iThemba LABS: The South African National Facility for Nuclear Physics and Accelerator Based Sciences

WG9 MEETING 03 June 2023

Rudzani Nemutudi


Hentiesbaai
Namibia
Gobabis
Botswana
Swakopmund
Windhoek
Namib-Naukluft
National Park
Rehoboth
Thohoyandou
Tzaneen
Polokwane
Kruger
National Park
Mokopane
Gaborone
Mariental
Mbombela
Pretoria
Maputo
Mahikeng
Johannesburg
Mbabane
Eswatini
Luderitz
Keetmanshoop
Kgalagadi
Transfrontier
Park
Sperrgebiet
Upington
Kimberley
Richards Bay
Bloemfontein
Maseru
Springbok
Lesotho
Durban
South Africa
Vredendal
Mthatha
Beaufort West
East London
Makhanda
Oudtshoorn
Worcester
Cape Town
George
Gqeberha
Plettenberg
Bay
Hermanus
Mossel Bay
Google

iThemba LABS: The South African National Facility for Nuclear Physics and Accelerator Based Sciences

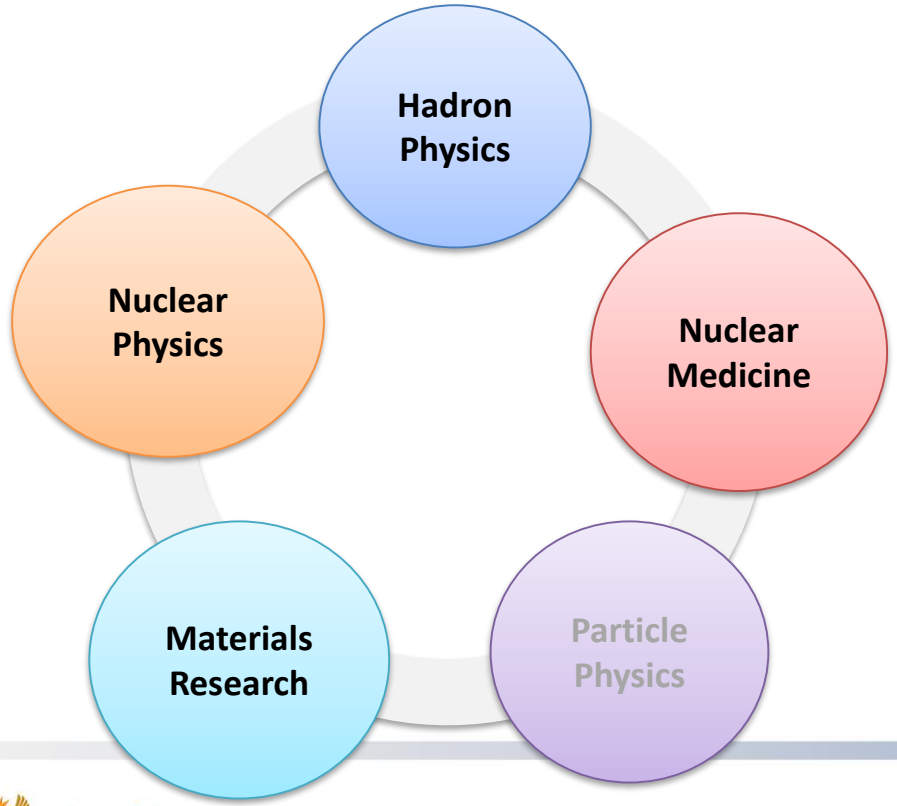
iThemba LABS

iThemba LABS is a research platform for pure and applied research, development and training in Accelerator Based Sciences

- fundamental studies of nuclear phenomena,
- applications of ion beams and associated techniques in materials and nanoscience research,
- accelerator mass spectrometry
- the production of radionuclides,
- radiation biology and medical physics

Research and Collaboration: iThemba LABS

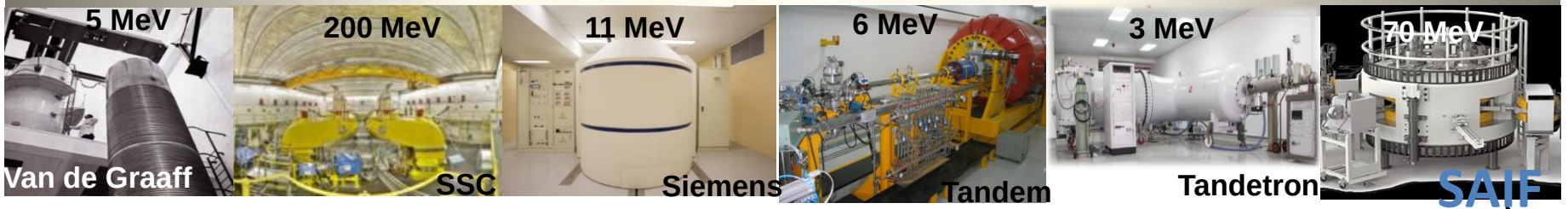
The transdisciplinary research agenda of iThemba LABS brings together scientists working in the physical, medical and biological sciences to solve real world problems while still considering the origin and evolution of the universe.



SA Collaborators and Users of the Platforms
University of the Western Cape
University of Cape Town
University of Stellenbosch
Cape Peninsula University of Science and Technology
University of the Witwatersrand
University of Pretoria
North West University
Fort Hare University
University of KwaZulu Natal
University of Zululand
North West University
Nelson Mandela Metropolitan
University of Limpopo
University of Venda
University of Johannesburg
Europe, Asia and America

Research Infrastructure Development

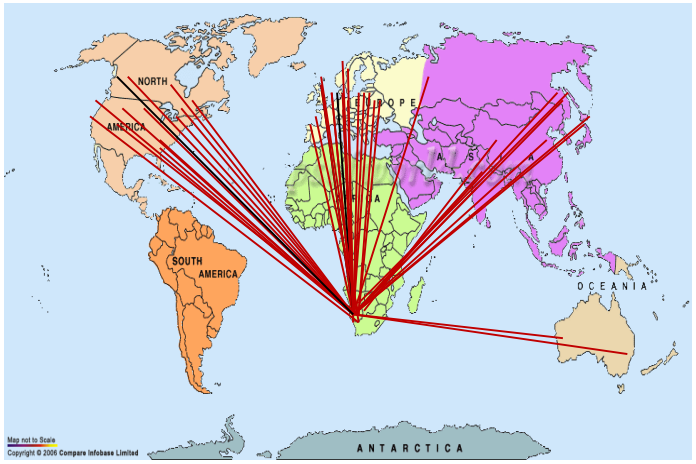
iThemba LABS: International African Hub of Expertise in Accelerator Based Sciences

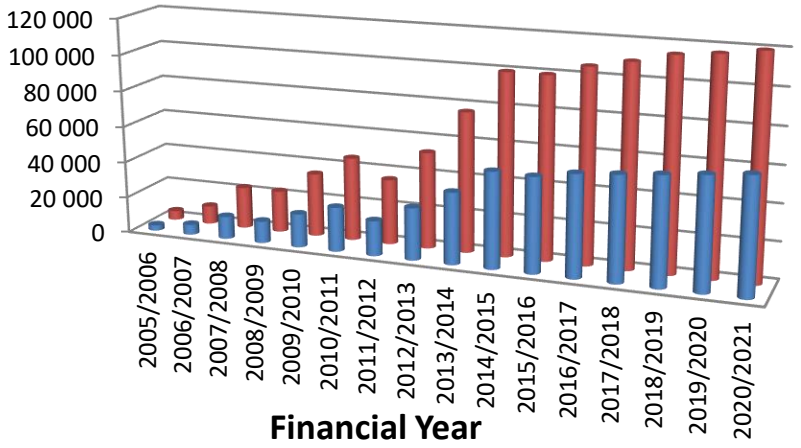


iThemba LABS Research Infrastructure Development (and Maintenance) has been the main basis upon which the Facility has remained locally and globally relevant since its inception.

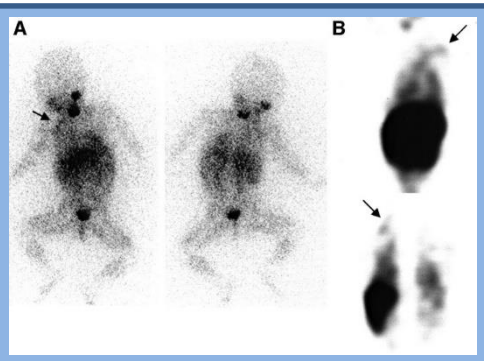
Infrastructure Procurement/Preference historically driven by demand and emerging technologies together with new fields of research.

iThemba LABS: Laboratories for Accelerator Based Sciences

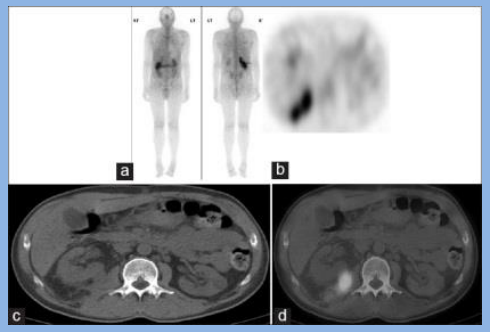




Current Medical Radioisotopes

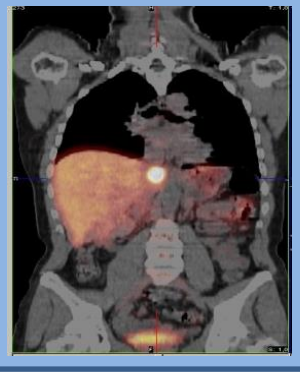


SPECT I-123: 2yr old child Thyroid Cancer



SPECT Ga-67: Kidney Infection

PET 18F-FDG: Brain Studies



PET Ge-68/Ga-68 generator
Liver tumour

New Wave of Medical Radioisotope Research

Alpha Emitters for Targeted Alpha Therapy

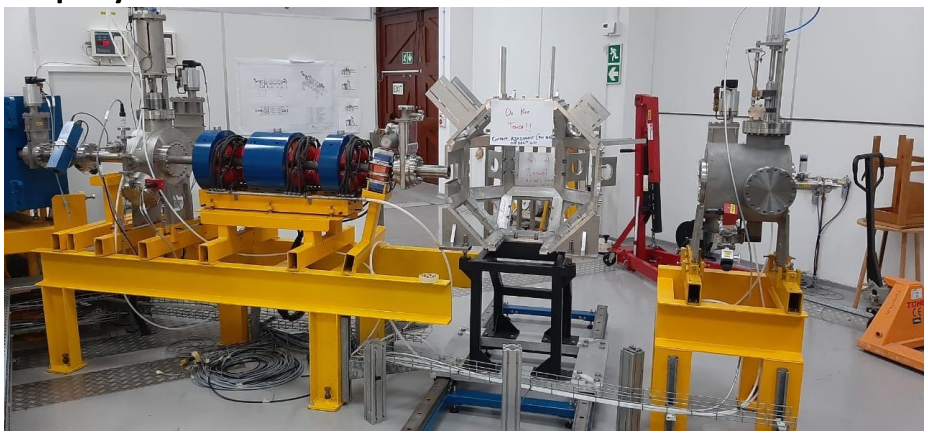
- At-211 [^{211}At-MABG]
- Ac-225/Bi-213 generator

Theranostic (Therapeutic-diagnostic) radioisotopes

- Sc-43 and Sc-47
- Cu-64 and Cu-67

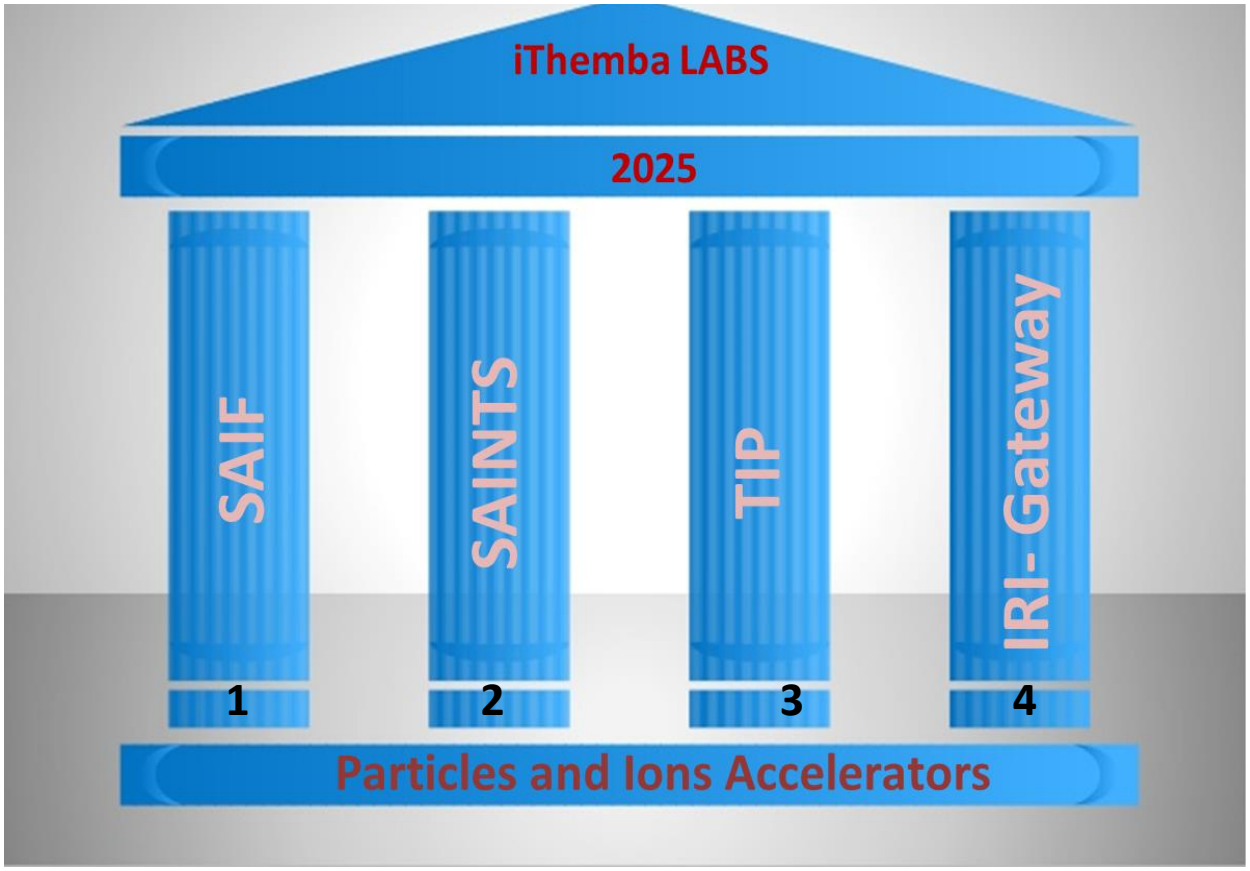
Recent projects completion (despite Covid19)

- New Nuclear Astrophysics beam line at the Tandetron Laboratory



- New Radiation Bio-Physics beam line at the SSC Laboratory

The pillars of the iThemba LABS Long Range Plan

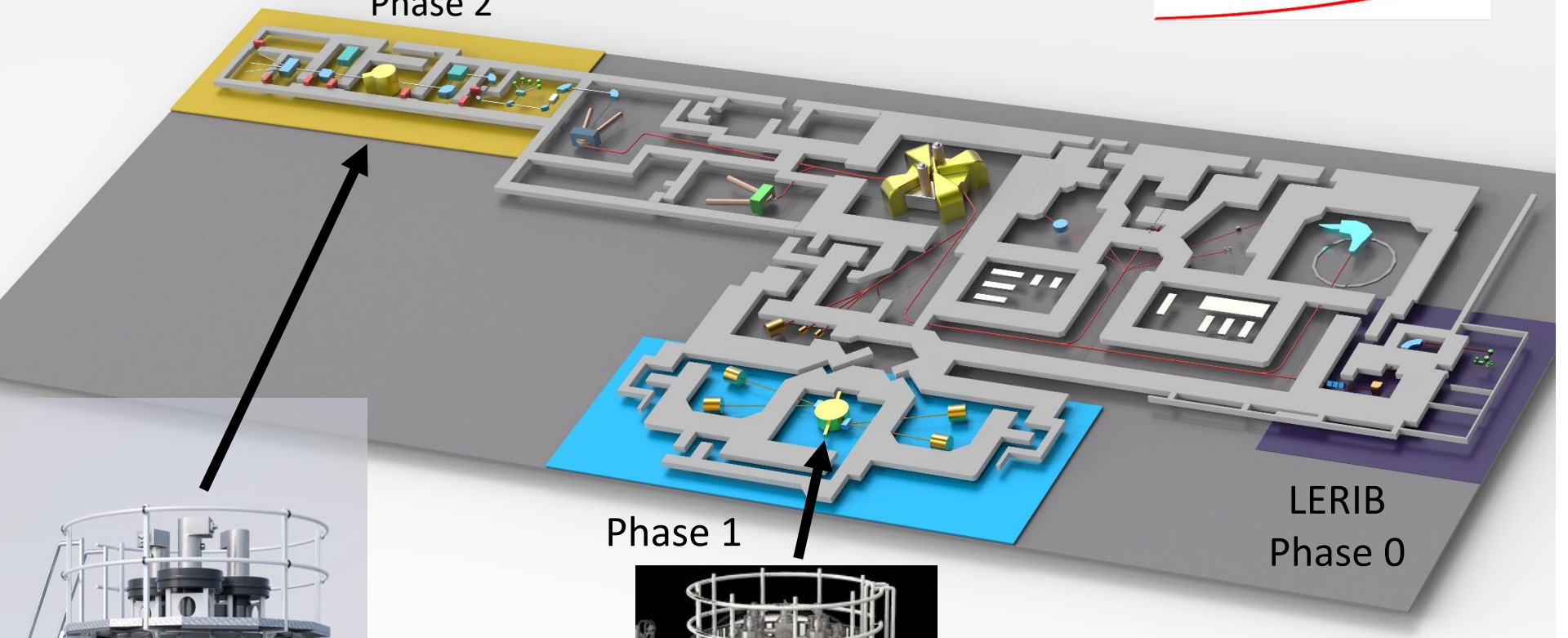


1. **Science**
2. **Training**
3. **Technology**
4. **Access to Research Infrastructure**

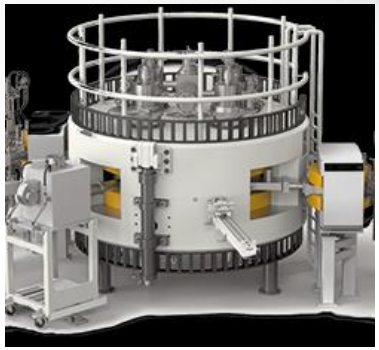
The envisioned success of our Long Range Plan pillars remain heavily dependent on a strong and durable tradition of sound, mutually beneficial international collaborations

SAIF SOUTH AFRICAN ISOTOPE FACILITY

Phase 2



Phase 1



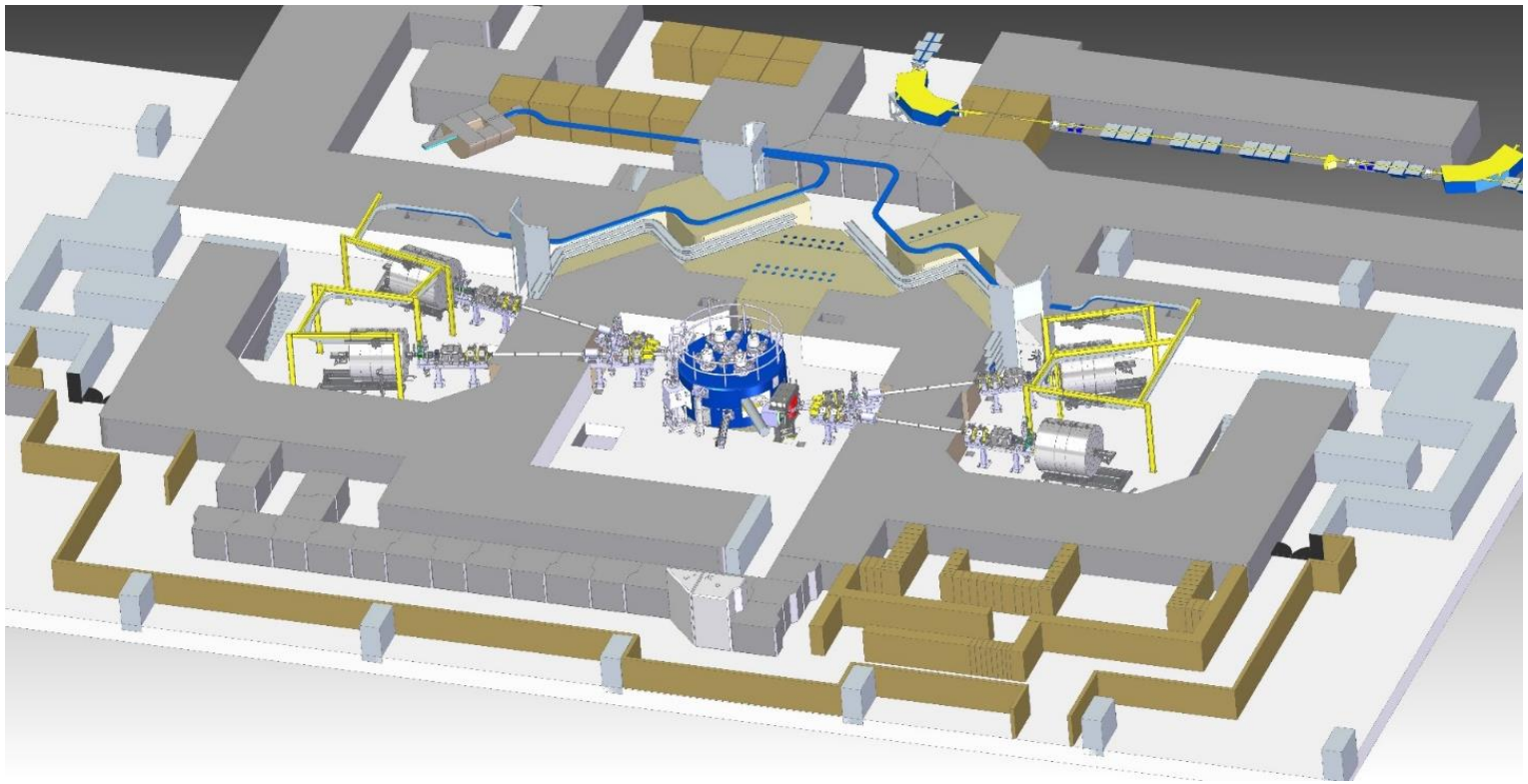
LERIB
Phase 0

iThemba LABS: South African Isotope Facility – Phase 1

SAIF SOUTH AFRICAN ISOTOPE FACILITY

Implementation STARTED SEP 2019:

- **70 MeV cyclotron**
- **New beamlines**
- **New target stations**
- **New buildings for utility services, waste disposal**
- **Regulatory licensing**

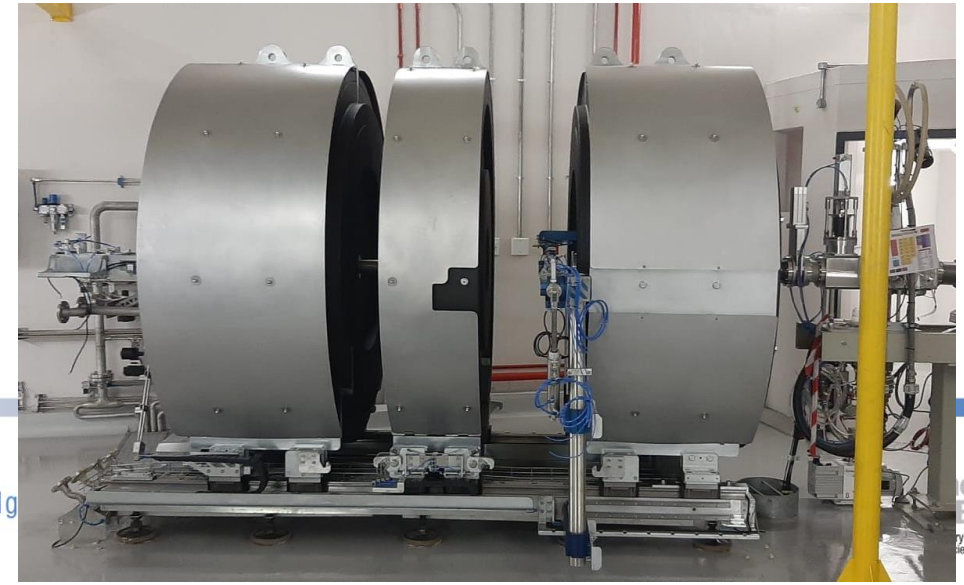


Installation of C70 cyclotron and beam transport lines

Installation of C70 cyclotron and beam transport lines

- Rigging into the TC vault completed on 14 Apr 2022
- Beam line equipment installed in cyclotron vault and both target vaults with water cooling manifolds
- Mechanical assembly of cyclotron complete 13 Dec 2022
- First beam extracted 19 Apr 2023

The South African Isotope Facility



iThemba LABS: South African Isotope Facility – Phase1

Target Systems

- Provide local radiation shielding (steel, lead, borated wax)
- Accommodate solid targets of Sr and Ga in tandem
- Water-cooled target capsules (up to 26 kW heat removal)
- Helium-cooled vacuum window
- Robotic transfer of target from target stations to chemical processing facility

iThemba LABS: South African Isotope Facility – Phase1

Infrastructure:

Electrical
- New transformers, MV and LV switchgear installed
- RUPS passed factory acceptance testing 24 May 2022

Mechanical
- New chiller plant installed, being commissioned
- HVAC ducting 80% completed
- Air handling units for vault areas installed
- Water cooling reticulation in progress

Power supply room / Control room / Change rooms
- Power supply room completed, IBA equipment installed
- Control room area completed
- Blue area change rooms completed
- Pump room completed

iThemba LABS: South African Isotope Facility – Phase1

Infrastructure:

Waste management building

The South African Isotope Facility

SAIF SOUTH AFRICAN ISOTOPE FACILITY

Activity Progress Schedule

Activity	Estimated completion date
Safety interlocking and vault clearance	Completed
Complete wiring & cabling of 2x target stations	Completed
C70 cyclotron: RF start	Completed
Ion source start	Completed
Beam extraction	Completed
Beam transport line commissioning	31 July 2023
C70 cyclotron: Site acceptance testing	31 Aug 2023
Complete regulatory licensing process	30 Sep 2023
Launch Inauguration	09 June 2023

TIP: Technology and Innovation Platform

Vision

- Developing innovative technology skills and know-how
- Sharing of technology with other Facilities and universities
- Transfer of technology to industry

Building completed September 2022

Pillar 2: TIP

Technology and Innovation Platform

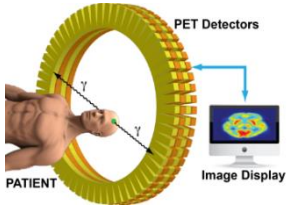
Building Completed

Objective Vison

- Implement TIP as a Technology Development Platform driven by Innovative projects such as Detector Development to enhance CERN Collaboration, Sharing of technology with other laboratories
- Infrastructure for Device Assembly and Testing
- Industrial Partnerships for Technology Transfer

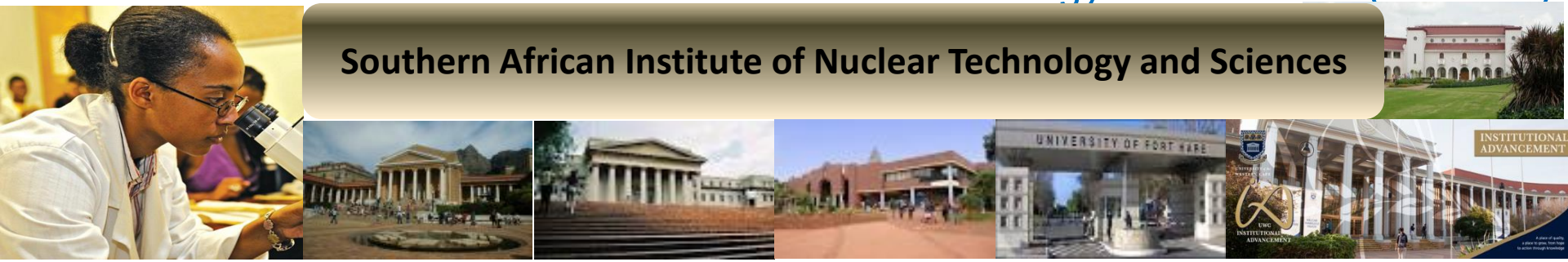
Flagship Projects

- PET Detectors



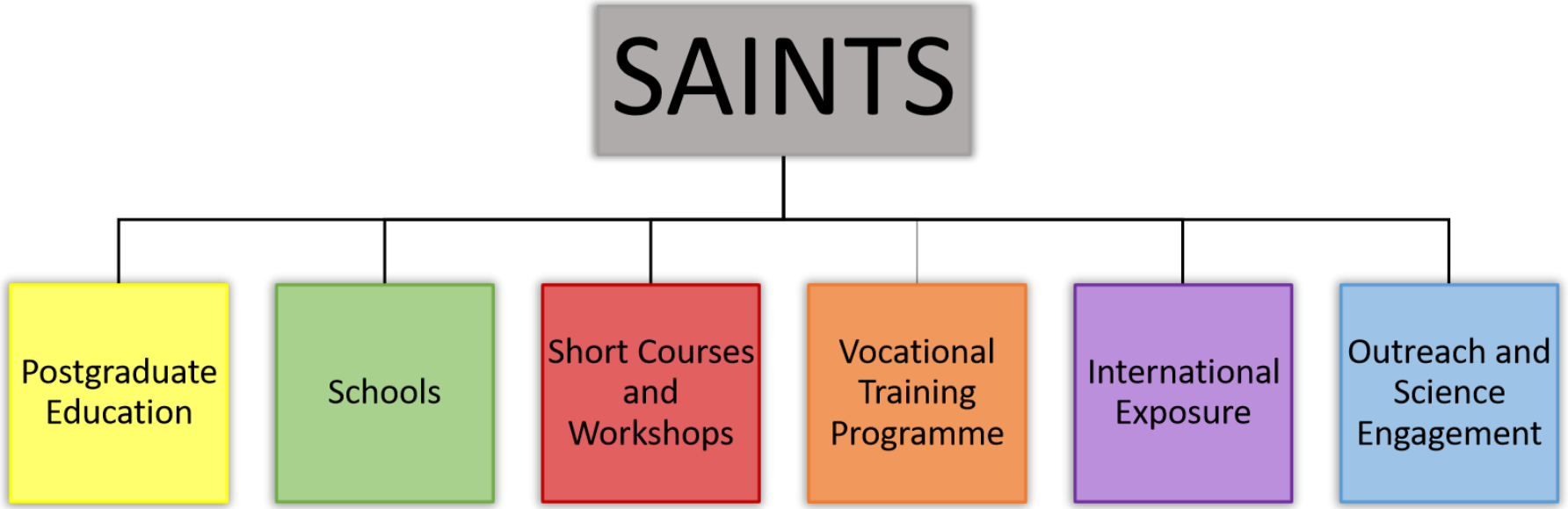
SAINTS

Southern African Institute of Nuclear Technology and Science (SAINTS)



Strategic Objectives

- Improve quality and quantity of research outputs
- Increase training capacity for technical human resource development
- Strengthen collaboration with Higher Education Sector



SAINTS

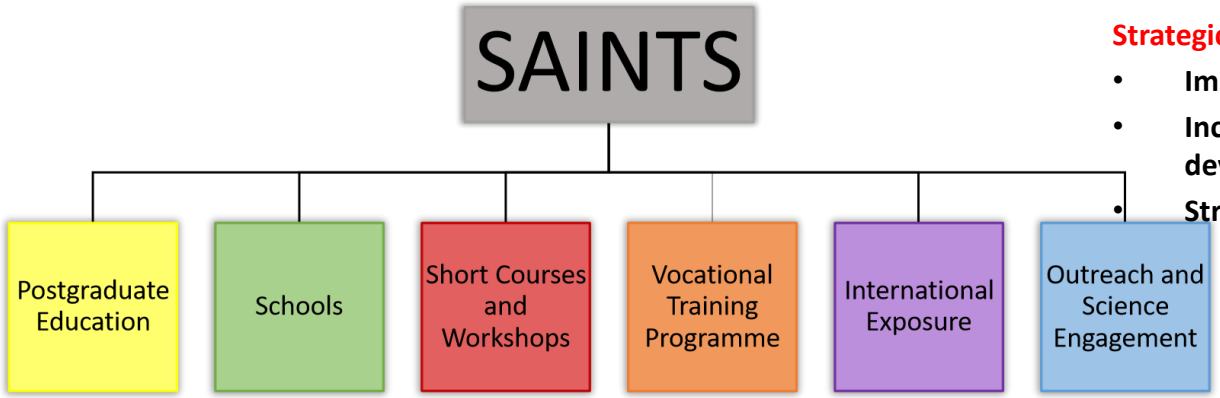
Expanding Post-graduate Training Platforms

Southern African Institute of Nuclear Technology and Sciences




Borne out from the need to close identified academic training gaps, SAINTS expands the current suite of post-graduate student training platforms through the establishment of a dedicated training institute which simultaneously addresses the growing HCD needs in the nuclear sciences, radiation protection, radiochemistry, radiation biophysics, and material sciences. Curriculum content developed through Working groups in collaboration with HEI Local and International partners.

The initiative to establish SAINTS (Southern African Institute of Nuclear Technology and Sciences) was fashioned along the model of the INSTN in Saclay,



Strategic Objectives

- **Improve quality and quantity of research outputs**
- **Increase training capacity for technical human resource development**
- **Strengthen collaboration with Higher Education Sector**

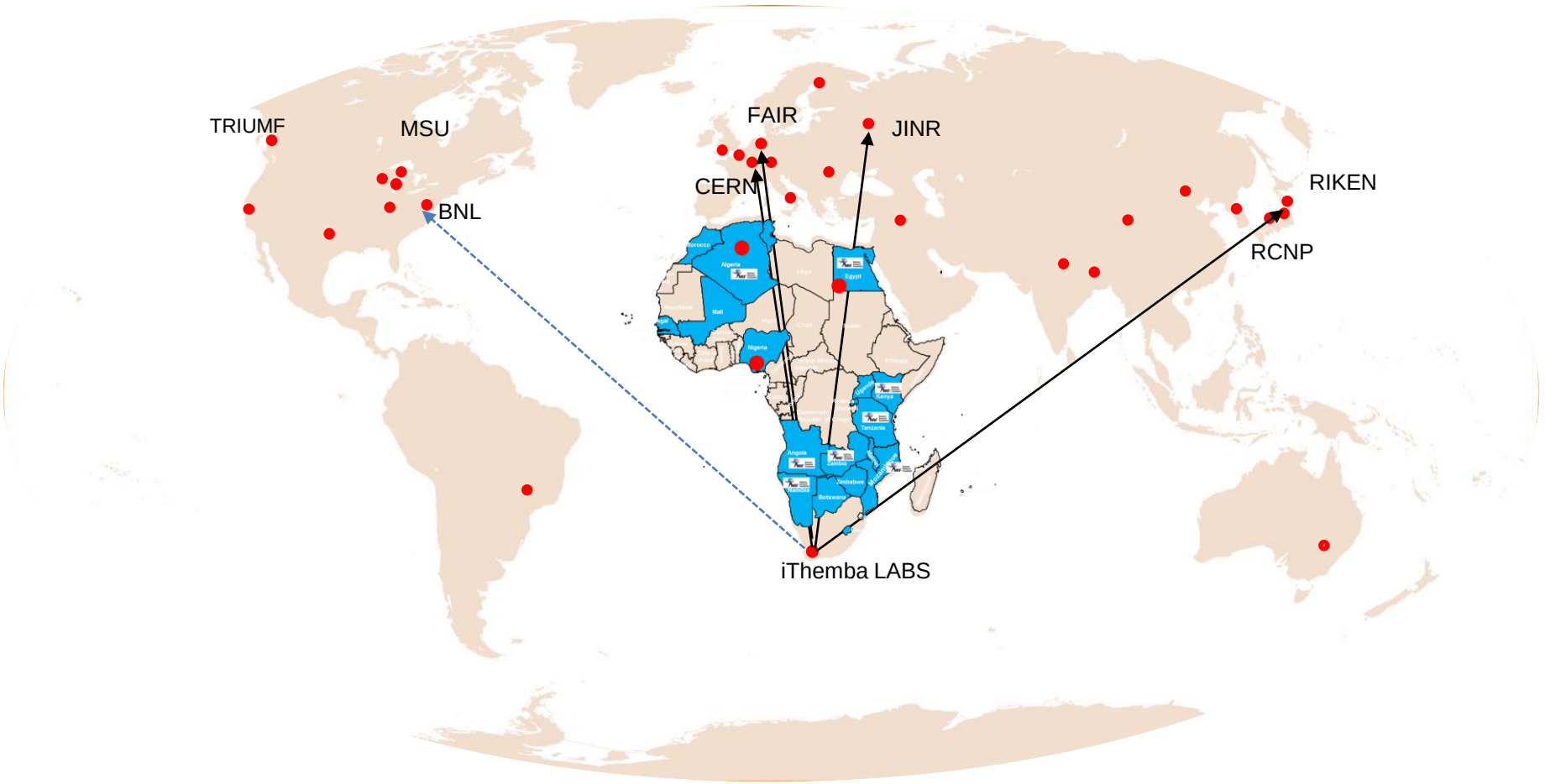
SAINTS: The South African Institute of Nuclear Technology and Science

First graduations : Master in 2022 and PhD in 2023

SA-JINR-SAINTS SUMMER SCHOOL HELD AT iTHEMBA LABS 16 Jan – 03 Feb 2023

IRI-G

IRI- Gateway (International Research Infrastructure Gateway)



The African gateway to International Large Scale Research Infrastructures

IAEA Collaborating Centre (November 2021)

Creation of APACC
African Particle Accelerator Collaboration Committee (February 2022)

Activities

- Capacity building:
  - ✓ Hosting visits of young researchers and scientists from Africa and other continents.
  - ✓ Organizing post-graduate training courses in fields relevant to Accelerator Based Sciences extended to IAEA member states across the African continent.
- Organization and/or hosting regional and/or international scientific/technical events (workshops, conferences, collaboration meetings, etc.)
  - ✓ Training Workshop on hands-on maintenance of electrostatic accelerators
- Ongoing Provision of expert services for expert and other missions on request

Workshop successfully held in GAUTENG at the TAMS Department on 05 -10 Dec 2022, with participation from several IAEA member states representatives, including participants from Ghana, Egypt, Nigeria, Iran, Lebanon, Syria, Pakistan and Argentina

IAEA
International Atomic Energy Agency

Training Workshop on Hands-on Operation and Maintenance of Electrostatic Accelerators

Hosted by the

Government of the Republic Of South Africa

through the

IThemba LABS

Cape Town and/or Johannesburg, South Africa

5 to 10 December 2022

PROGRAM ADVISORY COMMITTEES (PAC)

1. SSC

PAC - 16-18 January

Proposals presented to the PAC: 15
(plus an additional proposal with nuclear physics topic for Tandetron)

Total beamtime requested:

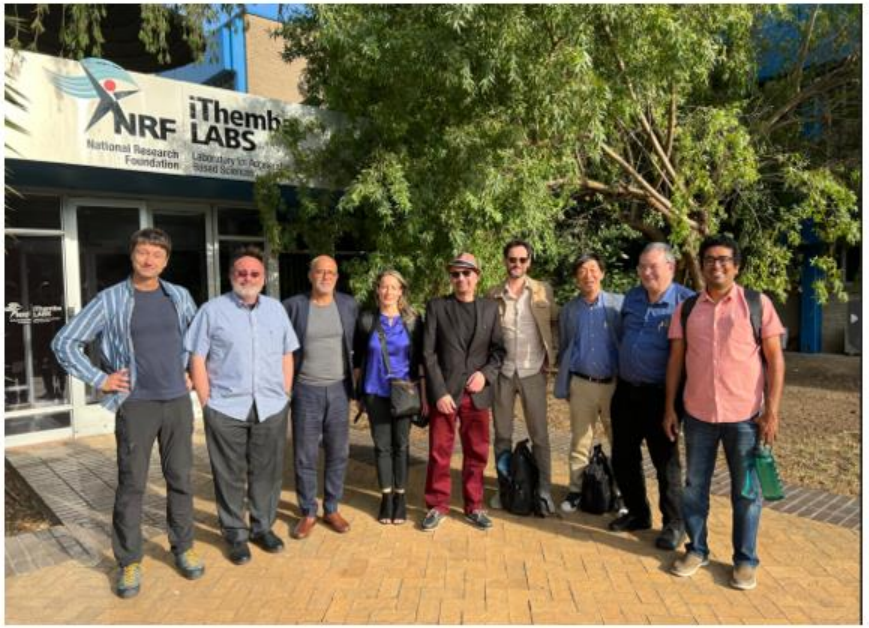
SSC: 446 shifts (8h each) - 3500 hrs / 150 days
Tandetron: 42 shifts (8h each) - 2 week

Total beamtime awarded:

SSC: 277 shifts (8h each) - 2200 hrs / 90 days
Tandetron: 42 shifts (8h each) - 2 weeks

Together with projects still in backlog, there are now 766 shifts of experiments to be done (6128 hours or 255 days) of which

- 18 are S-line experiments
- 11 are F-line experiments
- 5 are B-line experiments
- 4 are D-line experiments
- 3 are A-line experiments
- and 3 are to be done elsewhere (isotopes, G-line)



2. IBA PAC: 13 – 14 February

22 Proposals

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

Advancing knowledge. Transforming lives. Inspiring a nation.

NRF National Research Foundation
iThemba LABS Laboratory for Accelerator Based Sciences

CONFERENCES, WORKSHOPS and SCHOOLS

iNPC2022

Cape Town, South Africa

11 to 16 September 2022

Inauguration of SAIF phase1

Year of Basic Sciences for Sustainable development

100 years of IUPAP

100 years since Bohr's Nobel Prize

The INPC2022 was a resounding success. The first on the African Continent, with almost 500 participants, 185 invited papers, 38 of which were given by women. INPC2022 drew participation from 35 countries with 374 participants attending from outside host country

Conferences, Workshops, and Schools

Ndi a Livhuha, Enkosi, Thank you, Re a leboga, Siyabonga, Dankie

National Research Foundation | SARAO South African Radio Astronomy Observatory

National Research Foundation | SAAO South African Astronomical Observatory

National Research Foundation | SAEON South African Environmental Observation Network

National Research Foundation | SAIAB South African Institute for Aquatic Biodiversity

National Research Foundation | iThemba LABS Laboratory for Accelerator Based Sciences

National Research Foundation | SAASTA South African Agency for Science and Technology Advancement

National Research Foundation | RISA Research and Innovation Support and Advancement