Coincidence efficiency calculation using MCEEP

Hall A analysis workshop
June 2008

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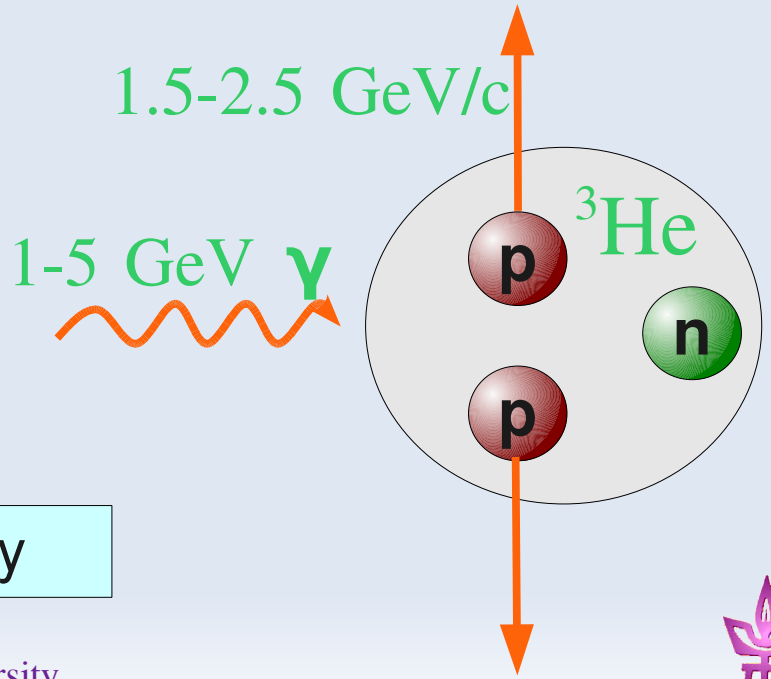
The experiment

- In June 2007, in JLab Hall A, We measured the cross section of the reaction:

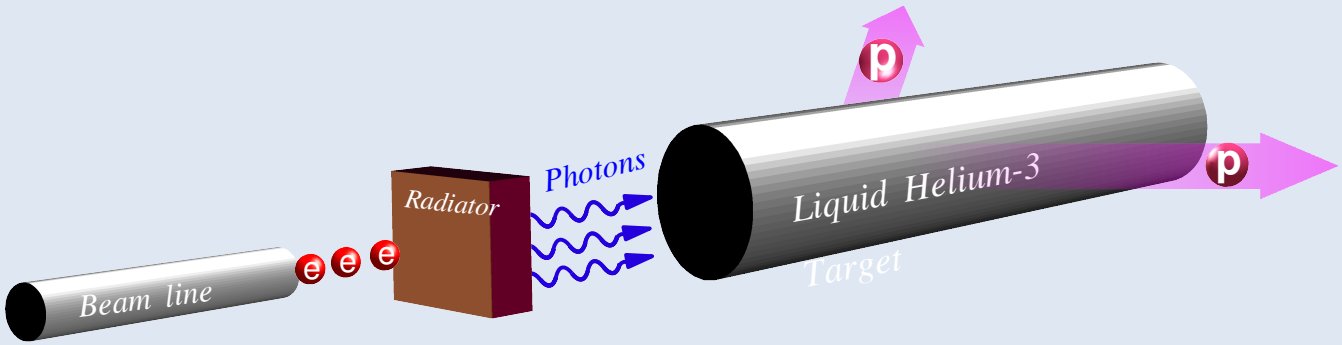
$$\gamma\ {}^{3}\mathrm{He} \rightarrow p(\text{high } p_t) + p(\text{high } p_t) + n(\text{slow})$$

- In this setup, the two protons emerge with high momentum in the transverse direction, while the neutron remain a “spectator”.
- The main experimental goal is to find the origin of this high transverse momentum.



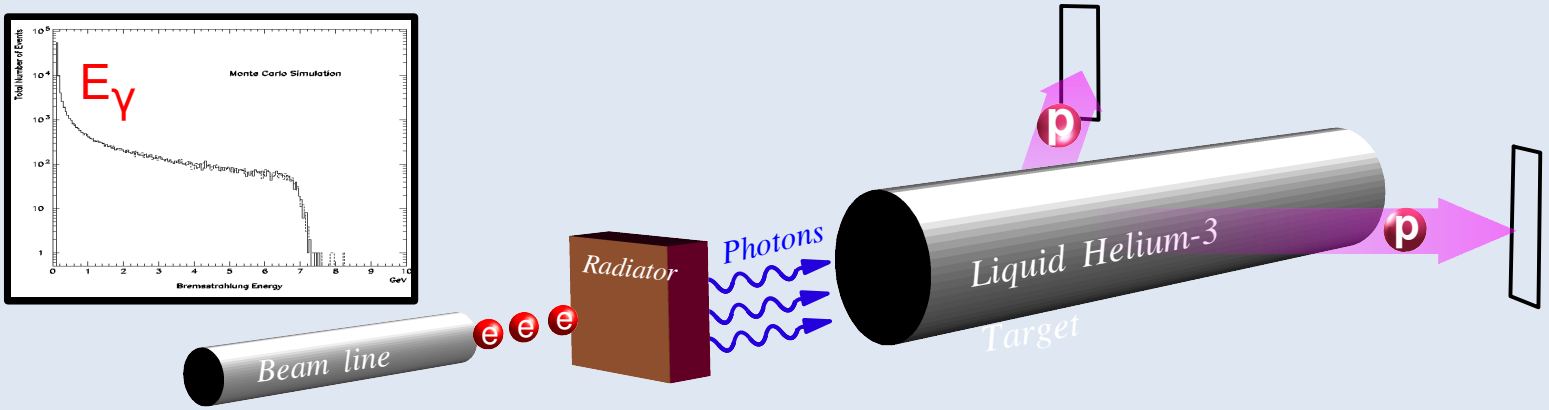
Spokespersons: Ron Gilman and Eli Piasetzky

Coincidence efficiency calculation



Coincidence efficiency calculation

- We set the spectrometers to detect events in which two protons emerged in coincidence. The edge of the HRS acceptance is set to detect a pair at rest disintegrated in 90^{o} c.m. from a photon with $E\gamma=E_{Beam}$.



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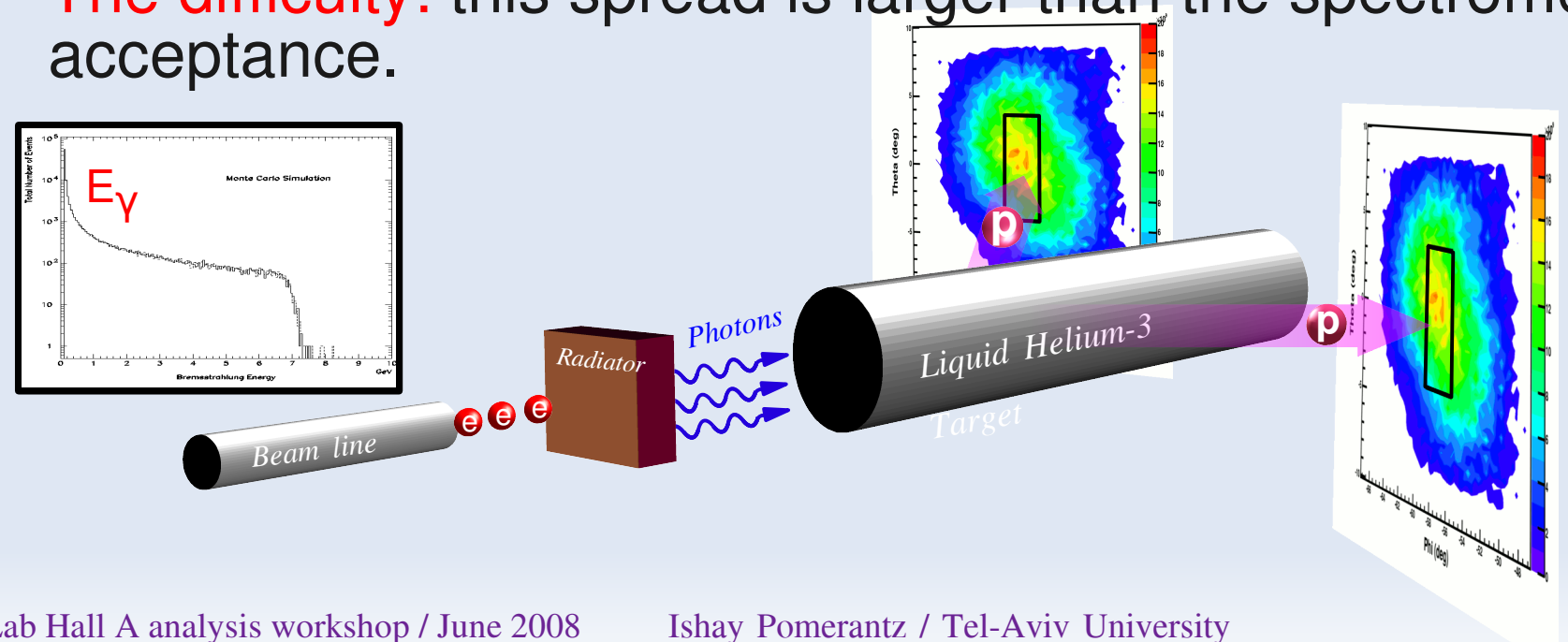
- The fermi motion of the proton pair and the $E\gamma$ spectrum results in a spread of the phase-space distribution of the outgoing protons.
- The difficulty: this spread is larger than the spectrometers acceptance.



Coincidence efficiency calculation

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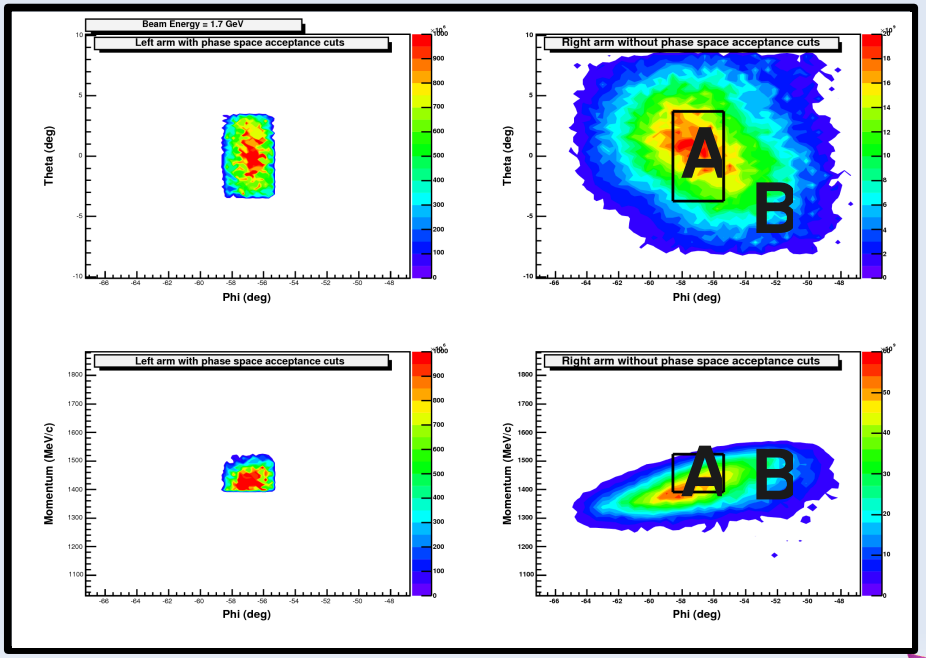
- A simulation will answer the following question: “if one proton has been detected in one HRS, what is the probability that the other proton will be detected in the other HRS ?”.
- $f_{coinc} = A/B$

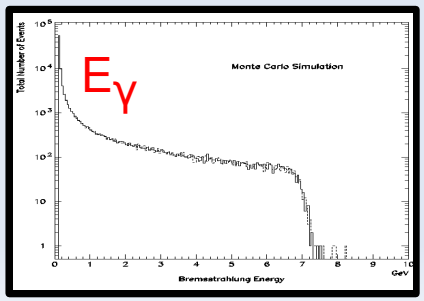


Coincidence efficiency calculation

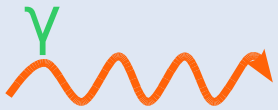
- MCEEP: Monte Carlo for (e,e'p) , the standard Hall A simulation software.
- Modifications based on work done by Lingyan Zhu in Jlab experiment E94-104, "Exclusive Photoproduction of Charged Pions in Hydrogen and Deuterium".
- Account for kinematics, cross section and bremsstrahlung photon yield calculation of a two-body photo-reaction.

Coincidence efficiency calculation

- MCEEP ingredients:
  - Randomly pick photon energy from a 140 MeV bin near the tip of the bremsstrahlung spectra.



E_γ



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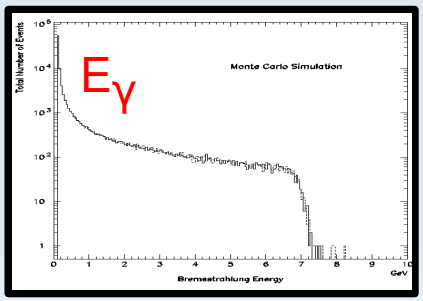

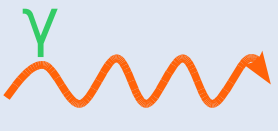

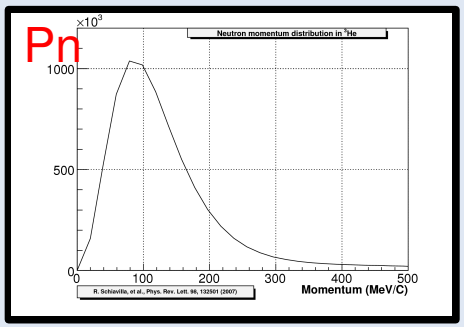

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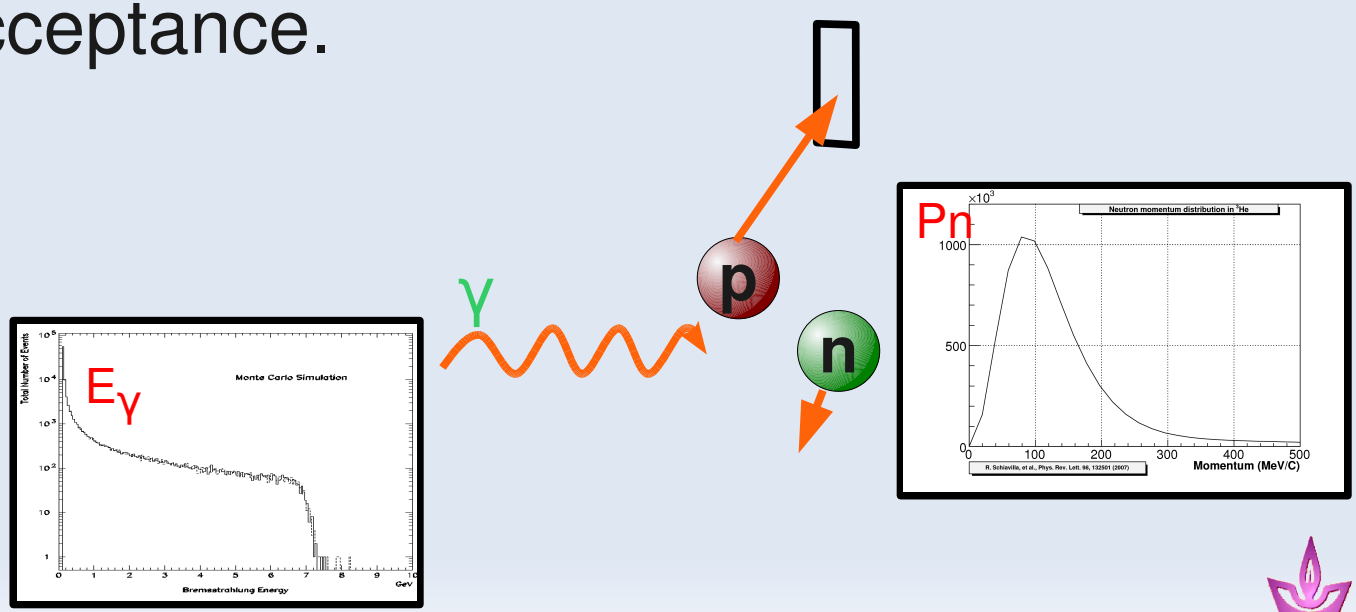

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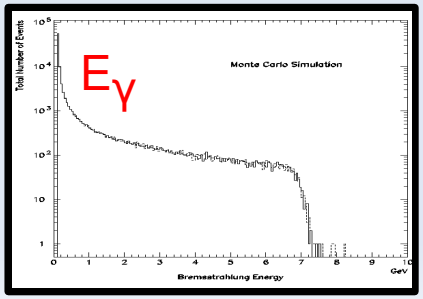
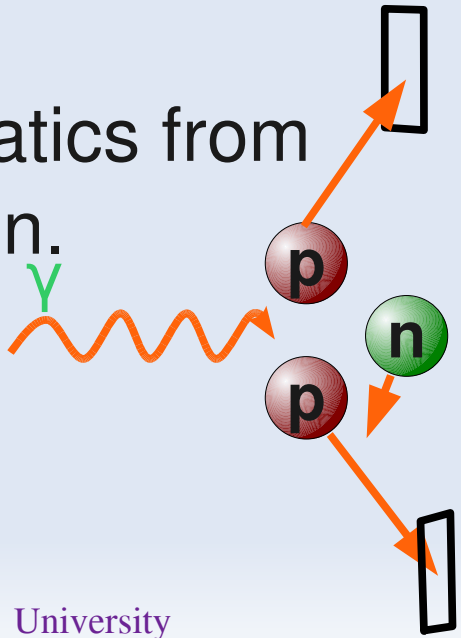
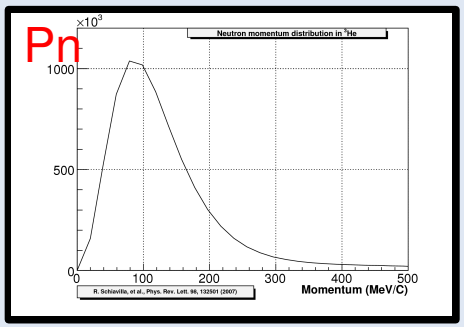
  - Calculate the rest of the kinematics from energy/momentum conservation.

$$E_\gamma + M_{^3He} = E_{P_1} + E_{P_2} + E_n$$
$$\vec{P}_\gamma = \vec{P}_{P_1} + \vec{P}_{P_2} + \vec{P}_n$$

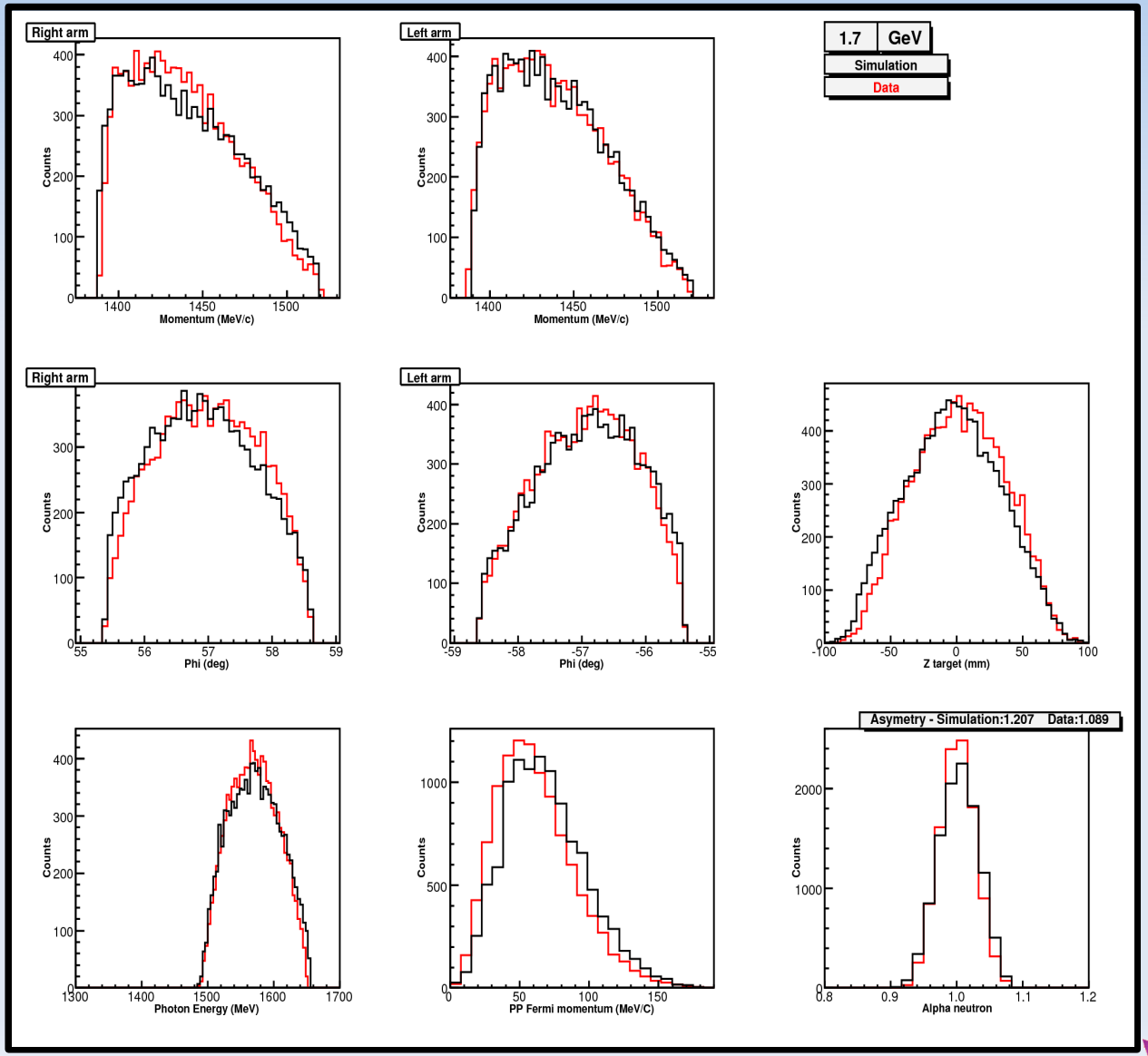






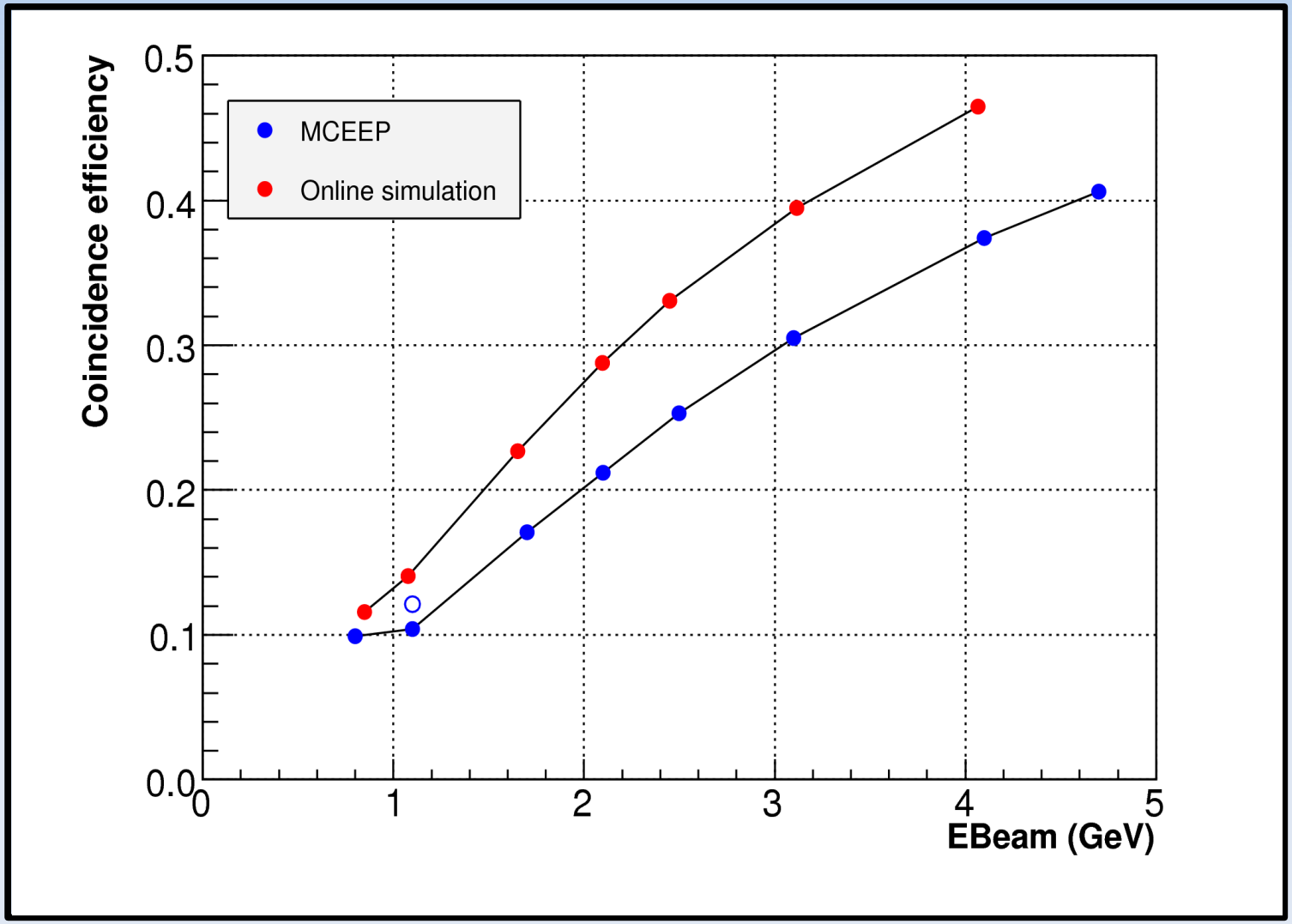
Coincidence efficiency calculation

- Comparison of kinematic variables between data and simulation results



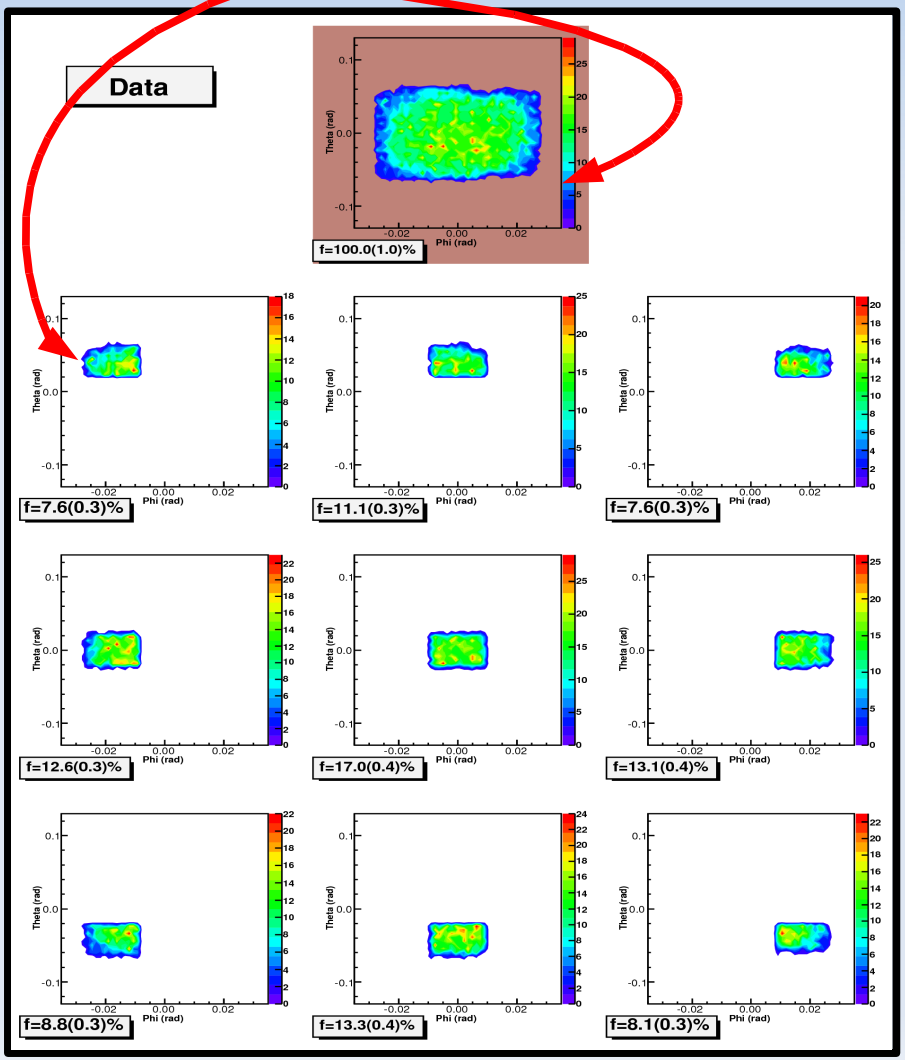
Coincidence efficiency calculation

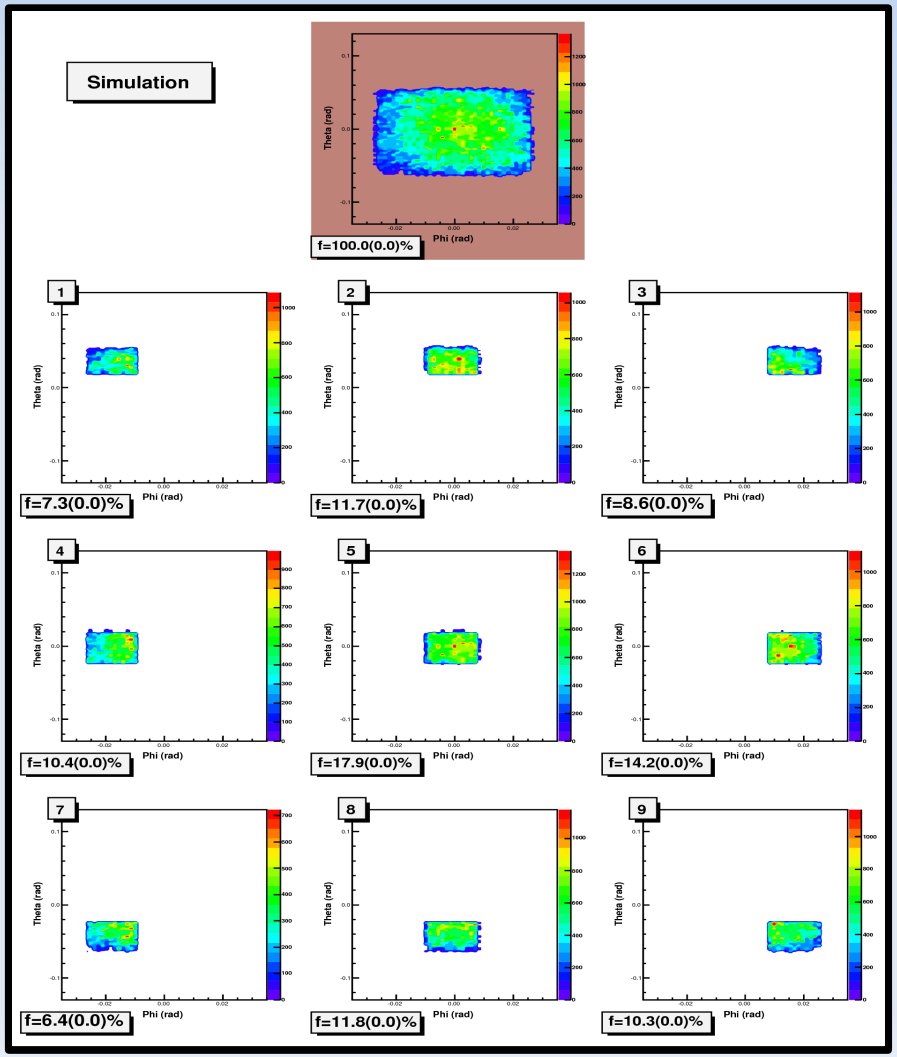
- Results



Coincidence efficiency calculation

- Validity test of the coincidence efficiency value
  - Divide phase space into boxes.
  - Find f=A/B for each box and compare f values between data and simulation.





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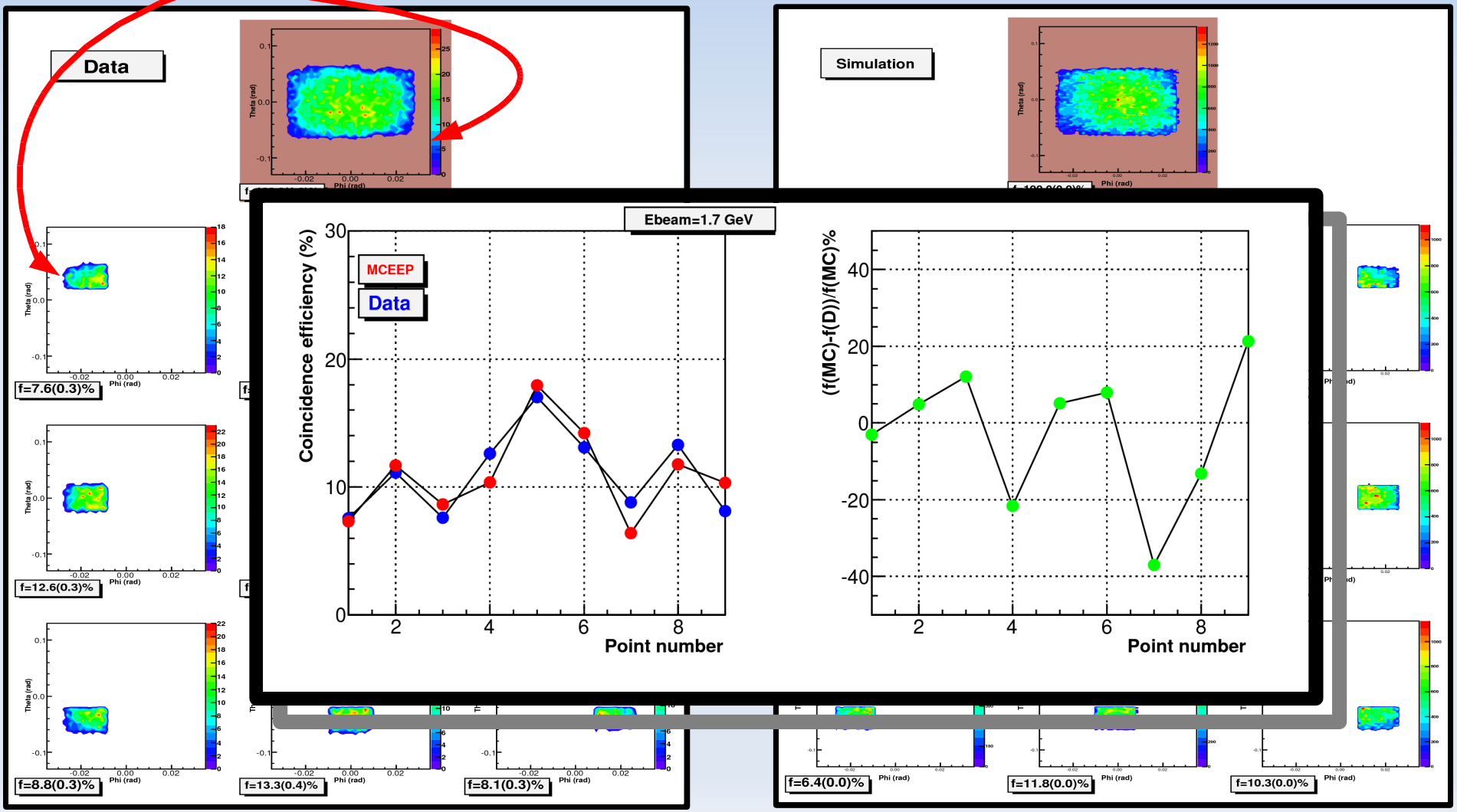

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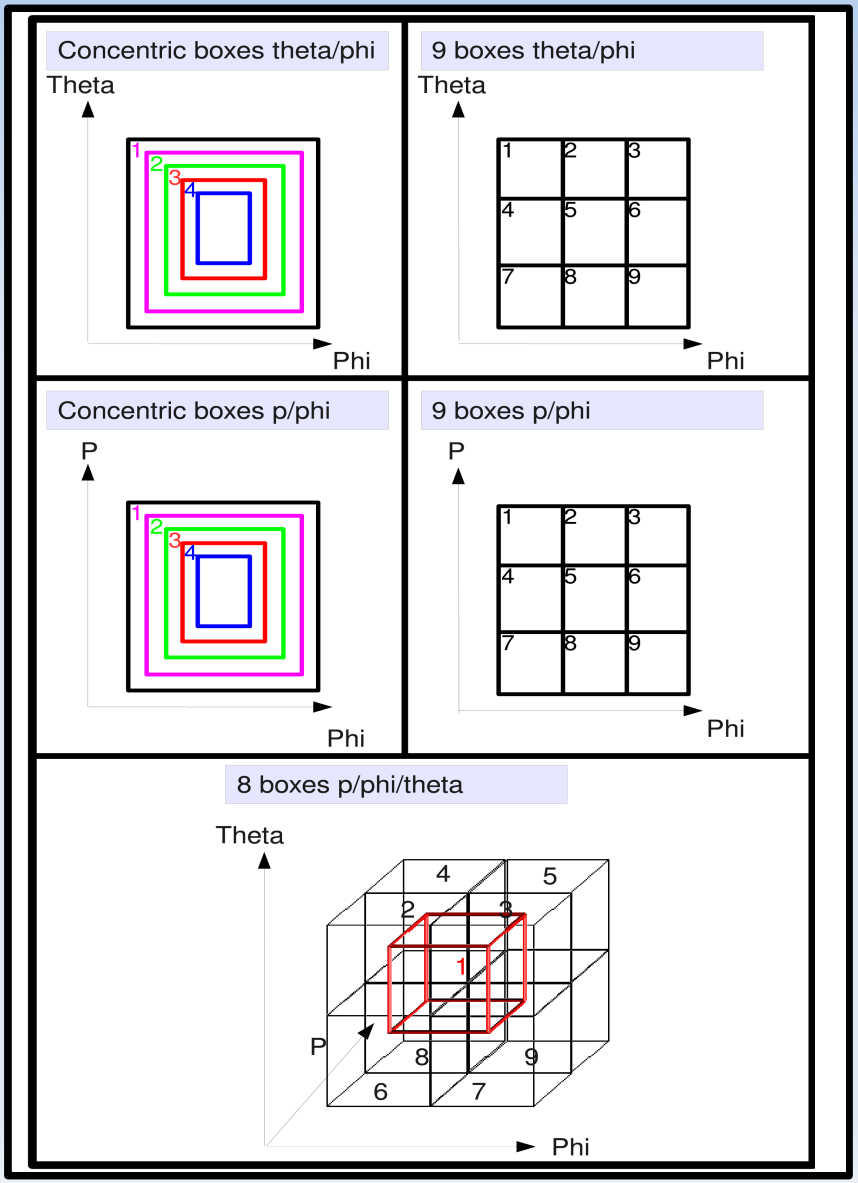

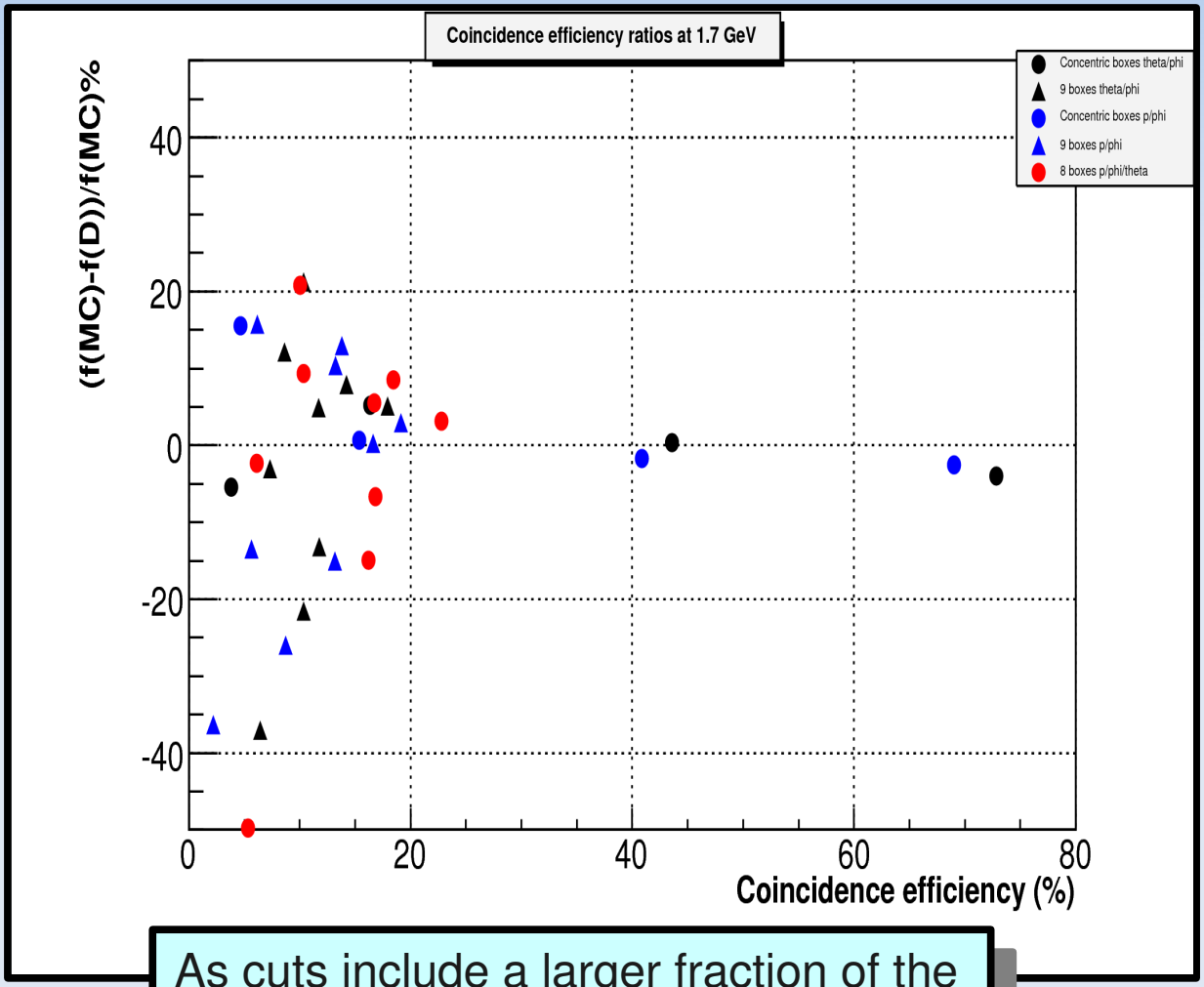

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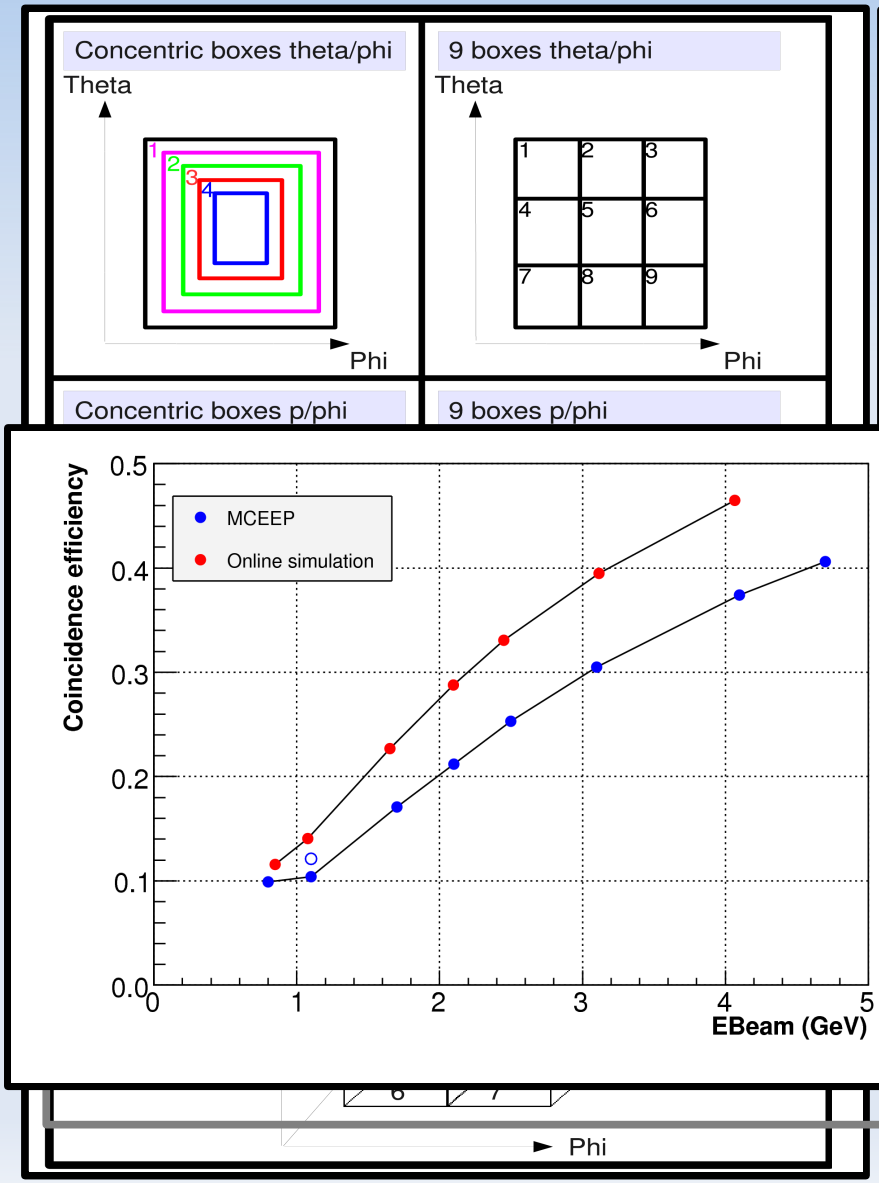

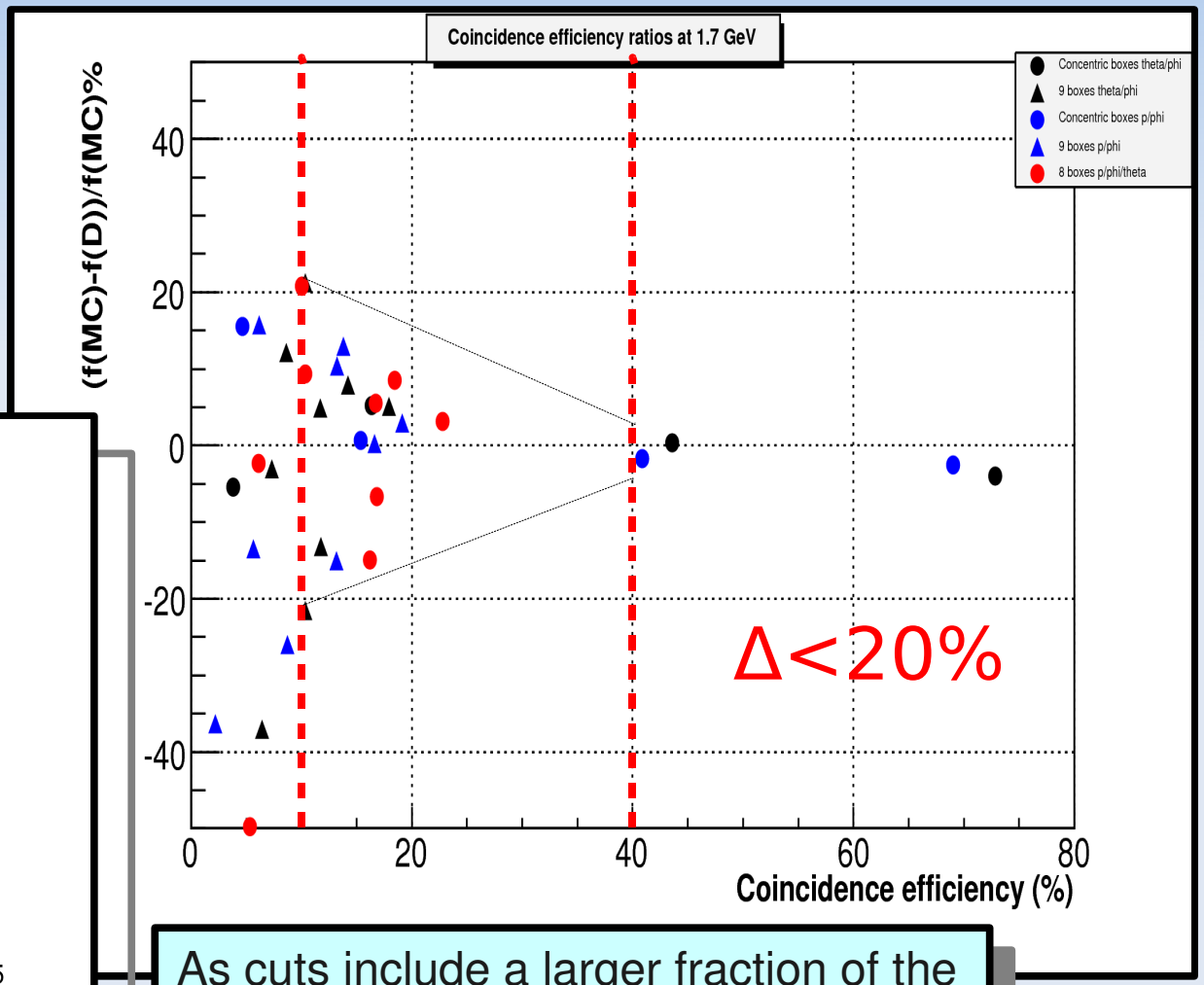

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Thank you