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Target Packing Fraction

- The packing fraction of the target is the ratio of the volumes of polarized material and helium inside the target.
- This quantity together with contributions from other materials determines the overall dilution factor of the measured asymmetry.
- The packing fraction of a target cannot be measured directly and may changes during data taking due to beam-target interaction.
- To determine the packing fraction we need simulation program which will reproduce rates from all component of the target.
- Such a program based on D. Potterveld and J. Arrington HMS general simulation code was modified for Gen experiment by Hunggou Zhu, Chris Harris and Nikolai Savvinov.

Target Model

- To simulate the dilution factors and the radiative corrections the E93-026 target model was used.
- The target material consists of 1-3 mm diameter granules of $^{15}ND_3$, sitting in the ^{4}He bath inside the target cavity.
- The target materials in the $^{15}ND_3$ in order they are traversed by the electrons are listed in the Table 1.

Packing Fraction

- The packing fraction is the fraction of target cell volume filled by $^{15}ND_3$ and liquid ^4He.
- To determine the packing fraction, the ND_3 data and ^4He or ^{12}C data can be used.
- For E01-006 (RSS) we have taken some thick ^{12}C data with a fixed length of about 0.69 cm.
- The radiation length of the carbon target is roughly the same as that of the deuteron target with a 50% packing fraction.

- The ratio of the HMS single event rate for the scattering from the ND_3 target to the HMS singles rate from the carbon target is given by:

$$r = \frac{R_t}{R_c}$$

or

$$r = \frac{P_f R_D + P_f R_{15_N} + (1-P_f) R_{Het} + R_{NMR} + \Sigma R_{unpol}}{R_C + R_{Hetc} + \Sigma R_{unpol}}$$

where $R_{NMR} = R_{Cu} + R_{Ni}$ and $\sigma R_{unpol} = R_{Al} + R_{Hex}$, with
$P_f \longrightarrow$ the packing fraction,
$R_t \longrightarrow$ rates from polarized target,
$R_c \longrightarrow$ rates from carbon target,
$R_i \longrightarrow$ rates from different components of the target materials.

Solving for the packing fraction yields: $P_f \longrightarrow$

$$\frac{r(R_C + R_{Hetc} + R_{Al} + R_{Hex}) - (R_{Het} + R_{Cu} + R_{Ni} + R_{Hex} + R_{Al})}{R_D + R_N - R_{Het}}$$

MC codes

- To get the packing fraction, a model of cross section σ_i for all target materials is required.
- The rate R_i can be expressed as $\rightarrow \frac{I_b}{e} n_i \sigma_i$ (e *is the electron charge,* $n_i = \frac{N_A \rho_i d}{A_i}$ *is the number density,* I_b *is the beam current*).
- Single arm Cross section calculation based on O'Connel and Lightbody QFS model.
- *Nikolai Savvinov* was used of QFS with a new Fermi momentum and separation energy (C. Harris modification for Gen kinematic).
- *Hongguo Zhu* have more general version of QFS. Which probably must give more correct prediction for RSS kinematic.
- I take some MC simulations for RSS kinematic on ND3 and C targets with this two codes and make comparison with the experimental data.
- Similar lose cuts (*momentum and angular*) was applied on experimental data and MC.

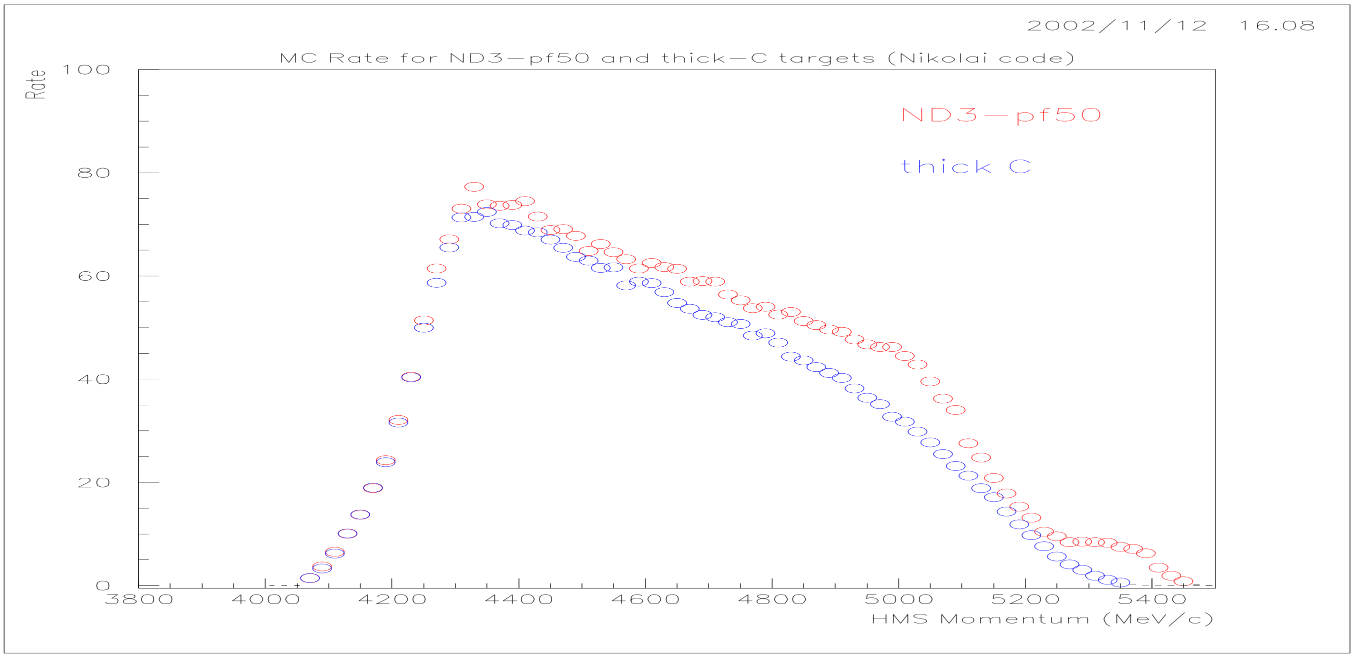

FIG. 1. MC Rate for ND3-pf50 and thick-C targets (Nikolai code)

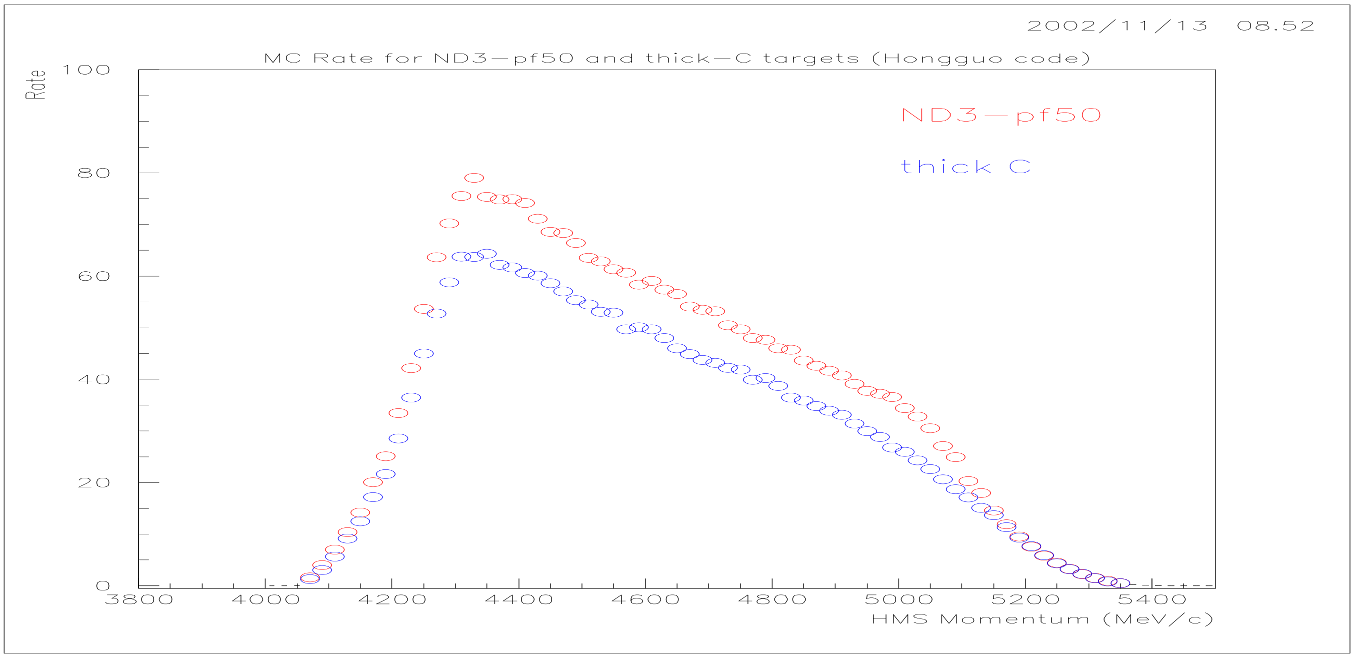

FIG. 2. MC Rate for ND3-pf50 and thick-C targets (Hongguo code)

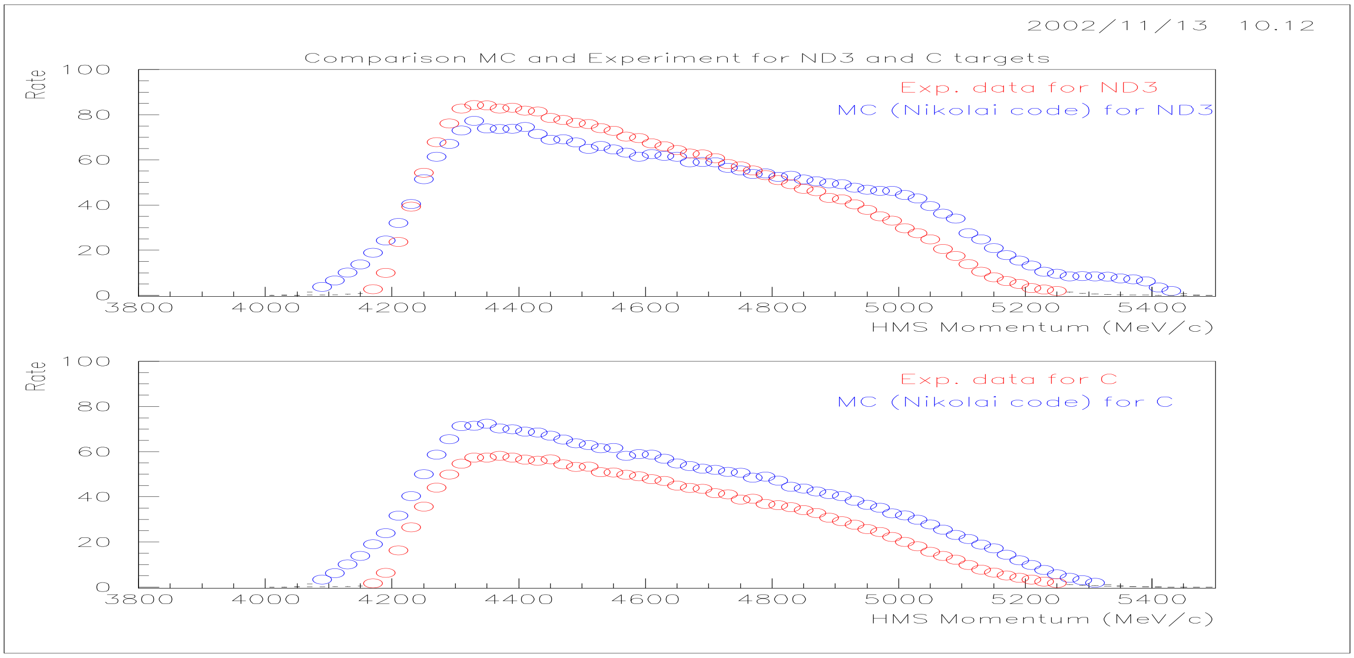

FIG. 3. Comparison of MC and Experimental Rates for ND3-pf50 and thick-C targets (Nikolai code)

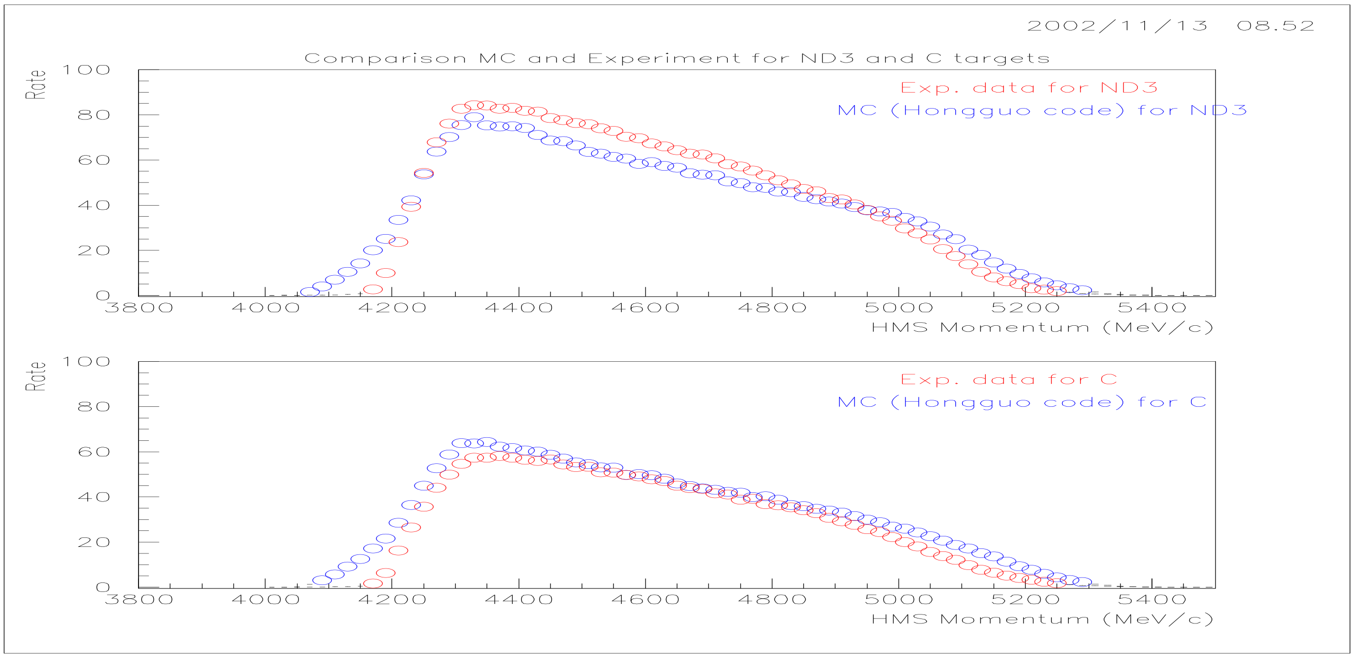

FIG. 4. Comparison of MC and Experimental Rates for ND3-pf50 and thick-C targets (Hongguo code)

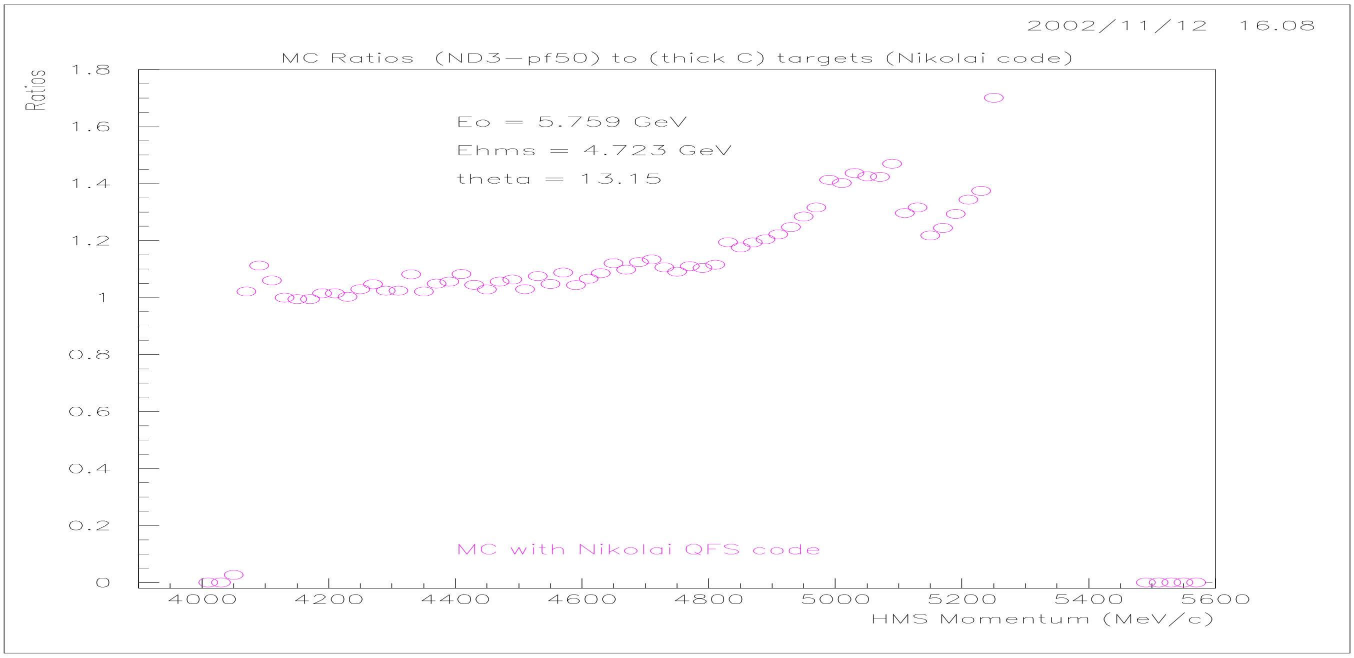

FIG. 5. MC Ratios (ND3-pf50) to (thick-C) targets (Nikolai code)

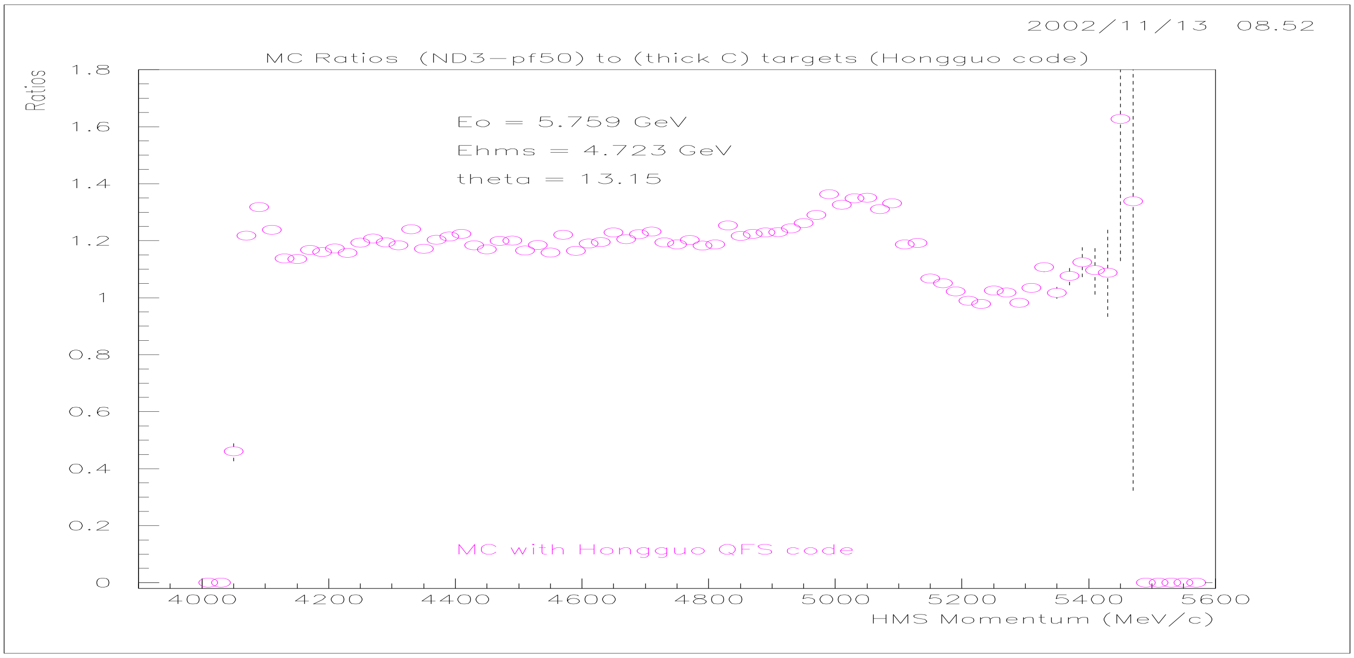

FIG. 6. MC Ratios (ND3-pf50) to (thick-C) targets (Hongguo code)

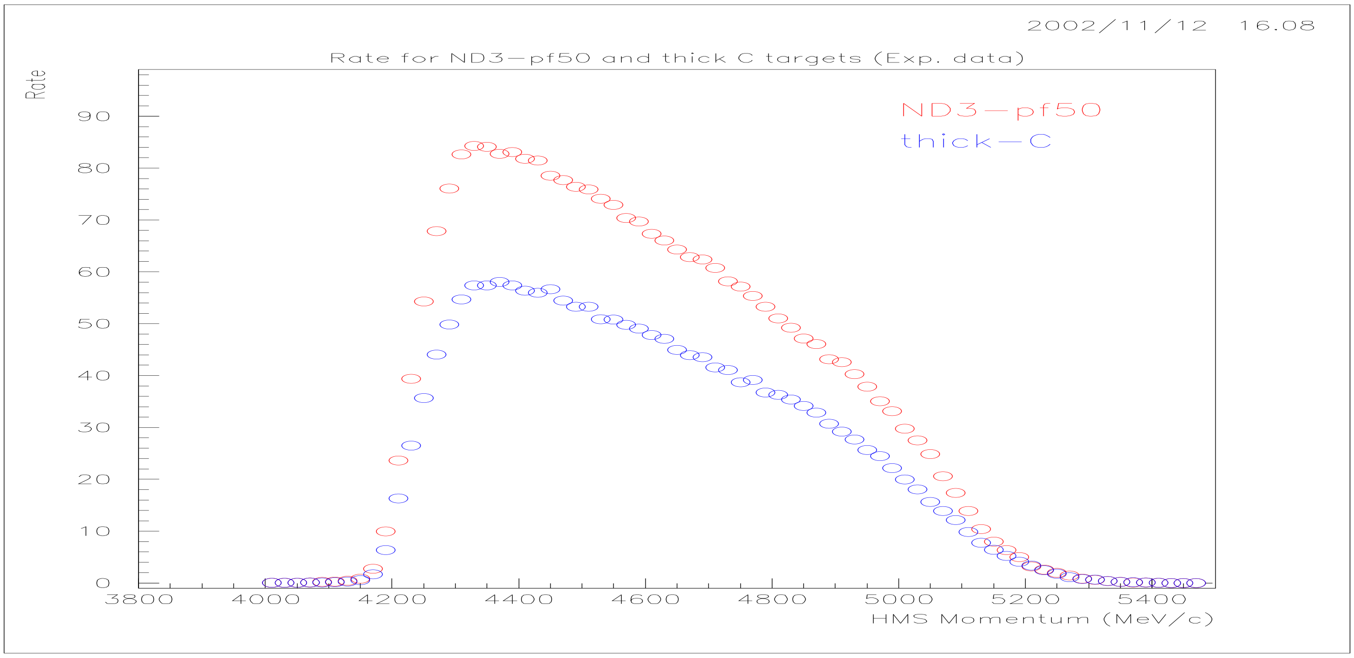

FIG. 7. Experimental Rates for (ND3-pf50) and (thick-C) targets

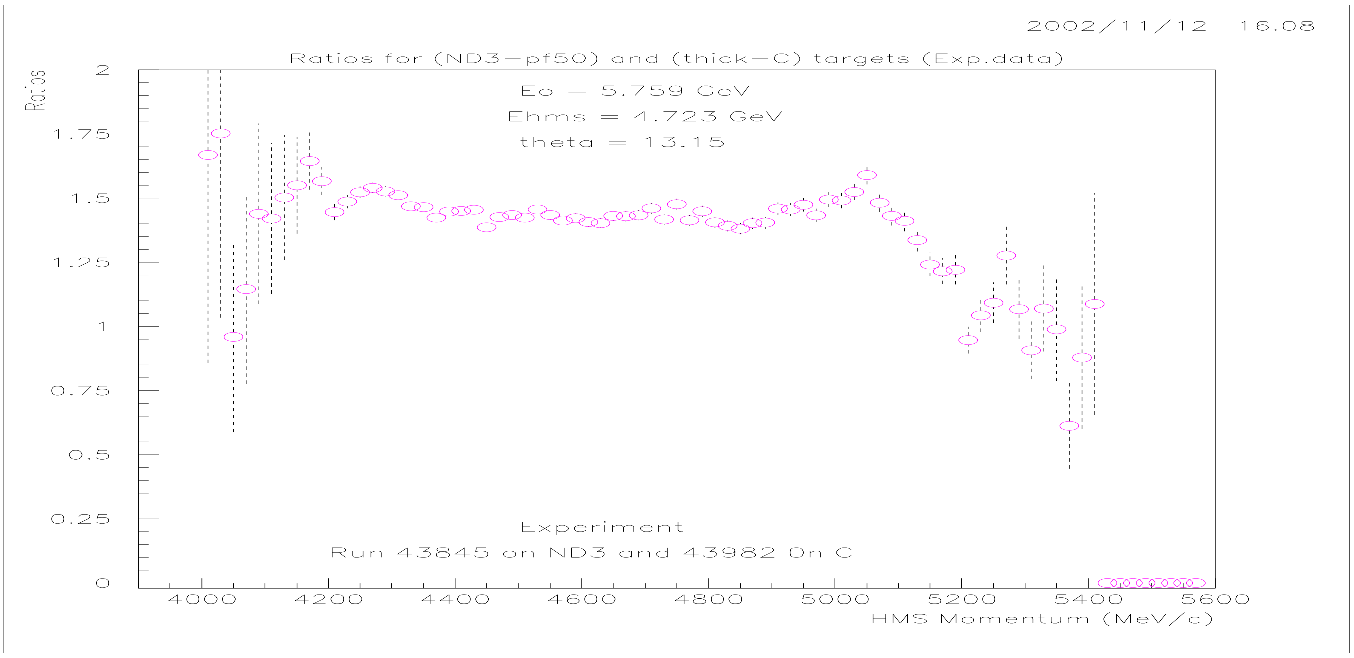

FIG. 8. Experimental Ratios (ND3-pf50) to (thick-C) targets

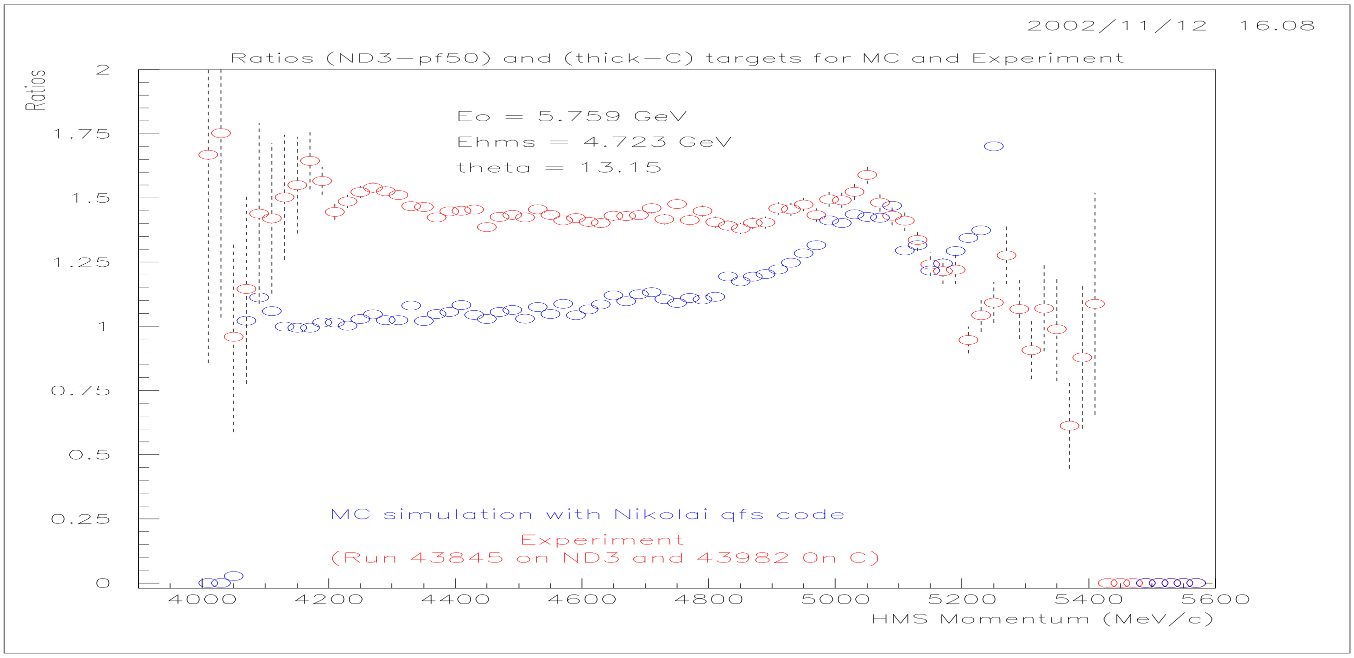

FIG. 9. Comparison of MC and Experimental Ratios (ND3-pf50) to (thick-C) targets (Nikolai code)

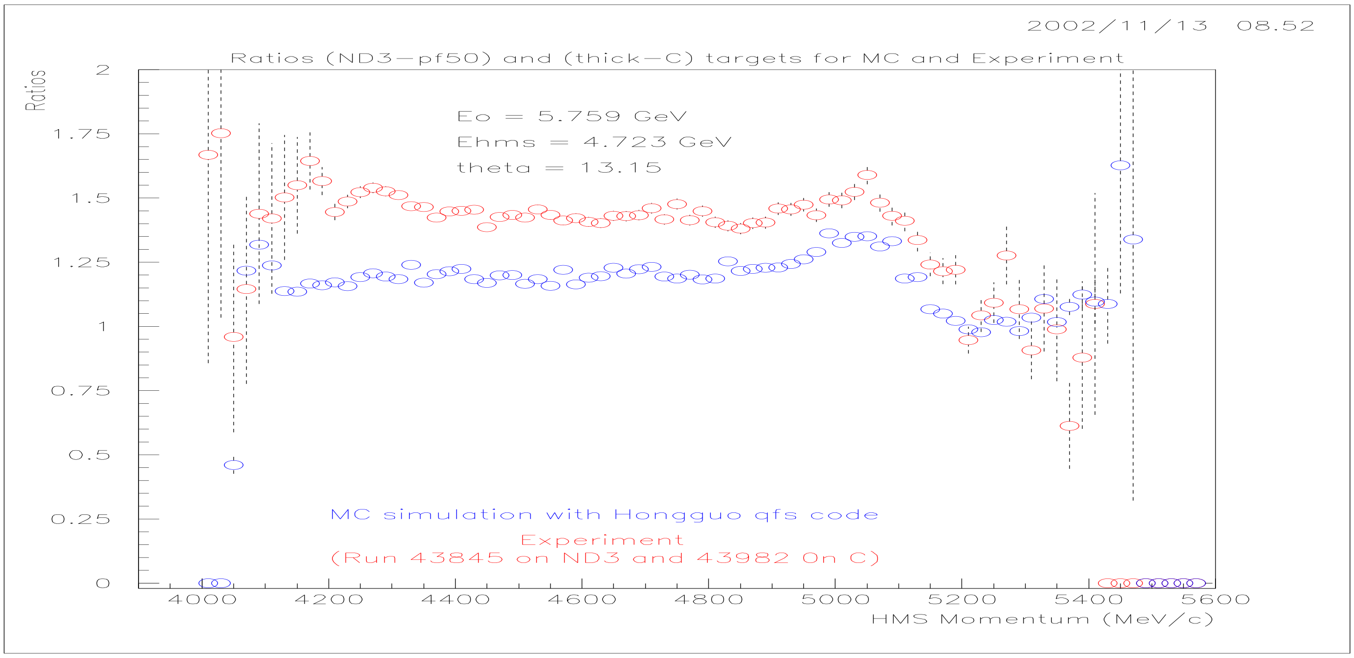

FIG. 10. Comparison of MC and Experimental Ratios (ND3-pf50) to (thick-C) targets (Hongguo code)

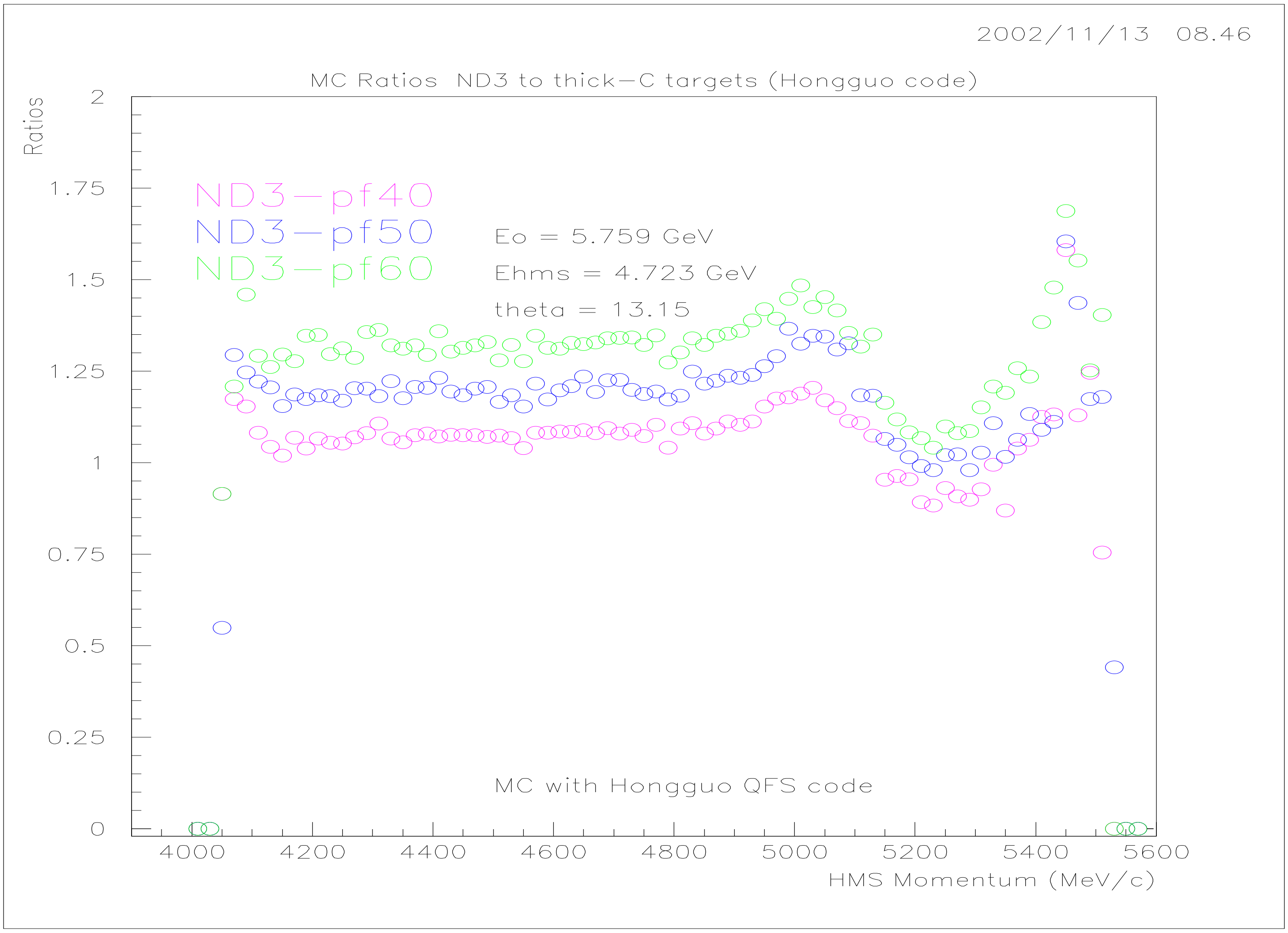

FIG. 11. MC Ratios ND3 to thick-C for different packing fraction (Hungguo code)

CONCLUSION

- No perfect agreement between MC and RSS experimental data.
- The ratio of the rates on ND3 and C targets looks more flat with Hungguo code.
- ND3/C experimental ratios $\sim$ 20-30 % higher than the values predicted by MC with ND3 target packing fraction 50 %.
- The agreement between experimental ratios and MC could be slightly improved by increasing the packing fraction.

What else To do ?

- MC simulation with and without radiation correction.
- Extract packing fraction for number of experimental runs.
- Determine average packing fraction.

Thanks N. Savvinov, H. Zhu and M. Jones for help and many discussions.