

Particle Physics @ ASFAP

Yasmine Amhis, Zinhle Buthelezi, Mohamed Chabab,

ASFAP Community Town Hall

13.07.2021

Standard Model of Elementary Particles

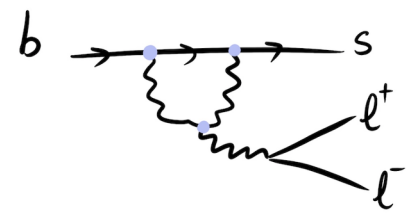
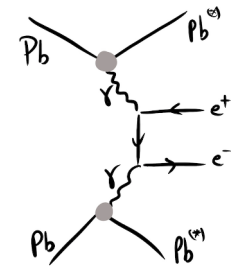
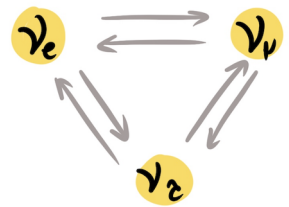
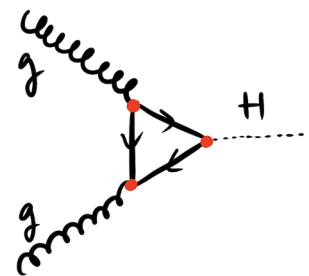
three generations of matter (fermions)			interactions / force carriers (bosons)	
I	II	III		
mass $=2.2 \text{ MeV}/c^2$ $\frac{1}{2}$ $\frac{1}{2}$ u up	mass $=1.28 \text{ GeV}/c^2$ $\frac{1}{2}$ $\frac{1}{2}$ c charm	mass $=173.1 \text{ GeV}/c^2$ $\frac{1}{2}$ $\frac{1}{2}$ t top	0 0 1 g gluon	mass $=124.97 \text{ GeV}/c^2$ 0 0 H higgs
mass $=4.7 \text{ MeV}/c^2$ $-\frac{1}{3}$ $\frac{1}{2}$ d down	mass $=96 \text{ MeV}/c^2$ $-\frac{1}{3}$ $\frac{1}{2}$ s strange	mass $=4.18 \text{ GeV}/c^2$ $-\frac{1}{3}$ $\frac{1}{2}$ b bottom	0 0 1 γ photon	SCALAR BOSONS
mass $=0.511 \text{ MeV}/c^2$ -1 $\frac{1}{2}$ e electron	mass $=105.66 \text{ MeV}/c^2$ -1 $\frac{1}{2}$ μ muon	mass $=1.7768 \text{ GeV}/c^2$ -1 $\frac{1}{2}$ τ tau	mass $=91.19 \text{ GeV}/c^2$ 0 0 1 Z Z boson	
mass $<1.0 \text{ eV}/c^2$ 0 $\frac{1}{2}$ ν_e electron neutrino	mass $<0.17 \text{ MeV}/c^2$ 0 $\frac{1}{2}$ ν_μ muon neutrino	mass $<18.2 \text{ MeV}/c^2$ 0 $\frac{1}{2}$ ν_τ tau neutrino	mass $=80.39 \text{ GeV}/c^2$ 0 1 W W boson	

QUARKS

LEPTONS

GAUGE BOSONS
VECTOR BOSONS

SCALAR BOSONS



Particle Physics in a nutshell

Particle physics

From Wikipedia, the free encyclopedia

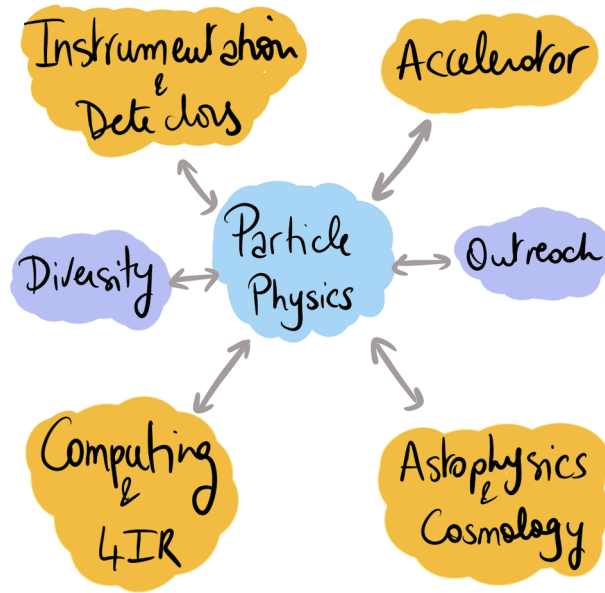
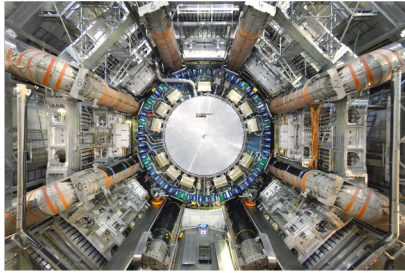
Wikipedia!

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 ?



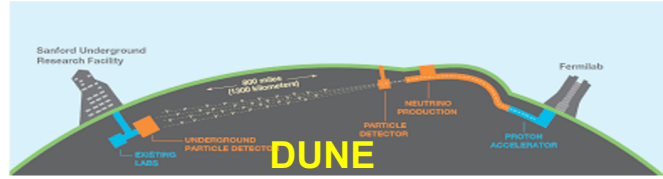
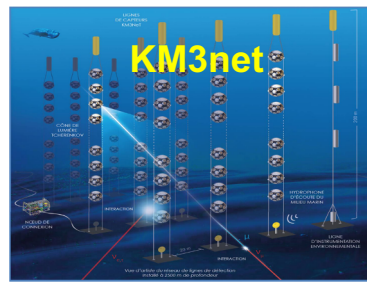
Established contact with all of the other WGs from ASFAP & discussions with individual researchers .

Particle Physics facilities

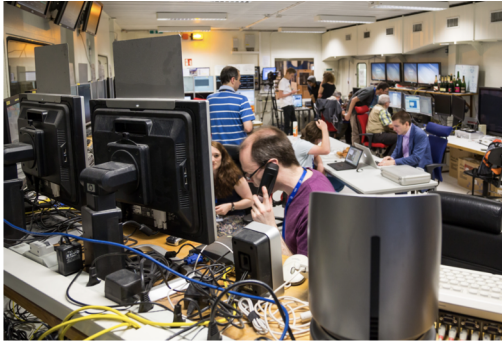
Colliders



Neutrino experiments



Typical operating structure (CERN)



**Operations/Shifts
for data taking**

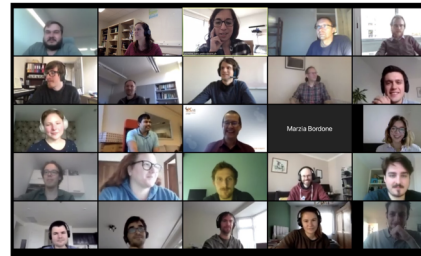
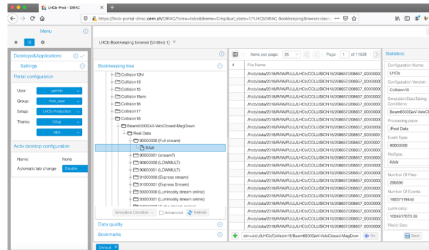


On site training



Brainstorming

**Large international
collaborations**



Remote access to data

Particle Physics conveners



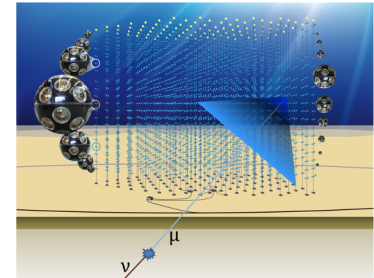
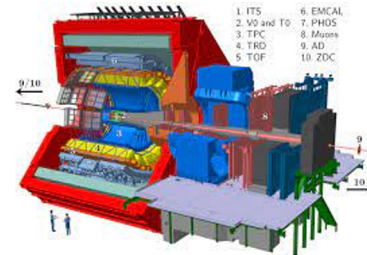
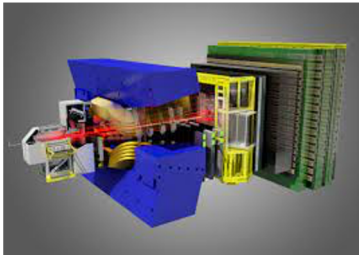
Yasmine Amhis



Zinhle Buthelzi



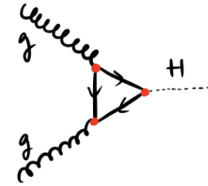
Mohamed Chabab



Proposed subgroups

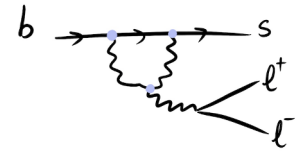
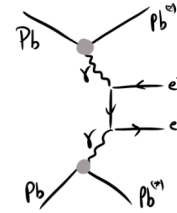
- **subWG I “Fundamental constituents & forces” :**

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



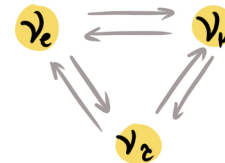
- **subWG II “Symmetries and composite structures”:**

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



- **subWG III “Light messengers” :**

- Neutrino Physics.



- **subWG IV “Infrastructures” .**

Note: For subWG I, II and III we would like to have 2 conveners, an experimentalist and a theorist.

Ongoing survey of activities -- 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

Ongoing survey of activities -- 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

Next steps: extend to Theoretical physics activities and other facilities.

Ongoing preparation of the LOI

Letter Of Intent - Particle Physics Working group

Yasmine Amhis, Zihle Buthelezi, Mohamed Chabab
(Add other members)

July 2, 2021

1 Particle Physics activities in Africa

African Strategy for Fundamental and Applied Physics (ASFAP) is an opportunity for African particle physicists to come together, identify and document a scientific vision for the future of particle physics in Africa.

2 Structure of the Particle Physics WG

Particle Physics (PP) reveals the profound connections underlying all observed phenomena, ranging from the smallest to the largest structures in our Universe.

For the structure of this working group, we propose to have four subgroups:

SWG-I Fundamental constituents & forces

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

SWG-II Symmetries and composite structures

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

SWG-III Light messengers

- Neutrino Physics

Will contain a presentation of :

- Structure.
- Current activities.
- Plans.
- etc.

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 !

Conclusion

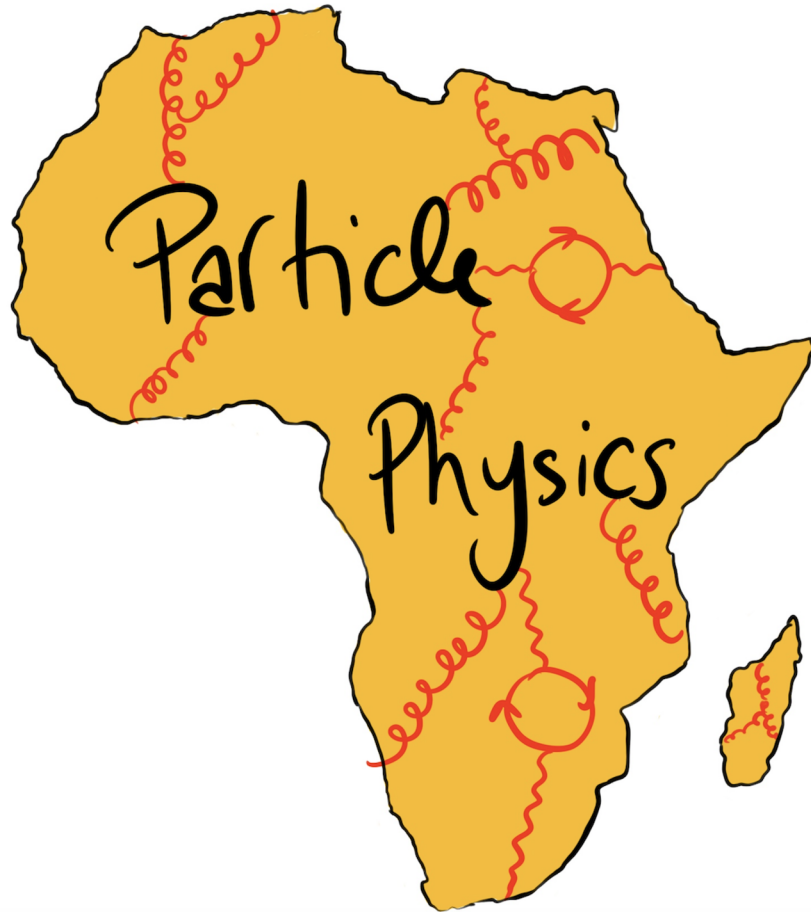
Agreed on a structure for the subWGs and opened a call for nominations.

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.





The landscape of experimental particle physics in Africa

4 Survey of the ongoing activities

The aim of the Particle Physics working group is to review and support activities in field in association with Africa. The list provided in Table 1 gathers the current (May 2021) involvements of African countries in particle physics experiments. Example of a citation [1].

Work in Progress !

Field	Activity	Institution	Country
Astro/Neutrino	ANTARES	University Mohammed V/I	Morocco
Astro/Neutrino	KM3Net	University Mohammed V/I, Cadi Ayyad University	Morocco
Astro/Neutrino	KM3Net	Universities of Johannesburg/Witwatersrand/North-West	South Africa
HEP-EXP	ATLAS	Faculté des Sciences Ain Chock, Université Hassan II, Casablanca	Morocco
HEP-EXP	ATLAS	Faculté des Sciences, Université Ibn-Tofail, Kénitra	Morocco
HEP-EXP	ATLAS	Faculté des Sciences Semlalia, Université Cadi Ayyad, LPHEA-Marrakech	Morocco
HEP-EXP	ATLAS	LPMR, Faculté des Sciences, Université Mohamed Premier Oujda	Morocco
HEP-EXP	ATLAS	Faculté des sciences Université Mohammed V Rabat	Morocco
HEP-EXP	ATLAS	Universities of Cape Town/Witwatersrand/Johannesburg	South Africa
HEP-EXP	CMS	Academy of Scientific Research and Technology of the Arab Republic of Egypt, Cairo	Egypt
HEP-EXP	CMS	Center for High Energy Physics (CHEP-FU), Fayoum University, El-Fayoum	Egypt
HEP-EXP	ALICE	iThemba LABS, Universities of Cape Town/Witwatersrand	South Africa

Table 1: Overview of ongoing Particle Physics activities in Africa

Important note :

- This is not the full picture yet.
- Does not include yet theoretical physics.