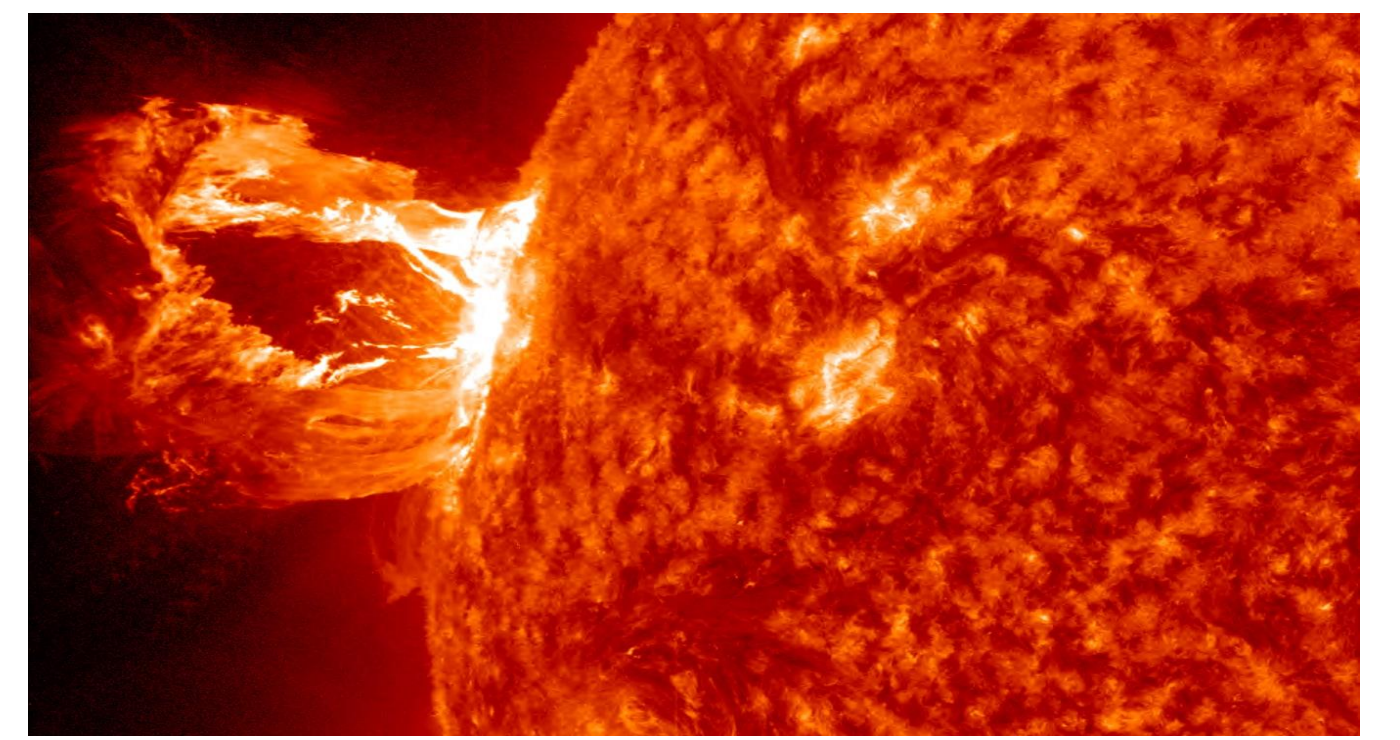


OBSERVATION OF THE FORBUSH DECREASE IN COSMIC RAY FLUX BY TELESCOPES ARRAY OF THE EXTREME ENERGY EVENTS (EEE) PROJECT

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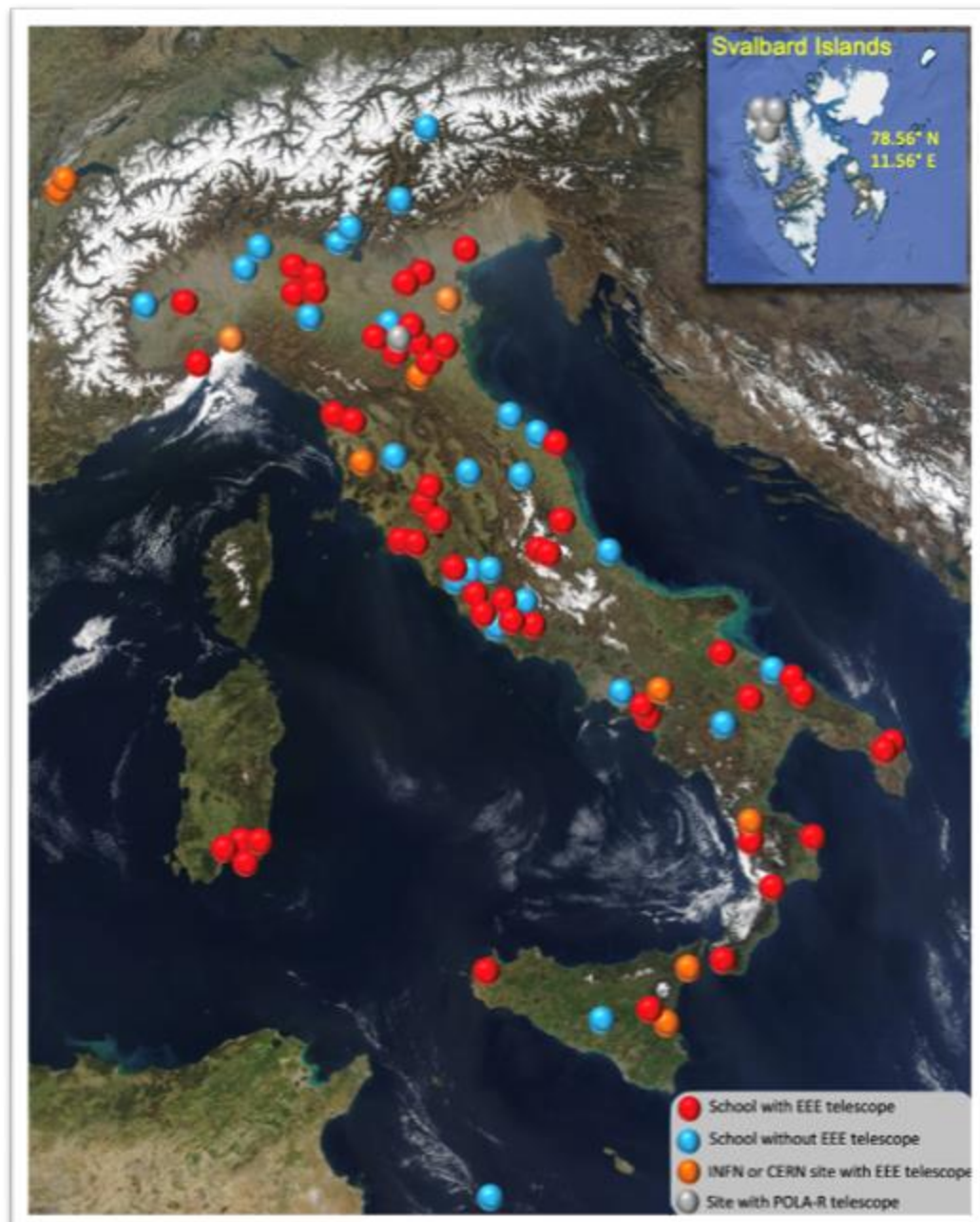
INTRODUCTION

A series of intense solar flares with coronal mass ejections which occurred in May 2024, produced a significant **Forbush decrease** in the cosmic ray flux observed on Earth. The Forbush decrease is typically characterized by a rapid variation in the cosmic ray flux, with an amplitude that, in some cases, can reach up to 10%, depending on the type of particles detected, and a recovery phase, usually lasting several days. The May 2024 event was observed and quantified by the various Multigap Resistive Plate Chambers (MRPC) telescopes of the Extreme Energy Events (EEE) Project as well as by the three EEE scintillator telescopes installed in Svalbard, at a high latitude (79° N).



EEE EXPERIMENT

The Extreme Energy Events (EEE) is large network of muon detector devoted to measurements of the cosmic ray fluxes



The EEE network consists of muon telescopes installed:

- in Italian high schools
- in Italian laboratories
- at CERN
- at Svalbard (North Pole)

All telescopes are GPS synchronised

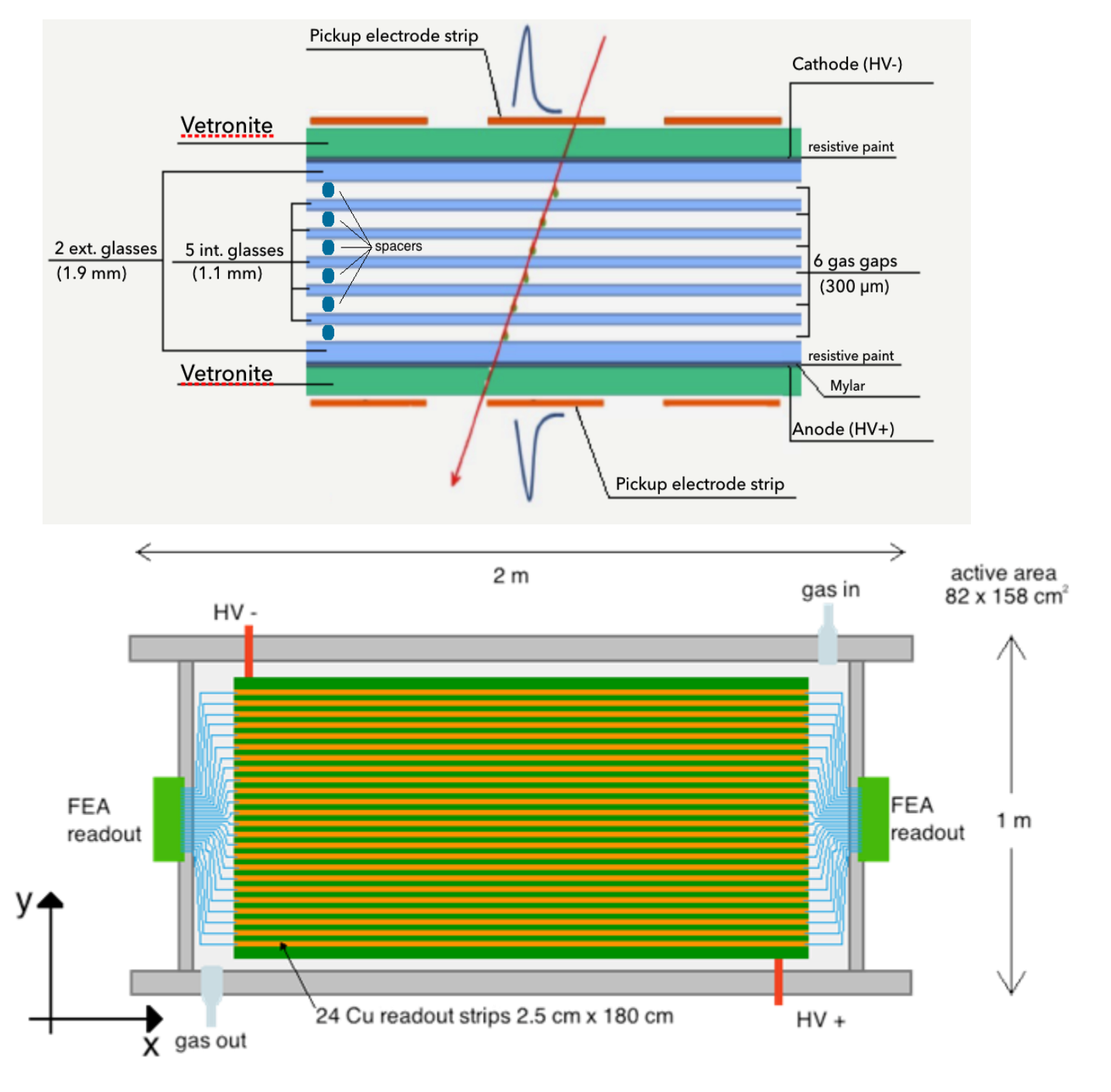
Data collection, quality monitoring and analysis is centrally performed at CNAF

EEE MRPC

Tracking MRPC telescopes composed of 3 chamber (0.82 × 1.58) m²



Each chamber has six 300 μm gas gaps with 24 readout copper strip electrodes (180 cm × 2.5 cm spaced by 7 mm)

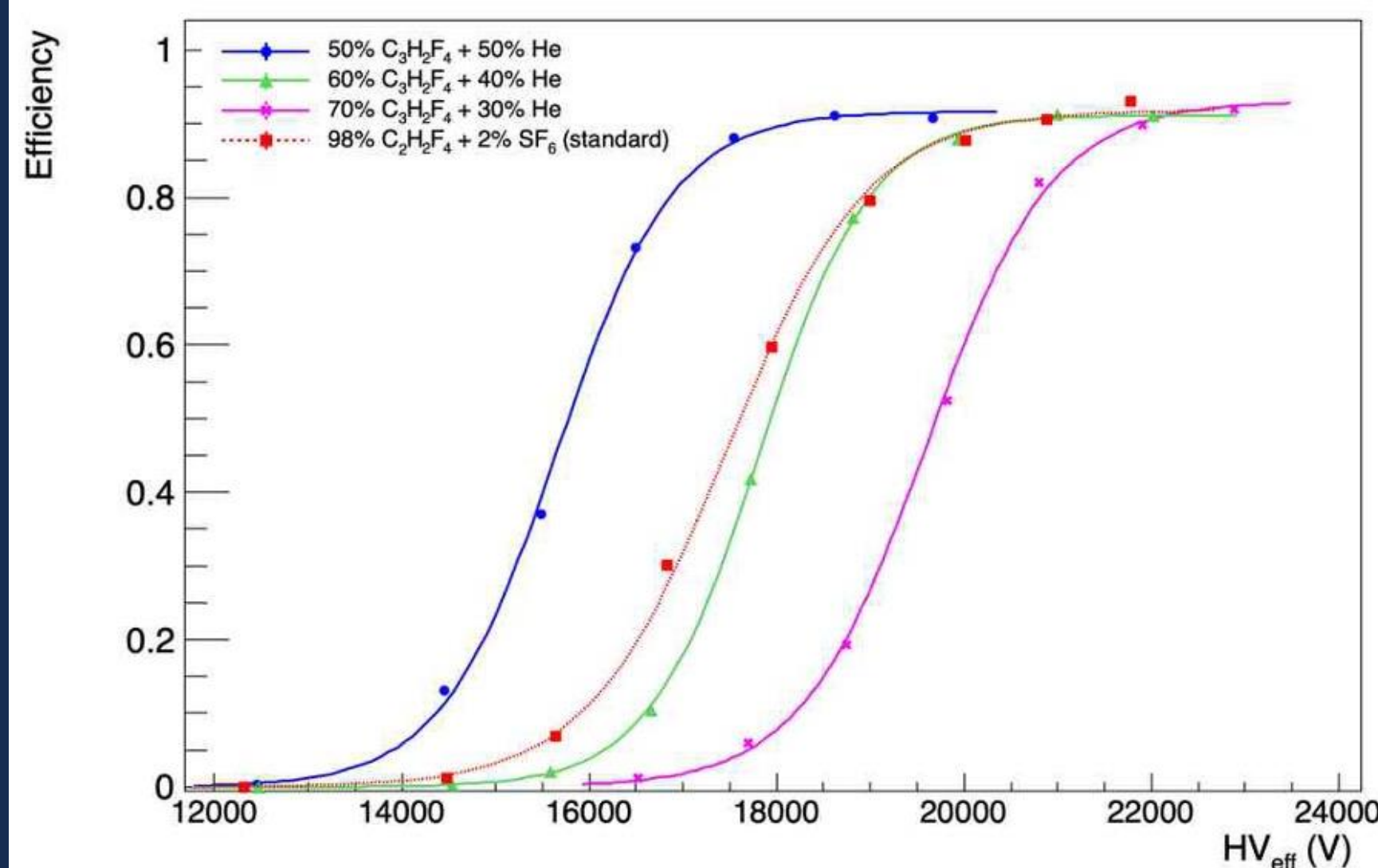


y determined by the strip on which the signal is induced

x determined by measuring the difference between the arrival time of the signal at the two ends of the strip

ECO GAS MIXTURE

Standard mixture adopted in the MRPC EEE telescopes was C₂H₂F₄ (98%) + SF₆ (2%) with GWP of ~ 1880



The chambers are filled with an eco gas mixture C₃H₂F₄ + He with GWP (~6)

The eco-friendly gas mixture provide similar performance at the same operating voltage as the standard mixture and no hardware changes

The EEE array is the first large-scale application with this new eco-gas mixture.

POLA-R

The presence of the POLA-R detectors extend the range of the experiment's telescope network at **extreme latitudes**.



A POLA-R detector is made of two planes (40 × 60) cm² of plastic scintillators coupled SiPM



DETECTORS INVOLVED for the analysis of Forbush decrease

Scintillators

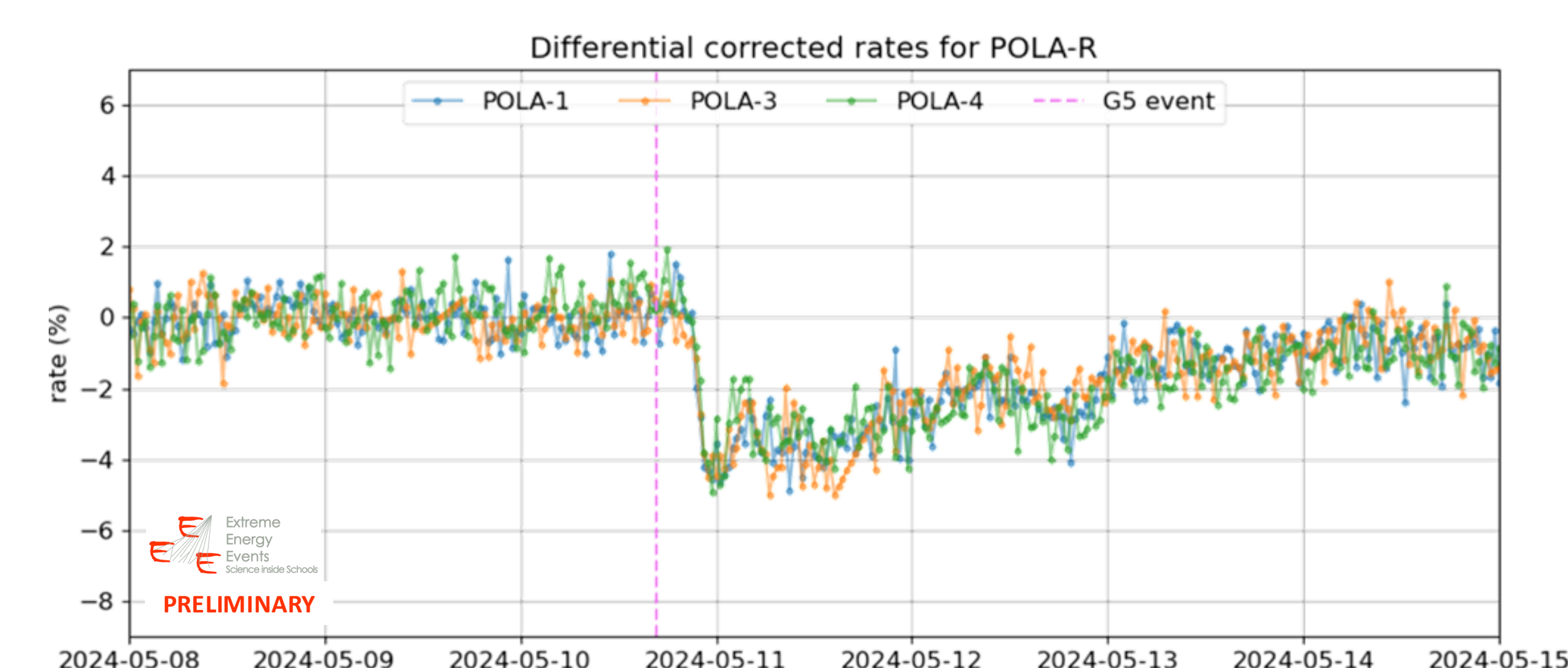
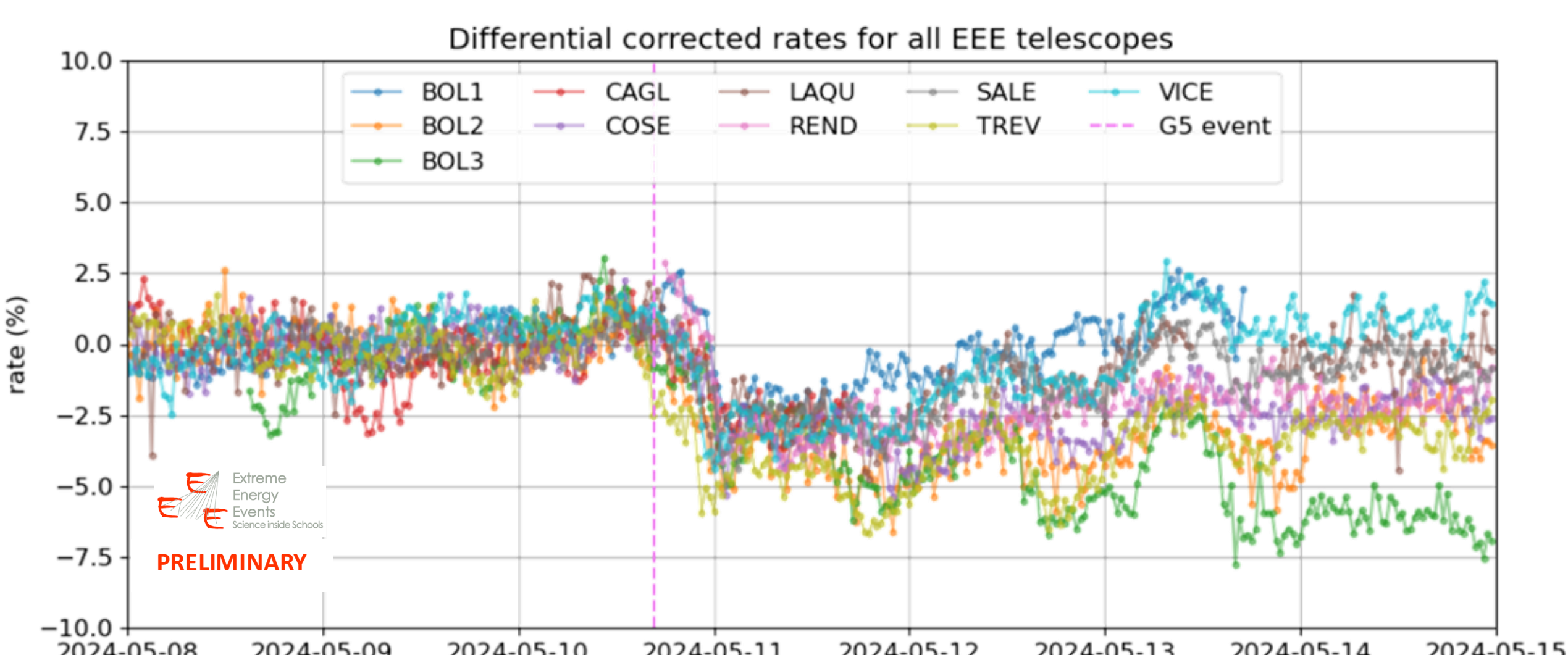
POLA-01
POLA-03
POLA-04

MRPCs

BOLO-01	CAGL-01	REND-01
BOLO-02	COSE-01	SALE-03
BOLO-03	LAQU-01	TREV-01
		VICE-01

FORBUSH EFFECT

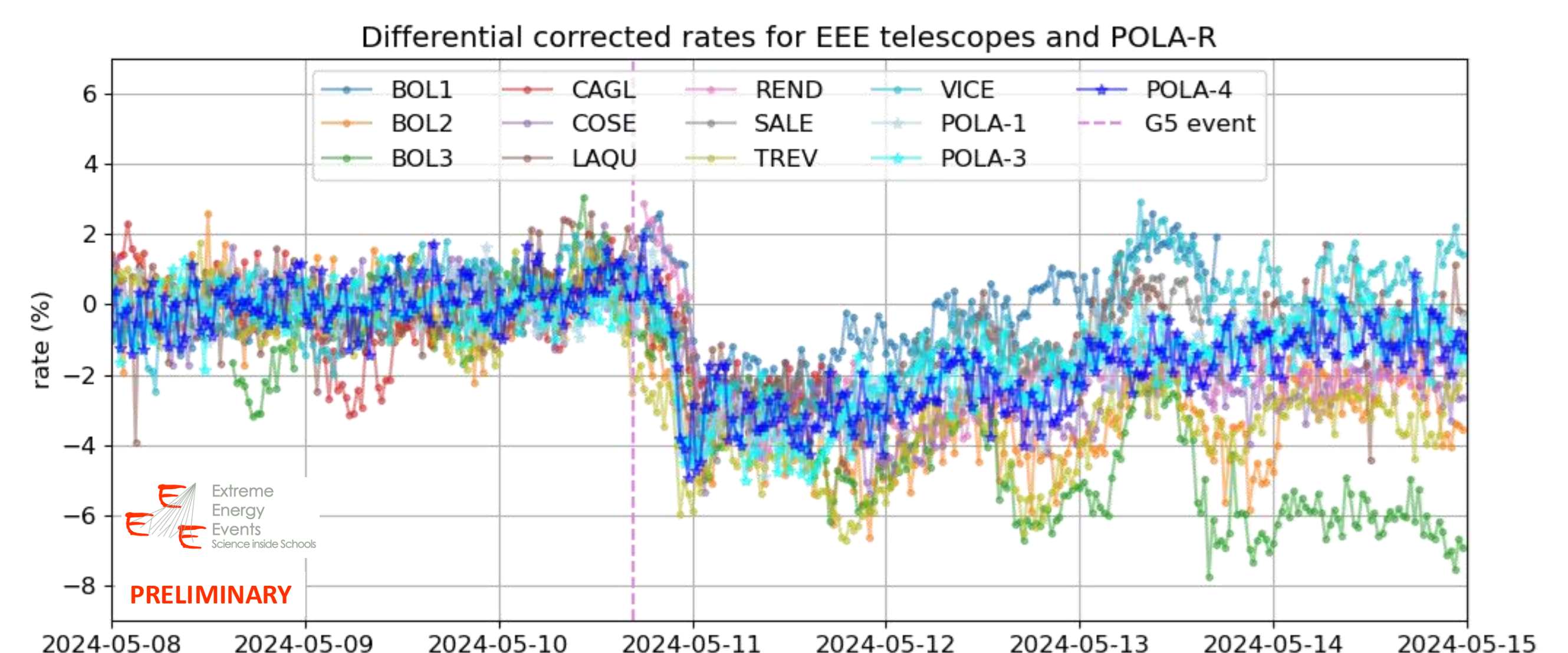
On May 2024 a flux decrease due to the Forbush event was observed at the same time by EEE MRPCs and POLA-R detector



The data collected by POLAR-R detectors show also a great correlation with those measured by neutron detectors located in the same site

Forbush period between May 8, 2024, and May 14, 2024, The peak of the G5 geomagnetic storm was estimated to occur around May 10, 2024, at 16:45 UTC (fuchsia dotted line)

Good agreement!



Barometric correction applied

CONCLUSIONS

- Forbush decrease observed by EEE array covering a large range in latitude and longitude
- These results are the first obtained with EEE MRPC operating with the new eco-gas mixture
- Good uniformity among the EEE sites.



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