

University of Mauritius
Faculty of Science
Department of Physics



Girish Kumar Beeharry
Head Mauritius Radio Telescope



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Department of Physics

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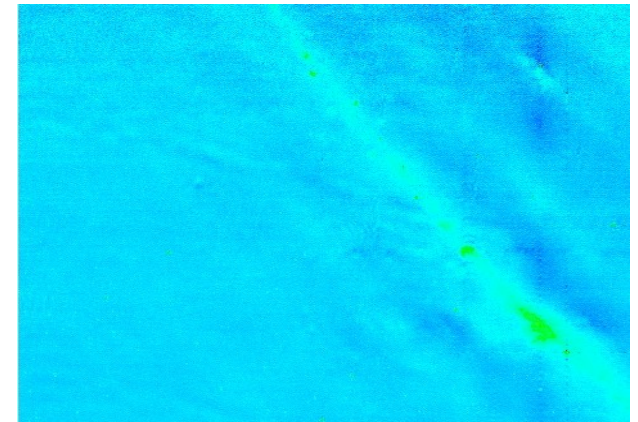
Research Highlights



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



UNIVERSITY OF MAURITIUS
MAURITIUS RADIO TELESCOPE (F O S)
MAURITIUS CALLISTO SPECTROGRAMS

RECENT OBSERVATIONS USING THE MAURITIUS CALLISTO SPECTROMETER





Ganesh Kumar Brothman, Head MRT
Saurabh Kumar Narasappa Rajapethara, Expert Observer MRT

ABSTRACT

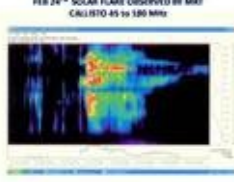
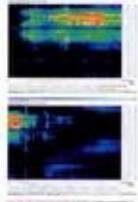
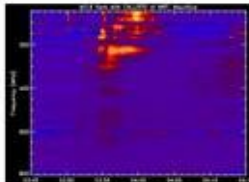
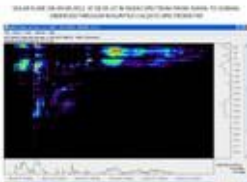
Daily solar flare spectral observations, from 45 to 870 MHz, are carried out by the Mauritius CALLISTO Spectrometer since the 27th April 2009. This instrument is located at the Mauritius Radio Telescope site in Bras de Dieu. On 20th May 2011 another spectrometer was connected to a second log periodic antenna, to monitor the radio flux in both U-V planes. A selection of the notable flares are presented here. On 24th February 2011, an M3-class solar flare erupted. On 7th June 2011, an M3-class solar flare was emitted at 0920 UT, and a C1-class geomagnetic storm ensued. At 0157 UT on August 4th, we registered a M2.5 flare. On August 9th at 0909 UT, magnetar SMO generated an X1-class solar flare, the third, and strongest so far, of the present Solar Cycle 24. The structure of all the flares, compared with results from other observatories is depicted here. As we head into the maxima of the solar cycle, these observations can guide us in better understanding solar triggered events in space weather.


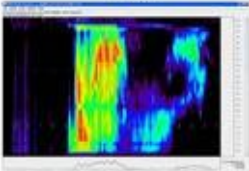
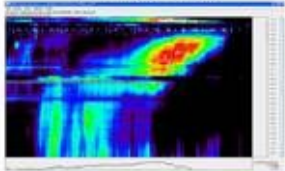

Recent solar eruptions, similar events or solar storms (coronal mass ejections) are monitored by the antenna and fed to the computer system which is the core of the antenna. Frequency data are sent to the computer system, which sends data to the internet, and made available to the public.

Above images are from the SOLAR and Heliospheric Observatory & the Solar Dynamics Observatory in space

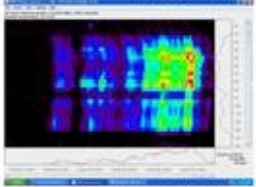
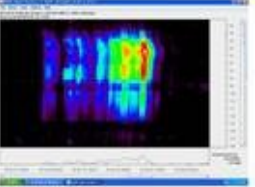
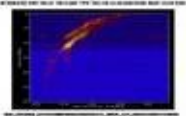



Above spectrograms are from the Mauritius CALLISTOs

The two log periodic antennas in the U and V planes

24-02-2011 Flare: From the log periodic tracking Human (Belgium) and the T in dish Blass (Switzerland); CALLISTO

WORLD WIDE CALLISTO NETWORK

Page 1 Flare in U plane and V plane on 21-08-2011 at 07:30 UT

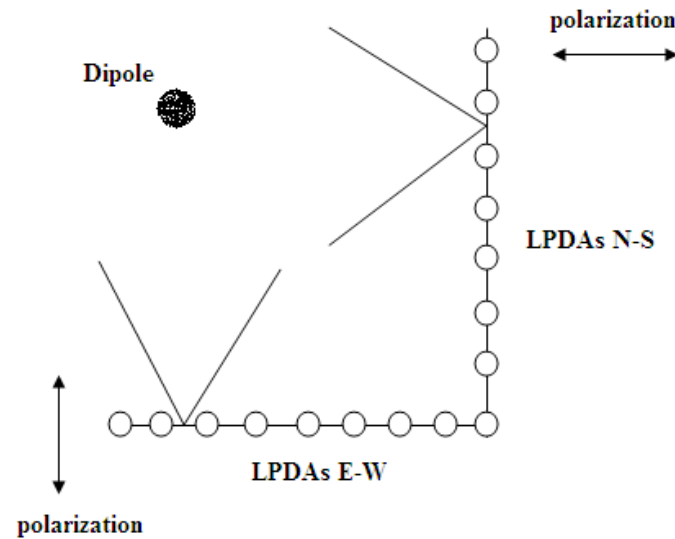
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Research Highlights

RADIOASTRONOMY



The Mauritius Radio Telescope site MITRA 1 and DUT node



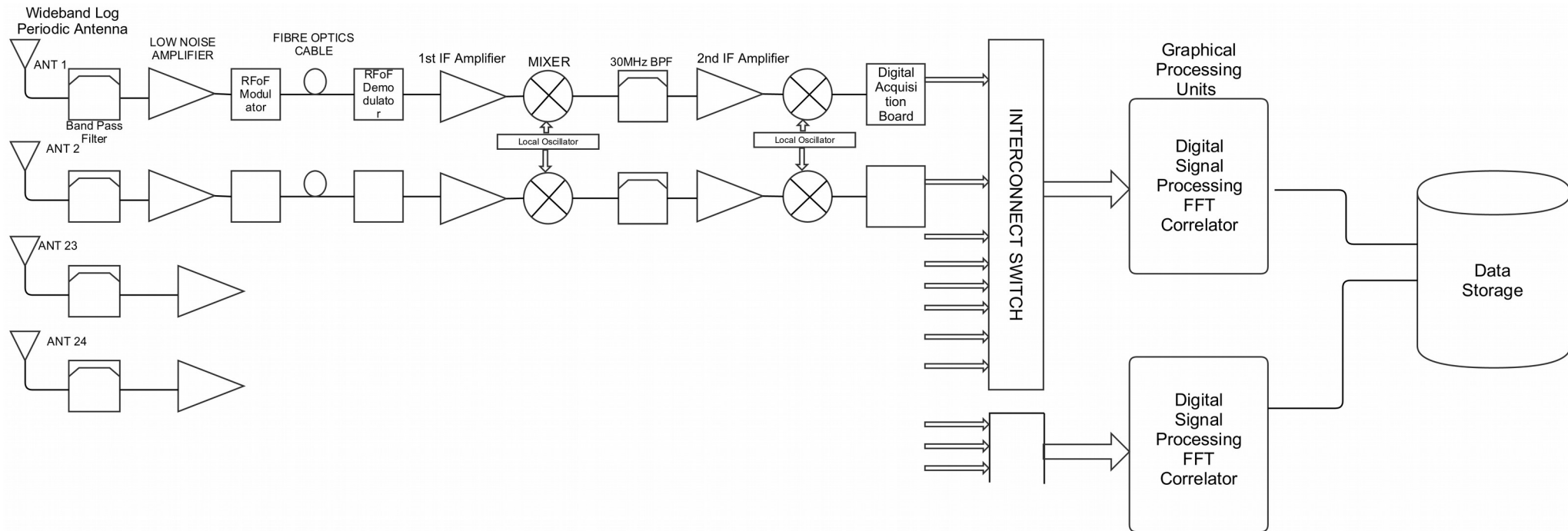
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Research Highlights



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

Vinand Prayag ,Nitish Ragoonundun.+ 2 soon



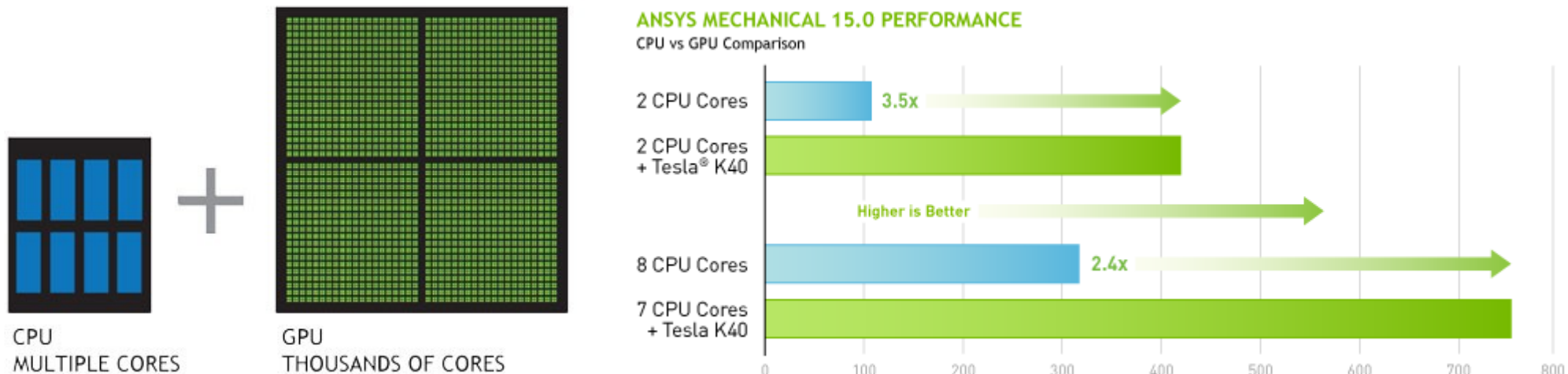
Imaging pipeline for a new array

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.

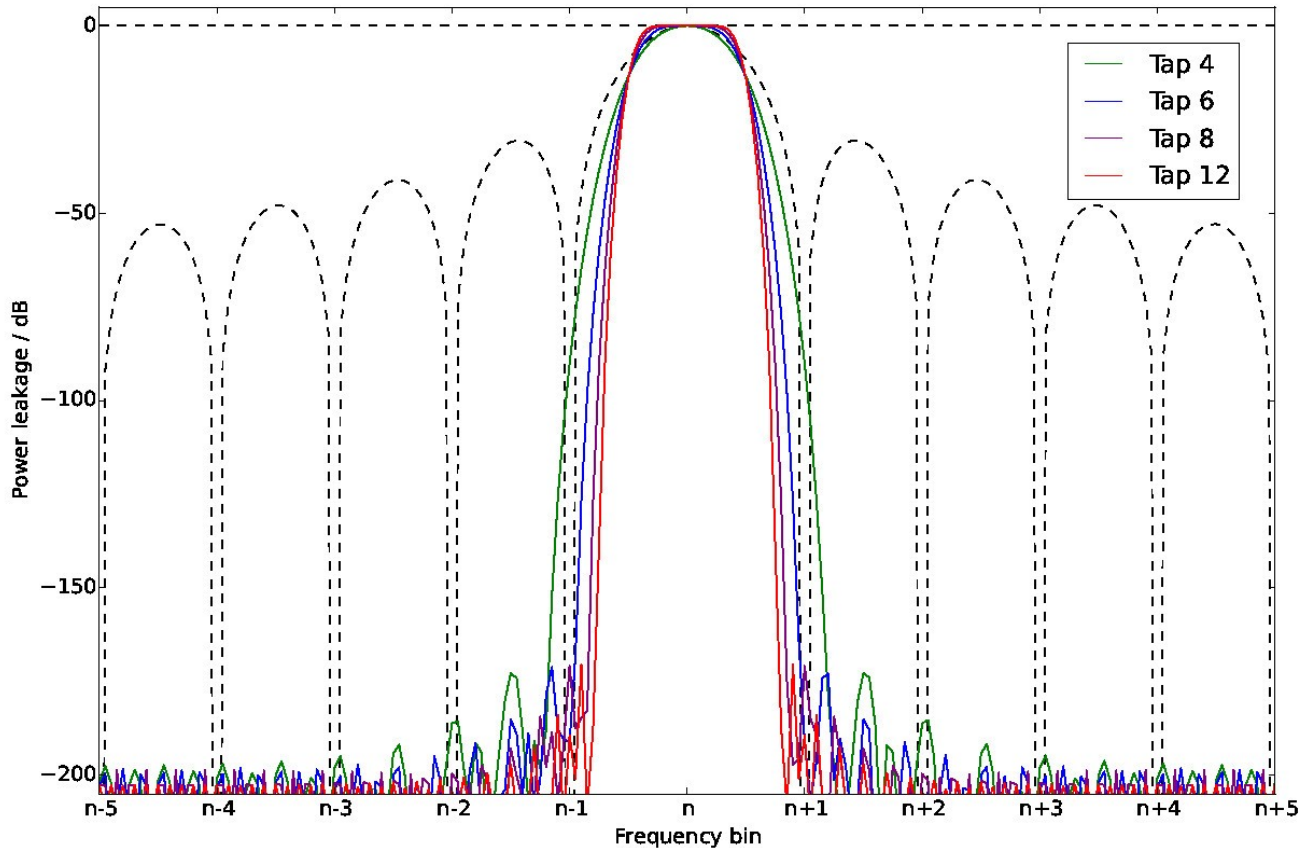
We aim at a novel imaging pipeline making use of a parallel framework in order to contribute to the high computing power demands expected for the Square Kilometre Array (Mount ExaFLOP).

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



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

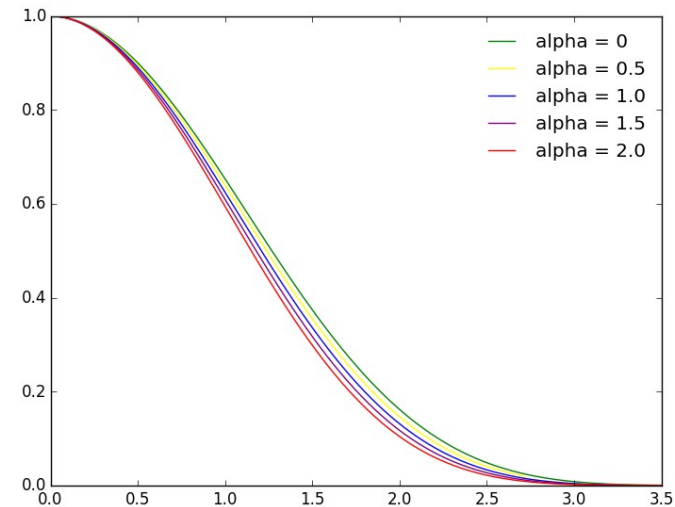


Correlation is a massively parallel process involving acquired data from different antennas.

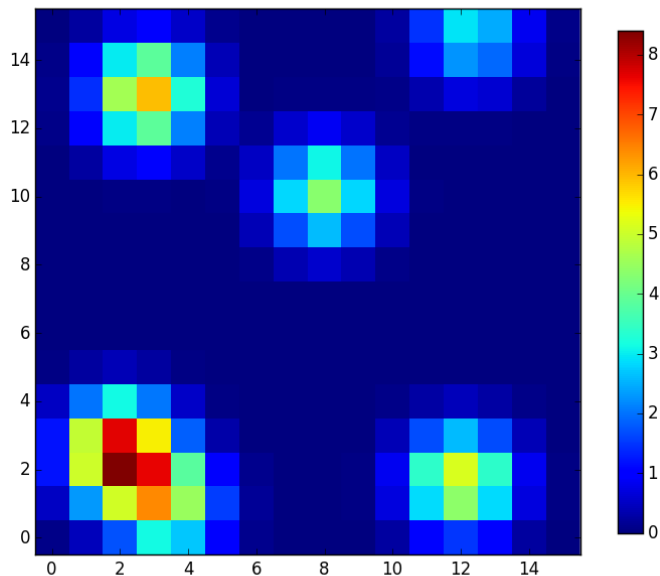
And considering that it is the most time consuming and compute intensive step in data processing pipelines, the GPU has huge potential to accelerate this process.

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.

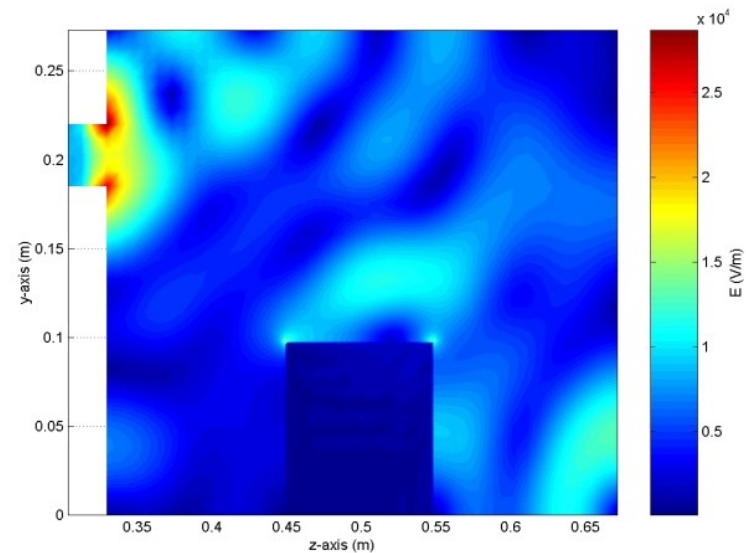
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APPLIED RADIO FREQUENCY

Electromagnetic Propagation and Microwave Heating



Extragalactic Radio Sources

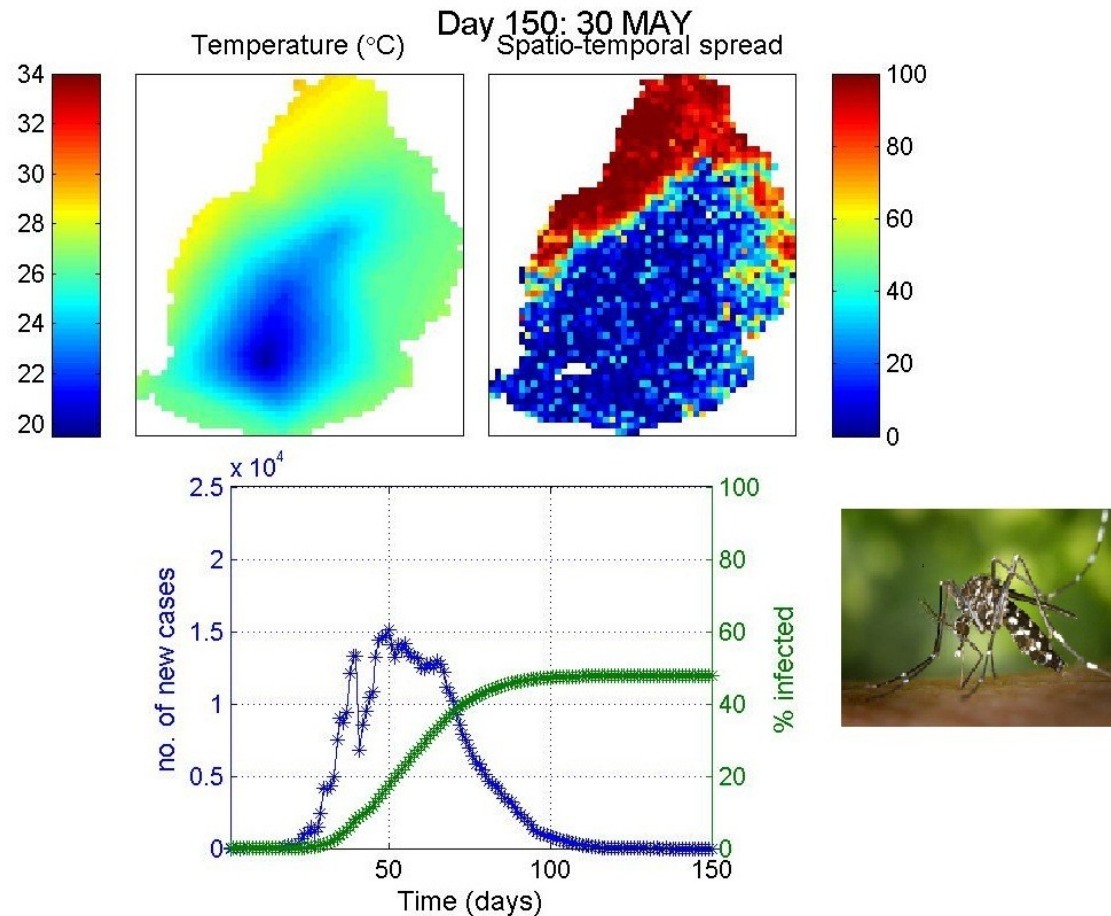
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COMPLEX SYSTEMS MODELLING

Epidemiology



Photonic crystals

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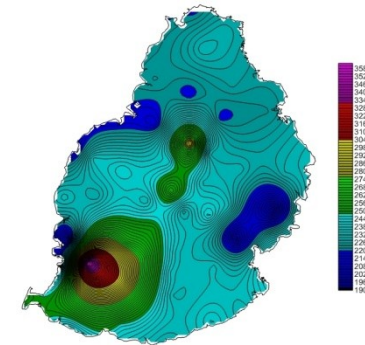
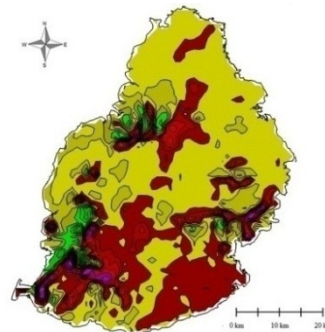
CLIMATE RESEARCH & RENEWABLE ENERGY

Scientific Grade

Weather Station



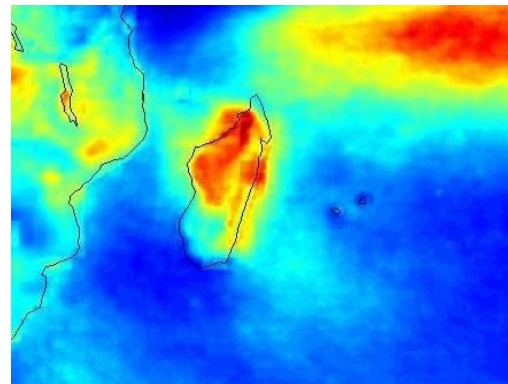
Wind Energy



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