



University of Birmingham Outreach team



Detecting Cosmic Rays with Quarknet

Typical activity

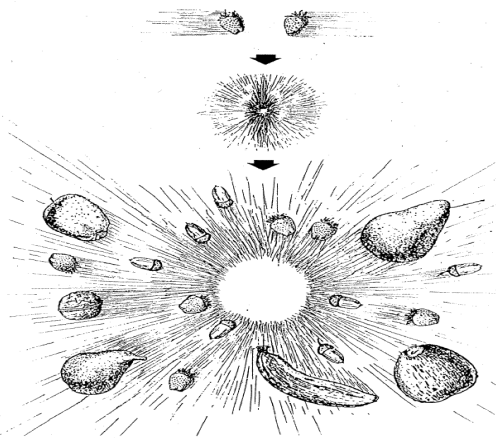
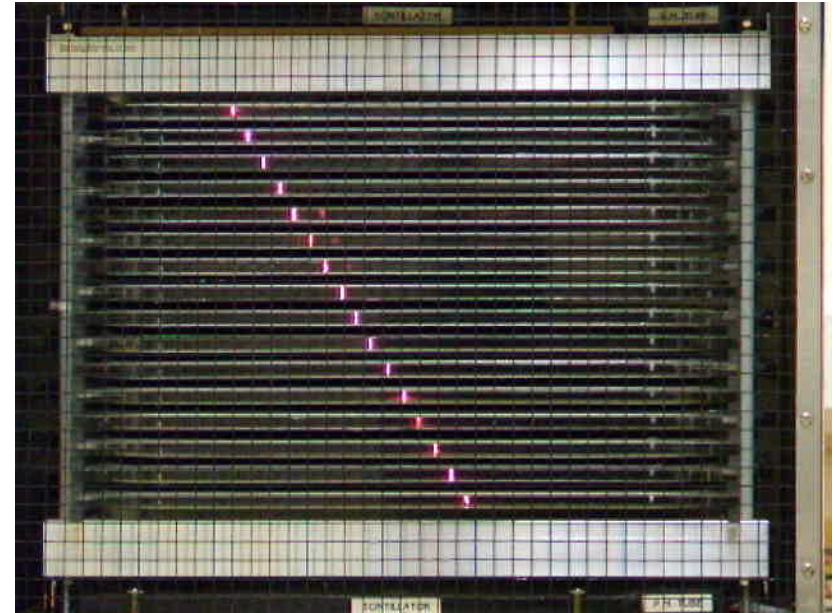
- Illustrate their presence with a spark chamber
- Measure their distribution with a scintillator telescope

Introduction to cosmic rays

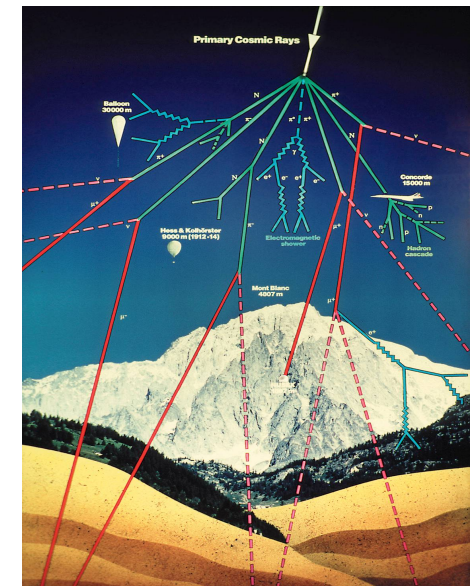
- **Demonstration** with spark chamber, designed and built by undergrads.

- **Description**

$E=mc^2$; Energy \leftrightarrow Matter
New particles are produced



Secondary cosmic rays
at ground level: mainly
muons (i.e. electrons
but 200 times heavier)



What might we measure?

- What is the flux of particles (per s per cm²) raining down on us?
- Does this flux vary with time (day vs night)?
- Does it vary with position:
 - a) locally (inside, outside, upstairs, downstairs)?
 - b) globally (i.e. with altitude, latitude/ longitude)
- Do the cosmic rays occur in showers (i.e. sprays of particles hitting the Earth almost simultaneously from the same source high in the atmosphere)?
- Are the cosmic rays really mainly **muons**?
- How to distinguish from electrons, protons etc?

Local investigations

Investigate by comparing with other sites.

Identify μ by its range; e and p will interact, but differently, in matter

Simple experiments

Exp1: Solid Angle

- Start with counters at fixed separation.
- Measure the flux of cosmic rays
- Change the separation
- Measure the flux again



Exp2: Zenith Angle

- Start at fixed separation.
- Measure the flux.
- Change the angle of the detector to the vertical.
(Keep the separation the same).



Exp3: Variation with height

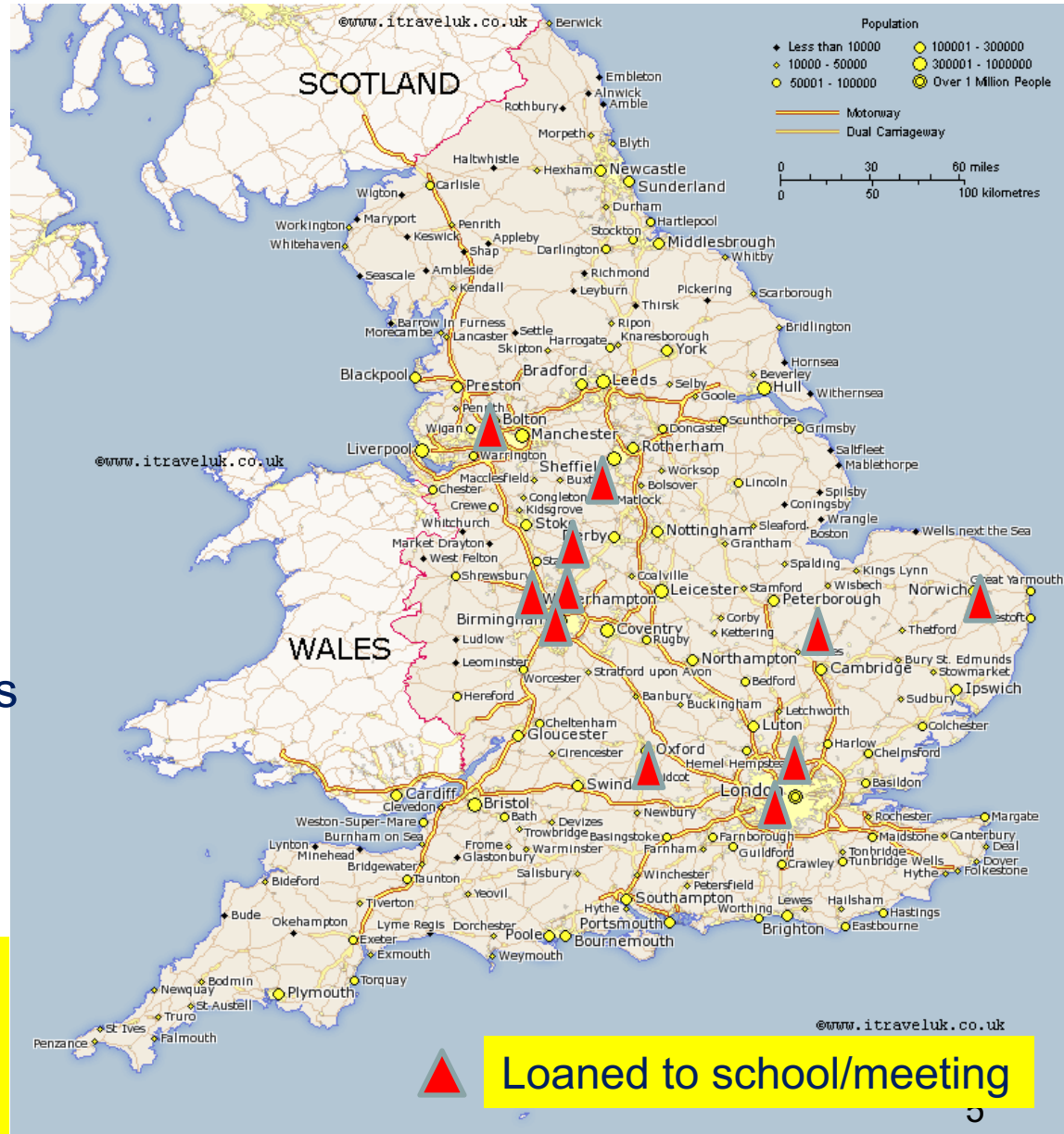
- Start at fixed separation with counters on a trolley.
- Measure the flux.
- Move to trolley from floor to floor.
(Keep the separation unchanged).

Summary of Quarknet telescope activities

- Loaned to schools (weeks - months)
But often difficult to fit projects into standard school day.

- used by groups of school students in University visits. Straightforward to make measurements after a brief introduction.

- demonstrated on Open Days and at public talks/meetings. Audience can easily gain hands-on experience.



Loaned to school/meeting

Quarknet is a very robust, effective means of making useful measurements and doing research.