Coherent Diffraction with A-1 Tagging

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Collaborators

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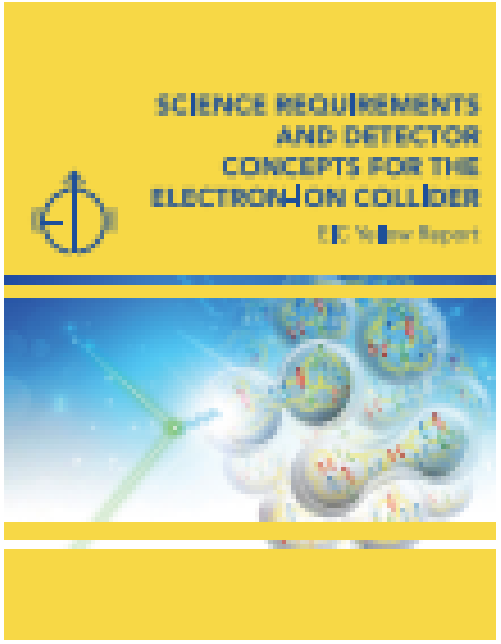
- Advice from: A. Deshpande, R. Ent, M. Strikman, R. Venugopalan, C. Weiss

The Message

- Coherent diffraction is essential to get at G(b).
- Veto tagging the incoherent events is critical.
- Detecting the nuclear remnant (down to A-1) provides a valuable veto tag.
- IP8 with a secondary focus is ideal for this.
- More work is needed for both BeAGLE & Sar*t*re (hopefully supported by Generic EIC R&D).

The importance of coherent diffraction



- Coherent diffraction is sensitive to the spatial distribution of gluons in the nucleus and to gluon saturation.
- The exact map $G(b) \leftrightarrow d^3N/dtdW^2dQ^2$ is not fully understood, but it's clear that we need to measure coherent diffraction!

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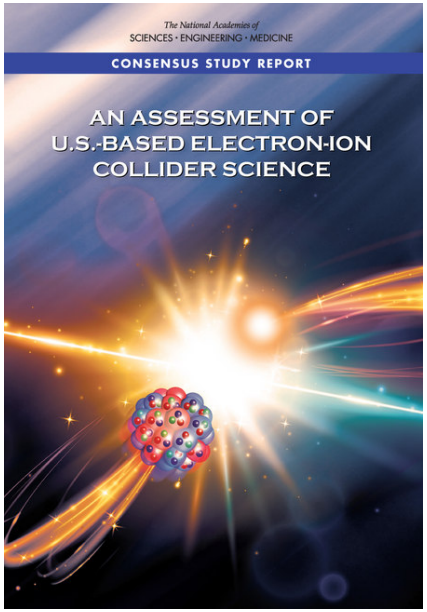
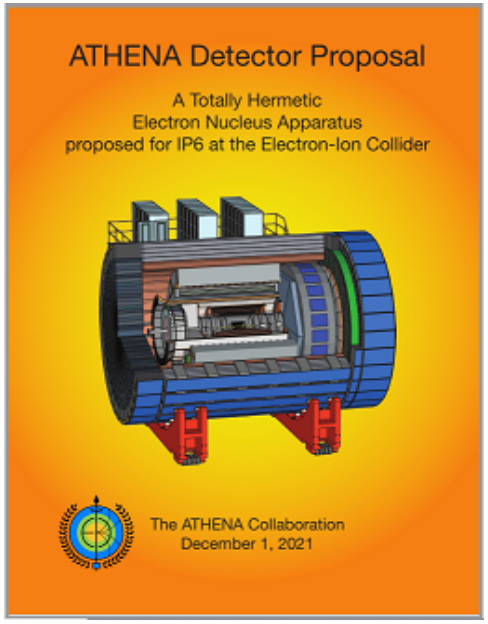
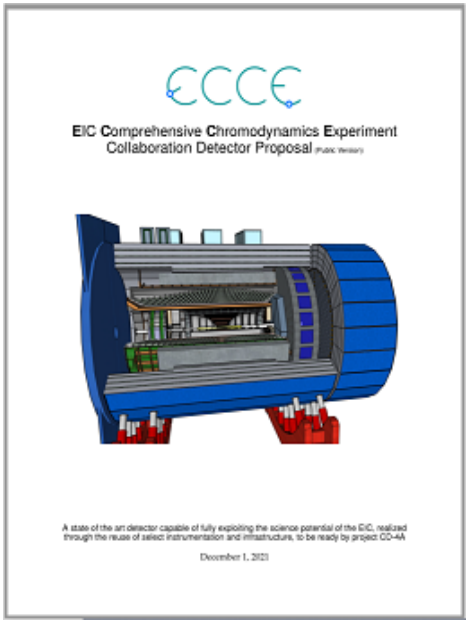


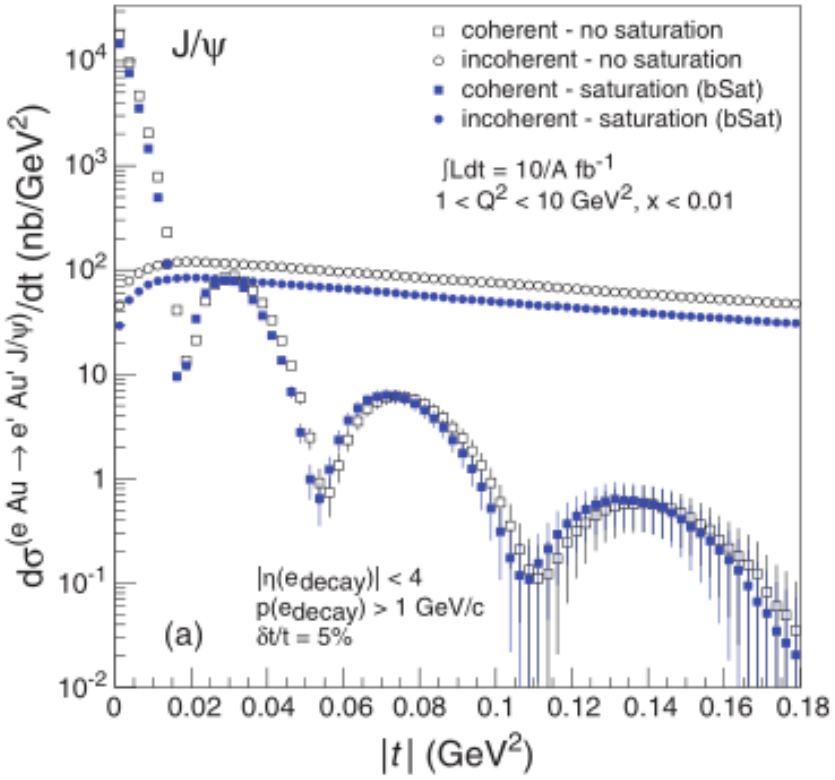




+ ...

Focus on S/B at the PEAKS in sar*t*re

T. Toll, T. Ullrich, PHYSICAL REVIEW C 87, 024913 (2013) and ...



Even if the peaks are shifted and the dips filled in, a good experimental figure of merit is S/B at the peaks after veto. Let's get that to 1:10 or 1:100.

Focus on S/B at the PEAKS in sar*t*re

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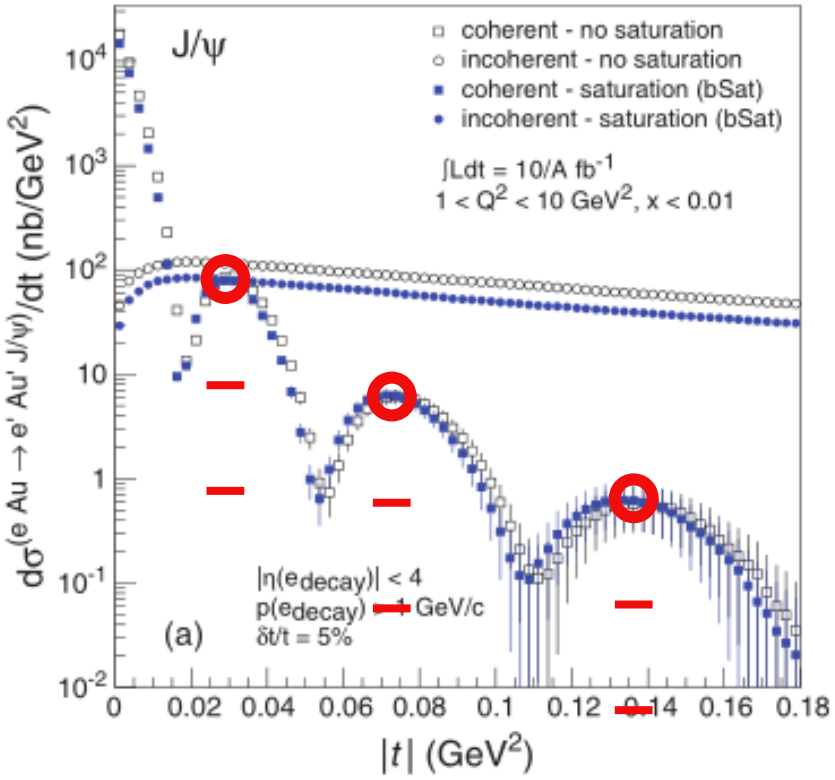

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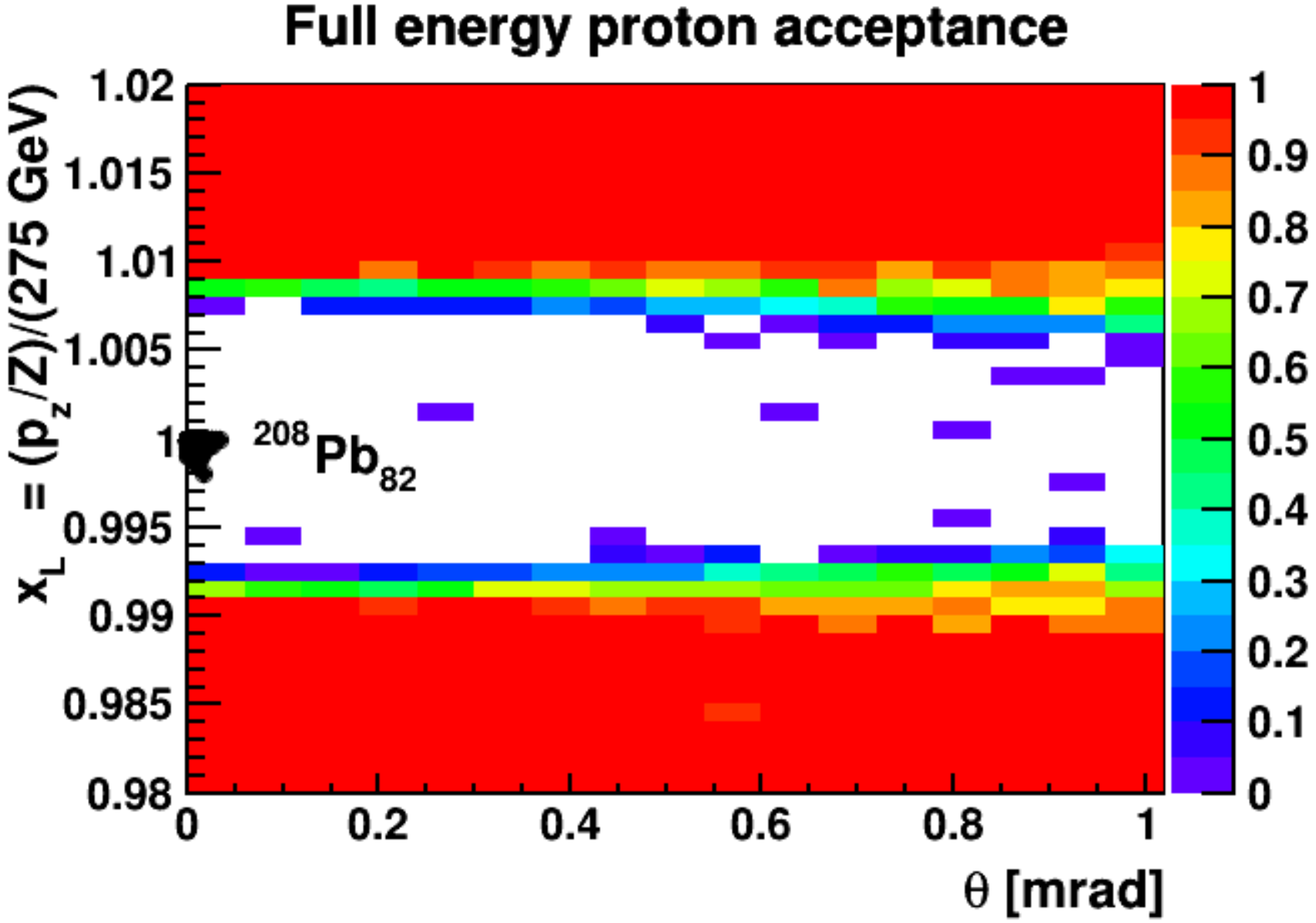
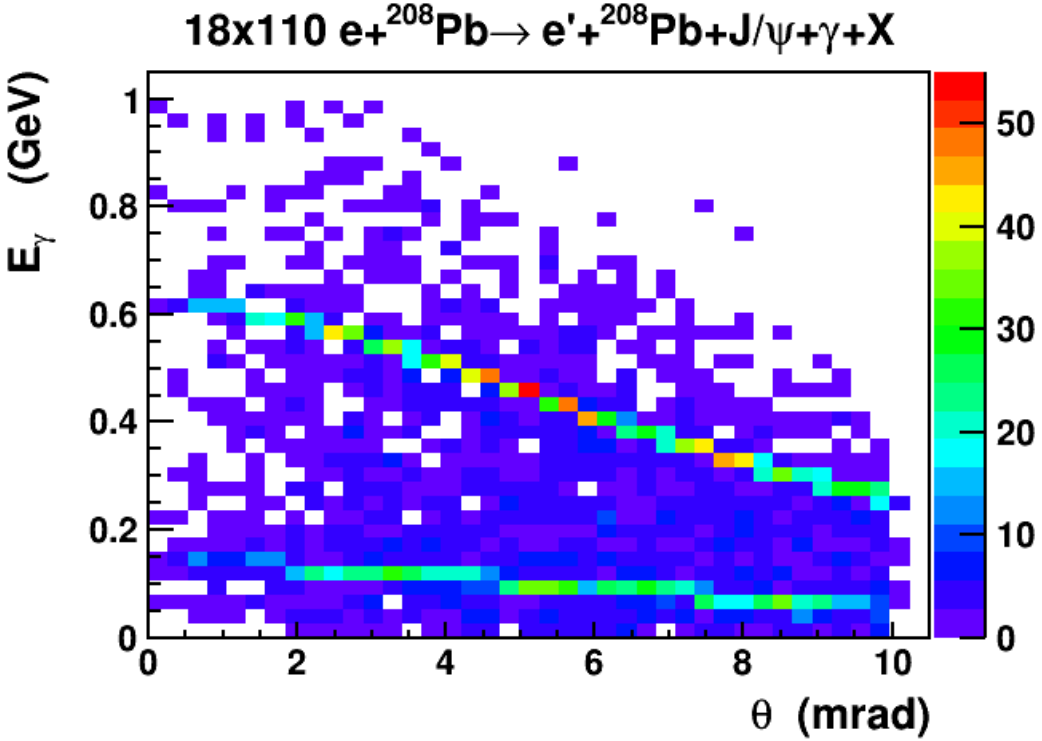
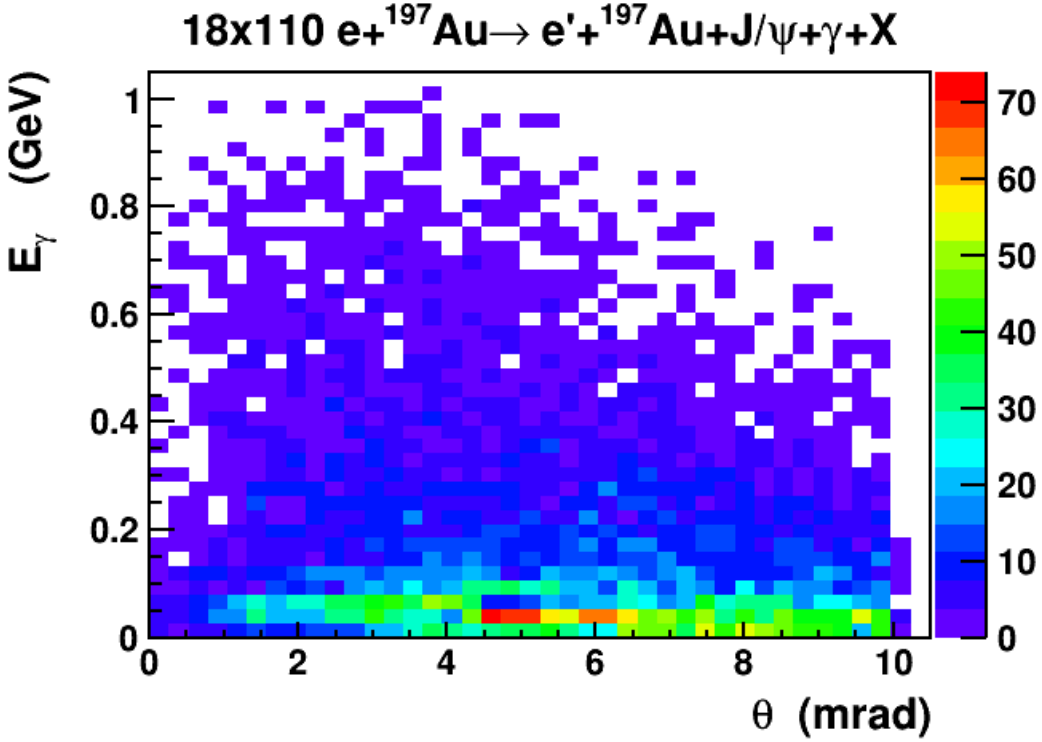
^{208}Pb from e+^{208}Pb J/ψ incoh. Diff. in BeAGLE



CAVEAT : ep acceptance assumed to carry over to ePb

Photons from $^{208}Pb_{82}$ vs. $^{197}Au_{79}$



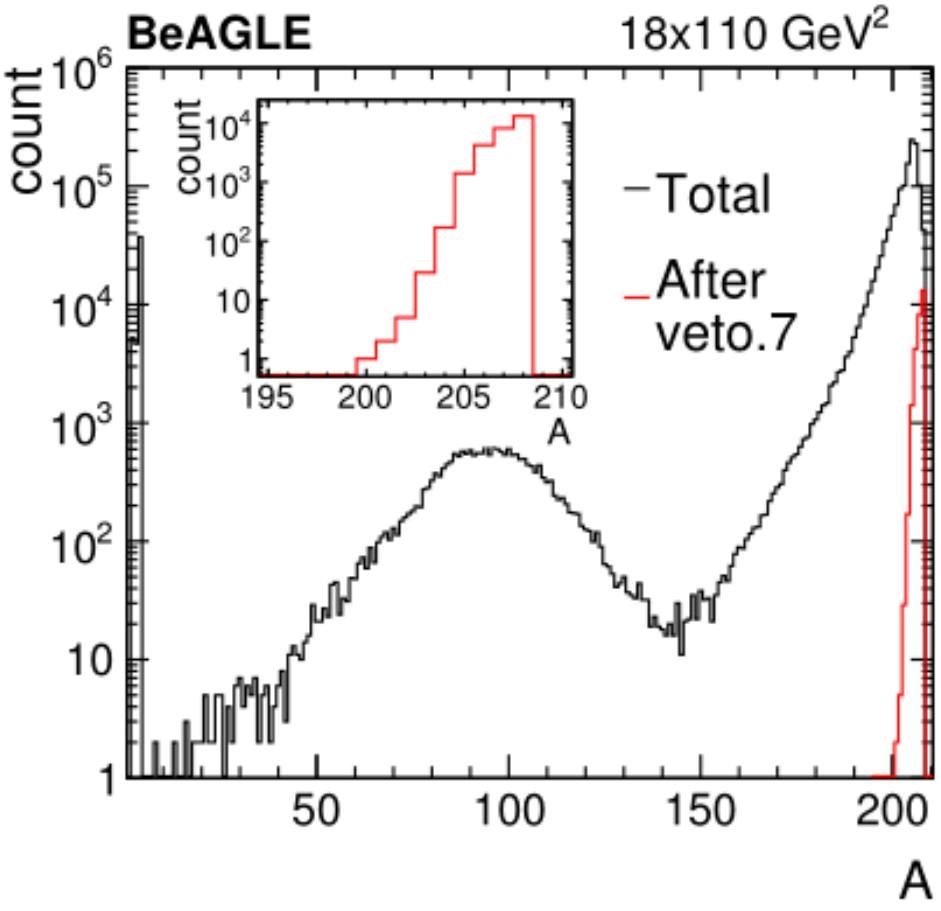


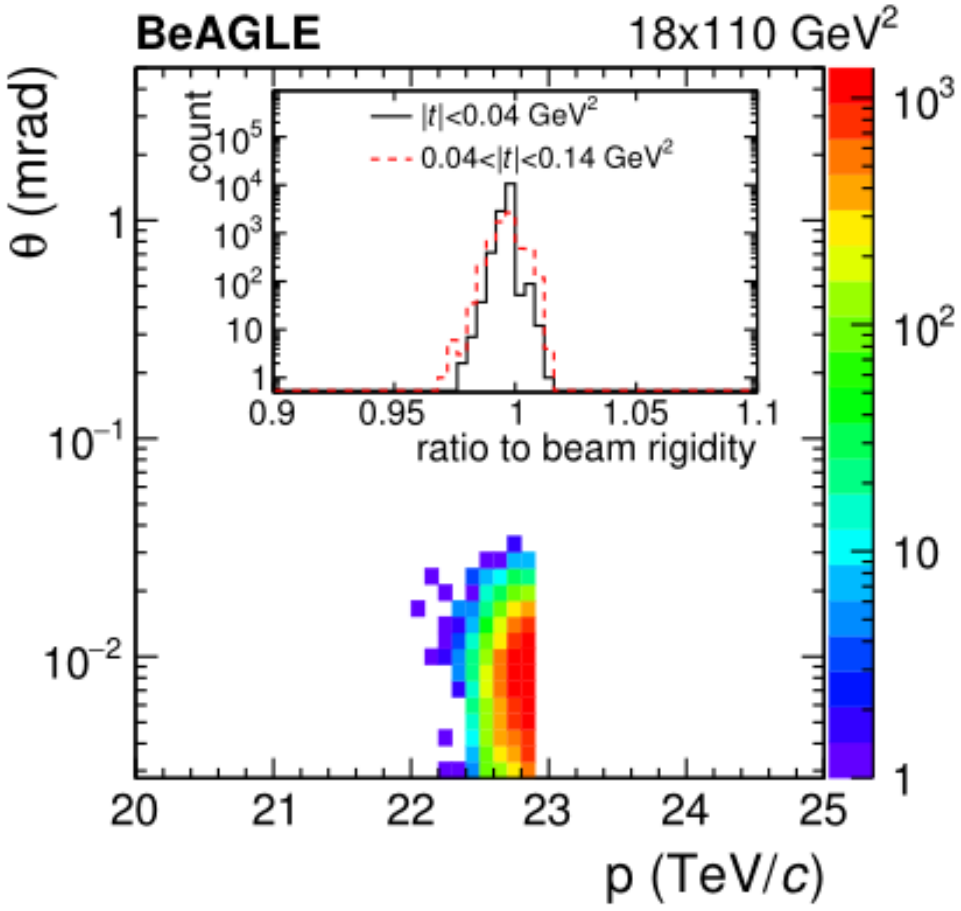
Pb much better than Au because the photons are more energetic!

A look at e+Pb events that are HARD to cut

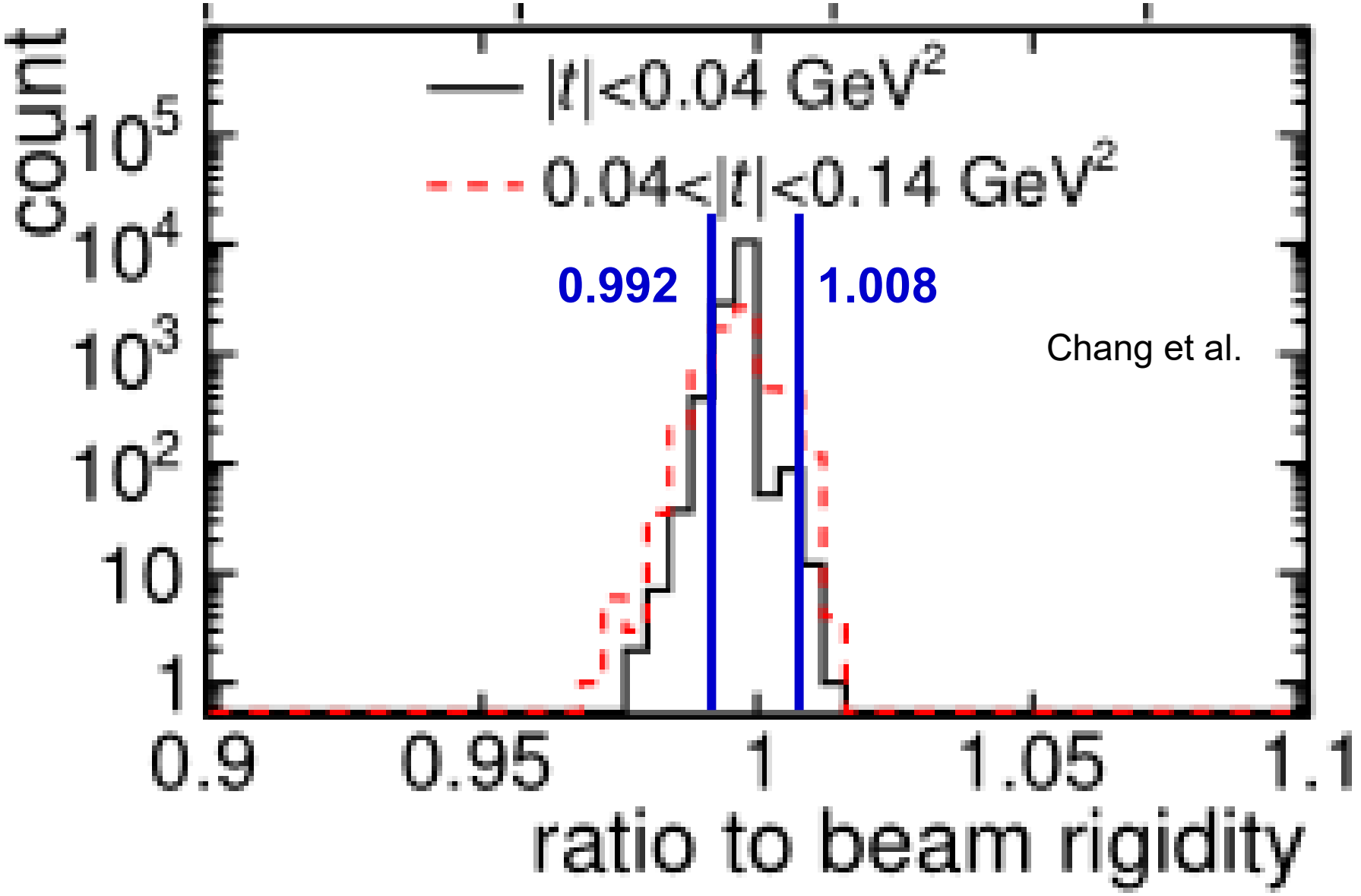
W. Chang et al. Phys.Rev.D 104 (2021) 11, 114030,

Events remaining in IR6 after cuts on forward protons, neutrons, and photons.

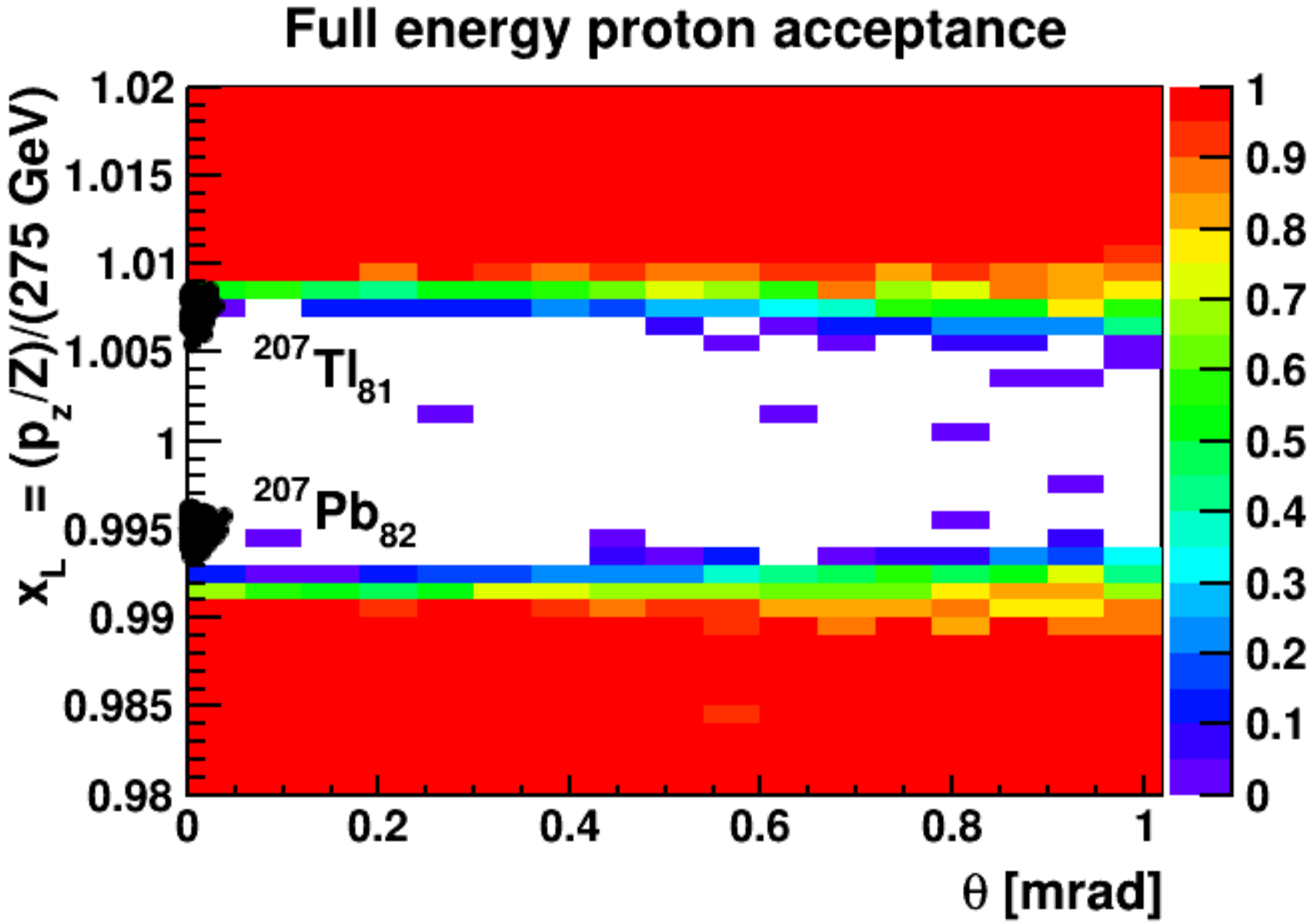




Zoom in for rigidity of remnants



A-1 from e+^{208}Pb J/ψ incoh. Diff. in BeAGLE



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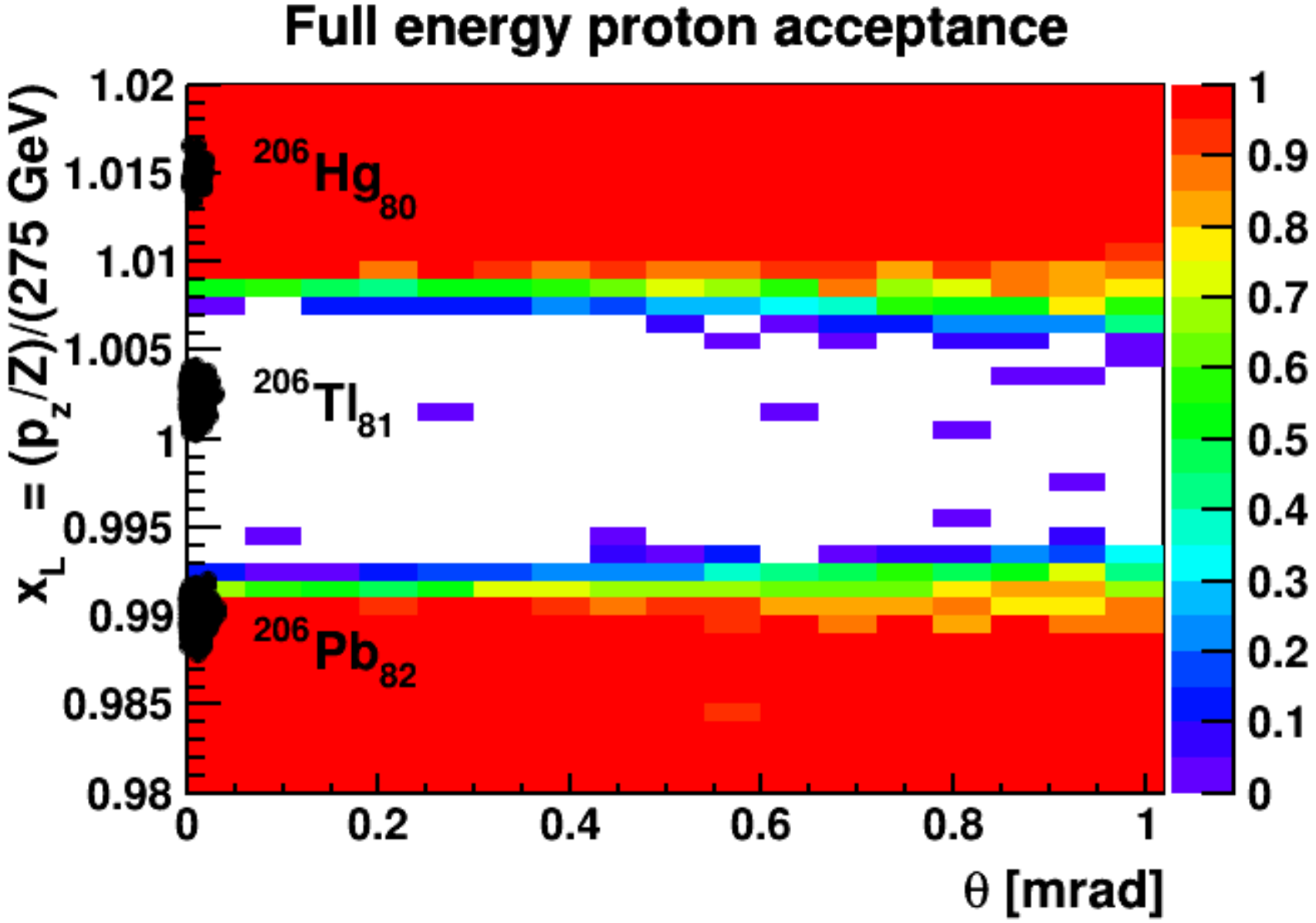
A-2 from e+^{208}Pb J/ψ incoh. Diff. in BeAGLE

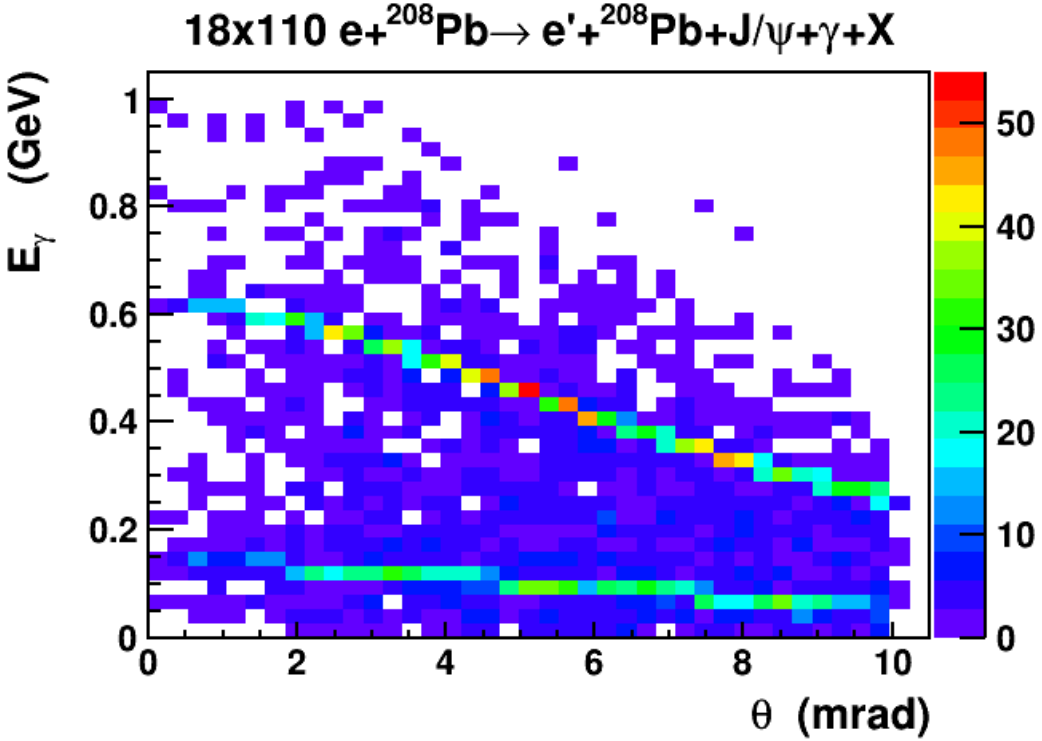


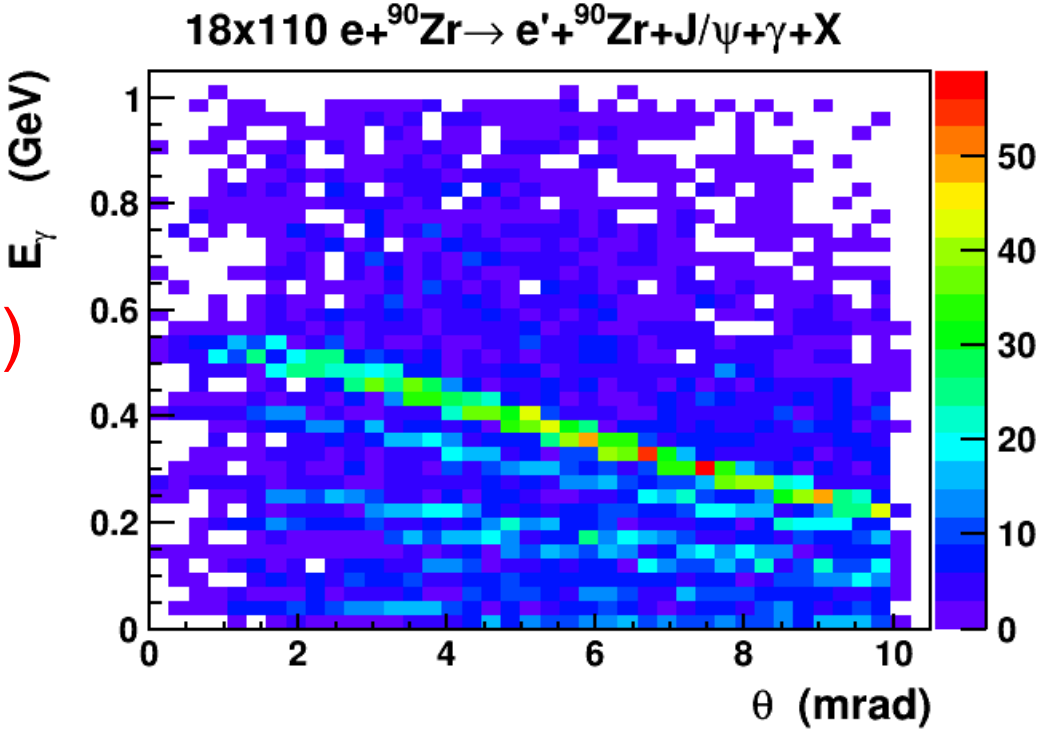
CAVEAT : ep acceptance assumed to carry over to ePb

What about Zirconium?

- Closed shells like Pb, so energetic γ's
  - Thanks Charles Hyde & Pawel Turonski
- Still interesting in terms of G(b)
- Saturation scale ALMOST as high
  - 24% Lower $A^{1/3}$
  - Slightly higher energy: 122.22/108.41 = +13%

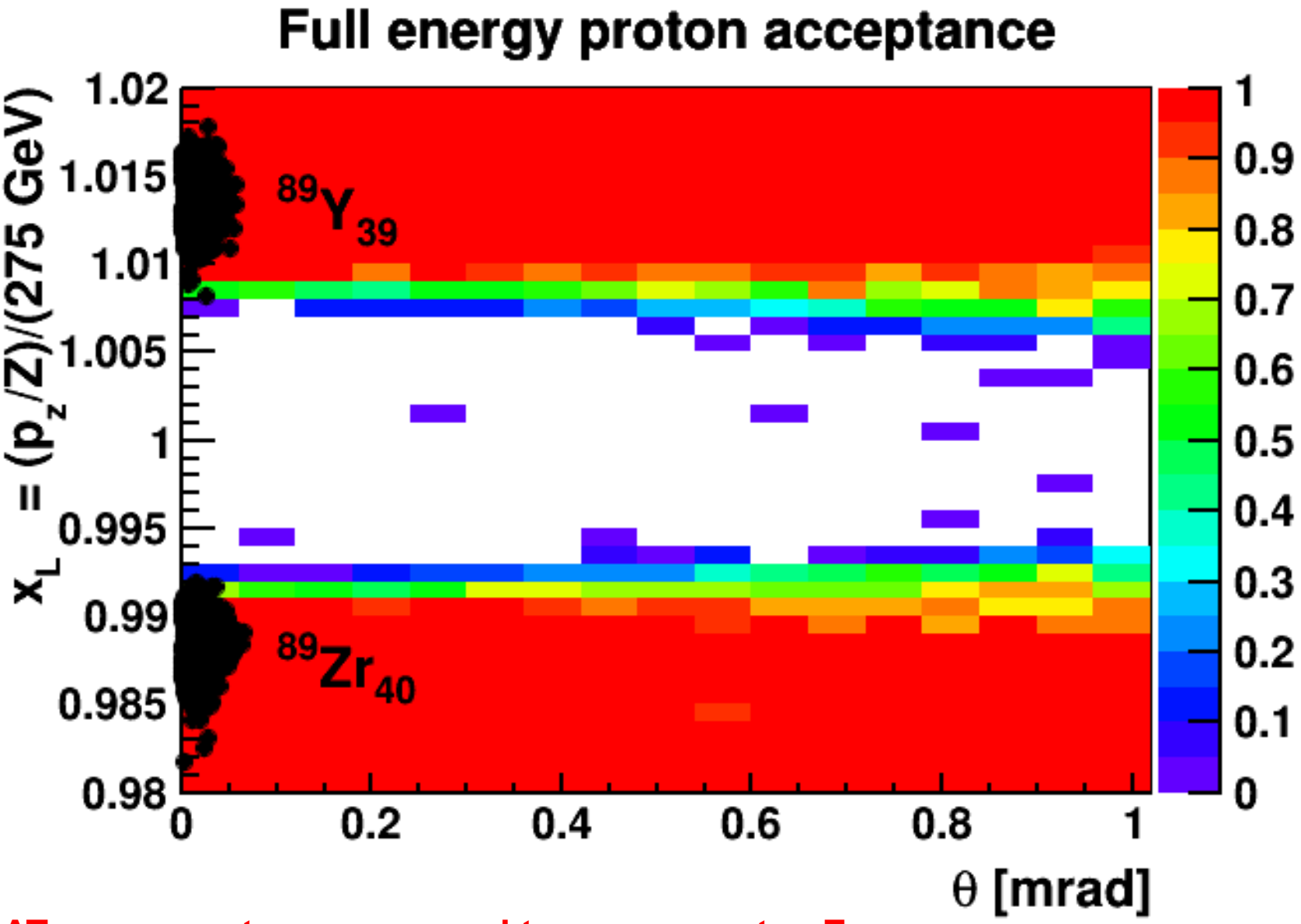
Photons from $^{208}Pb_{82}$ vs. $^{90}Zr_{40}$





Nuclear physics (closed shells) says that ^{90}Zr should be similar to ^{208}Pb…
Yes.

A-1 particles from e+^{90}Zr J/ψ diffraction



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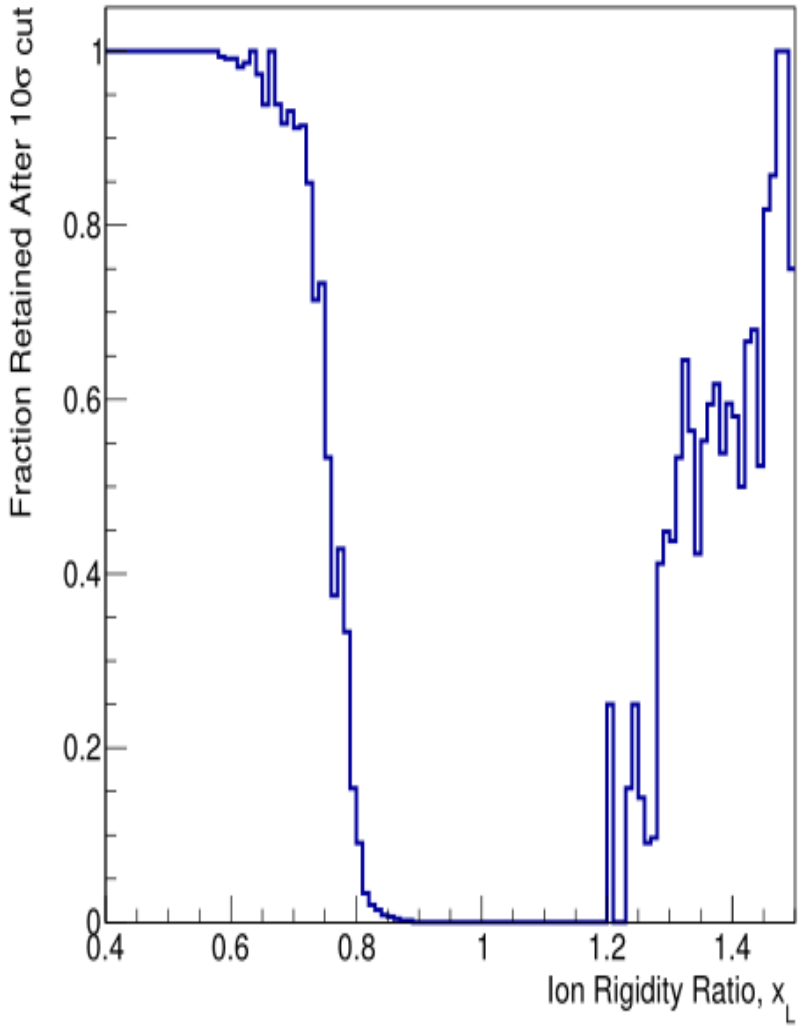
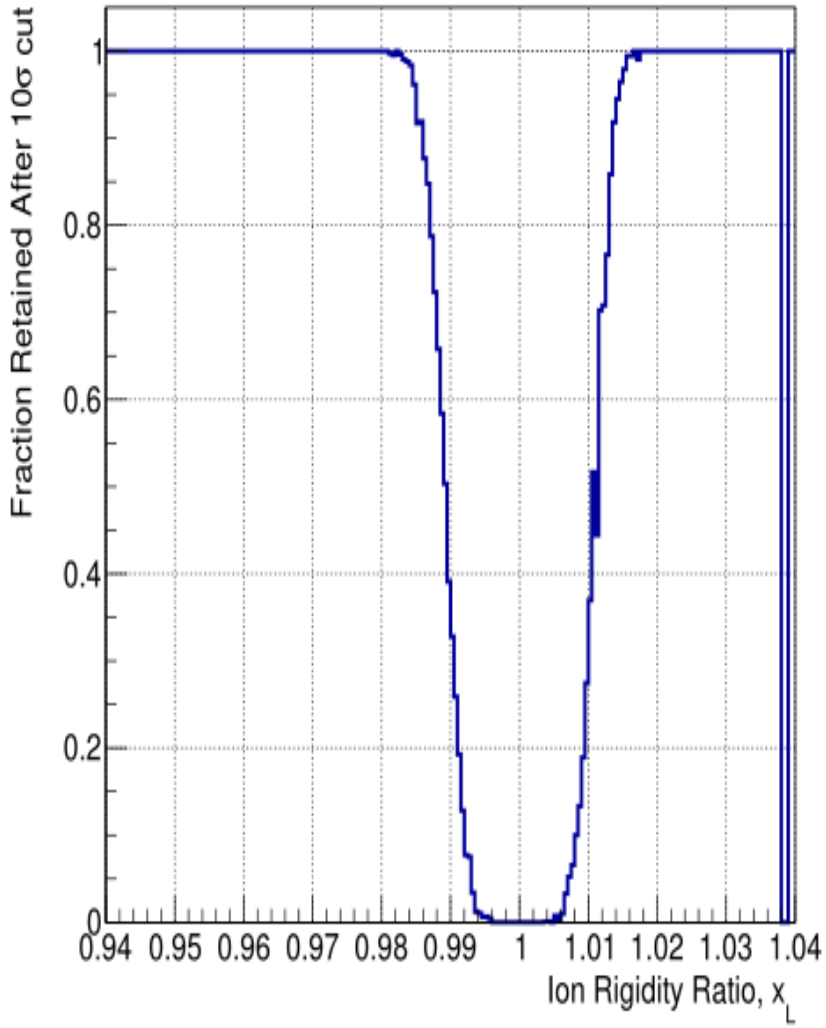
Roman Pot Acceptances

Detected/Produced (incoh. diff. In e+Zr)

Normal



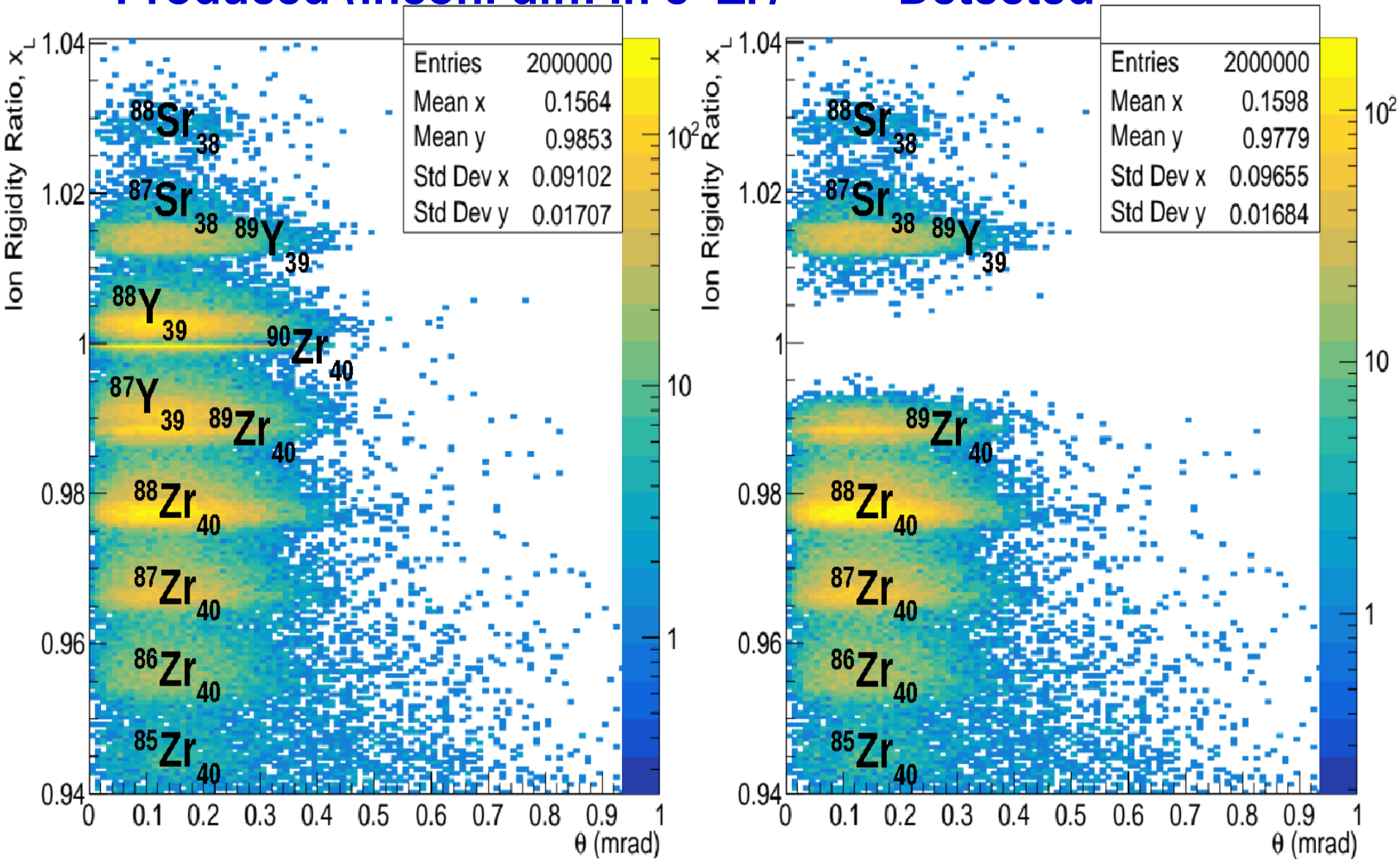
Secondary Focus



Bylinkin et al. (ECCE Collaboration) e-Print: 2208.14575 [physics.ins-det]

ECCE took a good first look at A-1 for Zr

Produced (incoh. diff. In e+Zr) **Detected**



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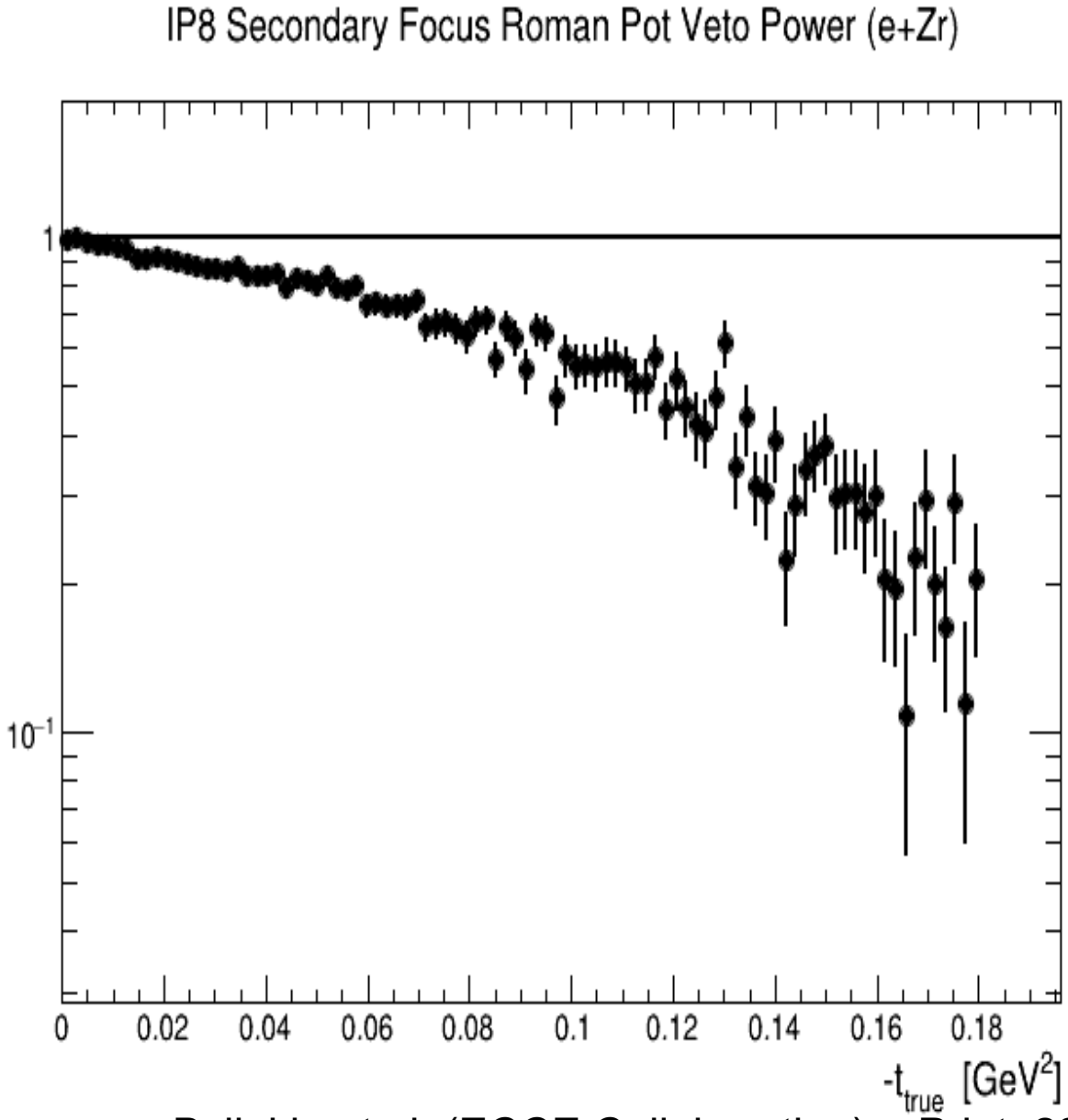
Extra background rejection with 2ndary focus



This is the extra veto power due to RPs at the 2ndary focus.

We are mostly vetoing on the non-identical nuclear remnant.

Bylinkin et al. (ECCE Collaboration) e-Print: 2208.14575 [physics.ins-det]

Diffraction in IP8

- IP8 may offer some improvement for e+Pb
  - Remove extra events (50%?) w/ ion detection
  - Better neutron acceptance etc.
  - e+Pb is close enough to the edge that this may make a difference.
  - Needs study!
- e+Zr at IP8 looks very promising
  - Needs study!

What do we need in order to study this?

- Sartre signal: diffractive J/ψ & ϕ for ^{90}Zr.
  - We need the 3D(t,Q^2,W^2) cross-section tables!
  - Tobias Toll et al. have improved the table generation speed using AI/ML interpolation to allow a sparser table.
  - EICGENRandD 2022 proposal #13 addresses this.
- BeAGLE background
  - We need to validate BeAGLE's nuclear response.
  - JLAB data on SRC+FSI (Short Range Correlation with Final State Interactions) would be a good test.
  - EICGENRandD 2022 proposal #4 addresses this.

Conclusion

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