Summary of the installation of the RENOIR experiment at Oukaimeden Observatory

Professor *Jonathan Makela* from the University of Illinois at Urbana-Chamapaign and his team composed of Dr *Pierdavide Coisson* and Ph.D students *Brian. J Harding*, *Timothy M. Duly* and *Daniel. J Fisher* came to Morocco in order to deploy a Fabry-Perot interferometer (FPI) and a wide-angle imaging system to the « Observatoire Astronomique Universitaire de L' Oukaimeden » in the Atlas Mountains near Marrakech, Morocco. This represents another installation of the Remote Equatorial Nighttime Observatory of Ionospheric Regions (RENOIR) project that is part of ISWI.

The deployement and the training of the Moroccan team have been achieved from 04 to 11 November 2013. The Moroccan team is composed of Professor *Zouhair Benkhaldoun*, the director of the Oukaimeden observatory, Professor *Mohamed Lazrek*, Professor *Aziza Bounhir*, *Ahmed Dassou* the engineer of the observator and PhD students who are involved in space weather : *Amine Laghrieb*, *Mohamed Kaab* and *Malki Khalifa*.

The deployement of these instruments is in the frame of a project of collaboration between Prof. Makela at the University of Illinois and Prof. Benkhaldoun at Cadi Ayyad University in Marrakech, Morocco .

1- The installation of the Equipement

Figure 1 : Pierdavid Coisson and Brian. J Harding at the roof cleaning the domes (left). Daniel. J Fisher, Ahmed Dassou, Malki Khalifa and Mohamed Kaab examining the SkyScanner for the FPI.

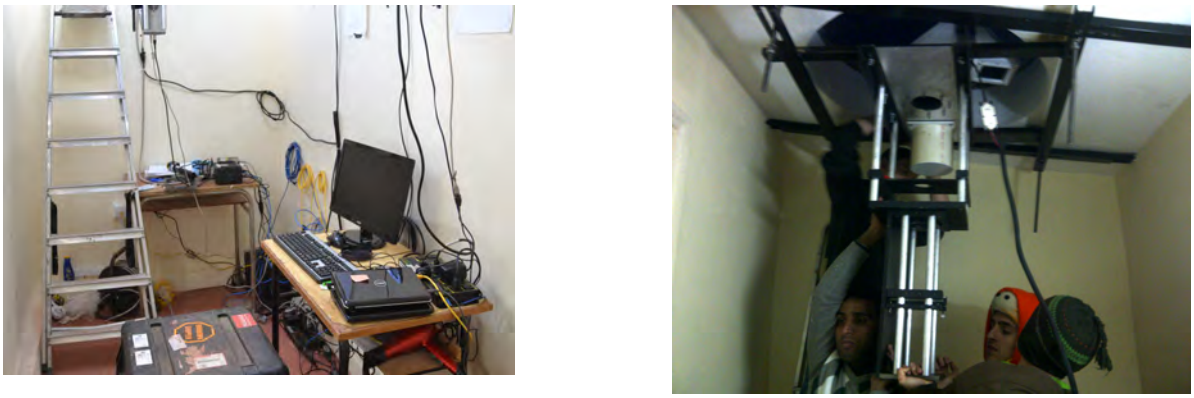


Figure 2 : The room housing the RENOIR experiment (left), Malki Khalifa, Daniel. J Fisher, Tim Duly and Mohamed Kaab lifting part of the FPI.

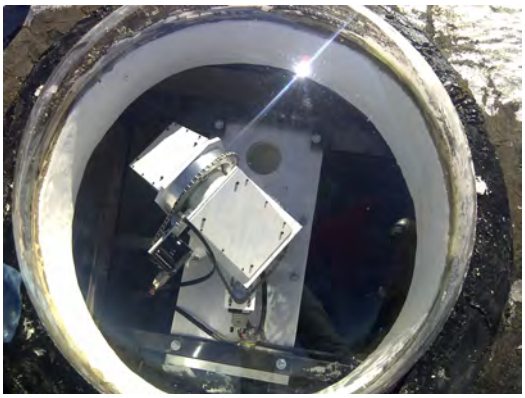
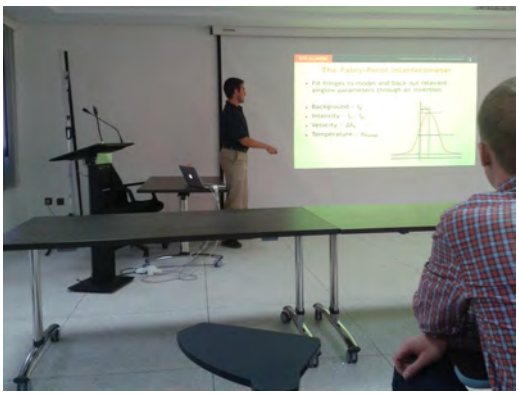


Figure 3 ; The Picasso Imager beeing programmed by Daniel Fisher (left), the FPI seen from the dome.

2- Training of the Moroccan team

Figure 4 : Professor Makela training the Moroccan team on the equipement and data analysis at the observatory.




Fugre 5 : Professor Makela and his students gave four conferences at the University Cady Ayyad dealing with the RENOIR equipements, the underlying physics, the scientifique objectives and the data analysis.

3- The scientific objectives of the RENOIR experiment in Morocco

The deployment of this instrumentation in Morocco will provide critical measurements of thermospheric dynamics and ionospheric structure required to come to a global understanding of space weather. On their own, data obtained from these instruments will be used to build climatologies of the neutral winds and temperatures as well as the occurrence of ionospheric structuring events.

Combined with data from existing sites in the American sector, the data from Africa will play a critical role in understanding large--scale tidal features in the upper atmosphere (see figure 6).

These data will be disseminated to the larger community through the appropriate databases (e.g., Madrigal and the CEDAR database).

We beleive it is a good starting point for the African sector having ground based measurements to monitor the neutral wind and the ionospheric structures in order to provide a continual monitoring of the upper atmosphere in that specific region.

Figure 6**:** Location of existing FPIs (green) similar to the one installed in Morocco and the site in Morocco (yellow).

The FPI will provide measurements of the thermospheric winds and temperatures. Data will be analyzed using routines developed at the University of Illinois (*Makela et al., 2011*) which have been demonstrated to be robust using measurements made at other stations in South America (*Meriwether et al., 2011*) and North America (*Makela et al.*, 2012). The wide-angle imaging system will provide measurements of plasma structures in the ionosphere (e.g., equatorial plasma bubbles, medium-scale traveling ionospheric disturbances) occurring in an approximately 1000×1000 km^2 region above the observing site (e.g., *Makela and Otsuka*, 2011). Both instrument designs have proven robust and are capable of being operated remotely without the need for manual intervention for long periods of time.

Initial science topics from RENOIR in Morocco include investigating

* possible tidal signatures
* gravity wave signatures
* wind signatures related to the occurrence of MSTIDs
* climatologies of MSTIDs and (maybe) EPBs over Africa
* response of the thermosphere to geomagnetic storms.

4- Preliminary results from Oukaimeden Observatory

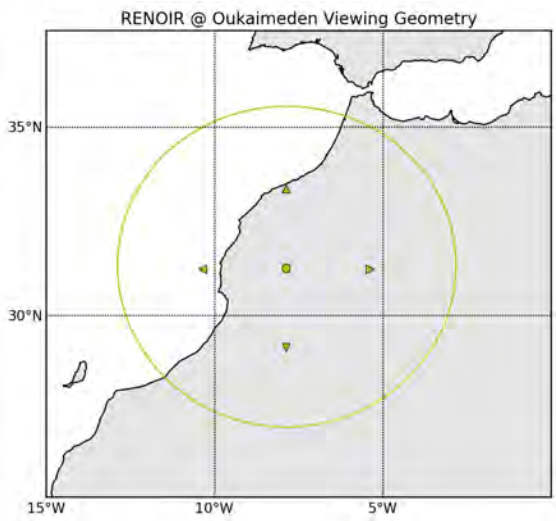


Figure 7: The viewing geometry of the RENOIR experiment.

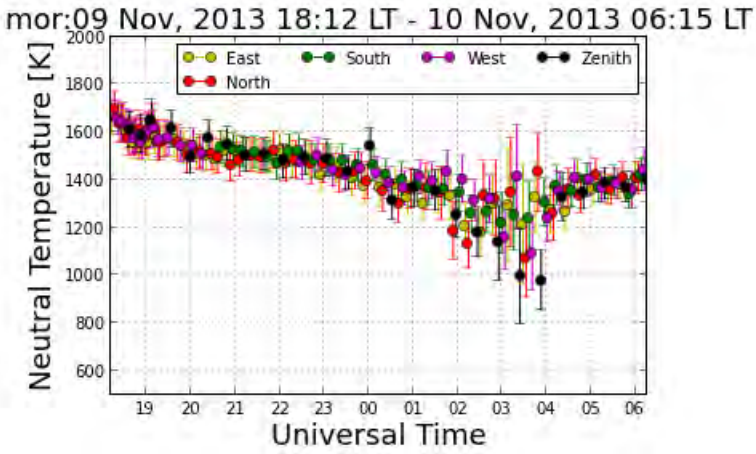


Figure 8 : Preliminary FPI neutral temperatures .

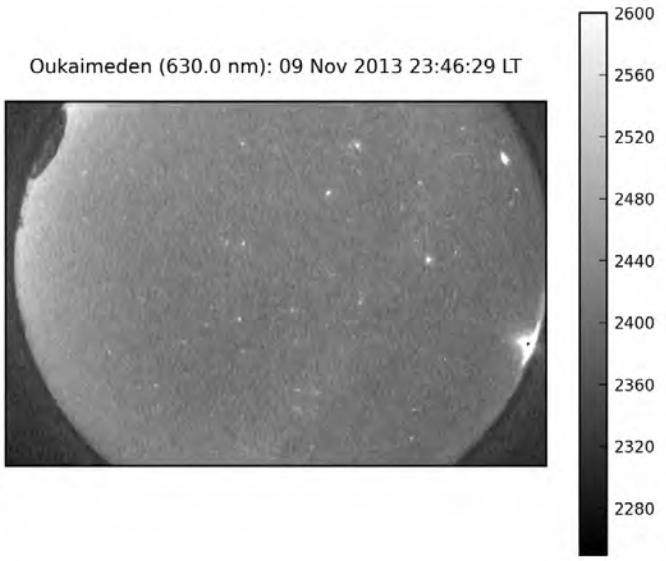


Figure 9 : An exemple of Picasso image.

The Illinois and Moroccan teams will collaborate on joint analysis and interpretation of results.

5- Visite of the Ministery in charge of research and higher education to the observatory during the deployement of the RENOIR experiment.

Figure 10 : American and Moroccan team for the RENOIR experiment in Morocco. The Ministery « delegué » in charge of research and higher education is the woman next to professor Jonathan Makela and Professor Zouhair Benkhaldoun.

The deployement of the RENOIR experiment have been covered by the official Moroccan TV on the news.

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