



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Neutrons

FOOT @ CNAO 2021

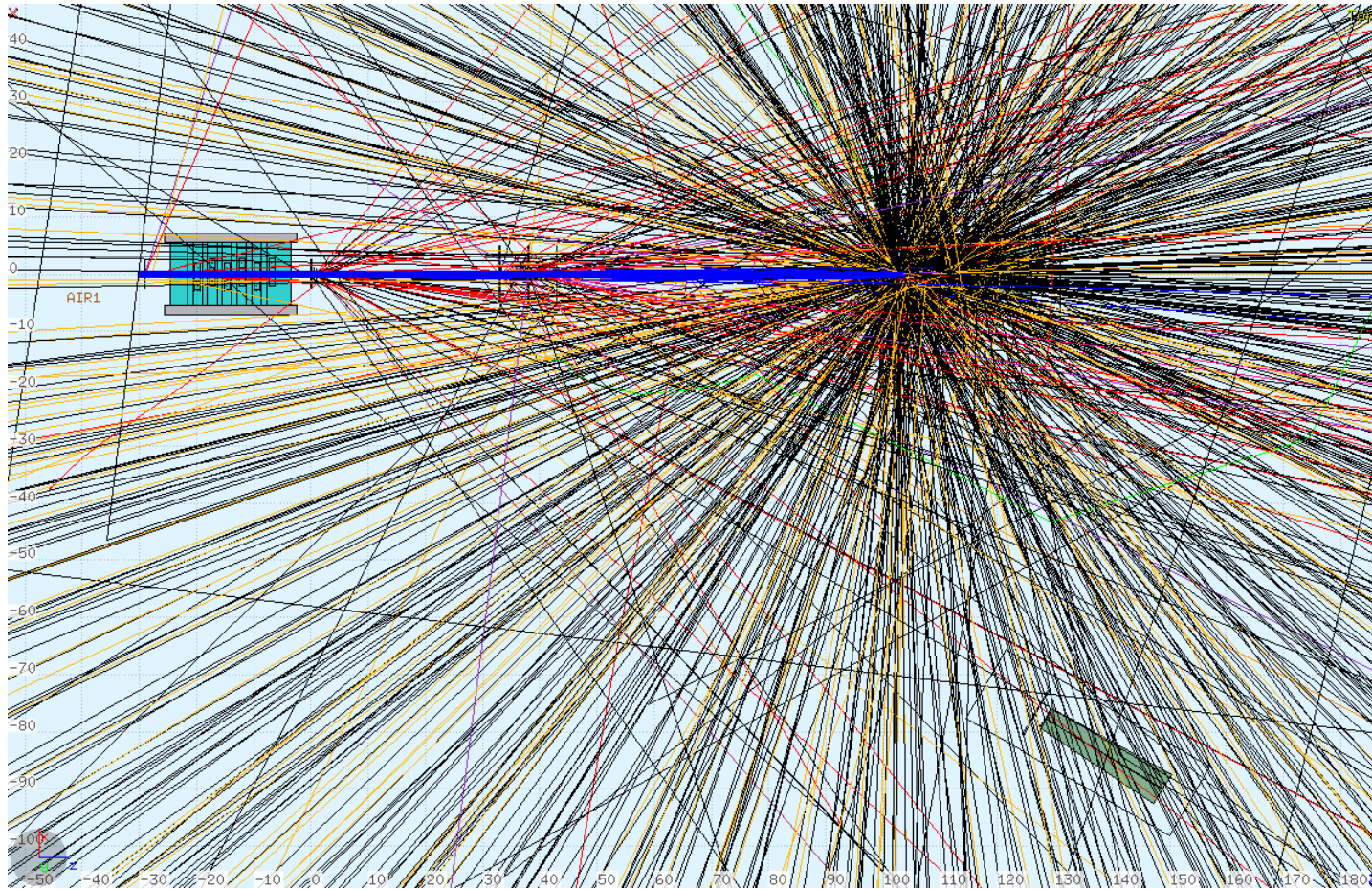
Cristian Massimi for INFN Bologna

Department of Physics and Astronomy

Outline

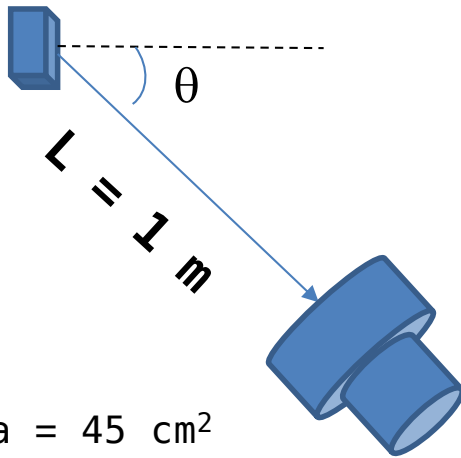
Towards the test beam @ CNAO

Courtesy of
Silvia &
Giuseppe



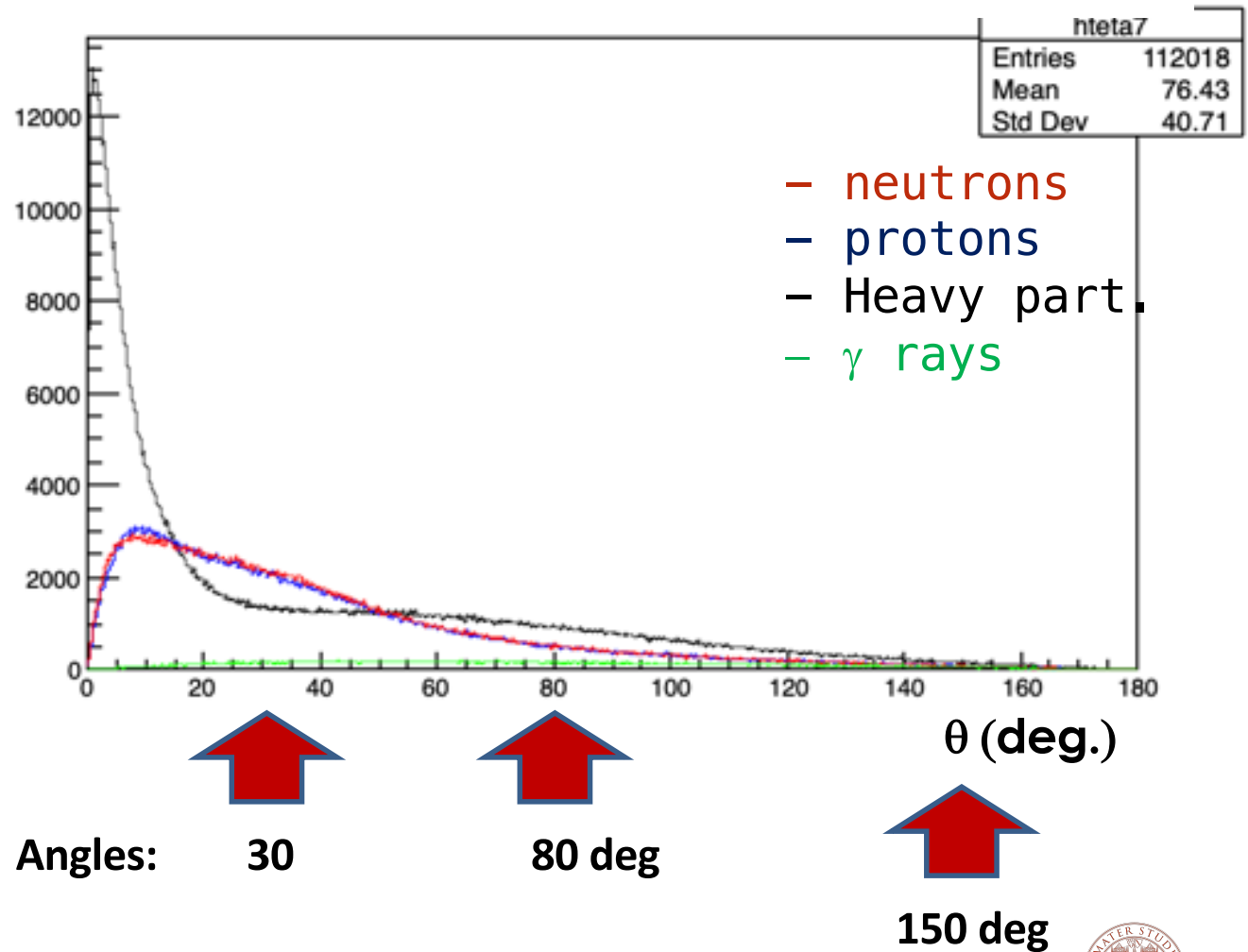
MC simulations – particles from target (2-mm thick)

$^{12}\text{C}+^{12}\text{C}$ @200MeV/u (CNAO)



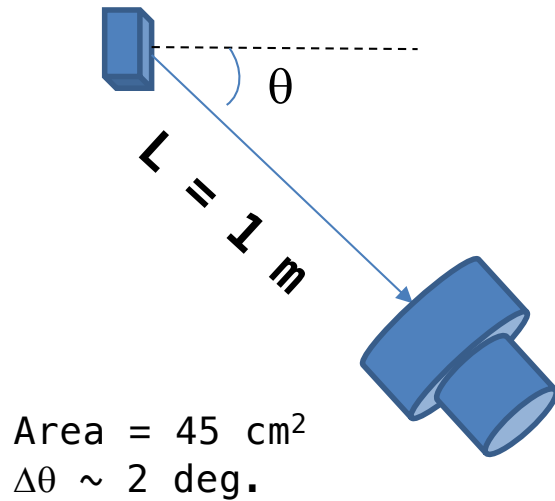
Area = 45 cm^2
 $\Delta\theta \sim 2\text{ deg.}$

E_n	TOF
1 MeV	72 ns
10 MeV	23 ns
50 MeV	10.6 ns
100 MeV	7.8 ns
200 MeV	5.9 ns

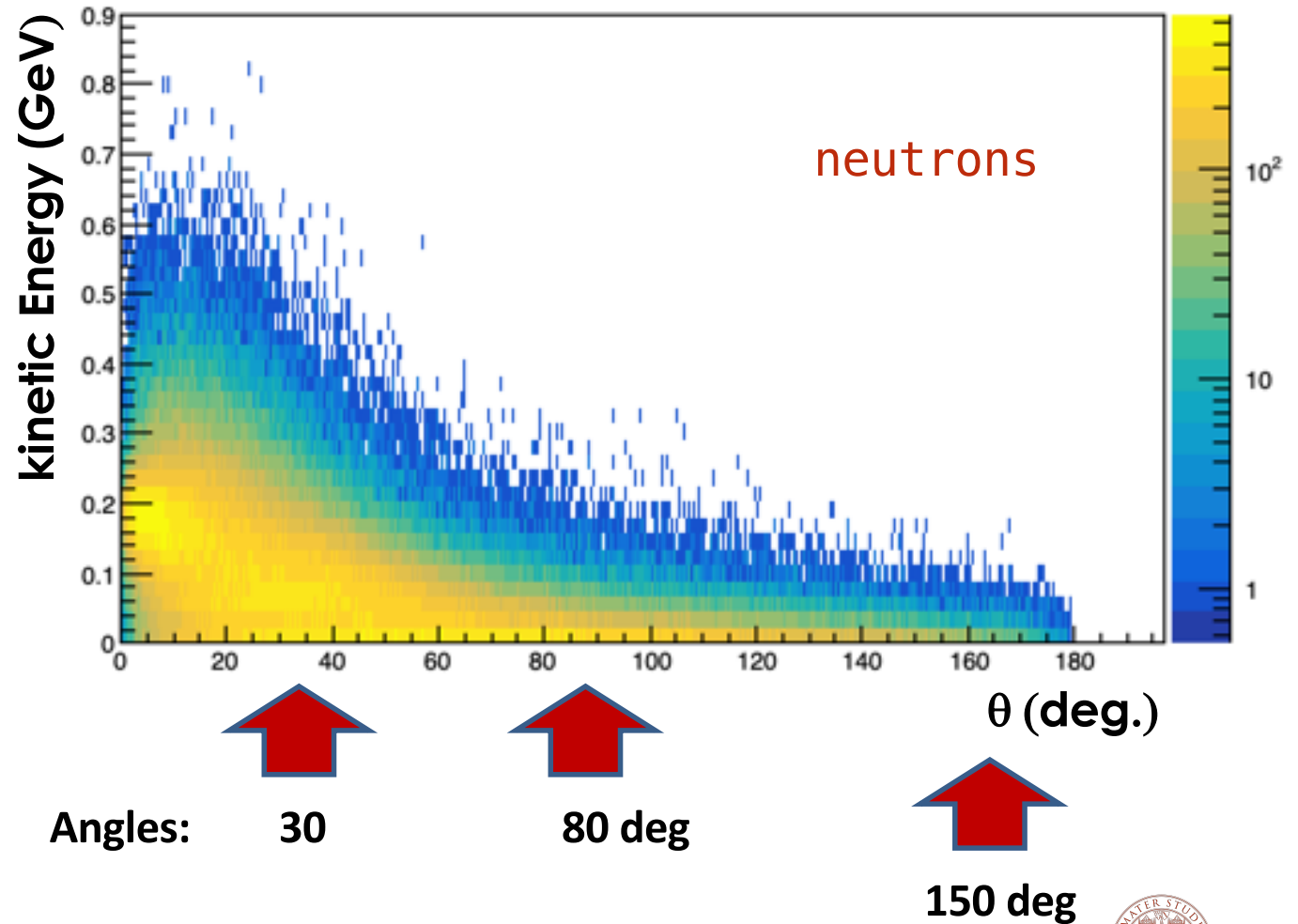


MC simulations – particles from target (2-mm thick)

$^{12}\text{C}+^{12}\text{C}$ @200MeV/u (CNAO)

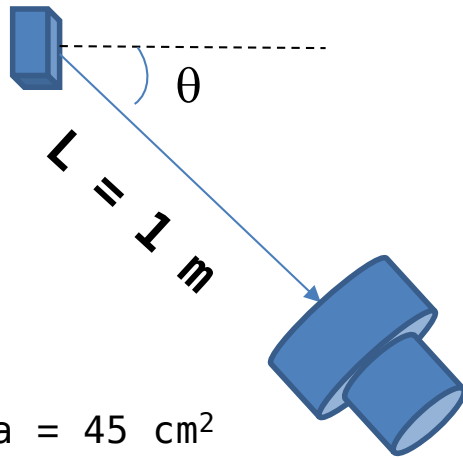


E_n	TOF
1 MeV	72 ns
10 MeV	23 ns
50 MeV	10.6 ns
100 MeV	7.8 ns
200 MeV	5.9 ns



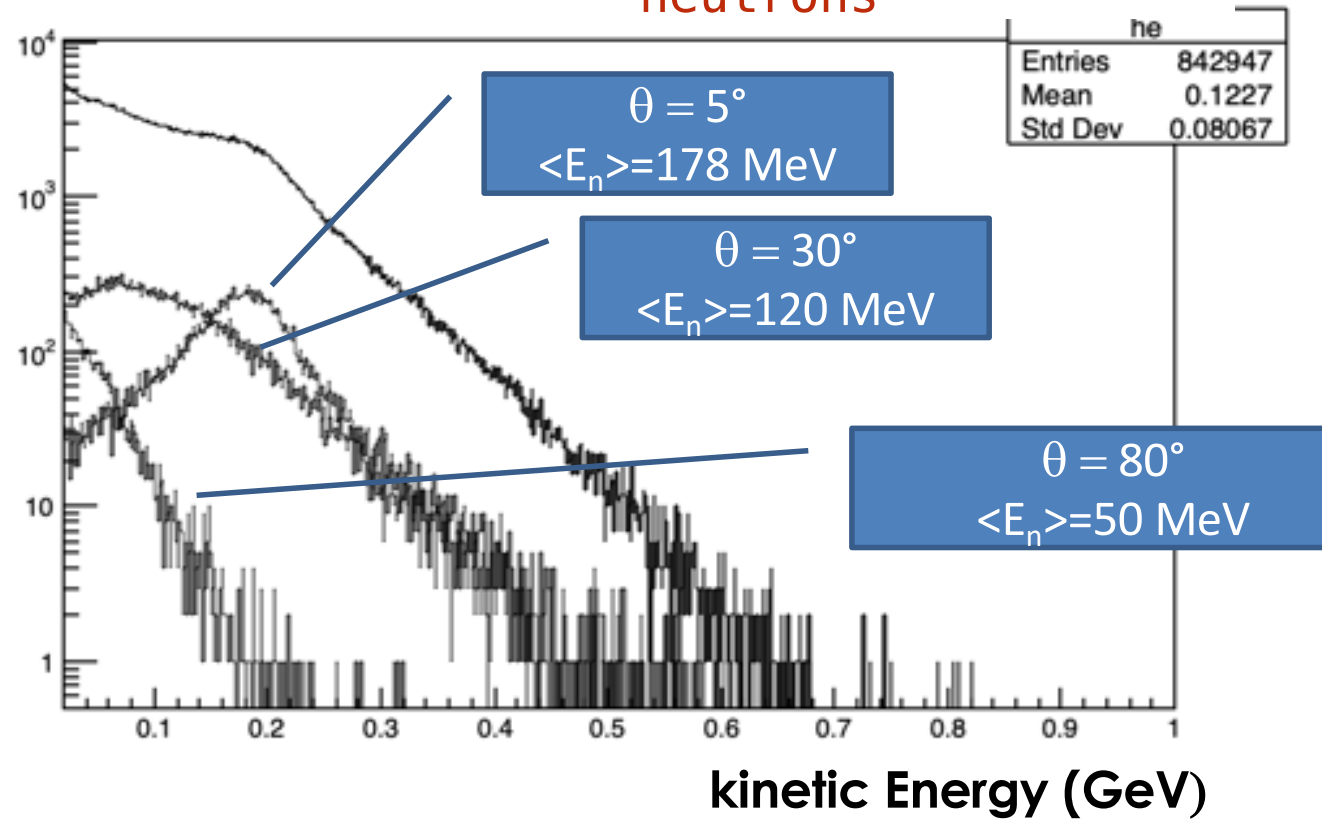
MC simulations – particles from target (2-mm thick)

$^{12}\text{C}+^{12}\text{C}$ @200MeV/u (CNAO)



Area = 45 cm^2
 $\Delta\theta \sim 2 \text{ deg.}$

neutrons

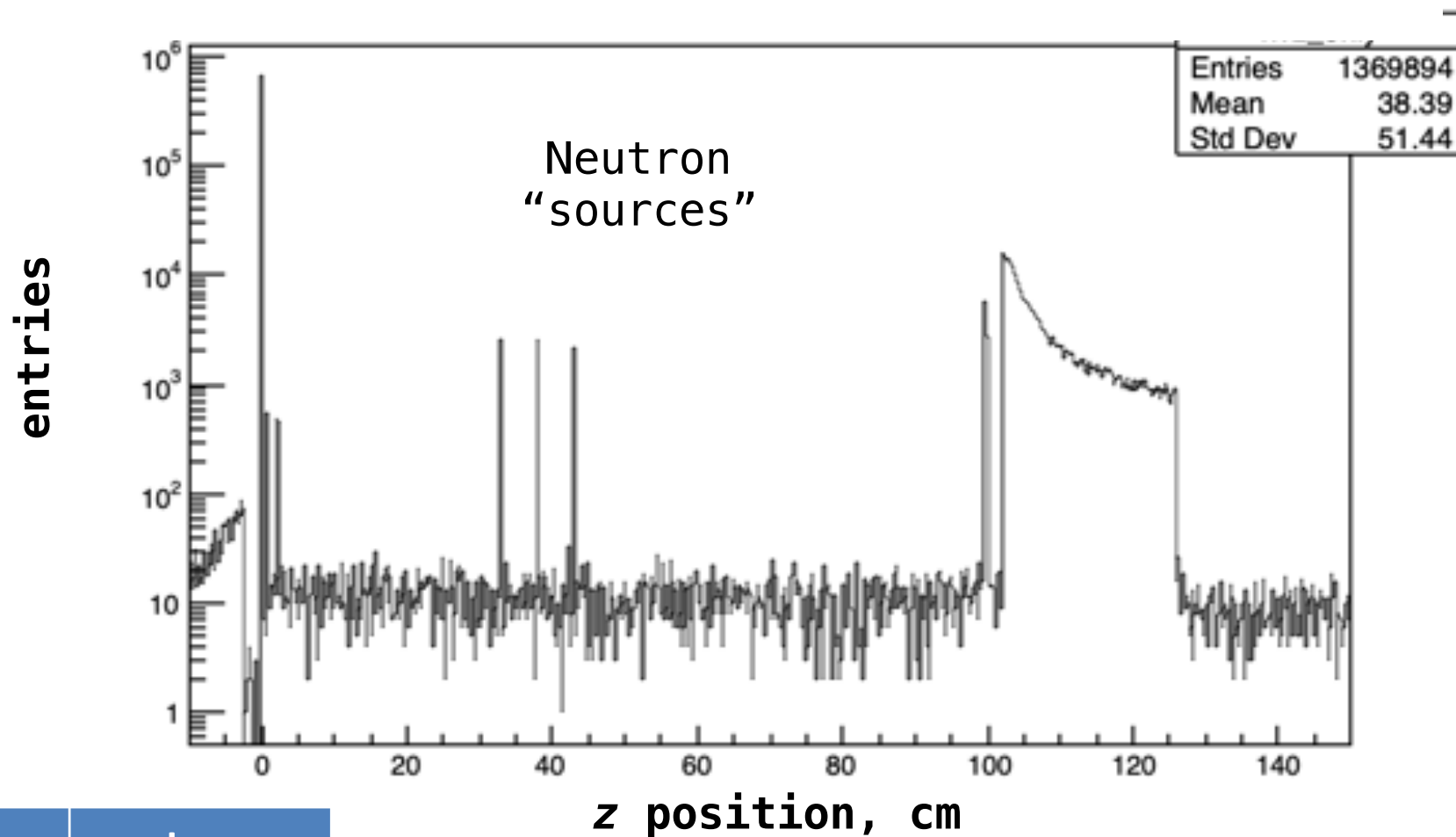


E_n	TOF
1 MeV	72 ns
10 MeV	23 ns
50 MeV	10.6 ns
100 MeV	7.8 ns
200 MeV	5.9 ns



MC simulations – particles from everywhere

$^{12}\text{C}+^{12}\text{C}$ @200MeV/u (CNAO)



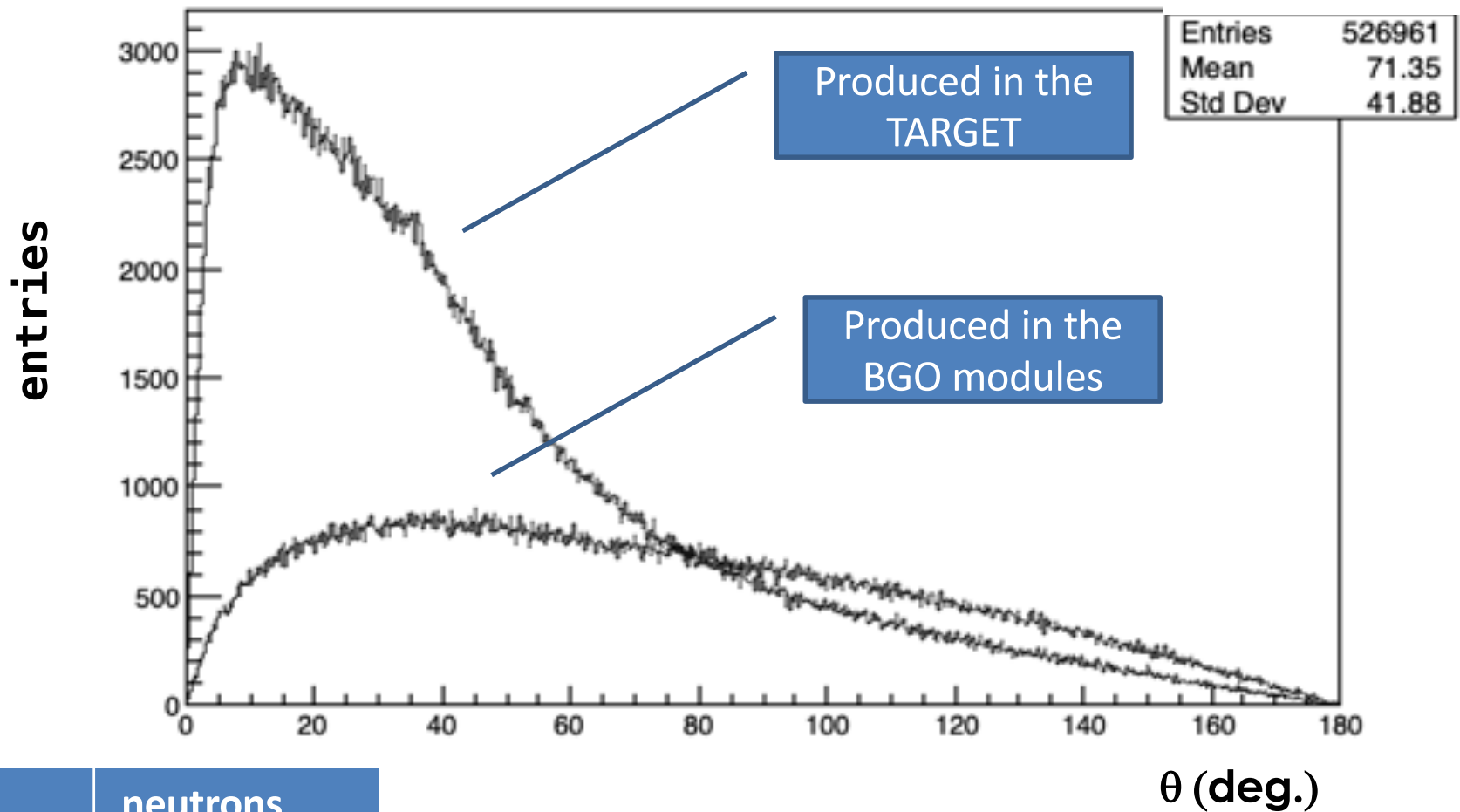
	neutrons
target	8.8×10^5
BGO	5.3×10^5



MC simulations – particles from everywhere

$^{12}\text{C}+^{12}\text{C}$ @200MeV/u (CNAO)

Neutrons



	neutrons
target	8.8×10^5
BGO modules	5.3×10^5



Conclusion

During the next test beam at CNAO It could be possible to **repeat** some **measurements** present **in the literature** about neutron production in $p+^{12}\text{C}$ and $^{12}\text{C}+^{12}\text{C}$ reactions:

- $^{12}\text{C} + ^{12}\text{C}$ @ 5, 30 and 80 deg. with **energy** of **135** and **290 MeV/u**

These tests will provide the information about the feasibility of detecting neutrons with the present setup and with other detectors.

Dedicated simulations are being generated.

Preliminary studies show the need for a shielding around the ancillary detectors at 5, 30 and 80 deg.



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Cristian Massimi

Department of Physics and Astronomy

cristian.massimi@unibo.it

www.unibo.it