

Basic science for sustainable development in South Africa : A Legacy which continuation as a Tradition is the *challenge*!



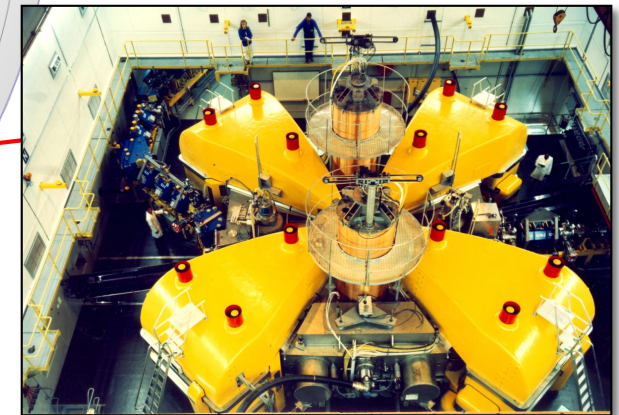
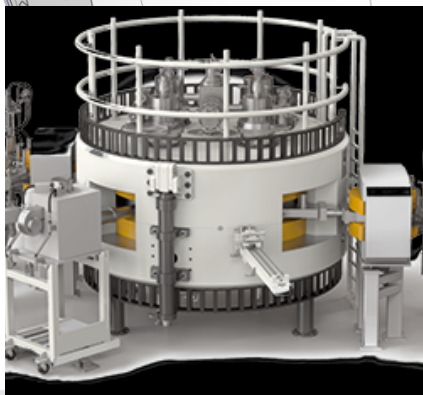
Faical Azaiez

Basic science for sustainable development in South Africa

The Legacy

Basic Science in South Africa is a very long tradition :

- 70 years of nuclear Physics and accelerator based sciences
- 200 years of astronomy



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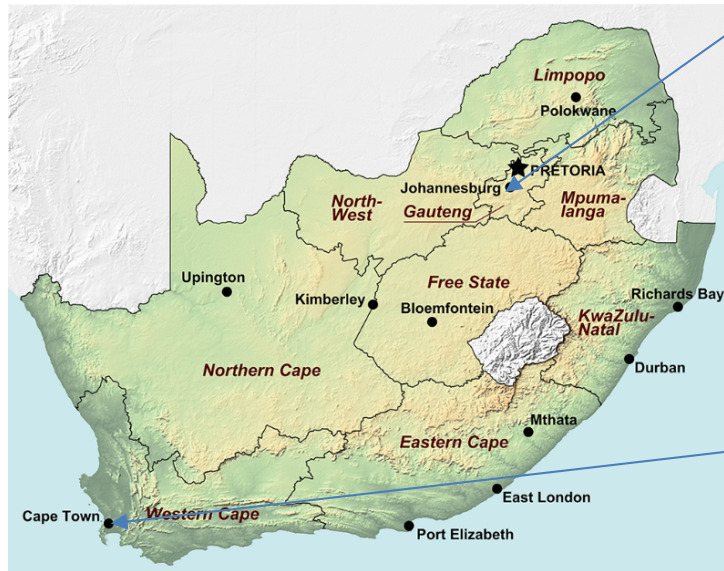
Advancing knowledge. Transforming lives. Inspiring a nation.



iThemba LABS : The largest facility of the kind in the southern hemisphere and one of the largest in the world



iThemba LABS (Laboratories for Accelerator Based Sciences)



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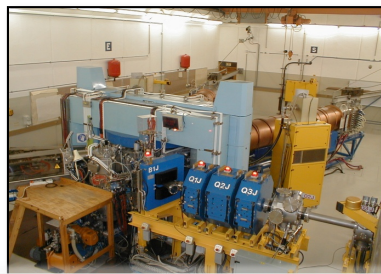
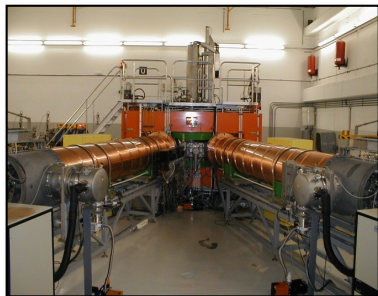
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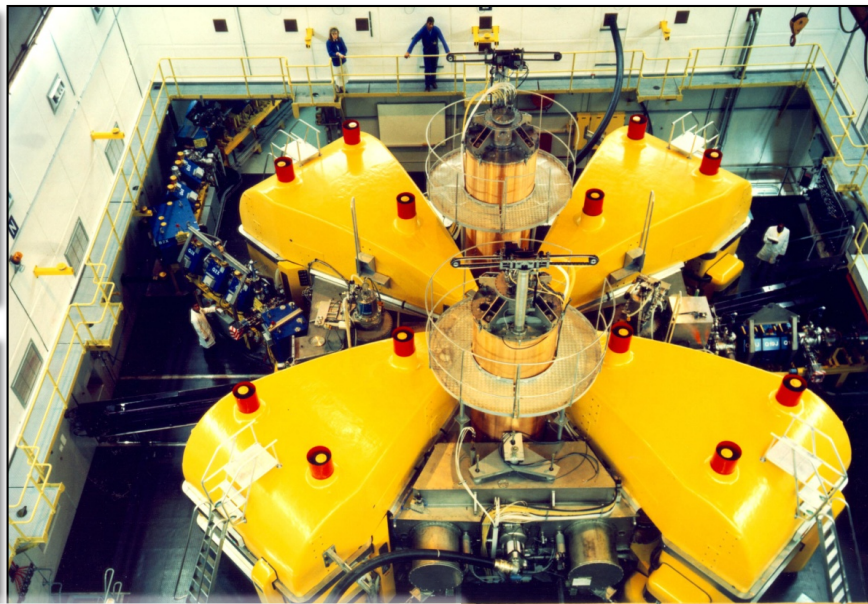


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LABS
National Research
Foundation
Laboratory for Accelerator
Based Sciences

iThemba LABS: 4 Facilities/Laboratories



K200 Separated Sector Cyclotron



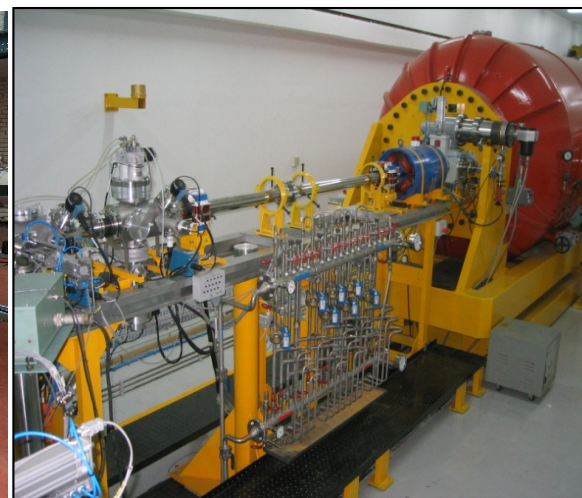
SSC Laboratory



K11 Cyclotron

Nuclear Medicine Laboratory

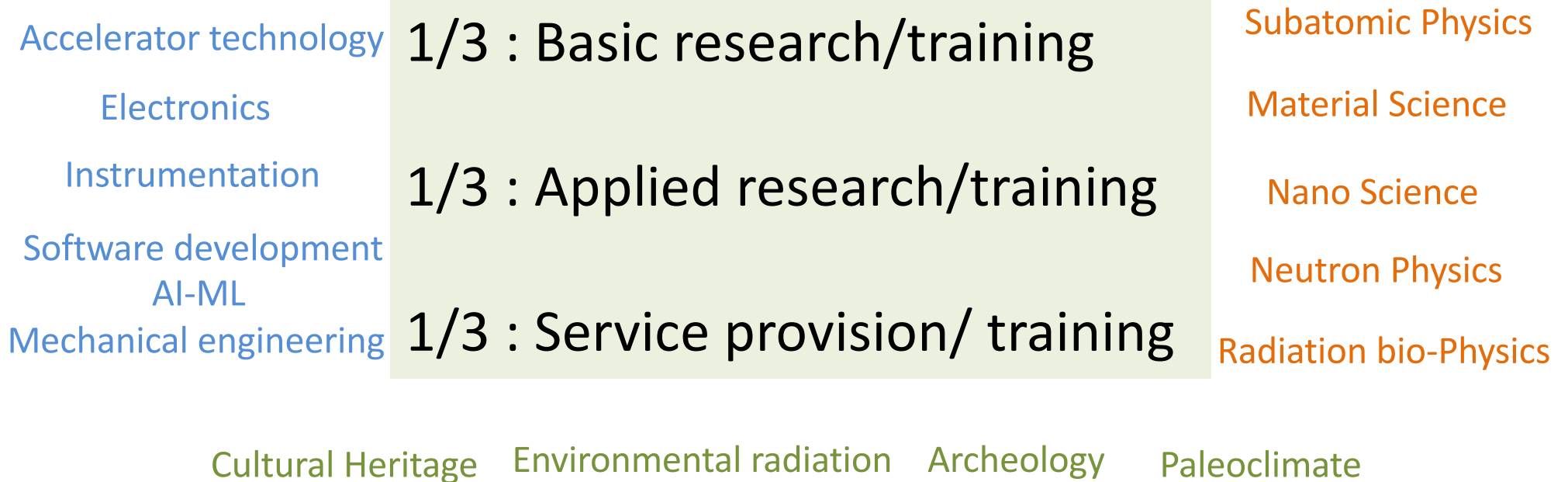
Tandetron Laboratory
3 MV Tandetron



TAMS Laboratory
6 MV Tandem

Core Business of iThemba LABS

Research and development oriented Innovation and Human Capacity Development



iThemba LABS

Key Statistics

- Annual Budget ~15MEuros (Isotope Production Revenue ~5MEuros)
- Staff ~ 300 , 52 Scientists
- Students Supervised ~ 90/year

iThemba LABS : Users facility



Cape Town

University of the Western Cape	University of Limpopo
University of Cape Town	University of Venda
University of Stellenbosch	University of Johannesburg
Cape Peninsula University of Technology	Sefako Makgatho University
University of the Witwatersrand	Tswane University of Technology
University of Pretoria	University of the Free State
North West University	University of South Africa
Fort Hare University	Rhodes University
University of Kwazulu Natal	AFRICA
University of Zululand	
Nelson Mandela Metropolitan University	EUROPE
	ASIA & THE AMERICA's



Johannesburg



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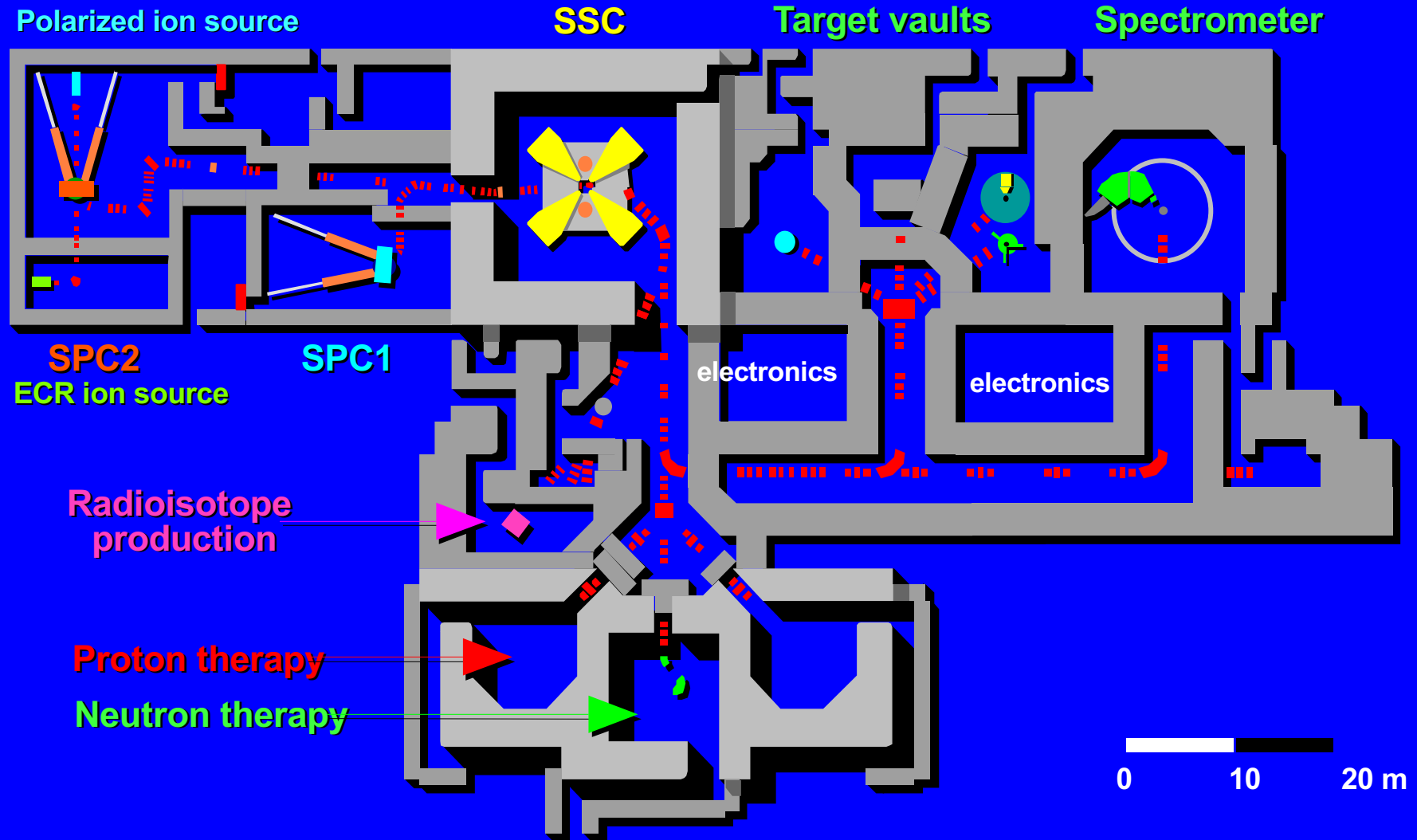
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Scientific Research : the Bridge to Technology and Innovation



**iThemba
LABS**
Laboratory for Accelerator
Based Sciences

Separated-Sector Cyclotron Laboratory



since 2016 : Phasing out of the neutron and proton therapy and the end of research during weekends only !



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Basic science for sustainable development in South Africa: The Continuation of the Tradition

The Long Range Plan

iThemba LABS : 2017-2025



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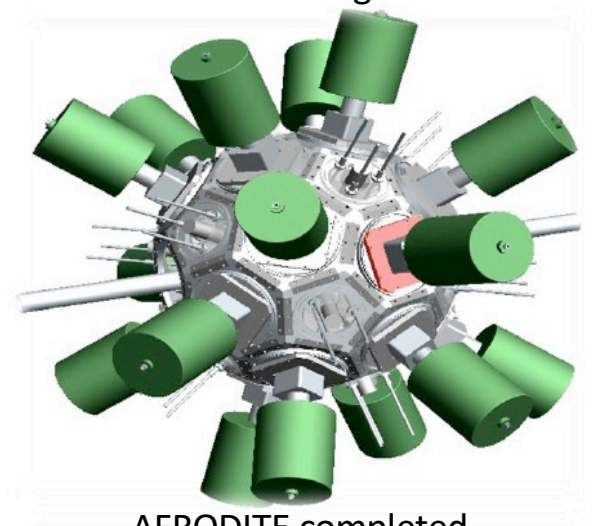
Scientific Research : the Bridge to Technology and Innovation



New state of the art detector arrays completed in 2020

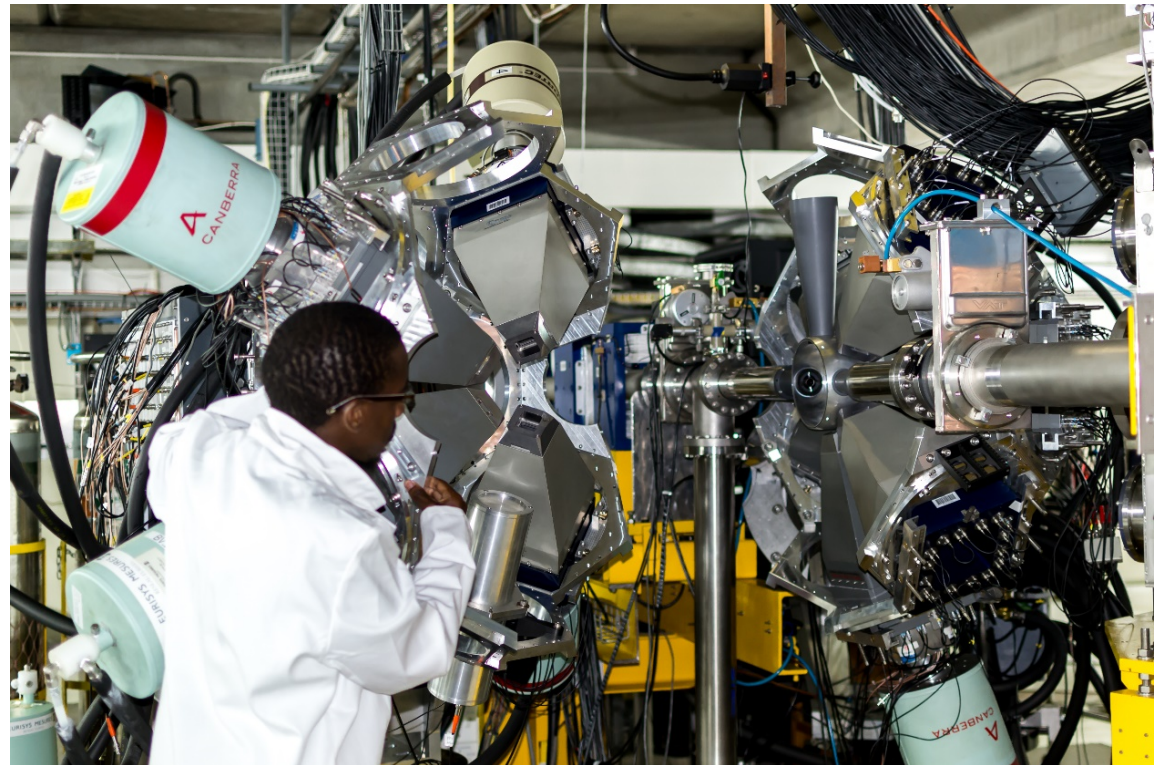


ALBA: 23 large volume LaBr3
and 8 fast timing LaBr3.



AFRODITE completed
to a total of 18 Clover + BGO

GAMKA = AFRODITE + ALBA



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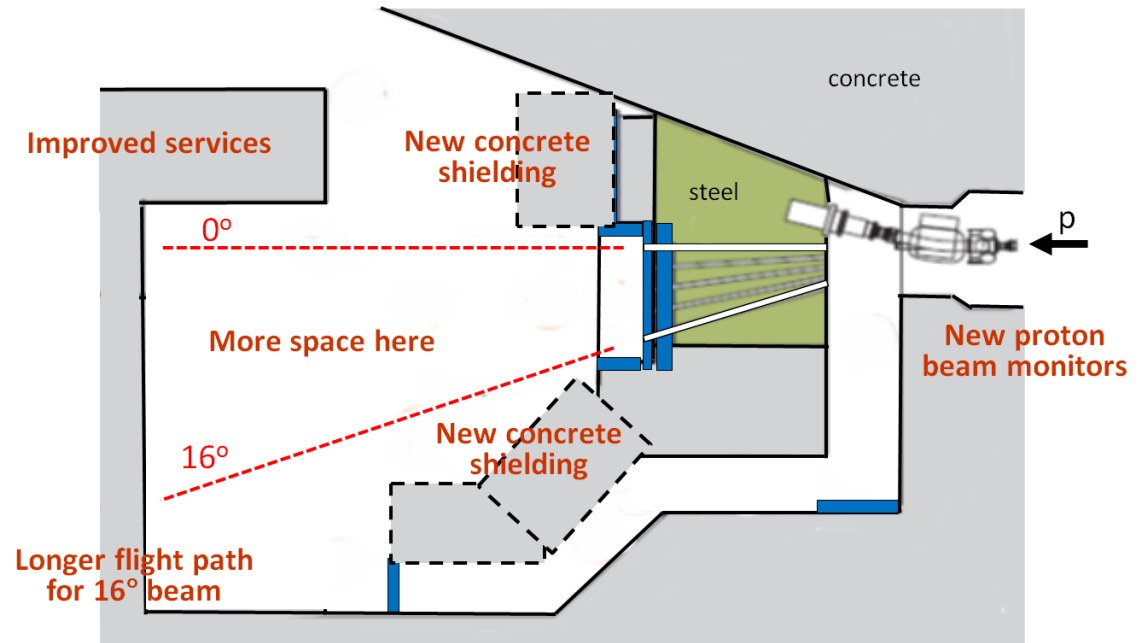
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New and Unique Neutron Beam Facility completed in 2021

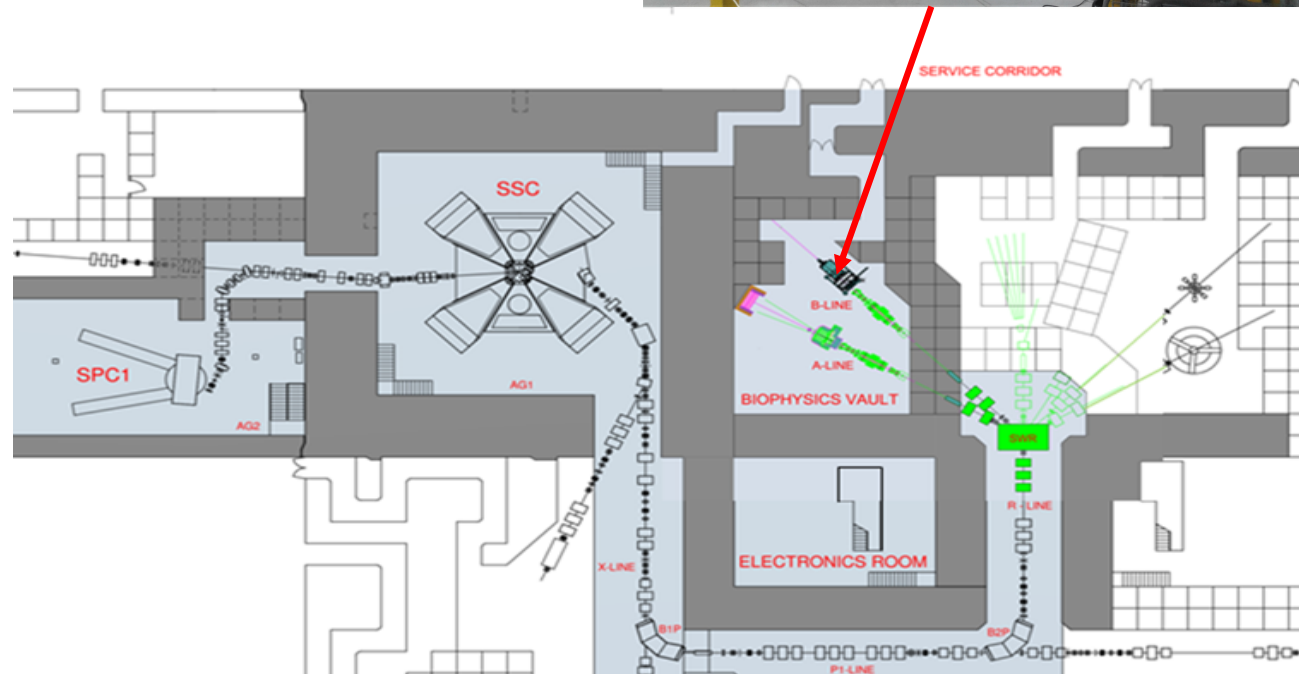
- **Targets:**
 - Li, Be: quasi-monoenergetic
 - C: quasi-white ('grey')
- **Beam currents**
 - 3-5 μA ($E_p < 100$ MeV)
 - 300 nA ($E_p = 200$ MeV)
- **Pulse selection:** 1/1 – 1/7
- **Time resolution:** ≈ 1 ns
- **Flight paths:**
 - 10 m (0°)
 - 8 m (16°)
- **Fluence rate** (1 mm Li):
 $j \approx 1 \cdot 10^3 \text{ cm}^{-2} \mu\text{A}^{-1}$ at 10 m



- Neutron metrology
- Detector calibrations
- Radiation hardness testing
- Neutron activation studies



New Radiation Biophysics Beam Line Completed in 2021



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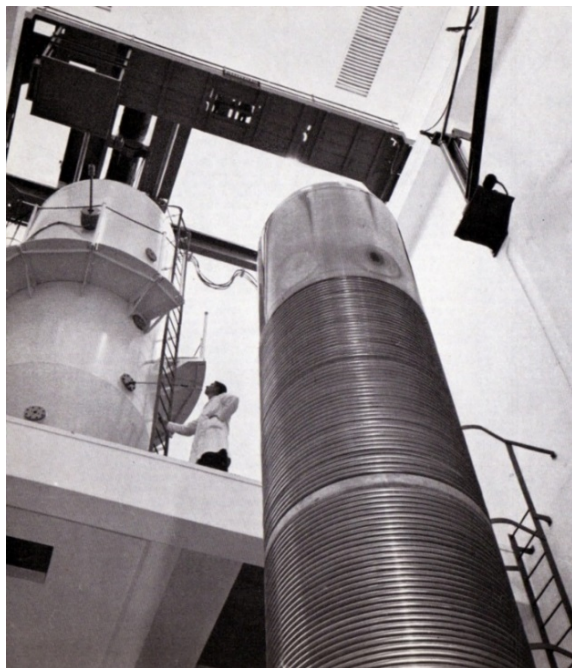
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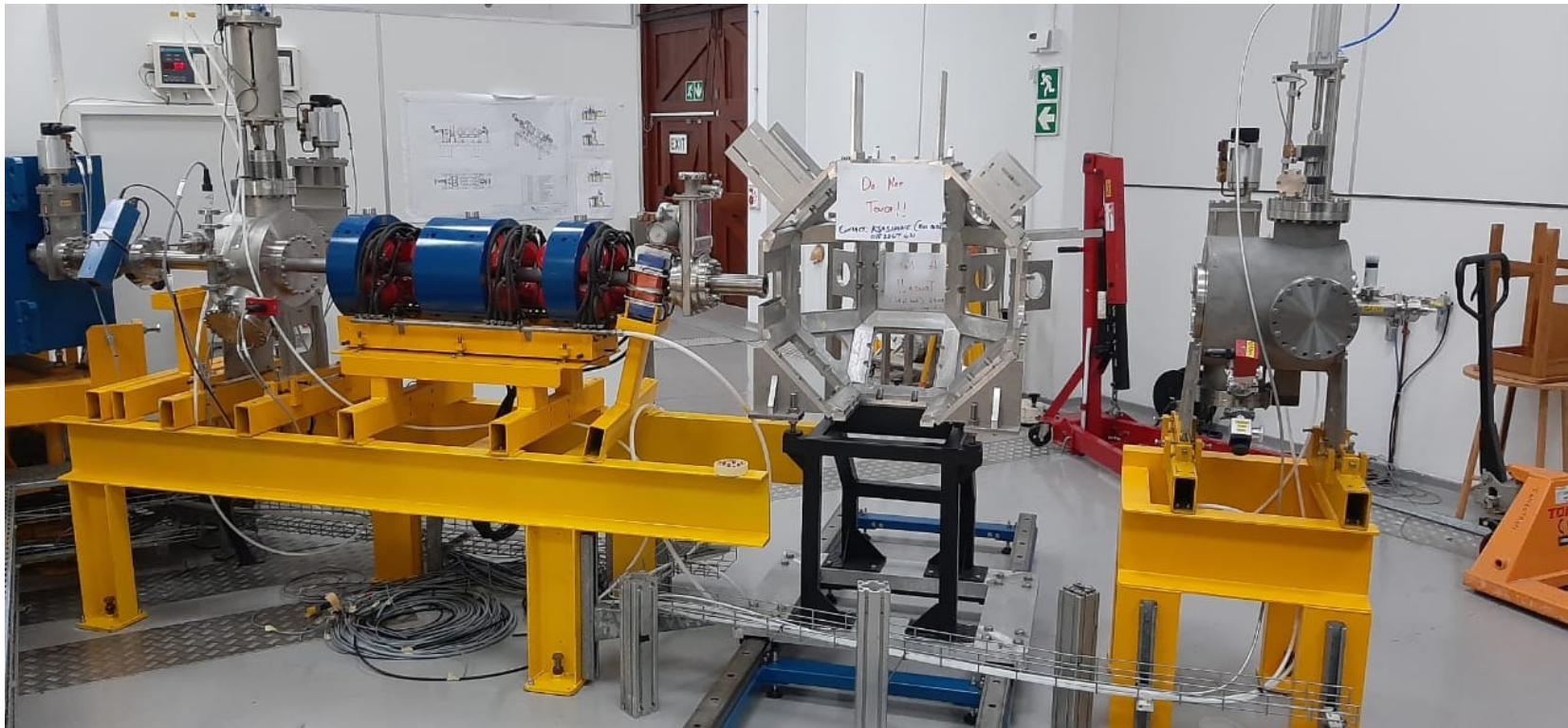
Tandetron Laboratory

Replacement of the 52-year-old Van de Graaff with a 3 MV
Tandetron accelerator



January 2018: First beam on target

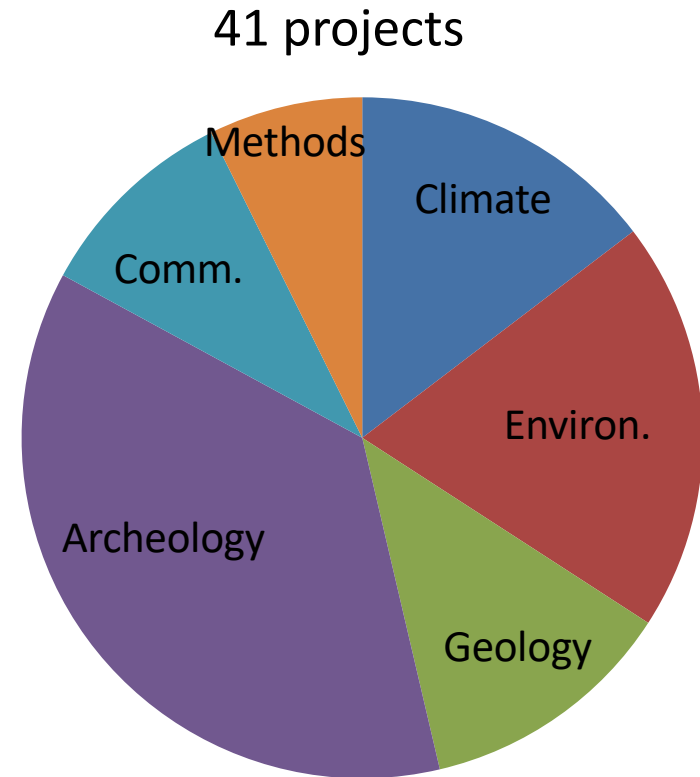
New Nuclear Astrophysics beam line at the Tandetron Laboratory



AMS @ iThemba LABS fully commissioned 2018- 2019: research started @AMS



dating: isotopes (^{14}C , ^{10}Be , ^{36}Cl , ^{26}Al)



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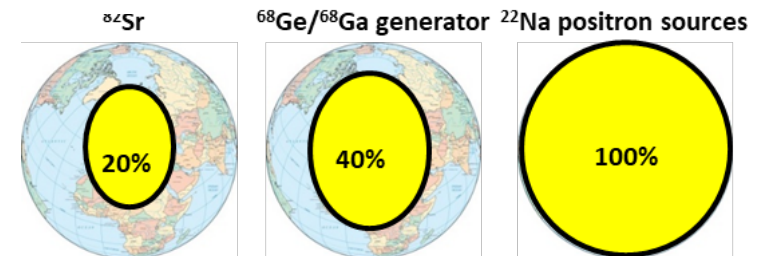
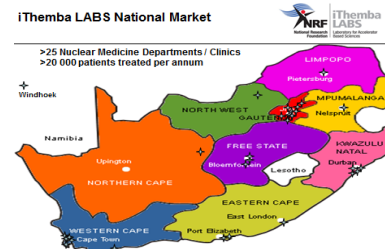
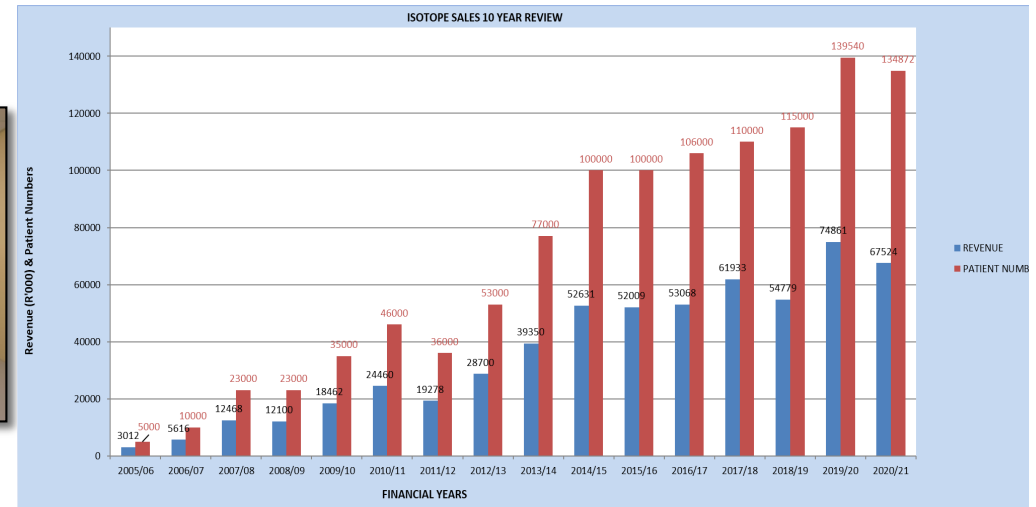
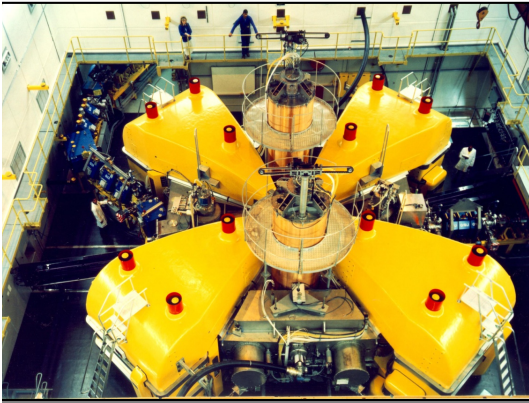
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iThemba LABS:

Leader in Accelerator Produced Radioisotopes for Medicine

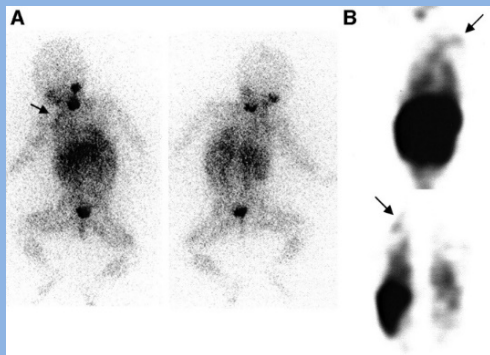


Market Share Examples

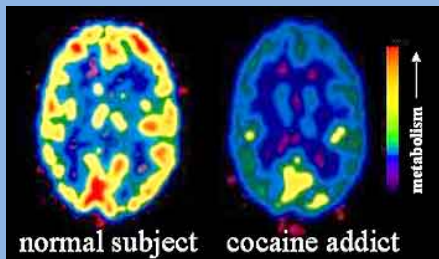
>60 clients

>40 clients

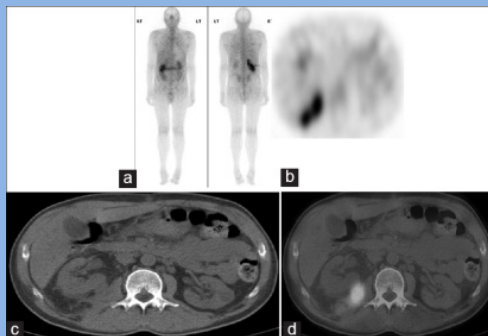
Current Radioisotopes



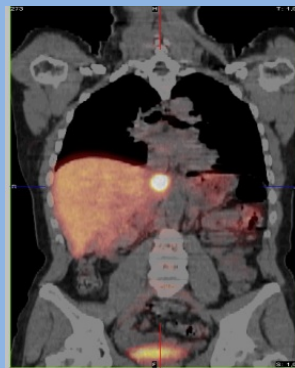
**SPECT I-123: 2yr old child
Thyroid Cancer**



PET 18F-FDG: Brain Studies



SPECT Ga-67: Kidney Infection



**PET Ge-68/Ga-68
generator
Liver tumour**

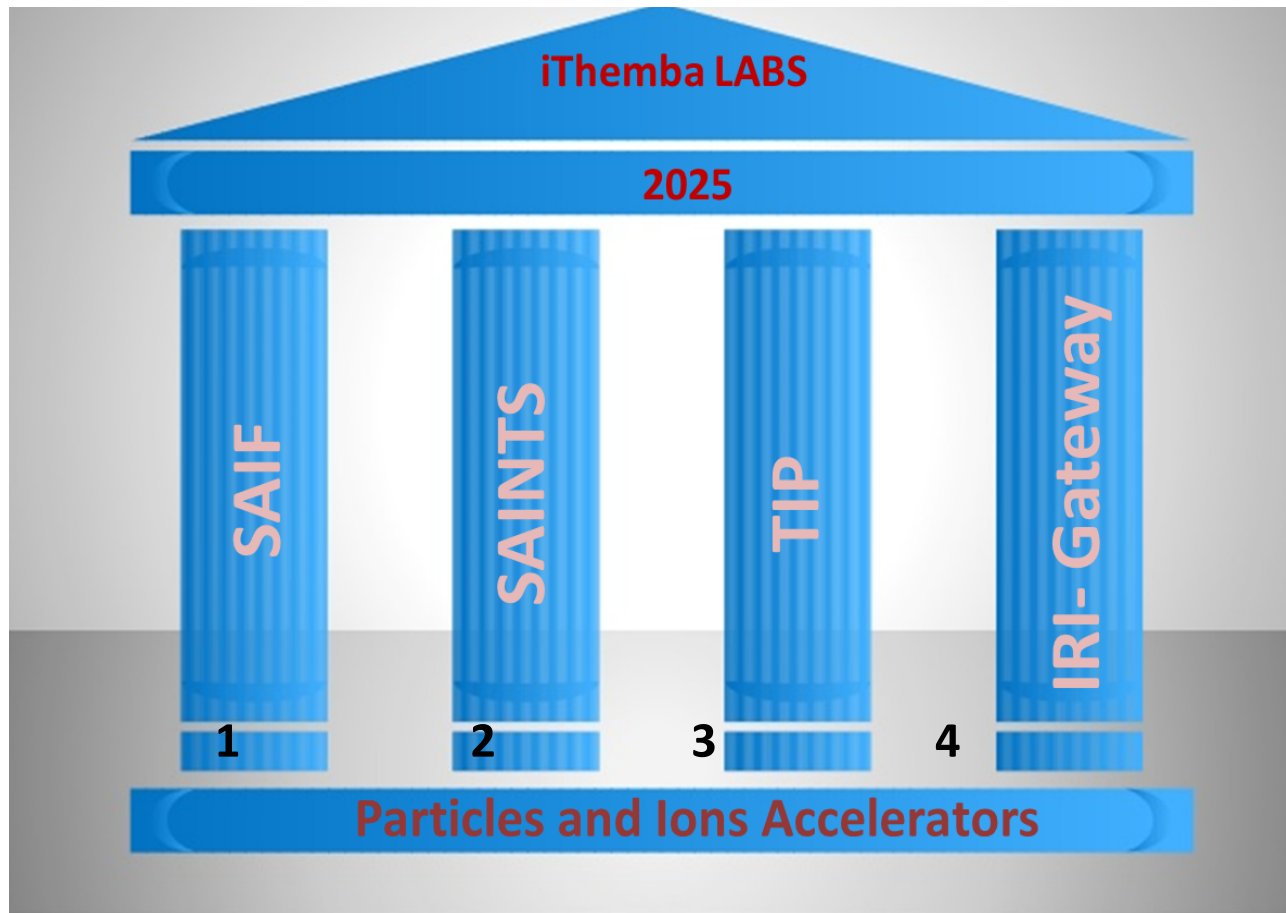
New Wave of Radioisotope Research

**Alpha Emitters for
Targeted Alpha Therapy (TAT)**

Alpha Emitters
Ac-225/Bi-213 generator
At-211

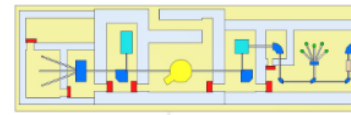
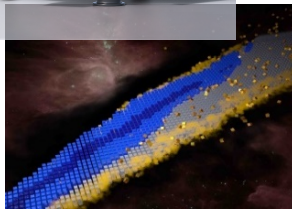
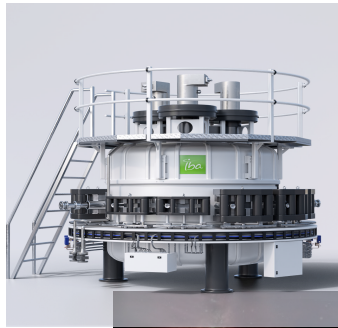
Theranostic
Sc-43 and Sc-47
Cu-64 and Cu-67

iThemba LABS Long Range Plan Pillars

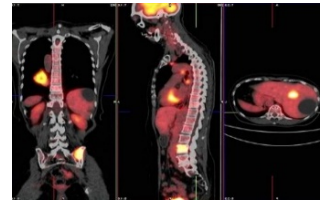


1. Research
2. Training
3. Technology
4. Access to Research Infrastructure

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



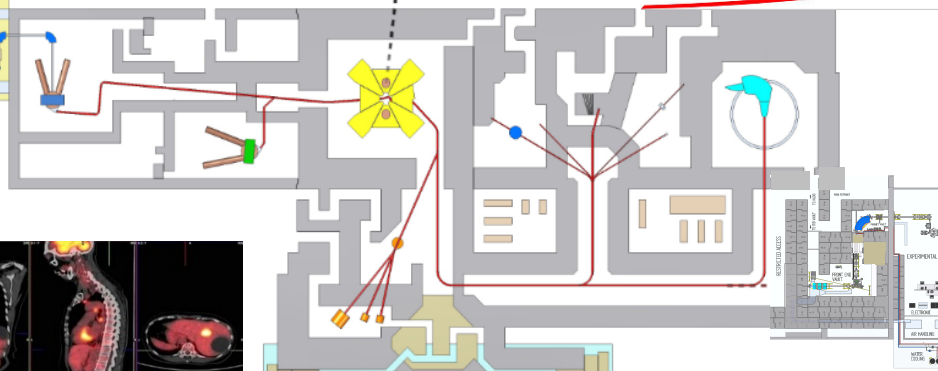
SAIF - Phase 2
Rhodotron



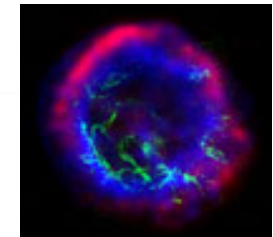
SAIF - Phase 1
Isotope production target
stations
Cyclone® 70 cyclotron (IBA)



Existing Separated
Sector Cyclotron



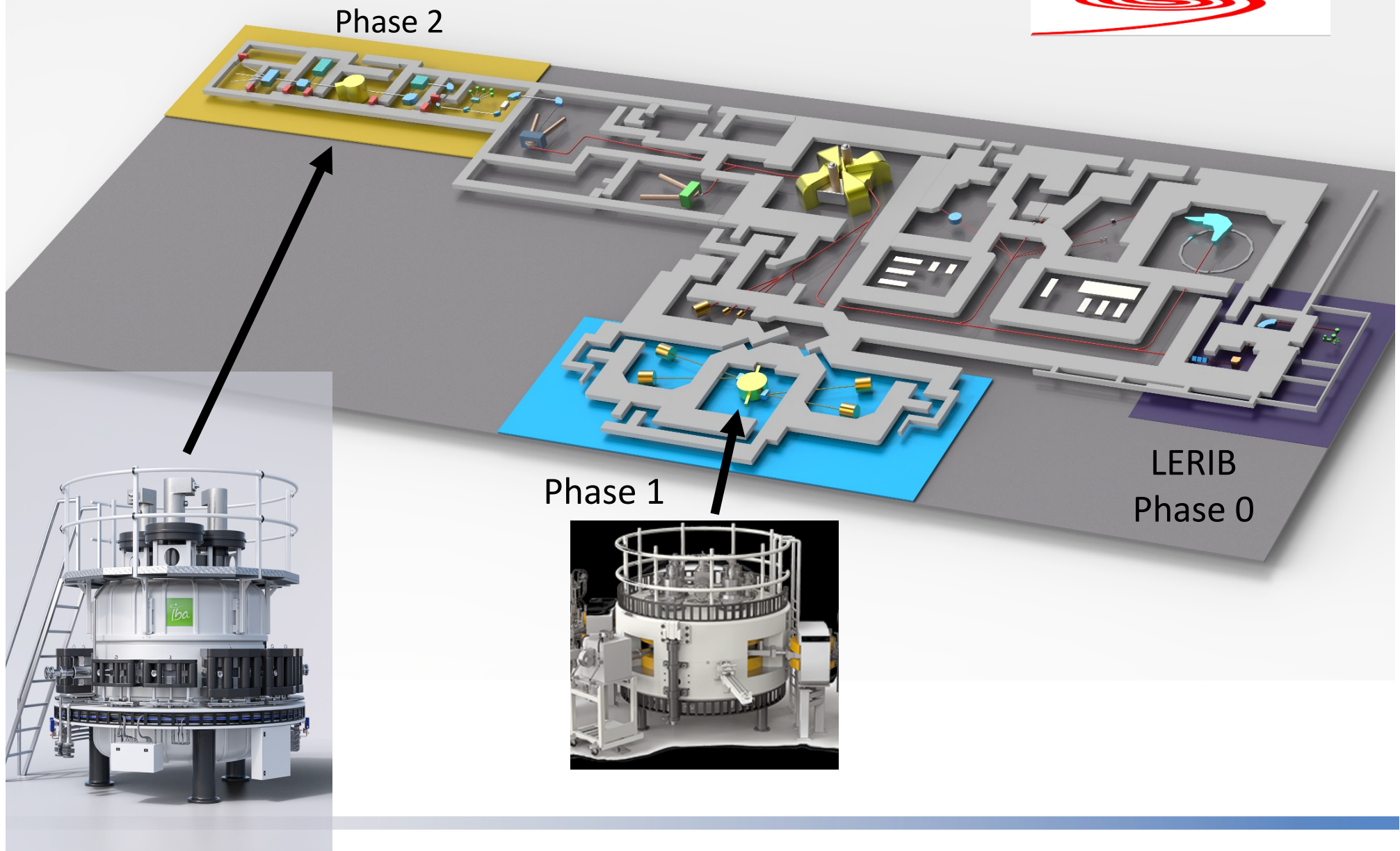
LERIB Phase 0



South African Isotope Facility (SAIF) is a phased approach project for the renewal and recapitalisation of the ageing (more than 30yrs) iThemba LABS research and training facility:

- **Phase 1 (2019-2023):**
 - ✓ A dedicated Accelerator facility for advanced radioisotopes for medicine
- **Phase 2 (2023-2027):**
 - ✓ An innovative multi disciplinary and multi-users research facility

- New and innovative solutions for cancer treatment and early diagnostics;
- Sub-atomic physics to obtain an understanding of the astrophysical origin of the elements;
- Radiation hardness testing for the space sciences;
- Development of nano-materials; and
- A doubling of the number of postgrads

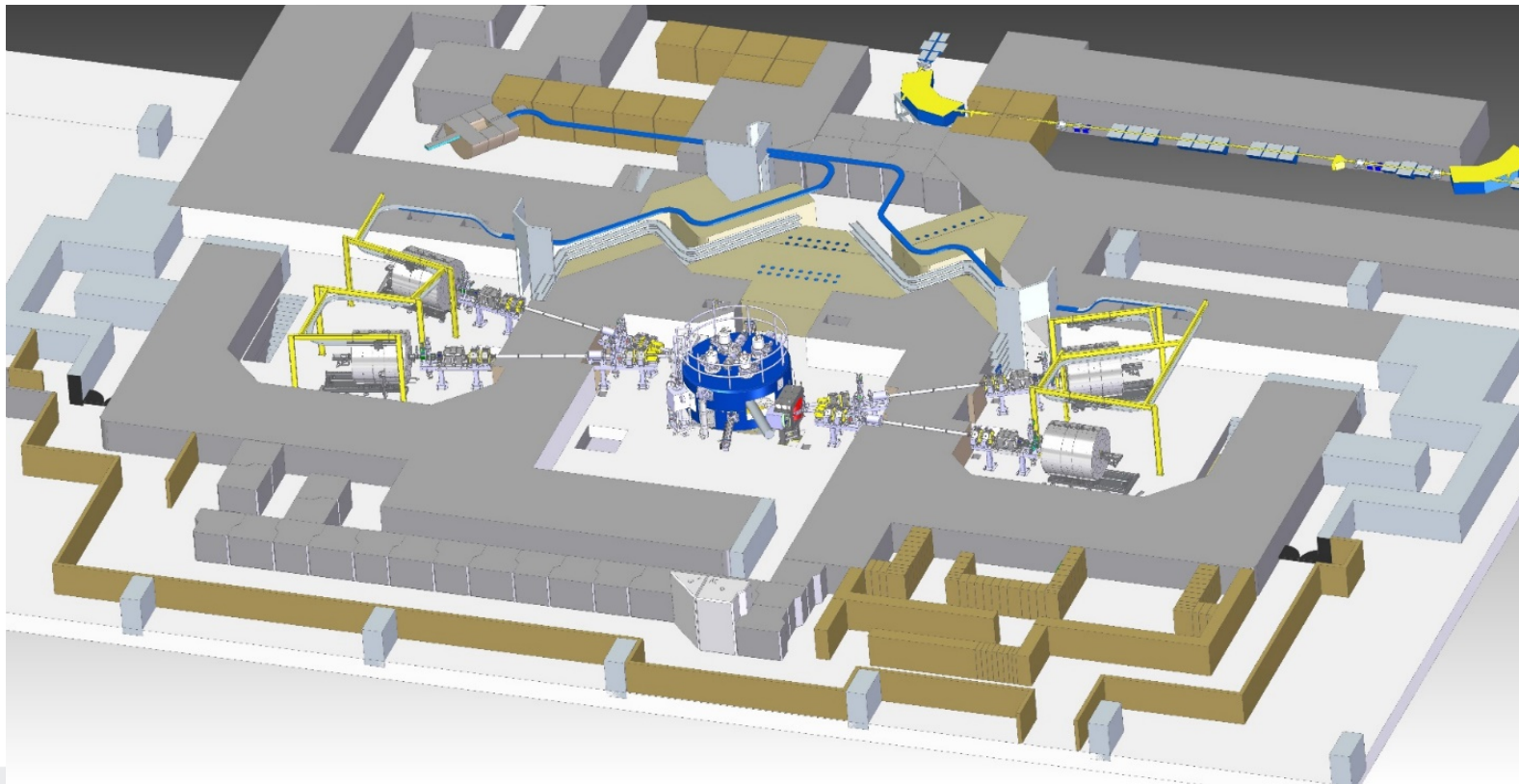


iThemba LABS: South African Isotope Facility – Phase 1 Desoign (2019)



Implementation STARTED SEP 2019:

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



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iThemba LABS: South African Isotope Facility – Phase1

April 2022



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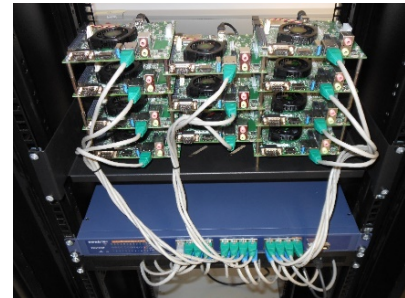


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TIP: Technology and Innovation Platform

Vision

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



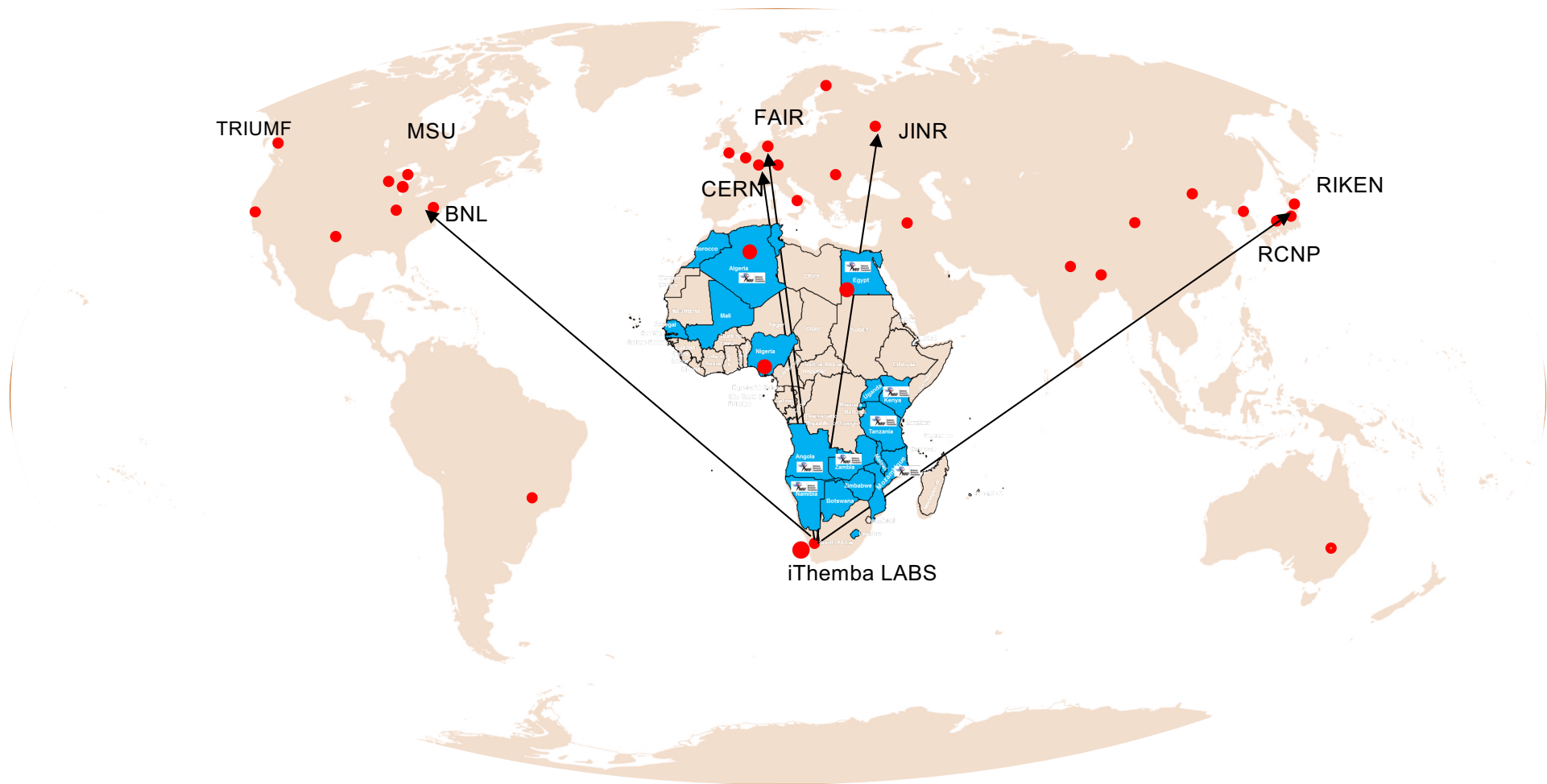
Building completed September 2022: but work started

SAINTS: The South African Institute of Nuclear Technology and Science

First graduations : Master in 2022 and PhD in 2023



iThemba LABS: The African Gateway to the International Research Infrastructures



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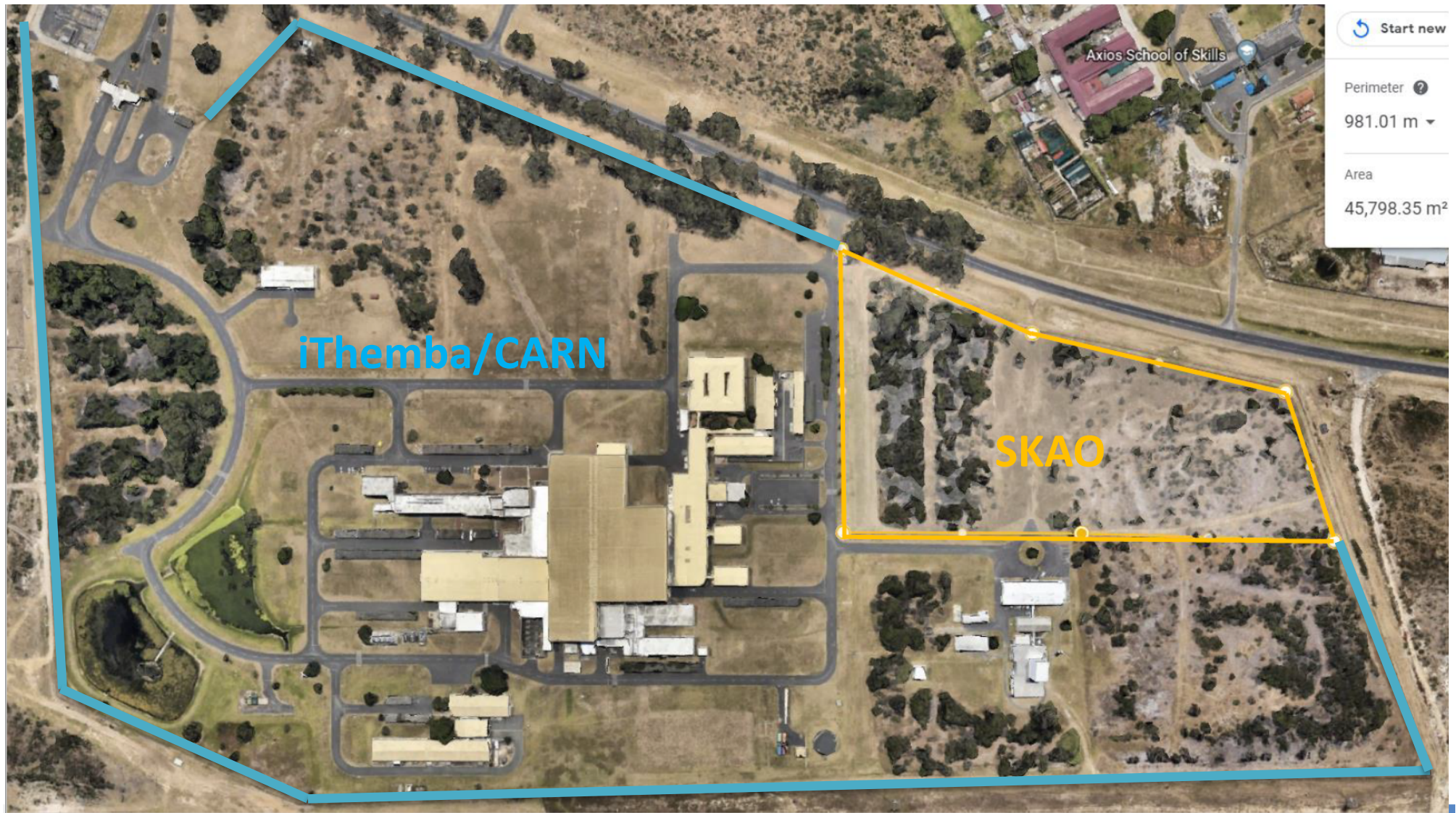
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IAEA Collaborating Centre (November 2021)



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

2030: CARN-SKAO Science Campus



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Dankie, Enkosi, Ha khensa, Re a leboga, Ro livhuwa, Siyabonga, Siyathokoza, Thank you



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Scientific Research : the Bridge to Technology and Innovation



Particle Accelerators Impact

Originally developed for fundamental research, today they are used for a range of applications for societal benefit

Energy & Environment

Health & Medicine

Industrial applications

More than **400 B€** of end products are produced, sterilized, or examined using industrial accelerators annually worldwide.

More than **24 000** particle accelerators have been built globally over the past **60 years** to produce charged particle beams for use in industrial processes. This number does not include the more than **11 000** particle accelerators that have been produced exclusively for medical therapy with electrons, ions, neutrons, or X-rays.

More than **24 000** patients have been treated by hadron therapy in Europe.

More than **75 000** patients have been treated by hadron therapy in the world.

Around **200** accelerators are used for research worldwide, with an estimated yearly consolidated cost of **1 B€**.



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