

# X-RAY APPLICATIONS IN DEVELOPING COUNTRIES: SUCH AS MADAGASCAR AND ITS NEIGHBORING COUNTRIES.

This project will be carried out by the Laboratory of Solid state Physics and Experimental Physics (LSPEP) from University of Antananarivo MADAGASCAR, in collaboration with IUCr (International Union of Crystallography). It is involved into the program "Initiative Africa".

X-ray is commonly used to analyze matter and its constituents. It is used in many fields, such as biology, geology, engineering, agronomy, medicine and pharmacology.

Thanks to their short wavelengths, X-rays can interact with the atoms and molecules which are arranged in special order in matter. These radiations are diffused in particular directions into space, and the study of the distribution of their spatial intensity allows us to characterize the matter arrangement. Knowledge of how atoms are arranged into crystal structures is the foundation on which we build our understanding of the synthesis, structure and properties of materials.

In science analysis, two X-ray methods are used:

- Crystallography, by powder diffraction for example.
- Spectroscopy, by X-ray fluorescence.

## APPLICATION RELATED TO:

### Farming:

- For farming countries, phosphorus may be a key to increase farming yield. Numerous researches on phosphorus use crystallography investigations. For example, solubility of phosphates (minerals which give Phosphorus) is deeply correlated to the crystal parameters of the hexagonal structure of apatite (mineral commonly used to build high fertilizer).
- Study of plant root uses usually x-ray cristallography and x-ray fluorescence. An example is the research leading to characterize "rhizosphere".  
Rhizosphere: is part of the root of plant which contains many bacteria that feed the plant cells.

### Environment:

- Global researches aim characterizing new materials which are more ecologic and useful. Nano- materials are one of them, and this class of material is widely studied by x-ray diffraction.
- Reducing soil degradation is one of the big challenges that developing countries must keep. That implies use of several disciplines including crystallography.
- X-ray crystallography is also commonly used to determine mineral structures. Combined with X-ray fluorescence it allows precise measurements of the purity of the sample.

### Energy :

Magnetic generators are the most renewable and cleaner source of energy. However, they have a relative short period of use. But now, it is well known that some rare-earth could present anisotropic magnetic properties in crystal structure (Madagascar export rare-earth minerals). This characteristics allows to the magnet a long lasting use.

### Drug and medicine :

- Molecules are too small to be seen with a normal microscopy. X-ray crystallography is one of the few techniques that can visualize them and it determines the first molecular structures ever known. For a long time, crystallography was the only tool used to determine DNA structure. And most protein, vitamin, are efficiently predicted by this method.
- In addition, X-ray could be useful in therapy such as in science of analysis. Indeed, the radiation of X-ray in radiotherapy is more intense than in radiography. This radiation is commonly used to treat cancer.

The LSPEP Laboratory treats essentially the study of interaction of wave and matter. The laboratory has currently developed electromagnetic wave and acoustics wave studies.

X-ray beam is an essential tool for analyzing matter. For now, it is the best method which can perform the analysis of matter in nano-scale, and which is accessible for both developed and developing countries. Crystalline structure and chemical elements components can be well known by the X-ray analysis methods. There are several applications for X-ray researches. Moreover they allow substantial impacts in developing countries. From its collaboration with IUCr, the Laboratory of LSPEP thanks and encourages every partner, every international and regional organization, to support researches in Physic both in fundamental and applications, in Southern countries.

