

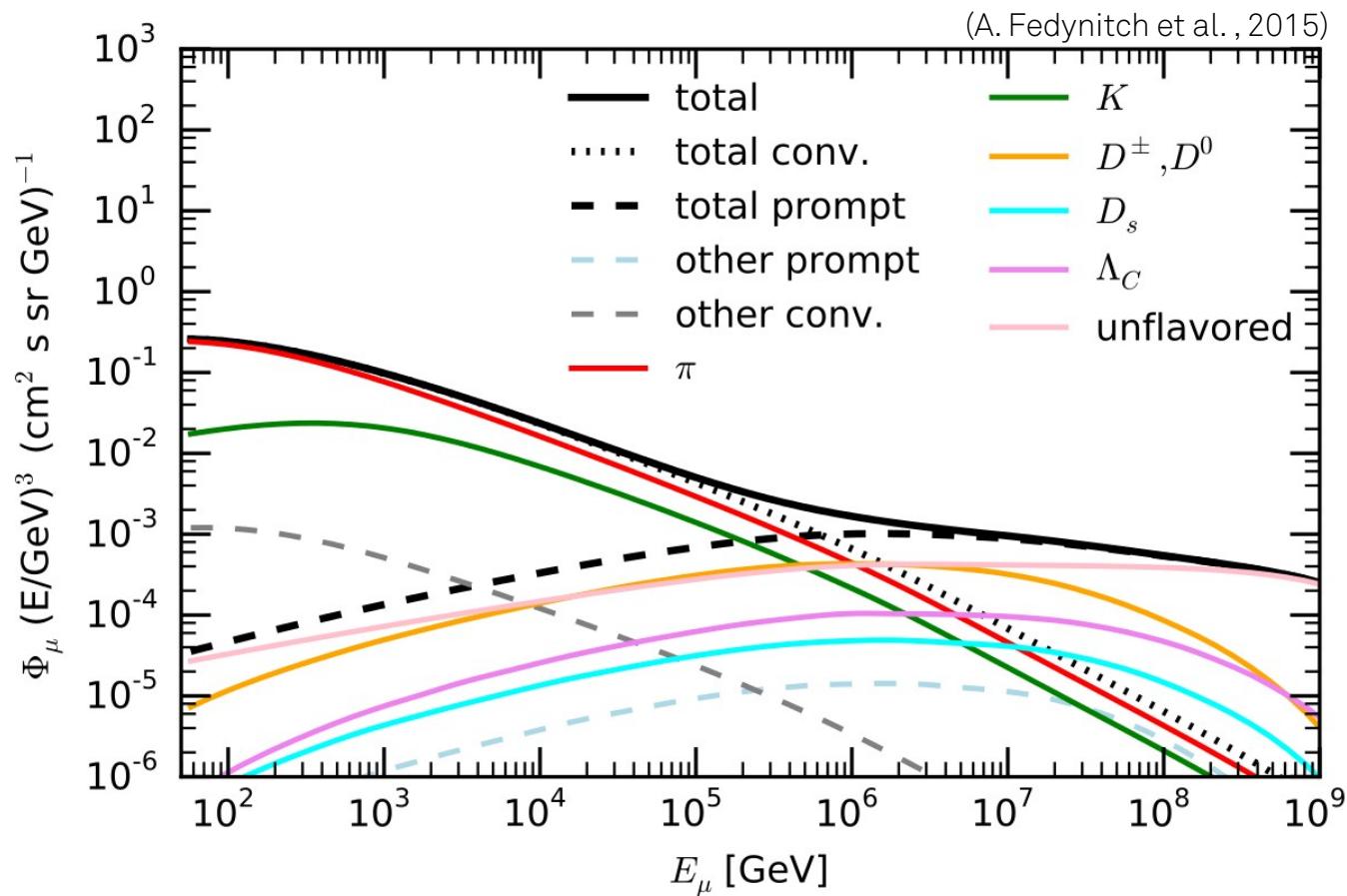


Development of a Machine Learning Based Analysis Chain for the Measurement of Atmospheric Muon Spectra with IceCube

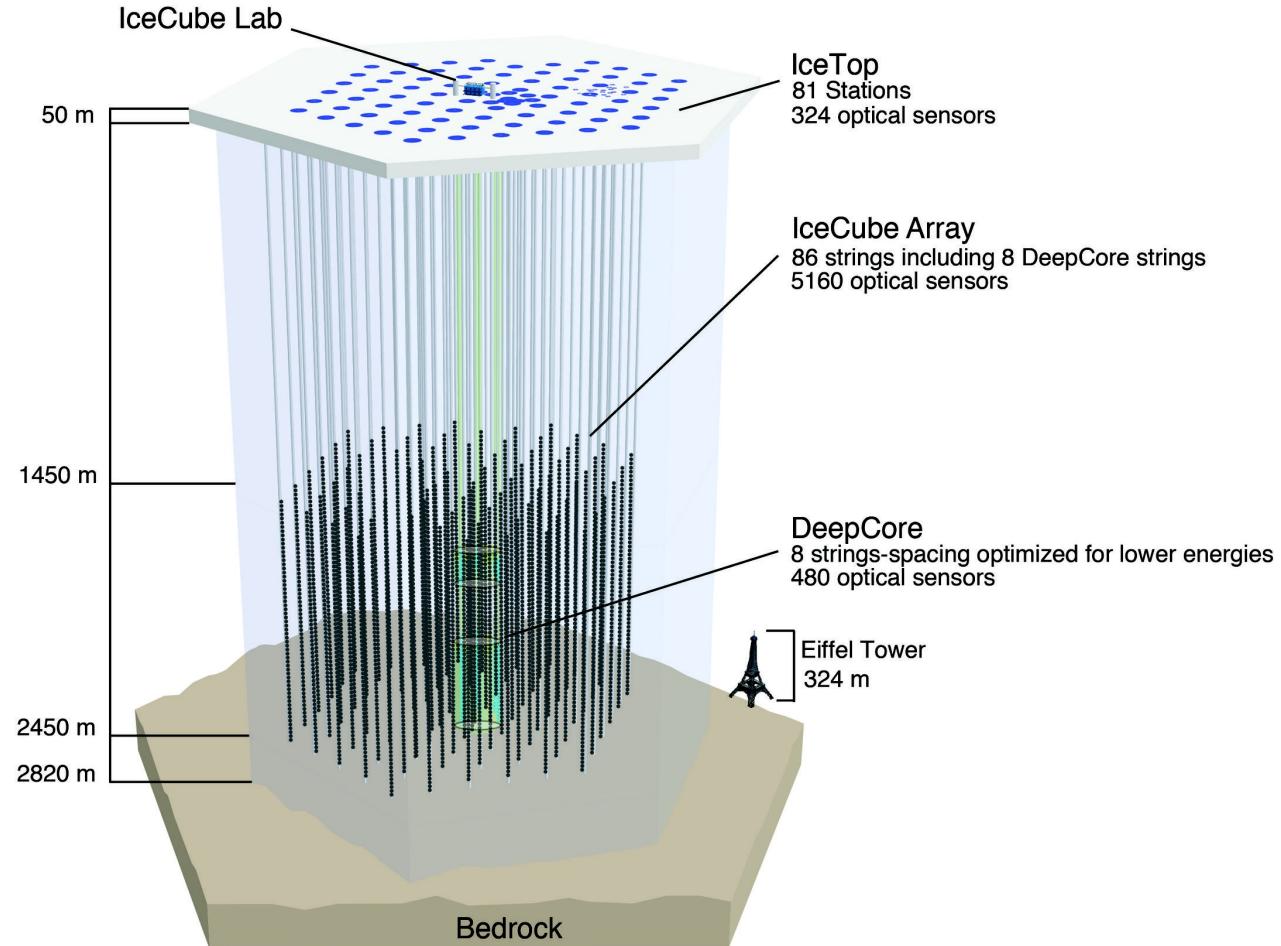
Tomasz Fuchs
for the IceCube Collaboration

European Cosmic Ray Symposium 2016
07. September 2016

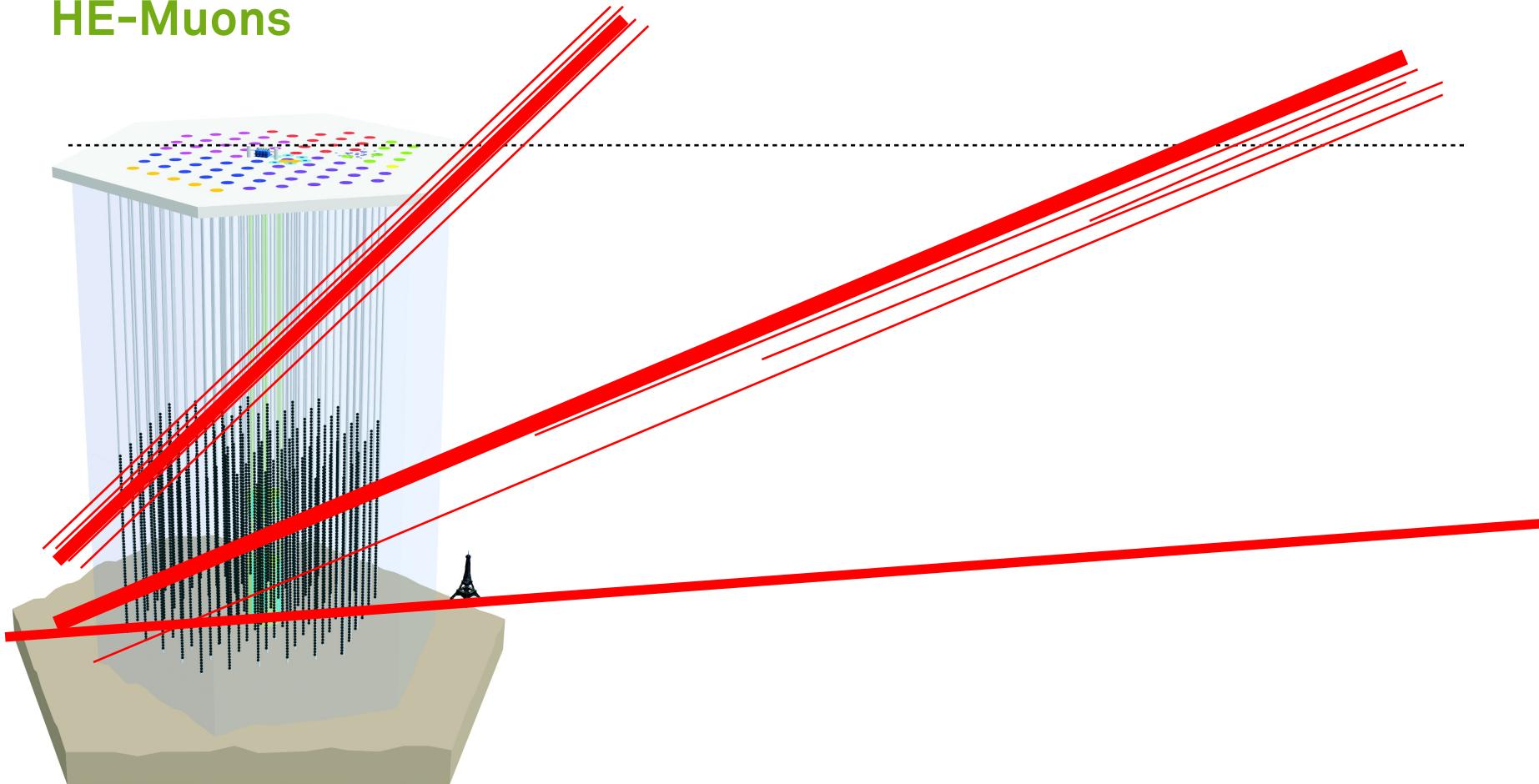
Muon Spectrum



IceCube

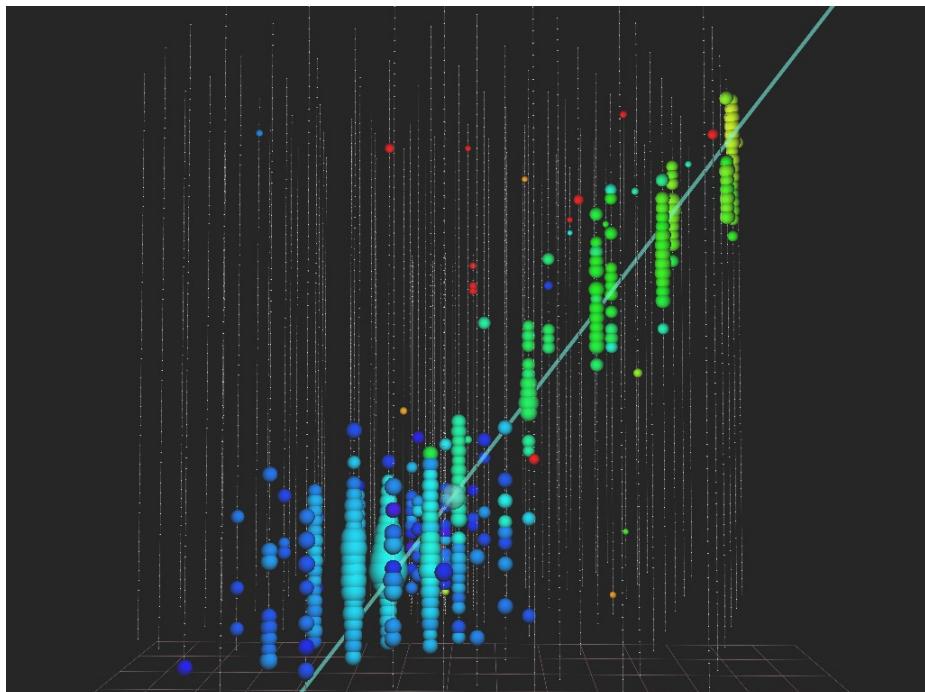


HE-Muons

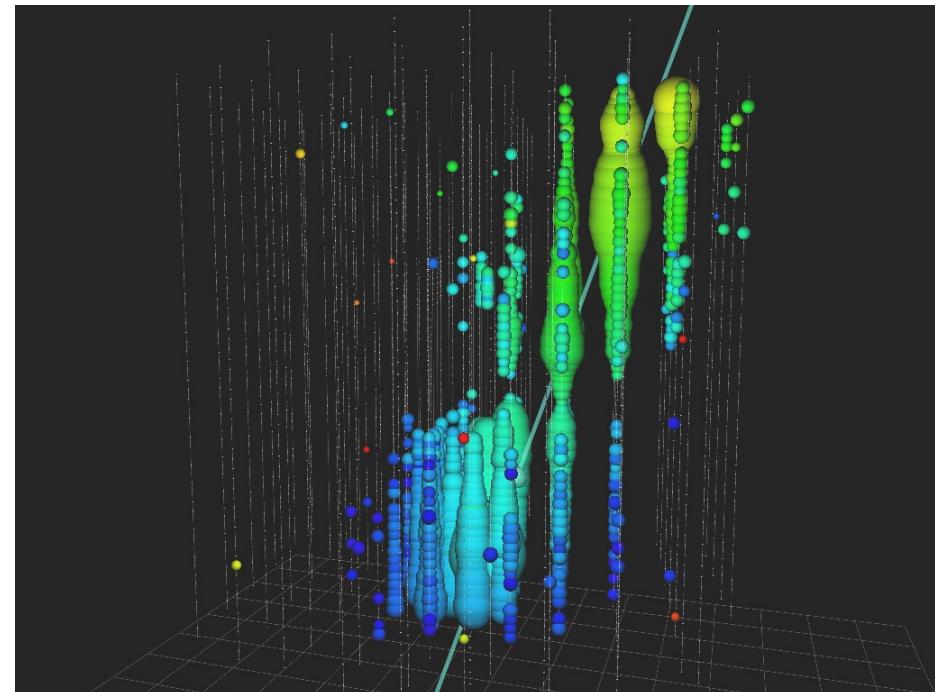


Event Types

High-Energy-Muon



Muon-Bundle

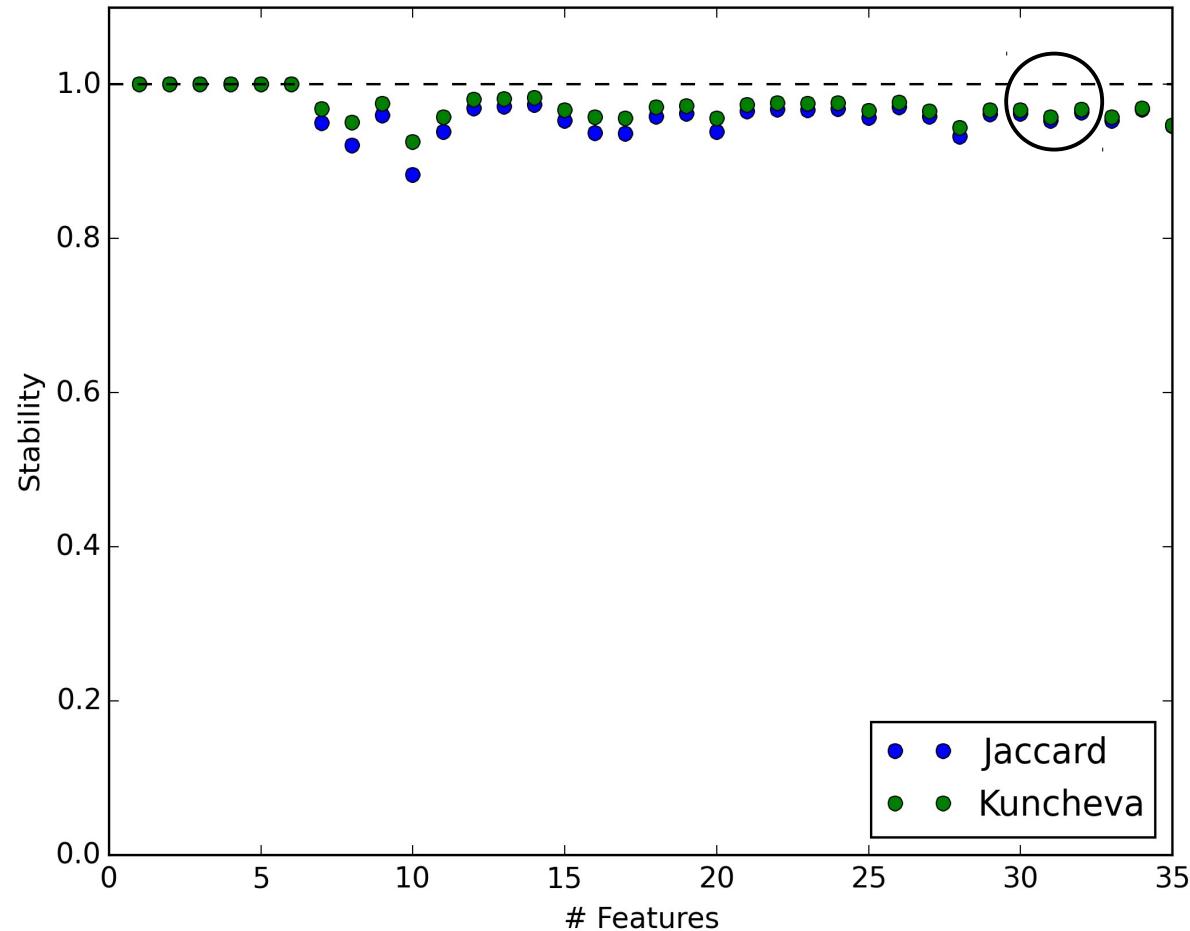


Feature Selection - Overview

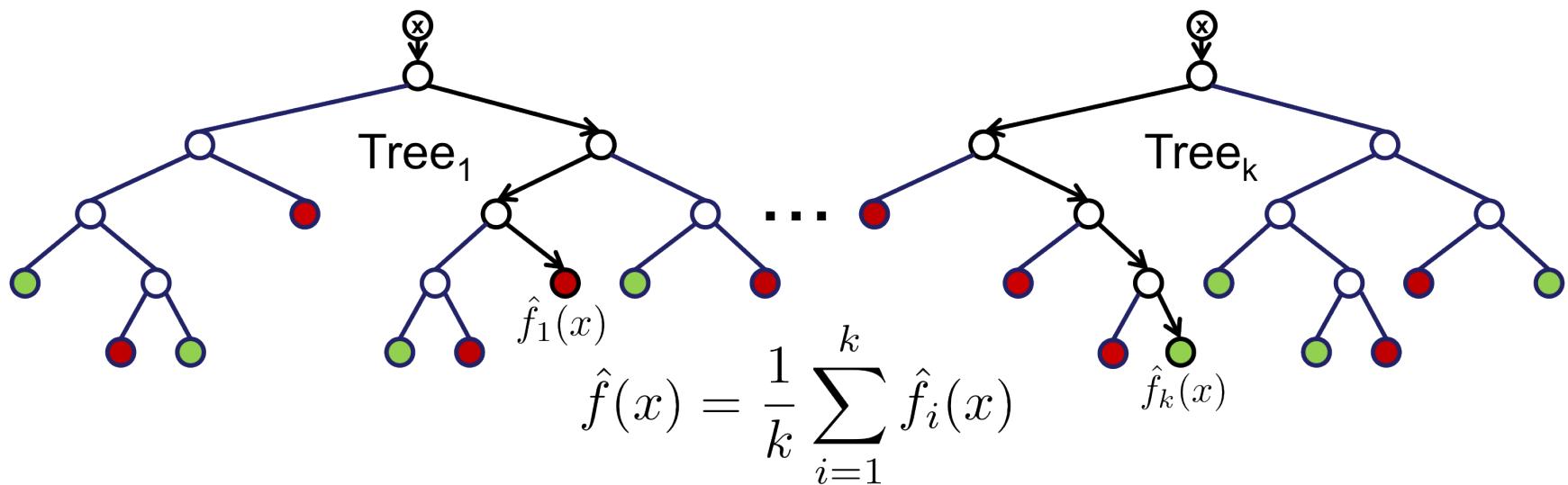


1. Selection of well simulated features by data vs MC agreement ($400 \rightarrow 130$)
2. Removal of correlated features ($130 \rightarrow 90$)
3. Creation of new features ($90 \rightarrow 96$)
4. Feature selection by mRMR ($96 \rightarrow 30$)

Feature Selection - Stability



Separation - Algorithm



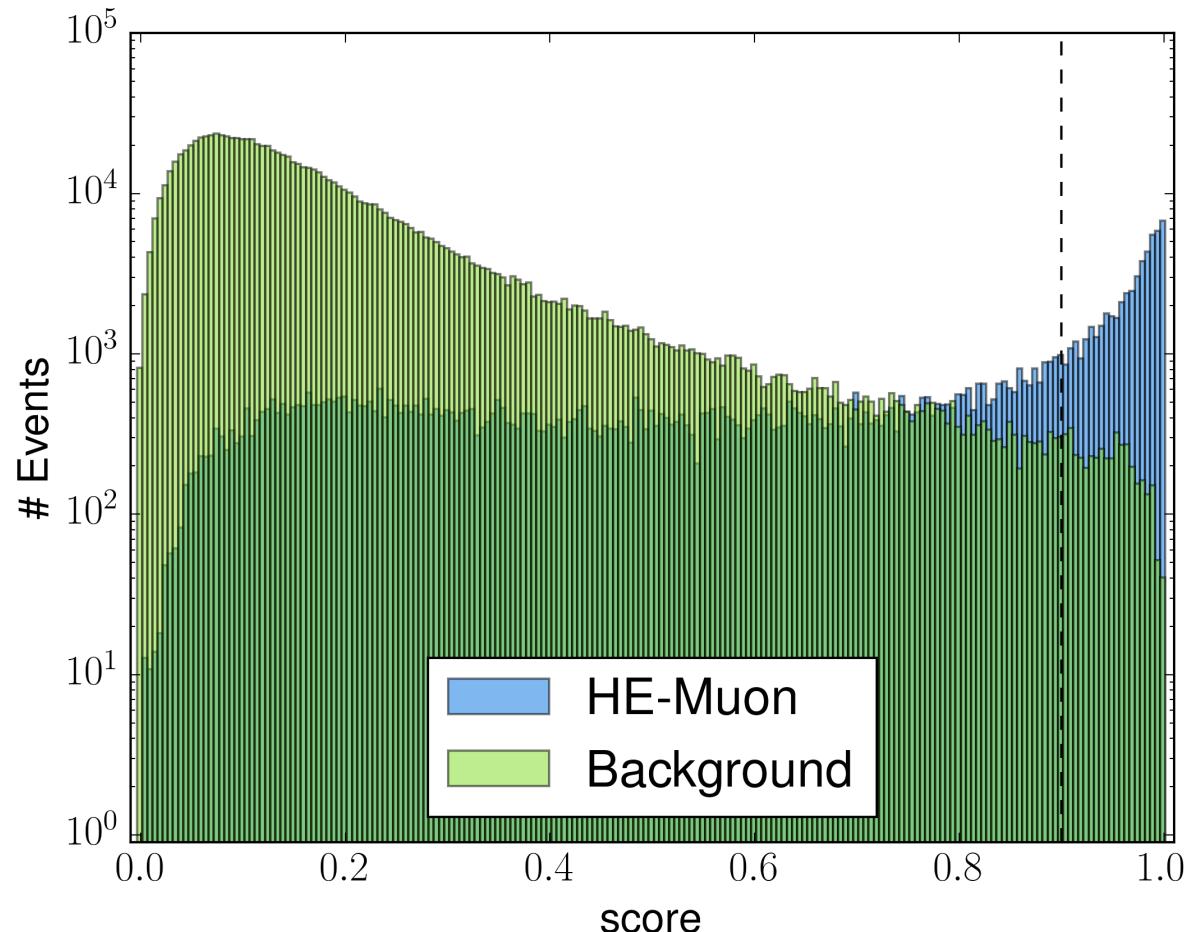
Separation - Setup



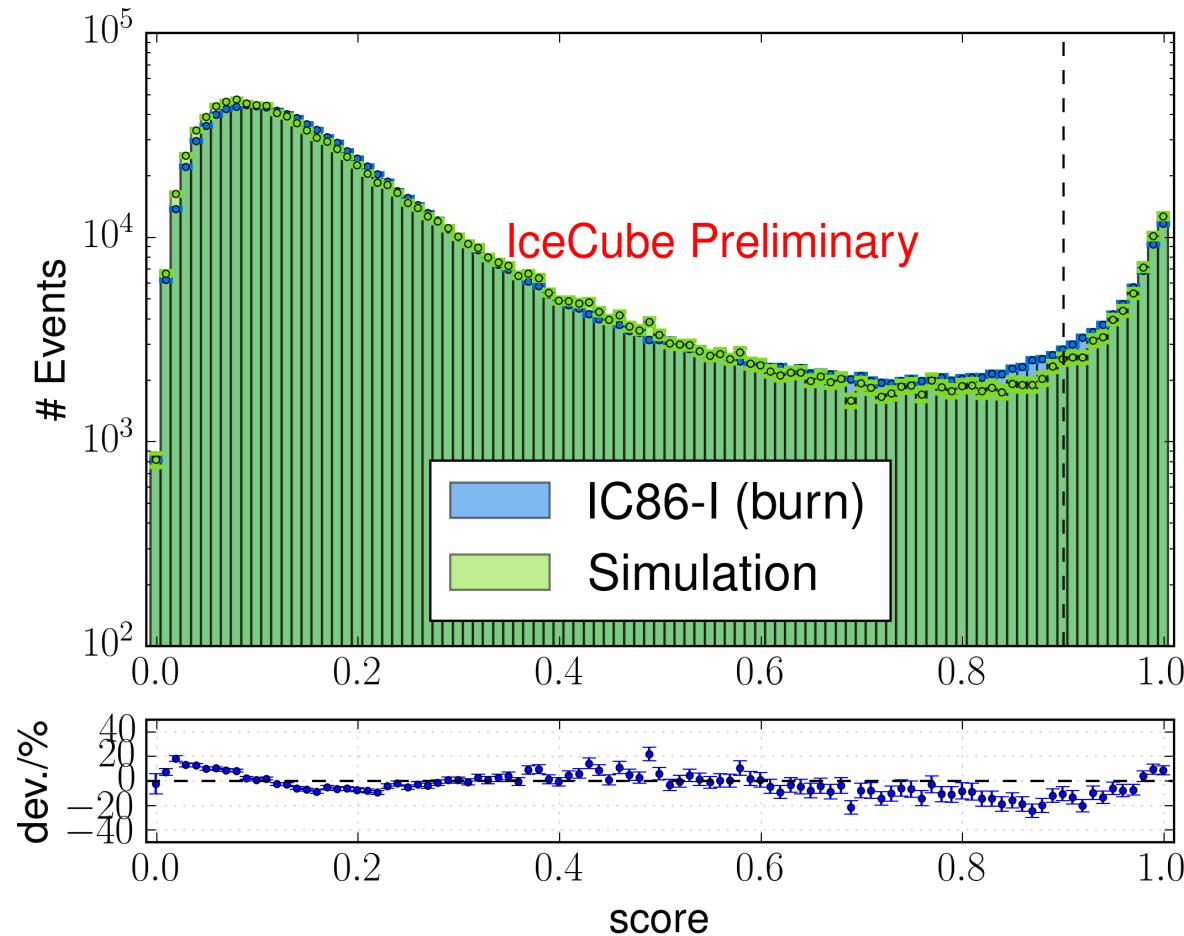
Random Forest Settings:

200	Trees
30	Attributes
5	Attributes per node

Separation - MC Result



Separation - Data Result





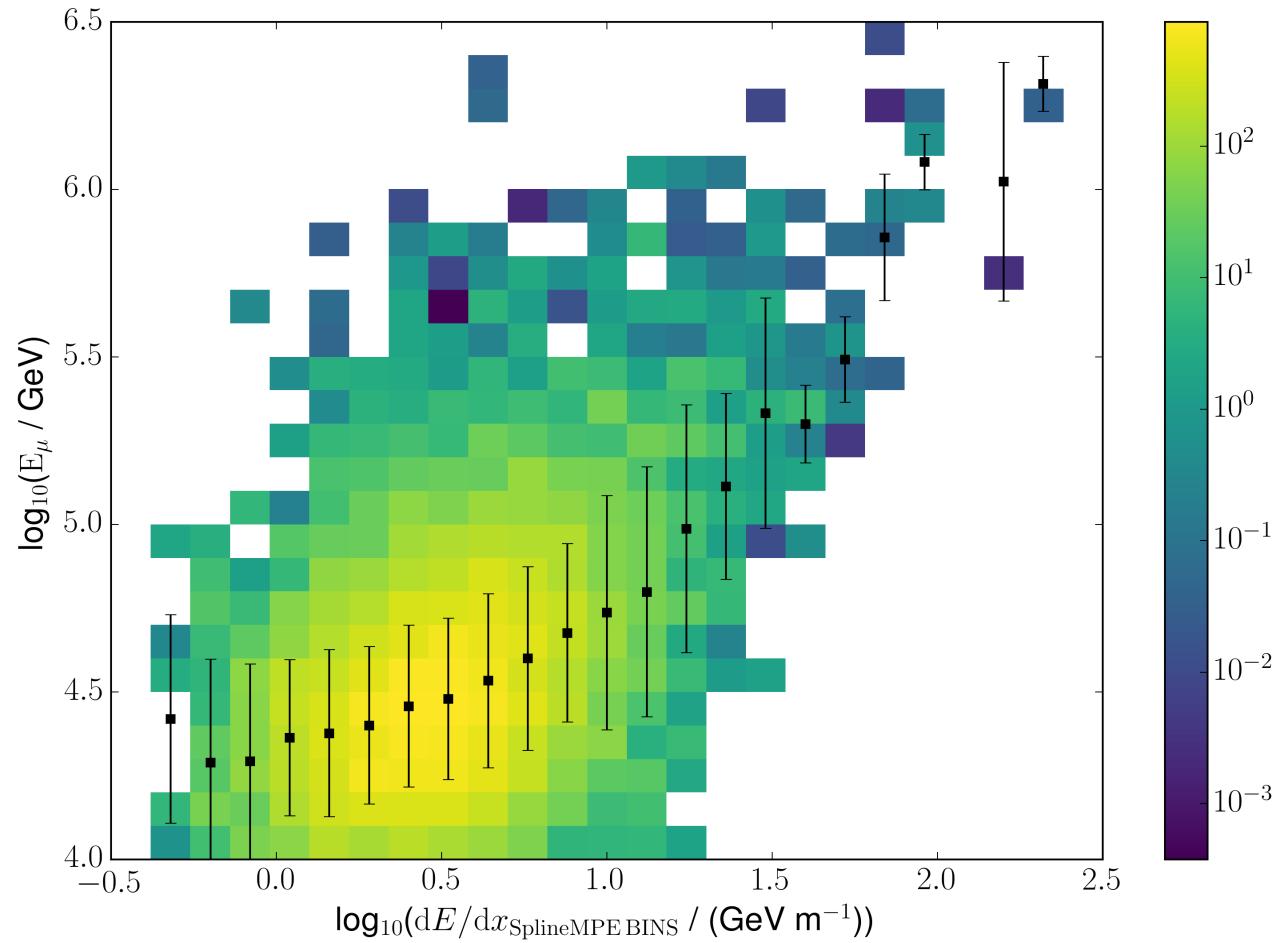
Unfolding - Overview

- TRUEE
(Time-dependent Regularized Unfolding for Economics and Engineering)
- Solves inverse problems:

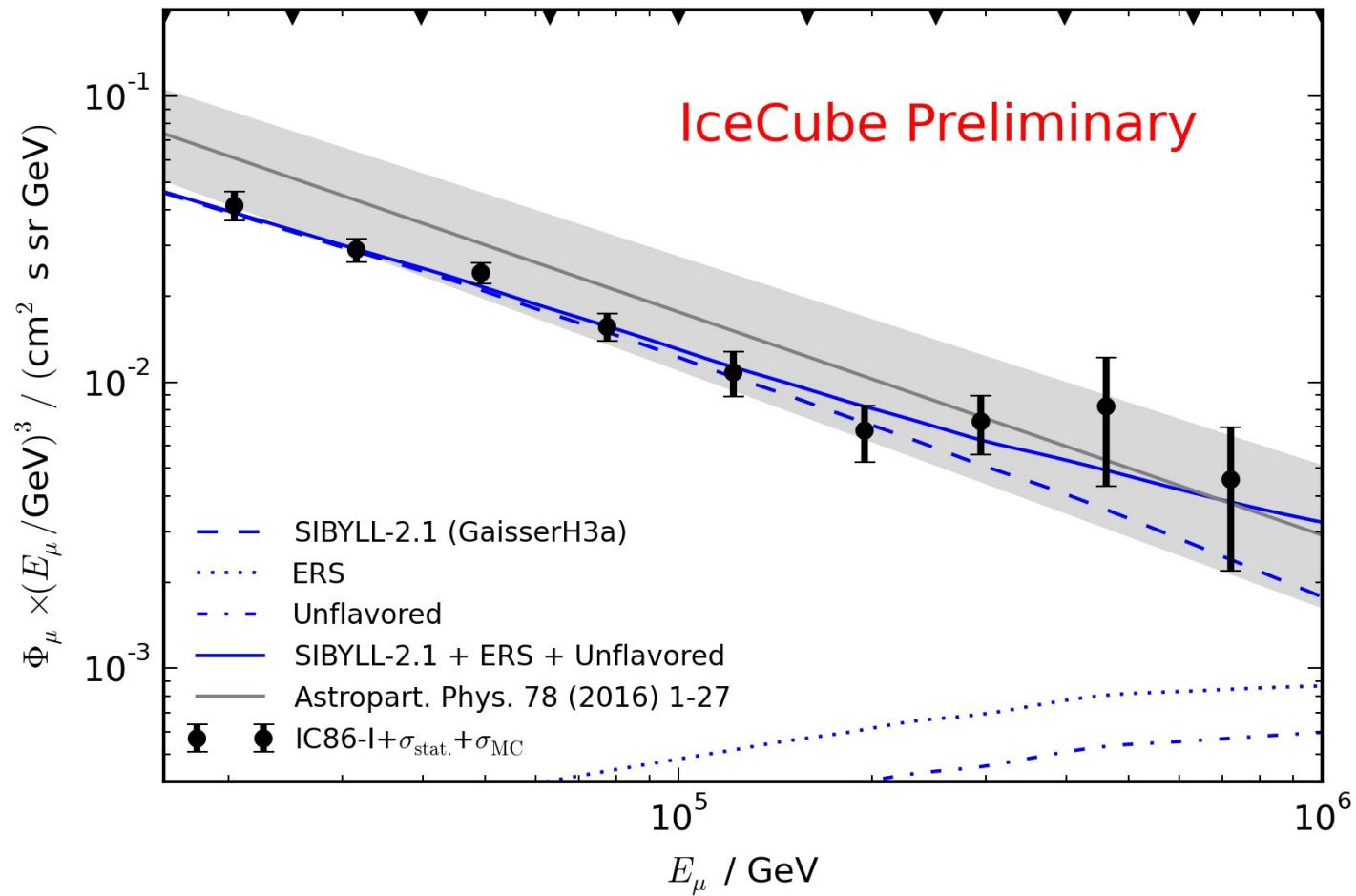
$$g(y) = \int f(x) A(x, y) dx + b(y)$$

- Model independent result

Unfolding - Input



Unfolding - Result



Conclusion & Outlook

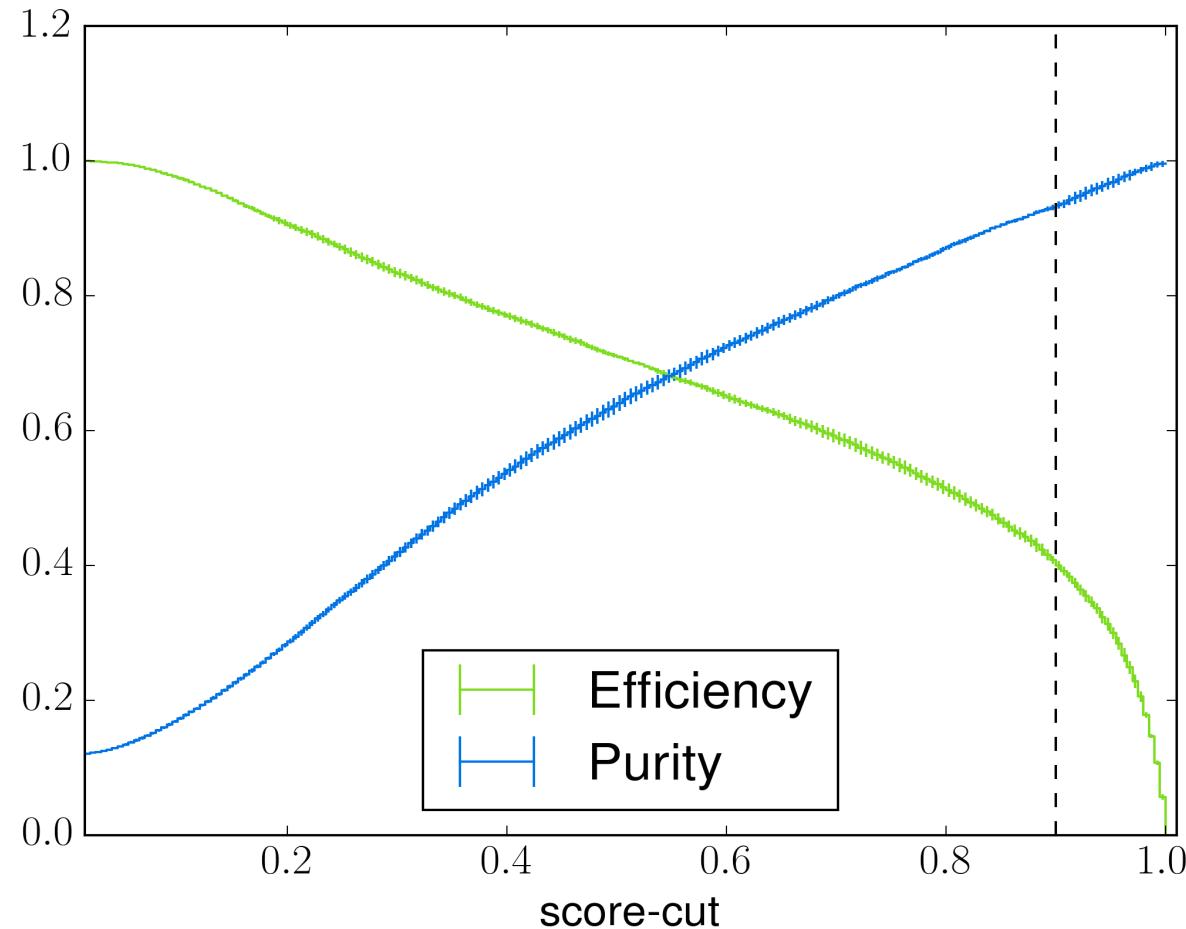
- Selected attributes for a separation
- Built a sample of HE-Muons
- Unfolded a spectrum of HE-Muons

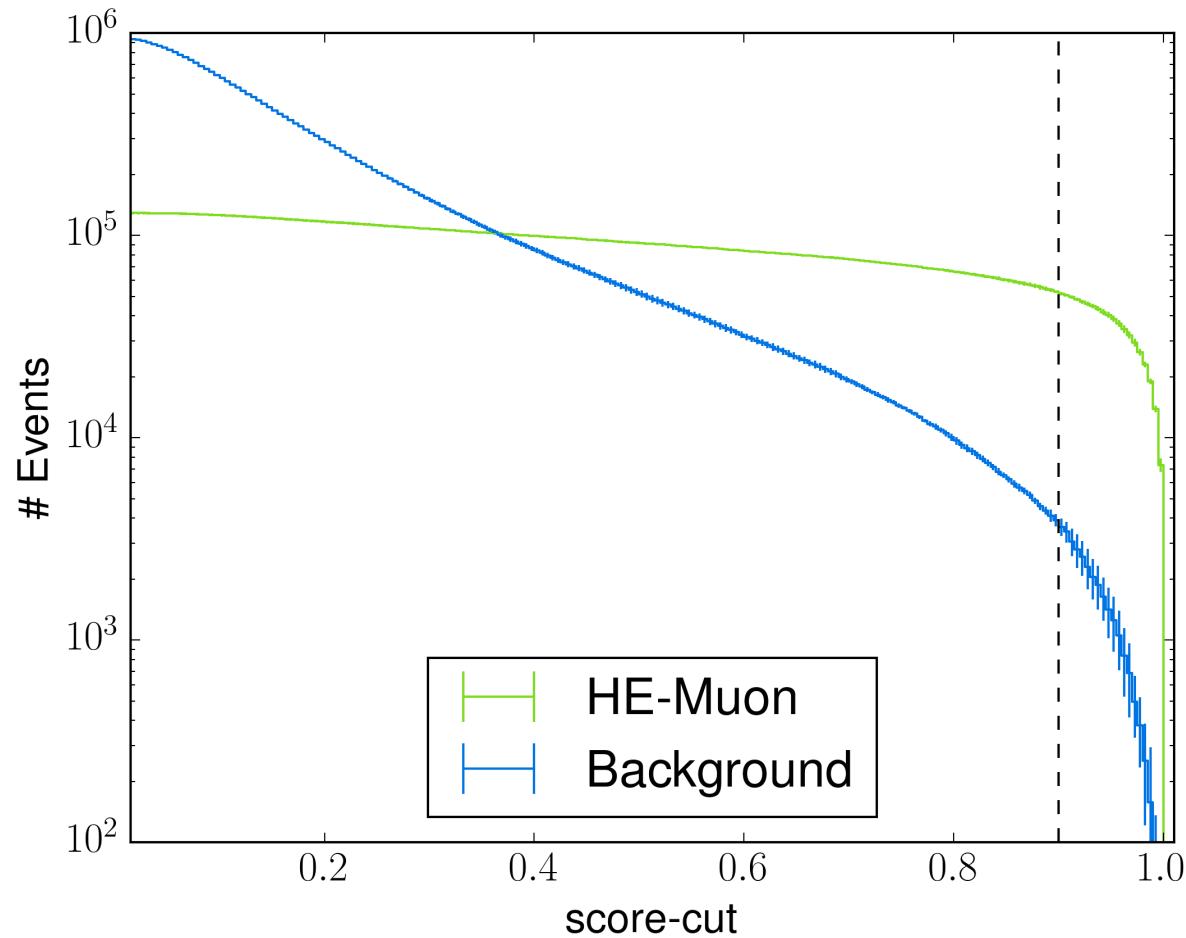
→ Statistical significance is not sufficient to determine if a prompt contribution is present on the predicted level

- Analysis of subsequent years of data



Backup





Unfolding – Input 2

