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The cross section of the inelastic interaction of  
protons and helium nuclei with the tungsten obtained  
with the PAMELA space experiment



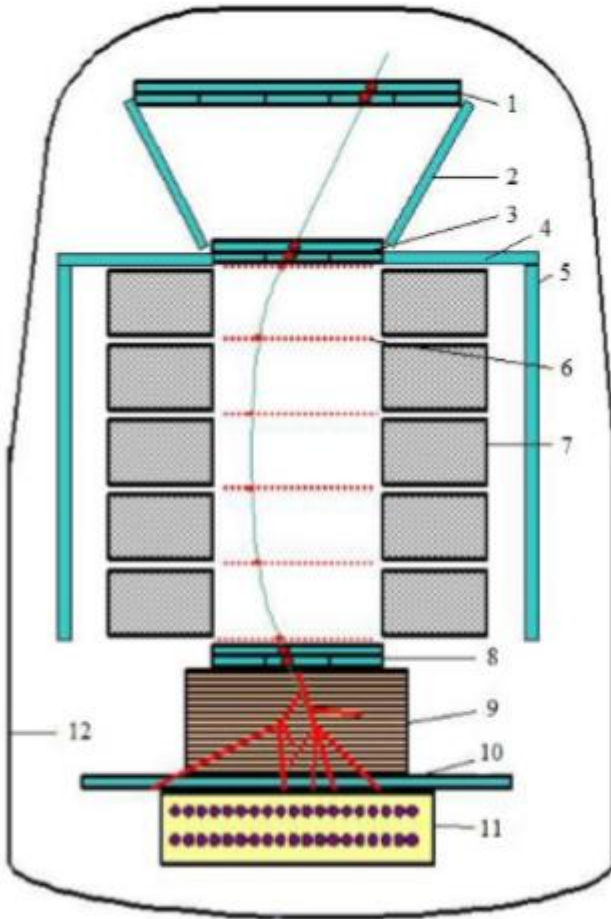
# Introduction

## Objective:

Obtaining the energy dependence of the cross section for the inelastic interaction of protons and helium nuclei with tungsten - 184 using data of the PAMELA experiment.



# PAMELA experiment

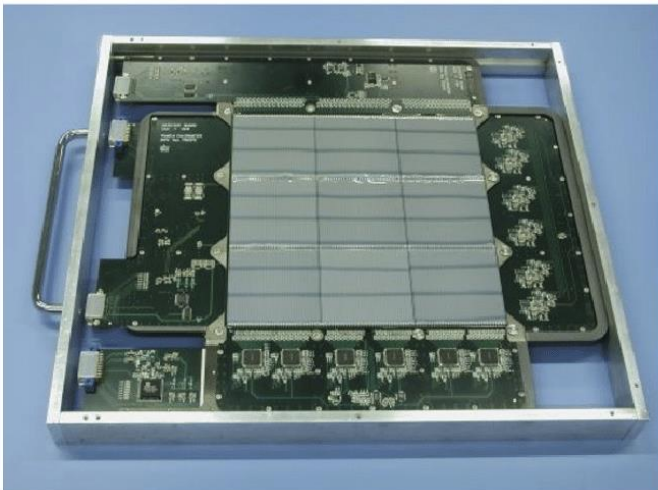


Number	Name
1,3,8	time-of-flight system
2,4,5	anti-coincidence system
6	track system
7	magnet
9	coordinate - sensitive calorimeter
10	scintillation storm detector
11	neutron detector
12	container

The scheme of scientific equipment PAMELA



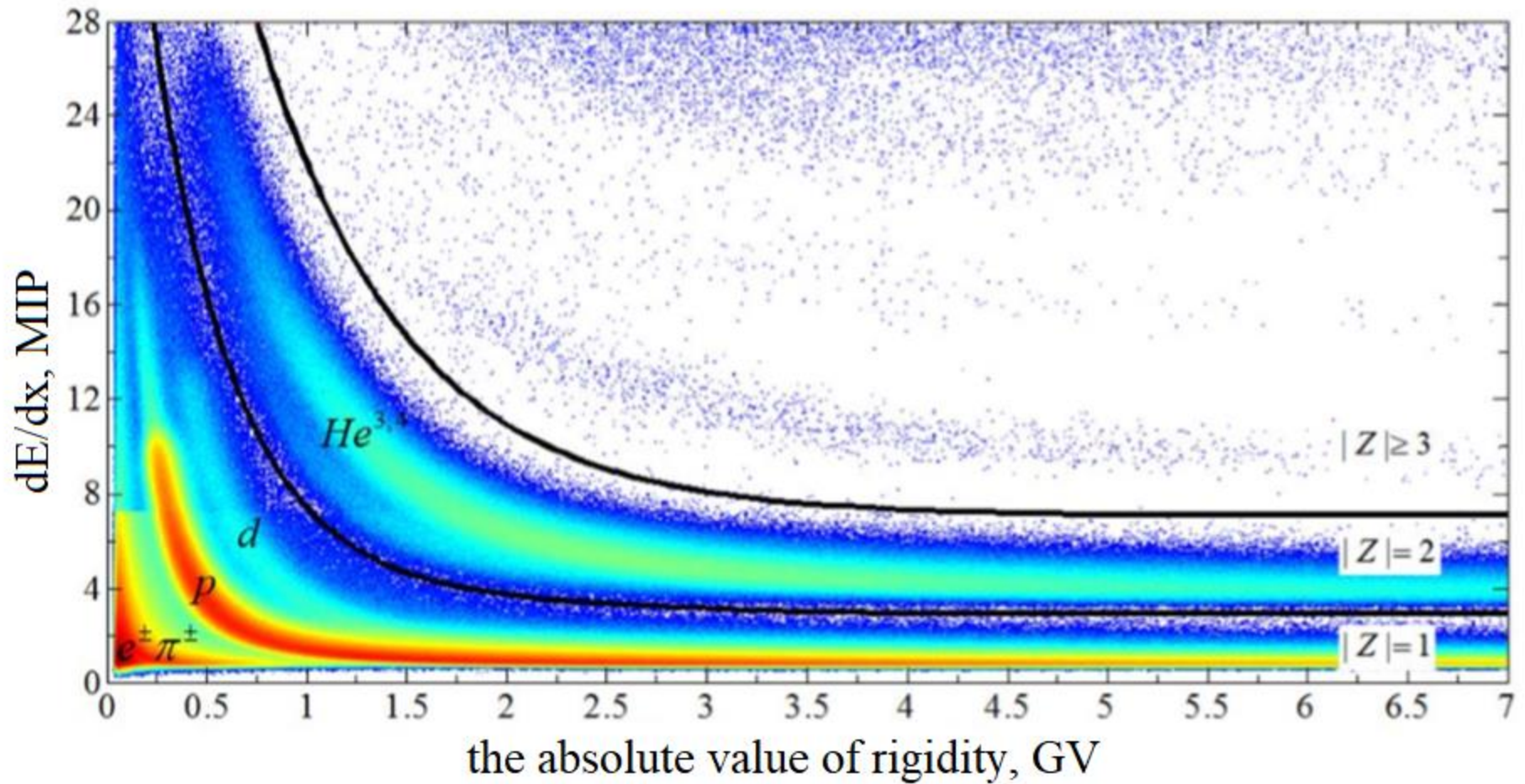
# Calorimeter characteristics



- 44 one-sided silicon position-sensitive planes (thickness 380  $\mu\text{m}$ )
- 22 plates Tungsten absorber (thickness 260  $\mu\text{m}$ )
- Total calorimeter thickness 0.6 nuclear interaction length

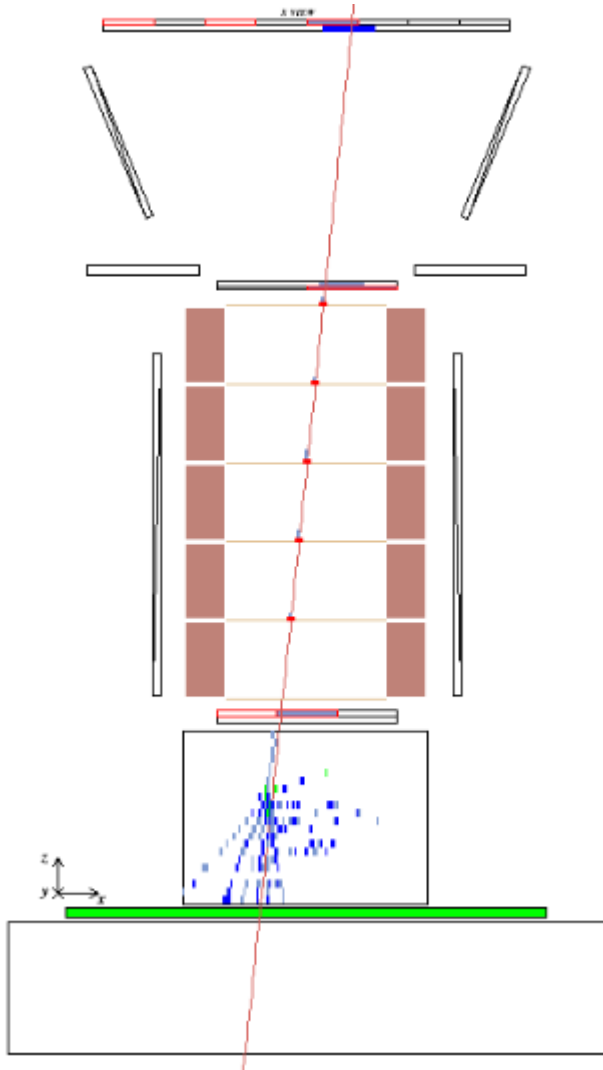


# Determination of the absolute value of charge





# Basic selection criteria

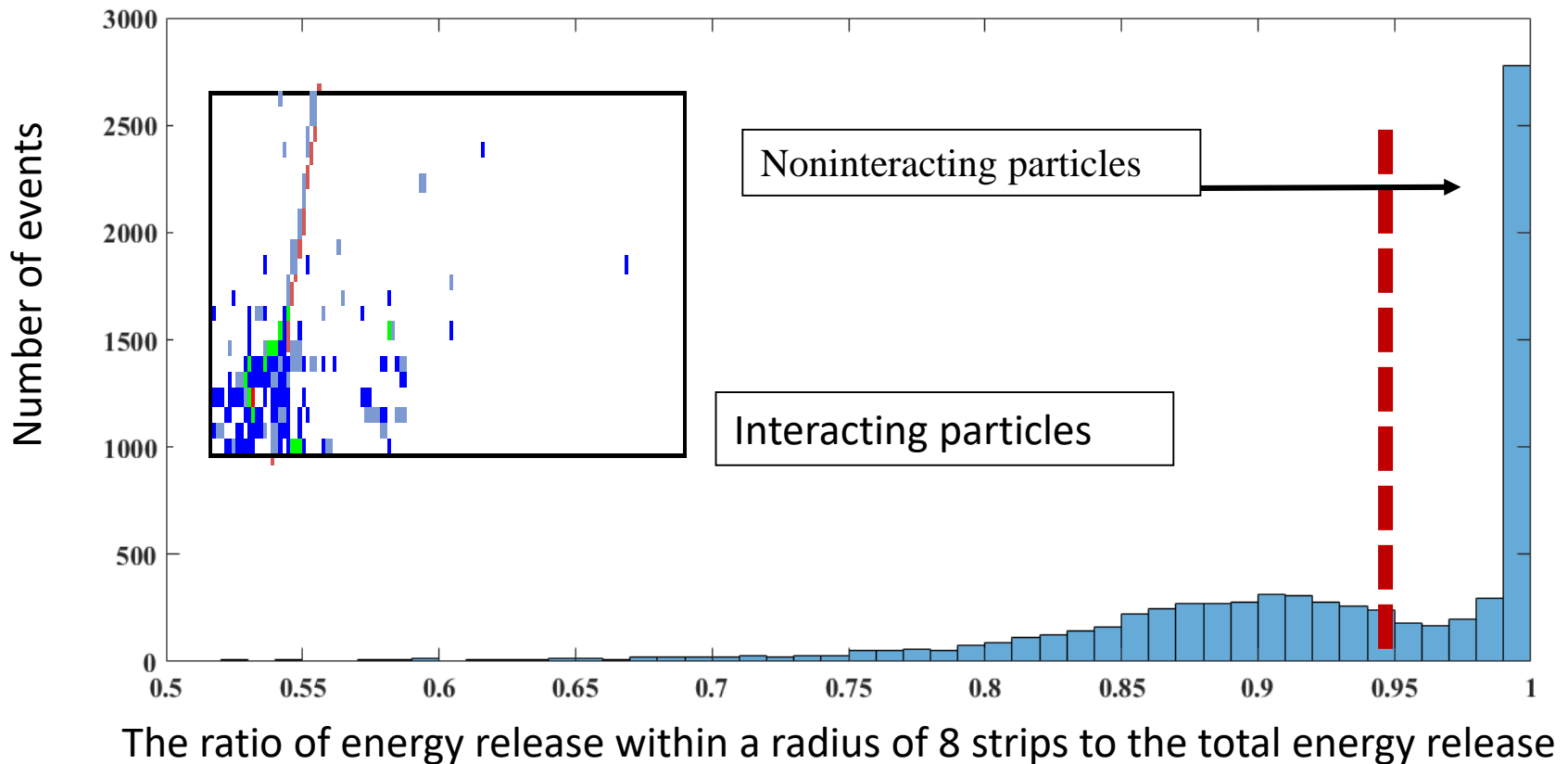


1. In the track system, one track is identified that does not touch the walls of the magnet
2. The trajectory in the tracker is restored using 4 or more points in the deflecting projection X, 3 or more points in the orthogonal projection Y
3. No signals in all counters of the anti-coincidence system
4. In each of the 6 planes of the ToF, no more than the 1 activated scintillation counter



# Additional selection criteria

1. Requirement for a particle to enter a calorimeter
2. The ratio of energy release within a radius of 8 strips to the total energy release is less than 0.95





## Formula for cross section

$$\sigma = \frac{1}{x \cdot n} \ln \frac{N_0}{N}$$

$x = 0.26$  (thickness of one plane)  $\cdot$  22(number of planes) = 5.72 cm

$$n = \frac{\rho \cdot N_a}{A} = \frac{19.25 \cdot 6.022 \cdot 10^{23}}{183.33} = 6.3 \cdot 10^{22} \text{ cm}^{-1}$$

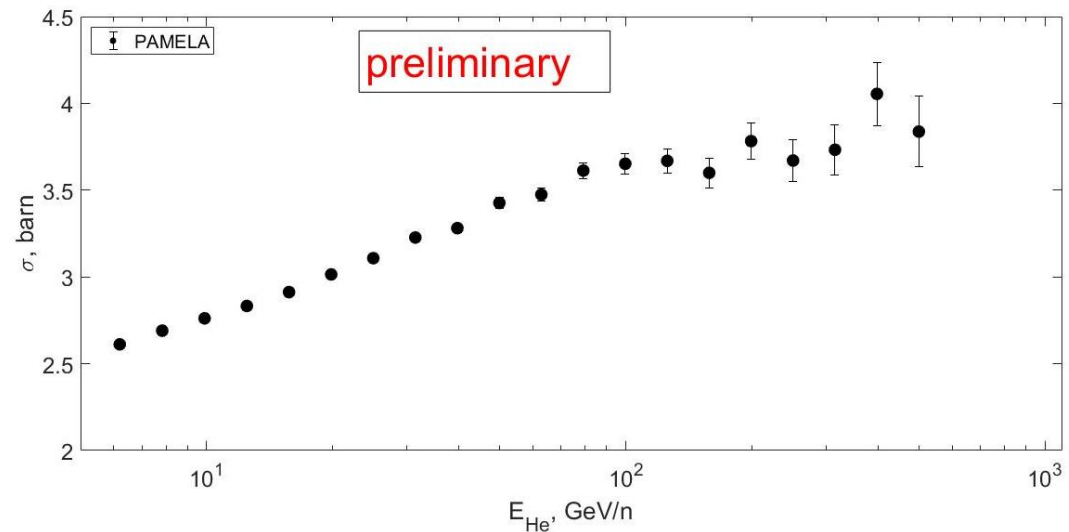
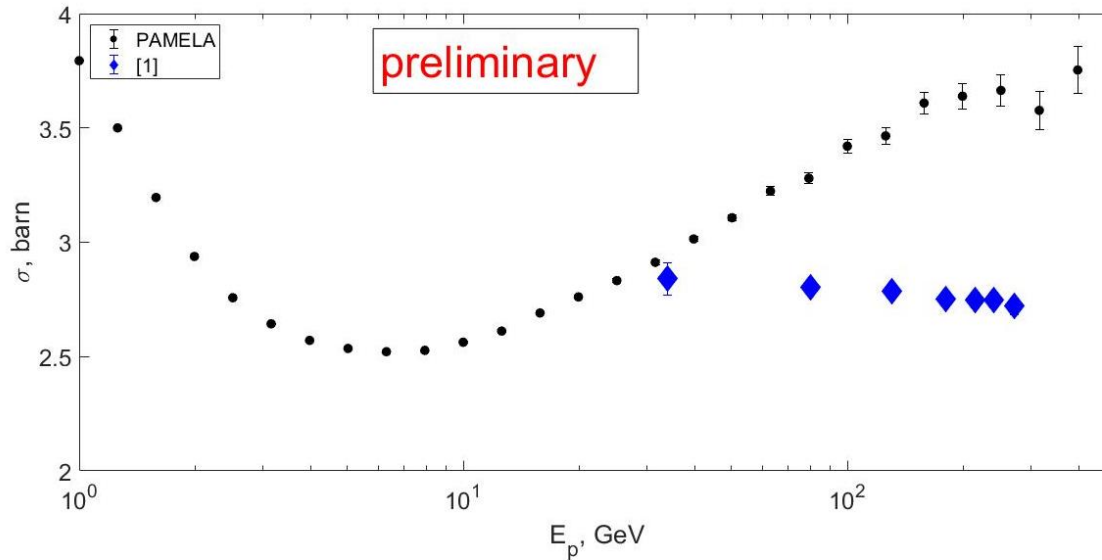
$N_0$  - number of selected events

$N$  - number of selected interacting events





# Energy dependence of the inelastic proton-tungsten and helium-tungsten interaction cross section



[1] P.V.R. Murthy, C.A. Ayre, Neutron total cross sections on nuclei at fermilab energies, 1975



# Conclusion

In this work was developed the selection technique of protons and helium nuclei that are interacted with calorimeter of PAMELA spectrometer.

The obtained technique is applied to the experimental data of the PAMELA spectrometer collected during the period of work from September 29, 2006 to October 18, 2008. Protons and helium nuclei, which interacted with the calorimeter of the PAMELA spectrometer, were selected and the energy dependences of the cross section of their inelastic interaction with tungsten were obtained.

This technique allows to obtain data on the interaction of particles with tungsten in a wide range of energies.

In the future it is planned :

- Improve selection technique
- Consider heavy nuclei