International Muon Week Muon Speed Study
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Summary of Results

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International Muon Week is an annual event organized by Cosmic Ray Fellows Jeff Rodriguez and Kevin Martz that encourages QuarkNet cosmic ray experimenters to take a break from their normal activities and to focus on a joint project. This year participants measured the average speed of muons. We reached out to our international colleagues and many Italian high schools from the EEE Collaboration joined the project.

Student groups around the world used two types of cosmic ray detectors to detect muons which travel close to the maximum possible speed in the universe. Students measured the average time it takes muons to traverse the distance between detectors. By recording data at more than one separation distance, the speed can be calculated. An international map shows location of the 54 registered participating groups.

Consistent results from groups using QuarkNet scintillation detectors and EEE tracking chambers are presented here separately. The scintillation detectors have 2ns timing resolution and their separation distance determines the track length definition, whereas tracking chambers have better timing resolution of 0.27ns and well-defined tracks. Average muon speed consistent with the speed of light: $2.71+-0.33 \times 10^8$ m/s (QuarkNet); $2.89+-0.08 \times 10^8$ m/s (EEE). Congratulations to our high school experimenters! Now that first results are in, QuarkNet users can take EEE's more precise measurement as a challenge to improve their results with further data taking. Previous QuarkNet student groups have published 1% measurements of the muon speed by increasing detector separation, accumulating more data, adding a third counter to improve track definition, and improving timing resolution. That is one of the fun and challenging components of research. Your friendly colleagues show that there are always ways to improve your experiment. Just ask CMS and ATLAS.

Link to map showing locations of participating groups:

https://www.google.com/maps/d/u/1/edit?mid=1qsWWhh2VBAv9Wuc85GsiwPNM2Y-PPvJU&ll=3.4912465566760886%2C0&z=2