Past, Present and Future of the Cosmic Rays observatory in Dourbes, Belgium

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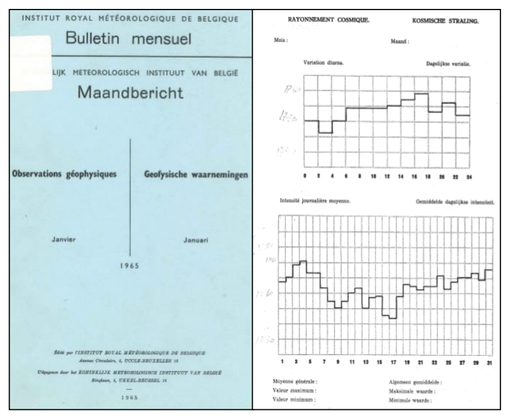
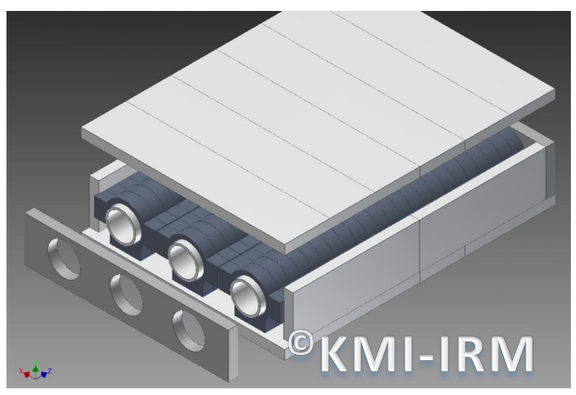
Past 1965 - 2003

1954 Geophysical Center in Dourbes, Belgium is established with the principle objects the measurements of the geomagnetic magnetic field, ionospheric soundings and ***monitoring of the cosmic rays***. The cosmic rays observatory consisted of several instruments: **neutron monitors** and a **muon telescope**. The neutron monitors were initially represented by **9-IGY** BF_3 filled detector tubes placed into a paraffin moderator. This detector put the beginning of the cosmic rays monitoring and operated from 1964 until the end of 1968. The first data were published in the monthly bulletin of the Royal Meteorological Institute in its January 1965 issue. Shortly after, the observatory was upgraded by a standard **9-NM-64** super monitor which is operational until present operational since October 1965 till present. Initially the monitor was recording data at a cadence of 15 min. The data was manually controlled and corrected for the variations of the atmospheric pressure. In September 2003, the data acquisition was upgraded and the data is recorded at a 1 min. rate. This monitor operates until present.

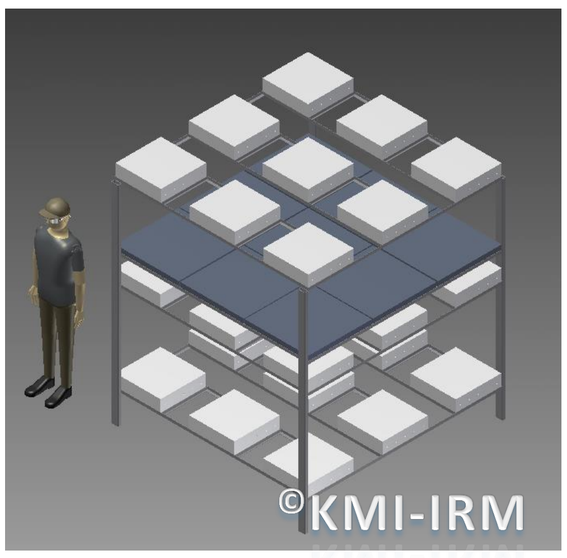
As a complimentary to the neutron monitors, two muon telescopes were constructed. The firs one was a simple vertical cubic telescope with a layer of 10 cm lead absorber. This instrument was soon upgraded to a two directional muon telescope directed to the east and west with zenith angles of 45°. The muon telescope was operational for short intervals during 1968 but did not produce any significant continuous data due to problems with temperature correction and noise and was soon decommissioned.



A section of 3 detector tubes from the 9-NM-64 monitor in Dourbes operational from October 1965.



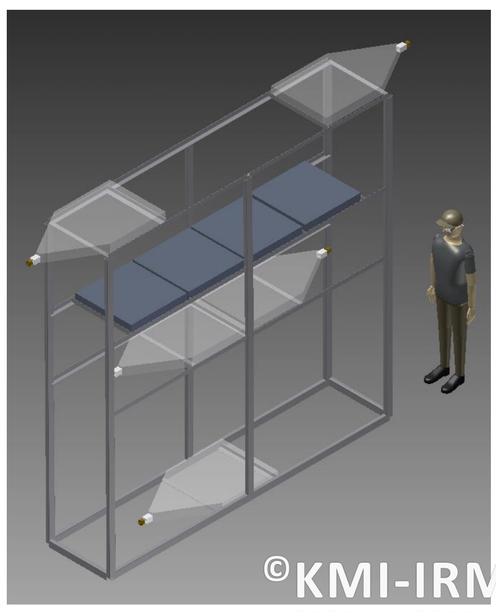
The final design of a section of 3 detector tubes of the second Belgian neutron monitor. It is expected that it will start providing data in 2017 however without the lead-producer.



Present design of a multidirectional high resolution 9x9x9 muon telescope for space weather applications and forecast.*

Present 2003 onwards

In 2012 the Royal Meteorological Institute purchased 9 detector tubes type LND 2061 filled with BF_3 gas. This marked the beginning of the design and construction of a second 9-NM-64m neutron monitor. It is based on a standard super monitor in that it has its standard elements. However, the response of the monitor has been modelled and optimized for the detection of neutrons resulting from the primary proton component of the galactic and solar cosmic rays. Study of the effect of the shape and dimensions of the components of the neutron monitor show that the reflector is of great importance in order to achieve a sufficient counting rate for proton source outside the atmosphere[1]. The neutron monitor was designed according to the obtained results. It will be commissioned in steps with the first section of 3 detector tubes expected to start monitoring in the summer of 2017.



This prototype muon telescope carried out feasibility study for the observation of secondary atmospheric muons. The instrument had two muon telescopes at zenith angles of 45° oriented at the east and west. The studies were carried out for a short periods of time during 1968.*

Future developments

A muon telescope will add another degree of freedom to the characterization of the interplanetary space and significantly improve the ability to provide a valuable space weather service. For these purpose, a multidirectional high sensitivity and high resolution muon telescope is being designed and developed. The initial design has been finalized and currently, the modelling studies are under way to characterize the parameters and the yield of the telescope. The design consists of a three layers 9x9x9 plastic scintillators with a phase shifting fiber optical cables and computerized coincidence and anticoincidence data acquisition electronics. A layer of lead absorber is also foreseen. The final design characterization and financial estimation will be ready by the end of 2017.

Another investment under consideration is the installation of a radio telescope (e.g. the 5.3 m RTP53) for the real time monitoring of the solar radio activity in real time complimentary to the GNSS, Ionosonde, and Cosmic Rays monitoring and measurements.

Principle research objectives:

- Monitoring of the intensity of the GCR and observation of the correlations between the solar activity, geomagnetic conditions and the their application for space weather study and forecast;
- Investigation of the behavior and response of the Neutron Monitor and modelling of its count rate depending on the various geomagnetic and solar parameters and indices in order to determine the power properties of the original events on the sun and in the interplanetary space;
- Qualitative and quantitative classification of precursors of solar events detected by the instruments in the observatory.;

References: 1 *D.Sapundjiev, S.M.Stankov, J.-C. Jodogne, On the optimisation of the construction of a ground-based neutron monitor, ICRC2015,30 Jul - 6 Aug 2015, The Hague.*

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