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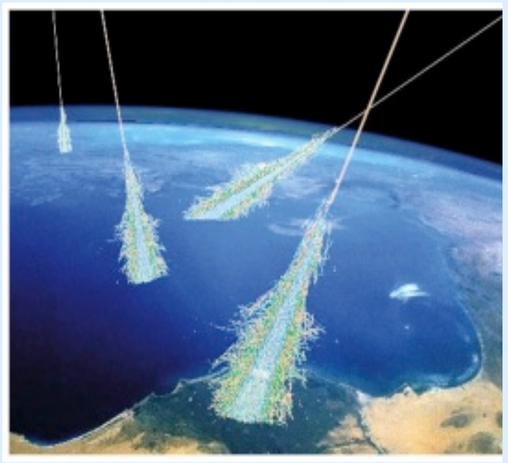
# The HiSPARC UK COSMIC RAY EXPERIMENT

**Cristina Lazzeroni, Maria Pavlidou, Angela Romano, Antonino Sergi**
**University of Birmingham**

## High School Project on Astrophysics Research with Cosmics



International collaboration of high-schools and academic institutions for high energy cosmic ray air shower research & outreach:

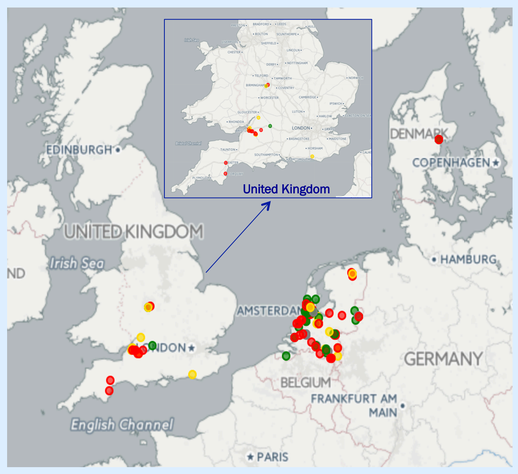
- Network of detectors measuring high energy cosmic ray showers
- Students responsible for detector assembly, installation on the roof of their school, monitoring and data analysis

Initiated and coordinated by Nikhef Amsterdam:

- organization, management, development, data collection and processing

Locations: more than 100 stations in the Netherlands, also stations in Denmark.

**UK grid (started in 2011): Bath, Birmingham(5 stations), Bristol(8 stations), Cardiff, Chippenham, Swindon, Sussex**

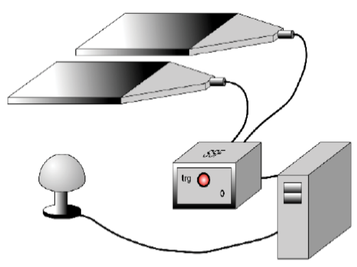


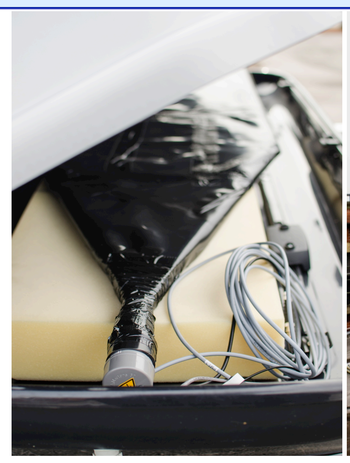

Detectors are reliable, robust and easily maintainable Hardware:

- 2 plastic scintillators
- 2 PMTs (-12 V)
- GPS device and antenna

(timestamps ~5 ns accurate)
HiSPARC III control box:

- USB 2.0
- Each channel @ 400 MHz
- 12 bit ADCs (-2V < Vin< 0V)






Images of the HiSPARC detectors on the Birmingham University roof

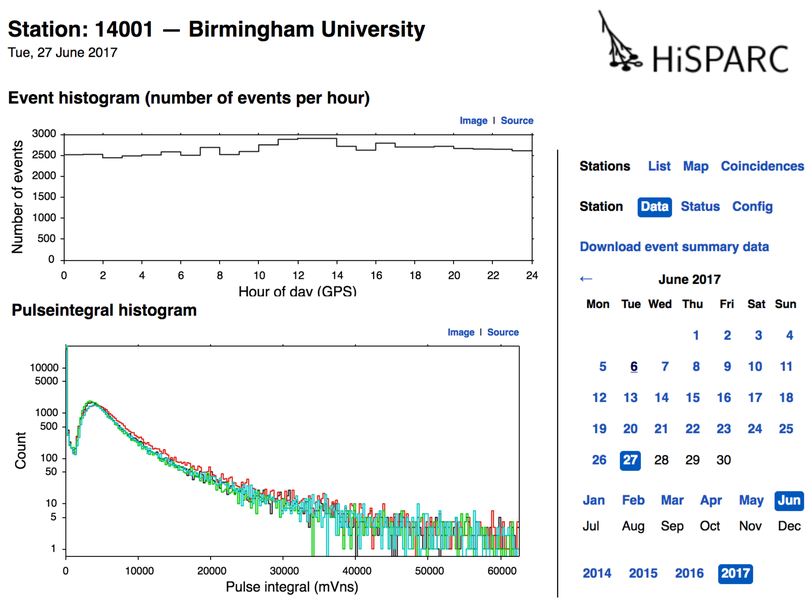
Detectors are positioned inside ski-boxes on the roof of high-school buildings

Typical HiSPARC station with 2 detectors

Option with 4 detectors for the reconstruction of cosmic ray shower direction

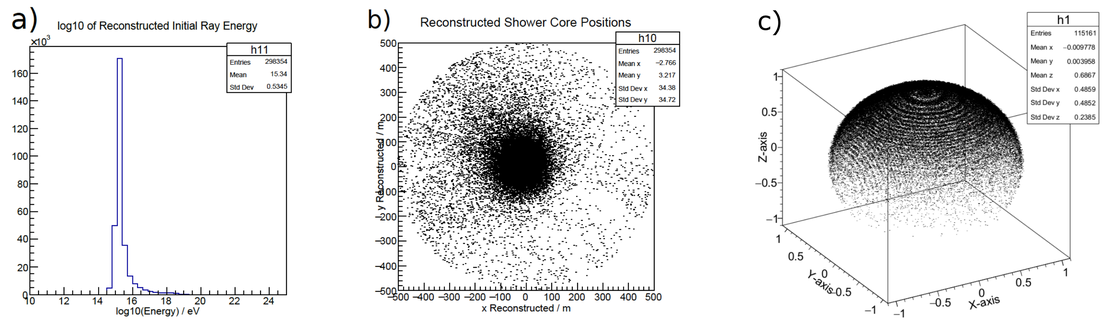
## DAQ, Physics Data and Analysis

Data is read out automatically into the central database
Online histograms, analysis, data available at
http://data.hisparc.nl/




Students research projects:

- Variation with latitude, altitude
- Night/Day, seasonal variation
- Determine effect of atmospheric variables
- Reconstruction of shower core energy a) and position b) (minimum detected shower energy $10^{14}$ eV)
- Extract position c) of primary incident ray using the time differences between the detection of particles in different detectors




Further research: detect large-scale correlated effects, like the Gerasimova-Zatsepin effect, or other unknown phenomena

## Outreach & Student Engagement


High-school students & University of Birmingham staff involved in the assembly of HiSPARC detectors and school exhibit at the Royal Society Summer Science in London, 2015

High school students are:

- engaged in hands-on analysis sessions
- invited to show their research at exhibitions and public events
- awarded for their research projects at annual conferences
- involved in actual scientific research and more interested in pursuing a scientific career


**References:**
[1] HiSPARC home page: http://www.hisparc.nl/
[2] D. Fokkema, “The HiSPARC Experiment”; PhD thesis
[3] M. Stankaityte, Lab Y3 Student Project @ University of Birmingham

Created by Angela Romano (**angela.romano@cern.ch**), Presented by Maria Pavlidou