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# A novel method to discriminate Z and kinetic energy of pass-through ions in active silicon telescopes: offline and real-time capabilities for ALTEA detector

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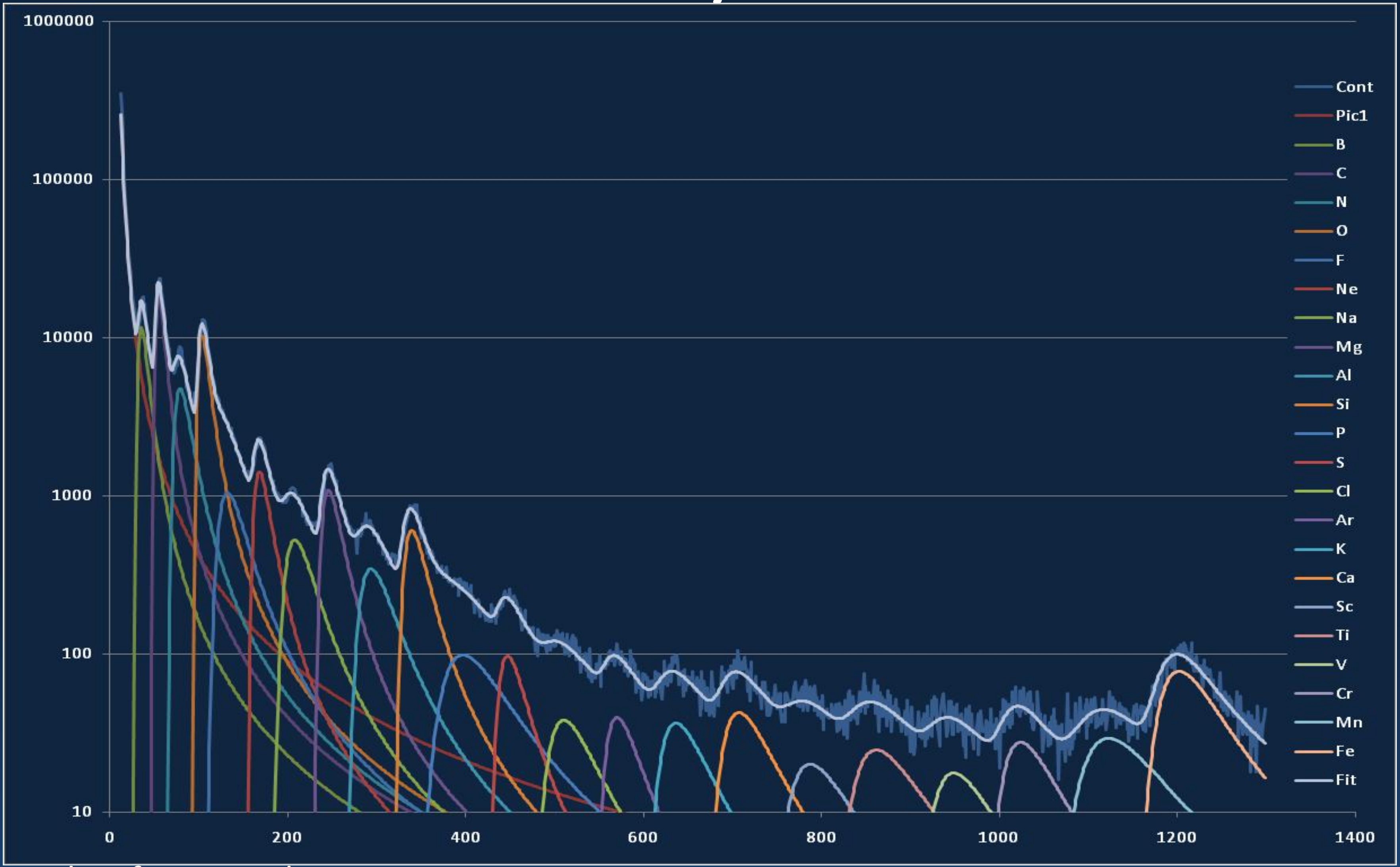
# Summary

- Radiation monitoring with ALTEA
- Current analysis description and its limits
- Novel method description
- Current status and first results
- Conclusions and future work

# Radiation monitoring with ALTEA

- ALTEA particle detectors are able to monitor pass-through particle fluxes and to record the energy loss on the six silicon planes for each single particle
- In order to study the radiation environment we need a detailed description of differential ion fluxes
- We need to identify ion species and estimate kinetic energy

# Current analysis method




- Filter fast particles
- Fit with a sum of Landau functions

-> Get contributions from each Landau curve

# Considerations

Pros

- Works with little statistics
- Few computational resources
- Model independent

Cons

- Only for fast particles
- Discriminates only Z >= 5
- Discriminates only Z, not Kinetic Energy
- Needs previous measurements
- Assumes constant spectrum shape

# Can we do better than this?

Goals:

- Ion recognition
- Kinetic energy identification
- Execution speed (for real time use)
- Identification confidence

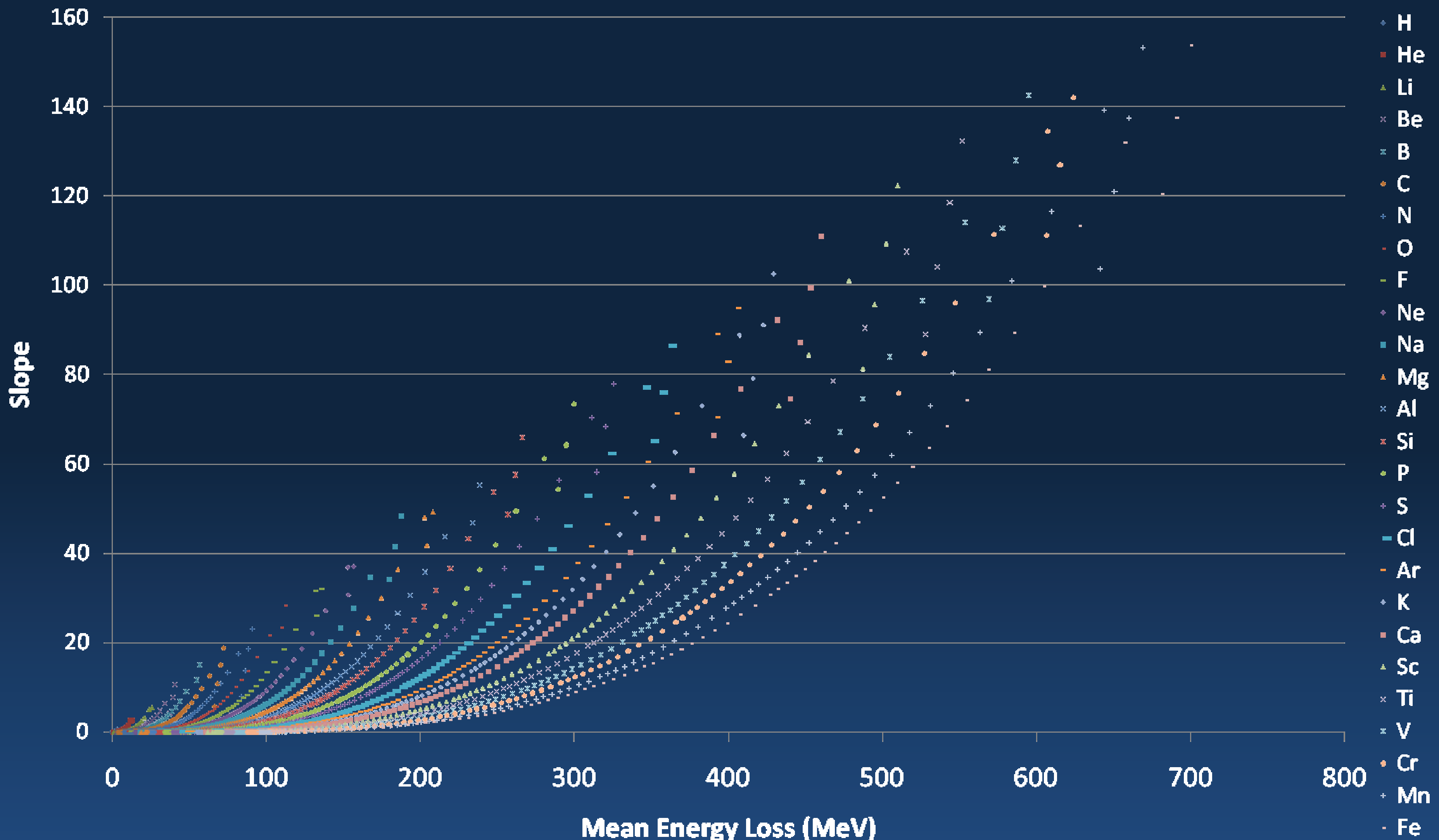
Major problems to face up:

- Pass-through particles (unknown kinetic energy)
- Undetermined flight direction
- Few detector planes (6 planes)
- Thin detector planes (380 μm)
- Electronic noise
- Energy loss fluctuations

# Novel recognition method

- New algorithm based on best match between the input and a matrix of energy losses by different ions with different kinetic energies obtained with a MC simulation (PHITS).
- Simulation properties:
  - Ions from H to Fe
  - Kinetic energies from bragg energies (>25 MeV/n) up to 2 GeV/n
  - Kinetic energy steps chosen to produce equally spaced mean energy losses.
- First approximation of best match: simple algorithms using different combinations of three measured parameters:
  - Mean energy loss
  - Energy loss on each one of the six planes
  - Slope of the energy loss through all planes

# Slope vs Energy Loss (20-2000 MeV/n)



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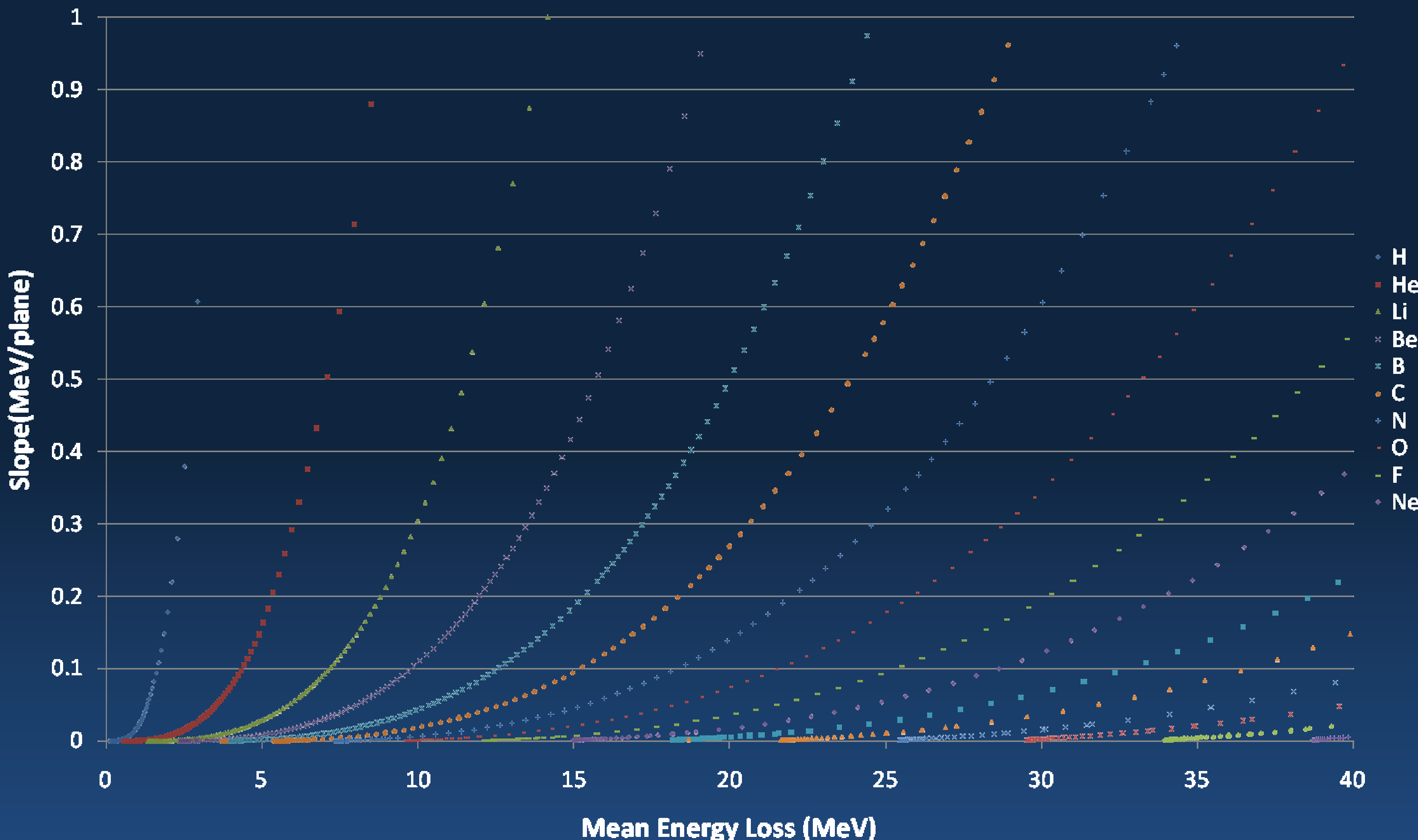
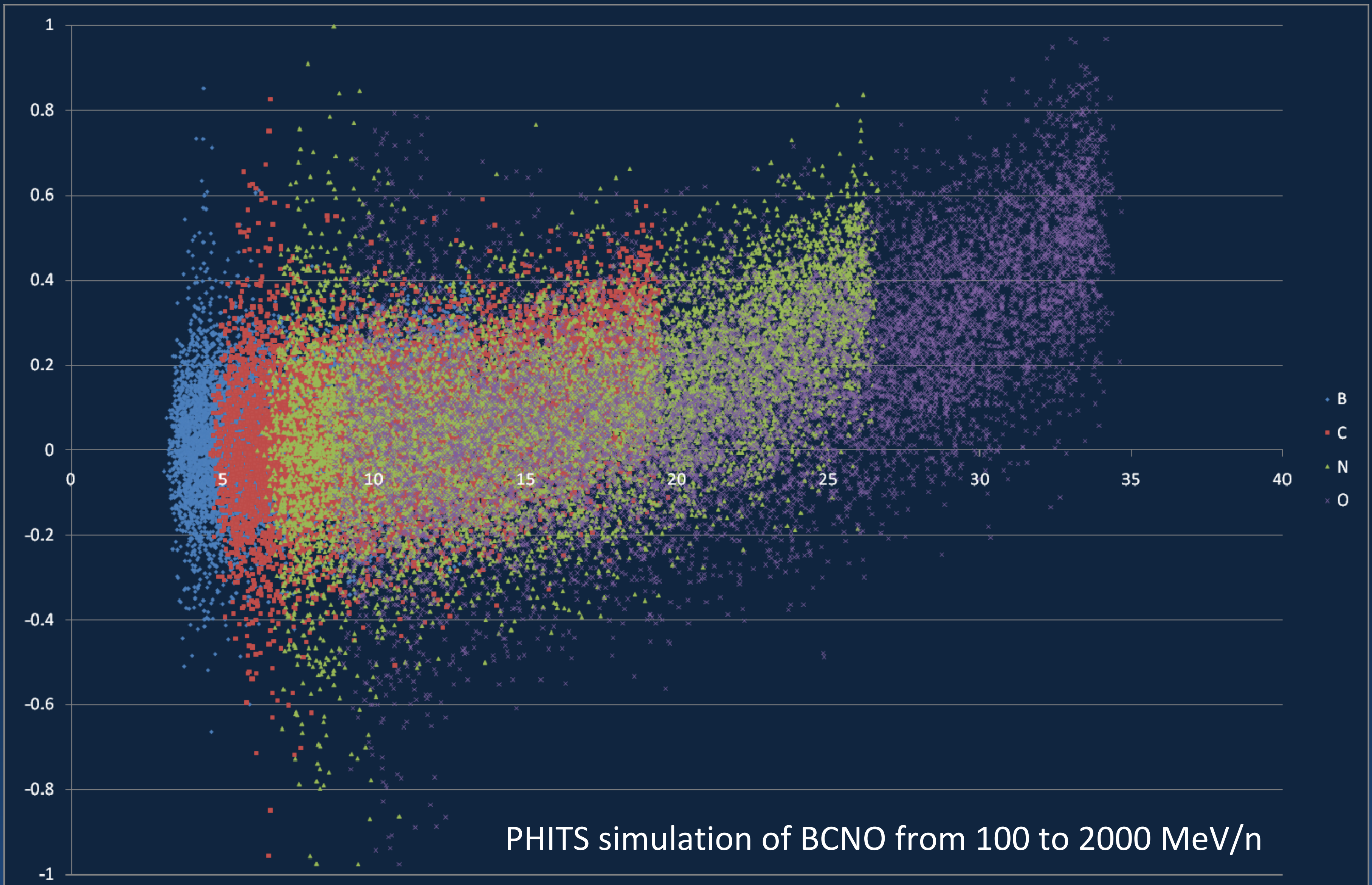
# Slope vs Energy Loss



# Slope vs Energy Loss (with straggling)



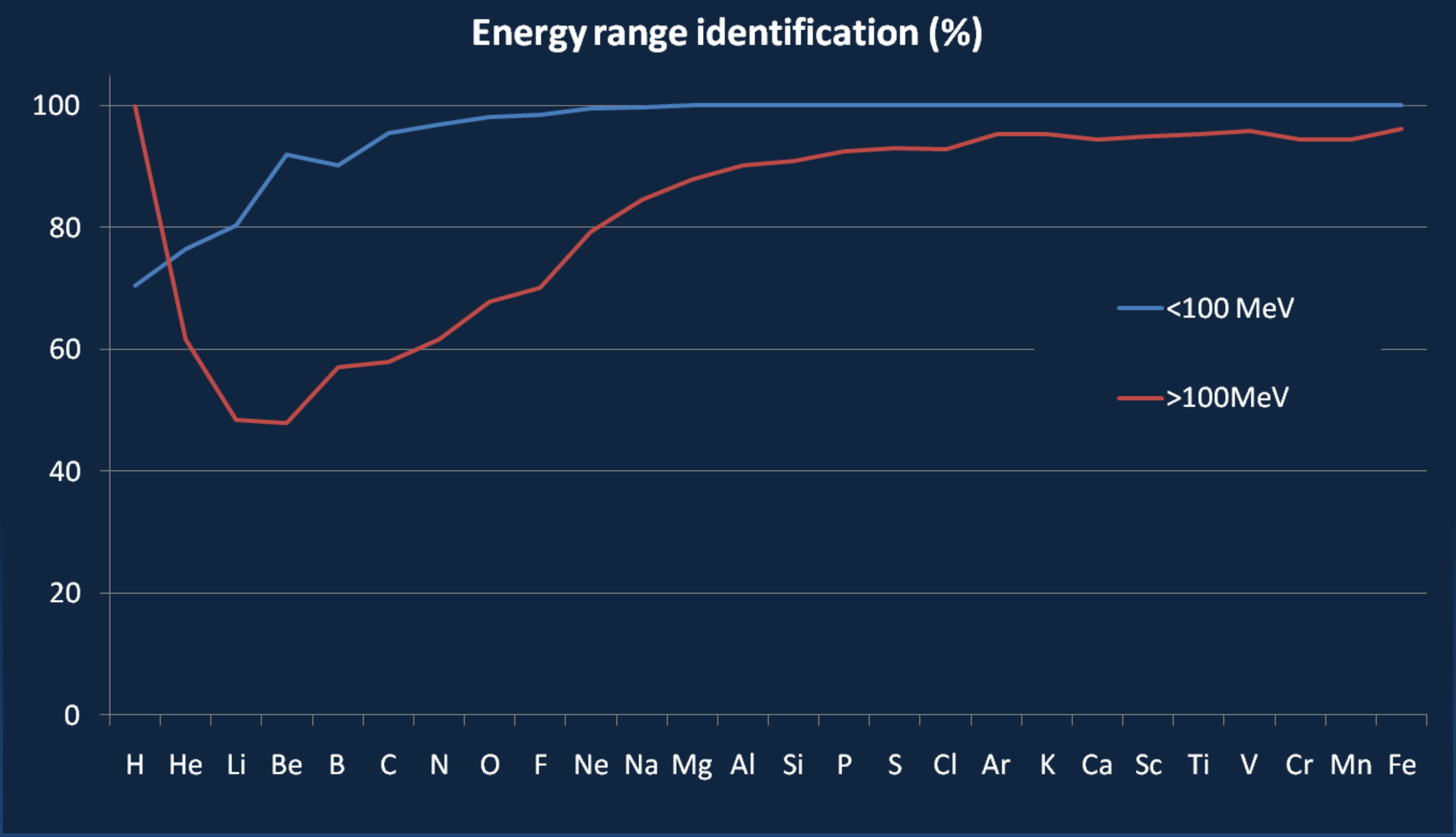
# Building the matrix

- Select a series of kinetic energies in order to obtain constant energy loss gap
- Calculate energy loss and associated $\sigma$ for each plane
- Apply fluctuations to each plane according to the distribution with the $\sigma$ value previously found
- Calculate resulting mean energy loss and slope with associated errors (taking into account the uncertainty of particle versus).

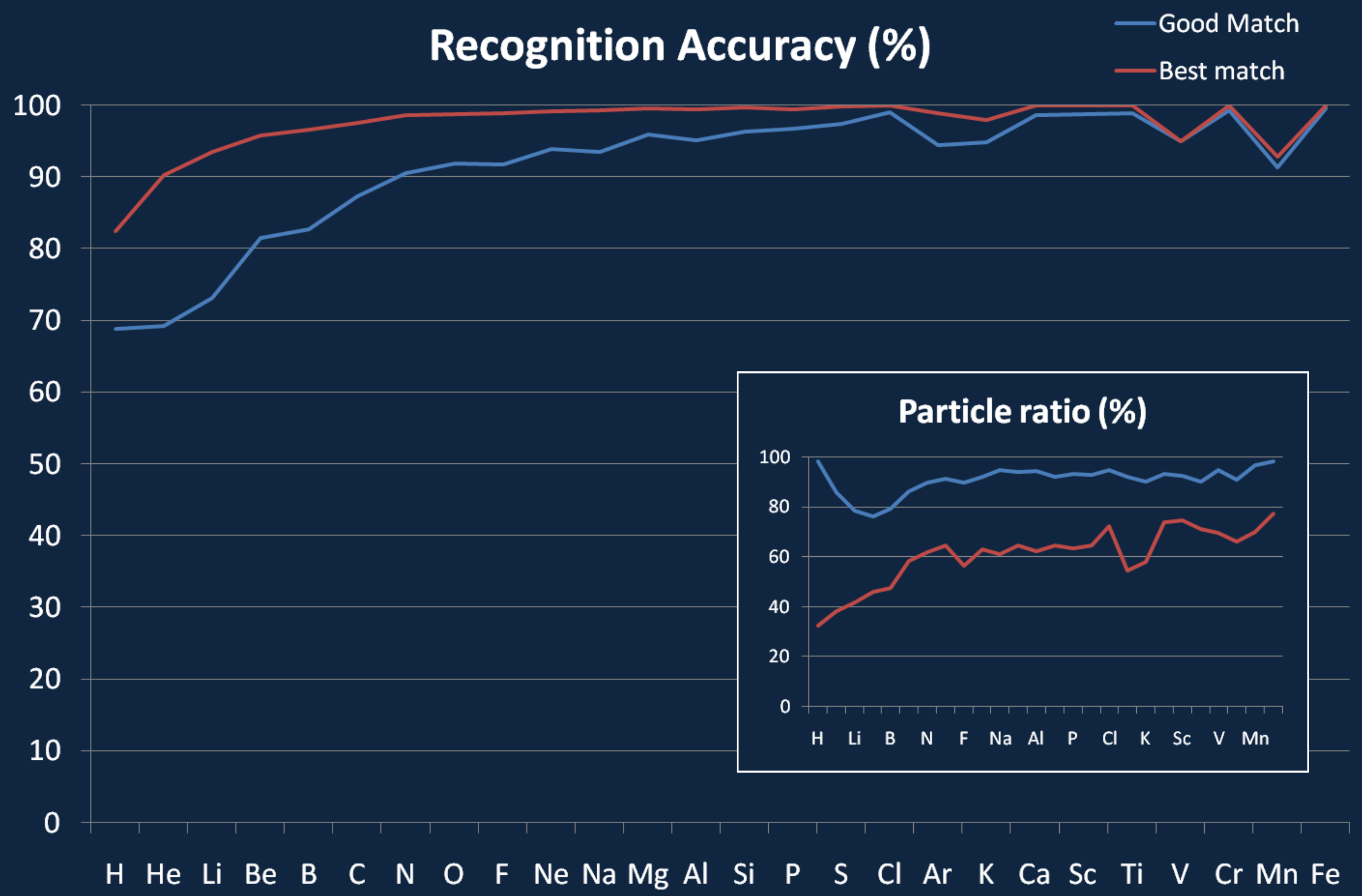
# Choosing the best candidate

- Look for the best match according to:
  - Mean energy loss
  - Energy loss on each one of the six planes
  - Slope of the energy loss
- Selection of the candidates which Z and kinetic energy are compatible within the errors
- Choice of the candidate that minimize the difference of above parameters with the input
- Each identified particle is given a score according to identification confidence

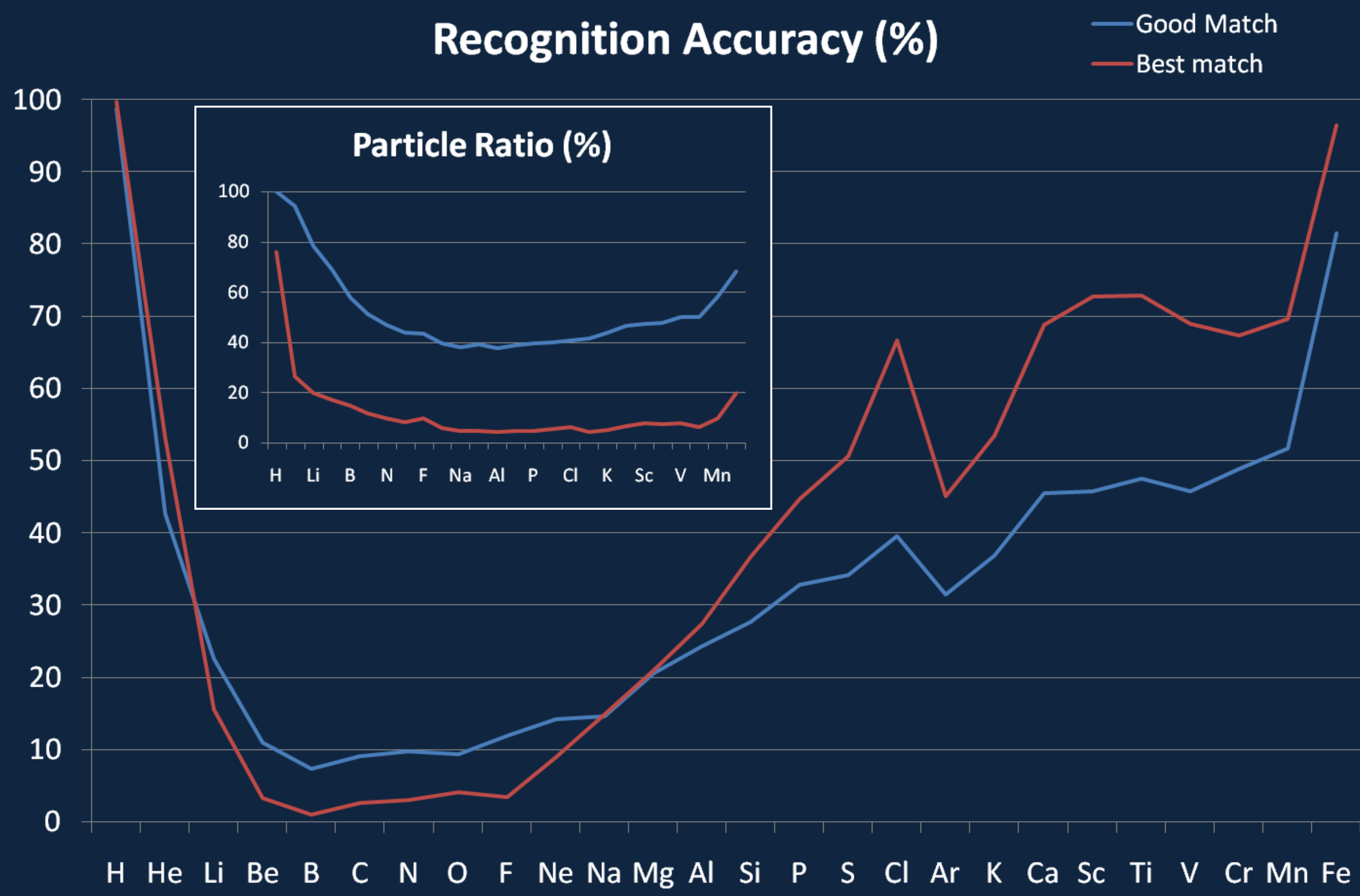
# Energy range identification



# Ion Recognition (K < 100 MeV)



# Ion "Recognition" (K > 100 MeV)



# Conclusions and future work

- Good identification of kinetic energy range
- Good recognition of slow particles
- Fast implementation: 0.3 ms/particle using a 4000-line matrix

- Study of fluctuations effects on mean values
- Improving recognition of fast particles
- Improving confidence ranking
- Test on beam data and flight data

# Thank you
# for your attention!