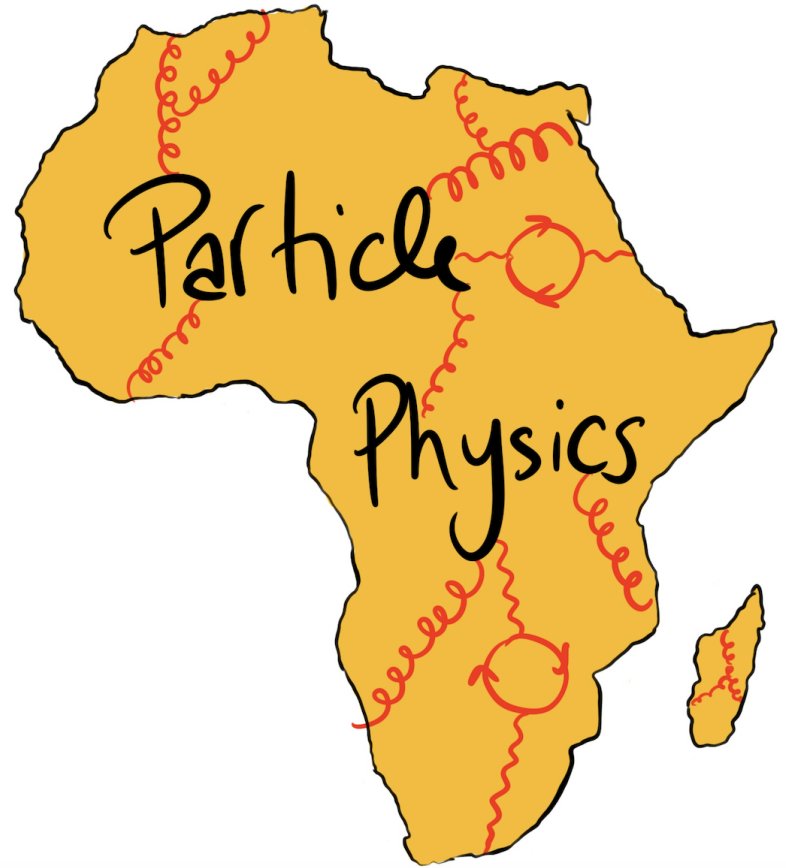


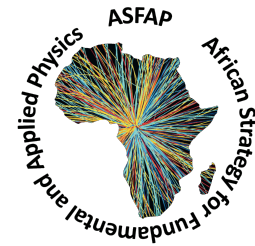


*Boosting Physics in Africa within the
ASFAP Strategy: Particle physics as
prototype*

*Mohamed Chabab
Cadi Ayyad U., Marrakech, Morocco*



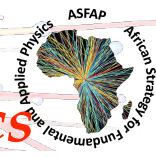
Outline



- ❑ ASFAP Strategy: Objectives and Structure
- ❑ Overview on Particle Physics (PP)
- ❑ Status of PP activities in Africa
- ❑ PP Working group: a summary



African Strategy for Fundamental Physics and Applications (ASFAP)



ASFAP initiative is co-founded by the Pan African and African
Diaspora physicists

Mandated by African Physical Society (AfPS)

Web : <https://africanphysicsstrategy.org/>

Wiki : [https://twiki.cern.ch/twiki/bin/view/](https://twiki.cern.ch/twiki/bin/view/AfricanStrategy)

[AfricanStrategy](https://twiki.cern.ch/twiki/bin/view/AfricanStrategy)

Twitter: <https://twitter.com/StrategyAsfap>

The African Strategy (ASFAP)

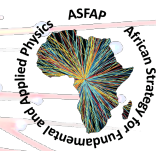
Objectives

- a. Develop a Strategy to boost African education and research capabilities, improve collaborations, and inform international partners, sponsors, policymakers on the strategic directions likely to impact African development.
- b. Engage African physicists and the international community in the Strategy development.
- c. Release of the strategy report which will suggest the direction, with actionable items for the next decade.
- d. Help to set the foundation with effective participation of African physicists in defining education and physics priorities most impactful for the continent.



ASFAP: General Structure

Committees & Conveners missions



Steering Committee (STC)

- Overall coordination
- Go-between IAC, OC, EC, W. Groups and Forums
- Final report preparation

International Advisory Committee (IAC)

- Review of progress
- Advice on scope
- Engage of International Communities and Policymakers
- Final Report Endorsement

Working Groups Conveners / Liaisons

- Encouraging and soliciting community inputs
- Preparation of the Group reports
- Liaisons have to ensure that cross-cutting topics receive proper coverage and consideration in all the relevant groups

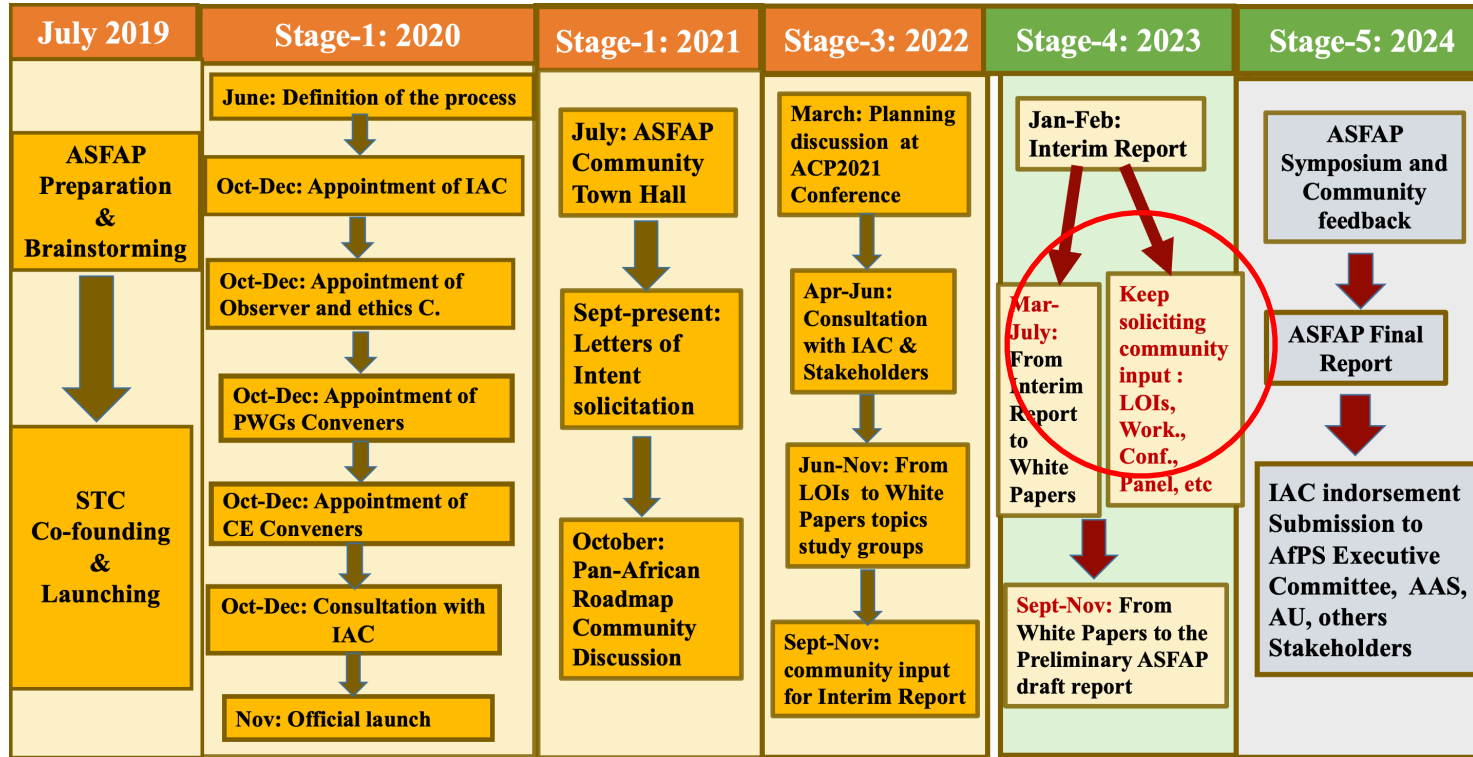
Observers Committee (OC)

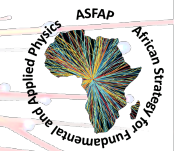
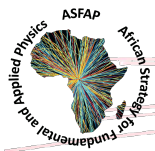
- Advising and conveying ideas between STC and WGs/ forums
- Review LOIs and White paper
- Help WGs in report editing

Ethics Committee (EC)

- Responsible for dissemination and maintain the Guidelines of **ASFAP Code of conduct**
- A subset of EC might serve as an Ombudspersons

ASFAP Process Roadmap Timeline





ASFAP Twikiactivities

<https://twiki.cern.ch/twiki/bin/view/AfricanStrategy>

SimonHConnell
Log Out
AfricanStrategy

DOCUMENTS
[Founding Document](#)
[Strategy Report](#)
[WG Guidelines](#)


SUPPORTS
[Endorsement](#)
[Financial & In-kind](#)

ORGANIZATION
[SteeringCommittee](#)
[AdvisoryCommittee](#)
[GroupConveners](#)

PHYSICS GROUPS
[Accelerators](#)
[Astrophysics & Cosmology](#)
[Atomic & Molecular Physics](#)
[Biophysics](#)
[Computing & 4IR](#)
[Earth Science](#)
[Energy](#)
[Fluid and Plasma](#)
[Instrumentation & Detectors](#)
[Light Sources](#)
[Materials Physics](#)
[Medical Physics](#)
[Nuclear Physics](#)
[Particle Physics](#)
[Optics and Photonics](#)
[Theoretical & Applied Mechanics](#)

ENGAGEMENT
[Community Engagement](#)
[Observers Committee](#)
[Ethics Committee](#)

Twiki > AfricanStrategy Web > WebLeftBar > WebHome (2021-04-23, GopolangMohlambengExternal) Edit Attach PDF



AFRICAN STRATEGY FOR FUNDAMENTAL AND APPLIED PHYSICS (ASFAP)

Scientific and technological achievements have become commonplace. As remarkable as these achievements are for other regions of the world, enormous challenges and opportunities remain to be addressed in Africa. Although vital for development, Africa's science, innovation, education and research infrastructure, particularly in fields such as Fundamental and Applied Physics, has been over the years under-valued and under-resourced. The vision is that Africa should take its equal place as a co-leader in the global scientific process, along with all the social-economic benefits thereto. The necessity of initiating ASFAP has become essential for Africa, hence our ambition and motivation to jump-start this process.

[The ASFAP website](#)

Introduction

[ASFAP ambition and challenges](#)

Events

1. The Steering Committee of the African Strategy has **launched** ASFAP on November 18, 2020, during an [online workshop organized jointly by AfPS and AfLS](#).
2. ASFAP was presented at the 107th meeting of the European Committee for Future Accelerators (ECFA) on November 20th, 2020. [Slides](#).
3. An introduction of the ASFAP strategy project was presented on December 8th, 2020 at the [12th General assembly](#) of the [African Academy of Sciences](#) (AAS).
4. ASFAP is on page 25 of the [ECFA Newsletter #6](#).

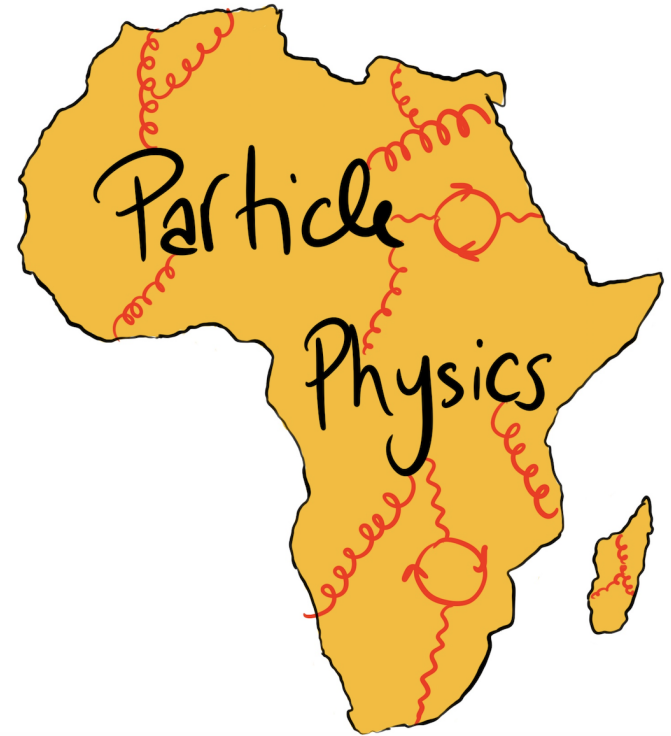
Attachments

| ! | Attachment | History | Action | Size | Date | Who | Comment |
|---|--|---------|------------------------|---------|--------------------|------------------------------|---------------------------------------|
| | Proposal-ASFAP.docx.pdf | r1 | manage | 168.1 K | 2020-10-16 - 14:21 | FairouzMalek | ASFAP version date October 15th, 2020 |
| | Proposal-ASFAP_cover.png | r1 | manage | 116.5 K | 2020-10-16 - 14:47 | FairouzMalek | |

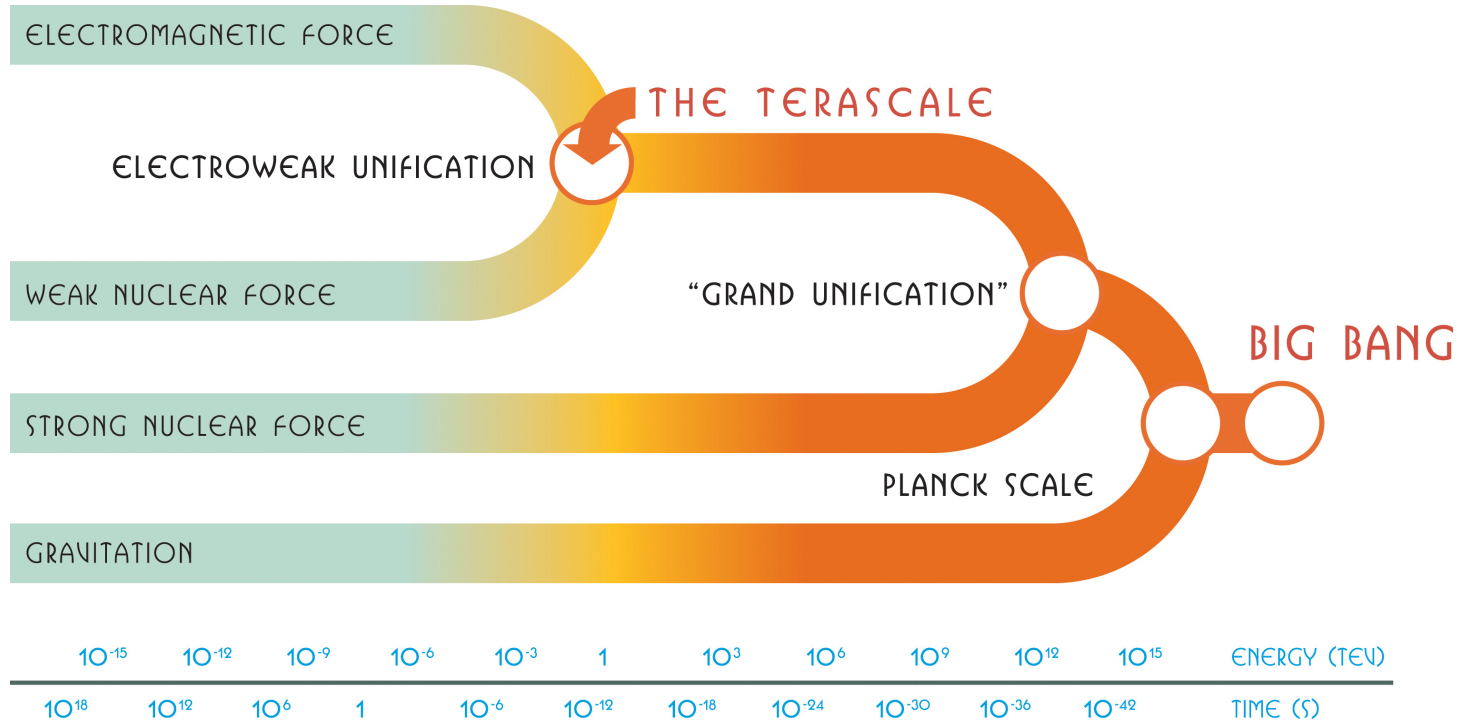
[Edit](#) [Attach](#) [Watch](#) [Print version](#) [History: r30 < r29 < r28 < r27 < r26](#) [Backlinks](#) [Raw View](#) [WYSIWYG](#) [More topic actions](#)

Topic revision: r30 - 2021-04-23 - GopolangMohlambengExternal

Brief Overview



Particle physics reveals the profound connections underlying all observed phenomena..from the smallest to the largest structure in our Universe.



Particle Physics in a nutshell : The Standard Model

Standard Model of Elementary Particles

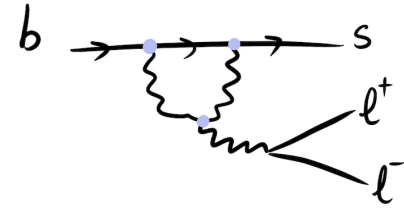
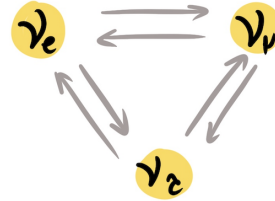
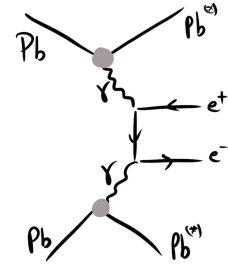
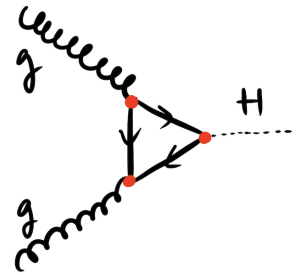
| | three generations of matter (fermions) | | | interactions / force carriers (bosons) | |
|--------|---|---------------------------------------|--------------------------------------|--|----------------------------|
| | I | II | III | | |
| mass | =2.2 MeV/c ² | =1.28 GeV/c ² | =173.1 GeV/c ² | 0 | =124.97 GeV/c ² |
| charge | $\frac{2}{3}$ | $\frac{2}{3}$ | $\frac{2}{3}$ | 0 | 0 |
| spin | $\frac{1}{2}$ | $\frac{1}{2}$ | $\frac{1}{2}$ | 1 | 0 |
| | u up | c charm | t top | g gluon | H higgs |
| | d down | s strange | b bottom | γ photon | |
| | e electron | μ muon | τ tau | Z Z boson | |
| | ν_e electron neutrino | ν_μ muon neutrino | ν_τ tau neutrino | W W boson | |

QUARKS

LEPTONS

SCALAR BOSONS

GAUGE BOSONS
VECTOR BOSONS



The Standard Model Framework

Particle physics has a *Standard Model* of particles and their interactions: GSW



New York Times, July 5, 2012

Physicists Find Elusive Particle Seen as the Key to Universe



POOL PHOTO BY DORIS BALBUENA

Physicists in Geneva applauded the discovery of a subatomic particle that looks like the Higgs boson.

SM cannot be complete

- Neutrino masses
- The pattern of fermion masses
- Dark matter / Dark energy



95% of the mass of the universe is dark matter and dark energy :
Not explained by the Higgs boson !



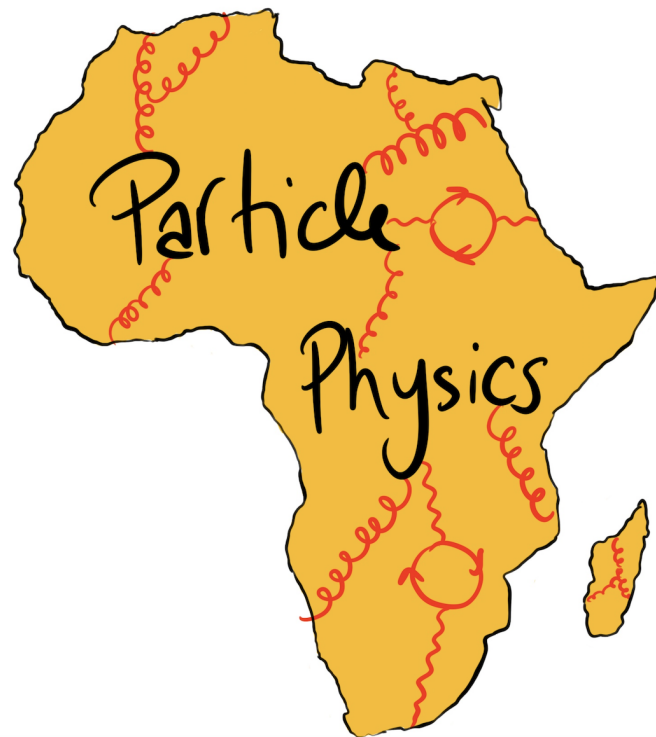
Experimental High Energy Physics



The forefront of experimental particle physics research takes place at CERN, in Geneva. Experimental Particle physicists participates in several experiments : *ATLAS CMS, ALICE, LHCb,...*

- The primary objective of the *ATLAS and CMS* experiments is to uncover new fundamental constituents of matter and their interactions.
- *ALICE* experiment is mainly focused on understanding the state of matter known as the Quark-Gluon Plasma.
- *LHCb* is dedicated to provide insight into the matter-antimatter asymmetries.

Status of PP activities in Africa



Presence @ CERN



Non-Member States, Territories and Regions Collaborating with CERN

| | | | | | |
|-----------------|------------|--------------|----------------------|--------------|-------------|
| Albania | Algeria | Argentina | Armenia | Australia | Azerbaijan |
| Bahrain | Bangladesh | Belarus | Bolivia | Brazil | Canada |
| Chile | China | Colombia | Costa Rica | Cuba | Ecuador |
| Egypt | Georgia | Ghana | Hong Kong | Iceland | Indonesia |
| Iran | Ireland | Jordan | Kazakhstan | Korea | Kuwait |
| Latvia | Lebanon | Madagascar | Malaysia | Malta | Mexico |
| Mongolia | Montenegro | Morocco | Mozambique | Nepal | New Zealand |
| North Macedonia | Oman | Palestine | Paraguay | Peru | Philippines |
| Qatar | Rwanda | Saudi Arabia | Singapore | South Africa | Sri Lanka |
| Taiwan | Thailand | Tunisia | United Arab Emirates | Uzbekistan | Vietnam |

Involvement in experiments either full members or associate:

ATLAS

CMS

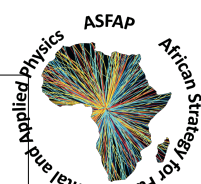
Alice

Training opportunities for example in LHCb.

Computing Tier 3 WLCG

Evolution of the level of participation and implication up to institutional collaborator.

Major collaborations



ATLAS EXPERIMENT

SAHAL YACOOB

ATLAS@UCT

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA · UNIVERSITEIT VAN KAAPSTAD

Egypt

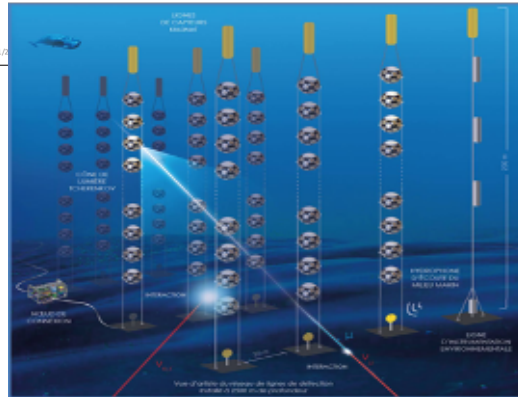
By

Sherif Elgammal
(on behalf of ENHEP)

Centre for Theoretical Physics (CTP)
British University in Egypt (BUE)

ATLAS Activities in Morocco

D. Benckroun
Hassan II University of Casablanca
On behalf the ATLAS Moroccan Group



HEP in Madagascar

D. Rabetiariivony,
on behalf of the
Institute of High Energy Physics of Madagascar, Univ. Antananarivo (MG)



South Africa Activities in ALICE



Zinhle Buthelezi,
for SA-ALICE

First ASFAP Particle Physics Day,
African Strategy for Fundamental Physics & Applications
18 November 2021

The UJ-ATLAS and Associated Innovation Group + UNISA + UWC

- Staff**
 - Simon Cornell (Prof)
 - Muazz Bhanjiye (Dr Lect)
 - Nicolaas Goedertse (Prof)
 - Loan Triuong Bectures, Visiting Prof
 - Francis Pretorius (Dr Lect)
- Post Docs**
 - Bongani Mwaabuka
 - Emmanuel Gumbere
 - Hairina Rafijana
- Students**
 - PhD: Phisoa Ntsoele
 - PhD: Thendo Nemaakachane
 - PhD: Mathene Cornell
 - MSc: Kola Mapekela
 - MSc: Mf Mubelli Phiri
 - MSc: Gideon Bantam
 - MSc: Chris Lee
- Associated sub-institute**
 - Lerethedi Lencwe (Prof UWV)
 - Vedra Mafa (Dr UNISA)
 - Morisiqoqa (Prof UNISA)
- News Associates**
 - Dr Graham Ganiak, Dr Dumani Mawanda, Eric Ombela, Litsea Bhebe
- Research Associates**
 - Dr Martin Cook (DRA US)
 - Dr Sergio Roldanero (DRA US)
 - Tim Brooks (DRA US)

+ many colleagues from ATLAS
Prof Kabele Assamang (BMC)

DUNE DEEP UNDERGROUND NEUTRINO EXPERIMENT

First ASFAP Particle Physics Day
DEEP UNDERGROUND NEUTRINO EXPERIMENT
and
UNIVERSITY OF ANTANANARIVO MADAGASCAR

Nov.18th 2021

KM3net@Morocco

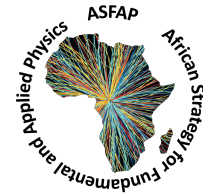
Laza Rakotondravohitra PhD
Universite d'Antananarivo
GenesisCare USA/ Duke University Medical Center

Contribution to ATLAS Computing in Algeria

Ecole Nationale Supérieure d'Informatique (ESI)

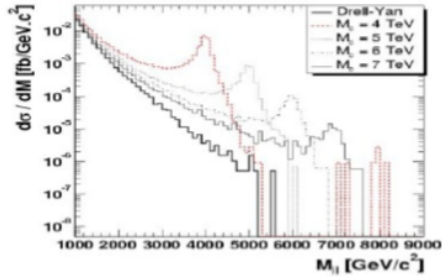
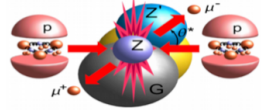


A few highlights

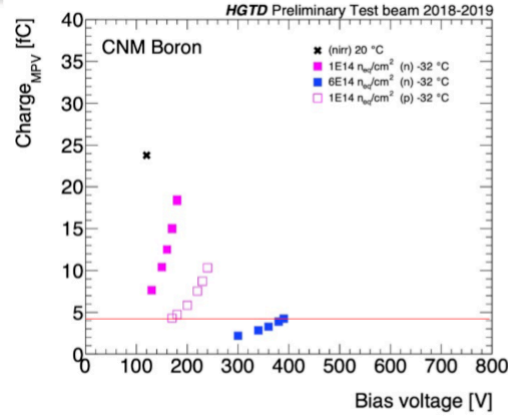


Physics analyses

Z prime models (BSM)



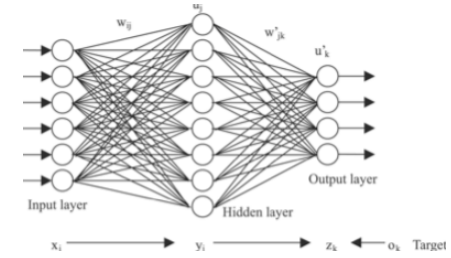
Beam tests



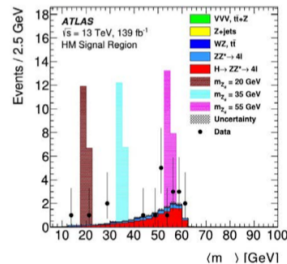
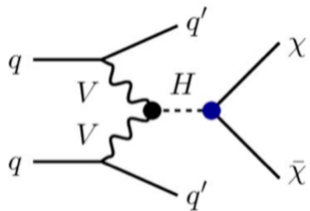
Electronics development



Machine learning



Remote operations





South Africa

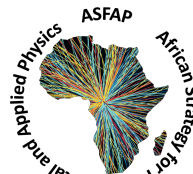
SA-CERN programme

ATLAS, ALICE, ISOLDE, CERN



science & innovation

Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA



iThemba
LABS
Laboratory for Accelerator
Based Sciences



NELSON MANDELA
UNIVERSITY



Participating institutions : 1 National Facility (iThemba LABS) and 10 Universities



| | ATLAS | ALICE | ISOLDE | Theory | Total |
|-------------|-------|-------|--------|--------|-------|
| PhD | 6 | 5 | 6 | 8 | 25 |
| MSc | 19 | 4 | 7 | 15 | 45 |
| Accad Staff | 8 | 6 | 6 | 7 | 27 |
| Tech Staff | 3 | 2 | 4 | | 9 |
| Post Docs | 5 | 2 | 2 | 2 | 11 |

26/9/23

2020 numbers, increasing trajectory

- SA has a long history in High Energy Physics, eg : 1st neutrino discovered and studied in nature 1965
 - Long history at CERN, BNL, JLAB, JINR, others
 - Also a long history of theoretical contributions
- SA-CERN Co-operation Agreement 1992**
- Now formal participation at CERN and JINR

Most HEP now in the SA-CERN and JINR Programmes

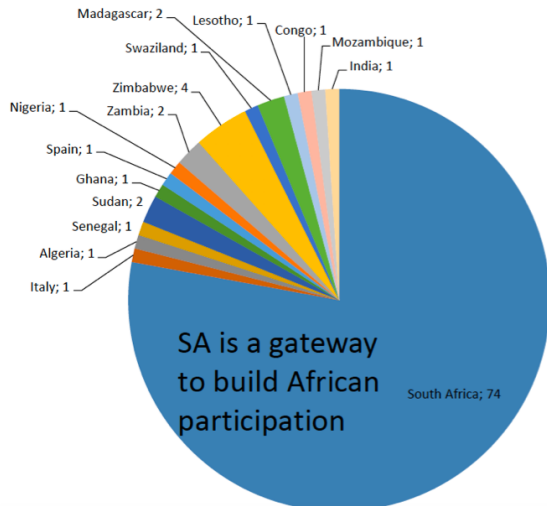
- ALICE since 2001
- ATLAS since 2010
- ISOLDE since 2017
- Theory
- JINR since 2005

*Decades of
"ad hoc"
participation*

SA participates in Physics, Upgrade activities, Engineering, Outreach

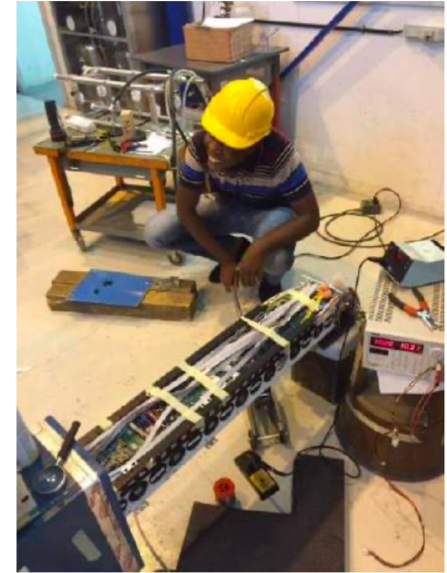


Some of the SA-CERN group



Staff and students at ALICE

Staff and students at ISOLDE

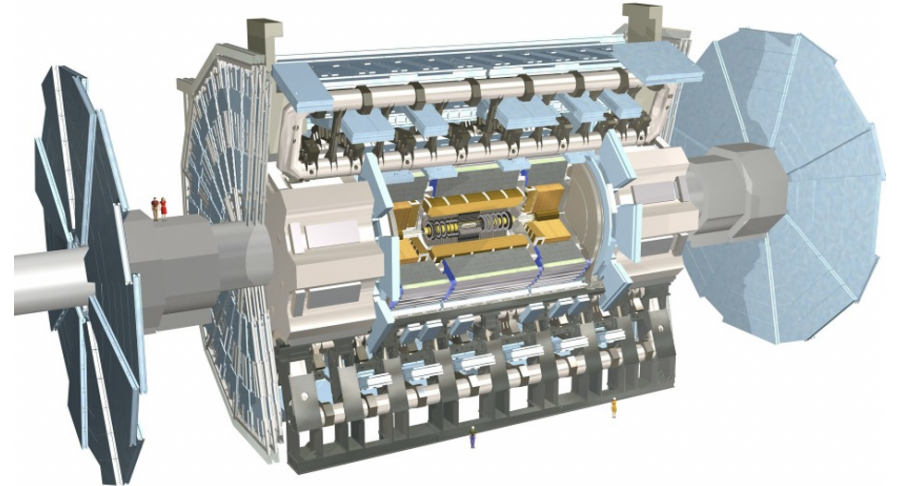


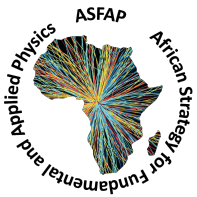
Testing modules developed in SA for ATLAS

Slides courtesy of Simon Connell, UJ



- Morocco has an internationally high-quality research in theoretical and experimental high-energy physics
- Morocco started its research in experimental particle physics with CERN in **1996** as a member of the ATLAS collaboration
- The scientific collaboration with CERN was boosted thanks to the foundation of the High Energy Physics framework (**RUPHE**)
- **RUPHE is formed of 5 Universities:**
 - Hassan II University in Casablanca;
 - Mohammed V University in Rabat;
 - Cadi Ayyad University in Marrakech;
 - Mohammed 1st University in Oujda;
 - Ibn-Tofail University in Kenitra
 - AbdelMalek Saidi University, Tanger





ATLAS Morocco group at a glance



- **Current ATLAS People :**

- **52 members:**

- 20 physicists
- 32 PhD Students
- 12 defended PhD thesis

- **Research Program includes the topics:**

- **1) Physics analyses:**

- Measurements: Standard Model (SM) and Higgs
- Searches: Beyond the SM and Exotic new physics
- Higgs boson and dark matter

- **2) Detector performance:**

- Jets & Missing Transverse Energy reconstruction
- Lepton reconstruction

- **3) Detector Operation:**

- Inner detector Offline Commissioning,
- Performance & Optimization

- **4) Upgrade:**

- ATLAS High Granularity Timing Detector

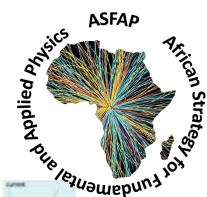
- **5) Computing:**

- Grid Data Processing & Analysis
- Deep Machine Learning
- High Performance Computing

- **4) Theory and Phenomenology**

- Multi Higgs models building
- Colliders Phenomenology

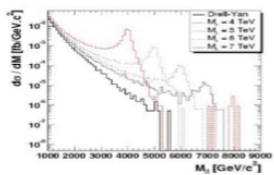
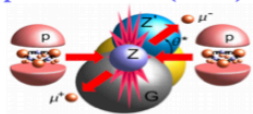
Egypt @ CMS



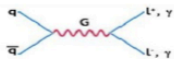
Search for new heavy resonant and non-resonant phenomena in dilepton channels

contact person Dr. Sherif Elgammal (BUE)

Z prime models (BSM)



Kaluza Klien excitation from Extra-dimensions



To explain $b \rightarrow s l^+ l^-$ anomalies at the LHC

<https://arxiv.org/abs/1805.11402>

High pt correlated tests of lepton universality in lepton(s) + jet(s) processes; EFT analysis

<https://arxiv.org/abs/2005.06457>

ATLAS published this analysis in

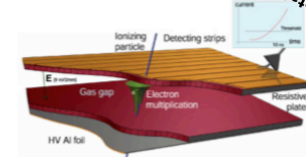
<https://inspirehep.net/literature/1853941>

Work still on going using CMS run 2

Egypt involved in the following CMS R&D projects

Resistive Plate Chamber (RPC)

- Prof. Elsayed Salama (BUE)
- Dr. Yasser Assran (BUE) **contact person**
- Shereen Aly (HU)
- Asmaa Fawzi (HU)
- Fatma Abdelkawy (AU)
- Tahany Elhussieny (AU)

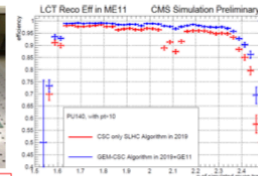
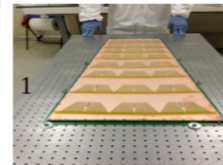


Egyptian groups participate in
 * Assembling of RPC detector
 * Efficiency tests

Gas Electron Multiplier (GEM)

- Dr. Ahmed Abdelalim (ZC)
- Dr. Shima Abuzeid (AU)
- Dr. Hassan Abdalla (CU)
- Salwa Mohamed (AU)
- Mohamed Elhoseny (CU)
- Aya Beshr (AU)
- Basma Elmahdy (BUE)

contact person



Advantage of GEM

- * Combine triggering and tracking functions.
- * Enhance and optimize the readout (η, ϕ) granularity by improve rate capability.

Egyptian groups participate in
 * Simulation of GEM detector
 * Efficiency tests

Search for mono-Z' + DM:

contact person Dr. Sherif Elgammal (BUE)

<https://arxiv.org/pdf/2013.04326.pdf>

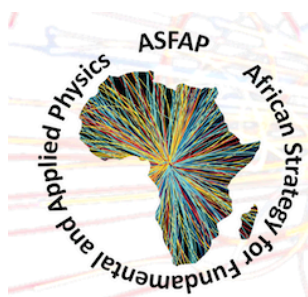
Search for mono-Higgs + DM:

contact person Dr. Sherif Elgammal (BUE)

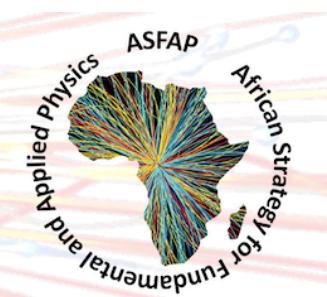
<https://link.springer.com/article/10.1007%2FJHEP03%282020%29025>

Search for mono-Z + DM:

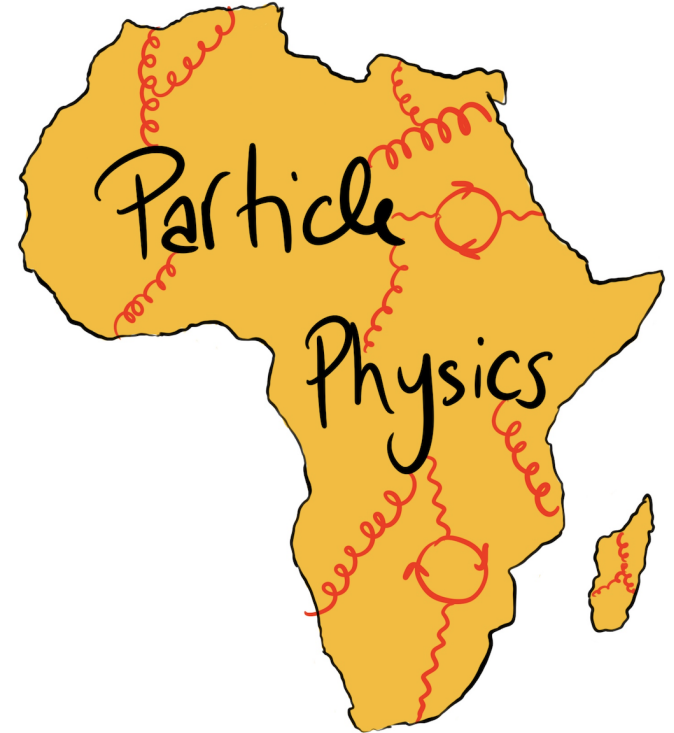
contact person Prof. Shaaban Khalil (ZC)



African Strategy for Fundamental and Applied Physics



PP Working group



Challenges of PP research in Africa



- 📌 Gaps in human capital
- 📌 Infrastructure deficits
- 📌 Weaker supporting systems for research
- 📌 Barriers to international mobility
- 📌 Small presence of African countries in world wide PP community
- 📌 Scientific collaboration among African countries is still below expectations

These factors have limited the contributions of the physics community to translate skills and expertise to a factor of development

However, despite these challenges, Africa has produced a vibrant research community with enormous potential

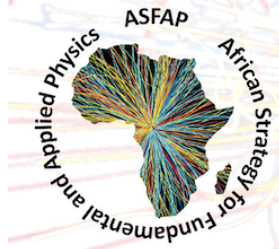
ASFAP: Scope of PP-WG



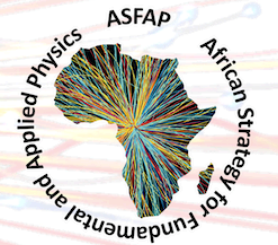
Define the particle physics community's direction for the current decade

Identify and prioritize the actions / activities in the coming years.

- Contribute to building a network of Particle Physicists in Africa.
- Push forward the ongoing activities and foster cooperations between African researchers for both Experimental and Theoretical physics.
- Address the possibilities of evolution and expansion of these involvements and drive future endeavors.
- Collect scientific inputs from African PP community: written contributions (LoI):
- Provide a shared roadmap for the field: **White paper.**



African Strategy for Fundamental and Applied Physics



Particle Physics Conveners



Mohamed Chabab (Morocco)



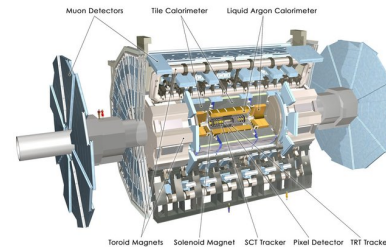
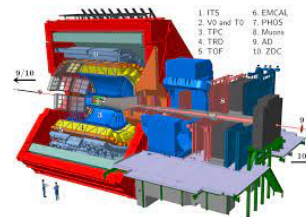
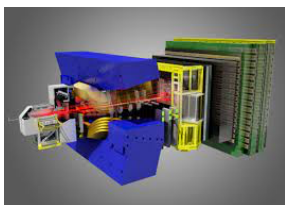
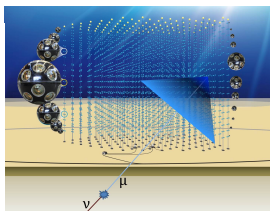
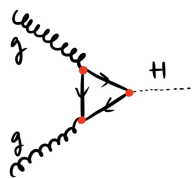
Yasmine Amhis (France)



Zinhle Buthelzi (SA)



James Keaveney (SA)



Subgroups:

- **subWG I “Fundamental constituents & forces” :**

- Higgs physics.
- Electroweak and BSM physics.
- Direct searches.

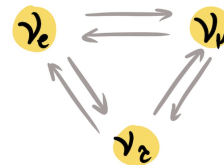
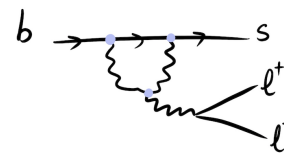
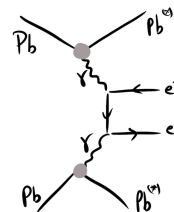
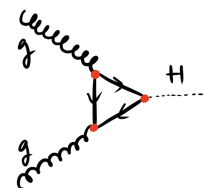
- **subWG II “Symmetries and composite structures”:**

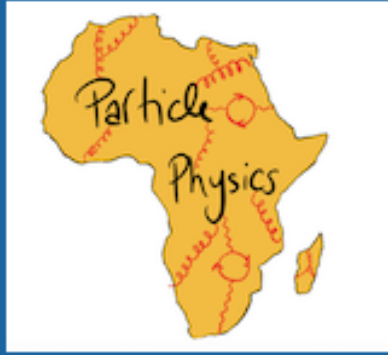
- Flavour physics, CP violation.
- Strong interaction, hadron physics, heavy ions.
- Indirect searches.
- nEDM.

- **subWG III “Light messengers” :**

- Neutrino Physics : neutrino parameters, CP violation, BSM.

- **subWG IV “Infrastructures”**

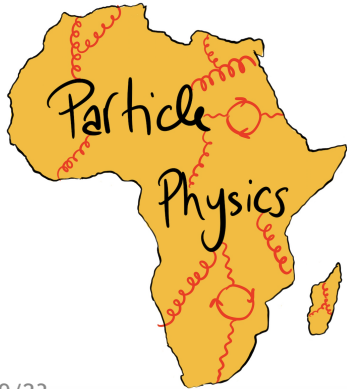




First ASFAP Particle Physics Day

18 November 2021
Online
Europe/Paris timezone

<https://indico.cern.ch/event/1080353/>



Second ASFAP Particle Physics Day PhD' students and postdocs

31 March 2022
Online

<https://indico.cern.ch/event/1126310/>

Where to find us?



<https://twiki.cern.ch/twiki/bin/view/AfricanStrategy/AfParticlePhysics>

| NAME | AFFILIATION | EMAIL | Gender | African origin/Diaspora |
|--|-----------------------|-----------------------------------|--------|-------------------------|
| Dr. Yasmine Amhis YaBio | CNRS-IN2P3, France | yasmine.sara.amhis[at]cern.ch | F | Algeria |
| Ass. Prof. Zinhle Buthelezi | iThemba LABS/WITS | edith.zinhle.buthelezi[at]cern.ch | F | South Africa |
| Prof. Mohamed Chabab ChababBio | Cadi Ayyad U, Morocco | mchabab[at]uca.ma | M | Morocco |

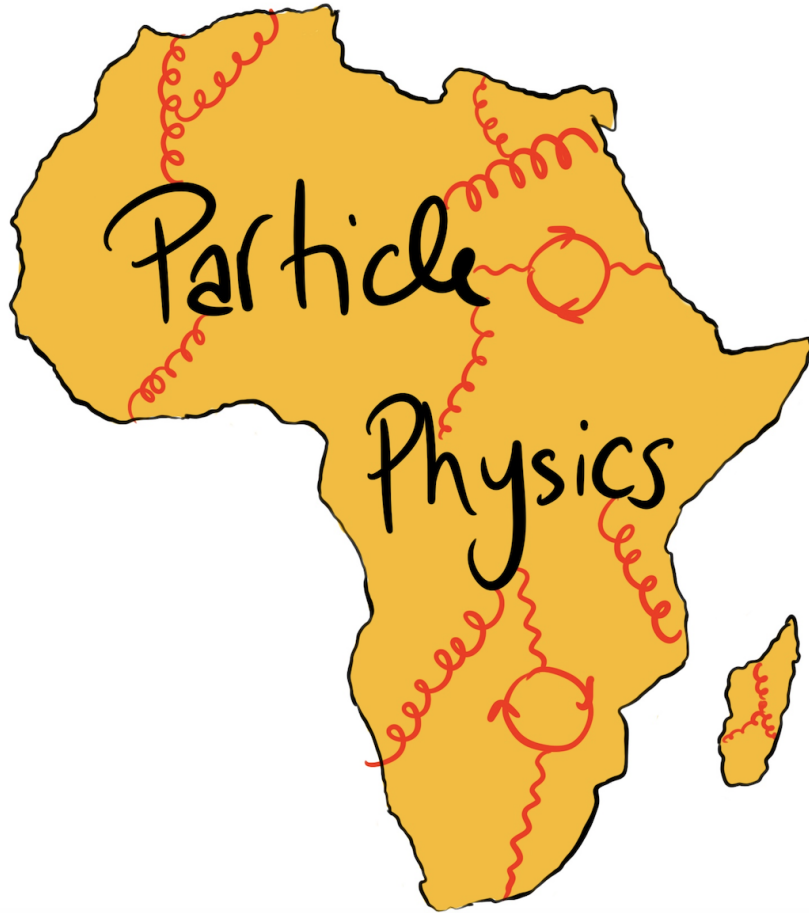
Observers Committee members

| NAME | AFFILIATION | EMAIL | Gender |
|-------------------------|--|----------------------------------|--------|
| Dr. Mary Bishai | Brookhaven National Laboratory | mbishai[at]bnl.gov | F |
| Dr. Samira Hassani | CEA, France | Samira.Hassani[at]cern.ch | F |
| Prof. Peter Jenni | Freiburg University and CERN | peter.jenni[at]cern.ch | M |
| Dr. Claire Lee | Fermilab, USA | claire.lee[at]cern.ch | F |
| Dr. María Moreno Llácer | IFIC, CSIC-University of Valencia, Spain | maria.moreno.llacer[at]cern.ch | F |
| Dr. Lydia Roos | LPNHE, CNRS and Sorbonne Université, Paris, France | lroos[at]lpnhe.in2p3.fr | F |
| Dr. Gopolang Mohlabeng | Queen's University | gopolang.mohlabeng[at]queensu.ca | M |

Other members

| | | | |
|-------------------------|--------------------------------|---------------------------|---|
| Dr. Chilufya Mwewa | Brookhaven National Laboratory | chilufya.mwewa[at]cern.ch | F |
| Dr. Kétévi A. Assamagan | Brookhaven National Laboratory | ketevi[at]bnl.gov | M |
| Prof. Farida Fassi | Mohammed V University in Rabat | farida.fassi[at]cern.ch | F |

Please reach us if you are interested !



Thank you