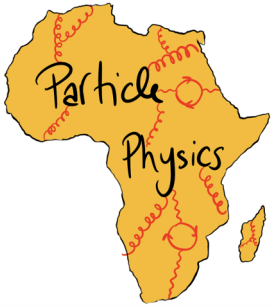


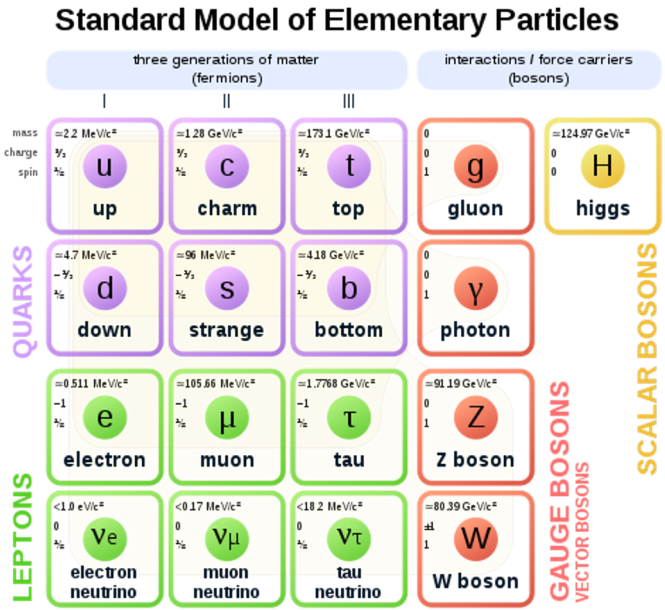
Particle Physics @ ASFAP

Yasmine Amhis, Zinhle Buthelezi, Mohamed Chabab,

ASFAP Community Town Hall

13.07.2021

Particle Physics in a nutshell



Particle physics

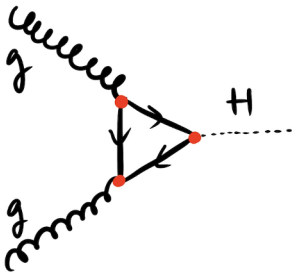
Wikipedia !

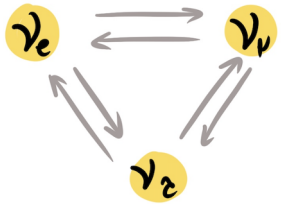
From Wikipedia, the free encyclopedia

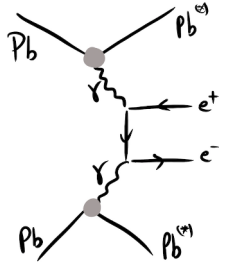
For other uses of "particle", see Particle (disambiguation).

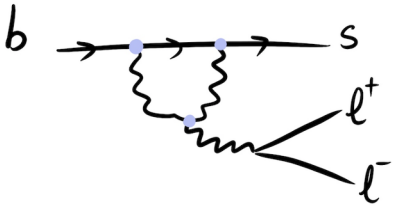
Particle physics (also known as **high energy physics**) is a branch of physics that studies the nature of the particles that constitute matter and radiation. Although the word *particle* can refer to various types of very small objects (e.g. protons, gas particles, or even household dust), *particle physics* usually investigates the irreducibly smallest detectable particles and the fundamental interactions necessary to explain their behaviour.

In current understanding, these elementary particles are excitations of the quantum fields that also govern their interactions. The currently dominant theory explaining these fundamental particles and fields, along with their dynamics, is called the Standard Model. Thus, modern particle physics generally investigates the Standard Model and its various possible extensions, e.g. to the newest "known" particle, the Higgs boson, or even to the oldest known force field, gravity.[1][2]

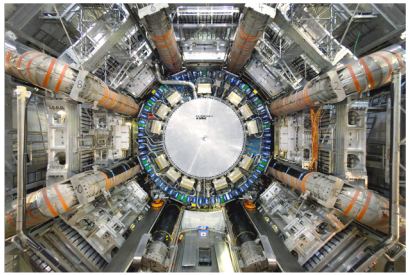


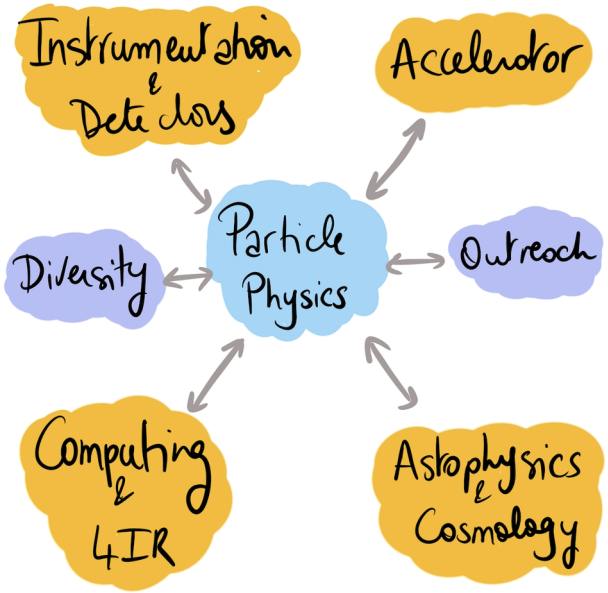






How we position ourselves in the field of fundamental physics ?

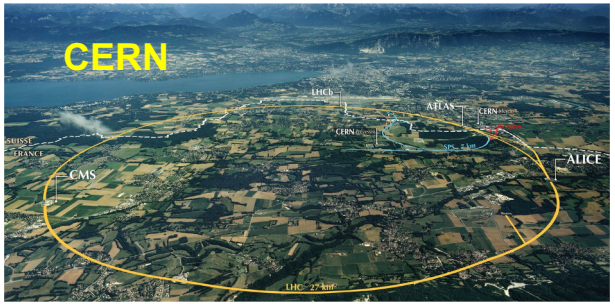




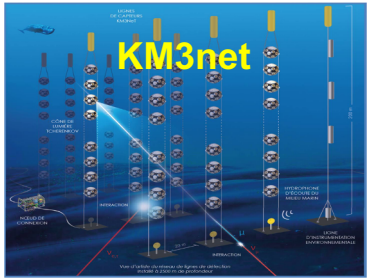
Established contact with all of the other WGs from ASFAP & discussions with individual researchers .

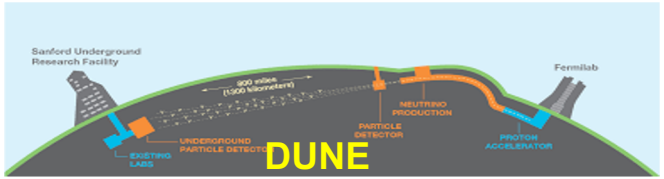
Particle Physics facilities

Colliders



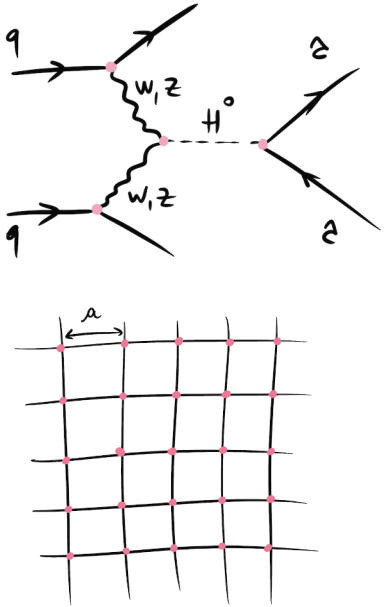
Neutrino experiments





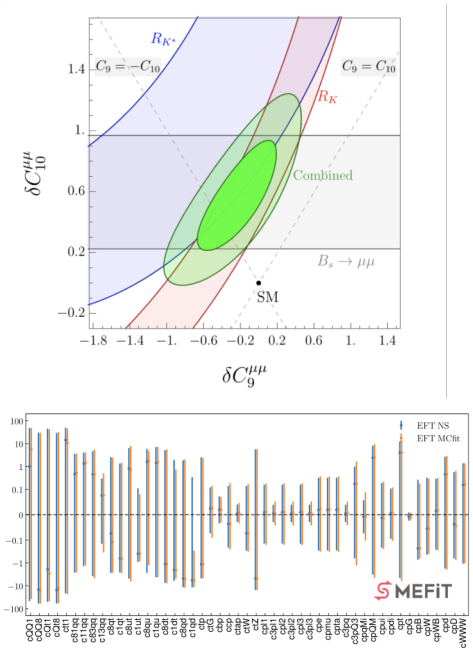
Theoretical physics

Predictions



Generators, Lattice QCD...

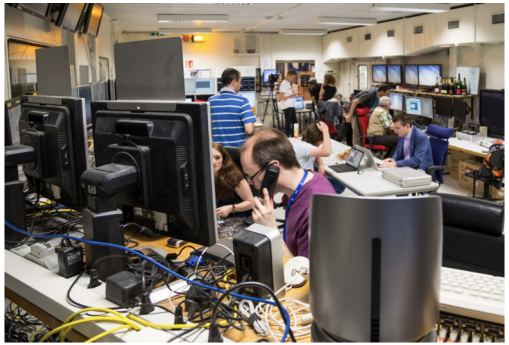
Interpretations



EFTs, CKM, PMNS...

Model Building

Typical operating structure (CERN)

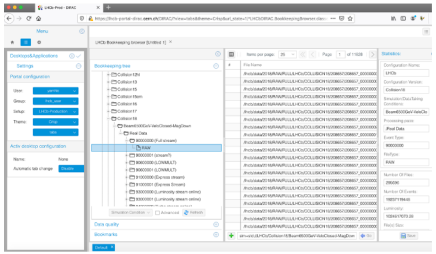


Operations/Shifts for data taking

On site training

Brainstorming

Large international collaborations



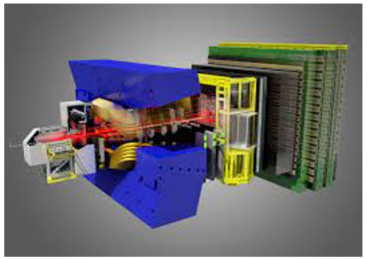
Remote access to data

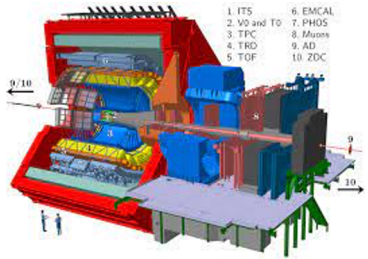
Particle Physics conveners

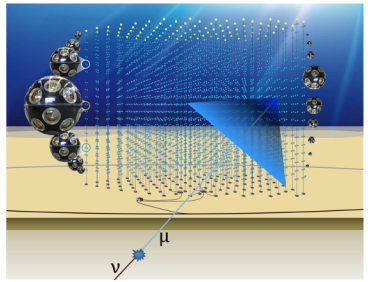
Yasmine Amhis

Zinhle Buthelzi

Mohamed Chabab







Our role

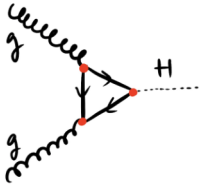
Contribute to building a network of Particle Physicists in Africa.

Start by making a survey of the ongoing activities and collaborations in Africa for both Experimental and Theoretical physics.

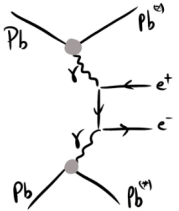
Address the possibilities of evolution and expansion of these involvements in the next few years.

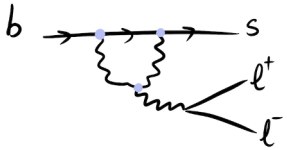
Proposed subgroups

- **subWG I “Fundamental constituents & forces”** :
  - Higgs physics.
  - Electroweak and BSM physics.
  - Direct searches.

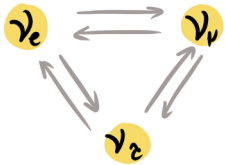


- **subWG II “Symmetries and composite structures”:**
  - Flavour physics, CP violation.
  - Strong interaction, hadron physics, heavy ions.
  - Indirect searches.
  - nEDM.





- **subWG III “Light messengers” :**
  - Neutrino Physics : neutrino parameters, CP violation, BSM.



- **subWG IV “Infrastructures” .**

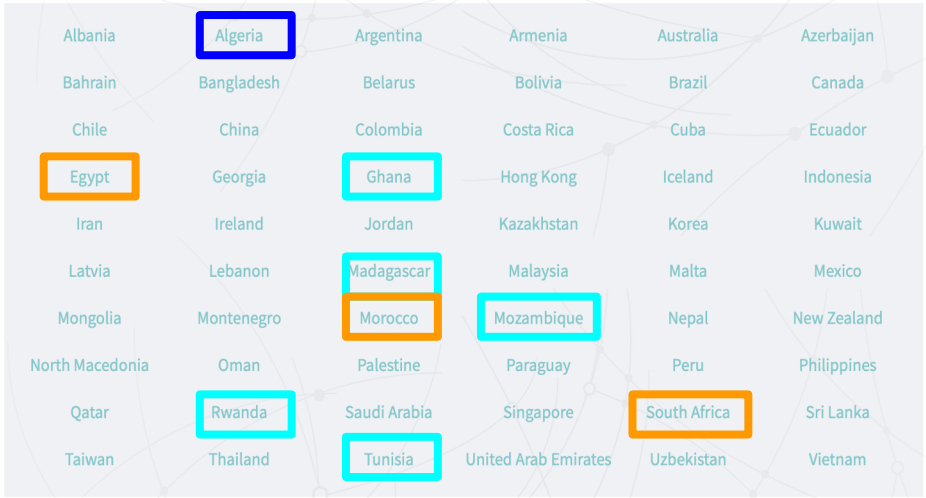
Note: For subWG I, II and III we would like to have two conveners, an experimentalist and a theorist.

Ongoing survey of activities -- CERN

https://international-relations.web.cern.ch/stakeholder-relations/Associate-Non-Member-State-Relations

Ongoing survey of activities -- CERN

Non-Member States, Territories and Regions Collaborating with CERN



Involvement in experiments either full members or associate:

ATLAS

CMS

Alice

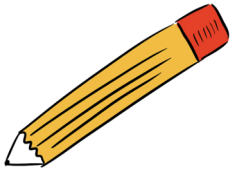
Training opportunities for example in LHCb.

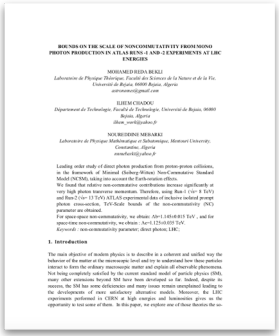
Computing Tier 3 WLCG

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

Next steps: extend survey to other facilities.

Theoretical physics





Topics covered :

- Standard Model Physics.
- Physics Beyond the Standard Model
- General relativity, Quantum Gravity
- Dark matter.
- Etc.

$$\mathcal{L}_{Yukawa} = -(Y_e)_{ij}\bar{L}_i \phi l_{Rj} - (Y_d)_{ij}\bar{Q}_i \phi d_{Rj} - (Y_u)_{ij}\bar{Q}_i \tilde{\phi} u_{Rj} + h.c,$$

Where to find us ?

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

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Prof. Mohamed Chabab ChababBio	Cadi Ayyad U, Morocco	mchabab[at]uca.ma	M	Morocco

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Other members

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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 !

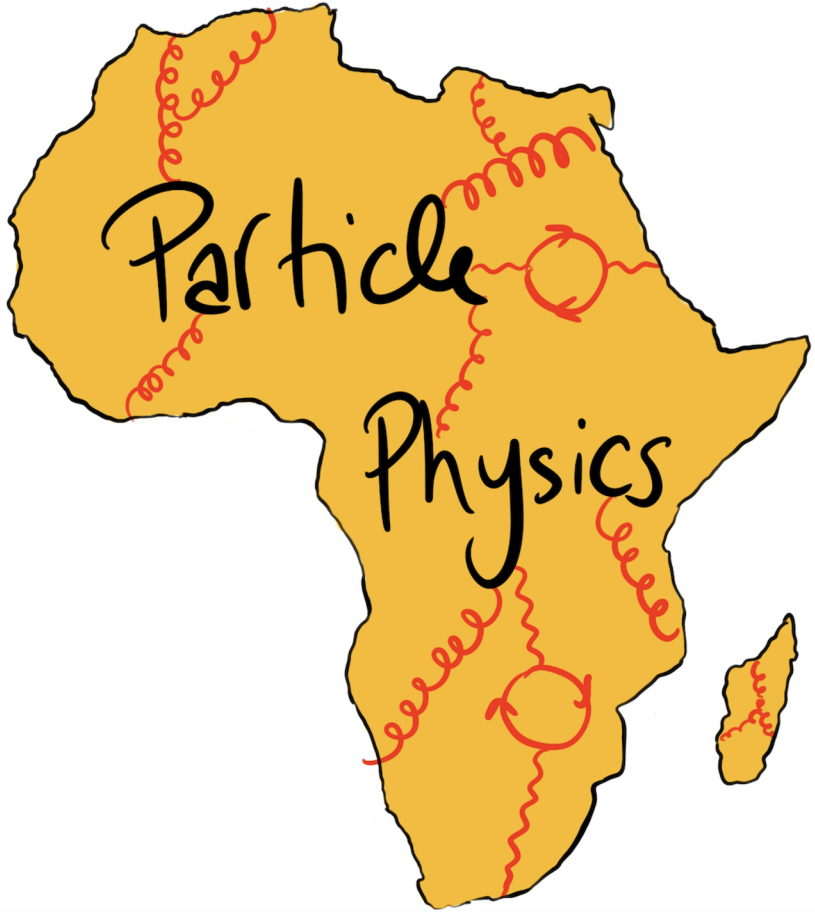
Conclusion

Agreed on a structure for the subWGs and opened a call for nominations.

Started a survey of the activities with CERN. This work will be extended to other facilities and to Theoretical Physics.

Looking forward to hearing back from you !

Special thanks to our observers for their input and feedback.


Particle
Physics

South Africa
SA-CERN programme
ATLAS, ALICE, ISOLDE, CERN

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

NRF National Research Foundation | iThemba LABS Laboratory for Accelerator Based Sciences | University of Cape Town | University of Johannesburg | University of KwaZulu-Natal | Nelson Mandela University | DUT Durban University of Technology | University of the Western Cape | Cape Peninsula University of Technology | University of the Witwatersrand, Johannesburg | University of Zululand

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

UNISA university of south africa

	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

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

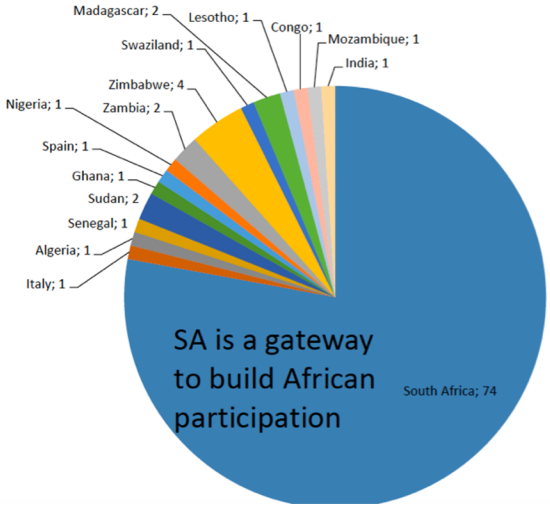
Decades of "ad hoc" participation

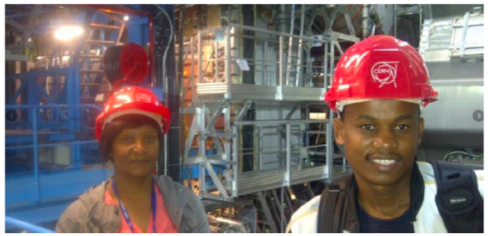
- ALICE since 2001
- ATLAS since 2010
- ISOLDE since 2017
- Theory
- JINR since 2005

Slides courtesy of Simon Connell, UJ

SA participates in Physics, Upgrade activities, Engineering, Outreach

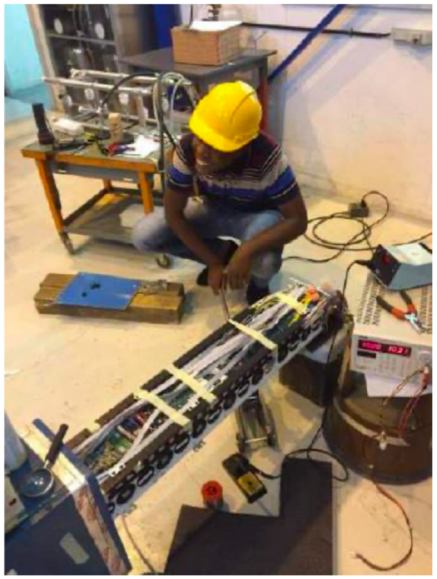
Some of the SA-CERN group





Staff and students at ALICE

Staff and students at ISOLDE

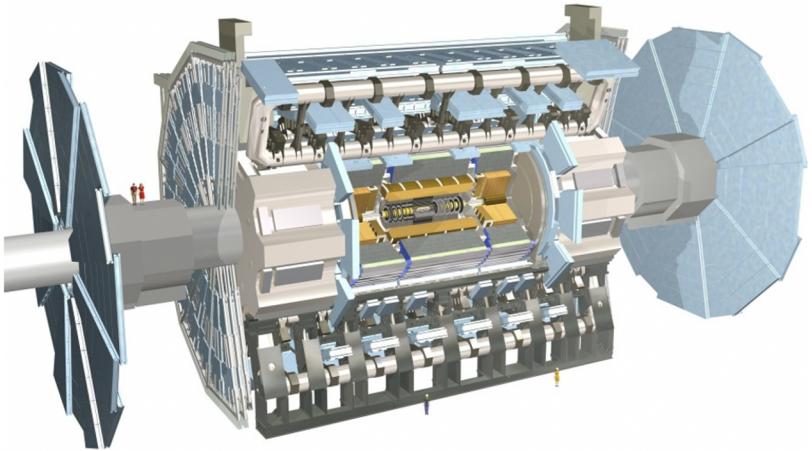


Testing modules developed in SA for ATLAS

Slides courtesy of Simon Connell, UJ

Particle Physics in Morocco : History

- 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



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**

CALICE Collaboration
Calorimeters for Linear Collider Experiments

- Performance of the ILD detector concept: Si-W ELM Calorimeter

- Higgs mass measurement at the International Linear Collider (ILC) in the ee→ZH→ee X channel

KM3NeT Collaboration
Search for Neutrino

- **ARCA** : Detection of high energy neutrinos of cosmic origin
- **ORCA:** detector dedicated to the determination of the mass hierarchy of neutrinos.

KM3NeT/Morocco: 3 Moroccan Universities are full members

- **Univ. Mohammed V, Rabat**
- **Univ. Mohammed I, Oujda**
- **Univ. Cadi Ayyad, Marrakech**

Members:

- **12 Physicists**
- **4 PhD Students**
- **1 defended PhD thesis**

Research Program includes the topics:

- **Search for Magnetic monopole**
- **Search for nuclearite**
- **Neutrino light curves from core collapse Supernovae**

Contribution to the construction of KM3NeT telescopes:

- **DOM integration in Rabat and Oujda Sites.**

Egypt

The ENHEP PhD theses:

Ahmed Abdelalim, Search for excited electron production using Di-electron + photon signature and search for new heavy neutral gauge boson using Di-electron signature with ATLAS at Vs=TeV (2011).

Shimaa Abu Zeid, Search for top quark Flavour Changing Neutral Coupling with the CMS Experiment at the LHC (2018).

Yasser Assran, Study and operational characteristics of RPC FOR THE CMS expriment at LHC (2012).

Mohammed Attia, A Study of Charged Particle Production in Proton-Proton Collisions at LHC (2007).

Sherif Elgammal, Detection of high energy electrons in the CMS detector at the LHC (2009).

Mai Elsawy, Search for Magnetic Monopoles in the CMS experiment at the Large Hadron Collider (2020).

Ahmed Lotfy, Study of Correlations in p-p Collisions at LHC (2017).