The Use of Convolutional Neural Networks for Processing Images from Multiple IACTs in the TAIGA Experiment

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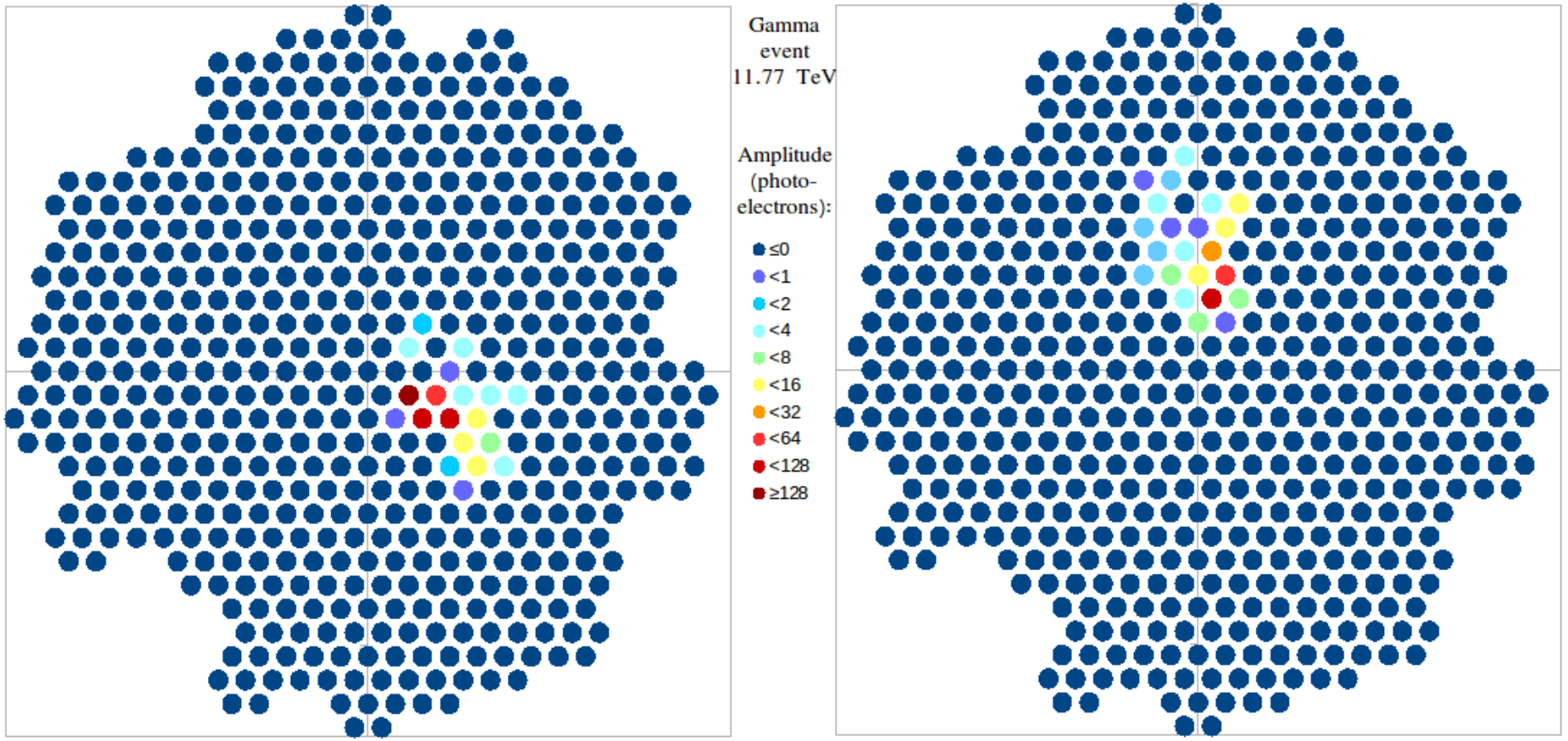
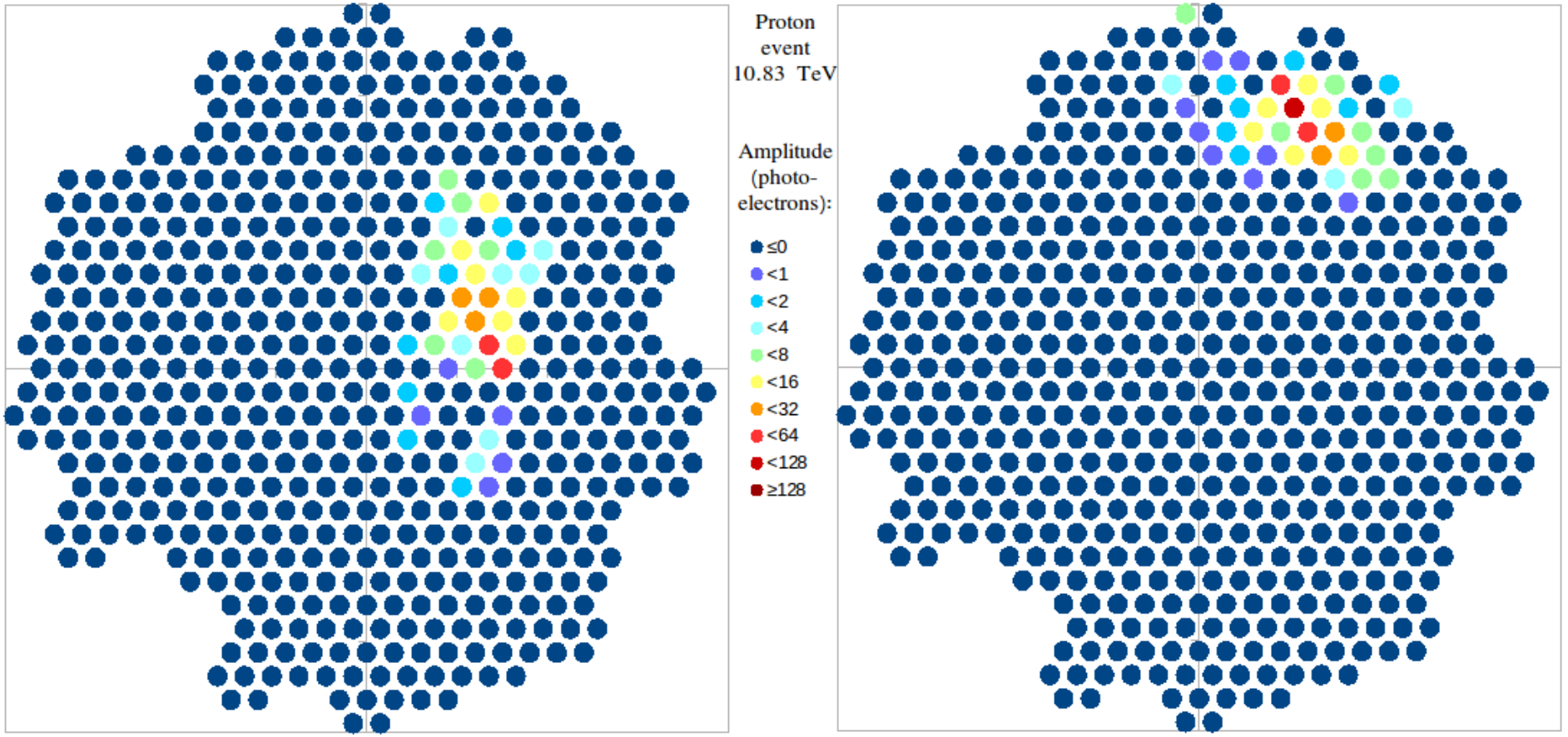
These following two slides show simulated images of extensive air showers detected by a pair Cherenkov telescopes. The first shower is a result of a high-energy gamma ray, and the second is a result of a high-energy proton.

Using a sufficiently diverse and large set of such images it is possible to train convolutional neural networks to identify the type of the original particle and estimate its parameters.


Gamma
event
11.77 TeV
Amplitude
(photo-
electrons):
≤0
<1
<2
<4
<8
<16
<32
<64
<128
≥128


Proton
event
10.83 TeV
Amplitude
(photo-
electrons):
≤0
<1
<2
<4
<8
<16
<32
<64
<128
≥128

We train convolutional neural networks to identify gamma rays and estimate their energy. Simulated images from one or two Cherenkov telescopes of a Russian experiment TAIGA are used as inputs.

Our results demonstrate good quality of gamma ray selection and accuracy of energy estimates when only one telescope image is used as input. Adding an image from the second telescope results in further improvement of the performance of the neural networks.