X-TechLab: towards a Pan African Synchrotron Feeder Facility

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AfLS2020

Bright solutions for Africa

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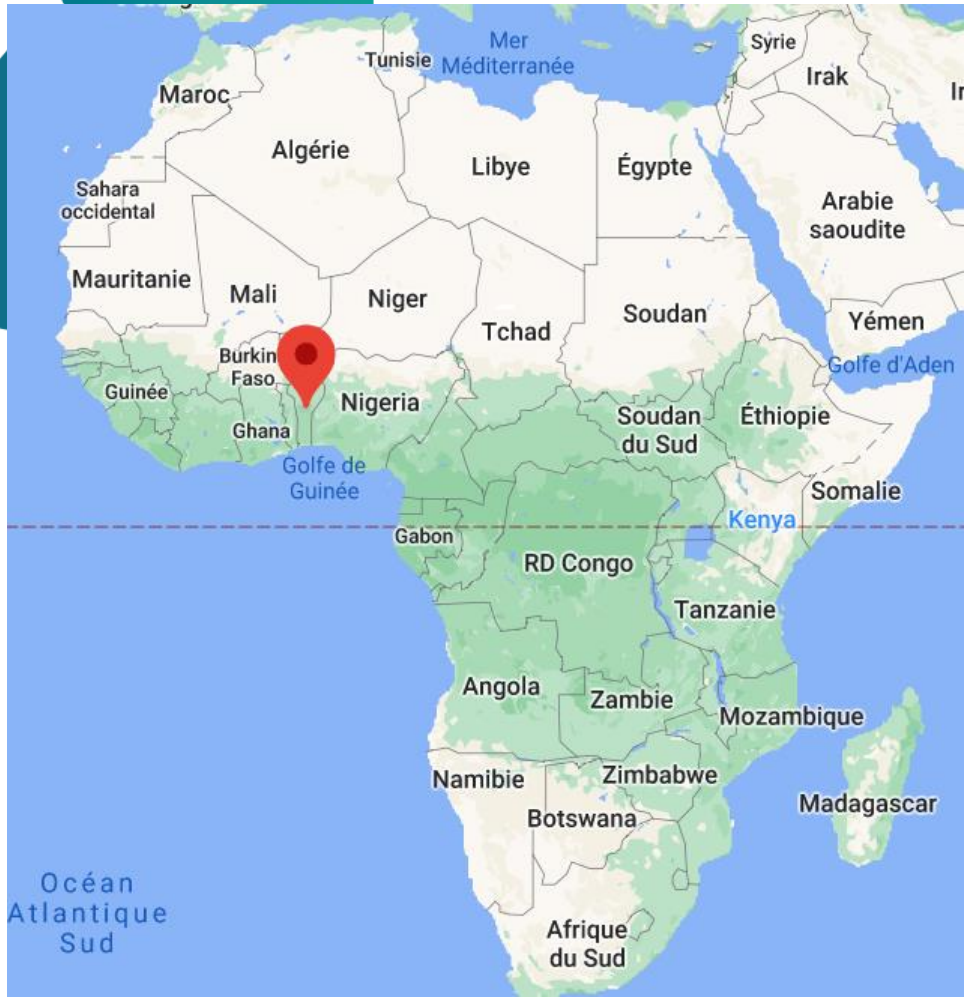

CONTEXT

Africa is a continent where:

- ❑ 60% of people are under 24 age
- ❑ 22 millions students are expected in West African universities from 2030
- ❑ Sub-Saharan Africa suffers from a severe deficit of engineers and scientists and relies heavily on imported expertise for three reasons:
  - Insufficient production of training institutions,
  - Poor quality of education,
  - Lack of practical experience among graduates

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At the origin of X-TechLab initiative

X-TechLab's objectives

- Provide hands-on experience with the use of modern X-ray equipment
- Develop problem solving skills based on X-ray techniques
- Become a Feeder Facility for a pan-African Light Source facility
- Build a community of experts who will be active users of the future African Synchrotron

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SÈMÈ CITY

Innovation Made in Africa

What's X-TechLab?

A regional training platform dedicated to the use of X-ray techniques for scientific and technological research with a strong focus on key issues facing the continent. It was established within the Sèmè City hub, one of Benin Government's flagship projects, which aims to create a world-class knowledge and innovation center in Africa.

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X-TechLab training offer

Crystallography & X-rays diffraction techniques

- **Theory:** fundamentals, single crystal and powder diffraction theory, crystal growth techniques, etc.
- **Practice:** crystal selection & mounting, sample preparation, measurements, data processing, structure solution, refinement, etc.

Mathematical engineering & X-rays imaging

- **Theory:** Image correlation applied to solids mechanics, continuum mechanics theory & mathematical morphology
- **Practice:** sample preparation, measurements, data processing, etc.

Thermomechanical engineering

(In progress…)

- **Theory:** heat conduction, heat transfer, thermal rays, pyrometry, analytical and numerical modelling using COMSOL, FLUENT and PYTHON.
- **Practice:** sample preparation, measurements, data processing, etc.

02 Training sessions in 2019

50 learners from 8 African countries (Bénin, Togo, Sénégal, Cameroun, RDC, Congo Brazzaville, Burkina Faso, Burundi) and 18 experts from France, Italy, UK, USA, Spain, Panama, Benin and Cameroun

Current training session

An hybrid session (online & face to face) from November 16 to 27, 2020:

- 30 learners from 6 African countries (Bénin, Nigeria, Cameroun, Ghana, Ethiopia and Côte d'Ivoire). 25 participants has attended the training in person while 5 are attending online;

- 20 Lecturers from France, Switzerland, Botswana, Italy, UK, USA, Spain, Panama, Jordan, and Benin.

- Participants from a wide variety of fields: Physics,, Materials science, Chemistry, Biology, Geotechnics, Pharmaceutical industry, Design engineering, Computer science, Civil engineering and Physiology.

Mathematical Engineering and X-ray imaging

- Image correlation methods;
- Mathematical morphology and image analysis;
- Continuum mechanics theory;
- Heat conduction, Transfer & Thermal rays;
- Mechanical tests and Measurements

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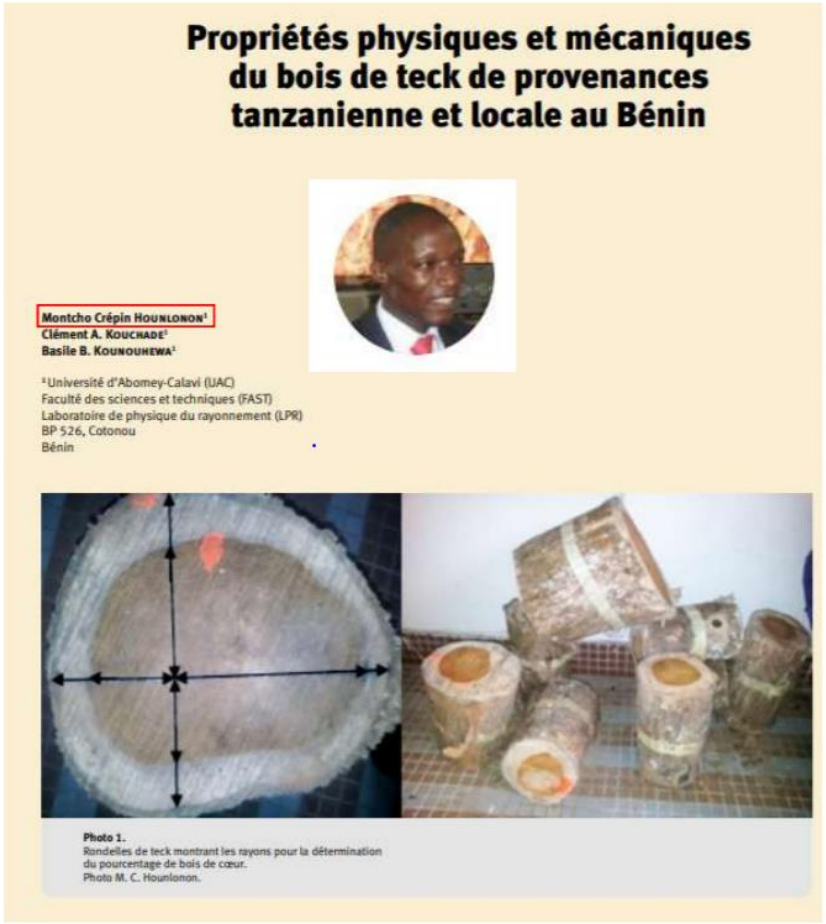

Propriétés physiques et mécaniques du bois de teck de provenances tanzanienne et locale au Bénin

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Photo 1.
Rondelles de teck montrant les rayons pour la détermination du pourcentage de bois de cœur.
Photo M. C. Hounlonon.

Physical and mechanical properties of teak wood from Tanzania and Benin

[Hounlonon *et al.*, 2017, *Bois et Forets des Tropiques* 331(1) pp. 45-53]

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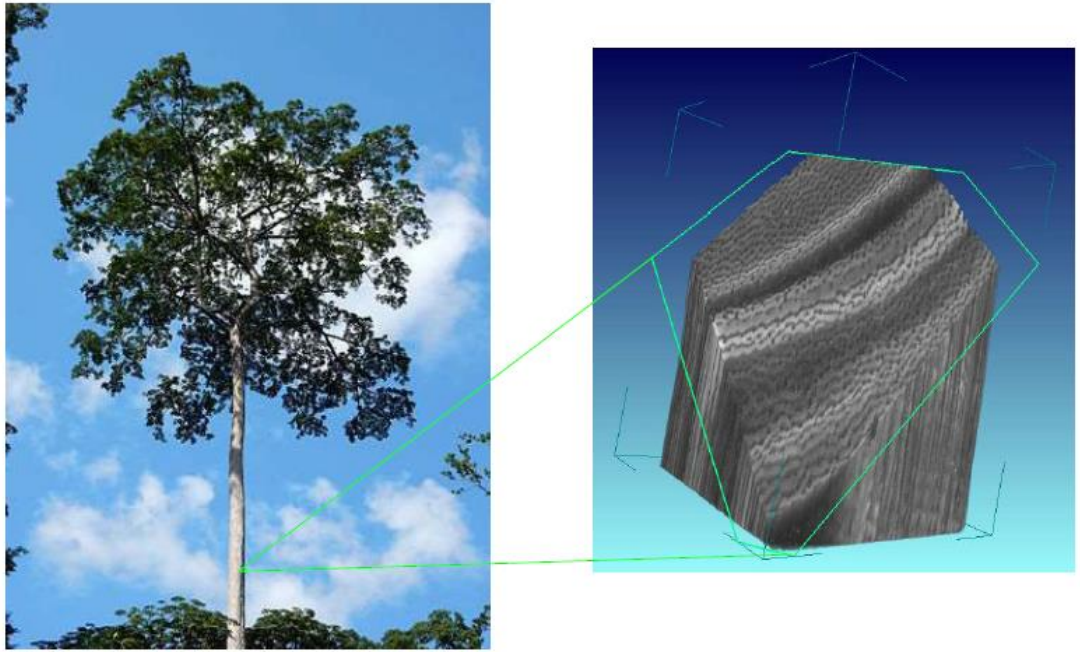
Frake Wood (Terminalia Superba)



[https://fr.wikipedia.org/wiki/Terminalia_superba]
Courtesy of B. Smaniotto

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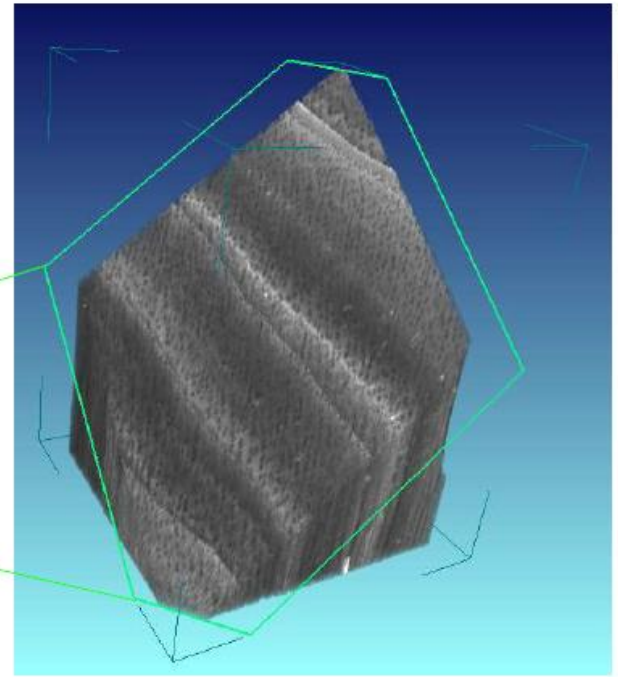
Teak Wood (Tectona Grandis)



[Aoudji *et al.*, 2014, *Bois et Forets des Tropiques* 319(1) pp. 7-17]
Courtesy of B. Smaniotto

Crystallography and X-Ray Diffraction techniques

- Crystal lattice
- Crystal symmetry
- Bragg diffraction
- Structure factors, Fourier Maps, structure solutions methods
- Instrumentation
- Structure solution and refinement
- Databases (CSD, ICSD)
- …

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Research & Development

Health

- **Project 1:** experimental investigation of molecules and herbal medicines for health uses.
- **Project 2:** development of Bleach-based disinfectants.

Sanitation

- **Project 1:** synthesis and characterization of eco-materials for wastewater recycling
- **Project 2:** development of thermosetting polymers from plastic waste and plant biomass for 3D printing

Agriculture

- **Project :** Improvement of organic fertilizers developed by one of Semè City start up. (ADJIYON)

Energy

- **Project 1:** development of new building materials to improve the thermal regulation and energy consumption of buildings, and help preserve the environment
- **Project 2:** contribution to the development of clay-based ceramic tiles (Government project)

Scientific Dissemination

Communications

- Scientific meetings and events: conferences, workshop, seminars, colloquium, etc.

Tutorials

- Tutorials for undergraduate students in "Initiation to Crystallography and crystal symmetry"

Crystal growth competition

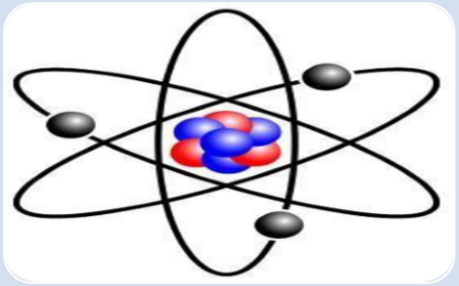
- Introduce students (Schoolchildren) to the challenging world of growing crystals.
- *(This activity has been postponed due to the covid-19 outbreak)*

Virtual Laboratory

(In progress …)

- Provide remote-access to the lab in various disciplines of Science and Engineering. This virtual lab would cater to students at the undergraduate level, post graduate level as well as to researchers.

Services



Analysis: sample characterisation, data processing, etc., for companies, industries, start up, …

Targeted internship for professionals (technician, engineers, etc.) from academic institutions, industries and companies.

Consulting: provide feedback on specific need (in the field of X-rays techniques) to an individual or organisation.

Acknowledgment

We warmfully thank our partners

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advancing structural science

cea

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Mens Agitat Molem
UNIVERSITÉ D'ABOMEY-CALAVI

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SORBONNE UNIVERSITÉS

Thank you for your attention!