Transient/Multi-Messenger Opportunities in Africa

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Status of Astronomy in Africa & Opportunities for MM Astronomy

- This talk is based on various reports received from astronomers who were contacted from the various African countries. South Africa is exluded from this work since a specific situation report was presented separately by David Buckley.

- We extracted the information from those received reports and also incorporated information gathered from other sources, whenever available, from some countries whose representatives didn't respond on time.

- Despite this, the situation in some countries is not reported from lack of data

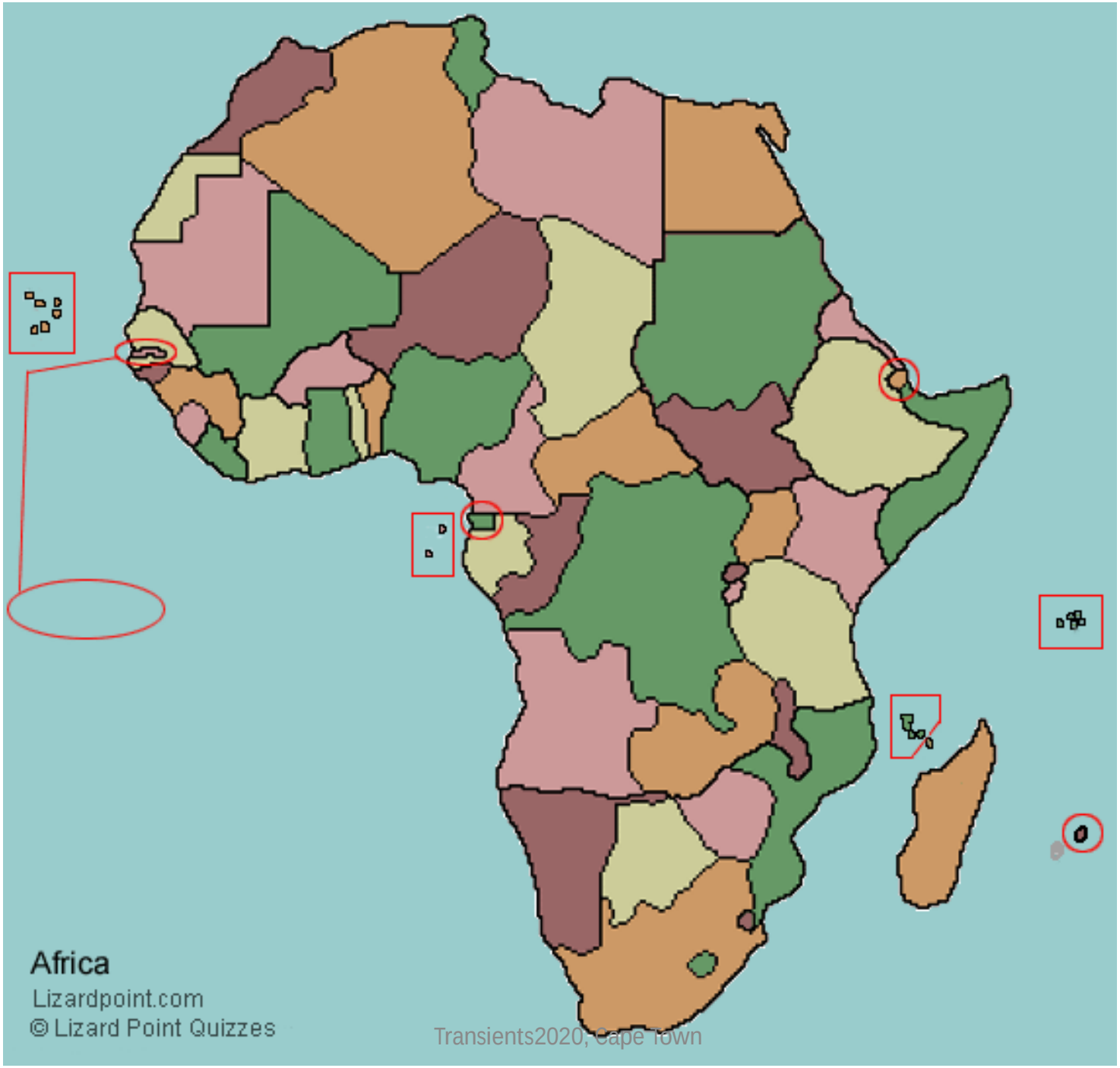
- We went East, then North and finally West following the coastline counterclockwise...

- For an extensive review of the situation of Astronomy in Africa, see:

- Development in astronomy and space science in Africa, Pović, M., Backes, M., Baki, P. et al. . Nat Astron 2, 507-510 (2018). https://doi.org/10.1038/s41550-018-0525-x

- The potential of astronomy for socioeconomic development in Africa, McBride, V., Venugopal, R., Hoosain, M. et al. . Nat Astron 2, 511-514 (2018). https://doi.org/10.1038/s41550-018-0524-y

Astronomy in Africa


Africa
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Morocco
Tunisia
Western Sahara
Algeria
Libya
Egypt
Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Djibouti
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Kenya
Rwanda
Burundi
Dem Rep of Congo
Congo
Gambia
Tanzania
Angola
Mozambique
Zambia
Zimb
Madagascar
Namibia
Bots
Malawi
Swaziland
Lesotho
South Africa
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AfAS Creation: March 2019

Astronomy in Africa Meeting

Professional Astronomers | Students | Government Officials | Key Stakeholders | Amateur Astronomers

What is ?

AfAS
African Astronomical Society

- **AfAS is an organization of professional astronomers** in Africa,

- **Vision:** Create a globally competitive and collaborative astronomy community in Africa

- **Mission:** To be the voice of astronomy in Africa and to contribute to addressing the challenges faced by Africa through the promotion and advancement of astronomy

Key Objectives of AfAS

- Cultivate and support **collaborative astronomy activities** in Africa and internationally
- Encourage the appreciation of the significance of astronomy in Africa
- Serve as an interface between the African Union and astronomy related activities
- Encourage governmental and intergovernmental investments in astronomy in Africa
- Encourage the use of astronomy for socio-economic development
- Use astronomy to attract African youth into science, technology, engineering and mathematics careers
- Organise meetings and events pertaining to astronomy and related fields
- Safeguard astronomical sites and indigenous knowledge in Africa

Astronomy In Ethiopia

- **Mirjana Pović, Ethiopia, ESSTI**
- **Alemiye Mamo, Entoto Observatory, IAU West African Office**

1. Astronomy & Astrophysics R&T focus on :

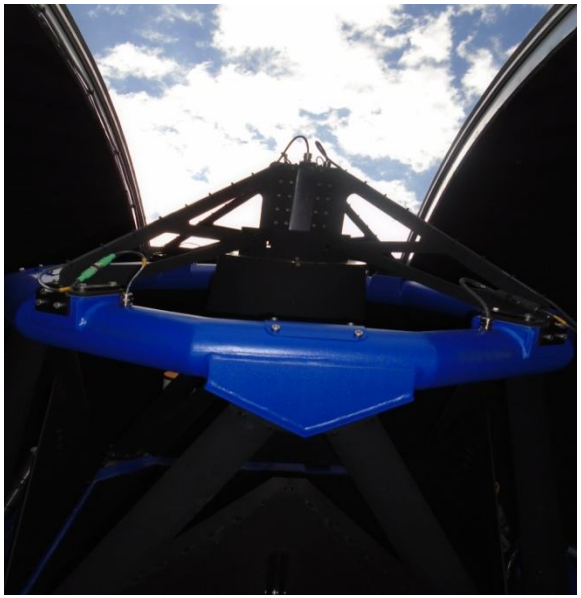
TRAININGS PhD & MSc

RESEARCH AREAS

OBSERVATIONAL & THEORETICAL

- **Planetary Astronomy**
  - Solar system ,Near Earth objects and Extra-solar
- **Stellar Astronomy & Astrophysics**
  - structure & activity of sun and other stars
- **Galactic & Interstellar Medium Astronomy**
  - structure , composition and evolution of our galaxy and nearby galaxies
- **Extragalactic Astronomy & Cosmology**
- **Space & Astronomical Instrumentation**

First light image of whirlpool Galaxy captured by EO Telescope



EO 1m-Diameter Telescope

A&A department

Current team: 14 members
(3 PhD, 5 MSc, 6 BSc)

RESEARCH SUMMARY

3 main research groups in:

- **Extragalactic astronomy**
- **Stellar astronomy**
- **Cultural astronomy**

RESEARCH SUMMARY

1. Extragalactic astronomy

Main project: Role of nuclear activity in galaxy formation and evolution

2. Stellar astronomy

Main projects: related with the accretion processes in stars, binary systems, stellar formation and formation of planetary systems, coronal mass ejection from the Sun, and variable stars

RESEARCH SUMMARY

1. Extragalactic astronomy

Importance of AGN studies:

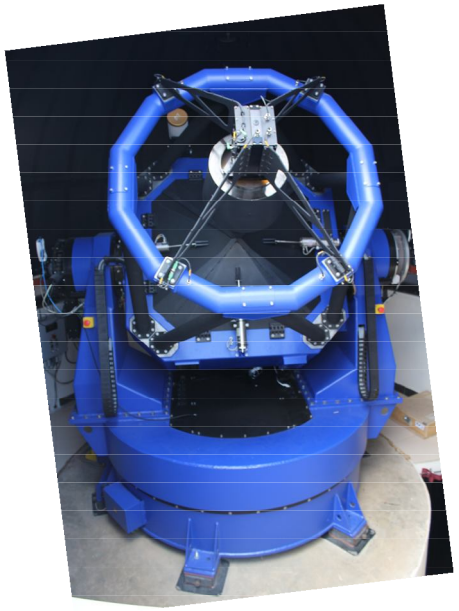
- Have very peculiar and complex physics → challenge
- Strong multiwavelength emitters → technological/innovation challenge
- High-energetic sources → development of X- and gamma-ray physics and instrumentation
- Possible origin of cosmic rays → important for space weather, satellite technologies, etc.
- Play a key role in galaxy formation and evolution → modeling constraints
- Most luminous and distant visible sources → cosmological labs
- Key element in understanding formation and evolution of the Universe

Entoto Observatory

2 optical telescopes of 1m diameter each

Current work:

- **Maintenance**
- **Construction**
- **Visitors program (> 10000 visitors in the last years)**
- **Current work on telescopes operation (expected to be operational at the beginning of 2020)**



Entoto Observatory

2 optical telescopes of 1m diameter each

Planned astronomical observations in 2020:

- Stellar activity of low-mass stars and possible detection of extra-solar planets
- Variability of nearby quasars
- High resolution spectroscopy of nearby active galaxies
- Different scientific cases in stellar astronomy research

Plus:

- Software development for EO
- Detailed site testing of EO
- Detailed instrumentation testing
- Development of professional observational platform and organisation of 'call for proposals'

POST-GRADUATE PROGRAM

PhD and MSc in astrophysics over the past 6 years

- Currently 19 students (10 PhD and 9 MSc)
- Graduated 3 PhD and 9 MSc

UNIVERSITIES INVOLVED IN

Astronomy & Space Science Programs in Ethiopia

- **Human Capital Development, Research & Educational Dev't**
- Provide high quality postgraduate training (MSc and PhD)

1. **Entoto Observatory and Research Center(EORC),**
2. **Addis Ababa University(AAU),**
3. **Bahir Dar University(BDU)**
4. **Mekelle University(MU)**
5. **Jima University**

CSIC
Consejo Superior de Investigaciones Científicas

Instituto de Astrofísica de Canarias
IAC

Uppsala Universitet
International Science Programme
ISP

University of Rwanda

Lomonosov Moscow State University

Instituto de Astrofísica de Andalucía
CSIC
IAA

NRF
National Research Foundation

SAAO
South African Astronomical Observatory

Istituto Nazionale di Astrofisica
INAF

iram
Instituto de Radioastronomía Milimétrica

The University of Dodoma
UDOM
Embracing Knowledge

The Open University of Tanzania
Chuo Kikuu Huria cha Tanzania
Since 1992
Affordable Quality Education for All

Mbarara University of Science and Technology
Succeed We Must

Tel Aviv University

Science Fund of the Republic of Serbia

KASI

CTY

NWU
North-West University
Noordwes-Universiteit
Unibesiti ya Bokone-Bophirima

esa

University of Toronto

UiO : University of Oslo

udp
Universidad Diego Portales

Universidad de Valparaíso
Chile

IAU

NASA

RECOGNISED AWARDS

Dr. Mirjana Pović

Nature Research for Inspiring Science Award (2018)

Dr. Solomon B. Tessema

'Higher Honor Laureate Prize' from Abyssinian Award (2019)

Astrophysics/Astronomy in Uganda

Jurua Edward Mbarara

University of Science and Technology (MUST)

- **Astrophysics Courses taught at Postgraduate**
  - Stellar Structure and Evolution
  - Extragalactic Astronomy
  - High Energy Astrophysics
  - Computational Astrophysics
  - Planetary Systems
- **Research Areas**
  - Asteroseimology
  - Planet formation
  - AGN
  - High energy astrophysics
  - Accretion disc instabilities
- **Data Used**
  - Mainly use online data e.g. from Kepler, Gaia, etc
  - Ground based observation, particularly for spectroscopy using telescopes from Belgium and India and photometry using telescopes from Germany
    - **Contact Person: Jurua Edward** ejurua@gmail.com

An Overview of Astronomical Facilities for Multi_Messenger Astronomy

Kottamia Astronomical Observatory

Somaya Saad

Astronomy Dept.
National Research Institute of Astronomy & Geophysics (NRIAG)
Head of the Egyptian National Committee of Astronomy and Space Science (Eg-NCA)

Kavli workshop_Transient2020: Cape Town 3-7 Jan 2020

NRIAG's Departments and Laboratories

Department of Astronomy:

Stellar Astronomy & Galactic and Extra Galactic , Theoretical and High energy Astrophysics

Department of Solar and Space Research:

Solar Research & Space Research

Department of Seismology:

General Seismology & The Egyptian National Seismic Network

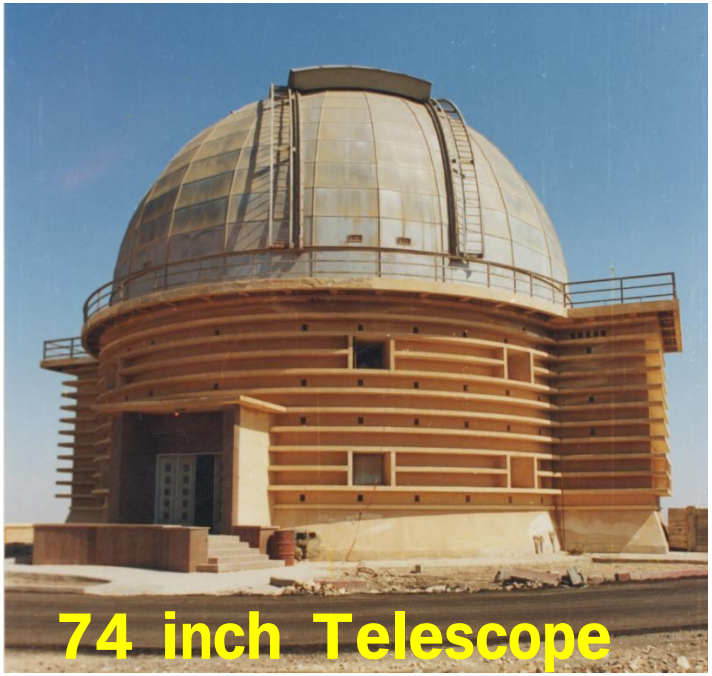
Department of Geomagnetism and Geoelectricity:

Laboratory of Geomagnetism

Laboratory of Geoelectricity and Geothermic

Department of Geodynamics:

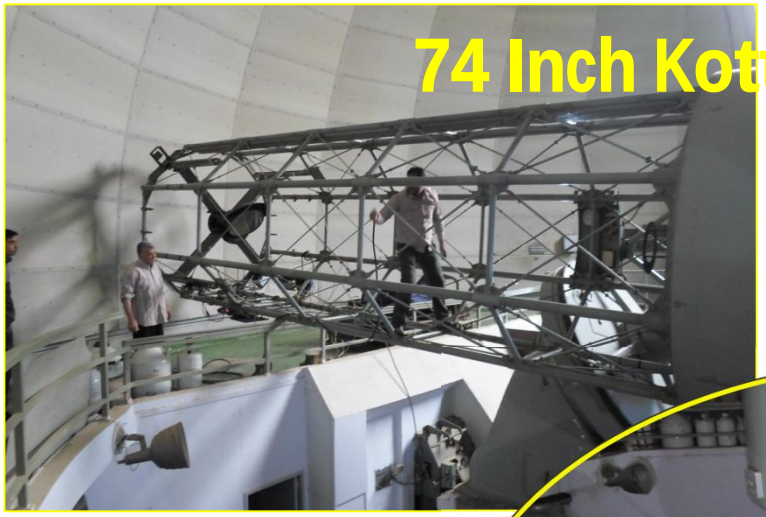
Laboratory of Recent Crustal Movement



30 inch telescope

Coude Solar telescope

74 Inch Kottamia Observatory



Recent Discoveries

https://www.aavso.org/vsx

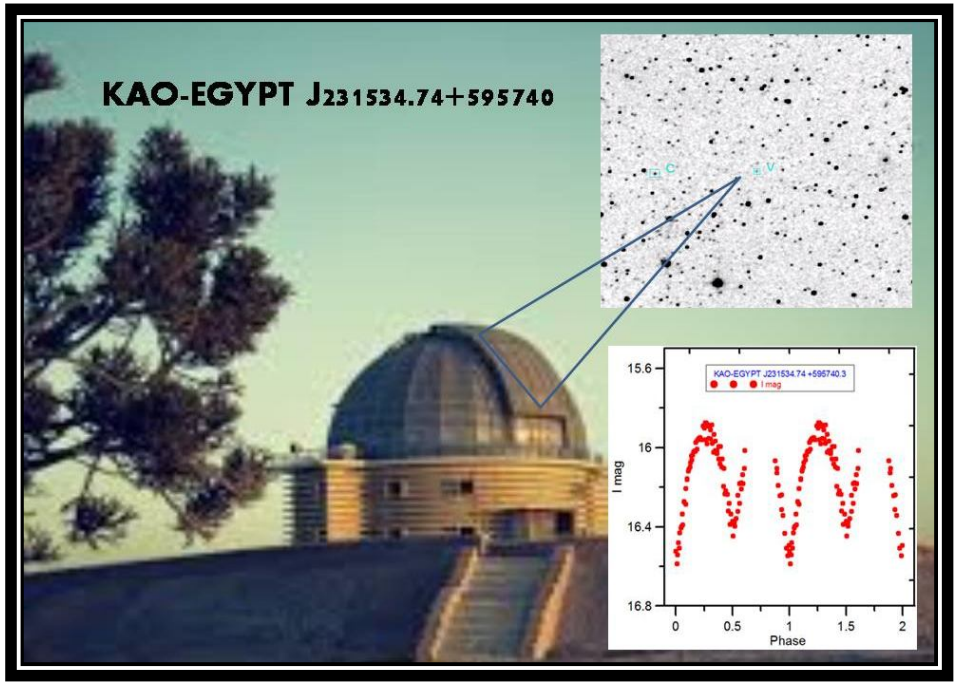
Variable stars

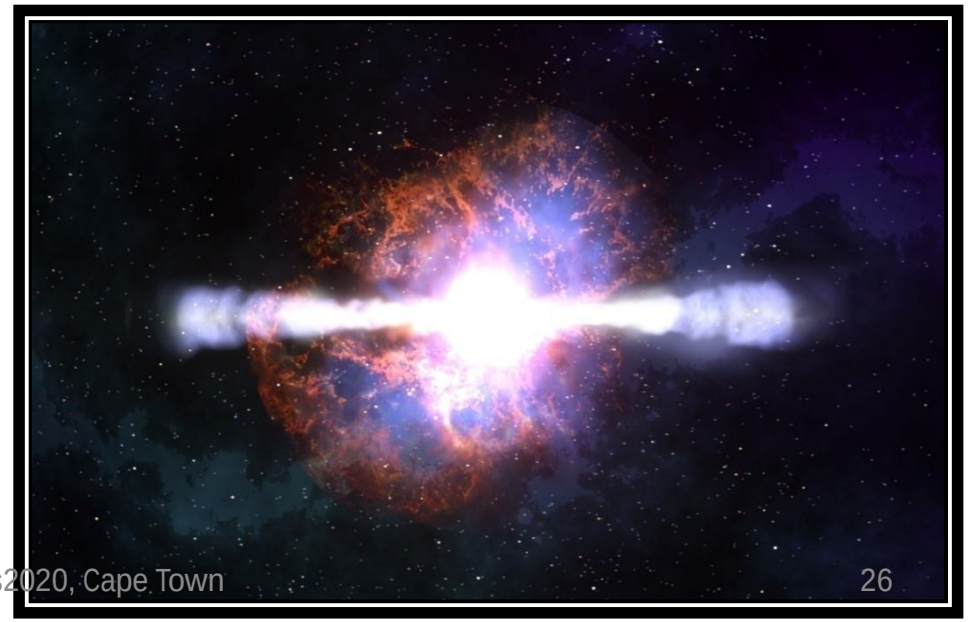
1- KAO-EGYPT J064512.06+341749
2- KAO-EGYPT J155828.08- 025753
3- KAO-EGYPT J200046.39+054747
4- KAO-EGYPT J200107.70+054221
5- KAO-EGYPT J214258.21+440520
6- KAO-EGYPT J225702.44+523222
7- KAO-EGYPT J222516.76+362017
8- KAO-EGYPT J214216.38+440015
9- KAO-EGYPT J231534.74+595740
10- KAO-EGYPT J231639.27+595223

http://gcn.gsfc.nasa.gov

Gamma ray bursts

1- GRB 140311A
2- GRB 160925A
3- GRB 170728B





Main studies in Astronomy Dept. at NRIAG

- ❑ BVRI Photometry
- ❑ Variable Stars using optical observations and 2MASS Data Base
- ❑ Study of magnetic activity and period variations of binary stars
- ❑ Photomertic studies of the contact binaries
- ❑ Massive stars, O and B-type stars
- ❑ Variable Stars in Open and globular Clusters
- ❑ Discovery of some variable stars
- ❑ Cosmology

Main Studies at Astronomy Dept. at NRIAG

- Limb effect of rotating stars
- Exo-planets: confrontation between Quantized period and observations
- Optical study of super novae .
- Light pollution and Night Sky survey
- Optical and UV Studies of Cataclysmic Variables
- X-ray Studies of Intgrated spectra of obscured AGNs using Suzaku X-ray satellite observations

Main studies in Astronomy Dept. at NRIAG
Field of Galaxy Clusters

- Galaxy Cluster Survey, X-ray and optical properties of the cluster
- Statistical Studies : fundamental parameters of isolated galaxy triplets in the local universe
- Study of distant clusters of galaxies in the 2XMM/SDSS
- Kottamia optical observations for some GRB
- Match between XMM-Newton/SDSS Galaxy Cluster Survey
- Spectral clustering for optical confirmation and redshift estimation of X-ray selected galaxy cluster candidates in the SDSS

Astronomy in Algeria
& Perspectives in Radio Astronomy

Dr Nassim Seghouani
Head of Astrophysics and High Energy Astrophysics division
CRAAG, Algiers Observatory

Modern Astronomical legacy

Algiers (Bouzareah) Observatory

- Build during French rule in 1890
- Four main instruments (3 refractors and a Foucault Telescope)
- Participated to some important projects such as « La Carte du Ciel » (Sky Map Project)

Télescope de Foucault (1888)

September 1861

the **Telescope** was fabricated by **Secrétan,** and reached **Alger on Newtonian**, Ø=**50 cm**, f= **3m50**

L'Equatorial Coudé (1888)

Gautier (Ø= **32cm** et f=**6m60)**

The New 80cm Telescope at the Bouzaréah Observatory

Astronomy in Algeria

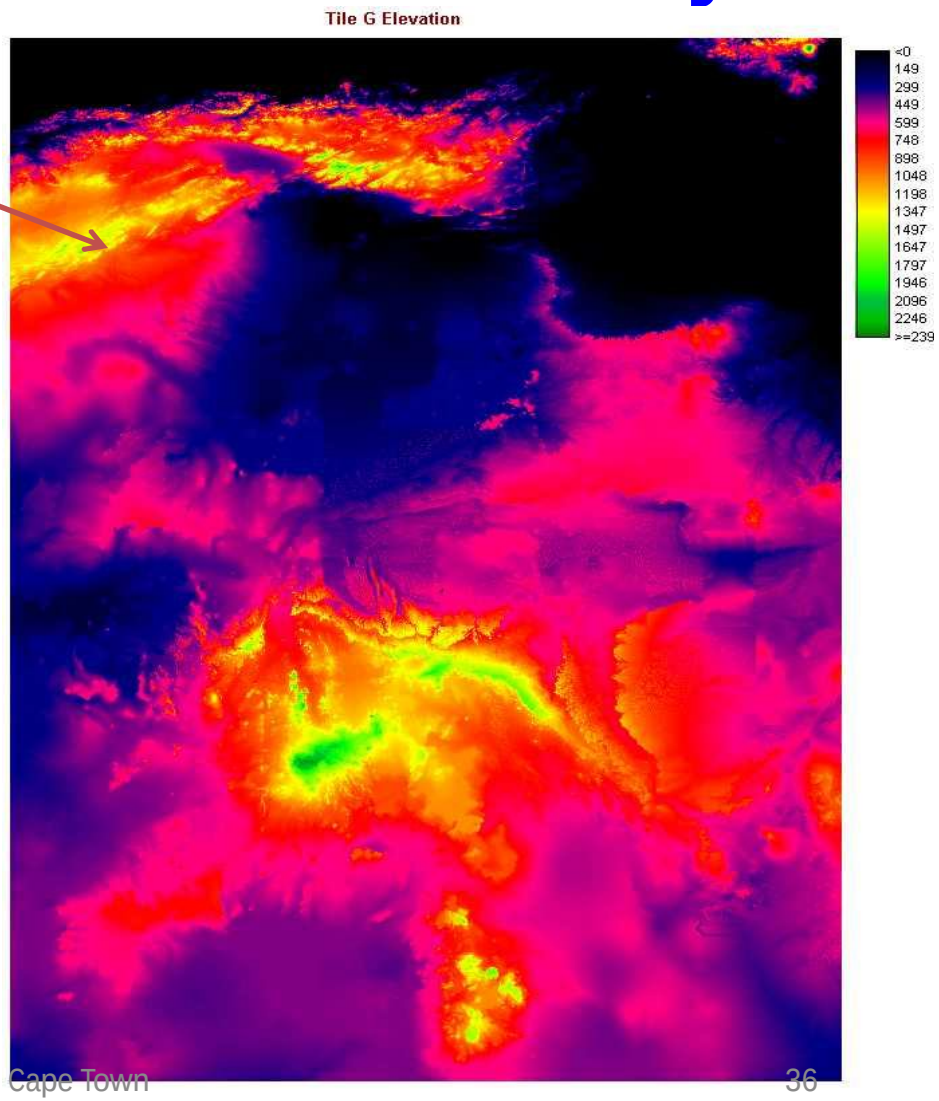
- About 25 Researchers in CRAAG in Astronomy & Astrophysics in 2 divisions:
  - Solar Physics Division
  - Stellar & High Energy Astrophysics Division
- There are also ~25 researchers in Universities (Mainly theoretical Astrophysics, GR)
- Several Masters in Astrophysics at Algerian universities

Main Fields of Research

- Solar Physics & Solar-Earth interaction
- Helioseismology & Asteroseismology
- Gamma Ray Bursts
- Cosmic Rays
- Binary stars
- Compact Objects…

An Ongoing Project:
1- **The Aures National Observatory**

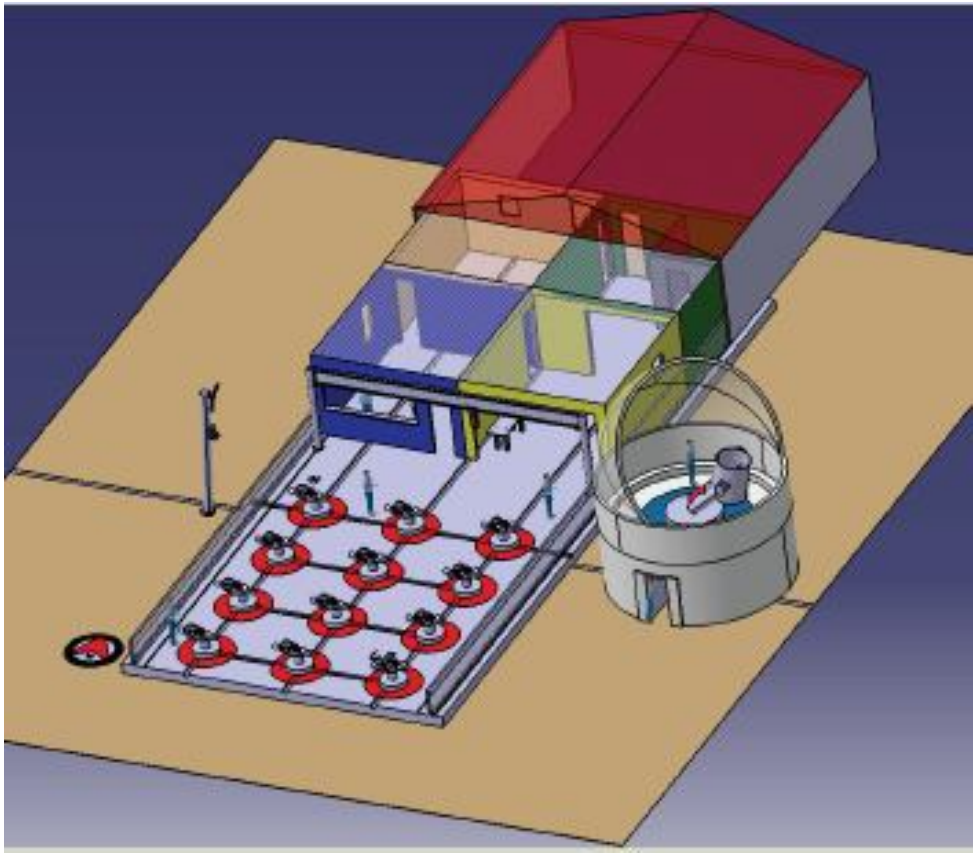
- A new Astronomical Observatory in the Aures Mountain (North- East of Algeria, Altitude~ 2000m).
- First seeing measurements point to an excellent sky quality
- Main Target: Finding the source of Gravitationnal Waves
- Open to host other projects



Main project: Observing the optical afterglows of GW's

How to Localise the source of Gravitational Waves? A Farm of Fast telescopes!

Robotic Advanced Multimessenger Space Environnement Surveyor



Projet *RAMSES*

16 Fast Telescopes
ϕ 25 to 35 cm x 2,5° (champ),

→ 100° in a single scan!! few secondes only after the alert

+ 01 telescope of ϕ 1 m avec spectrometer

The first station built at Chechar (Khenchela, Algeria)

CELESTRON

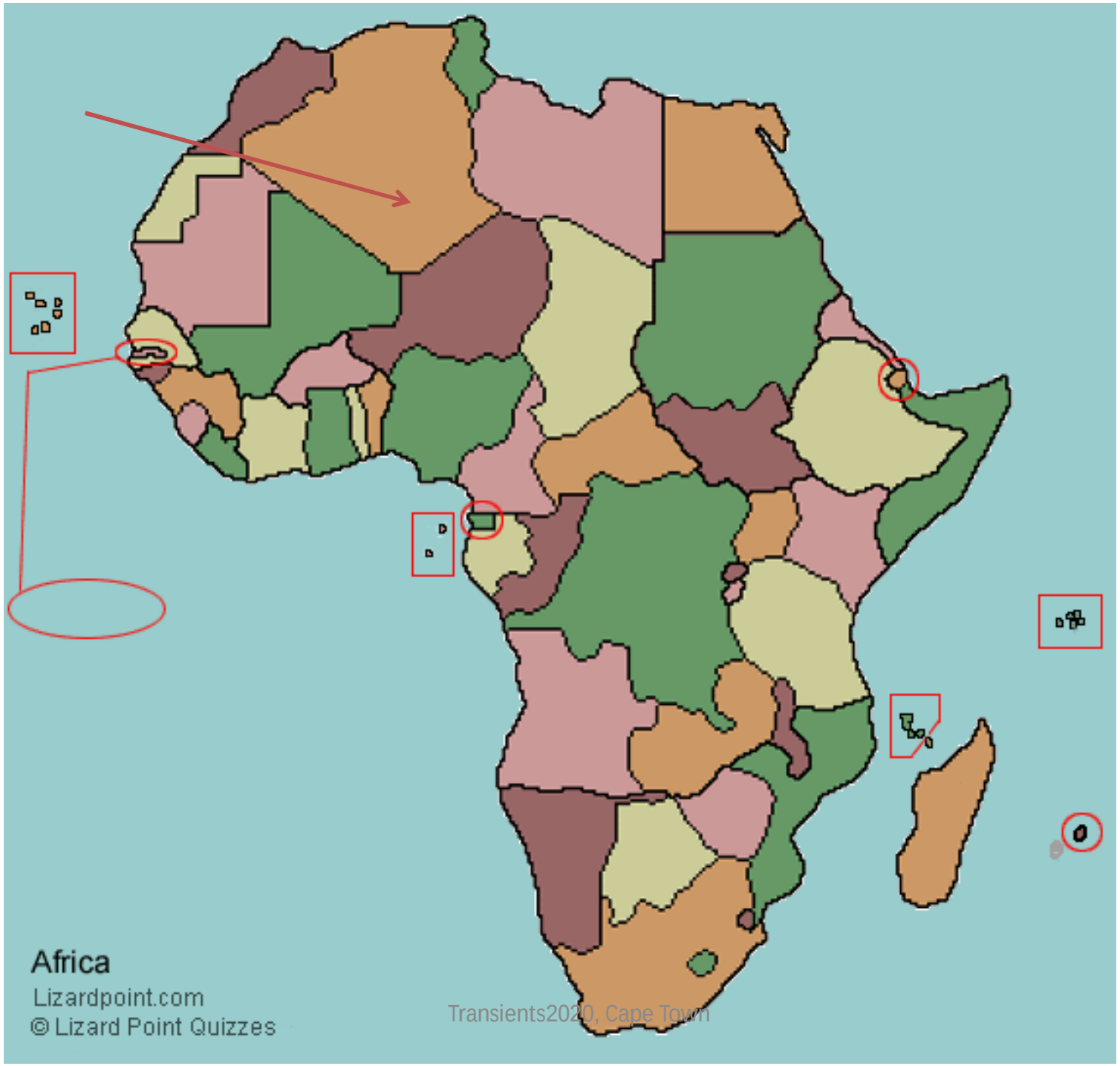
NATIONAL
AURES
OBSERVATORY
Crédit: Nassim Seghouani

2- A Future World class Observatory?

In the Hoggar, Assekrem high plateau

The Sirius Association team in the Hoggar

… and a perspective view of the group


Africa
Lizardpoint.com
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From the Hoggar, Algeria with Love

Abdeldjalil Djarri, Sirius Astronomy Association

A Radio-astronomy project

- **A project is under consideration:**

Using the several dishes available in Northern Algerai to turn them into radiotescopes:

  - 2 x 32m
  - 1 x 13m
  - 2 x 11m
  - 1 x 7m
  - …

- The site is owned , Ministry of Telecom, but a tranfert to the General Direction of Scientific Research is in progress

Radio-astronomy

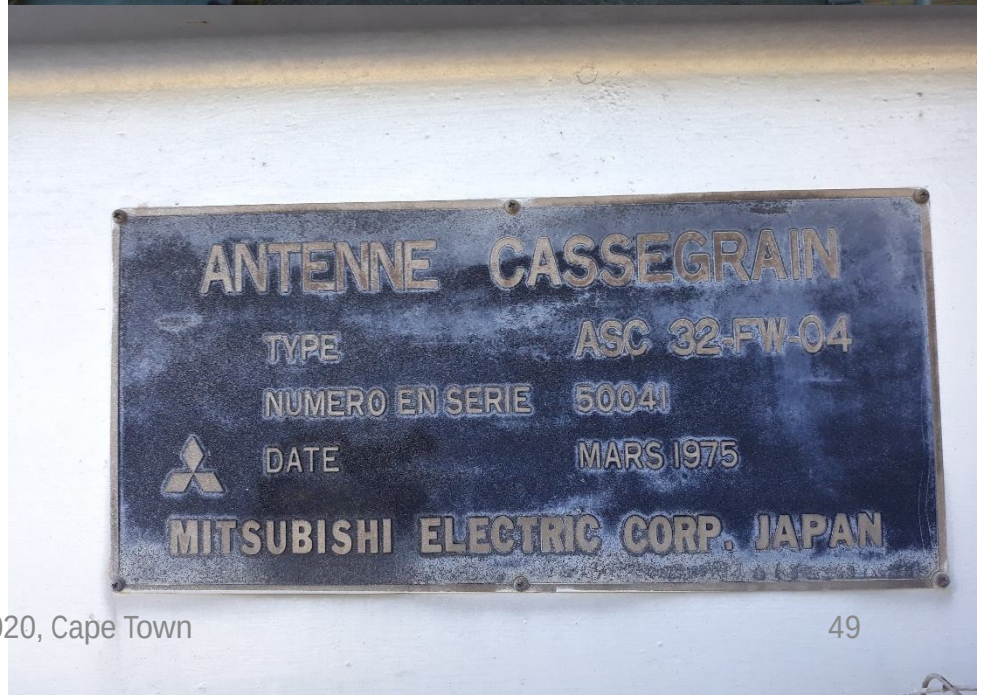
The Lakhdaria site

Coordinates:
36° 37’ 00’’ N
03° 35’ 00’’ E

The 32m Dishes

- One is mainly directed to the East, the second one to the West
- +/- 60° Azimuth
- 5 – 90° Elevation
- Works in 4-6 GHz

- Constructed by Mitsubishi in 1975
- Have been maintained and upgraded in~1990 by Vertex RSI (GDSatcom)
- It is in very good shape and fully operational.
- No more used although under constant maintenance



The author standing in front of some of the dishes

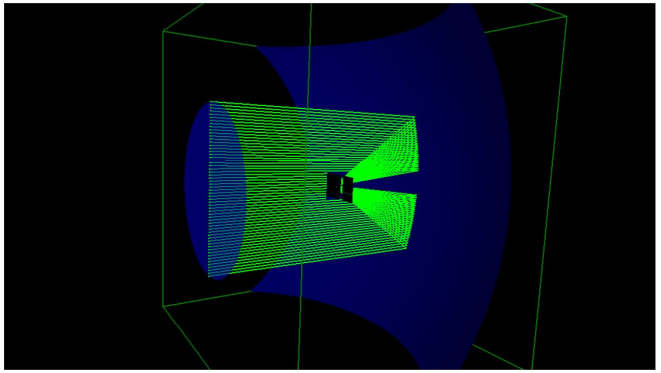
CRAAG- Algiers

The High Energy Group:
M.Fouka (head), Zouleikha Sahnoun, Slimateni Sami, Rahmani Yassine

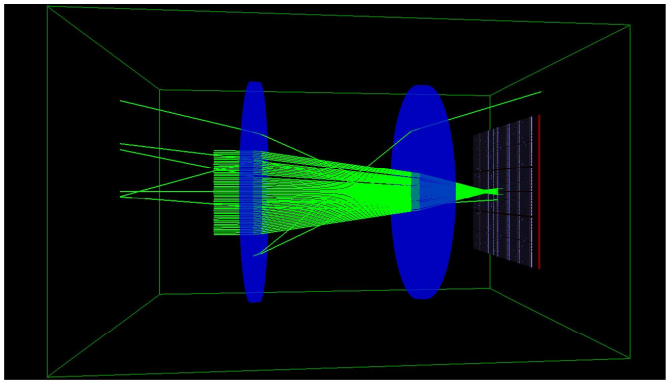
- Cosmic rays: JEM-EUSO
- GRBs external shock
- Compact stars merging
- High Energy Physics: Simulations

JEM-EUSO contribution

- Contribution to JEM-Euso Offline framework
  - Reconstruction code: Direction of the shower
  - Simulation of the shower signal on the focal surface



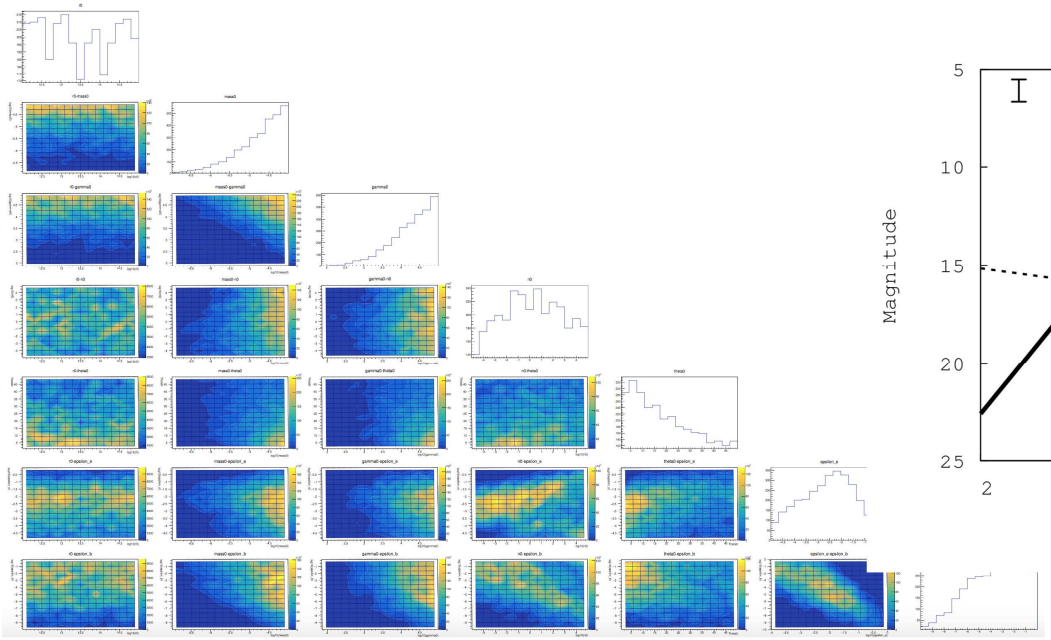
SPB2

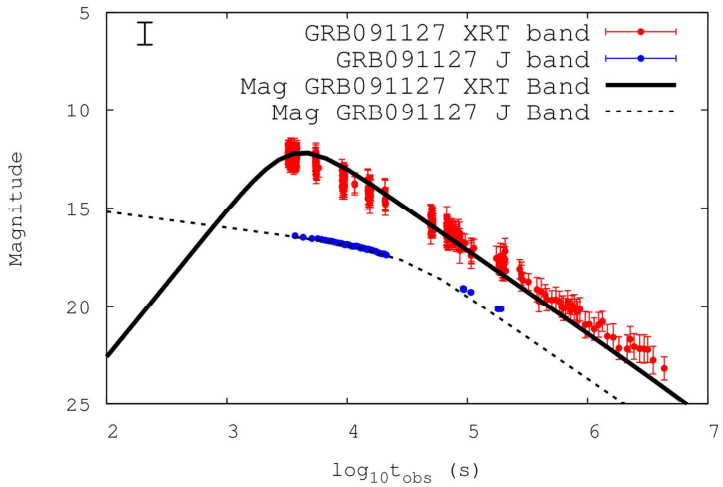


Mini-Euso

GRBs external shock

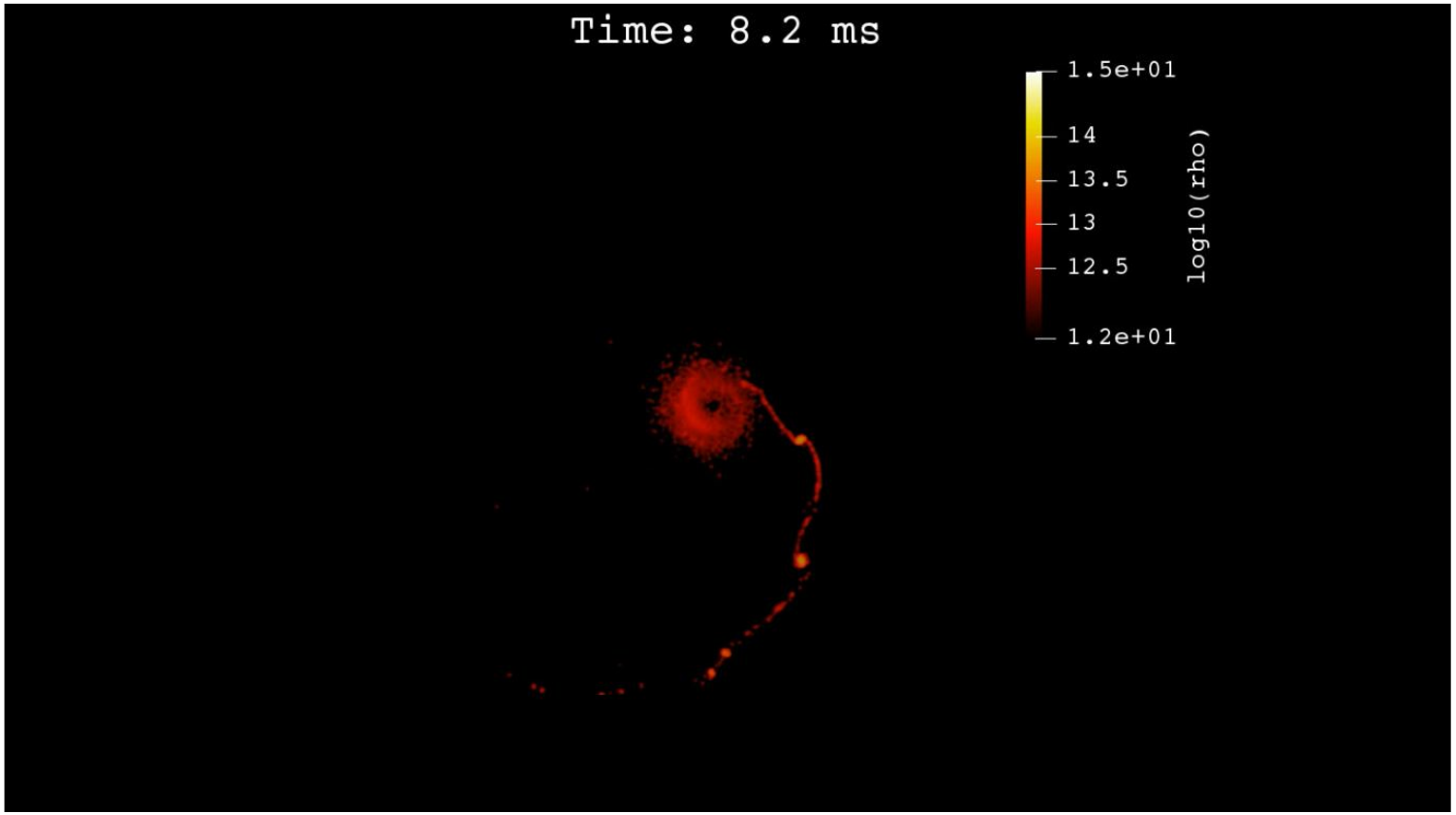
- Hydrodynamical evolution and light curves of the afterglow emission: Fits and Correlation study



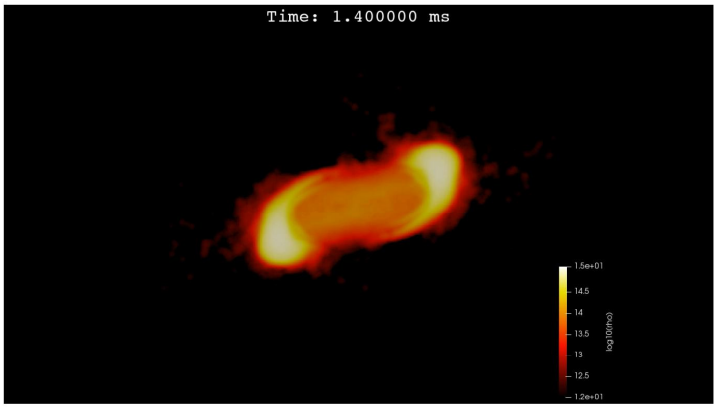


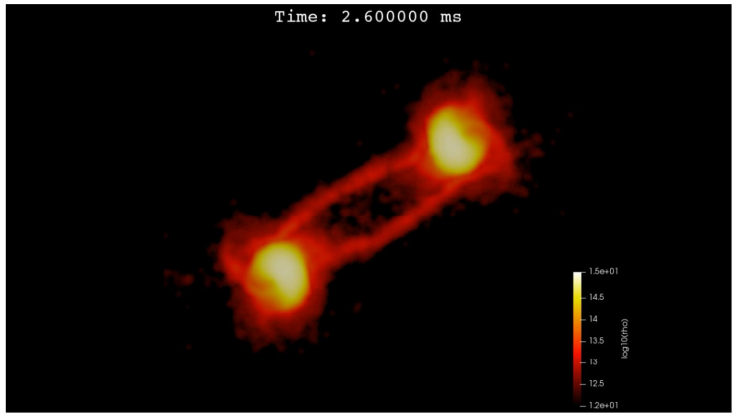
Compact stars merging

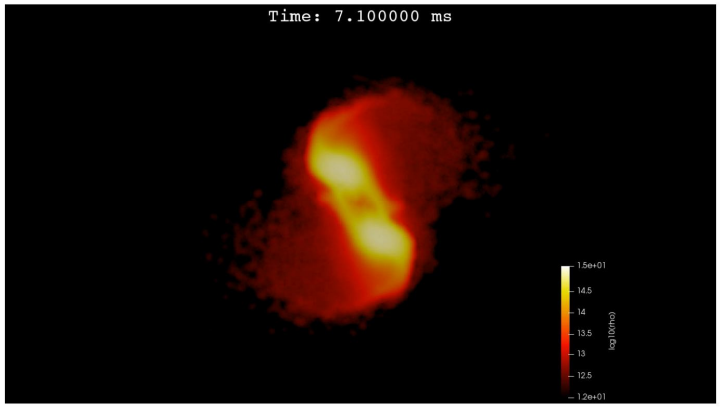
- Newtonian SPH Tree C++ Code for simulating compact stars merging (NS-NS, NS-BH)

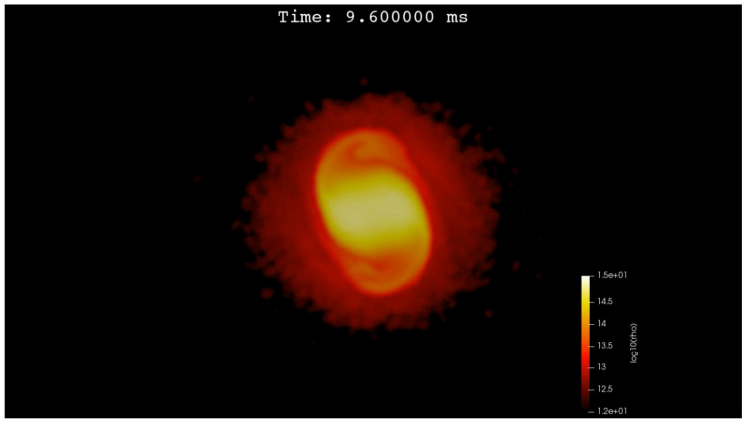


Compact stars merging









KM3NeT Collaboration

- Algeria is on the way to be granted an observer status at the next KM3Net collaboration board meeting in February 2020

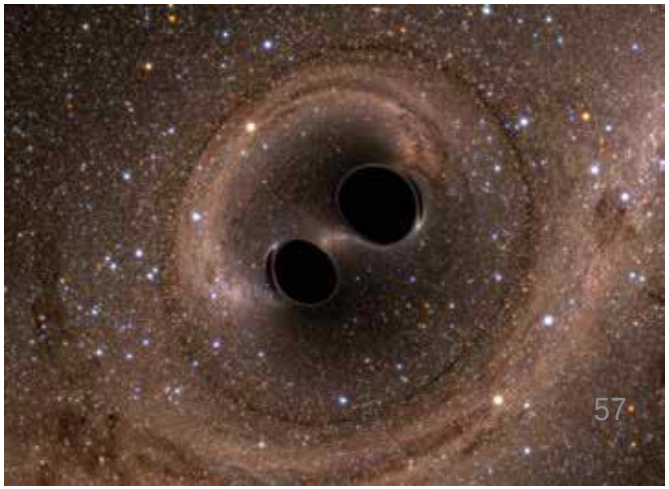
- Three groups from various Algerian Universities will be involved

Astronomy in Morocco

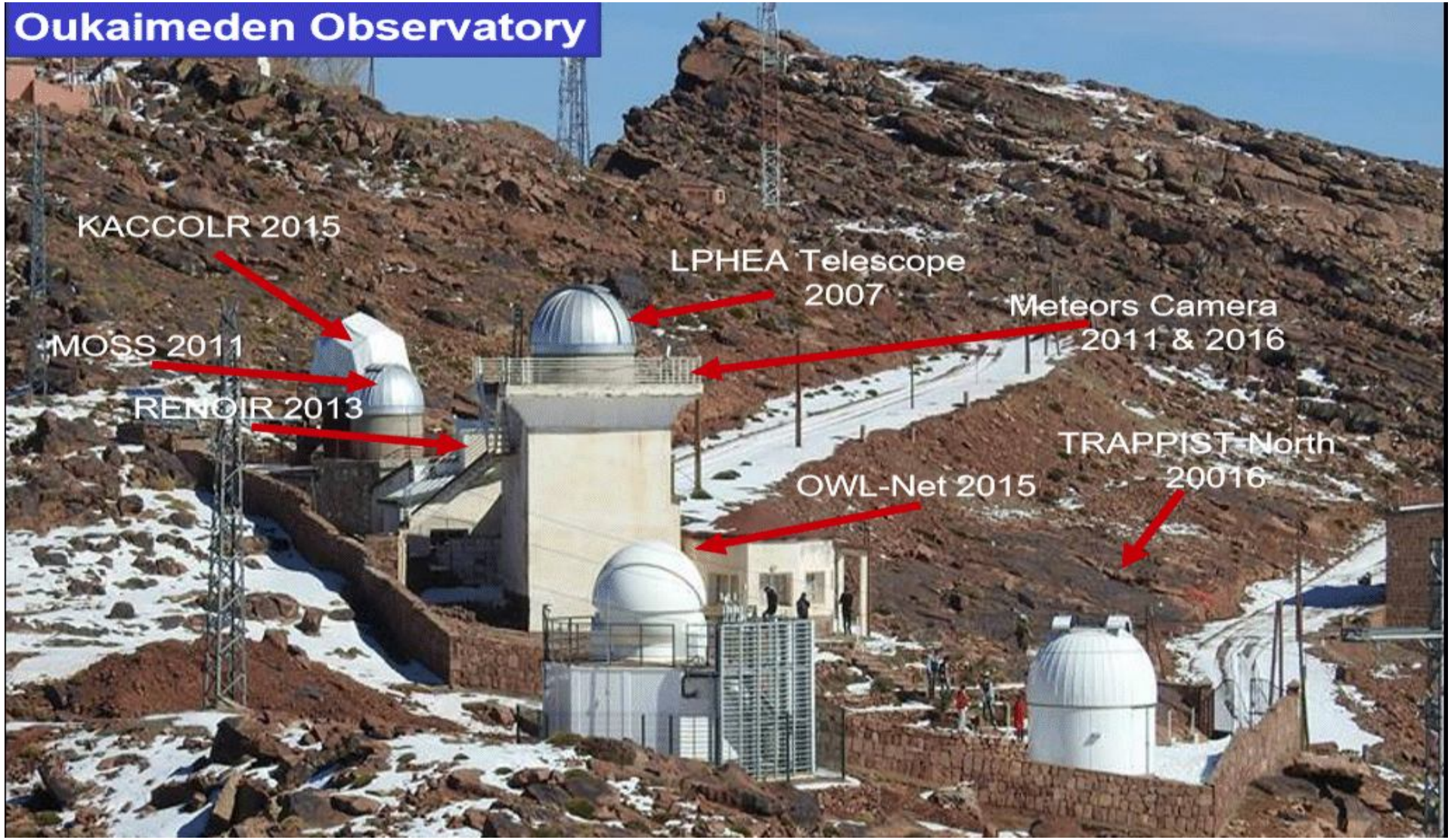
Facilities at Oukaimeden Observatory and various projects

Benkhaldoun Zouhair
zouhair@uca.ma

Cadi Ayyad University, LPHEA, Oukaimeden Observatory



The Oukaimeden Observatory, High Atlas mountains



High Energy & Astrophysics Laboratory

2 Research groups:

High Energy & Theory (EPHET)
Astrophysics & Astronomy (EA2)

21 Senior Researchers: 12 Faculty members + 9 Associates

Graduate Studies: Training in HEP and Astrophysics. At present **42** PhD students + 24 Msc students (M2) and 27(M1).

Monitoring of **OUCA Observatory** (75 km from Marrakech).

Observatoire Astronomique Universitaire de L'Oukaïmden
المرصد الجامعي لعلوم الفلك لأوكايمدن

LPHEA

KM3NeT Collaboration

- Several Moroccan researchers are also involved in KM3NeT project.
- a large a network of next-generation underwater neutrino telescopes in the Mediterranean Sea.
- discovery and subsequent study of high-energy neutrino sources in the Universe (ARCA) and the determination of the mass hierarchy of neutrinos (ORCA).

- 13 Countries
- 54 Institutes
- 220 Scientists

Researchers representing three universities:
- Mohammed V-Rabat,
- Mohammed I Oujda,
- **LPHEA** at the **Cadi Ayyad University**.

The Moroccan team contributes to the KM3Net by setting up a production line for the optical modules in Morocco, which includes the assembly, testing and insertion of modules in the lines of the telescope

Some High profile Non MMA projects
at the Oukaimden Observatory : MOSS , OWL...

Finding a home for OWL

http://www.eso.org/public/astronomy/projects/e-elt_fir.html

- An extraordinary telescope calls for an exceptional site. Much care is thus taken to ensure that the future home of the **E-ELT** will be the most adequate possible. This generally means a high, dry site, so as to have as little hindrance to the observations. The E-ELT site selection team is currently investigating in great detail several possible sites, in **Argentina**, in **Chile**, in **Morocco**, and in **Spain**
- Similar efforts are being carried out by the Thirty-Meter Telescope (**TMT)** site selection team. For the sake of efficiency, the TMT pre-selected sites (all in North and South America) are not included in the E-ELT study, but data are shared.
- Finally, **Ventarones** in Chile (part in TMT site testing campaign) has been selected.

The Candidates for OWL science program is:

- Follow-up astrometry of **bright Near-earth objects**
- Target of opportunity observations of **small bodies** in the Solar System
- Target observations of bright **variable stars** with improperly-determined periods
- **Emission-line** survey of the Galactic plane
- Follow-up observations of **GRB afterglow**

Education and training

(from MOU with KASI)

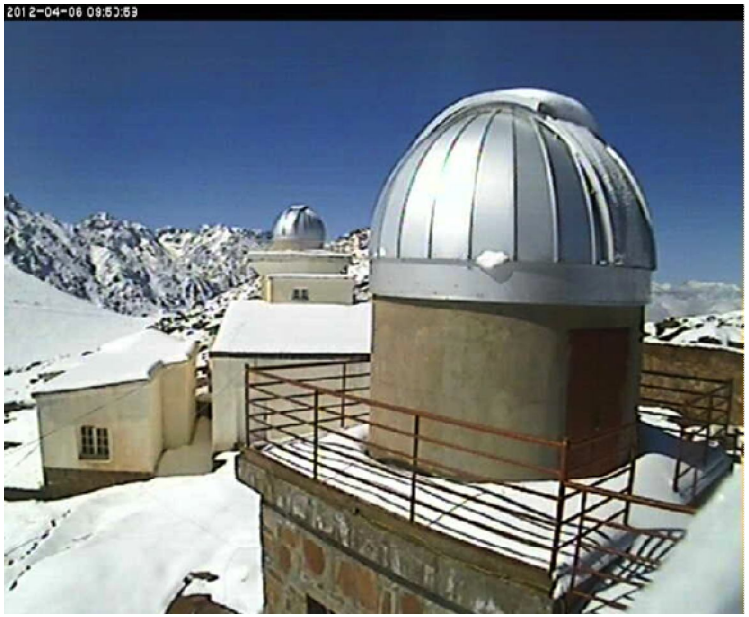
« Oukaimeden Observatory and KASI may exchange personnel (scientists, engineers and students) to participate in collaborative activities (research projects, conferences and seminars, or joint publications). They may collaborate on the development of training and exchange programs for staff and students… »

MOROCCO OUKAIMEDEN SKY SURVEY TELESCOP

Instrument :

The telescope has a **500mm** primary mirror and is used at prime focus with a Wynn corrector (**F/D=3,0**). The detector is a **SBIG STL11000** based on a Kodak KAF 11000 chip. The pixel size is of **1,2 arcsec**; the **field of view** is of **1,5 degree.**

The telescope is used in **remote control**, it is operated by three teams from Marrakech Cadi Ayyad University, from **France** and from **Switzerland**. Observing time is shared between observation of exoplanet transits and asteroid & comets search.



Efficiency

Starting from October 2011 5th, the Oukaimeden observatory (**UAI code : J43**) got **36017** new designations, so about **50 new designations per month**. MOSS send more than **one million and half** astrometry measurements to the **MPC** and is eighth among minor planets observatories.

The Oukaimeden recently integrated the top 50 best Observatories among the world(**27 in 2018**)

The success of **MOSS** come from the good astroclimatics conditions prevailing at the observatory of the Oukaimeden and also from the efficiency of the team who run the telescope.

The Wonderful Discovery

Announced by NASA on February 23, 2017

LETTER

doi:10.1038/nature21360

Seven temperate terrestrial planets around the nearby ultracool dwarf star TRAPPIST-1

Michaël Gillon[1], Amaury H. M. J. Triaud[2], Brice-Olivier Demory[3,4], Emmanuël Jehin[1], Eric
Susan M. Lederer[8], Julien de Wit[9], Artem Burdanov[1], James G. Ingalls[10], Emeline Bolmont
Sean N. Raymond[13], Franck Selsis[13], Martin Turbet[14], Khalid Barkaoui[15], Adam Burgasser
Sean J. Carey[10], Chris M. Copperwheat[18], Laetitia Delrez[1,4], Catarina S. Fernandes[1], Daniel
Aleksander Chaushev[17], Valérie Van Grootel[1], Yaseen Almleaky[21,22], Zouhair Benkhaldoun

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USA. [9]Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Ca
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de la Vierge, 5000 Namur, Belgium. [12]Laboratoire AIM Paris-Saclay, CEA/DRF–CNRS–Univ. Paris Diderot - IRFU/SAp, Centre de Saclay,
d'astrophysique de Bordeaux, Université Bordeaux, CNRS, B18N, Allée Geoffroy Saint-Hilaire, F-33615 Pessac, France. [14]Laboratoire de
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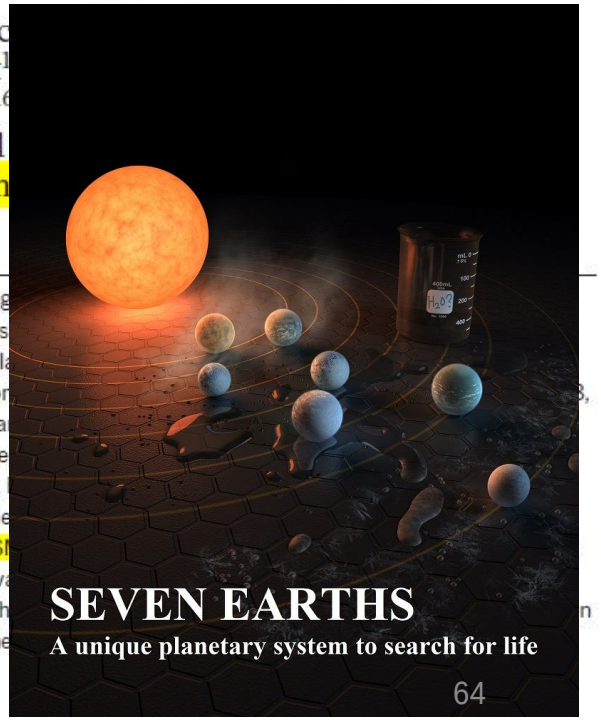
Leicester, Leicester LE1 7RH, UK. [18]Astrophysics Research Institute, Liverpool John Moores University, Liverpool L3 5RF, UK. [19]Jeremiah
PR1 2HE, UK. [20]South African Astronomical Observatory, PO Box 9, Observatory, 7935, South Africa. [21]Space and Astronomy Departme
Jeddah, Saudi Arabia. [22]King Abdullah Centre for Crescent Observations and Astronomy, Makkah Clock, Mecca 24231, Saudi Arabia.



Current existing Astronomical facilities in West Africa

Astronomy Facilities used for teaching and research in West Africa

Nigeria

(All located at the Centre for Basic Space Science (CBSS) Nsukka)

(1) 25 cm Meade Reflector
(2) 10cm Solar Telescope
(3) 6m Indigenous radio telescope
(4) 3m semi-professional radio telescope
(5) Radio Jove radio telescope
(6) Other redundant satellite dishes with possible conversion to radio telescopes

Ghana

(1) 32m Radio Telescope

Burkina Faso

(1) 1m optical telescope

Use of Redundant satellite dishes

- - There are redundant satellite communication dishes spread across the country that can be converted to radio telescopes. Their diameters ranges from 7 to 32m

- - One of these dishes is shown in the figure, the 32m satellite dish in Kujama, Kaduna State, Nigeria

Nigeria & Ghana Teaching & Training

James Chibueze

Nigeria:

- There are 3 researchers and 4 students that work on multi-wavelength studies of stars, galaxies and galaxy clusters.
- 2 PhD students at the Department of Physics & Astronomy, University of Nigeria, Nsukka are studying the evolutionary sequence of high-mass stars using multi-wavelength data (radio, infrared and x-ray). Dr Ikechukwu Obi studies galaxies at radio wavelength.

Ghana:

- DARA students are taught how to study astronomical objects using multi-wavelength data.

The Ghana 32m Radio Telescope (Nk)

Bernard Duah Asabere
(Research Scientist, GSSTI & Manager, GRAO)

EVN TOG MEETING @ SHANGHAI-CHINA, March 19, 2018

Current State of Nk

- **Uncooled dual pol. receiver system: (using Rb GPS clock)**
- Operational frequencies
  *** 5 GHz (124 MHz)**
  *** 6.7 GHz (370 MHz)**
- **Azimuth range:**
  - 8 - 327 deg
  (Az challenge: 327 – 352 deg)
- **Elevation range:**
  5 - 90 deg
  (science purpose: > 10 deg)
- **Slew rate (max. speed):**
  0.27 – 0.29 deg/sec
- **Angular Resolution at 6.7GHz:**
  6 arcmin (0.1 deg).

Steerable in both automatic and manual modes

https://radiowiki.mpifr-bonn.mpg.de/lib/exe/fetch.php?media=na:sustainability:tog:2018_03:nk.evn.tog.china.2018.pdf

Royal Society/Newton Fund Training Outline

Course Units for the Cohorts:

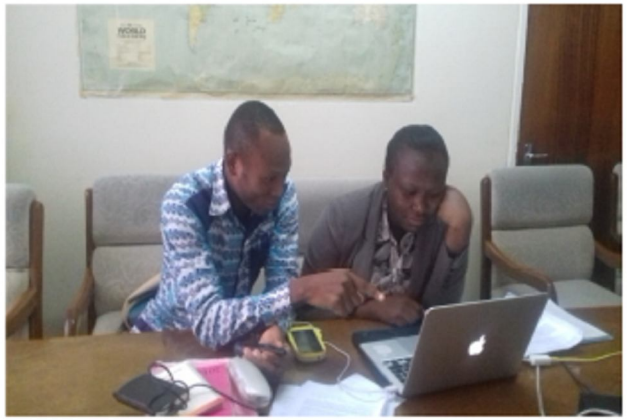
1. Astrophysics, Radio Astronomy Theory and multi-wavelength Astronomy
2. Radio Astronomy Observation, Survey Astronomy and Communication Skills
3. Radio Astronomy Data Reduction and Analysis, Telescope Time and PhD Applications
4. Satellite communication and Commercial Awareness (Entrepreneurship)
5. Observational and Technical training
6. Overseas Experience

Prof. Melvin G Hoare

Instructors for the Cohorts

1. *Prof. Melvin Hoare (UK)*
2. *Dr. Sharmila Goedhart (SA)*
3. *Dr. Charles Copley (SA)*
4. *Mr. Ian Jones (UK)*
5. *Dr. Katerine Johnson (UK)*
6. *Dr. Jay Blanchard (JIVE)*
7. *Dr. Alastair Gunn*
8. *Prof. Benjamin Strapper & PhD std Thomas*
9. *Dr. James Chibueze*
10. *South Africa AVN and Ghana Team, etc..*

Royal Society/DARA Training: PhD & MSc Studentship



Kuntunse Telescope Trainee Operators

- **Andrews**
- **Kingsley**
- **Benedicta**

Cohorts 1 & 2 Products

Alexander – PhD in SA (Rhodes)

Proven - PhD in Ghana (UG)

Benedicta- PhD in Ghana (UG)

Diana- MSc in SA (Rhodes)

- Emmanuel – Msc in UK (HU)
- Michael – Msc in Russia
- Benjamin – Msc in Finland

Mavis – MSc in SA (NWU)

Prosper - MSc in Brazil

- Kingsley – PhD (DARA), UK

Emmanuel – Msc/PhD (DARA), UK

Joseph- Msc (DARA) in UK

Naomi – PhD (DARA) in UK (MU)

DARA – Development of Africa with Radio Astronomy, a Newton Fund Project

Upcoming Programmes (2018)

- HPC System administrators training
- DARA (Ghana-Kenya) Technical and Observational training
- HPC Applications in Astronomy and Meteorology Training
- DARA/CHPC LINUX / Python training
- ESO ART Outreach to Cape Coast University
- **Teachers/Facilitators Workshop (Jumping Jive ?)**
- Dish Conversion Workshop (STFC-UK)

Take Home Messages

- Ghana has launched a 32m radio telescope (GRAO) in collaboration with South Africa at Kuntunse near Accra (known as the AVN Ghana, and as Nk to the EVN community)

- Astronomy has come to stay in Ghana with With Nk as pacesetter: a field the country has warmly embraced.

- Many enthusiastic students and young persons are seeking for opportunities to build carriers in astronomy and related fields to fully realize the potentials in the fields for socio-economic gains

- Ghana (Nk) is calling on all interested parties and institutions for partnerships, supports, collaborations and assistances in all areas of interests.

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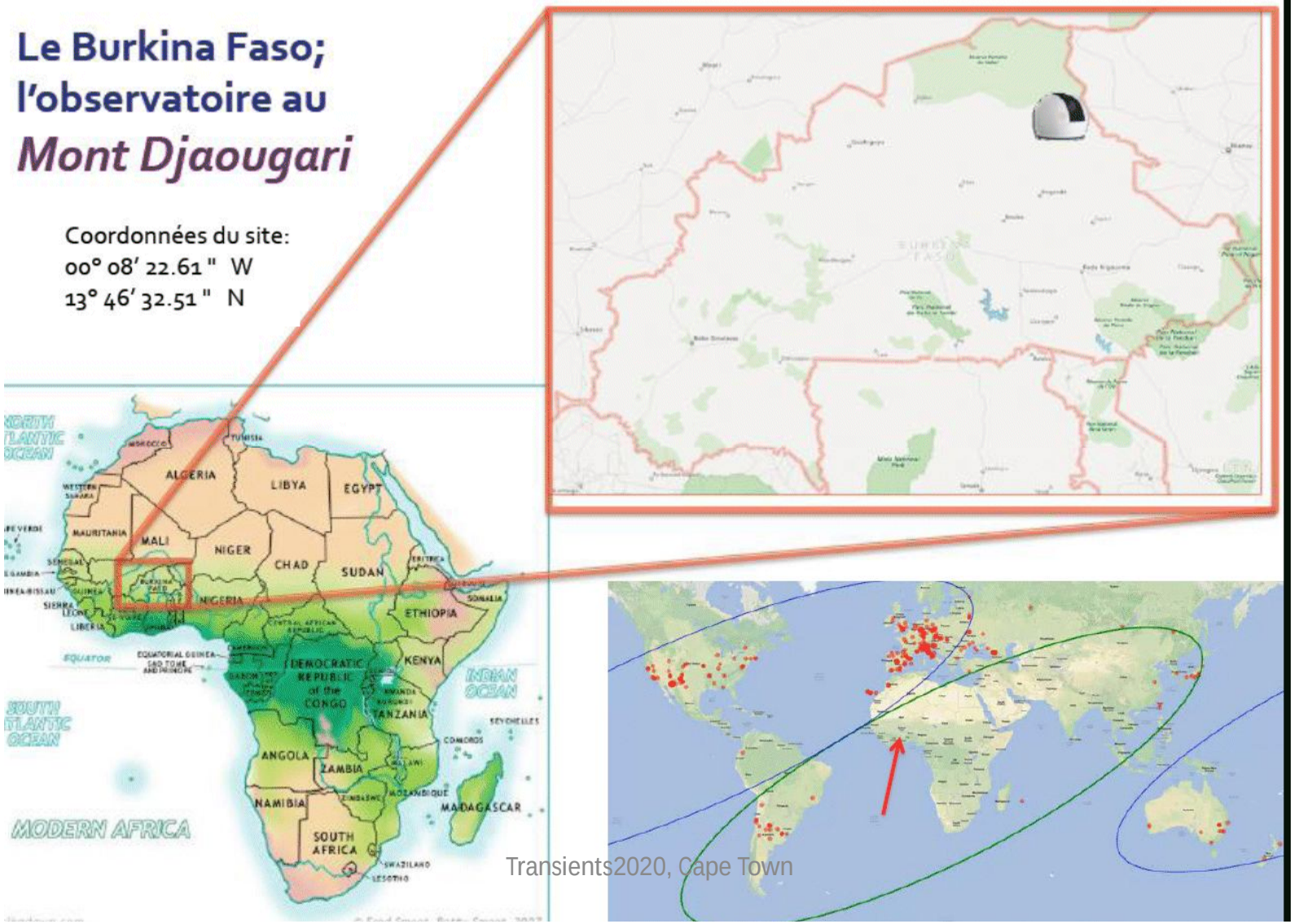
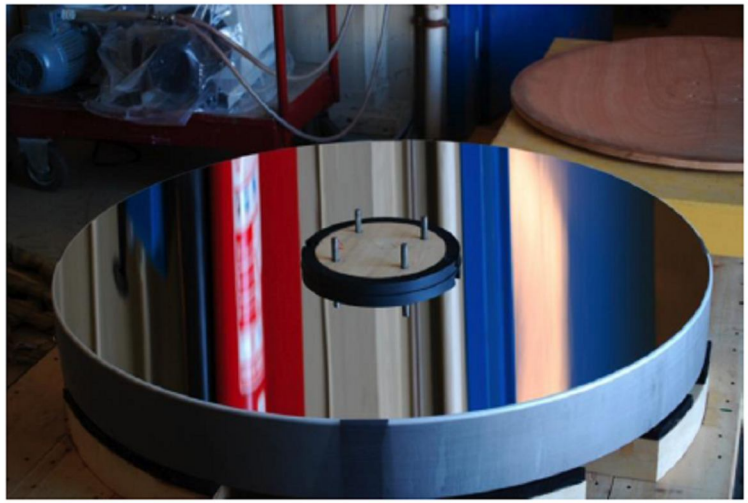
Burkina Faso

Observatory of Djaougari Mt, Claude Carrignan



Relocation of the Marly telescope



Dismantling of the telescope at the La Silla Observatory October 2009

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Teaching Program

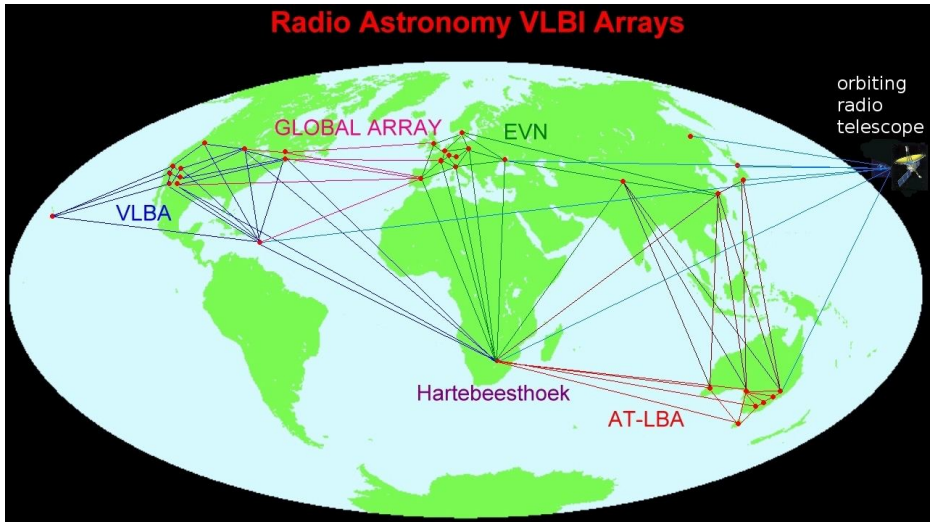
- The formation in Astronomy/Astrophysics is really given at the Msc level (20-40 students):
  - Galactic Astronomy* (end 2011)
  - Extragalactic Astronomy* (jan-mar 2009)
  - Cosmology* (jan 2011)
  - Interstellar Matter
  - Stellar Evolution* (mar-apr 2010)
  - Stellar Atmospheres* (mar-apr 2010)
  - Instrumentation

Left Out

Quite few countries left out

- Madagascar
- Ruanda
- Senegal
- Kenya
- ...

African Very Long Baseline interferometry Network



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

NRF
National Research Foundation

SARAO
South African Radio Astronomy Observatory

AfAS 2020

Objectives

- Share astronomy research from across Africa and promote discussions on research collaborations.
- Bring together participants from the African Astronomy community so that they can be better organised for astronomy research, education, outreach and development on the continent.
- Engage in discussions on the implementation of the AfAS Science Strategy.
- Discuss continental, regional and national plans for the 5 years leading up to the IAU General Assembly in 2024, and the envisaged legacy thereafter.