Update on GeNIALE

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ARPG

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SMF and BLOB

SMF (Stochastic Mean Field)

- Developed by Maria Colonna (INFN LNS, Catania)
- describes the time evolution of the density distribution
- involves the implementation of an effective attractive mean-field nuclear interaction
- mean-field is self-consistent, depends on the density
- includes two-bodies correlations through nucleon-nucleon collisions

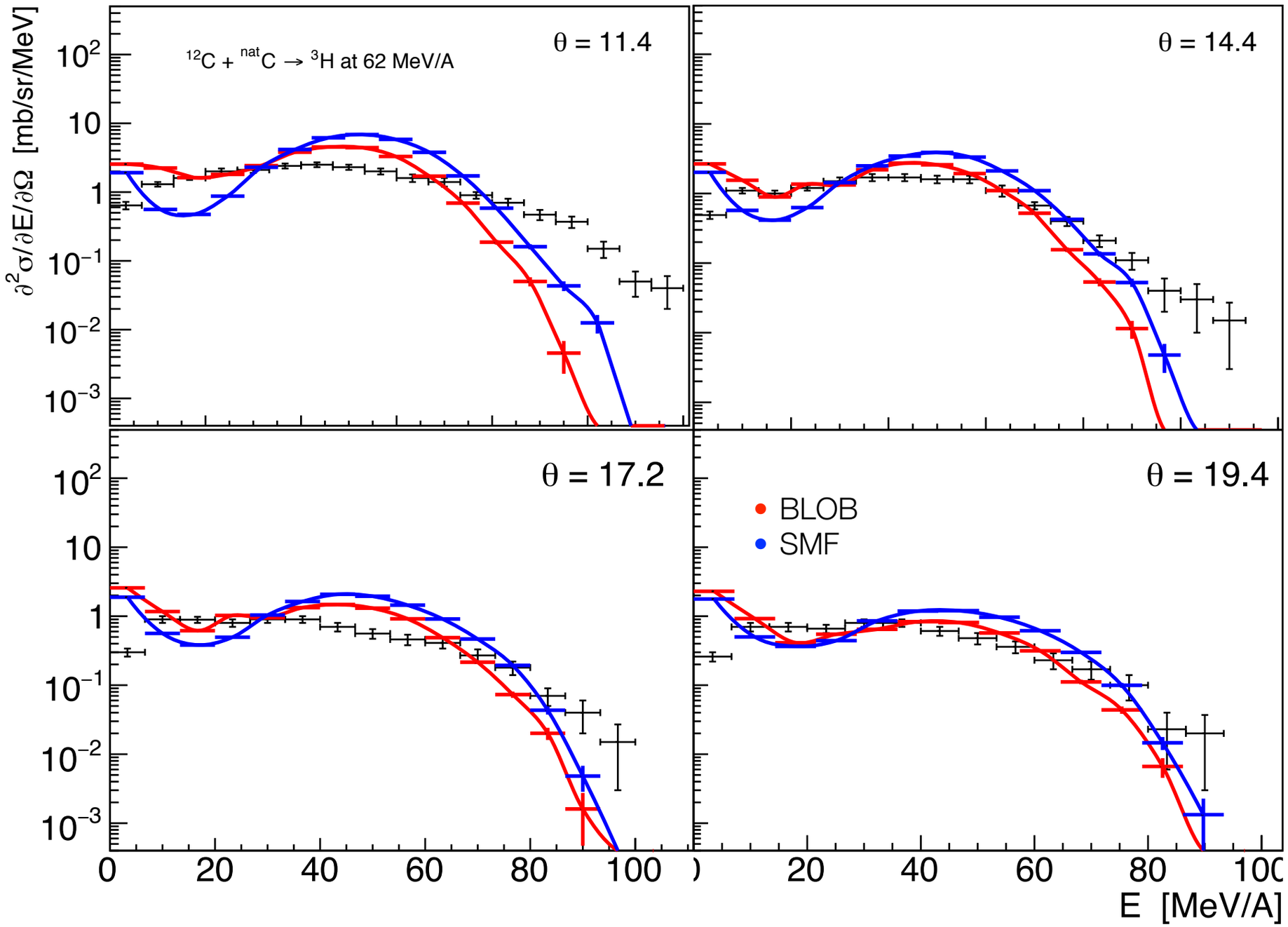
BLOB (Boltzmann-Lagevein One Body)

- Implemented by Paolo Napolitani (IPN, Orsay)
- Derived from SMF
- Adds fluctuations in the dynamics treating the nucleon-nucleon collisions as a stochastic process

Geant4 interface to SMF and BLOB

- Reads the output from SMF/BLOB
- Sample the final state
- Fragments mass and charge
- Gas particles emitted
- It will check momentum and energy conservation
- Applies Geant4 de-excitation to excited fragments

Interfacing SMF and BLOB to Geant4



[Exp. data from De Napoli et al. Phys. Med. Biol., vol. 57, no. 22, pp. 7651–7671, Nov. 2012]

preliminary

- Similar results between SMF and BLOB

Coalescence

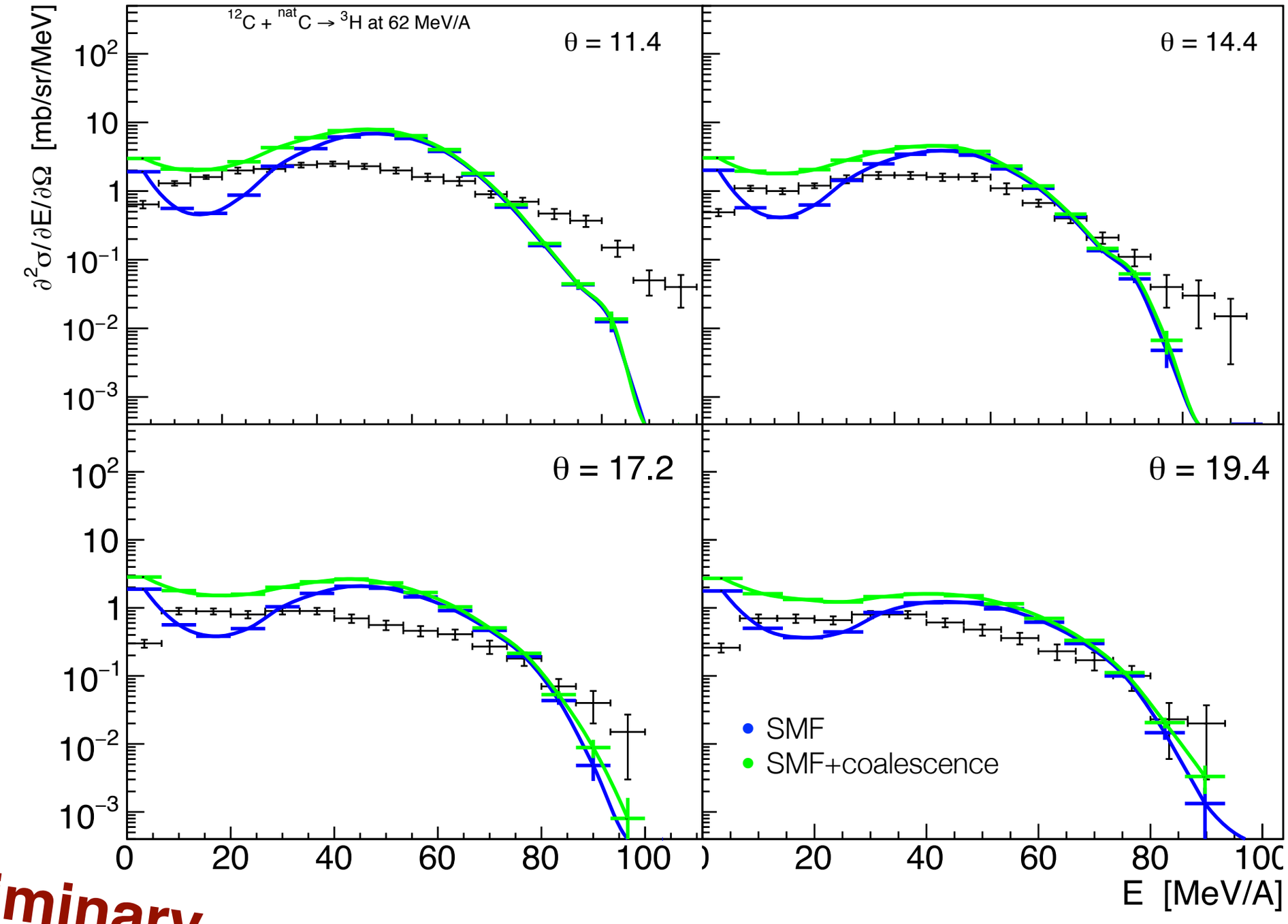
- SMF and BLOB do not have more than two bodies interaction

- I.e. they can’t simulate d, t and α production

- To insert more than two bodies correlation in an effective way, a coalescence phase has been implemented between SMF/BLOB and the de-excitation phase

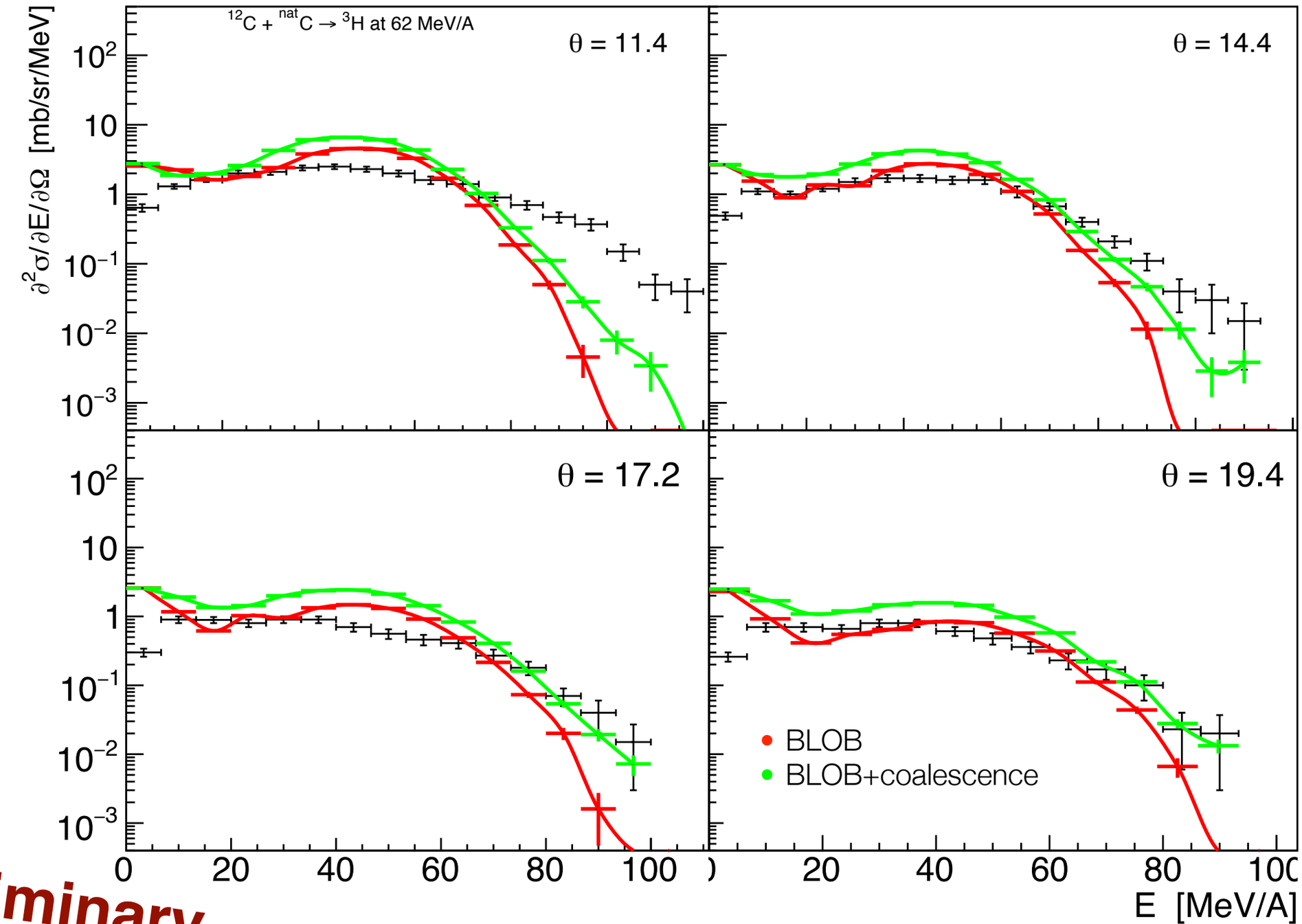
- If two nucleons are closer than 8fm they are coalesced

Tritium production



preliminary

Tritium production

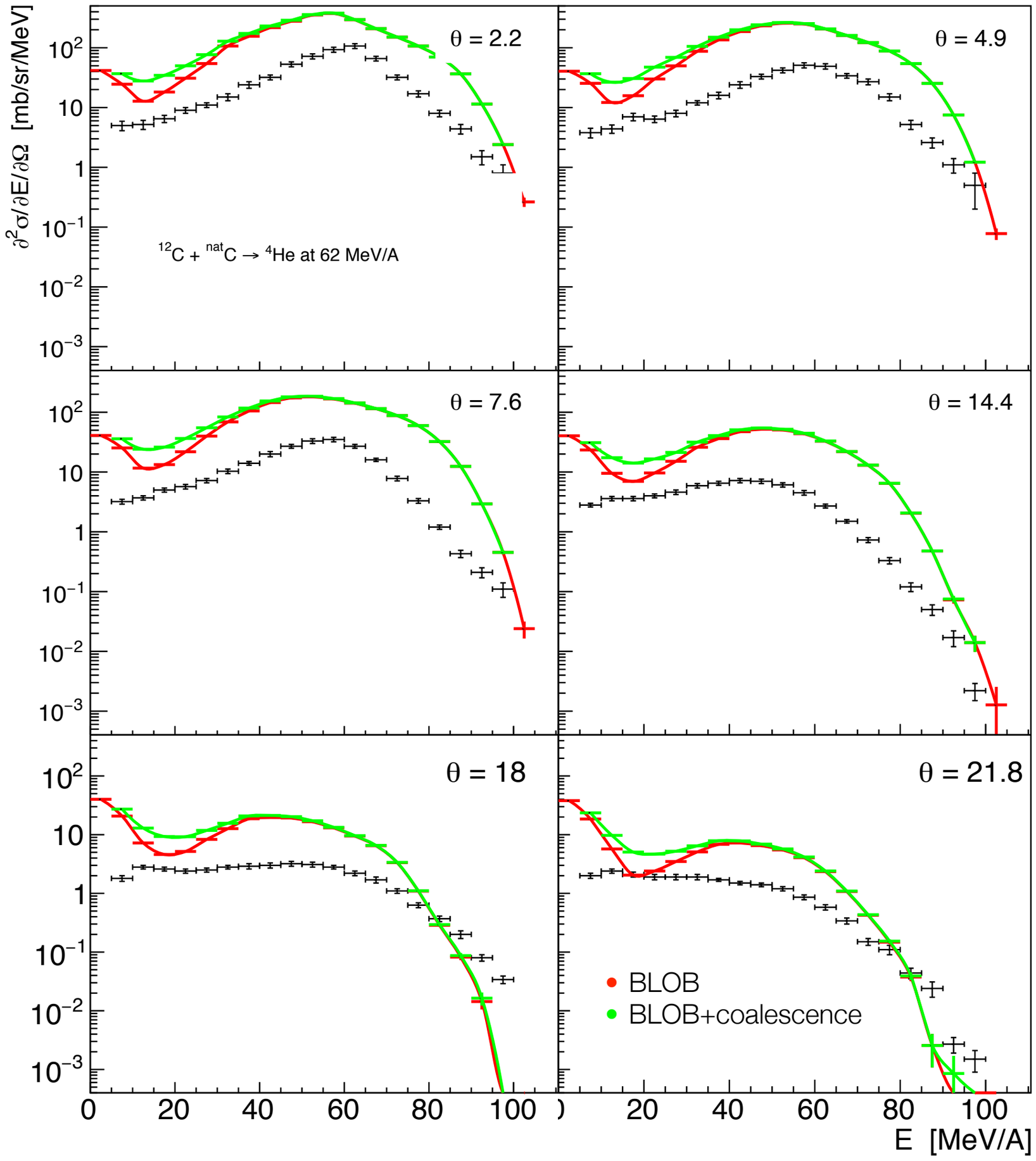


preliminary

α production

- Coalescence mitigates the gap between projectile and target fragments

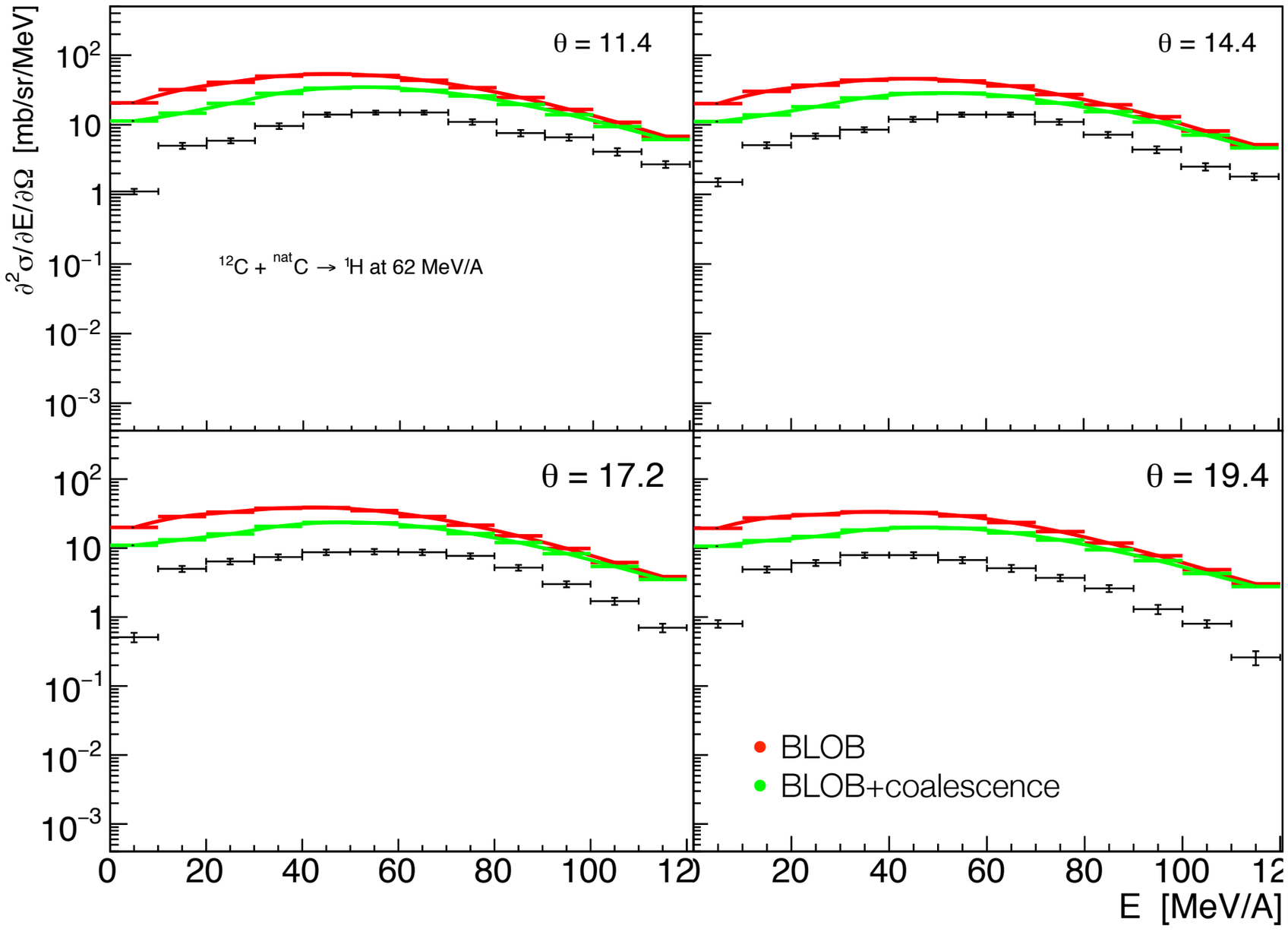
preliminary



Proton production

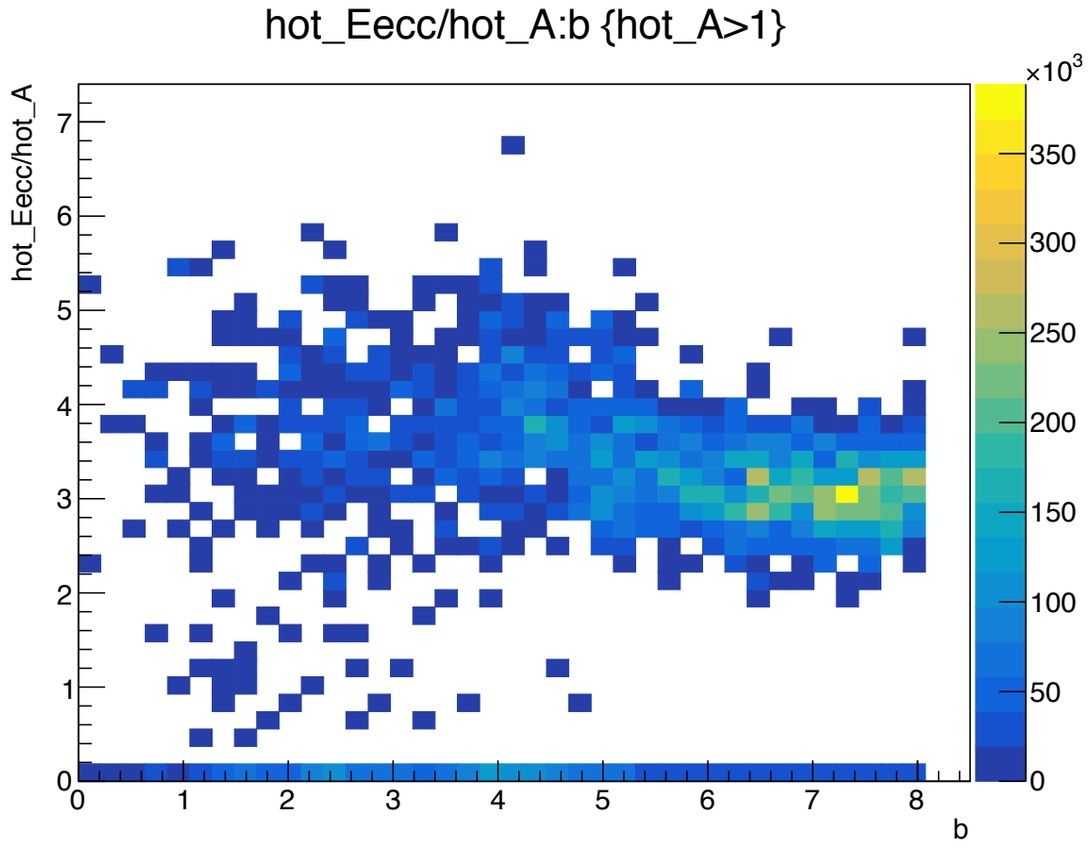
- The coalescence reduces the excess of proton

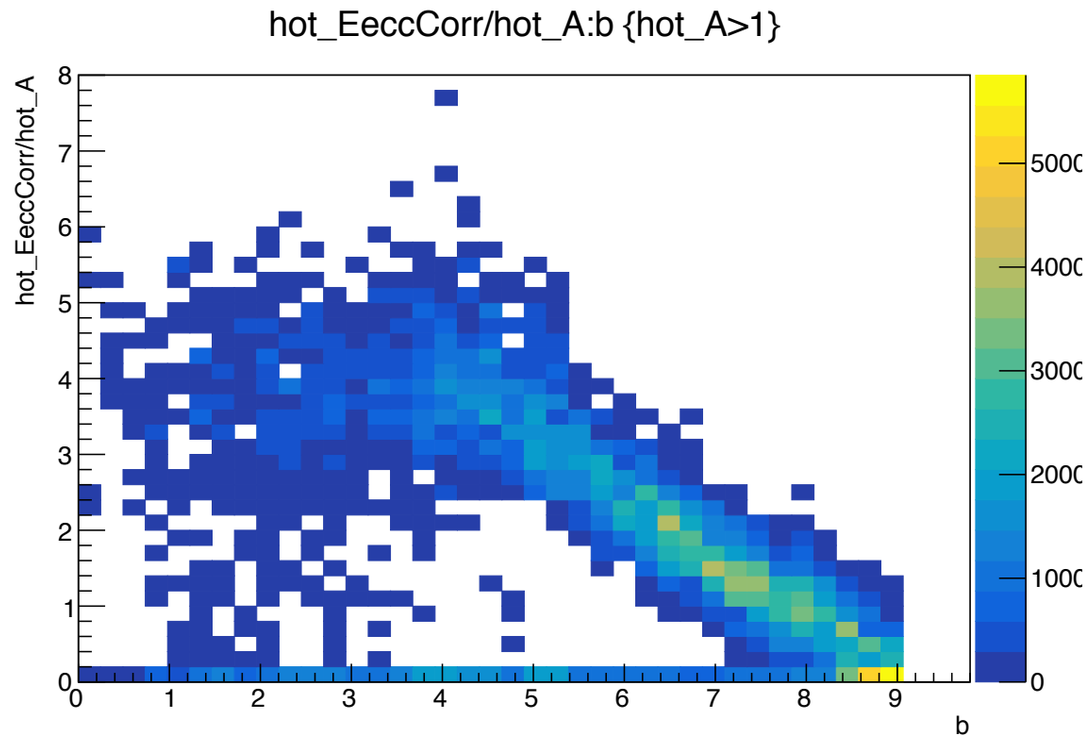
preliminary



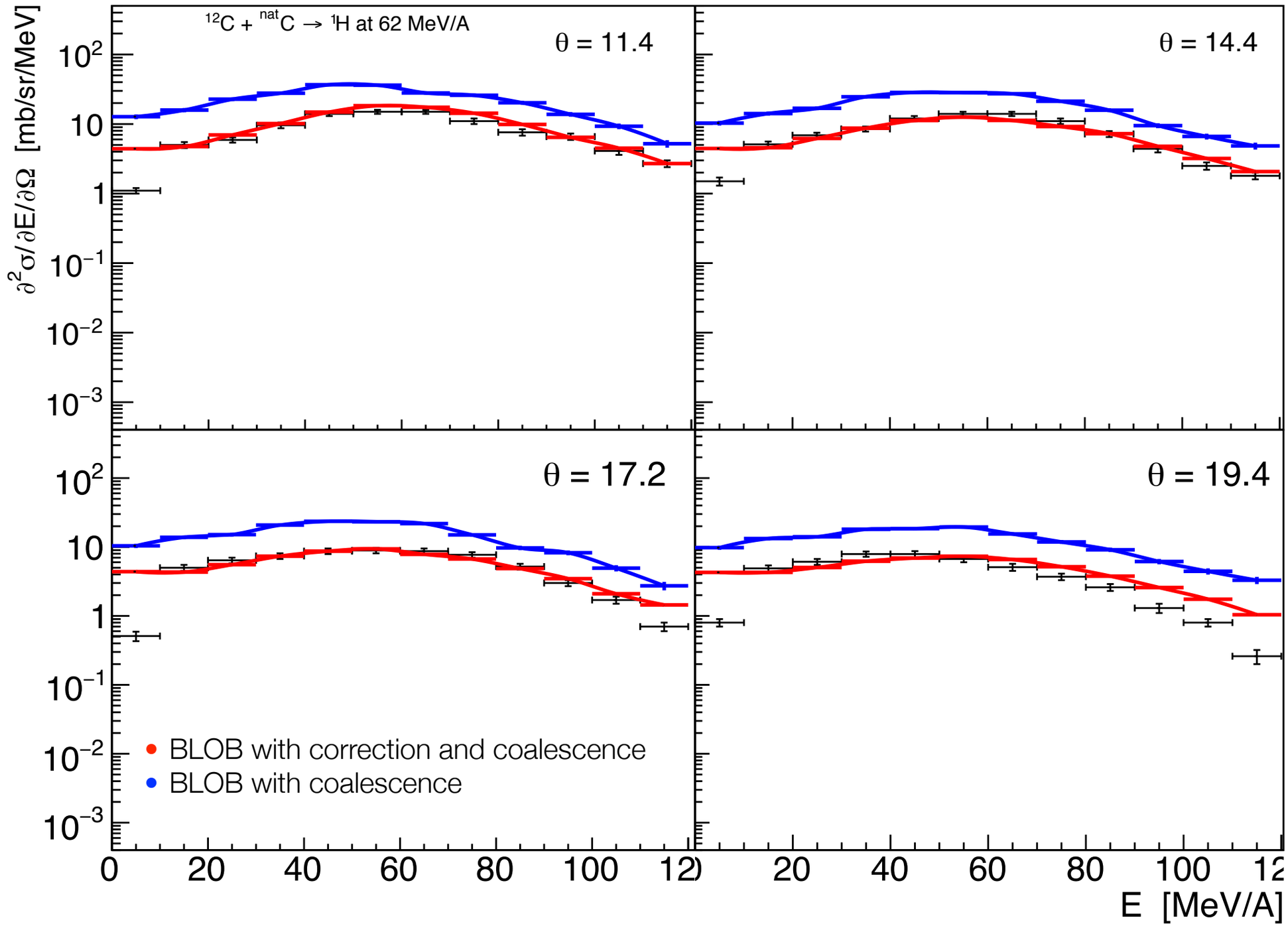
Excitation energy correction

- SMF and BLOB tend to overestimate the excitation energy
- Especially for peripherals interaction
- A correction to the excitation energy has been applied
- Linear with b
- Up to 3 MeV/A

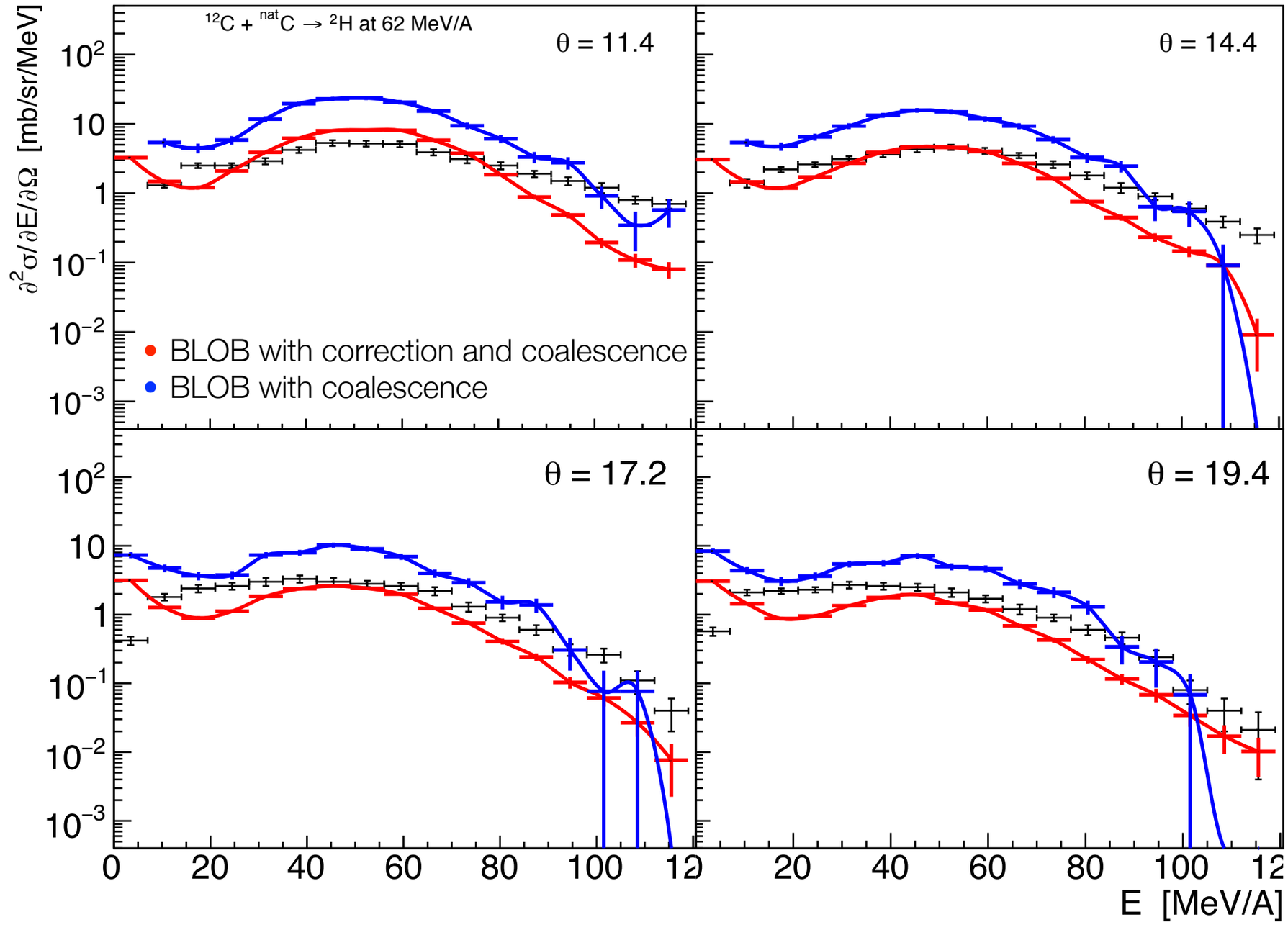




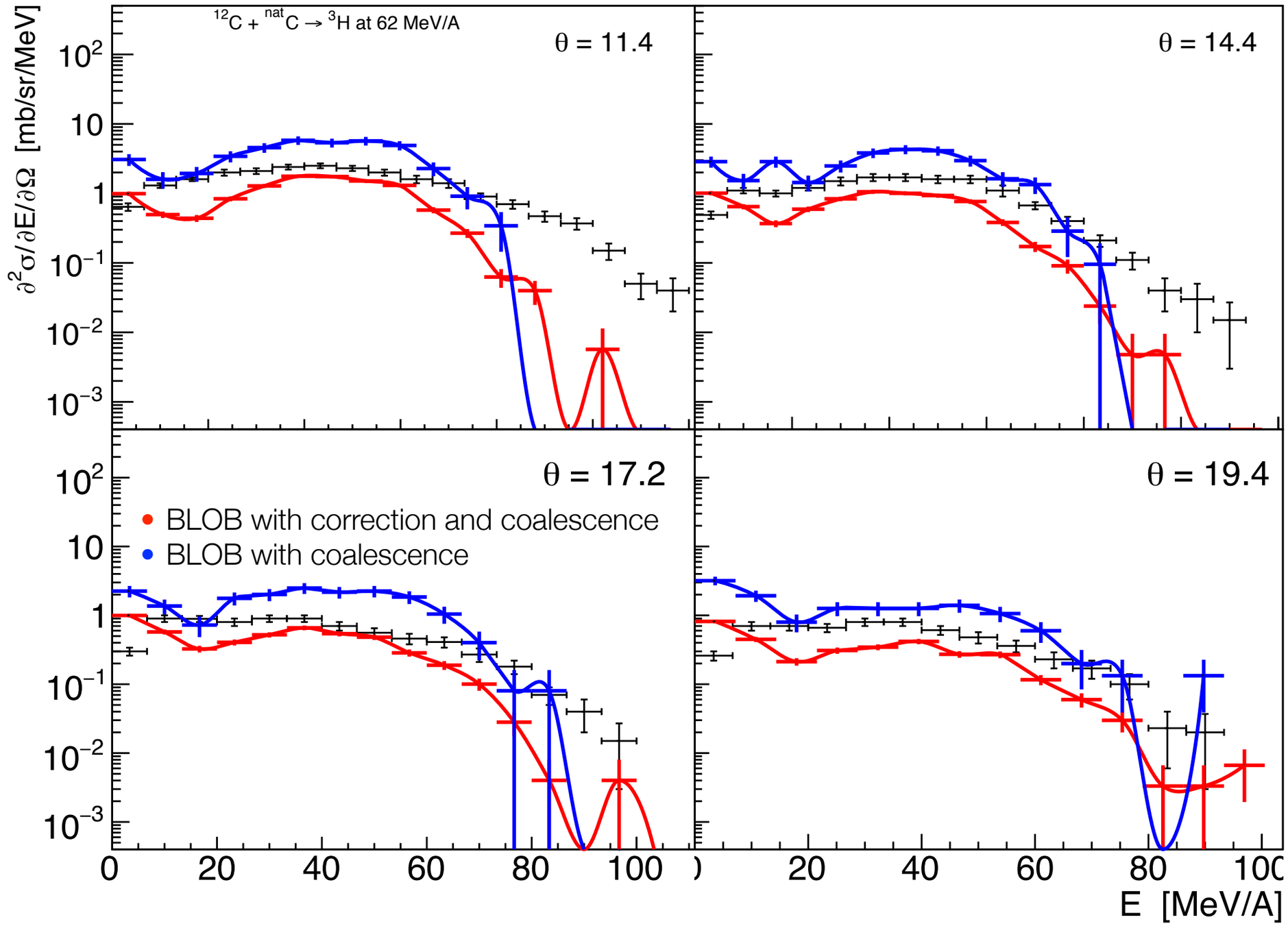
Proton production (E corr + coalescence)



Deuterium


$^{12}C + ^{nat}C \rightarrow ^{2}H$ at 62 MeV/A
θ = 11.4
θ = 14.4
θ = 17.2
θ = 19.4
BLOB with correction and coalescence
BLOB with coalescence
$\partial^2\sigma/\partial E/\partial\Omega$ [mb/sr/MeV]
E [MeV/A]

Tritium


$^{12}C + ^{nat}C \rightarrow ^{3}H$ at 62 MeV/A
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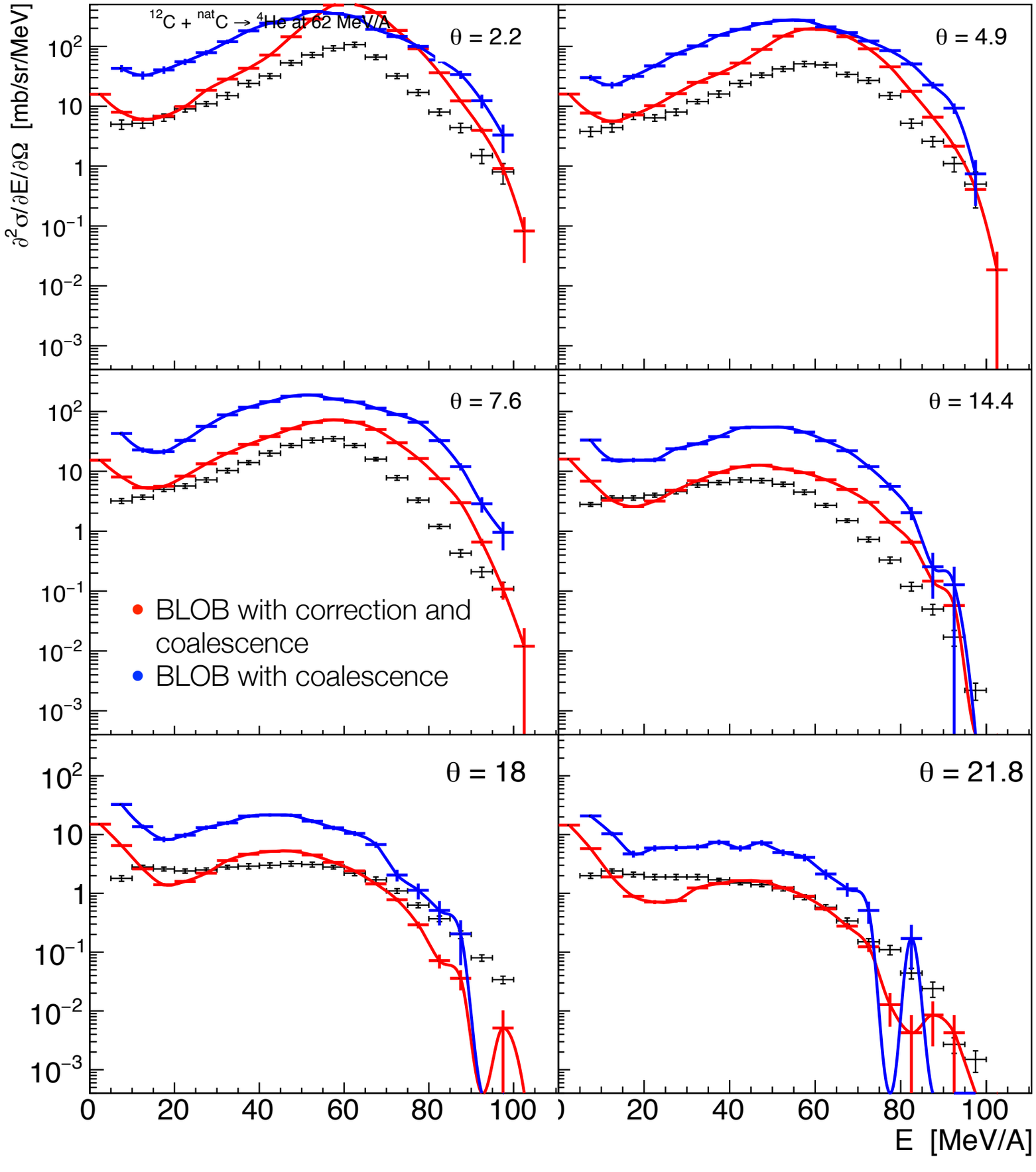
BLOB with correction and coalescence
BLOB with coalescence
$\partial^2\sigma/\partial E/\partial\Omega$ [mb/sr/MeV]
E [MeV/A]

alpha


$^{12}C + ^{nat}C \rightarrow ^{4}He$ at 62 MeV/A
θ = 2.2
θ = 4.9
θ = 7.6
θ = 14.4
θ = 18
θ = 21.8
$\partial^2\sigma/\partial E/\partial\Omega$ [mb/sr/MeV]
BLOB with correction and coalescence
BLOB with coalescence
E [MeV/A]

Increasing test particles number

- Increasing the test particles number (from 100 per nucleon to 500 per nucleon) the excitation energy problem is mitigated

- At the moment it is not possible to increase the number of test particle even further (the arrays are not all dynamically allocated)

- However simulate a final state (it is possible to sample from each ~100 reactions) takes 5 mins

Short term plans

- Increase number of test particles
- Test changing test particle cross section and surface coefficient
- Dissolve the few d, t and α produced by SMF/BLOB before coalescence

Not-so-long-term plans

- Apply for a Marie Curie Global Fellow
- 2 years at SLAC
- To port the code on GPU