Hadron Generator Update

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- HallD hadron event generator
- SIDIS Hadron Background Rate Update
- Summary and Outlook

HallD hadron generator (SoLID-Bggen)

- **SOLID-Bggen event generator (HallD) -----modified by Rakitha**
  - E>3 GeV: PYTHIA is used
  - 0.15<E<3 GeV: a mixture of 10 dominating exclusive processes ($\gamma + p$) is used. For the single pion production differential cross sections, the SAID code is used.
  - virtual photon (EPA approximation) and real bremsstrahlung photon
  - Fix to proton target: x_0=63.047g/cm^2, ρ=0.071g/cm^3, **beam current and target length** is hardly coded which can changed manually.
  - Additional code was used to count hadron rates and output a lund file for GEMC.

- **Bggen new version----modified by Jixie Zhang**
  - Run on the current ifarm environment
  - **Beam current, target X_0, ρ, and L for different target**.

Two methods for Getting Background Rate

- **Old method from Rakitha**

✧ The generator fix to the proton target (x_0=63.047g/cm^2, ρ=0.071g/cm^3)

✧ The correction factor **ρ(target)/ρ(H)** was used to correct the total rate

$$\dot{N} = \sigma * (N_{EPA}^{target}(\omega) + N_{BREMS}^{target}(\omega)) * \mathcal{L}$$

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$$N_{BREMS}(\omega) = \frac{d}{2X_0}\left(\frac{4}{3} - \frac{4\omega}{3E} + \frac{\omega^2}{E^2}\right) \qquad \frac{d}{X_0} = \frac{L*\rho}{X_0}$$

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The old method doesn't correct the flux part

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- **New method**

✧ Correct target information in the generator

$$N_{EPA}^{target}(\omega) + N_{Brem}^{target}(\omega)$$

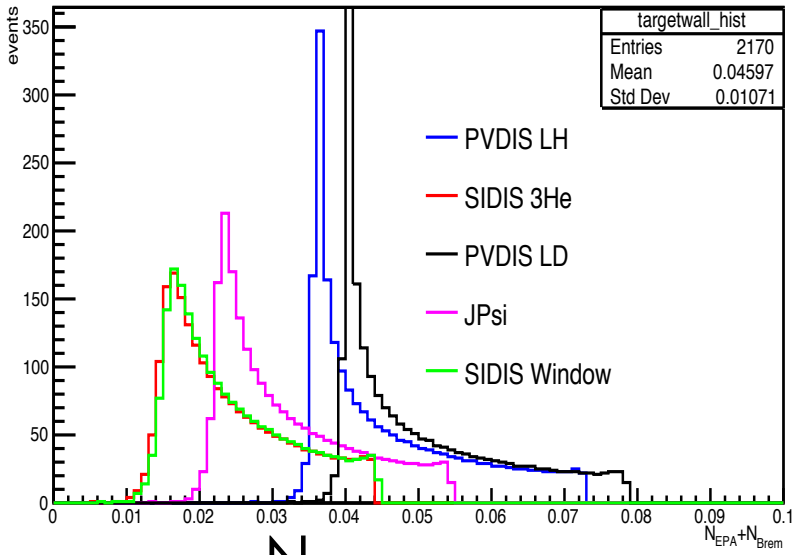
Problem check

Compare tow methods for the following setups:

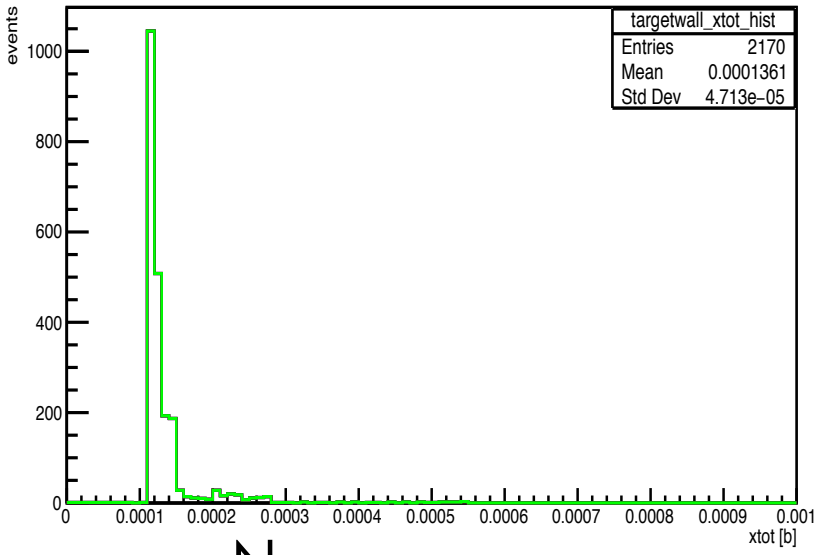
Target	Density g/cm3	Radiation Length g/cm2	Length cm
PVDIS LH	**0.071**	**63.22**	**40**
PVDIS LD	**0.169**	**125.97**	**40**
SIDIS 3He	**1.345e-3**	**67.42**	**40**
SIDIS upstream Window	**2.76**	**19.42**	**0.012**
JPsi	**0.071**	**63.22**	**15**

New Method plots

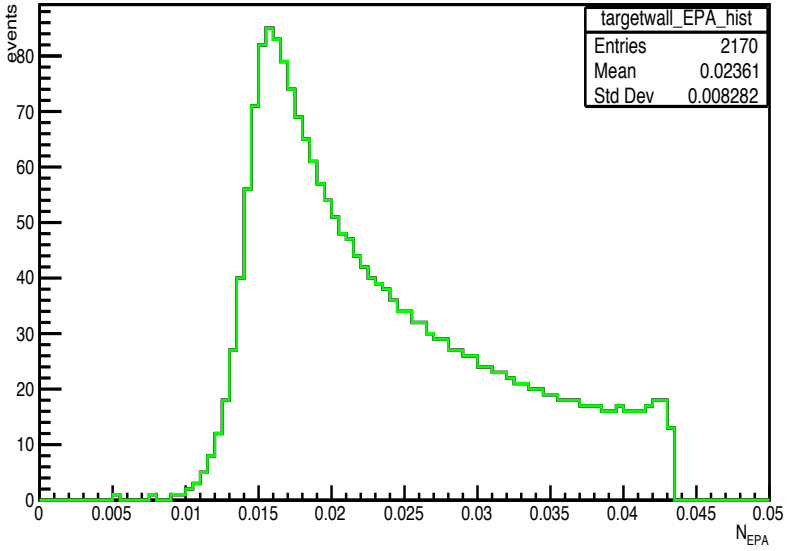
$N_{EPA}+N_{Brem}$



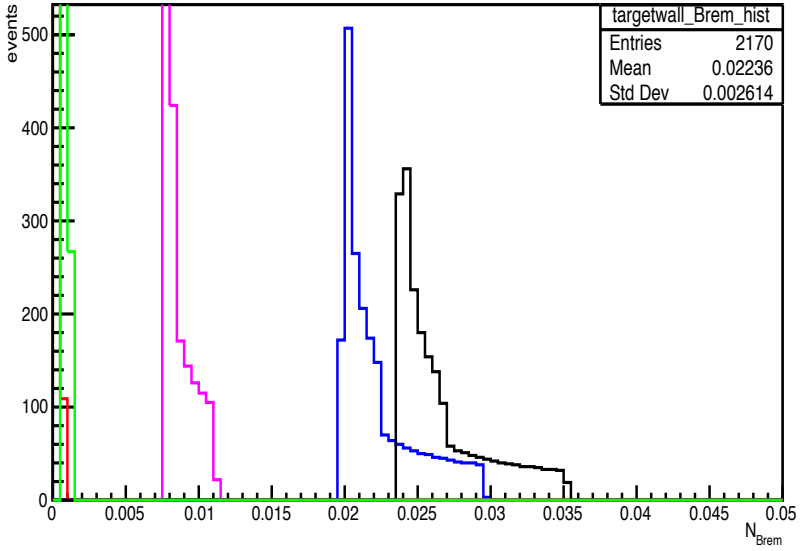
xstot



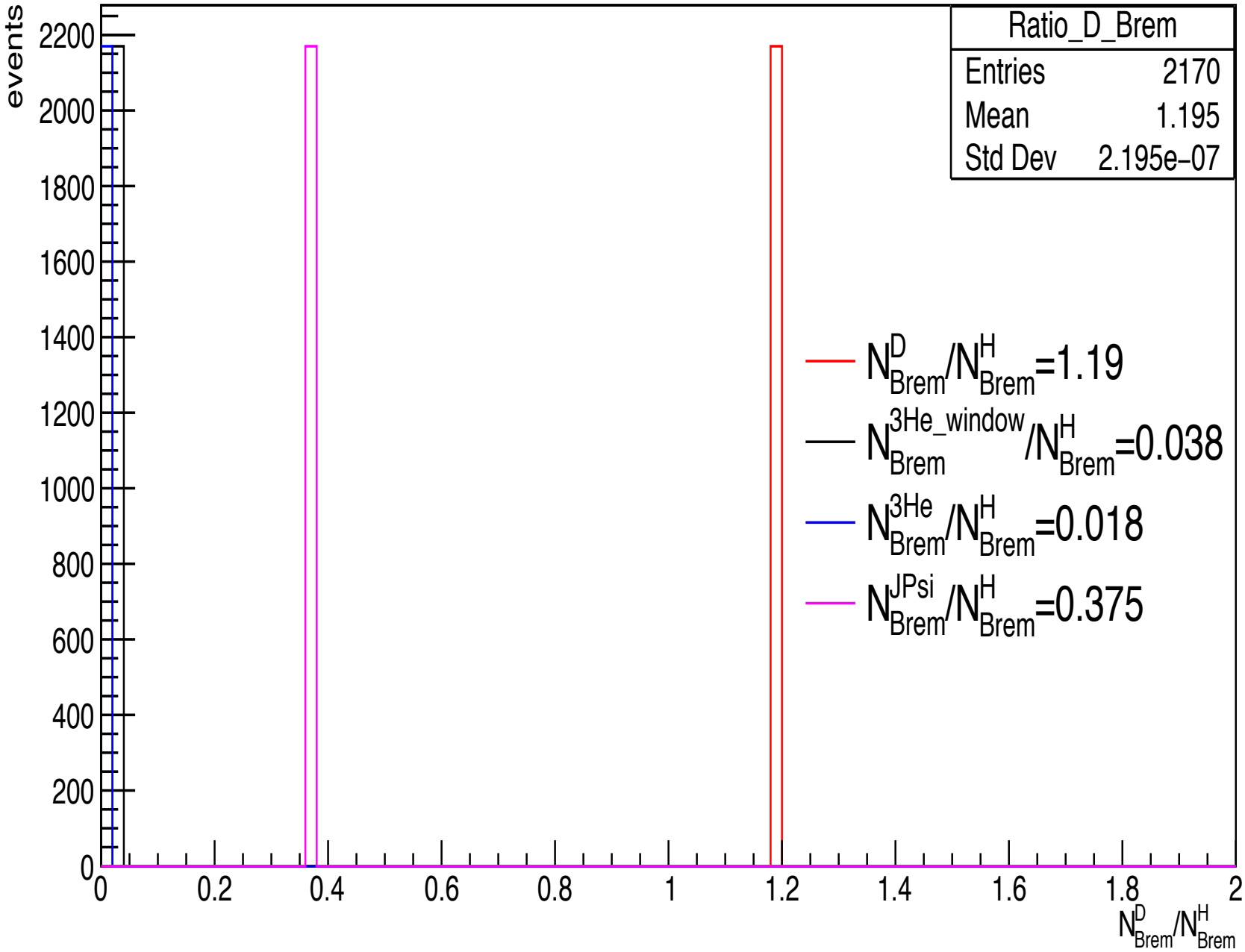
N_{EPA}



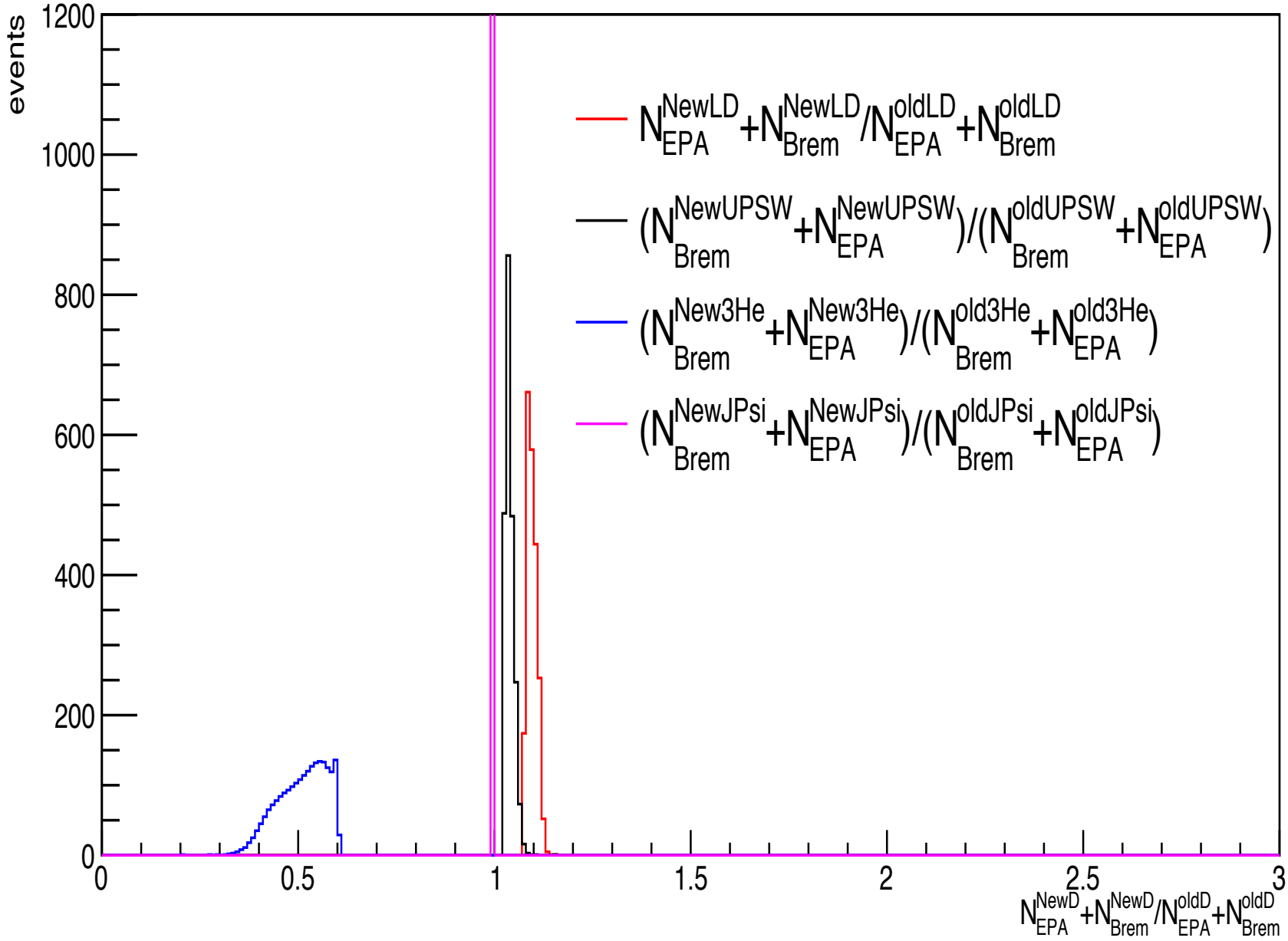
N_{Brem}



New Method plots



Two Methods Comparison



Generate Weight Comparison

	PVDIS LD		
	Bggen (Rakitha) kHz	Bggen (Ye) kHz	Bggen-Y/ bggen-R
π^+	2.88e+3	2.845e+3	0.98
π^-	2.88e+3	2.845e+3	0.98
π^0	2.75e+3	3.07e+3	1.1

Weight=Rate(Hz)/Event_counts

3He Generate Weight Comparison

	SIDIS 3He		
	Bggen (R) kHz	Bggen(Y) kHz	Bggen-Y/ Bggen-R
π^+	7.726	3.89	0.56
π^-	6.015	3.064	0.55
π^0	6.546	3.786	0.57

Weight=Rate(Hz)/Event_counts

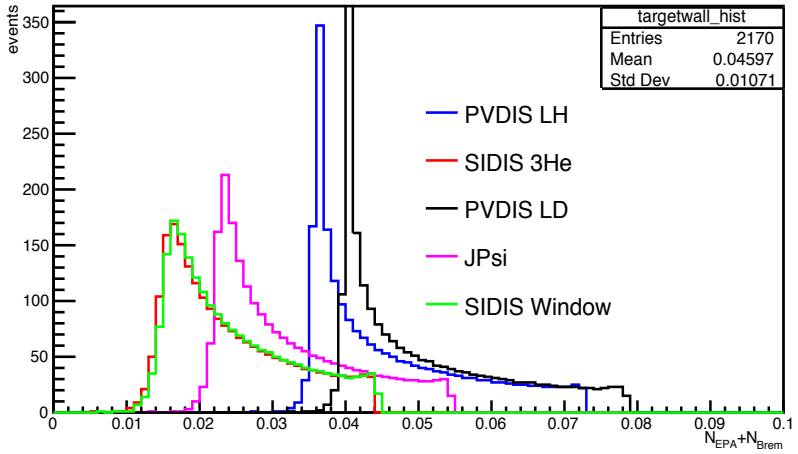
SIDIS Upstream Window Generate Weight Comparison

	SIDIS 3He Upstream Window		
	Bggen (Rakitha) kHz	Bggen(Ye) kHz	Bggen-Y/ Bggen-R
π^+	0.230	2.148	9.3
π^-	0.235	2.191	9.3
π^0	0.223	2.36	10

Beside the flux part, the previous window rate is unreasonable.

Window Rate previous issue

"For files Rakitha made at /work/halla/solid/evgen/solid_bggen/lund_format/10k_lundfiles/SIDIS_He3 pi+ for He3 of "hallD_pion_p_3He_10k_1.lund", the rate factor at the end of header line is 7704 pi+ for one window of "hallD_pion_p_DST_Winu_10k_1.lund", the same factor is 230 the ratio is 7704/230=33 Assuming pi+ cros section is same for neutron and proton, this ratio is only proportional to nucleon luminosity ratio nucleon luminosity ratio between 3He and one window should 1.6." ----from Zhiwen



The rate ratio between 3He and upstream window should be about 1.6

JPsi Generate Weight Comparison

	JPsi		
	Bggen (R) kHz	Bggen(Y) kHz	Bggen-Y/ Bggen-R
π^+	37.30	23.873	0.64
π^-	17.183	11.55	0.67
π^0	26.153	19.21	0.73

JPsi ratio should be 1.

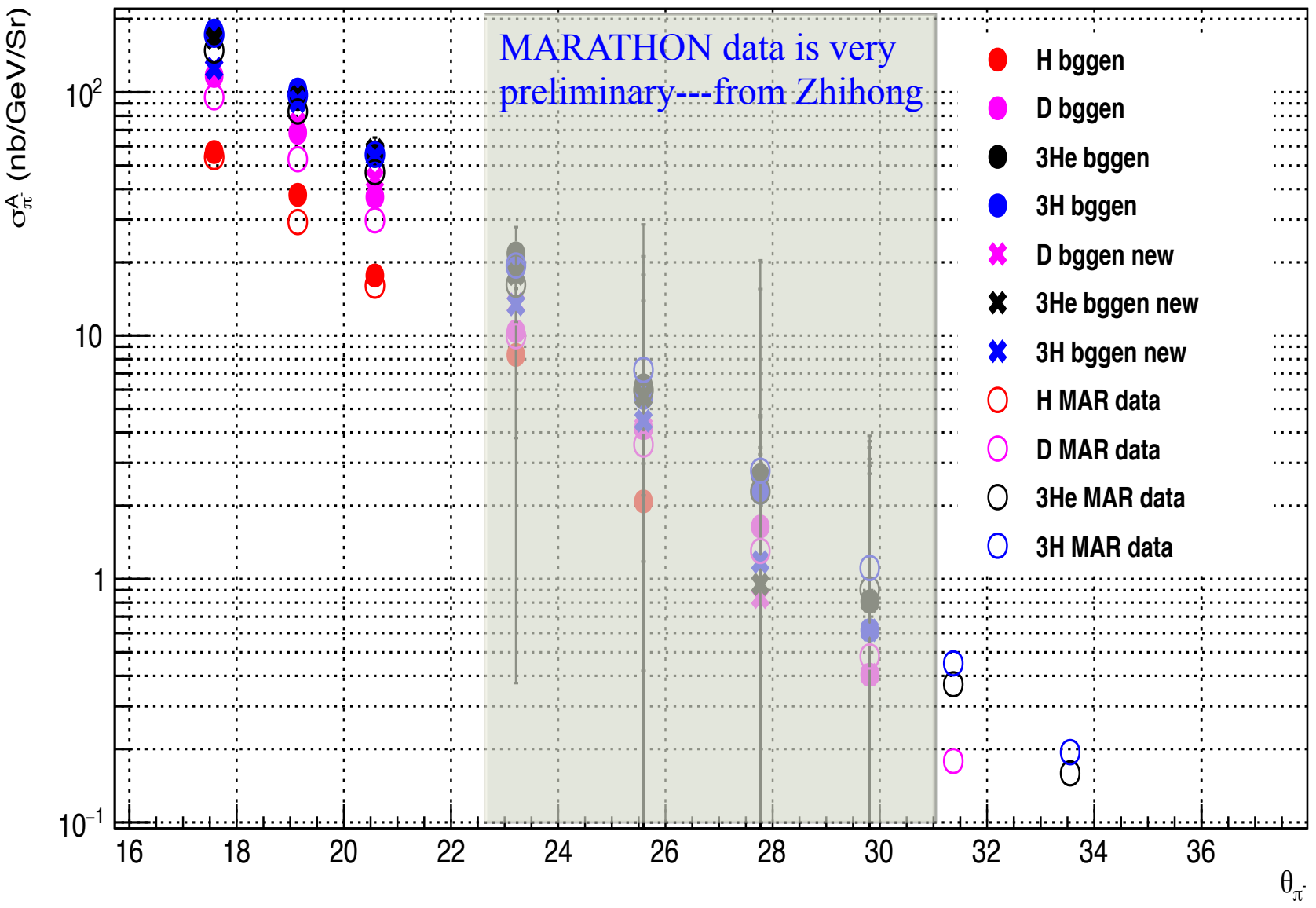
Charge Symmetry Assumption

- Cross section calculation for A>1:

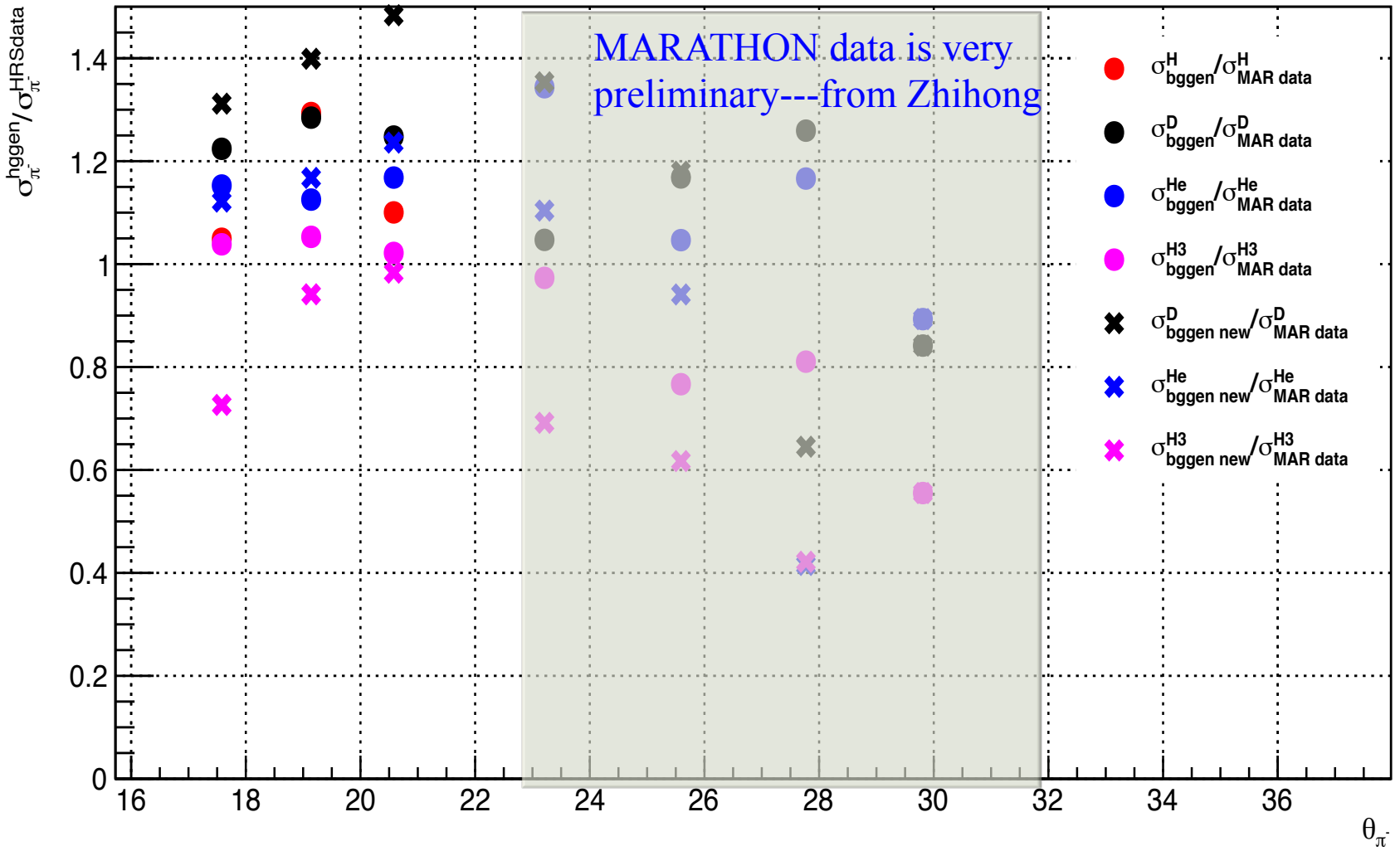
$$\sigma_{\pi-}(A) = \sigma_{\pi+}(p)*(A-Z)+\sigma_{\pi-}(p)*Z$$

Nucleon cross section

Bggen π^- cross section compare with Data



Bggen π^- cross section compare with Data



No strong conclusion is made at this stage

Summary and Outlook

- From the above comparison, the background rate for PVDIS_LD should be 10% larger than previous estimation. However, the hadron background rate for SIDIS_3He should be about 50% lower than previous estimation.
- The rate from SIDIS 3He target itself over upstream window is 1.67, close to nucleon luminosity ratio 1.6
- Compare to the MARATHON π^- data, the bggen event generator agrees with data at 30% level.
- Next step, try to treat charge symmetry assumption differently for the resonance reason.
- Study the downstream window rate.
- Compare bggen π^0 cross section with DVCS data----Ye Tian (SDU)

Backup

Generate Rates Comparison (per event)

	PVDIS LH			
	Bggen (Rakitha) kHz	Bggen (rerun) kHz	Bggen (Ye) kHz	BggenYe/ bggenR
π^+		1.473e+3	1.471e+3	1
π^-		7.23e+2	7.22e+2	1
π^0		1.185e+3	1.184e+3	1

10e4 events