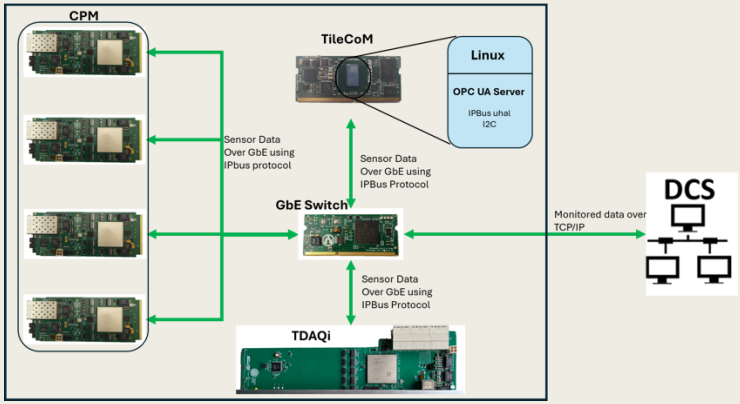
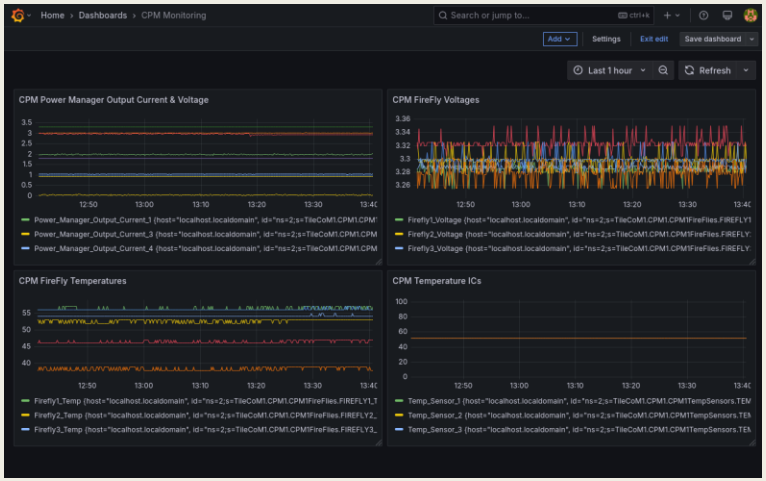
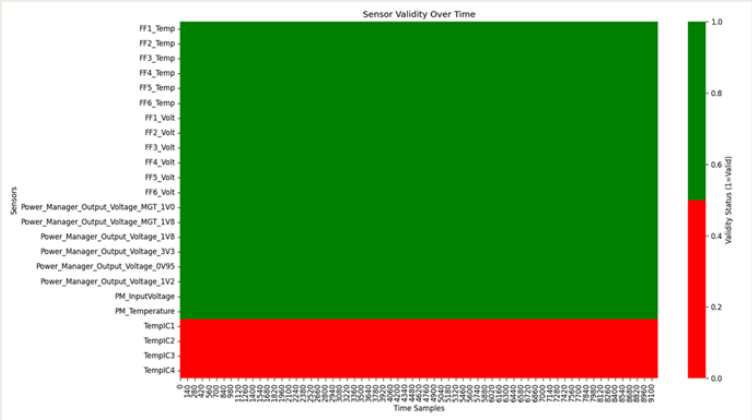
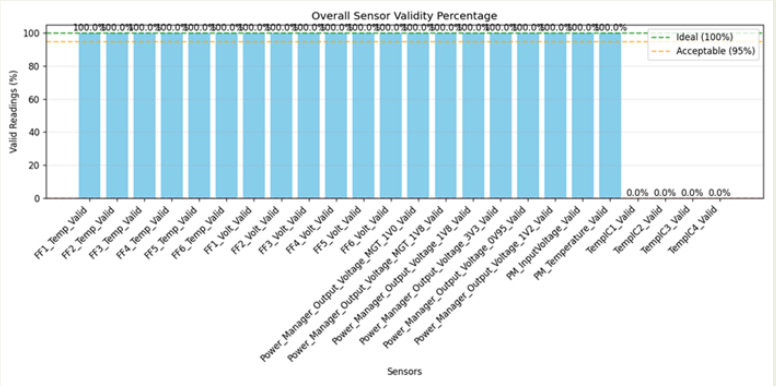
R&D Highlights: UJ

- Dr. Mpho Gololo and his student, Brenton Tapfumanei Munhungewarwa, are responsible for the **Tile PreProcessor (TilePPr)** South African contribution with a total of 24 % towards the final design of the Tile Calorimeter (TileCal) Phase-II upgrades.







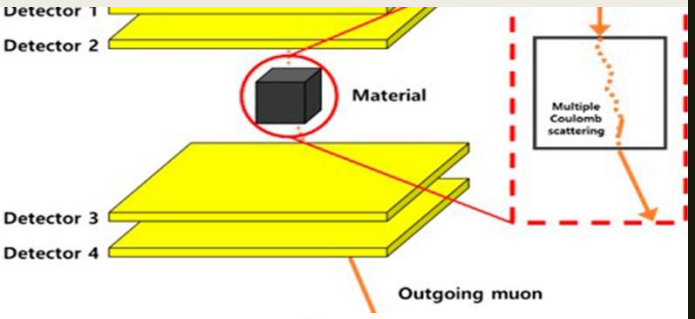


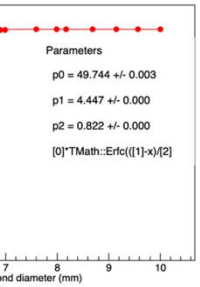
R&D HIGHLIGHTS: UJ+UNISA+UWC

iTK Fiber-Optic Sensors

Phase-II Upgrade Commitments

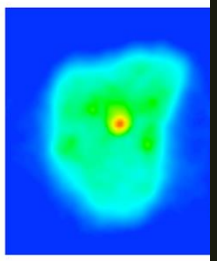
- TileCal power supply: Production readiness passed
- FOS: Production, QA/QC and tech transfer ongoing
- TilePPr: Firmware development, monitoring system tested
- UCT: Polymoderator design at CERN



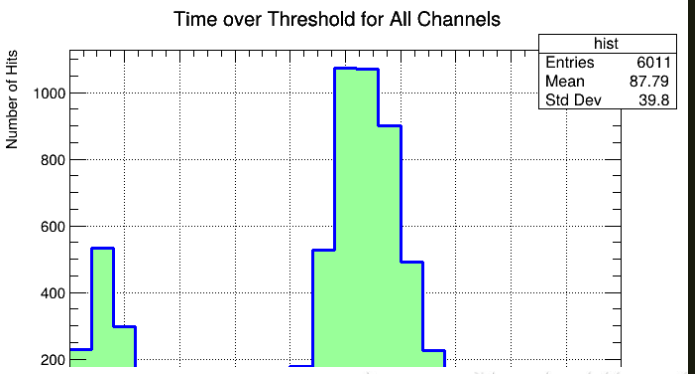


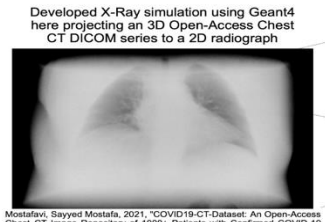
curve

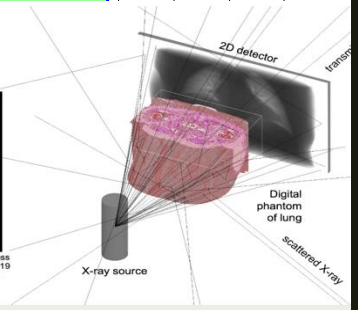
95mm long



2D slice from 3D PET reconstruction







Tech Transfer & Innovation

- muCT: Scintillator-based tomography prototype
- MicroMegas: Detector lab at UJ; DRD1 CERN project
- AI+CFD for Health: ICU-on-chip, TB, respiratory tools
- Greenhouse AI/CFD/IoT for agriculture: sensors, digital twins
- MinPET: Diamond imaging system commercialization

Human Capacity Development

New groups: UP, UKZN officially joined ATLAS

PhD/MSc/Honors student graduation and supervision

Notable Appointments and Research Tasks: Dr C Buckton (SU) digitisagtion iTK strip

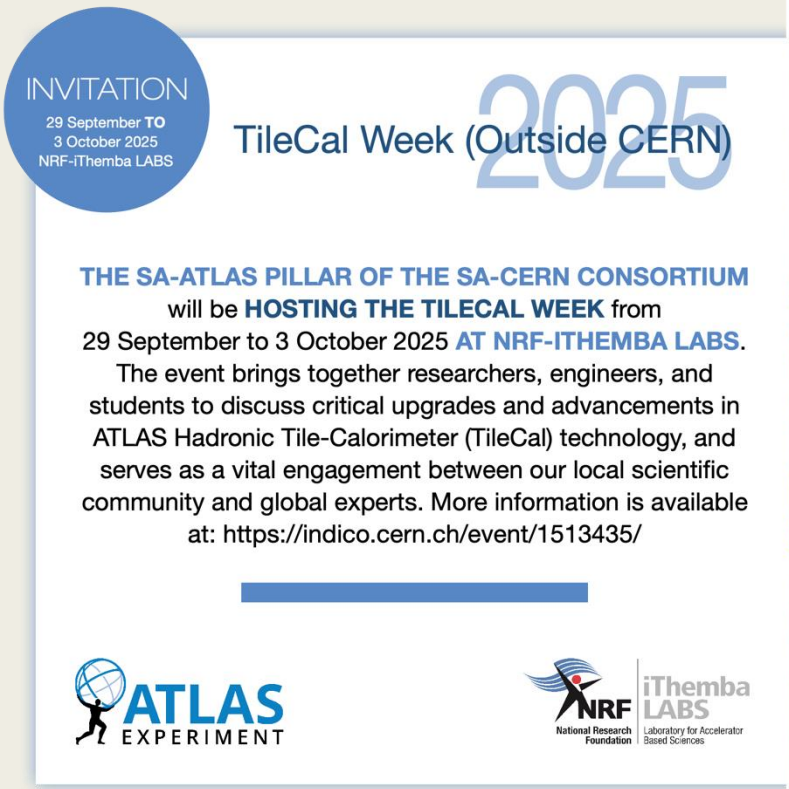
International roles and ATLAS leadership: Dr C Mosomane (iTL & ICPP Deputy Run Coordinator of the TileCal)

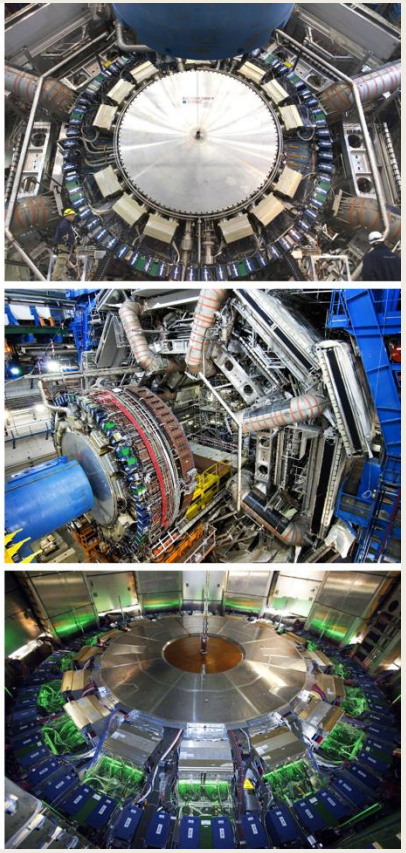
Prof Pedro Mafa (UKZN)
ATLAS iTK

Prof Muaaz Bhamjee (UP)
Thermoflow CFD upgrade
BSM exotic Higgs decays

KPIs & Challenges

- 2025/26 YTD: 17 PhD, 35 MSc students supervised
- 12 peer-reviewed articles published
- Need post-PhD support via fellowships & university roles
- DHET nGAP model proposed to address this

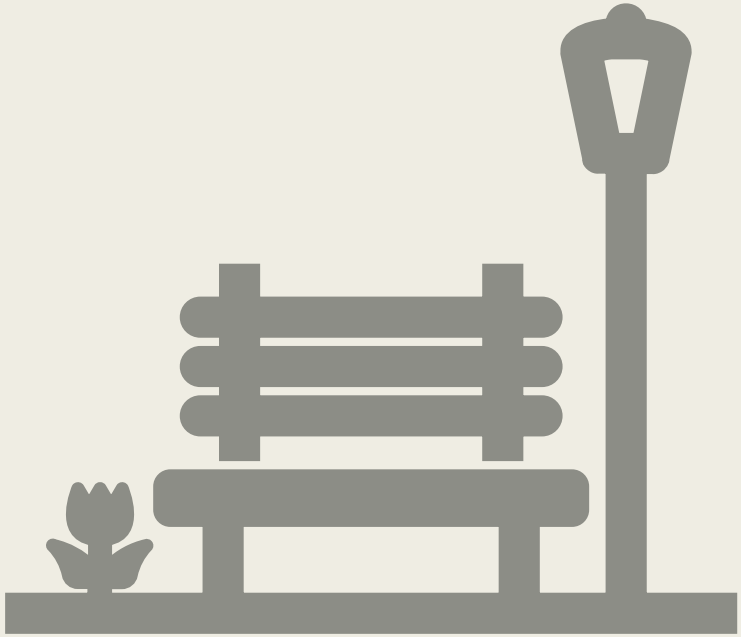




ATLAS TileCal Week (Outside CERN) at iThemba Labs, Cape Town

- Please Register and let me know (mukesh.kumar@cern.ch)
- https://indico.cern.ch/event/1513435/overview
- 29 Sep – 3 Oct 2025

Request to all local SA-CERN (ATLAS)



Discussions & Outlook

- SAIP-2026 ..
- Overall engagements …
- Funding Opportunities
- Student representatives & role(s)?