Contribution ID: **275** Type: **Oral talk (15 min + 5 min questions)**

Nuclei Identification by Multiple Energy Losses in Detectors of the PAMELA Spectrometer

Friday, 15 July 2022 10:00 (20 minutes)

PAMELA magnetic spectrometer [1] includes a set of detectors, each of which measures the energy losses of charged particles along its trajectory. In total, it is possible to obtain up to 6 values of energy loss in detectors of the time-of-flight system, up to 12 values in the track system, and up to 43 values in the calorimeter. This information combined with rigidity and velocity measurements can be used for effective identification of particles.
We propose two algorithms for identification of nuclei with atomic numbers 1 − 26 (from protons up to iron): the first algorithm is based on maximum likelihood estimation method, and the second is based on machine learning. For both algorithms we performed Monte Carlo simulation of particles interaction in detectors of PAMELA with Geant4 software [2].
The first algorithm consists of the following steps.
1. Fit the energy loss distributions in simulation for each detector depending on particle type and magnetic rigidity R by a 2-parametric family of distributions $f(x;\mu,\sigma)$.
2. Approximation of the relation between parameters (μ,σ) and particle rigidity by some functions $\hat{\mu}(x)$ and $\hat{\sigma}(x)$. As a result, we obtain a set of functions $\hat{\mu}_{ij}(x)$ and $\hat{\sigma}_{ij}(x)$ for each nucleus number (charge) i and detector number j.
3. After that, we can apply an algorithm to the experimental data. For each nucleus type calculate a likelihood function (where R is magnetic rigidity):
$\mathrm{L}_i(R) = \sum_{j=1} N \ln f(R;\hat{\mu}_{ij}(R),\hat{\sigma}_{ij}(R)) Theresultofanidentificationalgorithmisanucleus \mathrm{n}, whichminimizes \mathrm{L}_i(R)$:
= $\arg\min_i\ L_i(R)$.
$Thesecondmethodisbasedonmachinelearningusingthegradientboostingmethod, whichiscurrentlyoneofthereferencemethods$
$Wepresenttheresultsofeachoftheabovemethodsseparately, aswellasincomparisonwitheachother.$
$1. AdrianiO.etal.AstrophysJ(2014)791:93$
$2. S.Agostinellietal., Nucl.Instrum.Meth.A506, pp.250-303, 2003.$
$3. Friedman, Jerome.(2000).GreedyFunctionApproximation: AGradientBoostingMachine.TheAnnalsofStatistics.29.10.12$

The speaker is a student or young scientist

No

Section

1. Experimental and theoretical studies of nuclear reactions

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