The 8th International Conference
Channeling 2018

FUTURE TRANSITION RADIATION DETECTORS: THEORY AND EXPERIMENT

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on behalf of

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OUTLINE

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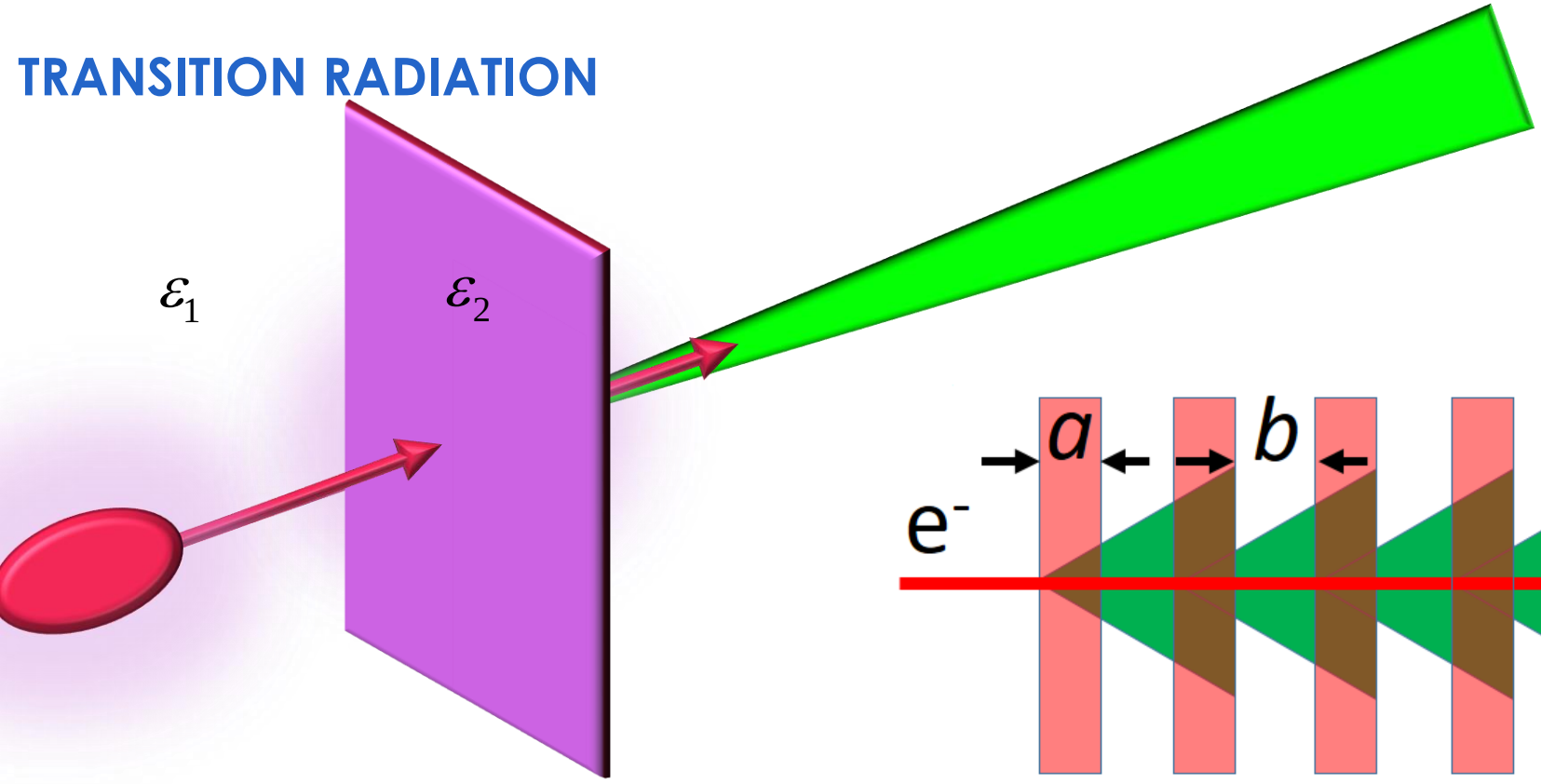
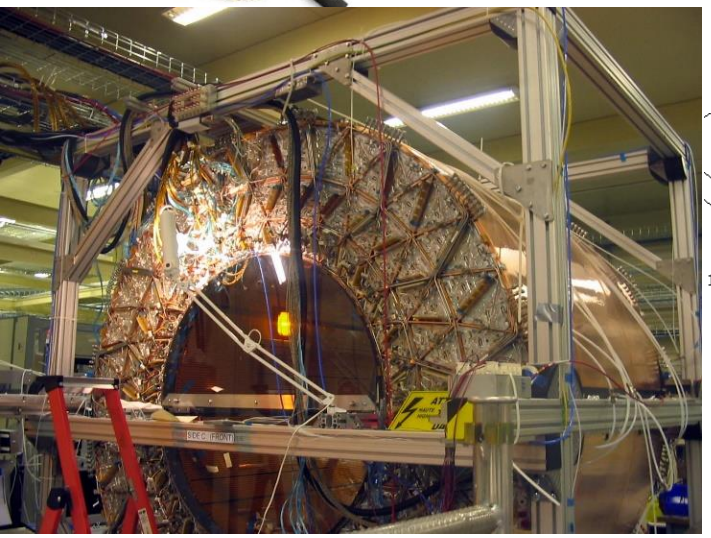
INTRODUCTION

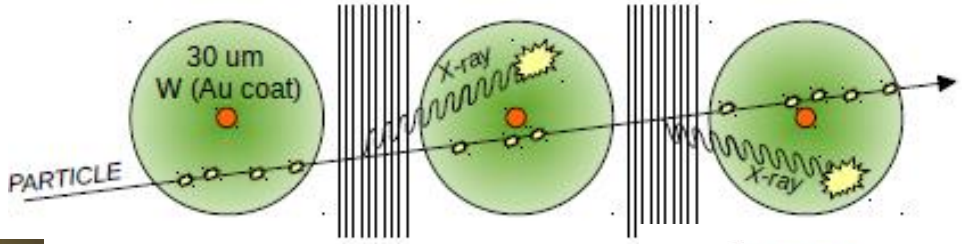
TRANSITION RADIATION

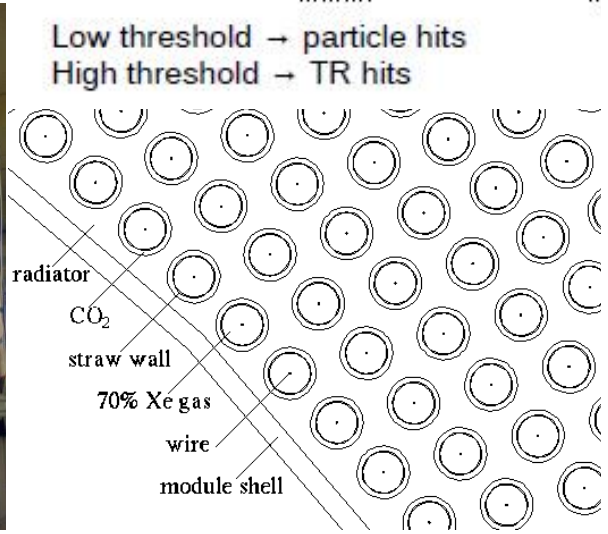


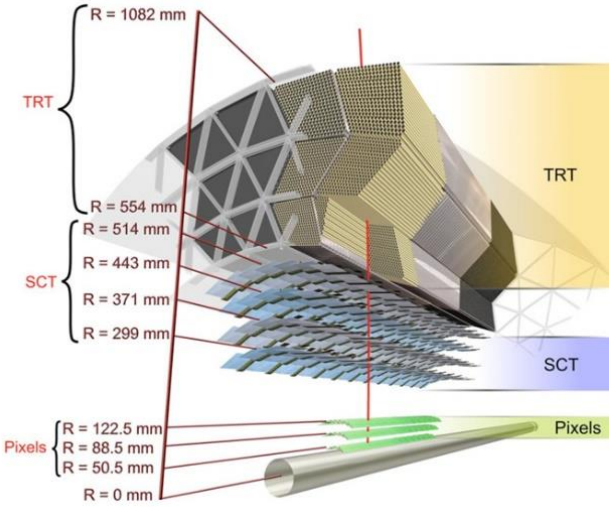
saturation

EXAMPLE: THE ATLAS TRANSITION RADIATION TRACKER (TRT)









MOTIVATION

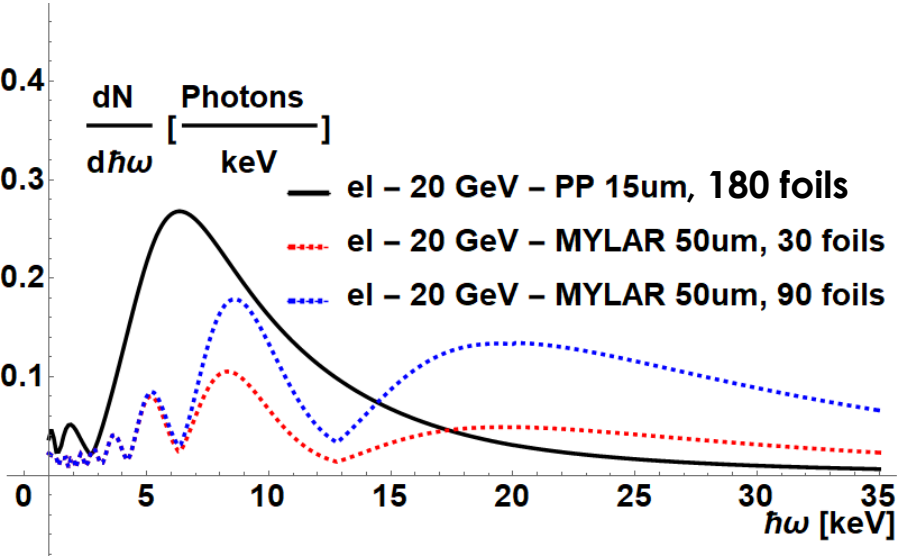
- Electron-hadron separation works good only up to $\gamma \sim 500$.
- At $\gamma \sim 2 - 3 \times 10^3$ TR saturates (we need more than 10^5 for future colliders and cosmic ray detection).
- Possibility of simultaneous TR angular and energy distribution measurements due to using of pixel detectors instead of gaseous.
- For example: future Small-angle Spectrometer at LHC
  - hadron separation at small angles.
  - pions, kaons and protons at 1 – 6 TeV range.

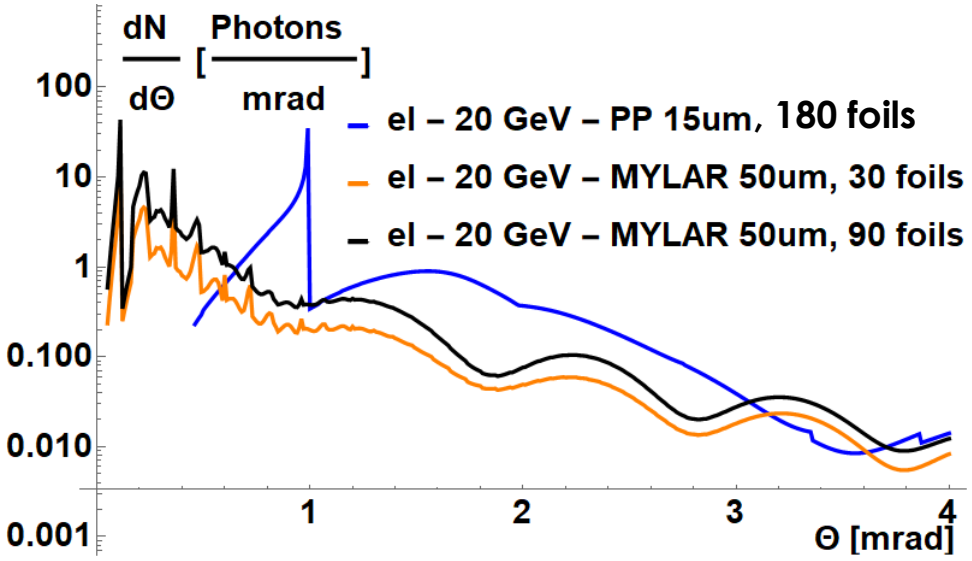
THEORETICAL PREDICTIONS

180 layers of 15 μm PP foils and 0.2 mm gap between foils

30 layers of 50 μm Mylar foils and 3 mm gap between foils

90 layers of 50 μm Mylar foils and 3 mm gap between foils





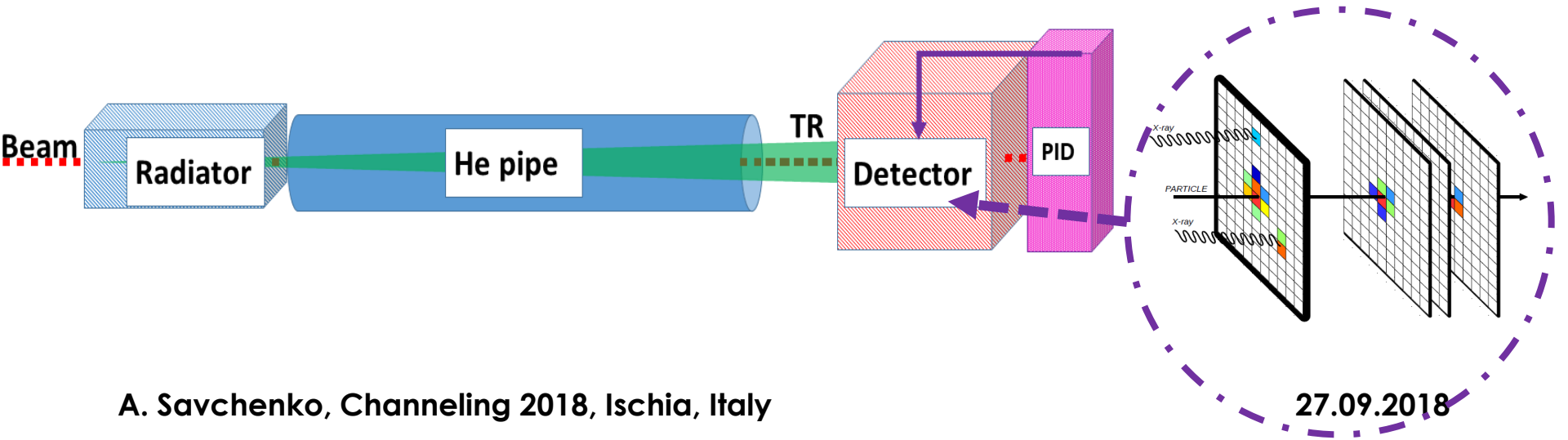
G.M. Garibian, Y. Shi, X-ray Transition Radiation, Erevan (in Russian) (1983).
A.A. Savchenko, D.Yu. Sergeeva, A.A. Tishchenko, M.N. Strikhanov, Small-angle X-ray transition radiation from multilayered structure, (2018) to be published.

TimePix

credit: E. Jr. Schioppa

- 1.4 cm x 1.4 cm
- 256 x 256 pixels
- 55 um x 55 um pixel size
- Single photon counting
- For this experiment, 500um silicon sensor

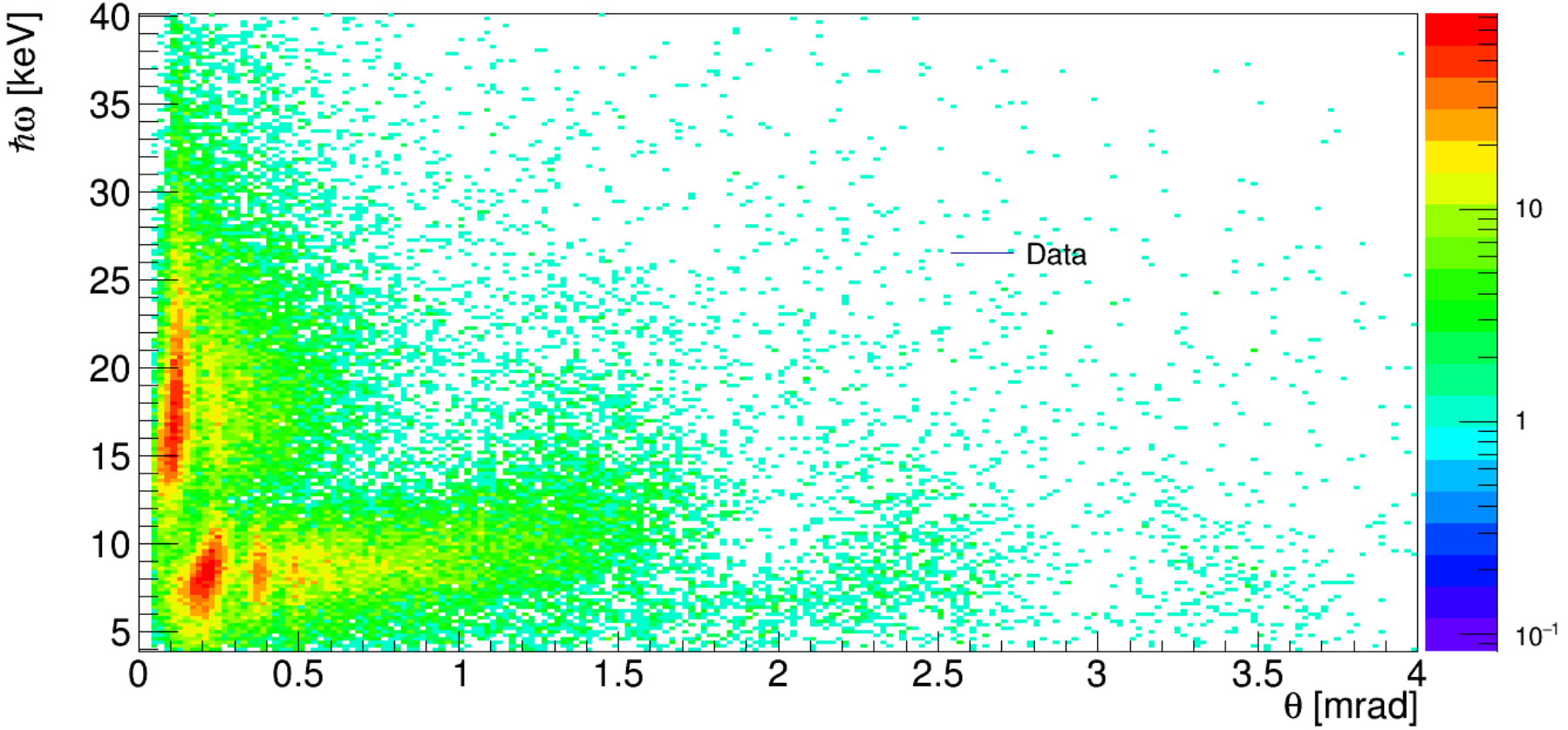
EXPERIMENT



RESULTS OF EXPERIMENT

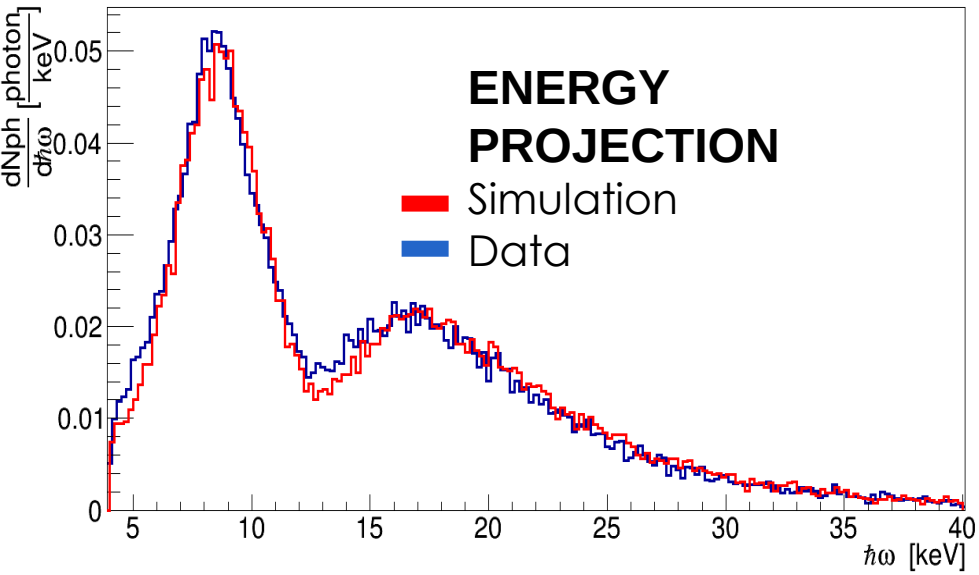
30 layers of 50 μm Mylar foils and
3 mm gap between foils

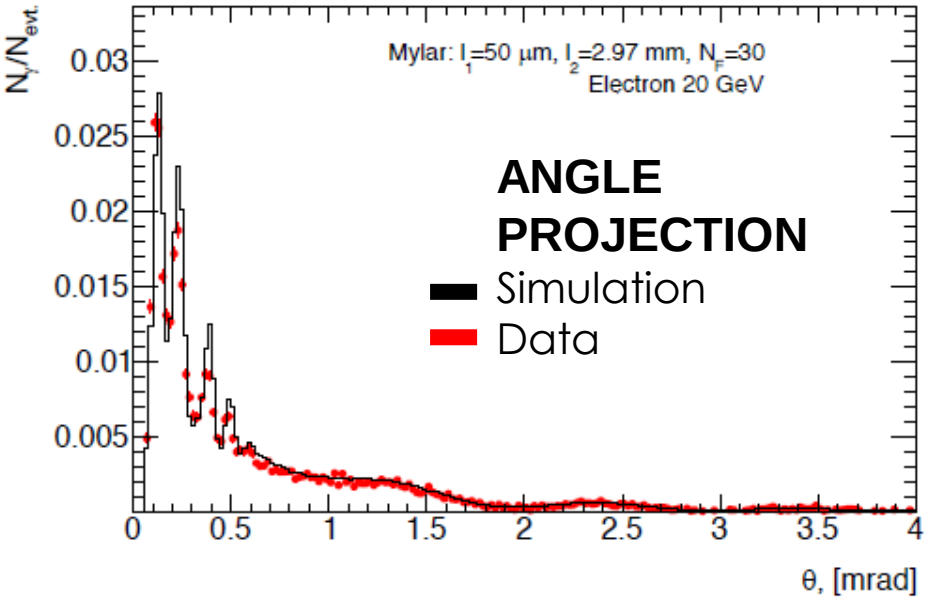
ELECTRONS 20 GeV



SIMULATION AND DATA

30 layers of 50 μm Mylar foils and
3 mm gap between foils
ELECTRONS 20 GeV

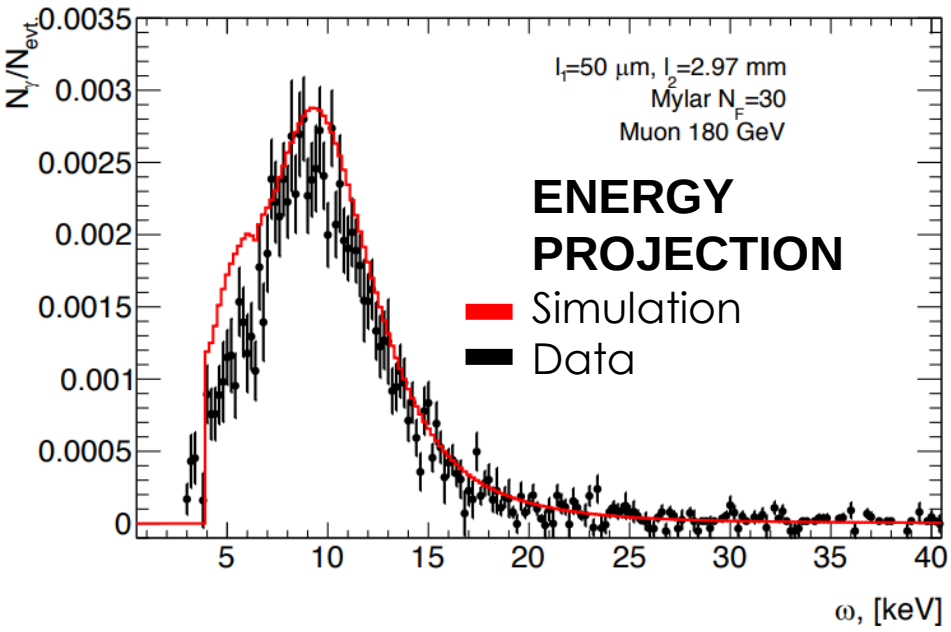


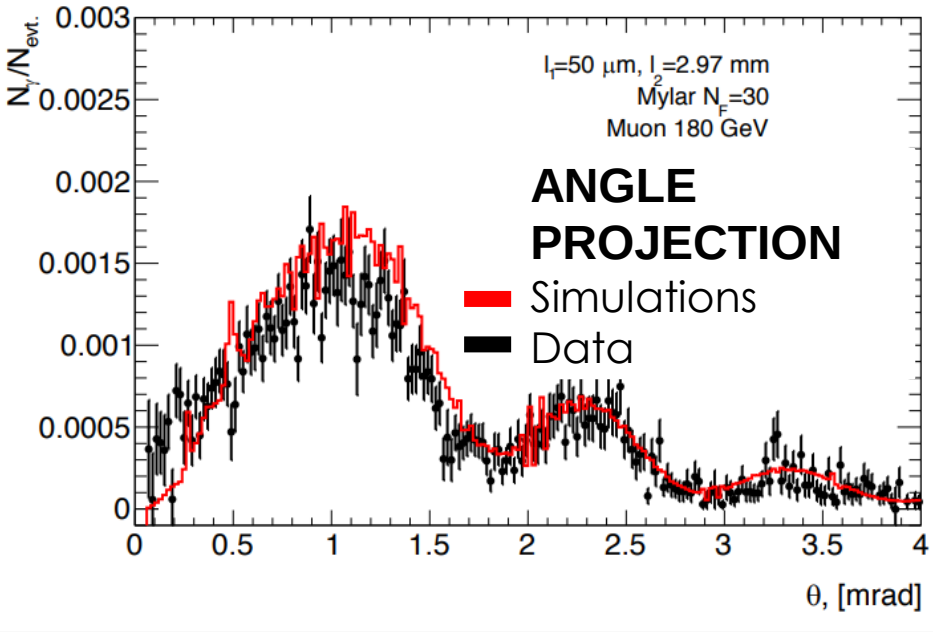


1. Geant4, version 10.4, official web-sites, http://www.Geant4.org/Geant4/; http://Geant4.web.cern.ch/Geant4/
2. RADIATOR: A program to calculate the Transition Radiation quanta yield, https://radiator.hepforge.org/

SIMULATION AND DATA

30 layers of 50 μm Mylar foils and
3 mm gap between foils
MUONS 180 GeV

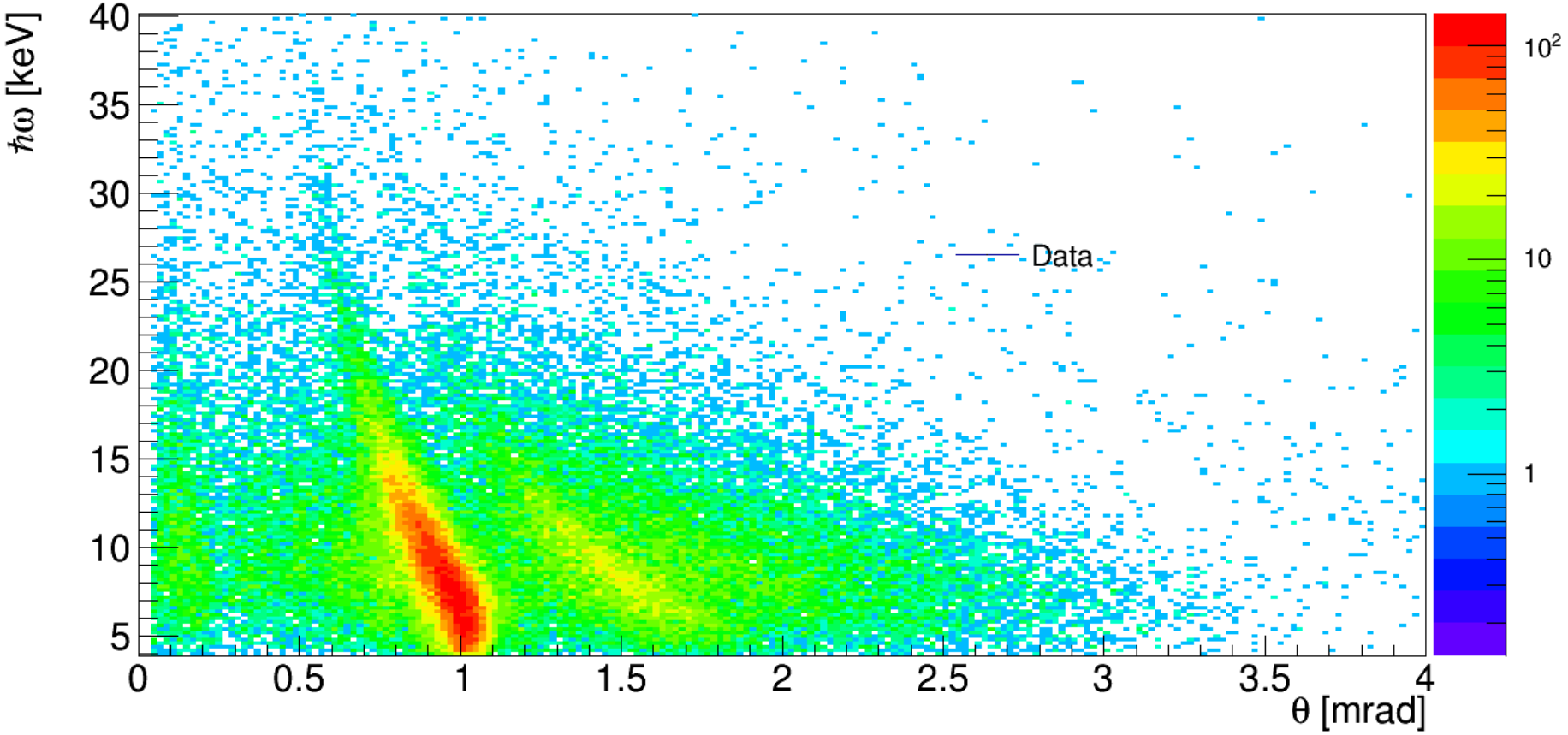




RESULTS OF EXPERIMENT

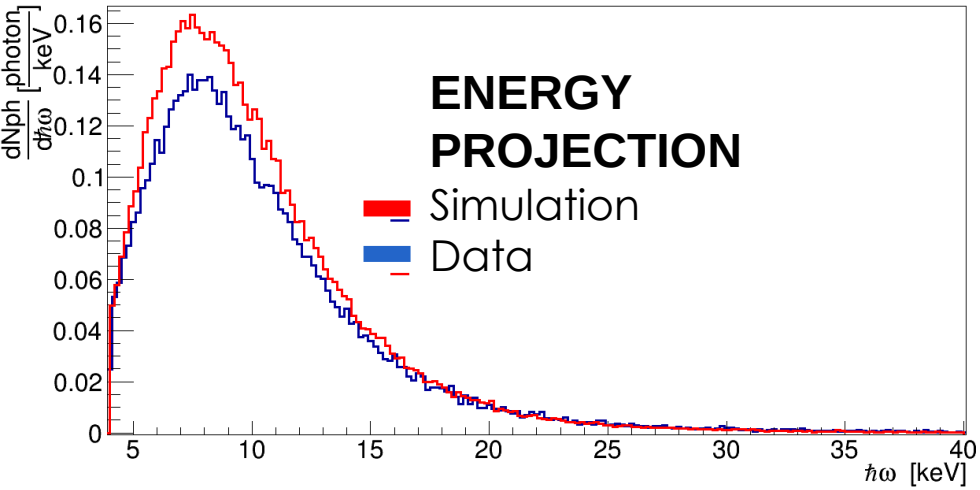
180 layers of 15 μm PP foils and 0.2 mm gap between foils

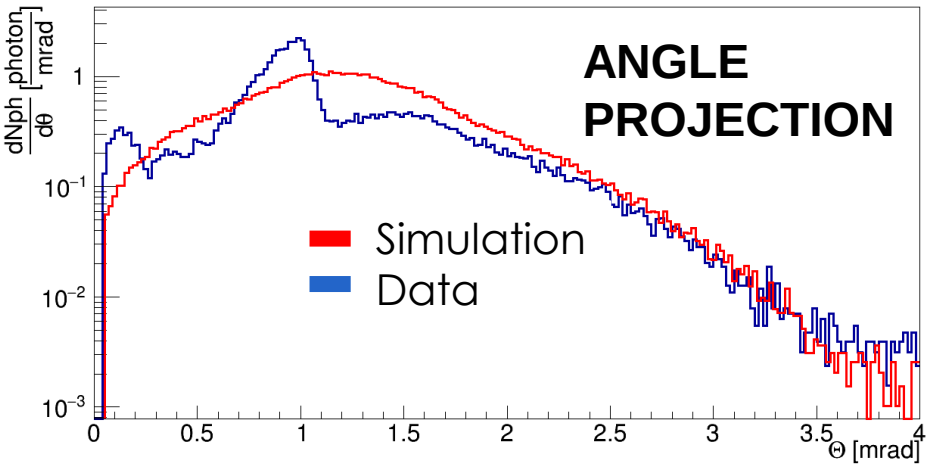
ELECTRONS 20 GeV



SIMULATION AND DATA

180 layers of 15 μm PP foils and
0.2 mm gap between foils
ELECTRONS 20 GeV





SUMMARY AND PLANS

- Our Test Beams gave us encouraging results.
- First observation of TR both angular and spectral distributions with good resolution – coincide with our theoretical calculations.
- Using both TR angular and spectral distribution we can work with $\gamma \sim 10^5$ after proper selection of TR radiators properties.
- These investigations would be useful for future colliders and cosmic ray experiments.

THANK YOU FOR YOUR ATTENTION!!!