University of Mauritius

Faculty of Science

Department of Physics

Girish Kumar Beeharry

Head Mauritius Radio Telescope

Contents

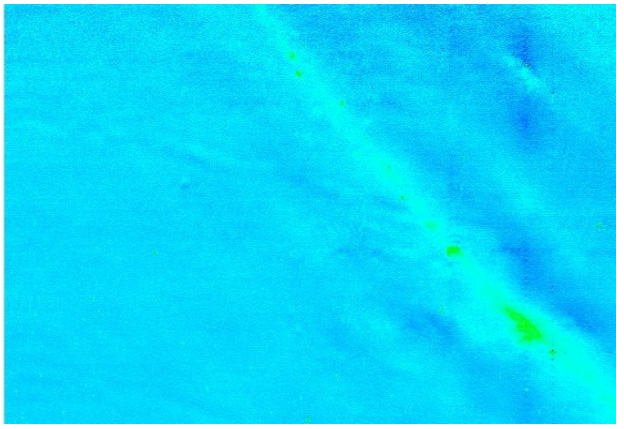
Department of Physics

Research Highlights

RADIOASTRONOMY & APPLIED RADIO FREQUENCY

The Mauritius Radio Telescope MRT sky survey: -10° to -70° dec, 24h RA

The Mauritius Radio Telescope (MRT) is a 2 x 1 km array of helical antennas situated at Bras-D' Eau. It was built (1988-1992) by an Indo-Mauritian team with UoM as the local partner to survey the Southern Radio Sky at 151.5 MHz ~3 arcmin resolution and has also been used to observe Pulsars.



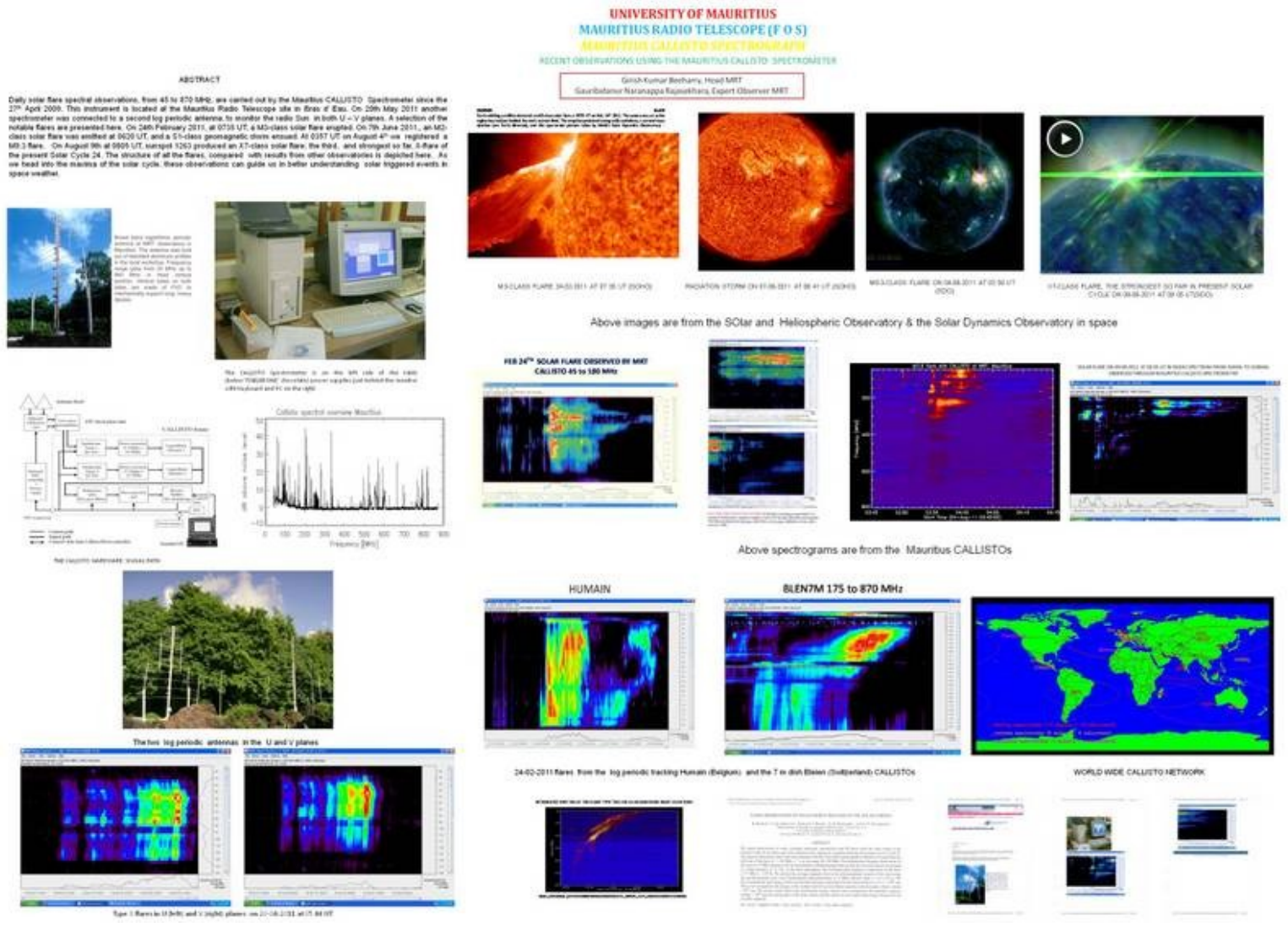
The observatory is a unit in the Physics Dept. under the leadership of the Head of MRT.

Department of Physics

Research Highlights

RADIOASTRONOMY & APPLIED RADIO FREQUENCY

The Mauritius Radio Telescope site: CALLISTO



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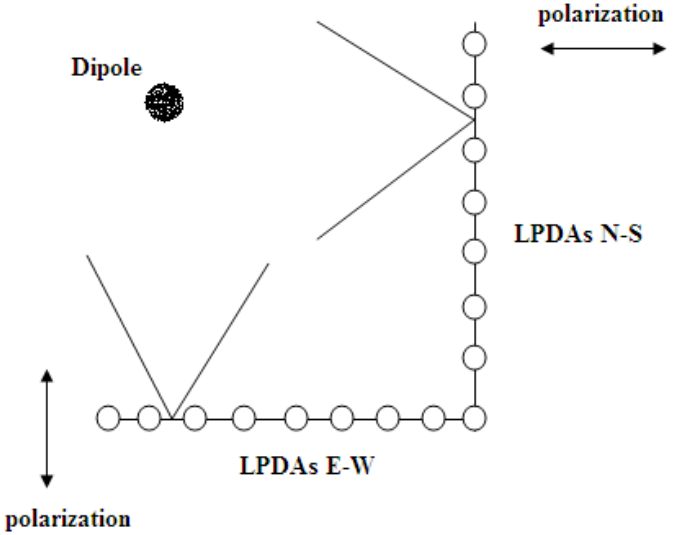
RADIOASTRONOMY

The Mauritius Radio Telescope site MITRA 1 and DUT node



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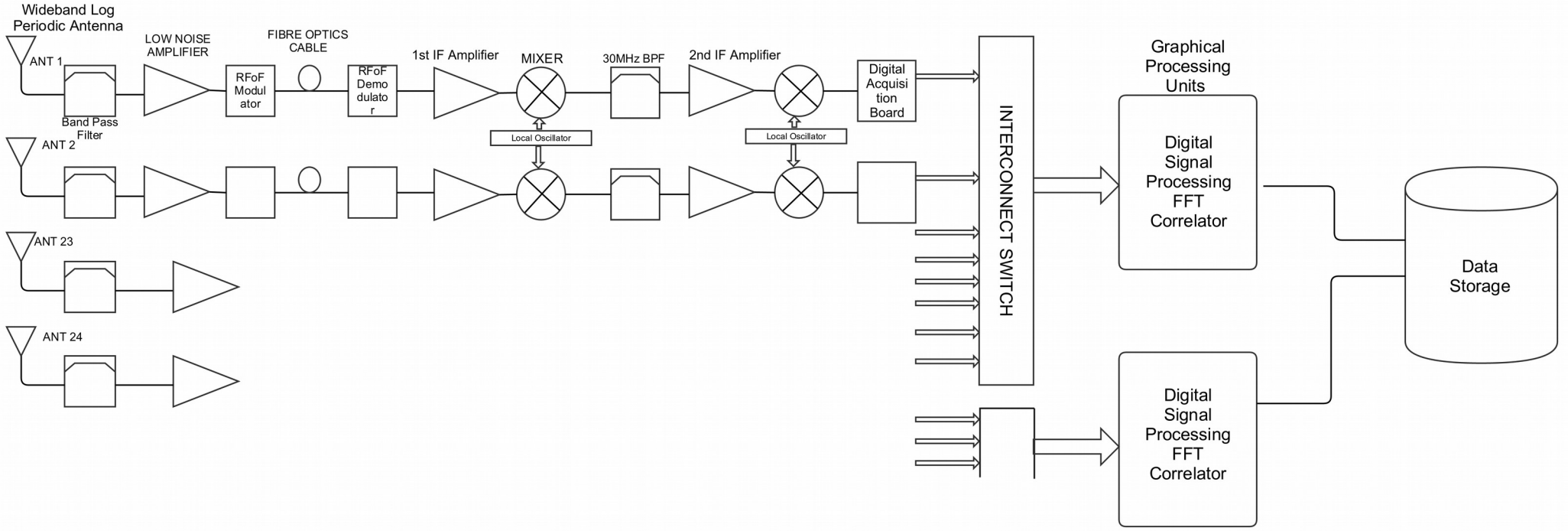
RADIOASTRONOMY

The Mauritius Radio Telescope site MITRA Deuterium Array



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Research Highlights

RADIOASTRONOMY

The Mauritius Radio Telescope site MITRA Deuterium Array

We aim at building a telescope to observe the deuterium line at 327.4 MHz.

Telescope designed in the form of an interferometric array. We will experiment with new techniques of doing imaging with interferometers.

We aim at a novel imaging pipeline making use of a parallel framework in order to contribute to the high computing power demands expected for the Square Kilometre Array (Mount ExaFLOP).

We will make use of off-the-shelf gaming GPUs to achieve a low-cost system

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Imaging pipeline for a new array

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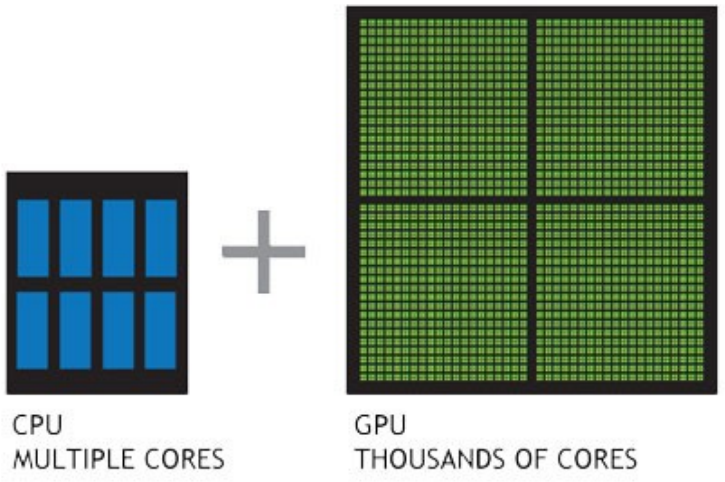
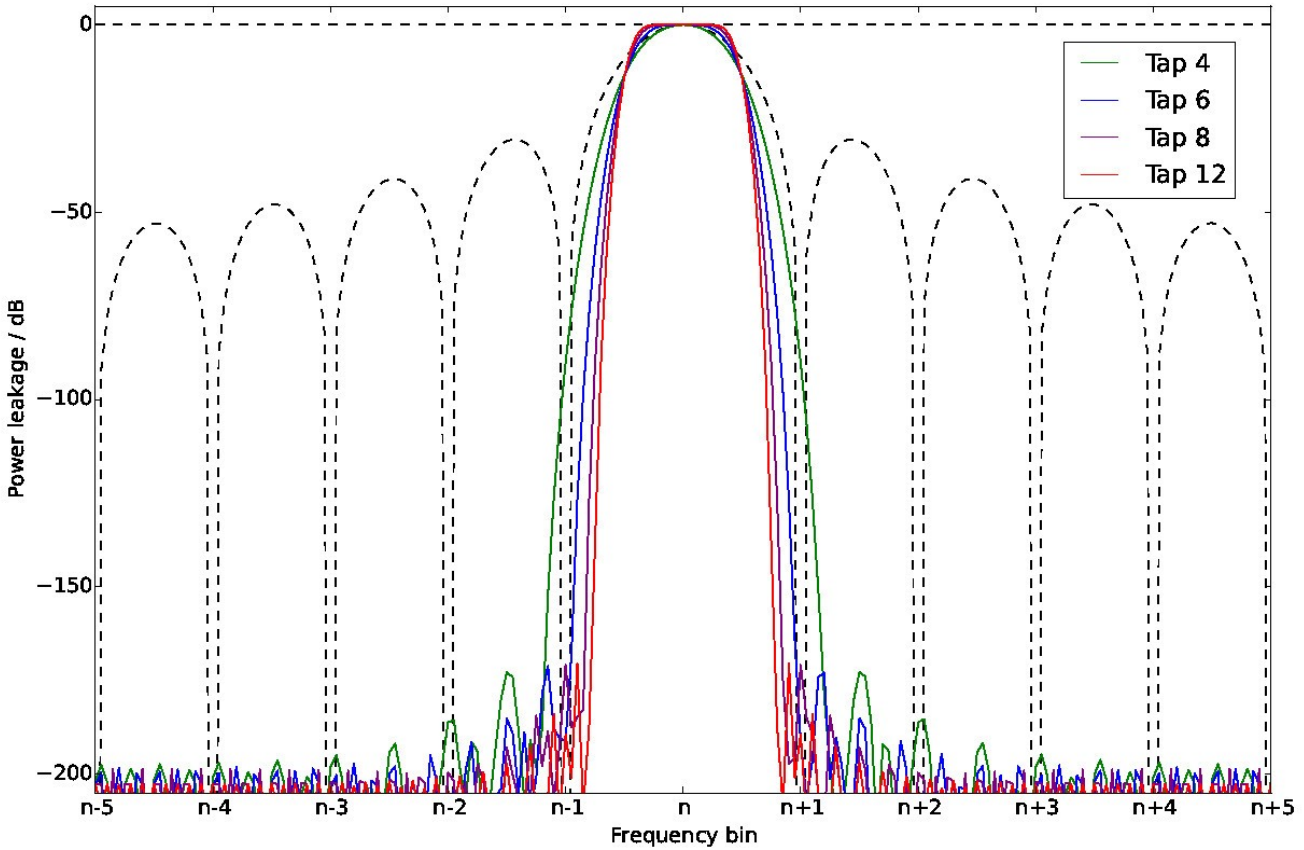


Our objective is a system fully integrated on GPU, where the only copy process to and from GPU memory is the acquisition at start and retrieval of images at the end.

Data Acquisition and Polyphase Filtering



The dotted curve represents leakage due to a simple FFT.

In radio astronomy leakage in the frequency domain can cause a strong source to hide a weaker source in other part of the spectrum.

Windowed FFT and a polyphase structure can reduce the leakage significantly.

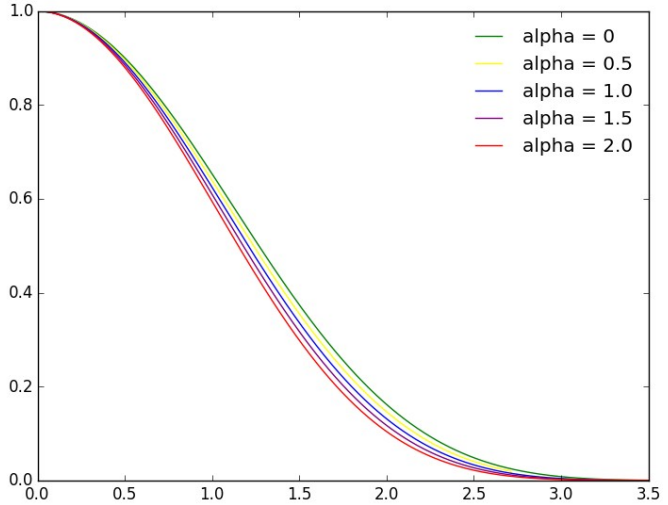
Since we are working with digital filterbanks and filtering is practically calculating the polyphase structure and multiplying with every sample, this procedure can be parallelized. We can use a GPU's general memory as filterbank and apply the polyphase filtering directly on GPU and perform FFT immediately.

Correlation and Gridding of uv data

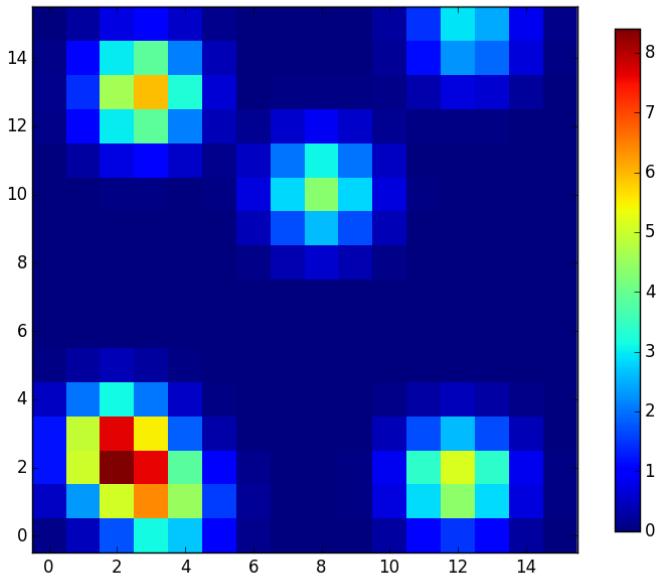
Correlation is a massively parallel process involving acquired data from different antennas.
And considering that it is the most time consuming and compute intensive step in data processing pipelines, the GPU has huge potential to accelerate this process.

Our plan is to perform correlation followed by optimal gridding.

We are developing algorithms for gridding as it is a computationally expensive process and hard to parallelize due to its convolutional nature.



Testing convolutional function for a support of 7 grid cells (whereby half is shown above here.)



Optimal gridding of a sample of visibility values shown on the left here. We used spheroidal functions in 2D with a support of 7 grid cells. The interpolation dies off well on the edges of the support, which reduces aliasing in the final image.

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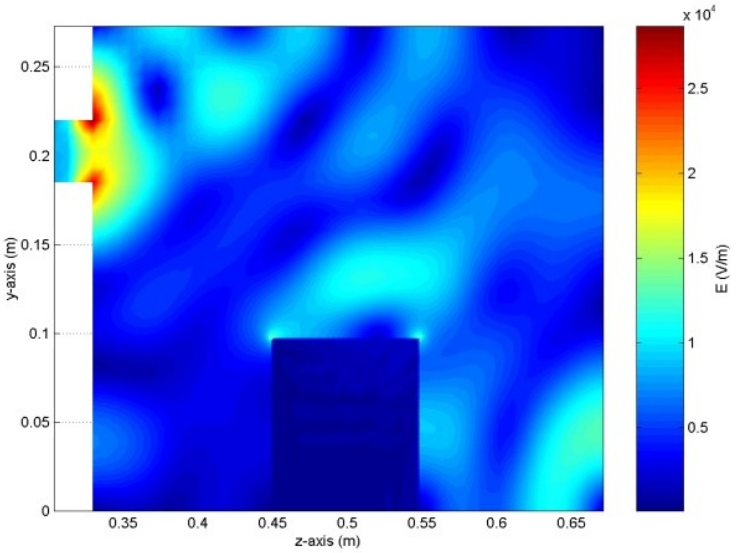
APPLIED RADIO FREQUENCY

Electromagnetic Propagation and Microwave Heating



Extragalactic Radio Sources

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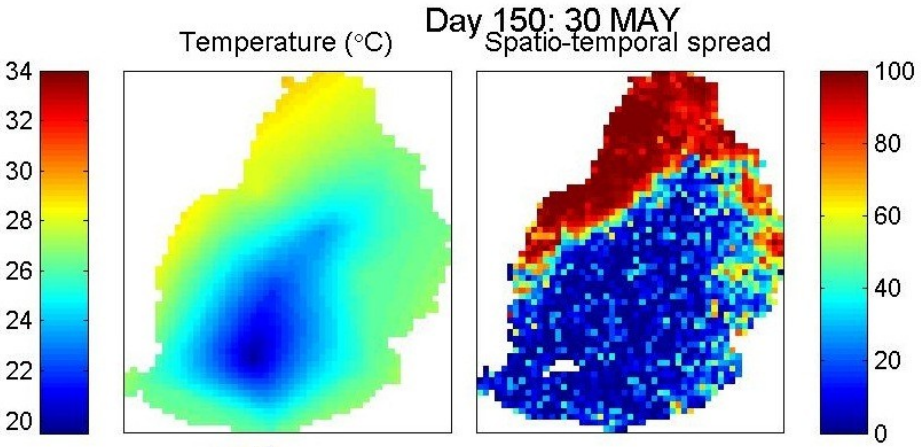
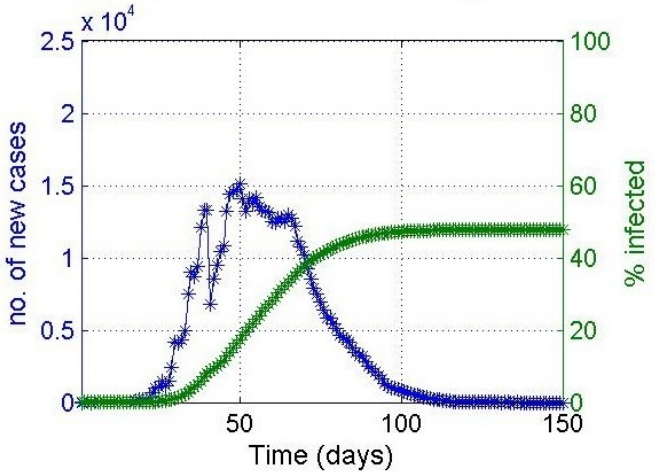
Research Highlights

COMPLEX SYSTEMS MODELLING

Epidemiology





Photonic crystals

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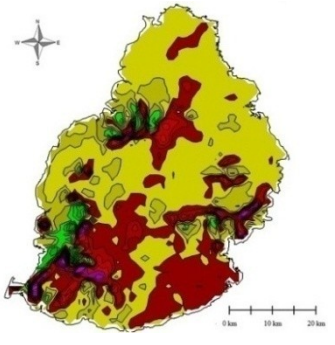
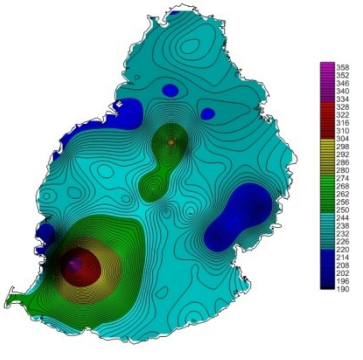
Research Highlights

CLIMATE RESEARCH & RENEWABLE ENERGY

Scientific Grade Weather Station

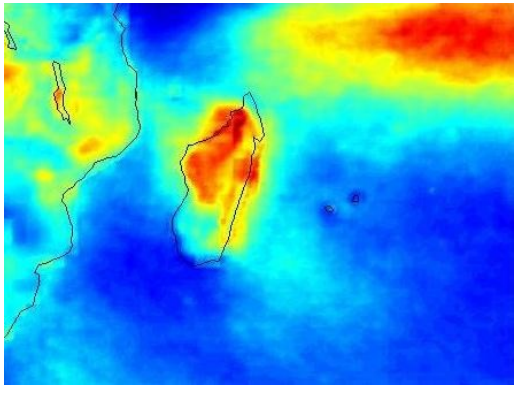
Wind Energy





Solar Power Development for Mauritius

Climate Research



Department of Physics

Teaching equipment

Basic radioactivity kit, GM Tube, Electron diffraction tube, alpha Particle detector, Spin resonance equipment, digicounter, X ray: spectrometer, crystallography, radiography

Bsc(Hons) Physics/Physics with Computing
Syllabi Nuclear and Elementary Particle Physics
(Special relativity, non-relativistic Quantum physics year 1-2)

PHYS 3001(5) - NUCLEAR PHYSICS (PQ: PHYS 2005(3))
Nuclear structure and size. Binding energy and semi-empirical mass formula. Nuclear forces and nuclear models. Radioactivity (natural and artificial). Fission and fusion. Theories of alpha, beta and gamma decay. Nuclear reactions. Fission and fusion reactors. Controlled fusion. Fusion processes inside stars.
PHYS 3003(5) - ELEMENTARY PARTICLE PHYSICS (PQ: PHYS 2005(3))
The standard model. Leptons, quarks, hadrons and gauge bosons. Strong, Electromagnetic and Weak interactions and transmission. Particle properties and quantum numbers. Conservation laws in particle physics. Introduction to Feynman diagrams.

Brief on Radiation Protection Authority

The Radiation Protection Authority (RPA) was set up in 2006 the proclamation of the Radiation Protection Act 2003, as an effectively independent national regulatory body to regulate the use of ionising radiation.
The main objectives of the Authority are to:

Regulate all practices involving the use of ionising radiation;
Provide radiation protection services; and
Promote radiation safety.

REGULATORY

Registration of Radiation Sources -
Inspection of Radiation Practices and Facilities
Importation and Exportation of Radiation Sources -
Transportation of Radioactive Materials

SERVICES

Personal Radiation Monitoring Service (PRMS)
Radioactivity Analysis Service (RAS)
Radiological Emergency Response Service

Training on Radiation Safety