

Fondamental Physics Research in Morocco

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ASP - Genesis

The rainbow school of physics



The participants to the first African School of Fundamental Physics and its Applications photographed with some of the school's organizers.

The first ASP received a great deal of interest in the African community and the organizers had a hard time selecting between the very motivated applicants. "The participants were selected to come from various backgrounds and education levels," says the head organizer, Christine Darve. "At the school the students, lecturers and organizers shared the same dynamism and this allowed everybody to build durable networks in a physics world without borders," she continues enthusiastically.

The students were informed by their local universities about the possibility of participating in ASP2010. "Mr Mwinga, a lecturer in the department of physics of my univer-

Students from 17 African countries took part in the first African School of Fundamental Physics and its Applications (ASP2010), which took place this month in South Africa. The school, organized by several physics laboratories including CERN, not only met but in some cases far exceeded the students' expectations. Their enthusiasm made the organizers' efforts worthwhile.

sity, asked interested students around the department and he instructed them how to go about the application process", confirms Gifti Sichone, a graduate student from the University of Zambia. "He also helped me in writing up the motivation letters."

The experience was extremely valuable for all the participants, with some of them going as far as saying that it changed their life. "The school has far exceeded my expectations", enthuses Ekuu Mensimah, the only participant from Ghana. "Not only was I exposed to the beauty of physics, but I also

(Continued on page 3)

www.cern.ch/bulletin



A word from the DG

Nurturing talent in Africa

The first African School of Physics draws to a close tomorrow, and I'm proud that CERN has been a part of it. From an initiative launched by Fermilab scientist, Christine Darve, the African School of Physics has grown to involve institutes and universities from all over Europe and the United States.

(Continued on page 1)

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<http://bulletin.cern.ch>

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A word from the DG

(Continued from page 1)

Nurturing talent in Africa

It's being hosted by South Africa's National Institute for Theoretical Physics, NITheP, at Stellenbosch, and has attracted 150 applicants from all over the continent and beyond for the 65 places available. That alone makes it a success, even before NITheP Director Frederik Scholtz uttered his words of welcome nearly three weeks ago.

When I show people the map of where CERN's users come from, it's gratifying to see it spanning the world, and in particular to see southern hemisphere countries starting to join the global particle physics family. Africa, however, remains notable more for the number of countries that are not involved than for those that are. What this school has brought home very clearly is that there is the talent and the will in Africa to engage in advanced scientific education, and indeed with fundamental physics in general. Already at CERN, we have 51 African scientists involved with our programmes, with 18 of them coming from African institutes. This year we also welcomed our first Summer Students and Doctoral Students from Morocco. It's a start, and it is a trend that I hope to encourage. Over the coming years, I look forward to seeing our users map fully representing the depth and breadth of African talent that this first school has revealed.

Roel Heuer

The rainbow school of physics

(Continued from page 1)

Did you know?

Facts and figures

Out of the 150 applications received by the organizers, 60 of the students selected came from Africa, representing Algeria, Cameroon, the Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Morocco, Nigeria, Rwanda, South Africa, Senegal, Sudan, Tunisia, Zambia and Zimbabwe. One student each came from Canada, Germany, India, Switzerland and the US.

The programme lasted three weeks, from 1st to 21st August, and it included lectures on physics, acceleration and detection techniques, as well as related technologies.

The school was held in Stellenbosch in the "Rainbow Nation" of South Africa, and was sponsored by 14 Labs and institutes around the world and four governmental institutions.

had the opportunity to meet great lecturers, make friends from different countries, and have a fun time visiting various sites here in South Africa. The school gave me the wings to fly to a higher ground in my academic career. This has definitely had an impact in my life, one that I will always be grateful for".

The praise to the organizers comes not only from the African participants but also from the others, such as Jörn Lange, a PhD student from the University of Hamburg, in Germany: "I am privileged because my university regularly gives me the opportunity to participate in physics schools. However, the ASP opened my mind as to how important it is to give such an opportunity also to people who otherwise could not have the chance to participate in international high-energy physics and gave me the motivation to get involved in supporting this kind of initiative".

The school was also a great opportunity for participants to establish new networks and professional links. "Some of them are already thinking about how to establish new links and scientific collaborations", confirms Christine Darve. Naima Zahar from the University Hassan II in Morocco concludes: "I will never forget the organizing committee, Christine Darve and Steve Muanza. They were very nice and helpful". The next ASP will be in two years; the venue will be decided in October.

CERN Bulletin

Further reading:
The first African School of Physics 2010 in Bulletin Nr. 21-22/2010.

The ASP2010 website with programme, sponsors and contacts:

<http://africanschoolofphysics.web.cern.ch/AfricanSchoolofPhysics/>



(ASP2020)

Tuesday 2 April 2019, at the Hassan II Academy of Science and Technology - Rabat

Prof. **Omar Fassi-Fehri**, Permanent Secretary of the Academy, **A. Hoummada** (Director of Sciences)

- **B. S. Acharya** (ICTP, Trieste Italy & King's College London, UK - IOC) ,
- H. B. White Jr.** (Fermilab, Batavia Illinois USA- IAC)
- R. Mazini** (Academia Sinica, Taipei Taiwan - IOC) ,
- S. Muanza** (CNRS-IN2P3, Marseille France- IOC) ,
- H. Severini** (University of Oklahoma, Norman Oklahoma USA 13 Fermilab, Batavia Illinois USA - IAC) ,
- E. Dabrowski** (CERN, Geneva Switzerland - IOC) ,
- L. Elouadrhiri** (Jefferson Lab, Newport News Virginia USA - IAC) ,
- A. K. A. Assamagan** (BNL, Upton New York USA - IOC) ,
- M. Chabab (Cadi Ayyad University, Marrakesh Morocco - LOC) ,
- R. Cherkaoui El Moursli (University Mohammed V in Rabat and Hassan II Academy, Rabat Morocco -) ,
- F. Fassi (University Mohammed V in Rabat, Rabat Morocco - LOC) ,
- M. Goughri (Ibn Tofail University, Kenitra Morocco- LOC) ,
- M. Mansour (Sultan My Slimane University, Beni Mellal Morocco - LOC) ,
- A. Arhrib (Abdelmalek Saadi University, Tangier Morocco - LOC) ,
- Y. Tayalati (University Mohammed V in Rabat, Rabat Morocco- LOC) ,

(ASP2024) In Morocco

Approval of : Prof. **Omar Fassi-Fehri**, Permanent Secretary of the Academy,
Academy's Governing Bodies : Academy Council and Works Commission

Moroccan High Energy Physics Cluster : Representative of Morocco at ATLAS Experiment and CERN since 1995

- Cadi Ayyad University, Marrakesh ,
- University Mohammed V - Rabat
- Ibn Tofail University, Kenitra,
- Abdelmalek Saadi University, Tangier ,
- University Hassan II of Casablanca
- University Mohammed 1st of Oujda
- MASCIR
- University Mohammed VI Polytechnic

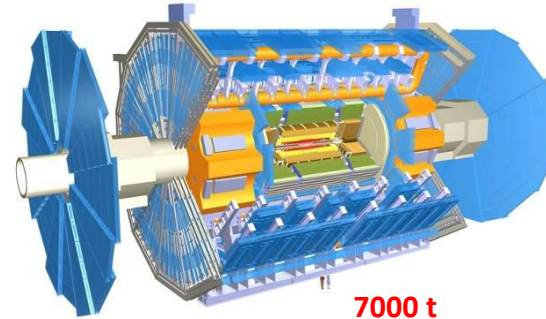
Others institutions :

- Local Organizing Committee
- Date and duration : 2024
- Venue :
- Format and scientific program of the school : Same as 2022

The worldwide Fundamental Physics

- What our world is made of
 - How it works at the most fundamental level
- Particle physics
 - Physics experiments
 - Accelerators
 - Underground laboratories
 - Space observatories
 - Lasers
- International huge collaborations

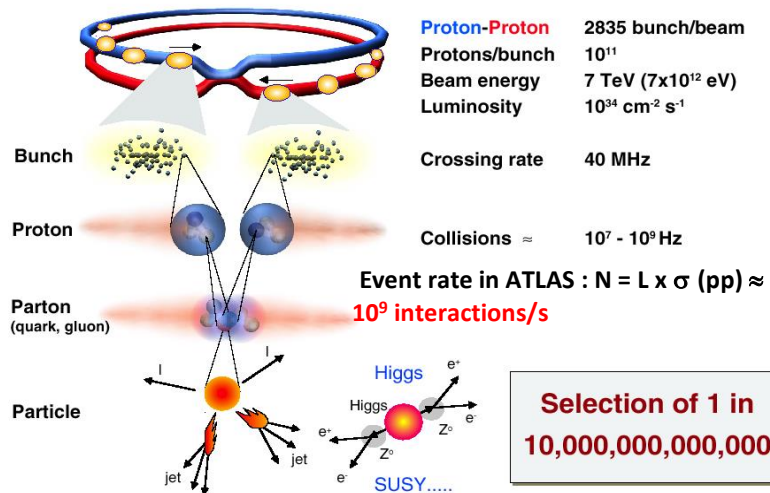
The ATLAS Experiment



7000 t
3000 Physiciens 54m x 28m



Collisions at LHC



Selection of 1 in 10,000,000,000,000

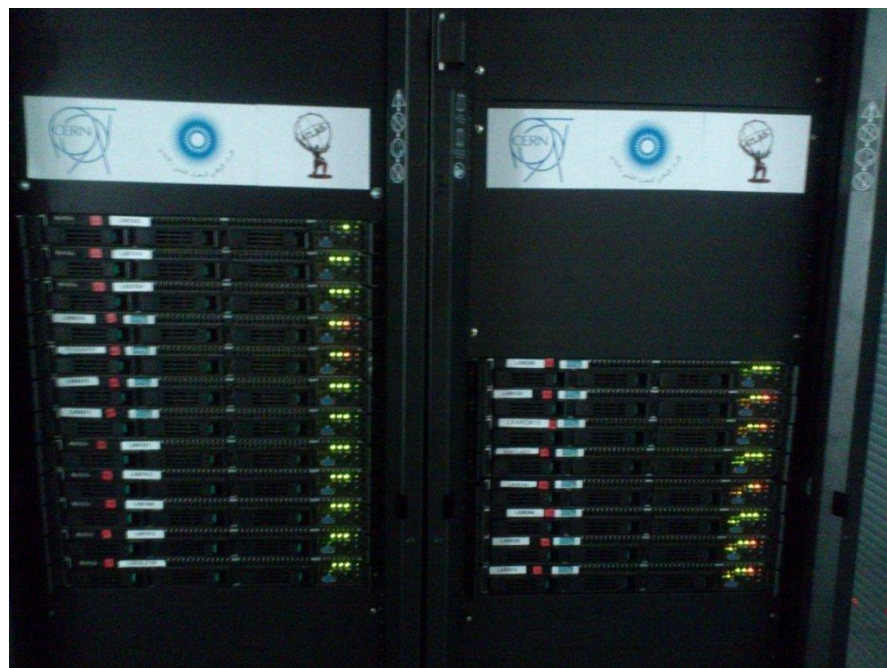
RUPHE Réseau Universitaire de Physique des Hautes Energies- RUPHE- ATLAS OVERVIEW WEEK 2013 07-11 October - Marrakech, Morocco

A. KETEVİ



ATLAS - CNRST

- Réception des serveurs (DON CERN) – 19/11/2012
- Installation et configuration des serveurs – 27/11/2012
- Visibilité du site sur Gstat et les autres outils de monitoring – 30/11/2012

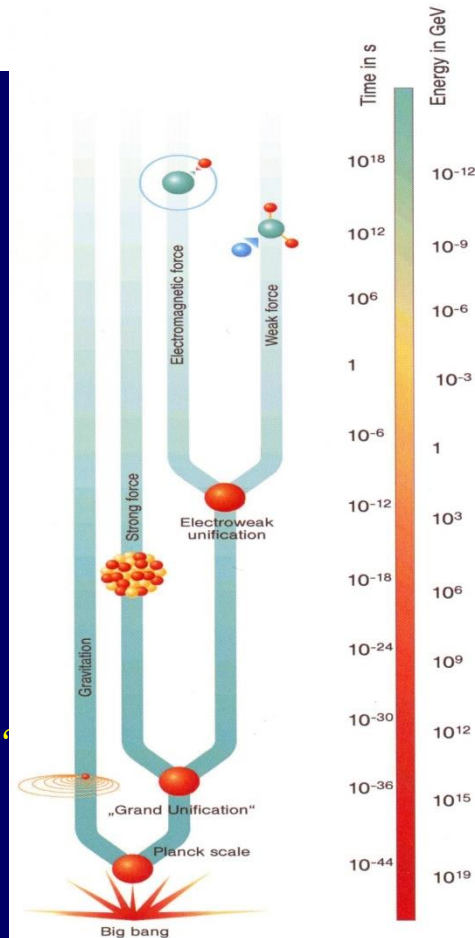


Open Questions from Twenty to Twenty First Century

- What message do neutrinos bring from the beginning of time ?
 - Nature of neutrino (Dirac or Majorana, other,...), origin of his mass
- What's the matter with antimatter ?
- How can we solve the mystery of dark energy ?
 - Universe expansion
- What is dark matter ?
 - Nature of dark matter
- Are there extra dimensions of space ?
- What is the trajectory of our universe ? How did it evolve ?
 - The destiny of the universe

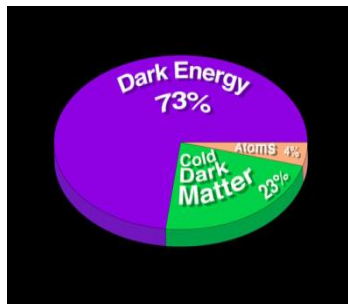
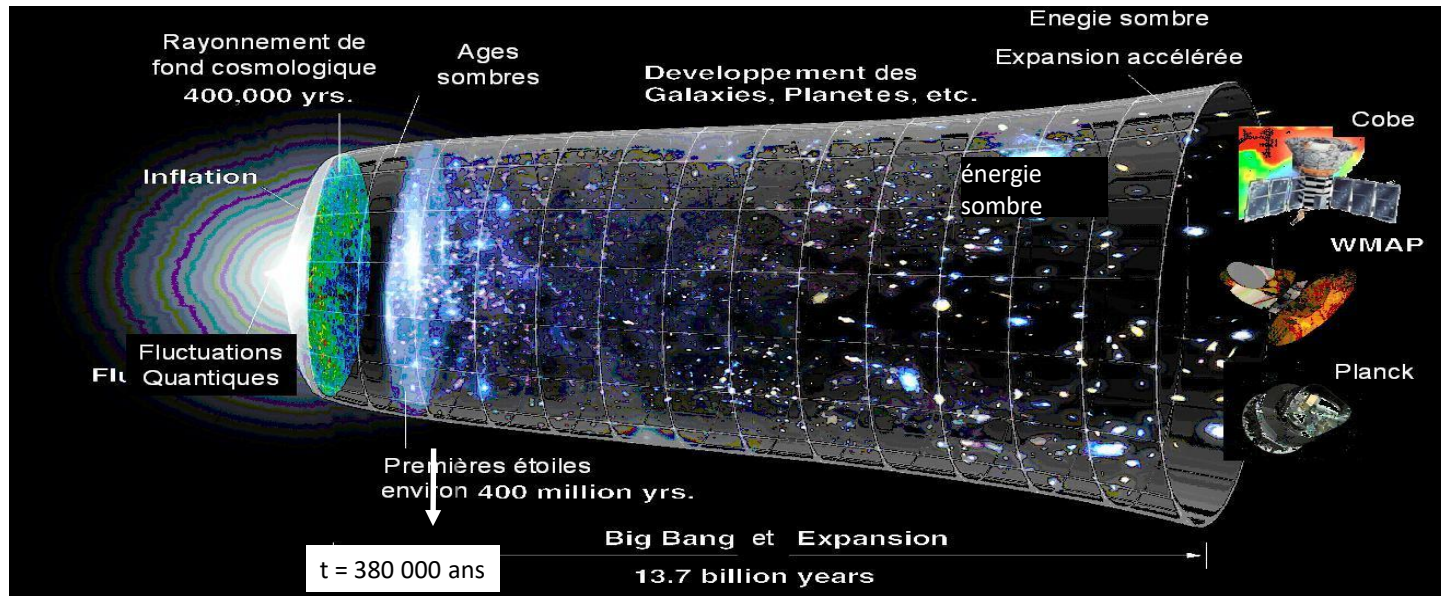
Open Questions beyond the Standard Model

- What is the origin of particle masses?
due to a Higgs boson?
- Why so many types of matter particles?
- Unification of the fundamental forces?
- Quantum theory of gravity?



L'histoire de l'Univers et son contenu

L'évolution et la structure de l'Univers dépendent de son contenu !



Des observations de l'évolution et de la structure de l'Univers, nous déduisons aujourd'hui que **notre matière ordinaire** (nous, les planètes, les étoiles, les galaxies ...) **ne compose qu'environ 4 % de notre Univers**. L'essentiel nous échappe

Est-ce que le LHC pourra créer un peu de cette matière sombre ?

Our research activities:

- ▶ Phenomenology of Particle Physics: Tangier (A.A), Marrakech (M. Chabab), Safi (R. Benbrik), Agadir (L. Rahili) , Benimellal (B. Manut), Rabat (E.H Saidi),
- ▶ Tools for HEP: Tangier (A.A), Marrakech (M. Chabab) , Safi (R. Benbrik), Agadir (J. ElFalaki)
- ▶ Cosmology, Black Holes, Branes and String theory: Marrakech (M. Chabab), Rabat (R. Ahl Laamara, A. Belhaj), Oujda(T. Ouali), Agadir (H. Moumni), A. Jellal (ElJadida) , Casablanca (M. Benai)
- ▶ Quantum information: Kenitra (M. Daoud), Rabat (Y. El Hassouni), Benimellal (M. Mansour)

Research topics

1. Radiative corrections in the SM and beyond.

- ▶ Radiative corrections to several SM observables at 1-loop level and try to find a hint for new physics: $h \rightarrow f\bar{f}$; $h \rightarrow VV$; $e^+e^- \rightarrow Zh_{SM}, H^+H^-$; $pp \rightarrow hh$; triple Higgs coupling hhh .
- ▶ Very complicated calculation, too many Feynman diagrams
- ▶ www.FeynArts.de , www.FormCalc.de
- ▶ Model file for FeynArts: 2 Higgs doublet model w/wo CP violation

2. Perturbative unitarity and boundedness from below for scalar potentials and EWPT

- ▶ Many BSM models, involve Higgs with high representation: more doublet, more singlet, doublet and triplet...
- ▶ Several CP-even Higgses, CP-odd, charged Higgs, doubly charged Higgs...

3. Charged Higgs phenomenology

- ▶ Charged Higgs decay in extended Higgs sector: Bosonic decay of the charged Higgs $H^\pm \rightarrow W^\pm h, W^\pm A$
- ▶ Radiative corrections to $e^+e^- \rightarrow H^+H^-$

4. Vector like quarks(VLQ): T, B, X, Y...

- ▶ VLQ associated with extended Higgs sector may lead to new signatures for the new quark decays.
- ▶ Tools
 - ▶ Radiative corrections is a very complicated task, too many Feynman diagrams
 - ▶ www.FeynArts.de , www.FormCalc.de
 - ▶ Model file for FeynArts: 2 Higgs doublet model with/without CP violation
 - ▶ Model file for FeynArts: Higgs triplet Model (type II seesaw)
 - ▶ HEP tools (include VLQ in the existing tools)

6. Cosmology, Black Holes, Branes and String theory:

- ▶ Finding out phase transitions and thermodynamical properties of black holes in general relativity and beyond.
- ▶ Probing the behavior of black holes in the presence of perturbation: quintessence, cloud of strings... in modified gravities
- ▶ String theory and branes,
- ▶ Inflationary Cosmology:
Non-minimal Higgs inflation in the context of holographic cosmology.
An interacting holographic dark energy model within an induced gravity brane.

7. Astronomy and astrophysics:

- ▶ Qualification studies of astronomical sites.
- ▶ Detection of exoplanets by photometric measurements.
- ▶ Trappist Nord (Marrakesh-Oukaimden and Liege):
(TRANsiting Planets and Planetesimals small Telescope), to observe both exoplanets and comets. A twin telescope is already operating in Chili.

8. Experimental Physics and collaborations :

- * LHC-CERN, ATLAS experiment (Rabat, Casablanca, Marrakech, Oujda and Kenitra) and CNRST
- * Search for new physics in Top-Antitop Production at ATLAS.
- * Charged Higgs search.

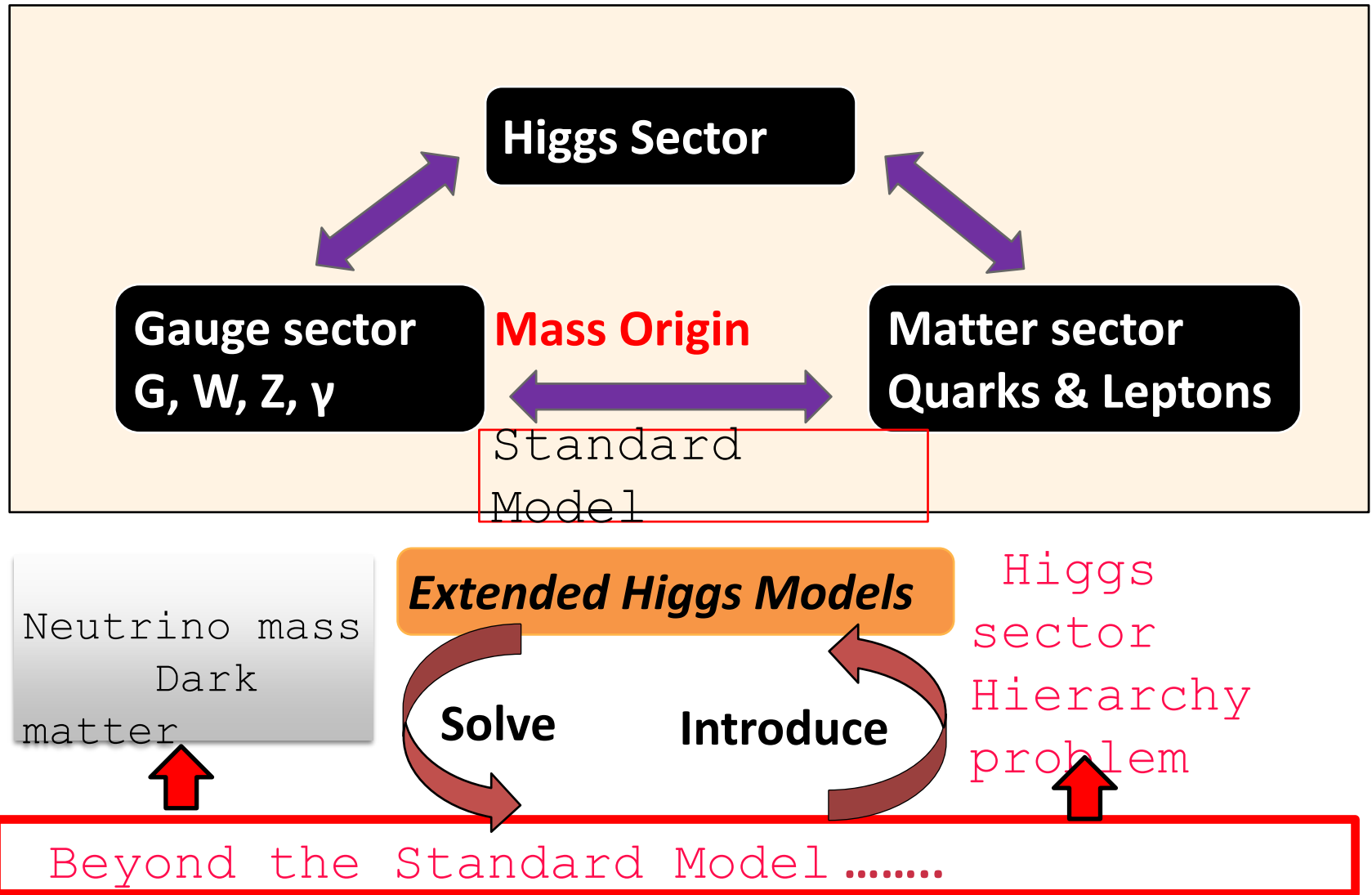
- * Search for high energy cosmic neutrino and determination of the neutrino mass hierarchy with KM3NET and Antares undersea telescopes (Italy, France, Greece and Morocco): (Rabat, Marrakech, Oujda)

The Kenitra HEP group is joining three international collaborations :

- **Hyper-Kamiokande Collaboration in Japan (Kenitra, Rabat, Casablanca, UM6P)**
- **The ATLAS collaboration at CERN , Physics analysis level :**
 - **Search of high mass resonances decaying into pairs of di-bosons**
 - **Di-Higgs searches in $bbVV^*$ decay channel : two modes (resonant and non-resonant)**
 - **Search for the charged Higgs boson decaying via $H^+ \rightarrow h(\gamma\gamma)W^+$ with 0 & 1 lepton in the final state at $\sqrt{s} = 13 \text{ T eV}$**

and the ePIC collaboration at EIC - (USA)

LPHEA: HEP Phenomenology — Pr. M. Chabab - Marrakech



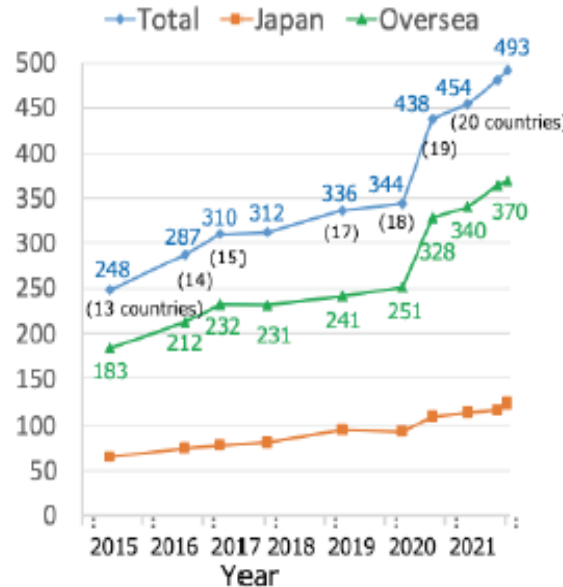
Hyper-K Collaboration

20 countries, 99 institutes, ~500 people as of Jan 2022, and growing

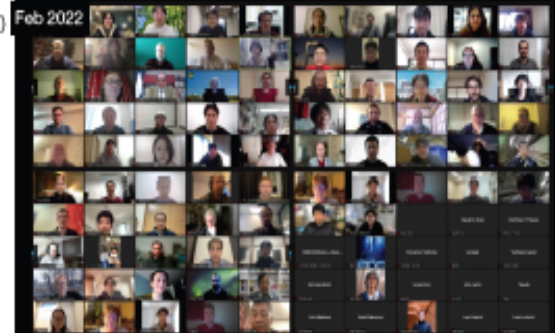
Collaborating Institutes



Number of Collaborators



20 countries, 99 institutes, ~500 people as of January 2022, and growing



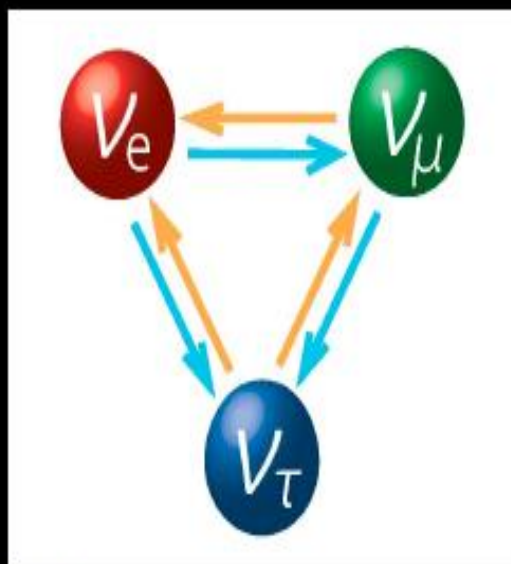
Team leader of the Moroccan cluster - **Pr. Mohamed Goughri** - Ibn Tofail University of Kenitra Casablanca – UM6P – Rabat

The Hyper-Kamiokande Experiment



Neutrino Oscillations

Neutrino Oscillations will be measured based on **accelerator** and **atmospheric** neutrinos.



Astrophysical Neutrinos

Solar, supernova, and supernova relic neutrinos will be explored for astronomical research.



Rare Decays

Rare processes such as **proton decay** or **neutron decay** processes that violate baryon number will be searched.



Neutrino Oscillations

PMNS mixing matrix relates mass and flavour eigenstates

$$|\nu_f\rangle = \sum_{i=1}^N U_{fi}^* |\nu_i\rangle$$

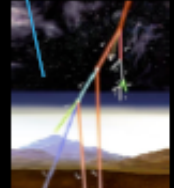
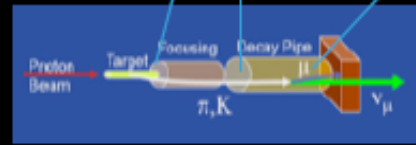
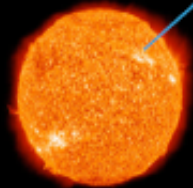
Free parameters usually written in terms of three rotation angles and one complex phase: $\theta_{12}, \theta_{23}, \theta_{13}, \delta_{CP}$

Parametrise mixing matrix U as:

$$c_{ij} = \cos\theta_{ij} \quad s_{ij} = \sin\theta_{ij}$$

$$\begin{pmatrix} U_{e1} & U_{e2} & U_{e3} \\ U_{\mu1} & U_{\mu2} & U_{\mu3} \\ U_{\tau1} & U_{\tau2} & U_{\tau3} \end{pmatrix} = \begin{matrix} \text{Solar} \\ \begin{pmatrix} c_{12} & s_{12} & 0 \\ -s_{12} & c_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix} \end{matrix} \begin{matrix} \text{Accelerator/Reactor} \\ \begin{pmatrix} c_{13} & 0 & s_{13}e^{i\delta} \\ 0 & 1 & 0 \\ -s_{13}e^{-i\delta} & 0 & c_{13} \end{pmatrix} \end{matrix} \begin{matrix} \text{Atmospherics} \\ \begin{pmatrix} 1 & 0 & 0 \\ 0 & c_{23} & s_{23} \\ 0 & -s_{23} & c_{23} \end{pmatrix} \end{matrix}$$

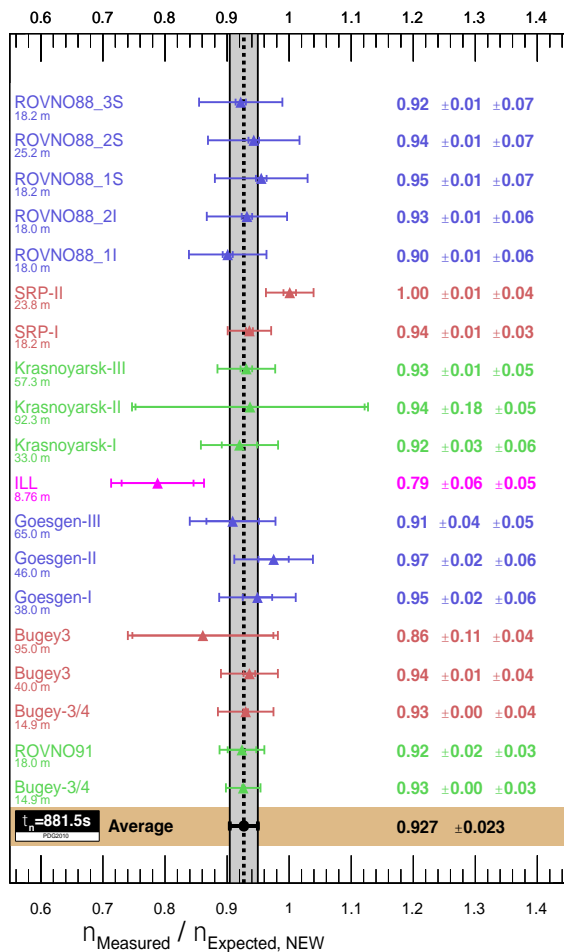
Hyper-Kamiokande will be able to study the solar, atmospheric and accelerator neutrinos.



$$\begin{pmatrix} U_{e1} & U_{e2} & U_{e3} \\ U_{\mu1} & U_{\mu2} & U_{\mu3} \\ U_{\tau1} & U_{\tau2} & U_{\tau3} \end{pmatrix} = \begin{pmatrix} c_{12} & s_{12} & 0 \\ -s_{12} & c_{12} & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} c_{13} & 0 & s_{13}e^{i\delta} \\ 0 & 1 & 0 \\ -s_{13}e^{-i\delta} & 0 & c_{13} \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & c_{23} & s_{23} \\ 0 & -s_{23} & c_{23} \end{pmatrix}$$

The Reactor Anomaly (casablanca since 1995)

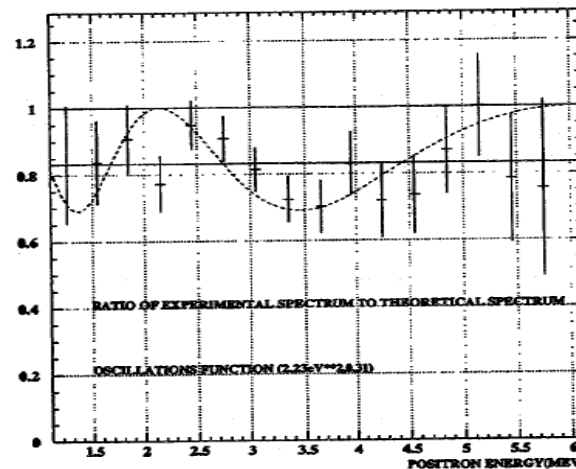
STEREO experiment at ILL - Grenoble



■ **Best fit : $\mu = 0.927 \pm 0.023$**

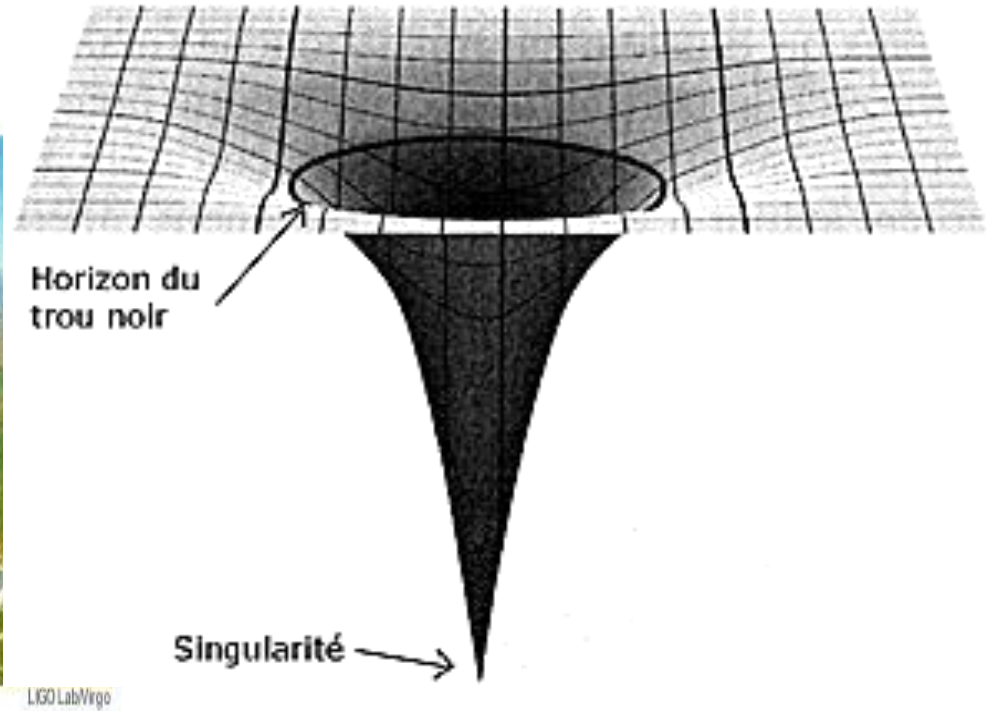
■ **At least three alternatives:**

- Wrong prediction of ν spectra ?
- Bias in all experiments ?
- New physics at short baselines... steriles neutrinos



Oscillations Function $\sin^2 2\theta = 0.31 - \Delta m^2 = 2.23 \text{eV}^2$

Hep - theory



➤ *Strong Gravity & Black holes*

- *Black holes Thermodynamics in General Relativity and Higher dimension Theories.*
- *Criticality and Phase transitions*
- *Quasi normal modes of BH: a tool to probe GW ?*

Theoretical Nuclear Physics

- Development of new theoretical approaches within collective models: Particularly, improved geometrical model of Bohr-Mottelson.
 - Aim: calculations of different collective properties of nuclei (Energy spectra, transition rates....)
 - Analytical Solutions of many differential wave equations (Schrödinger, KG, Dirac,..) via powerful mathematical methods:

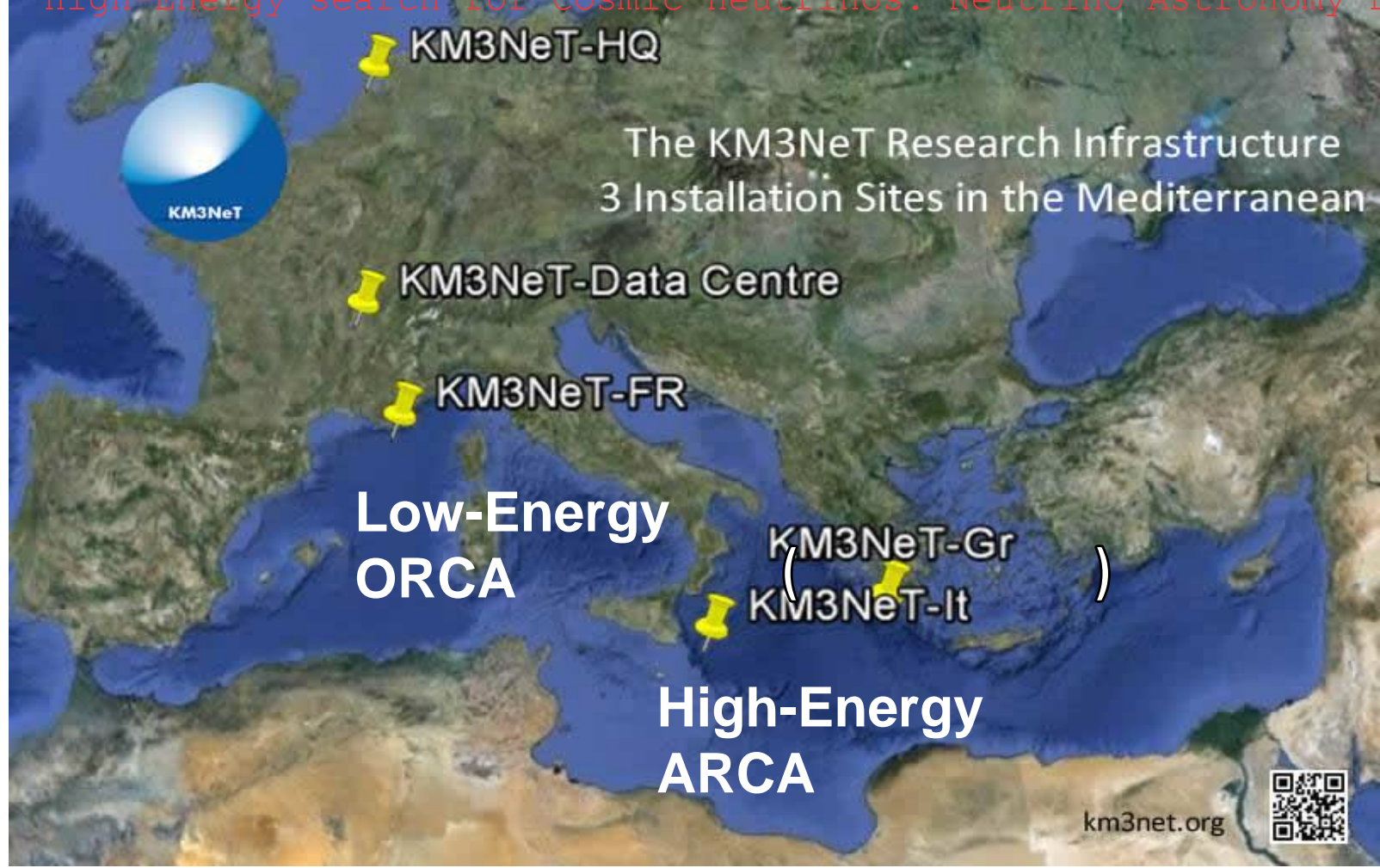
(El Batoul, Lahbas, El Adri, El Bassem, Moumene, Oulne, Ait Korchi, MC) — **UCA-Marrakech**



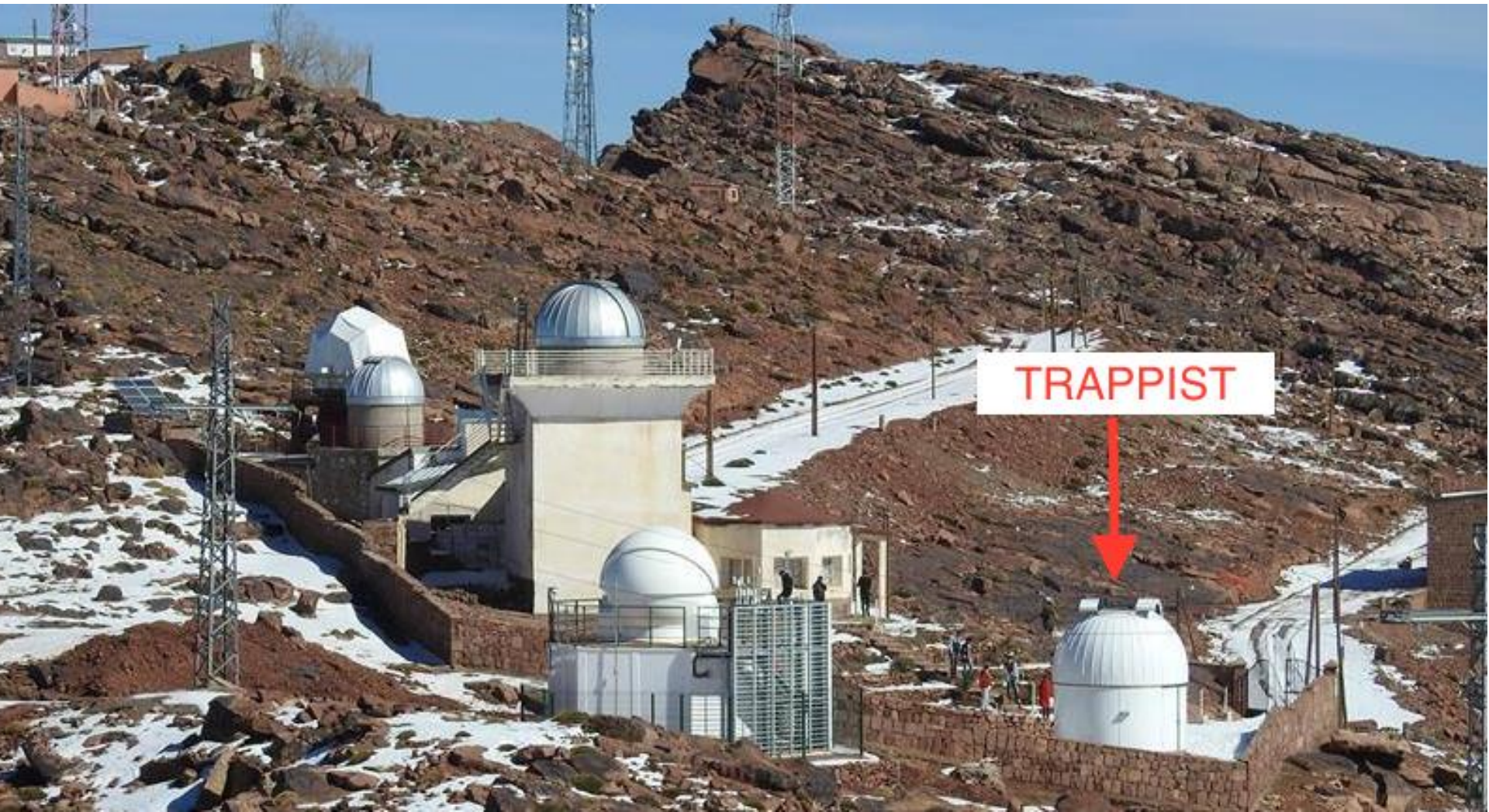
KM3NeT: Next generation detectors

KM3NeT is a distributed research infrastructure with 2 main physics topics:

- Low-Energy studies of atmospheric neutrinos
- High-Energy search for cosmic neutrinos: Neutrino Astronomy Era



Trappist North



(since October 2016...)

A &A Research topics



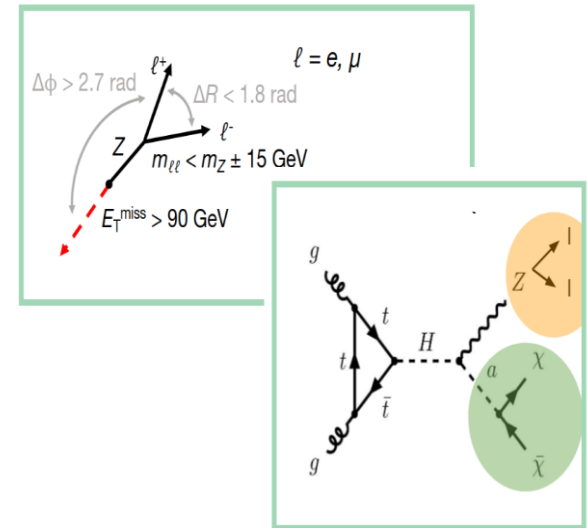
Search for new physics at LHC with the ATLAS detector

(Casablanca – Dris.Benchekroun@cern.ch)

- Search for dark matter produced in association with a Z boson :

Theoretical context : 2HDM + a model

Expected signal : 2 leptons + missing E_T



- Search for low mass dimuon resonances :

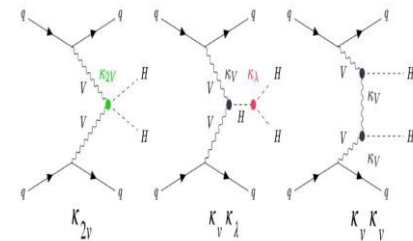
Dark photon, (Axion Like-Particle) ALP ...

- Search for di-Higgs production at LHC :

→ resonant and non-resonant production :

bbll and 4b channels

- Search for ALP in the channel : $H \rightarrow aa \rightarrow 4$ photons



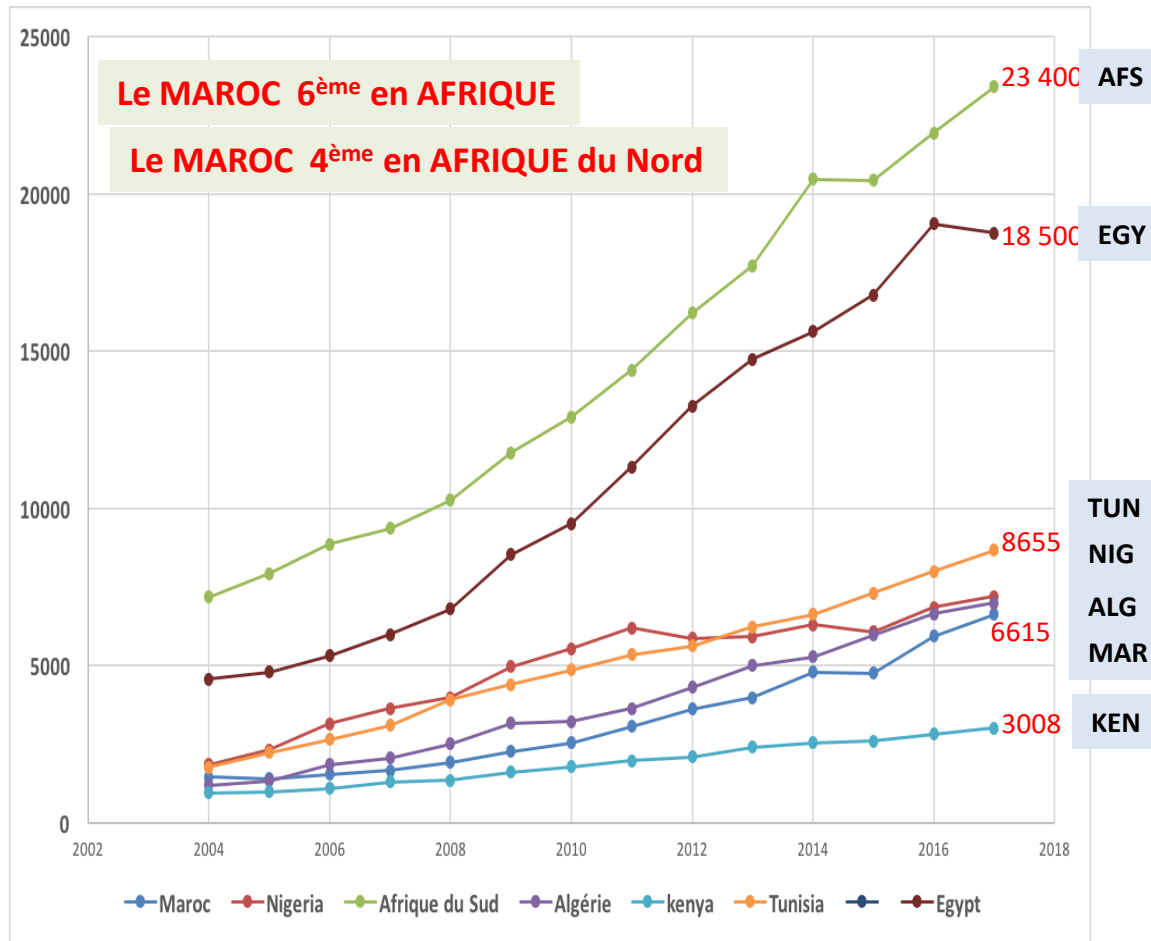
Study of non-collision background at LHC

- Study of signals not produced by normal collisions at LHC
- Cosmic rays background signal
- Measure of muons +/- rate : test of atmospheric shower models
- Study of parasitic collisions : p-p collisions not occurring at the nominal interaction point

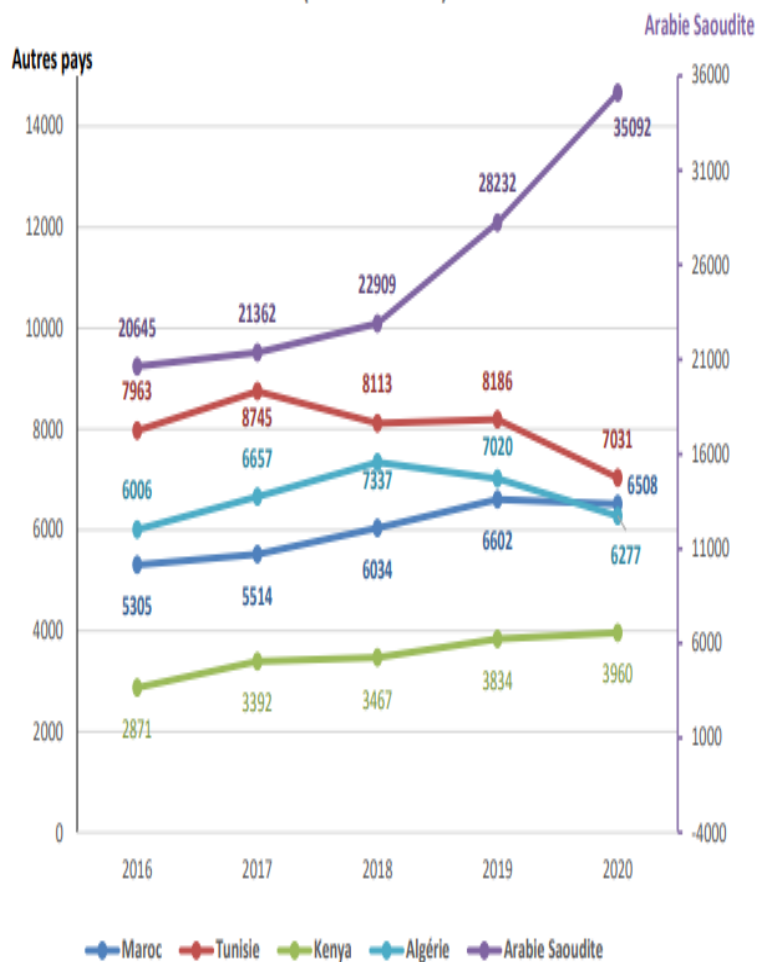
Solid state physics – atomic physics – Matter Radiation Interaction

- **Laboratoire de Matière Condensée et Sciences Interdisciplinaires (LaMCScl) – Pr. H. Ez-Zahraoui & A. Benyoussef**
 - New materials for energy and Hydrogen storage
 - Materials and system for magnetic refrigeration
 - Perovskites / oxides studies
 - Energy storage in nanomaterials
 - Materials at low dimensions and nanoparticles
- **Matter radiation Interaction – Pr. Bouzid Manaut – University Moulay Ismaïl – Beni Mellal**
 - Relativistic and ultra-relativistic Laser Matter interaction
 - Relativistic atomic physics
 - Nuclear Physics
 - Materials Physics
 - Energy storage

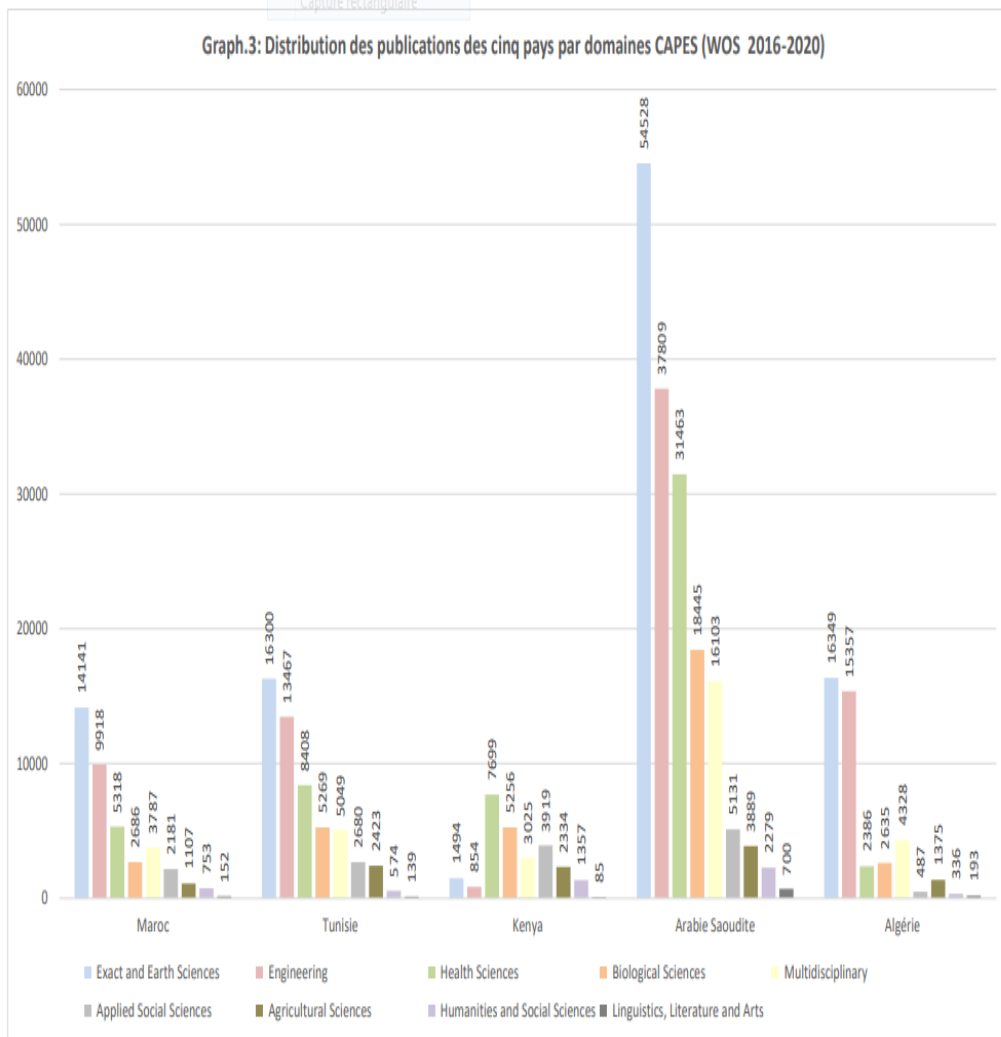
Le Maroc en Afrique : Comparaison de l'évolution de la PSI par pays



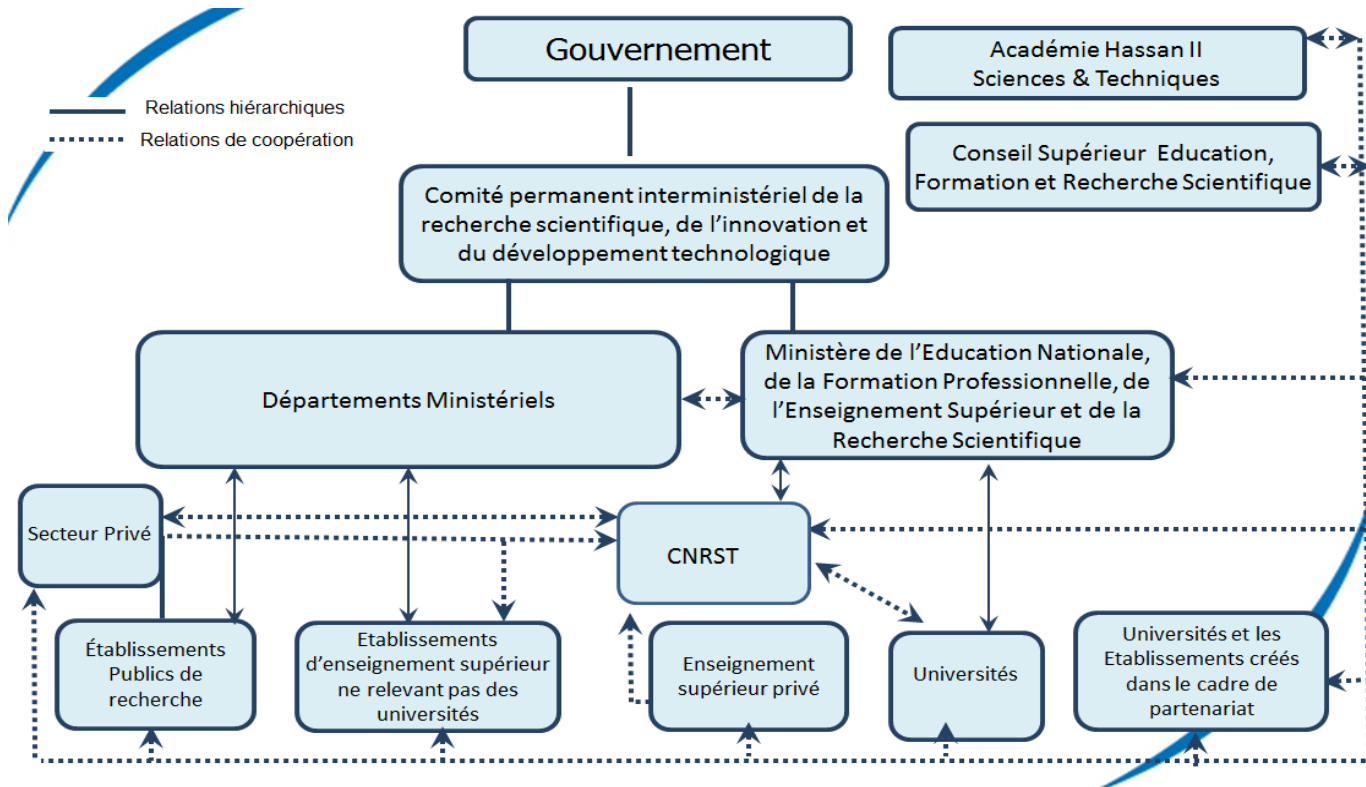
Graph.2: Evolution temporelle des publications par pays (WOS 2016-2020)



Graph.3: Distribution des publications des cinq pays par domaines CAPES (WOS 2016-2020)



Système National de Recherche et d'Innovation



Relations entre les différentes structures intervenants dans la RS : complexité ; manque de coordination ...

Mission I – Promote, fund and develop the scientific and technical research

Activities	
1. Solemn Annual Plenary Sessions	Date
Solemn Inaugural Plenary Session	May 18-20, 2006
Presentation of 26 communications covering various scientific disciplines	February 21-23, 2007
Celebration of the “International Year of Planet Earth”	February 20-22, 2008
“The lessons of the world food crisis, agri-food strategies and the contribution of scientific research”.	February 25-27, 2009
"emerging and re-emerging diseases, and pandemic threats"	February 17-19, 2010
"Chemistry facing the challenges of sustainable development"	March 16-18, 2011
“Computational Sciences and Engineering (SIN)”	February 15-17, 2012
“Physics today and its applications	February 20-22, 2013
“Renewable Energy Sources and Energy Transition: Facts, Challenges and Opportunities for Morocco”.	February 19-21, 2014
“Natural hazards: Earthquakes, storm surges, extreme climatic phenomena”.	February 24-26, 2015
“Science in all its states”. (Commemoration of the 10th Anniversary of the Academy)	February 16-18, 2016
"Ocean and Climate-Case of Morocco"	February 21-23, 2017
“Research&Development, Innovation and Industrialization”	February 20-22, 2018
“Engineering and medicine at the service of diagnosis, prevention and therapy”	February 26-28, 2019
“Natural heritage and sustainable development ”	February 25-27, 2020
Postponement due to Covid-19	2021
Postponement due to Covid-19	2022
Food security and sovereignty of Morocco: Role of Science and Innovation	2023

Mission I – Promote, fund and develop the scientific and technical research

Activities

2. Funding of research projects

Research support program	Number of projects funded (2007-2022)	Spin off
Call for tenders 2007-2008	17	<ul style="list-style-type: none"> - Involved scientific personne: 1074 - Doctorates supported: 231 - Masters : 262 - Number of scientific articles : 1016 - Number of patents: 5 - Number of scientific conferences and congresses: 1142
Call for tenders 2010-2011	12	
Call for tenders 2017-2018	07	
Excluding tenders	04	
International collaboration (Brazil, Spain, France and Senegal)	04	
Public-Private Partnership: Academy, Ministry & SAFRAN Group (Aeronautics)	03	
T o t a l	47	

Scholarships

- Moroccan Agency for International Cooperation – AMCI

For the 2019/2020 academic year, approximately 14,500 foreign students continued their studies in Moroccan public higher education institutions, including 12,500 students from 47 African countries have benefited of scholarships from the Kingdom of Morocco.

- ASRIC-AU in partnership with Euro-Mediterranean University of Fes (UEMF)

2019, 2021, 2022 and 2023 – UEMF offered 40 scholarships for African PhD Students

The scholarship includes; tuition fees of about \$9,000, an annual return ticket from the student home country with a maximum contribution of \$1,000 during summer vacation, and stipend allowance of \$1,000 monthly for 11 months every year.

<https://blog.aau.org/call-for-applications-3rd-asric-uemf-phd-scholarships-for-african-students/>

- Hassan II Academy Excellence Allowance

Since 2010 the Academy in partnership with the Ministry of National Education stipend substantial allowance up to 1600 Euros per month, for 10 students, each year, having the best results at the Baccalaureate, up to now **108 students** benefited of this allowance. **PHD students** in the best Universities of the world : Columbia University, University of Berkley, ENS Paris, Ecole Centrale, Ecole Polytechnique, MIT, ENS Cachan, University of Montreal, University of Harvard

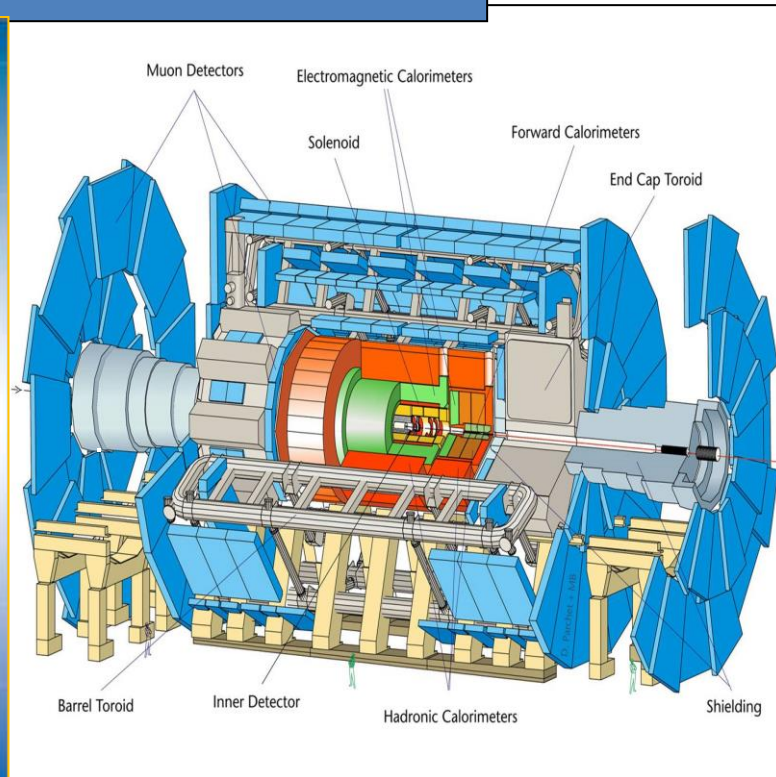
- CNRST Excellence Allowance

300 scholarships offered by the CNRST to the best Master students for PhD studies

- Ministry of High Education Scientific Research and Innovation : 70% (30.000) of Master and PhD students benefit of 150 Euros per Month as Scholarship

- Private Institutions : Private Universities, OCP, Foundations

The ATLAS Detector



3000 Scientists from 178
Institutions and 38 countries

Diameter

25 m

Barrel toroid length

26 m

End-cap end-wall chamber span

46 m

Overall weight

7000


Tons

Argentina	Morocco
Armenia	Netherlands
Australia	Norway
Austria	Poland
Azerbaijan	Portugal
Belarus	Romania
Brazil	Russia
Canada	Serbia
Chile	Slovakia
China	Slovenia
Colombia	South Africa
Czech Republic	Spain
Denmark	Sweden
France	Switzerland
Georgia	Taiwan
Germany	Turkey
Greece	UK
Israel	USA
Italy	CERN
Japan	JINR

Modèle d'organisation globale qui vise la coopération ouverte non concurrentielle sur le long terme.

Maroc membre d'ATLAS depuis 1996, à travers le RUPHE. Un exemple pour le Magreb et l'Afrique.

ATLAS Collaboration



On peut regretter que l'Afrique et le Moyen Orient ne soient pas plus présents, car la science est un vecteur de paix et de développement parmi les peuples.