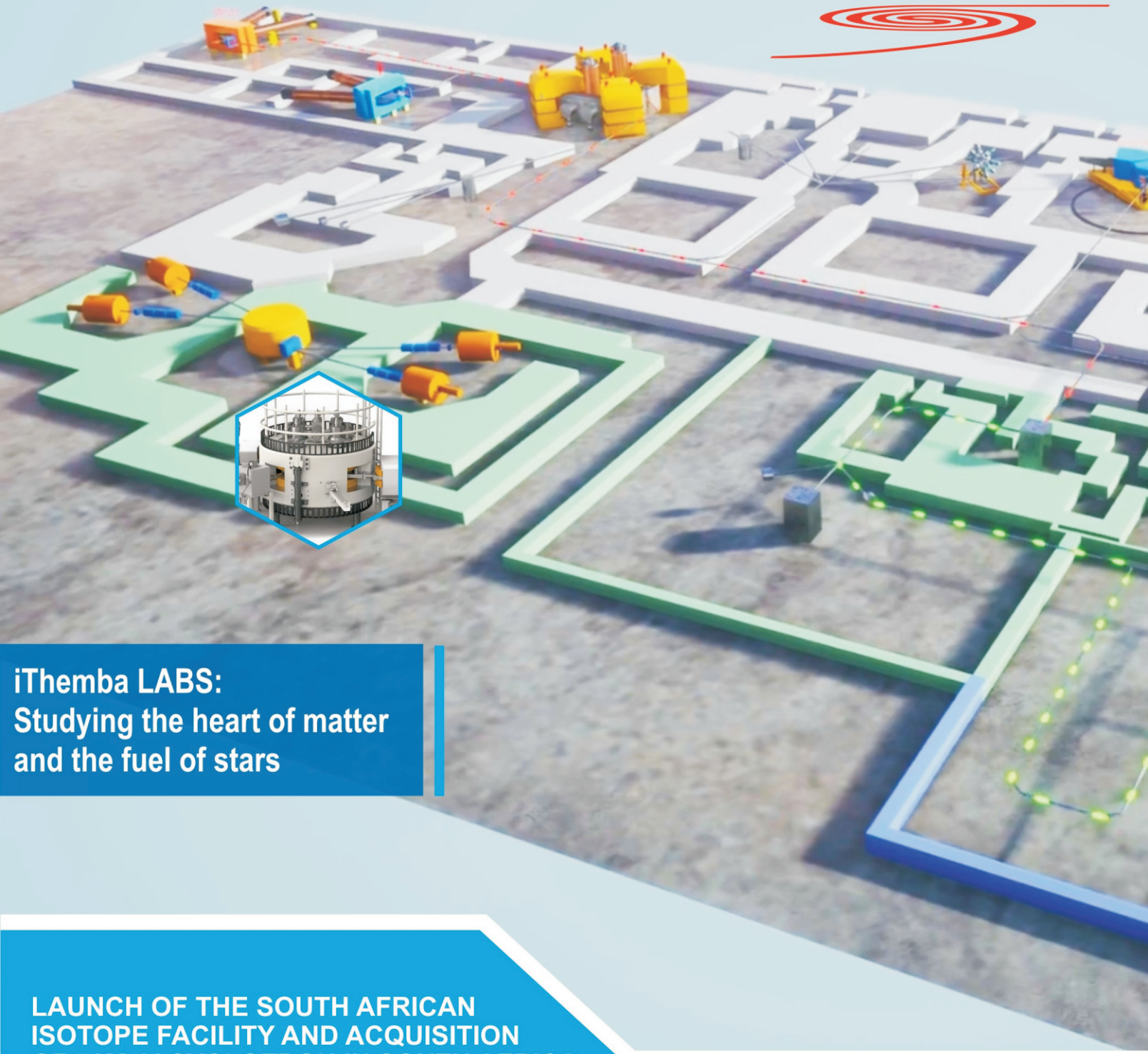
NEWSLETTER

SAIF SOUTH AFRICAN ISOTOPE FACILITY



iThemba LABS: Studying the heart of matter and the fuel of stars

LAUNCH OF THE SOUTH AFRICAN ISOTOPE FACILITY AND ACQUISITION OF 70MeV CYCLOTRON IN SOUTH AFRICA

iThemba Laboratory for Accelerator Based Sciences (iThemba LABS), a National Facility of the National Research Foundation (NRF), launched the South African Isotope Facility (SAIF) with the procurement of a Cyclone® 70 Cyclotron and associated beam lines from Ion Beam Applications S.A. (IBA) to be used as a high-energy, high-intensity proton cyclotron for isotope production and research.

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Foreword by Dr Faïçal Azaiez Director iThemba LABS

Dr Faïçal Azaiez Director iThemba LABS

iThemba LABS has embarked on a recapitalization program, the overall objective of which is to safeguard the long-term sustainability of Africa's most unique Accelerator Based research facility. The Southern Hemisphere's epicentre of accelerator infrastructure, iThemba LABS currently sees its long-term sustainability secured through the realization of four strategic pillars, namely SAIF, SAINTS, TIP, and IRI-G.

The first pillar, SAIF (South African Isotope Facility), is dedicated to research infrastructure renewal whose accomplishment is geared to achieve the twin objectives of increase in radioisotope production and research on the one hand, and the freeing up (on the other hand) of beam-time from the 200 MeV Separated Sector Cyclotron which will be dedicated for sub-atomic physics research and applications.

With the SAINTS (Southern African Institute for Nuclear Technology and Sciences) pillar focussed on improving the quality of training at iThemba LABS, and TIP (Technology and Innovation Platform) dedicated to the establishment of a Technology Innovation Platform.

The IRI-G (International Research Infrastructure Gateway) pillar is meant to augment the internationally competitive standing of iThemba LABS as the preferred African Gateway to access accelerator-based International Research Infrastructure.

Whereas all the four pillars are of central importance for future sustainability of iThemba LABS, the establishment of SAIF is viewed as initially the most critical, not least because its first and second phases of establishment require initially the most substantive quantum of capital outlay. The first phase of SAIF is centred around the acquisition of a 70 MeV Cyclotron to enhance research and production of radioisotopes for nuclear medicine; with the concomitant benefit to free-up more beam time for subatomic physics research and applications. The significant capital investment as well as the funding plan required to initiate the first phase of the SAIF project has now been approved by the NRF board and supported by the South African Government; setting in motion a process which will culminate with a dedicated 70 MeV Cyclotron and its associated beam lines installed at iThemba LABS by year 2022.

The management of iThemba LABS is most delighted with these latest developments as it portends well for future sustainability of iThemba LABS as one of South Africa's most unique and cherished assets. Confirmation of government funding, virtually on the eve of iThemba LABS hosting the 22nd International Conference on Cyclotron (CYC2019), could not have come at a more opportune moment.

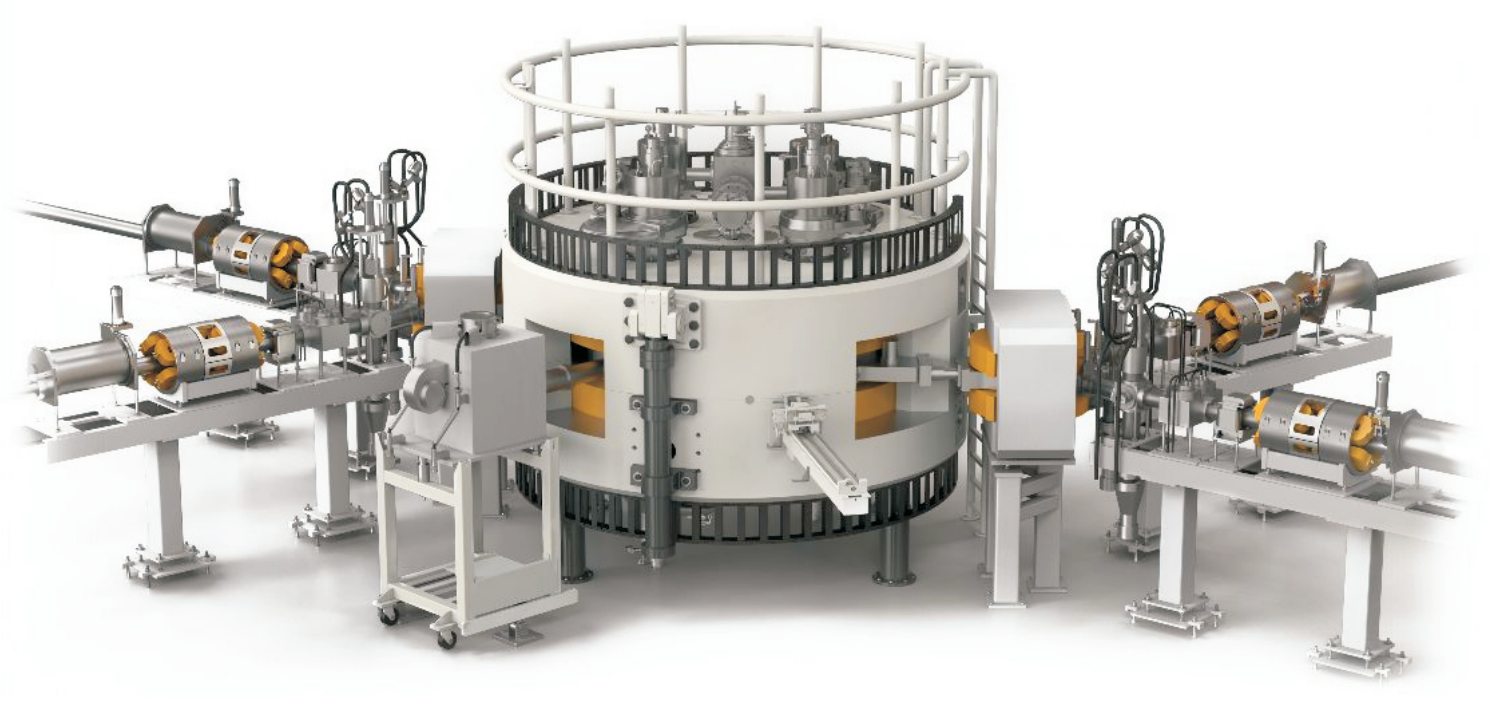
In his keynote opening address to CYC2019 conference delegates in Cape Town, the CEO of the NRF (National Research Foundation), Dr Molapo Qhobela said, “As a young democracy, with a relatively small but highly ambitious science system, we as South Africans are delighted that our country features prominently on the list of countries that have major Cyclotron facilities. Preponderance of technical expertise in accelerator-based Science and Technology is something that South Africa is particularly proud of; exemplified by our National Research Facility iThemba LABS, which stands as one of its kind not only on the African continent, but throughout the Southern Hemisphere.” Dr Qhobela added, “Our intention and ambition is to strengthen and enhance the capacity, capability and standing of iThemba LABS and the country in the coming period. In this regard, our government, recognising the potential impact of scientific research, in particular that being undertaken at iThemba LABS and our universities, has recently awarded funding to embark on an infrastructure renewal program under the South African Isotope Facility (SAIF) Project”.

Dr Molapo Qhobela
CEO National Research Foundation

Based on the current timelines and estimates, the installation at iThemba LABS of the 70 MeV Cyclotron by 2022 is set to coincide with yet another International Conference which is scheduled to be hosted by iThemba LABS in Cape Town, namely the International Nuclear Physics Conference (INPC).

The launch of this dedicated newsletter is meant to provide continuous brief to the national and international community on the ongoing development around SAIF as the strategic flagship project of iThemba LABS.

Left to right: Dr M Sakildien (iThemba LABS), Mr V Spannenberg (iThemba LABS), Dr R Nchodu (iThemba LABS), Dr Danny Adams (DSI), Dr M Qhobela CEO NRF, Prof Z Vilakazi (Wits University), Dr F Azaiez Director iThemba LABS, Dr L Conradie (iThemba LABS)



Cyclotron to be dedicated to the production of radiopharmaceuticals for diagnosing and treating critical illnesses worldwide

iThemba LABS signs contract with IBA to install Cyclone® 70

IBA (Ion Beam Applications S.A., EURONEXT), a provider of solutions for the diagnosis and treatment of cancer, announced on 11 September 2019, that it has signed a contract with **iThemba Laboratory for Accelerator Based Sciences (iThemba LABS)**, one of the official research facilities of the National Research Foundation (NRF) of South Africa, to install a Cyclone® 70 cyclotron system in Cape Town, South Africa.
The typical end-user price for a Cyclone® 70 solution is between .

EUR 12 and 15 million

Bruno Scutnaire, President of RadioPharma Solutions at IBA, commented: "Following a rigorous public tender process, we are delighted that IBA has been selected as the cyclotron provider at this important South African research institution. It will be the sixth cyclotron of its kind installed by IBA worldwide. This new order further demonstrates IBA's market-leading expertise and success with high energy cyclotrons. This 70 MeV Cyclotron will be dedicated to the production of new generation medical isotopes used mainly in the diagnosis of critical illnesses."

"We selected IBA for its leading technology and unique know-how in developing high energy 70 MeV cyclotrons," said **Dr. Faïçal Azaïez, Managing Director of iThemba LABS**.

"With the combination of our expertise and the latest in cyclotron technology, we are convinced that iThemba LABS will be able to develop new solutions for the world of Nuclear Medicine as well as for other applications in Physics. This project would not have been realized without the support of the South African Department of Science and Innovation as well as the National Research Foundation.

The acquisition of the 70MeV Cyclotron as part of Phase One of the South African Isotope Facility (SAIF) also presents an opportune vehicle for iThemba LABS to broaden its scope for the training of young South Africans to acquire technical skills in Accelerator Based Sciences and Technologies."

Vincent Spannenberg (iThemba LABS) and Bruno Scutnaire (IBA)

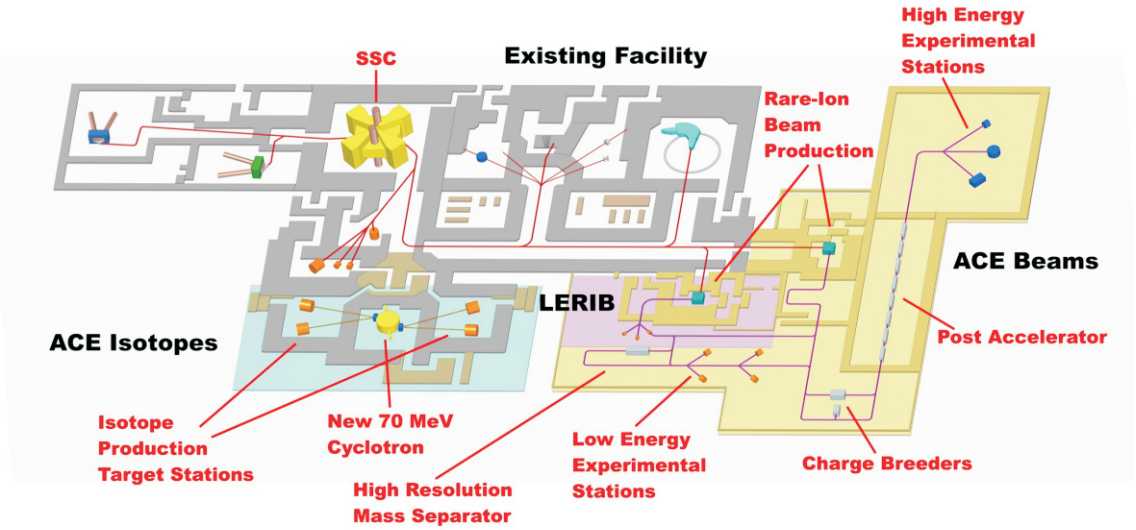


Figure 1: Layout of the main facility at iThemba LABS, with the new 70 MeV isotope production facility shaded in green, the LERIB facility shaded in pink and the second phase of the rare-isotope facility shaded in yellow.

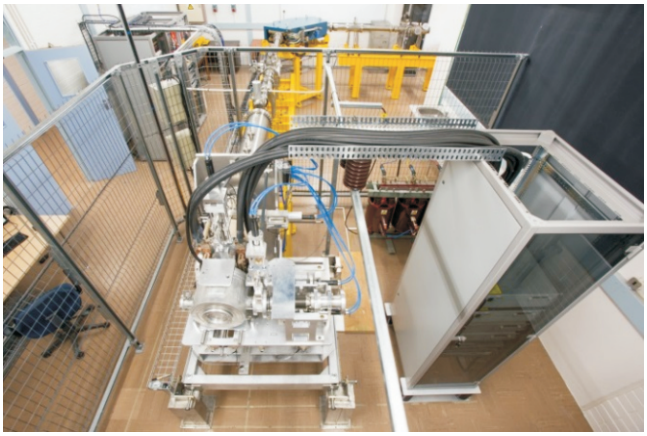
RARE-ISOTOPES AT iTHEMBA LABS

Once radionuclide production has been moved to the 70 MeV cyclotron, the SSC will be largely dedicated to research. To explore new frontiers in the field of nuclear physics, iThemba LABS has embarked on a project to establish a Low-Energy Rare-Isotope Beam (LERIB) facility, indicated in Fig. 1. The project will use the Isotope Separation On-Line (ISOL) method to produce radioactive isotopes of special interest in, for example, the study of neutron-rich nuclei involved in the r-process.

The project is proceeding in phases. Following a Memorandum of Agreement between the NRF and the Istituto Nazionale di Fisica Nucleare (INFN), a “front-end” Target/Ion Source (TIS) has been manufactured and delivered to iThemba LABS. It is being incorporated into an offline test facility as seen in Fig. 2. The TIS in the foreground, HV platform, extraction beam line complete with analysing magnet in the background is nearing completion and will be commissioned during the last quarter of 2019.

A complete EPICS-based control system is under development and will control all elements of the TIS, as well as the beam line components.

Figure 2: The LERIB test-bench contains a target/ion- source (foreground) on a high-voltage platform, and a beam line with an analysing magnet (background).



With this test bench only stable beams will be produced by means of an oven technique and will be used to measure beam emittance from the TIS front end, ionisation yields of the surface ion source and efficiency of the extraction system. Provision is also made for experimenting with plasma and resonant laser ionisation techniques.

The next phase will see the construction of an on-line test facility, “LERIB Phase 0”, over the next two to three years. RIBs will be produced through the bombardment of
boron- and silicon carbide targets with a 1 μA, 66 MeV proton beam from the SSC. It will still be largely dedicated to the development of new RIB production techniques, such as the Versatile Arc Discharge Laser Ion Source (VADLIS) [3] and the use of carbonyl molecules to ionize refractory elements.

The construction of LERIB Phase 1 will follow, and will be capable of accommodating 66 MeV proton beams of up to 50 μA from the SSC. Uranium carbide targets will be fissioned in the TIS to produce neutron-rich ions of up to 60 keV energy. The facility will include a heavily shielded bombardment station, long term storage for spent targets, dedicated laboratories for target manufacture and later disposal, and an experimental hall.

The next step beyond LERIB, Phase 2 (see Fig. 1), will be to post-accelerate the low-energy RIBs to high-energies, sufficient to initiate nuclear reactions. Because LERIB will use the SSC as the driver accelerator, a new post-accelerator will be required. The requirement of high beam transport efficiency and beam purity leads to a system needing an RFQ beam cooler and high-resolution mass separator to refine the LERIB beams. Next, they will be charge bred for post-acceleration in one of two ion-sources, i.e. an ECRIS or an EBIS. The post-accelerator is envisaged to be a LINAC in order to optimize transport efficiency. Post-accelerated energies will initially be approximately 5 MeV/A.