BeAGLE: Shadowing & data files

MDB

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Simple Classical Shadowing

\[ N_{\text{ev}} = 4 \mathcal{L} \sigma \]

\[ N_{\text{ev}} = 2 \mathcal{L} \sigma \]
Quantum collisions still shadow

The virtual photon spends part of its time as a hadronic state ("dipole") with a coherence length of \( \lambda \sim 1/(2Mx) \).

So at low \( x \) it can hit BOTH the front and the back ("shadowed") nucleon. But the number of events is still reduced compared to the case of \( A \) nucleons "side-by-side"!
Quantum Shadowing (large $\lambda$)

$N_{ev} = 4\mathcal{L}\sigma$

$N_{ev} = 2\mathcal{L}\sigma$
BeAGLE shadowing approach genShd>1 (multinucleon at low x)

This is the basic conventional theoretical approach to low x eA, Details will vary by theorist...

\[ R \equiv \frac{\sigma(eA)}{A \sigma(eN)} \]

EPS, JHEP 0904 (2009) 065
With Shadowing \( (\text{genShd}=2) \)

Roll a Pythia event:

**FIXES** \( x, Q^2 \)

Pick one of the struck nucleons at random to replace with the hard Pythia interaction

**Look up** \( R_{\text{Au}}(x, Q^2) \)

\( x > 0.1 \) OR \( R > 1.0 \): like \( \text{genShd}=1 \)

ELSE

**Look up & use** \( \sigma_{\gamma^*N}(R_{\text{Au}}) \)
With Shadowing (genShd=2)

Roll a Pythia event:

**FIXES x, Q^2**

FOR NOW: The other struck nucleons give a random $k_T$ kick to the forward-going parton and recoil elastically.

Look up $R_{Au}(x, Q^2)$

$x > 0.1 \text{ OR } R > 0.995$: like genShd=1

ELSE

Look up & use $\sigma_{\gamma^*N}(R_{Au})$
With Shadowing (genShd=3)

Roll a Pythia event:

**FIXES** \( x, Q^2 \)

Similar to genShd=2, but:
Pick the **FIRST** struck nucleon to replace with the hard Pythia interaction

Look up \( R_{Au}(x, Q^2) \)

\( x > 0.1 \) OR \( R > 0.995 \): **like genShd=1**
ELSE
Look up & use \( \sigma_{\gamma^*N}(R_{Au}) \)
What about d in multinucleon (shadowing) eA events?

Define $d_{1\text{st}}$ as the d from the 1$^{\text{st}}$ interaction
Define $d_{\text{avg}}$ as the average of d's from all inelastic collisions.

I would guess our parton propagation physics cares more about $d_{\text{avg}}$.

The definition of d is much cleaner away from the low x region.
Jet quenching/modification may prefer lower energy and/or higher x!

Large d

vs. Small d

Just a mess
Available data files

/u/group/ldgeom/liang/BeAGLE/running/outForPythia
100k:
- ePb_10x40_Q2_1_20_y_0.01_0.95*Shd1*.txt
- ePb_10x40_Q2_1_20_y_0.01_0.95*Shd2*.txt
- ePb_10x40_Q2_1_20_y_0.01_0.95*Shd3*.txt
  USED w/ all x for Guohui's Figures 8-10??

Now on /u/group/ldgeom/data/mdbaker

100k events y>0.01 (no shadowing!)  USED For Fig. 3 w/ x>0.02
ePb_10x40_Q2_1_20_y_0.01_0.95*Shd1*.txt
(can also use for x<0.002)
25k @ ePd_10x40*Shd1*.txt,
eCa_10x40*Shd1*.txt,
eAu_10x40*Shd1*.txt
Pd & Pb & Ca used in Fig.2 w/ x>0.02
Simplified $R$ using $F_2^{\text{EPS09LO}}(x,Q^2)$

$$R(x \to 0, Q^2=1.69\text{GeV}^2) \equiv y_0(A) = 0.890 \left(\frac{A}{12}\right)^{-0.0803} = 0.711 \text{ for Au}$$

$$0.708 \text{ for Pb}$$
Available data files

On /u/group/ldgeom/data/mdbaker

200k events $y>0.3$ to use for $x<0.002$  
\textbf{USED FOR Fig.14-15 in prop.} 
ePb\_10x40\_Q2\_1\_20\_y\_0.3\_0.95*Shd3*.txt

125k events $y>0.2$ to use for $x<0.003$:  
ePb\_10x40\_Q2\_1\_20\_y\_0.2\_0.95*Shd3*.txt  
(can also use for $x<0.002$)

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Figure 14: Bjorken $x$ distribution for $Q^2>1$ GeV$^2$, $y<0.95$ and $x<0.002$ for 10x40 GeV e+Pb collisions.

Figure 15: Average thickness for peripheral (42.1%) and central (1.1%) samples tagged using evaporation neutrons in 10x40 GeV e+Pb collisions for $Q^2>1$ GeV$^2$, $y<0.95$ and $x<0.002$. 
What would be interesting to see...

Guohui-style plots for $T(b)$ vs. Neutron fraction included for $x<0.002$ genShd=3

& $T(b)$ vs. $T(b)$ fraction included (perfect tagging)

Neutron acceptance fraction vs. Theta after 2nd dipole
Charged particle acceptance fraction vs. Theta and $p/Z$