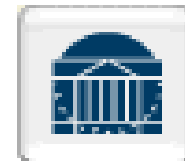# Data Analysis: Progress and Preliminary Results

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Data Analysis: Progress and Preliminary Results

There are 4 graduate students

- ➢ Nadia Fomin
- ➢ Jason Ceely
- ➢ Aji Daniel
- ➢ Roman Trojer

Every student is responsible for his/her own analysis code, which gives us 4 cross-sections to compare and help eliminate mistakes.

In this presentation, we'll focus on comparing Jason's and Nadia's results

Extracting cross-sections

1. **Raw yields**

   Complete agreement

2. **Charge and efficiency normalized yields**

   Agreement

3. **Acceptance-corrected yields**

   Agreement

4. **Bin-centered yields/cross-sections**

   Agreement

5. **Yields/Cross-sections corrected for Radiative effects**

   Not done

6. **Coulomb-corrected yields/cross-sections**

   Not done

Extracting cross-sections, step by step

➤ Data is binned in 2 dimensions: δ and θ/y'.

➤ All the runs for a given setting get their own histogram, where the charge and efficiencies for a run are applied

➤ The individual run histograms are then averaged into one 2-D histogram containing all the data for a given setting and target (which now is the charge and efficiency normalized yield).

There is more than one way to combine runs. The way we do it is can be written as

$$< Yield >= \frac{\sum\limits_{i} \frac{Y(i)}{\sigma(i)}}{\sum\limits_{i} \frac{1}{\sigma(i)}}$$

Where

$$Y(i) = \frac{N(i)}{Q(i)*Eff(i)}$$

A popular shortcut can be written as:

$$< Yield >= \frac{\sum\limits_{i} N(i)}{\sum\limits_{i} Q(i)*Eff(i)}$$

Extracting cross-sections, step by step (contintued)

➢Acceptance corrections are applied

  ➢Nadia divides each event by the appropriate $d\Omega$

$$d\Omega_{eff} = \frac{N_{recovered}(\delta, \theta/y')}{N_{generated}(\delta)} \Delta\Omega_{generated}^{total}(\delta)$$

  ➢Jason incorporates acceptance and bin-centering into one correction

Extracting cross-sections, step by step (contintued)

➢Bin-centering corrections are applied

  ➢Nadia applies a weight to each event at the same time as the acceptance correction is applied, which moves the event to the central theta

$$C_w = \frac{\sigma^{\text{mod}}(E, E', \theta_c)}{\sigma^{\text{mod}}(E, E', \theta)}$$

  ➢Jason applies the correction to the whole 2-D bin

$$Cw = \frac{\sigma^{\text{mod}}(p_o, \theta_o) \cdot \Delta p \cdot \Delta \theta}{\int\limits_{\theta_o - \Delta\theta/2}^{\theta_o + \Delta\theta/2} \int\limits_{p_o - \Delta p/2}^{p_o + \Delta p/2} A(p, \theta) \cdot \sigma^{\text{mod}}(p, \theta) \, dp \, d\theta}$$

➢Once we have a 2-D histogram that's corrected for acceptance and bin-centering effects, we average over one of the dimensions: θ/y'

➢The resulting histogram is 1-D in δ. (Nadia subtracts the charge-symmetric background at this point)

➢Finally, we convert our δ bins into E' bins with a simple Jacobian

Effects of Various Corrections

➢ Yellow line shows charge-normalized yields with no acceptance corrections (divided by a solid angle of 6mSr to get the scale right)

➢Multi-colored plots show the effect of the acceptance correction

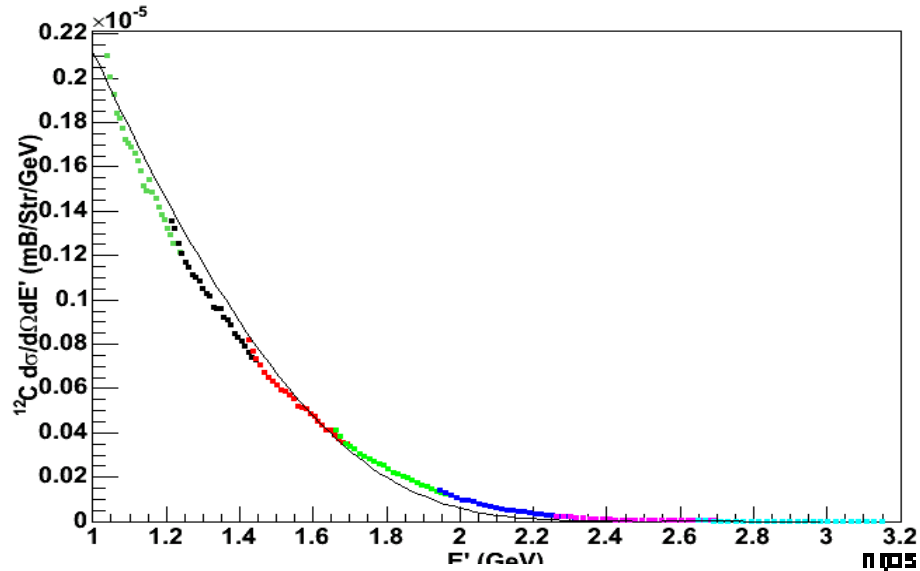2%Carbon at 40 degrees, by Jason
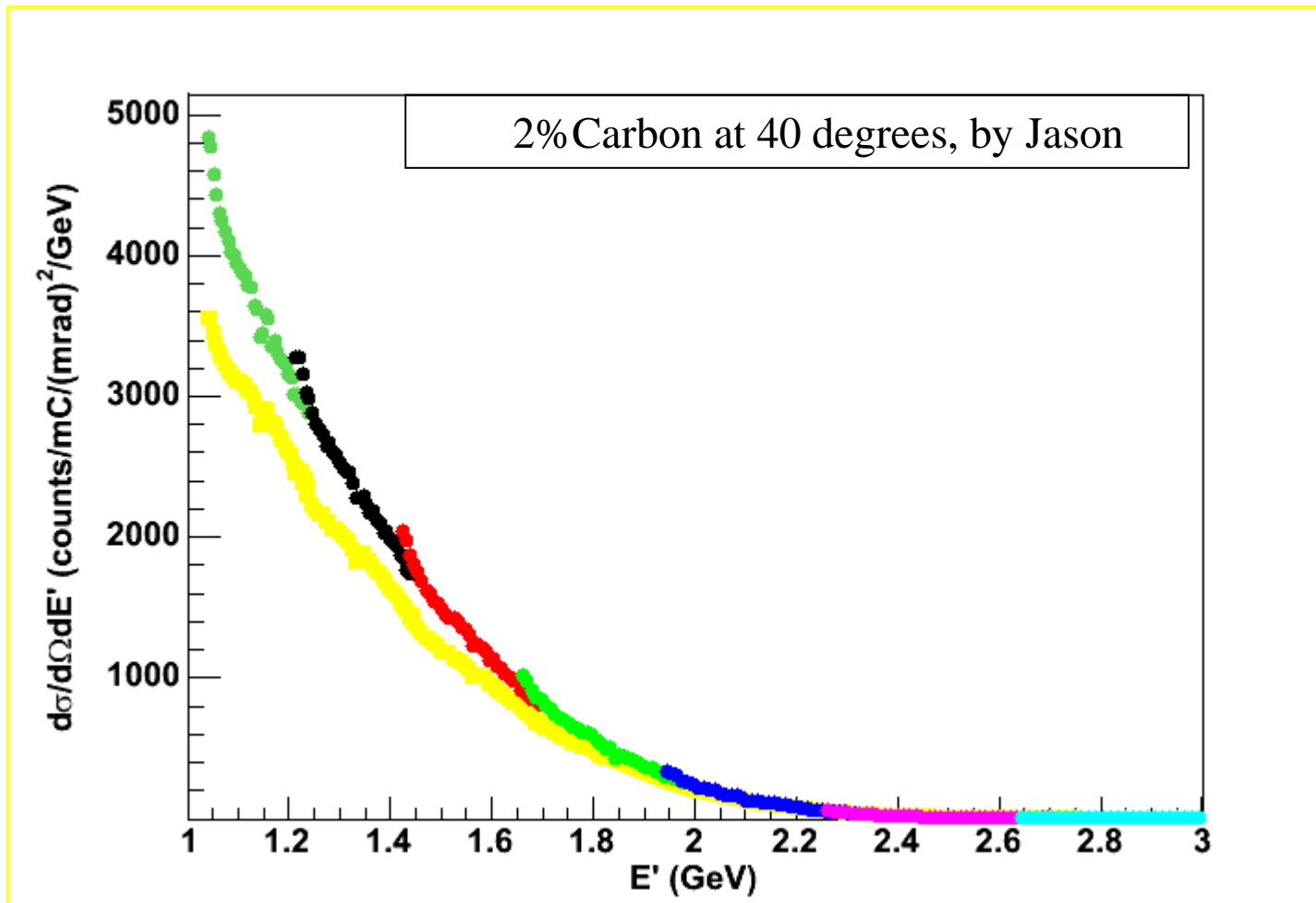
Effects of Various Corrections
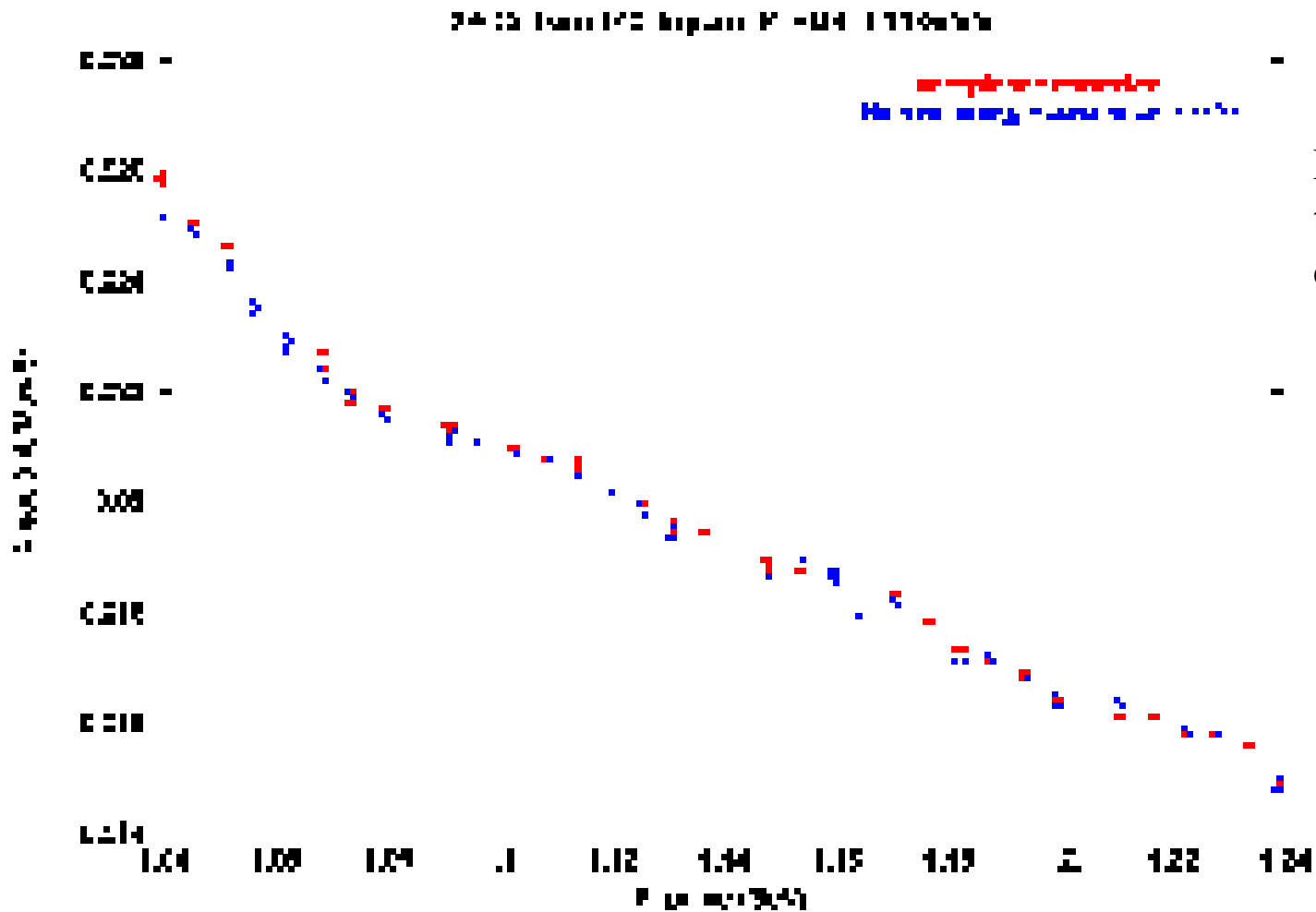
Nadia's results to show the effect of bin-centering corrections

Effects of Various Corrections

➢Agreement is good, but not perfect

➢Data was binned and acceptance corrections applied in different variables (θ vs. y')

➢Different number of bins

➢Different models used for bin-centering corrections
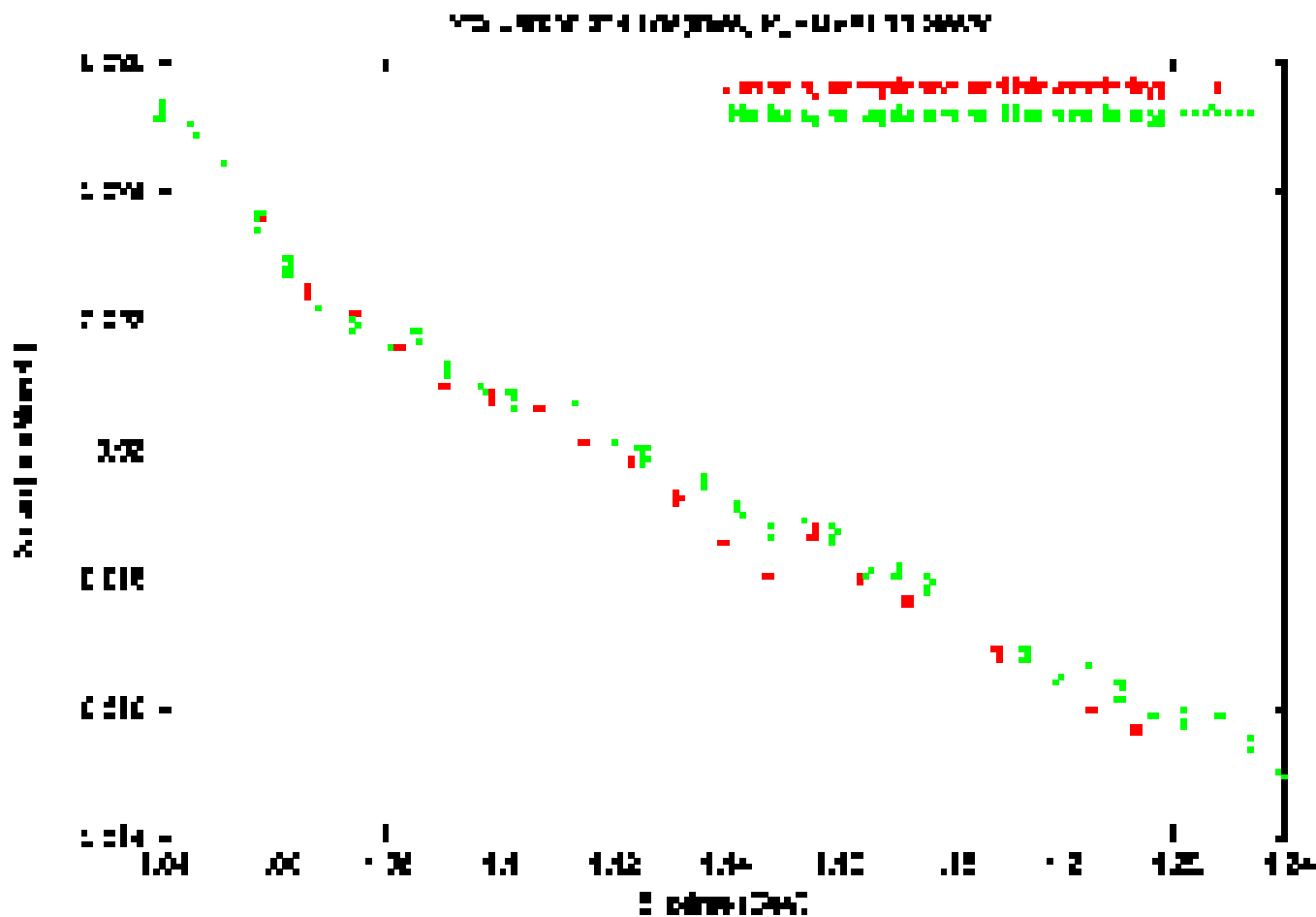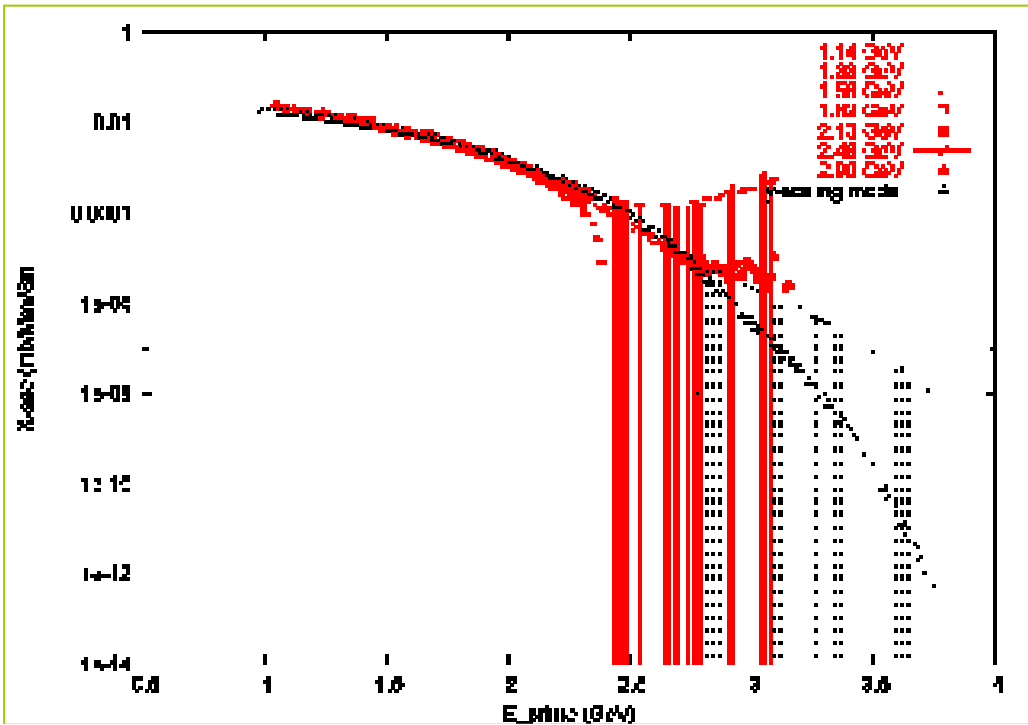
Models for the Data (Carbon at 40°)

Jason uses John's xsi-scaling model

⬅

Nadia uses Donal's y-scaling model

➡

Carbon at 40 degrees with acceptance corrections
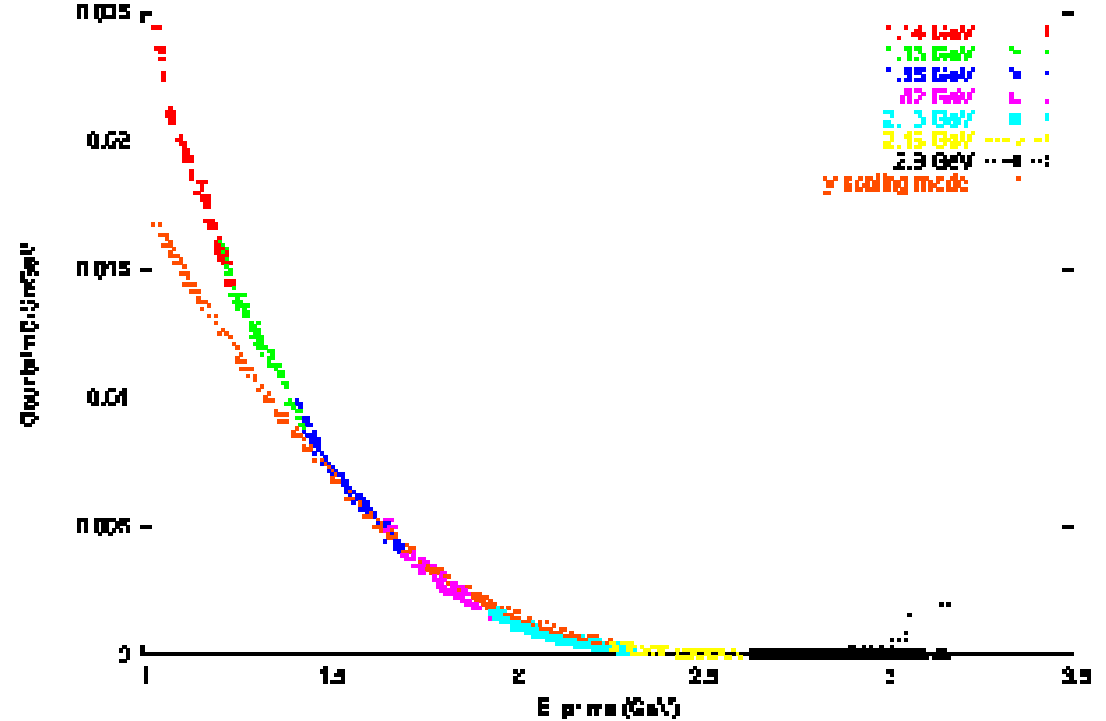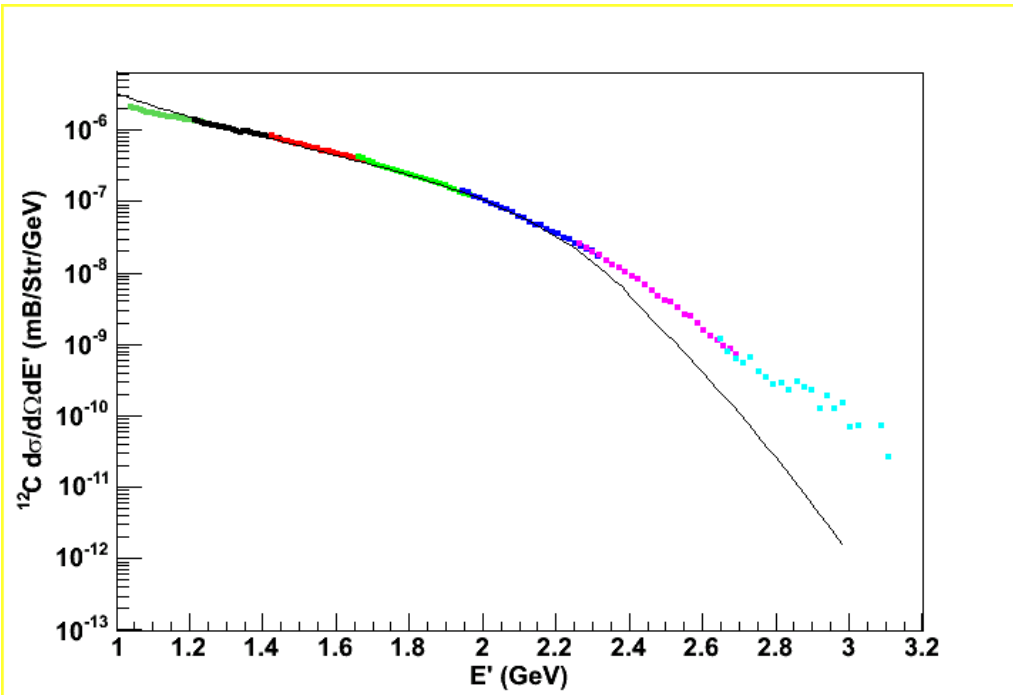
Jason uses John's xsi-scaling model
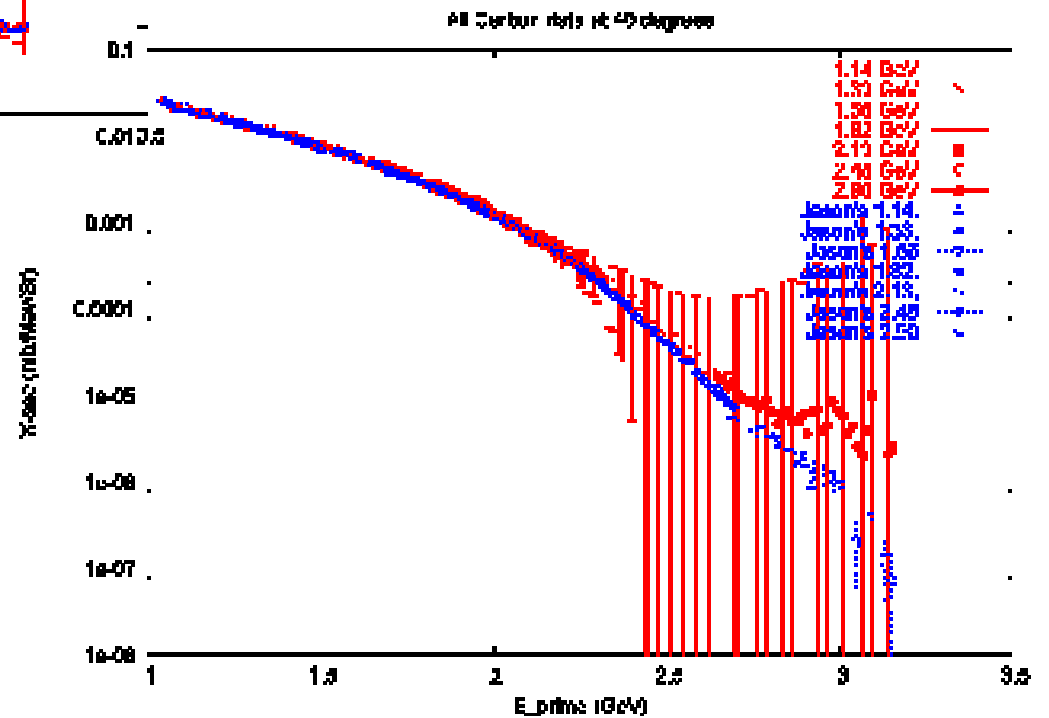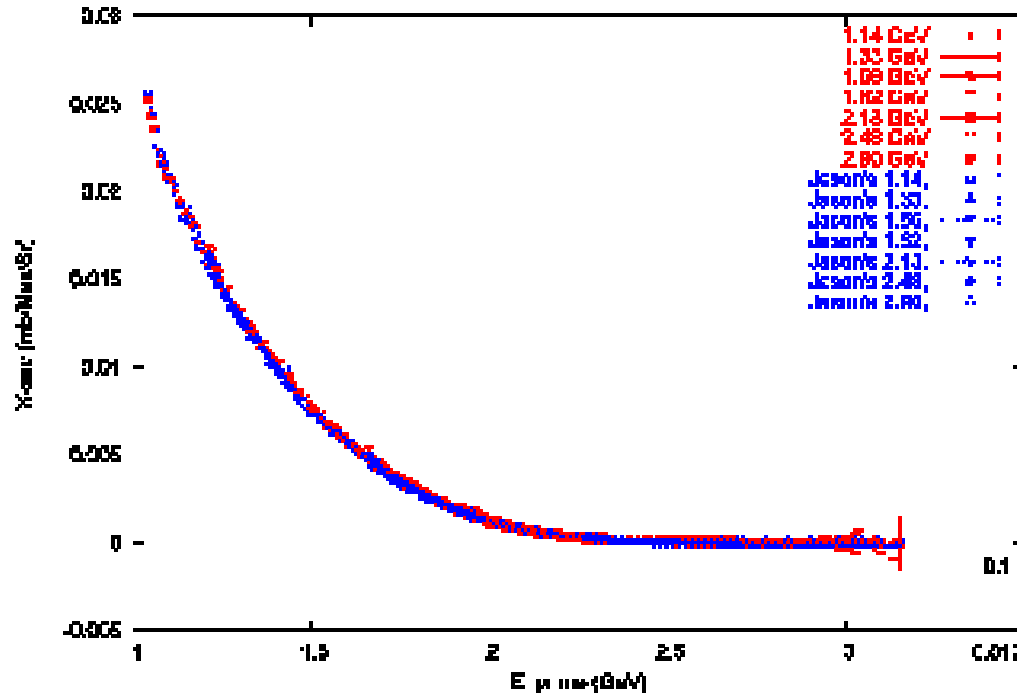
Nadia uses Donal's y-scaling model
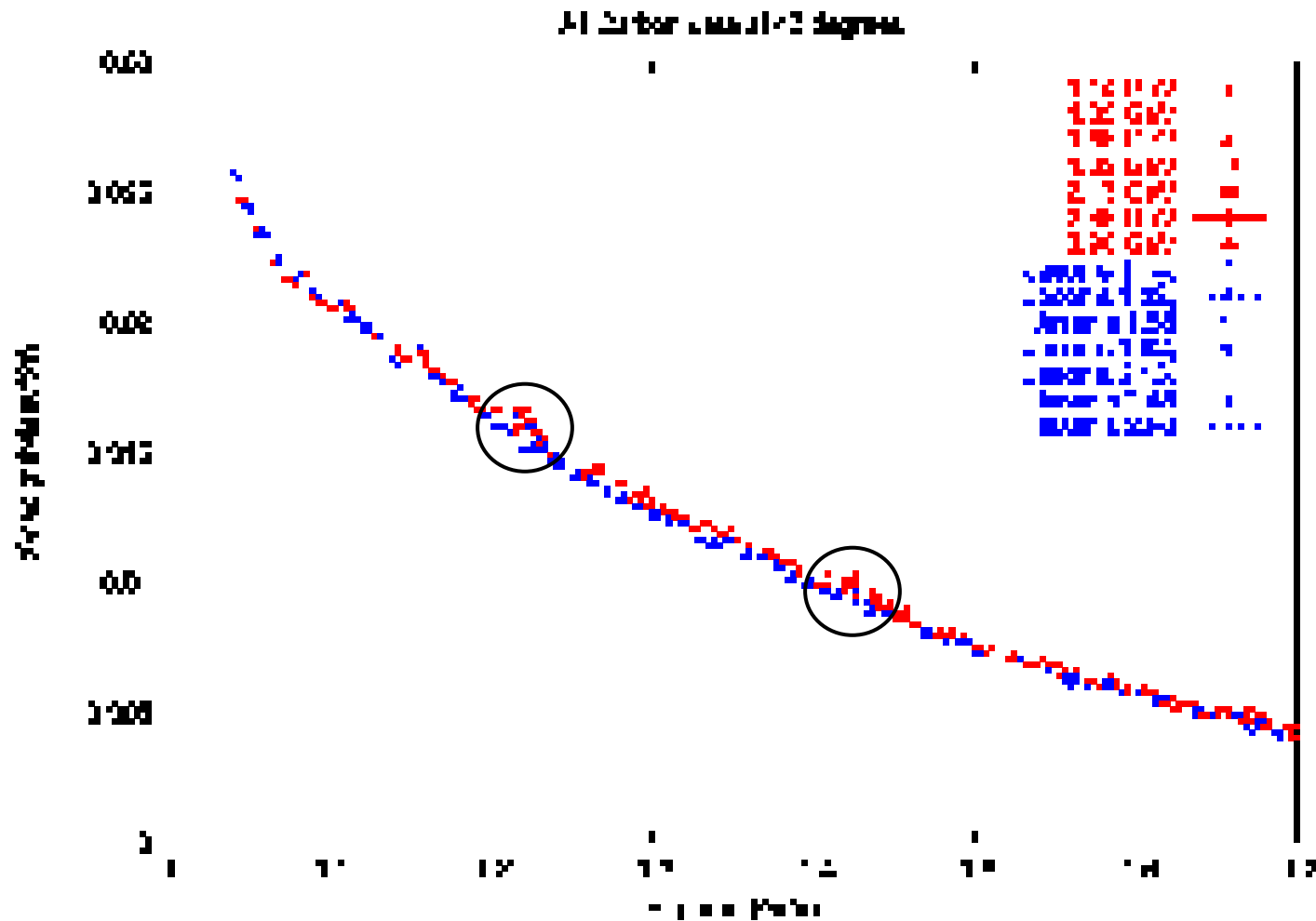
Effects of Various Corrections
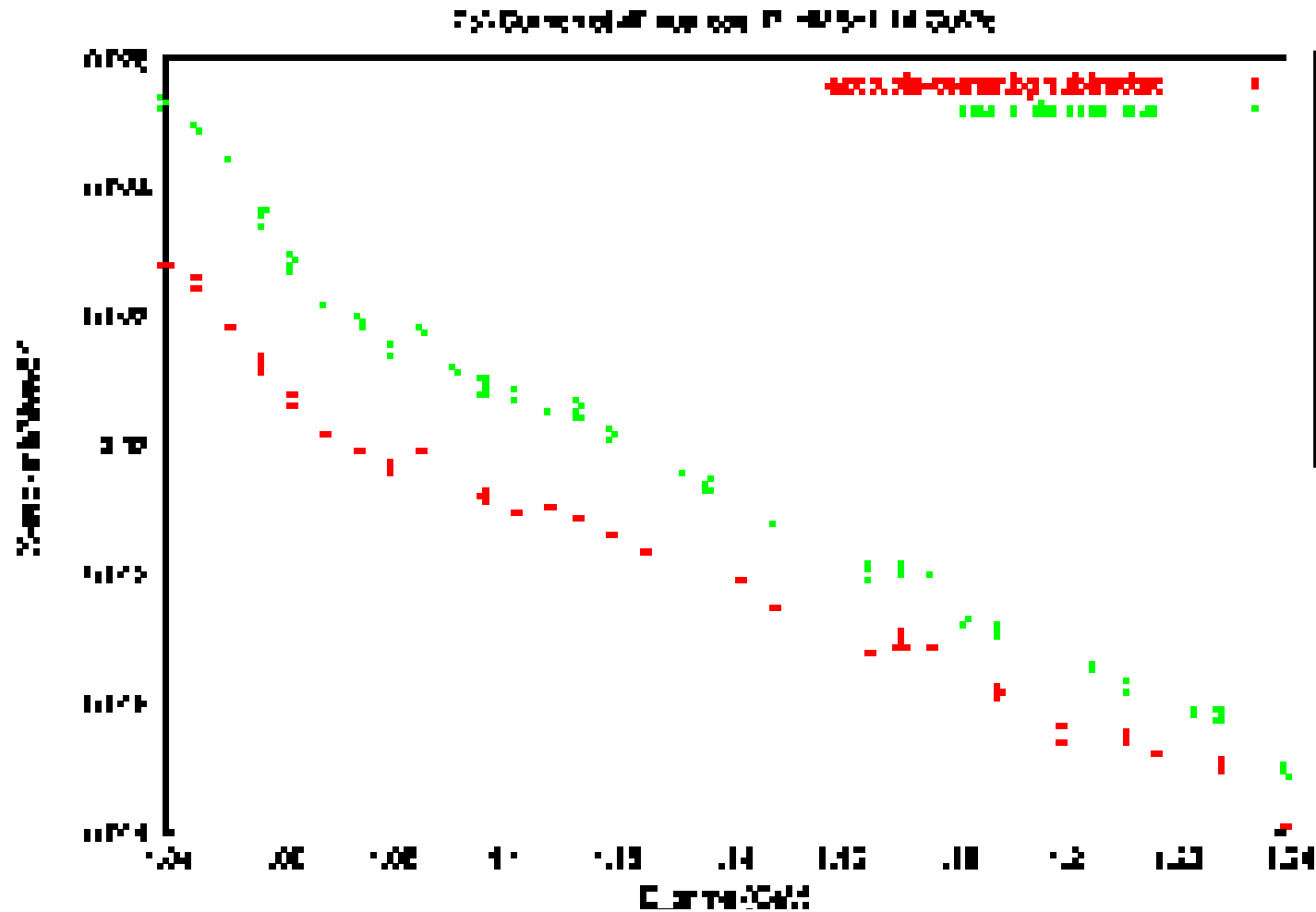
Nadia's analysis with charge-symmetric background subtraction

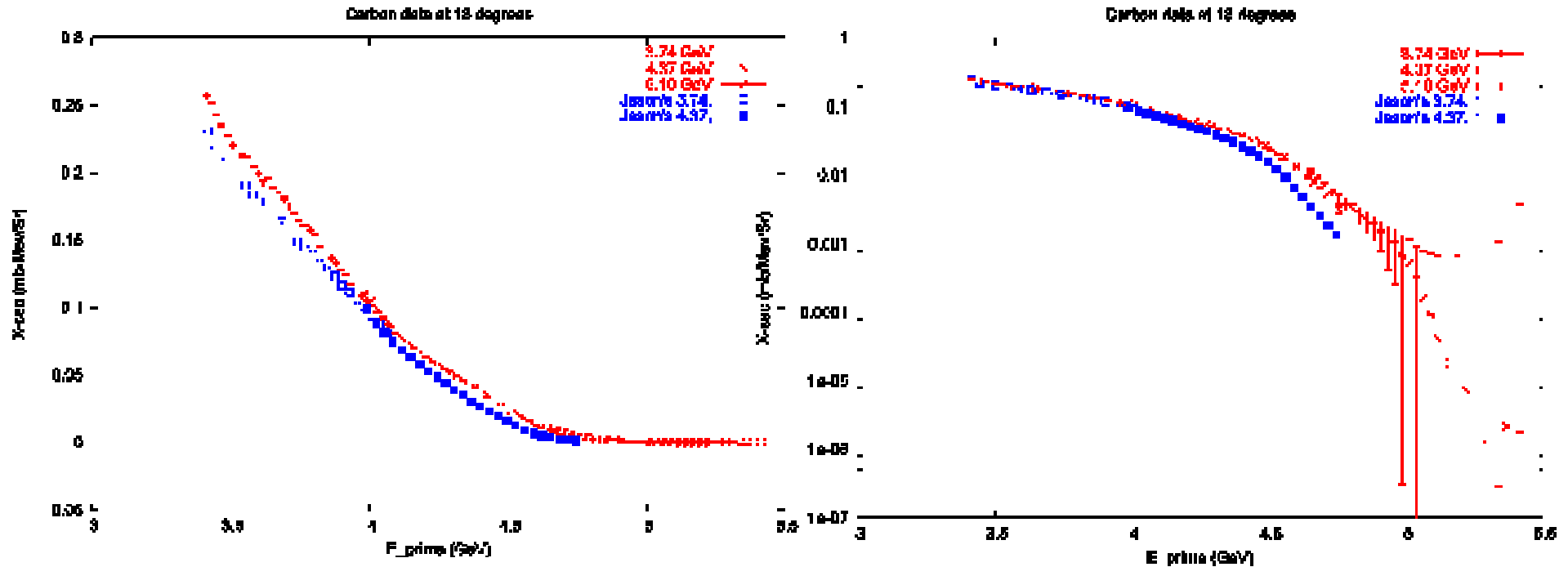# All the Carbon data at 40 degrees

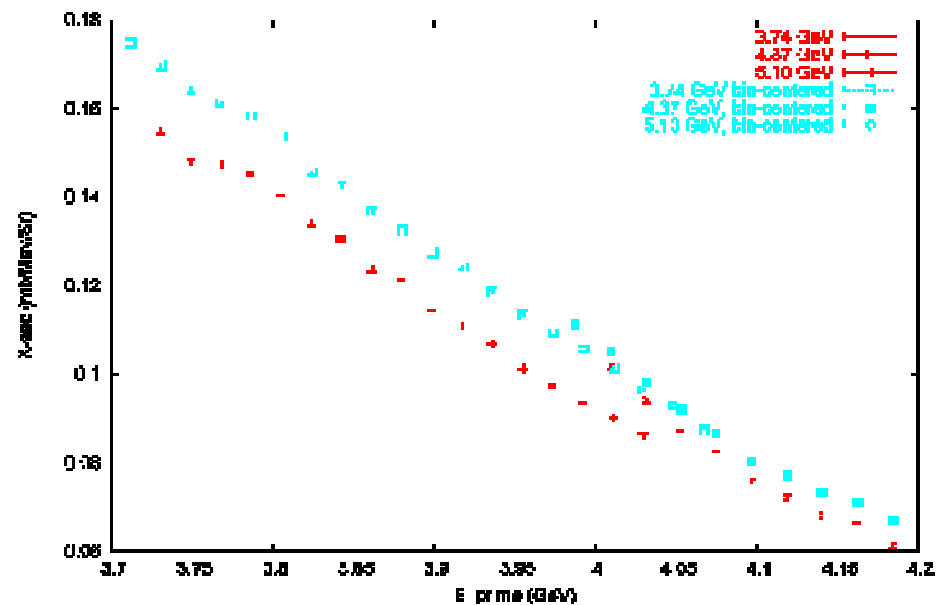# All the Carbon data at 40 degrees: close up

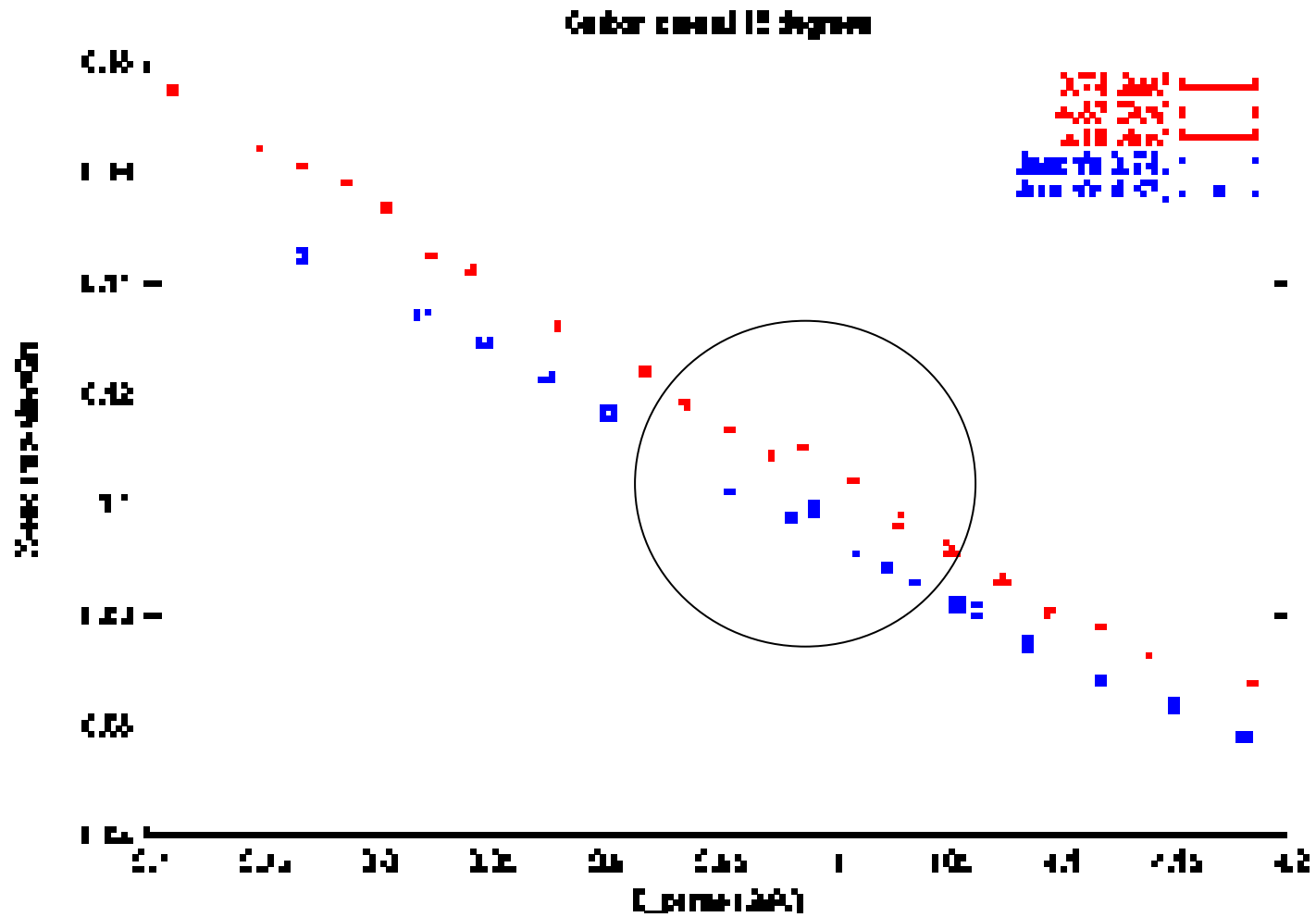Overlap region is of some concern in the highlighted areas.

Carbon at 18 degrees

> There's something wrong with the method used to do error calculation in the red (Nadia's) data

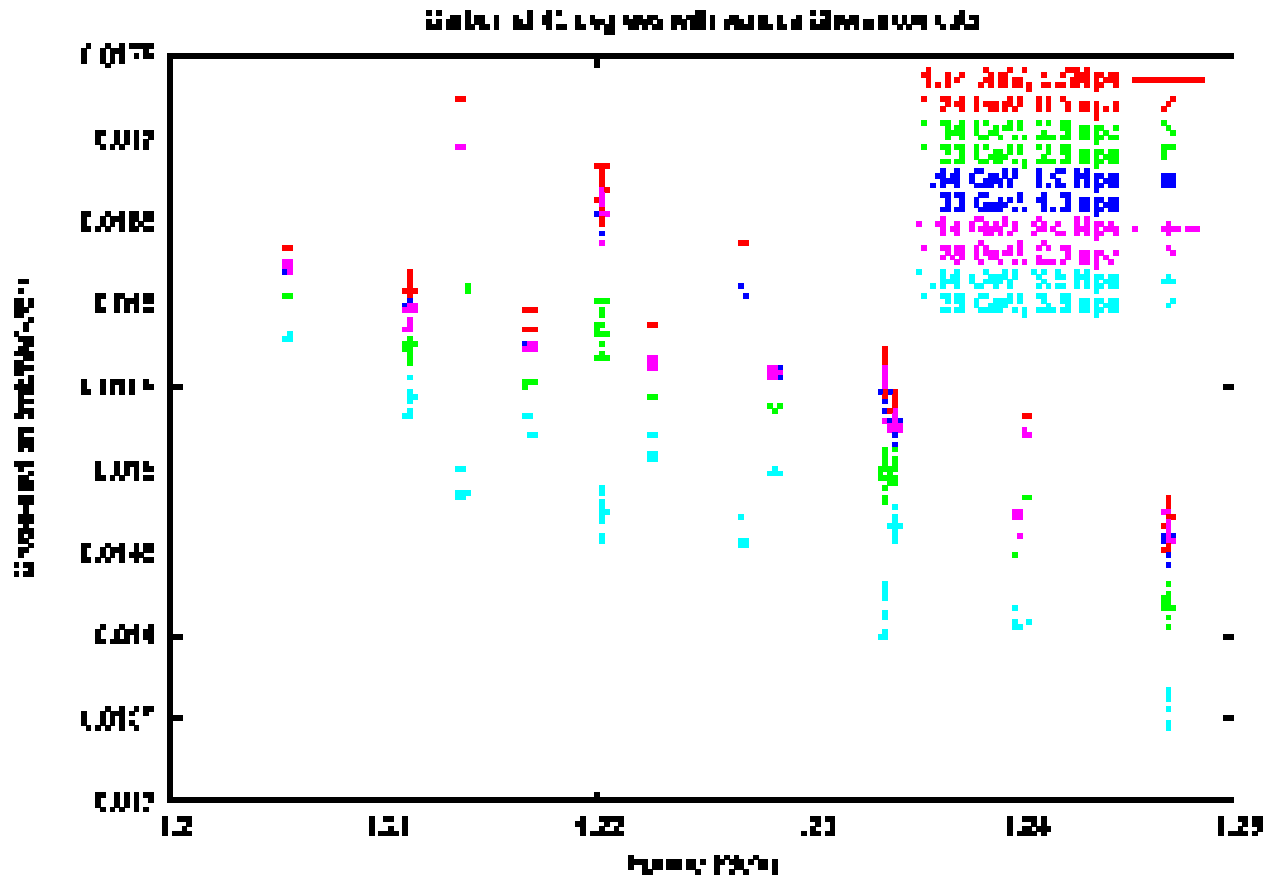> Bin-centering models used differ at high-X, where they matter more

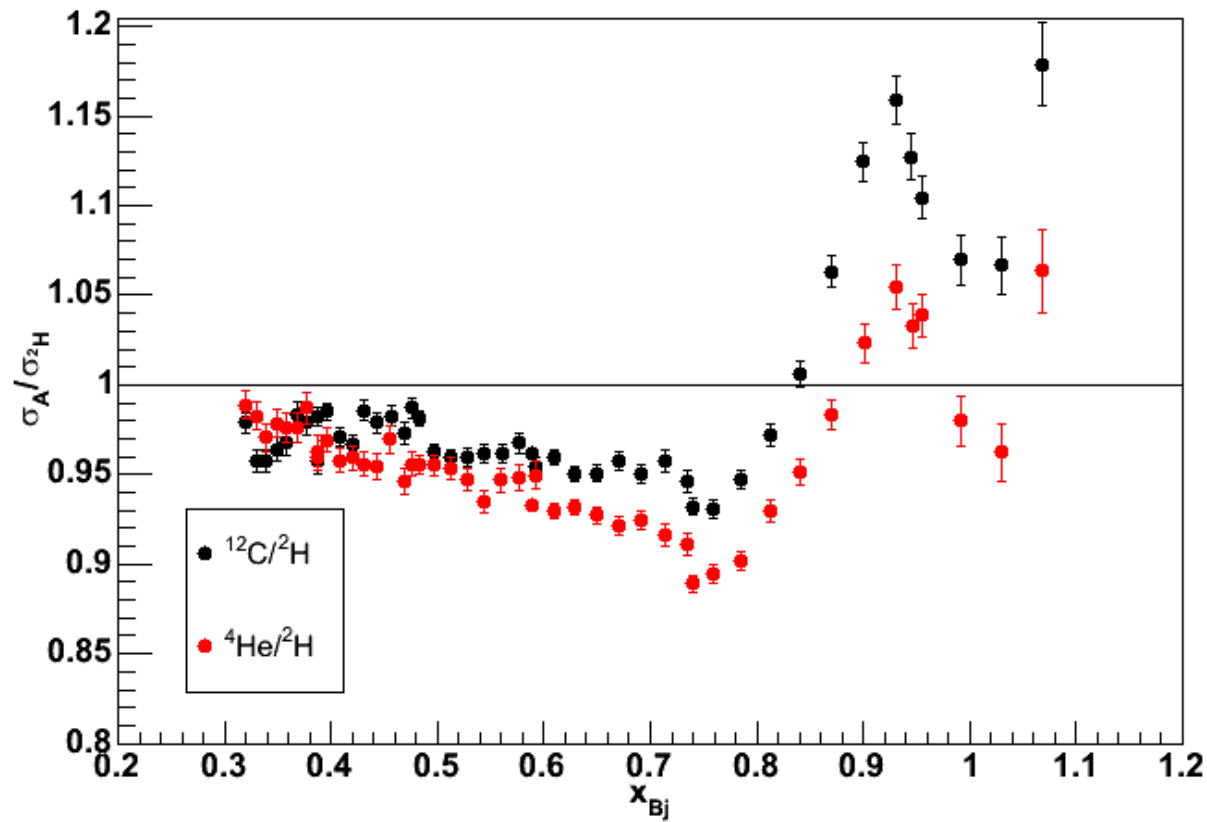# Carbon at 18 degrees: a closer look

A look at one possible reason for the overlap mismatch

➢ We tried varying the Cherenkov cut to see what would happen

➢ The overlap improves with a tighter Cherenkov cut.

➢ So, this could be related to the Cherenkov efficiency, or the presence of pions.

Some very preliminary EMC ratios

Summary and Future plans

➢ We've made some good progress with the data analysis (the goal of having preliminary cross-sections by June was met!)

➢ Fairly good agreement between two different methods and two different cross-section models

➢ Still to do:

❑ Have Aji and Roman catch up and see how their cross-sections compare

❑ Try using the same model for the data and see how good the agreement is

❑ Work on solving the overlap problem

❑ Start working on radiative corrections

❑ Start working on Coulomb corrections.