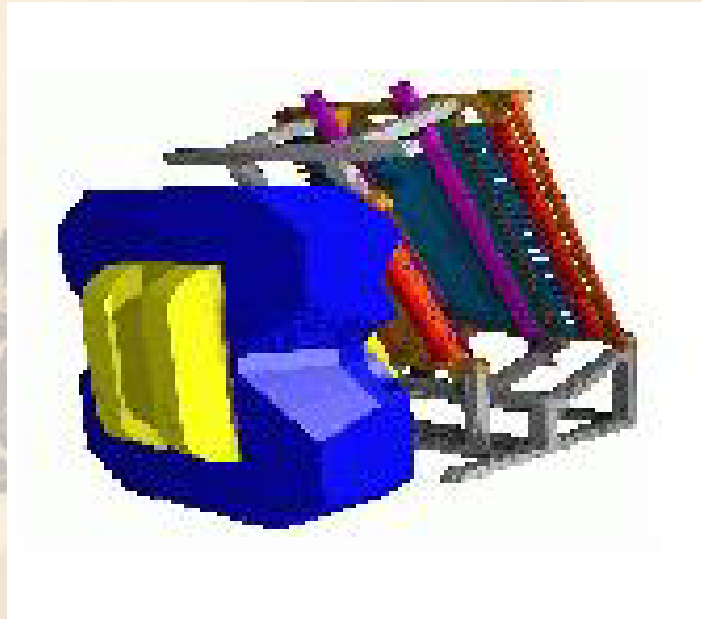
BigBite Background simulation Progress Report

Xin Qian

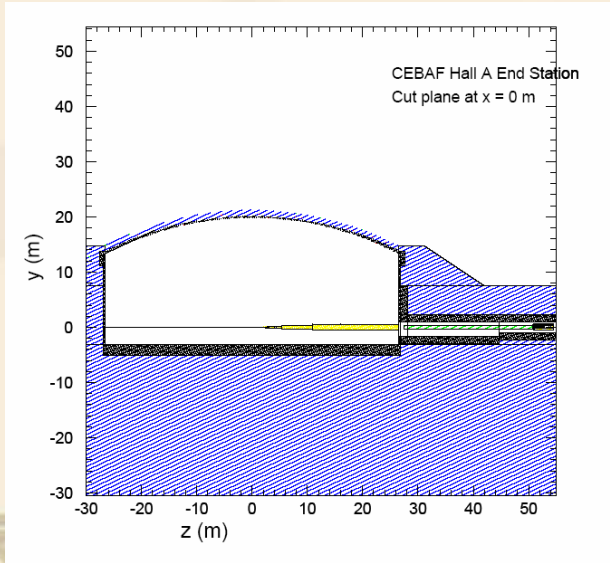


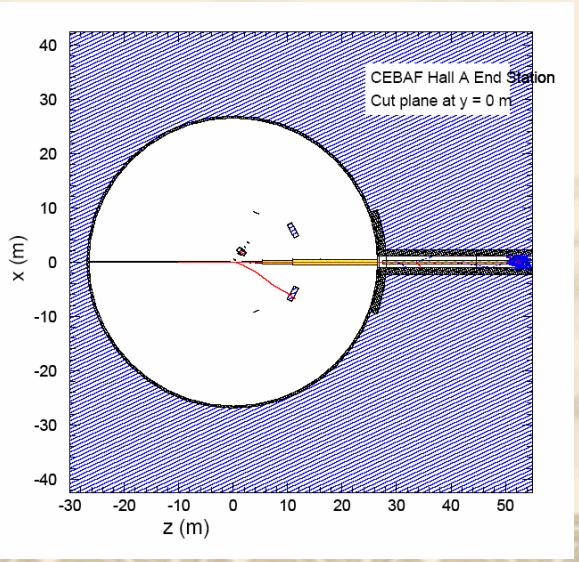
Motivation & Plan

- Provide reliable background rates on BigBite wire chamber and calorimeter.
  - Step 1: Compare with TRAN test run.
  - Step 2: Compare with N20 data.
  - Step 3: Compare with SRC data
  - Step 4: Compare with bare wire chamber data
  - Step 5: Extend to TRANSVERSITY and GEN experimental condition.
  - Step 6: Study shielding possibilities.

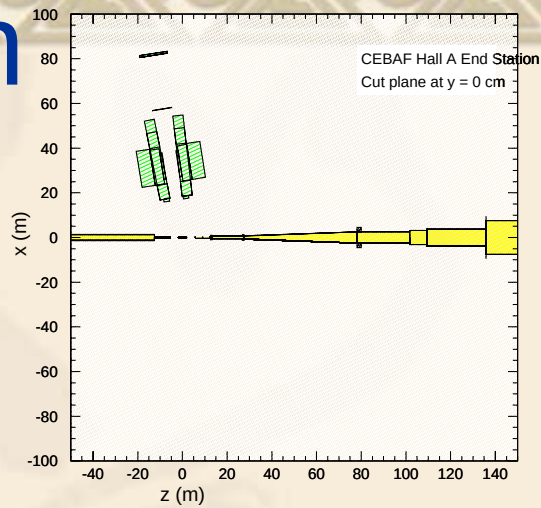
GENAT3 based simulation

- GEANT3 with modified physics.
- Modified Physics:
  - Use exclusive event generator: photon-nuclear fragmentation package DINREG in GEANT substitutes old ‘PFIS’ mechanism.
  - Electron-nuclear interactions are modeled using equivalent photon representation of an electron.





TRAN Test Run



Aux plane 1400*500*2 mm

dE plane 2000*500*3 mm

E plane 2000*500*30 mm

Distance between E plane and Aux plane ~900mm

Aux plane is put in the position of first drift chamber

15 cm LD2 target 2 μ A

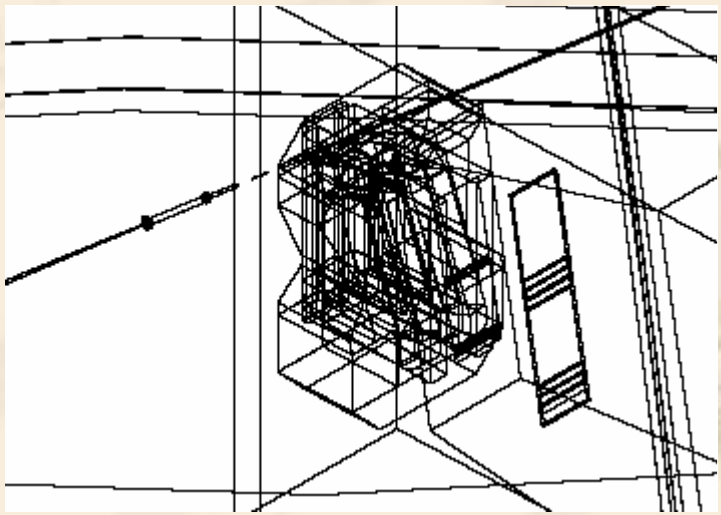
Ee = 4.6 GeV θ_B = 99 degree

B_B = 0.986 T

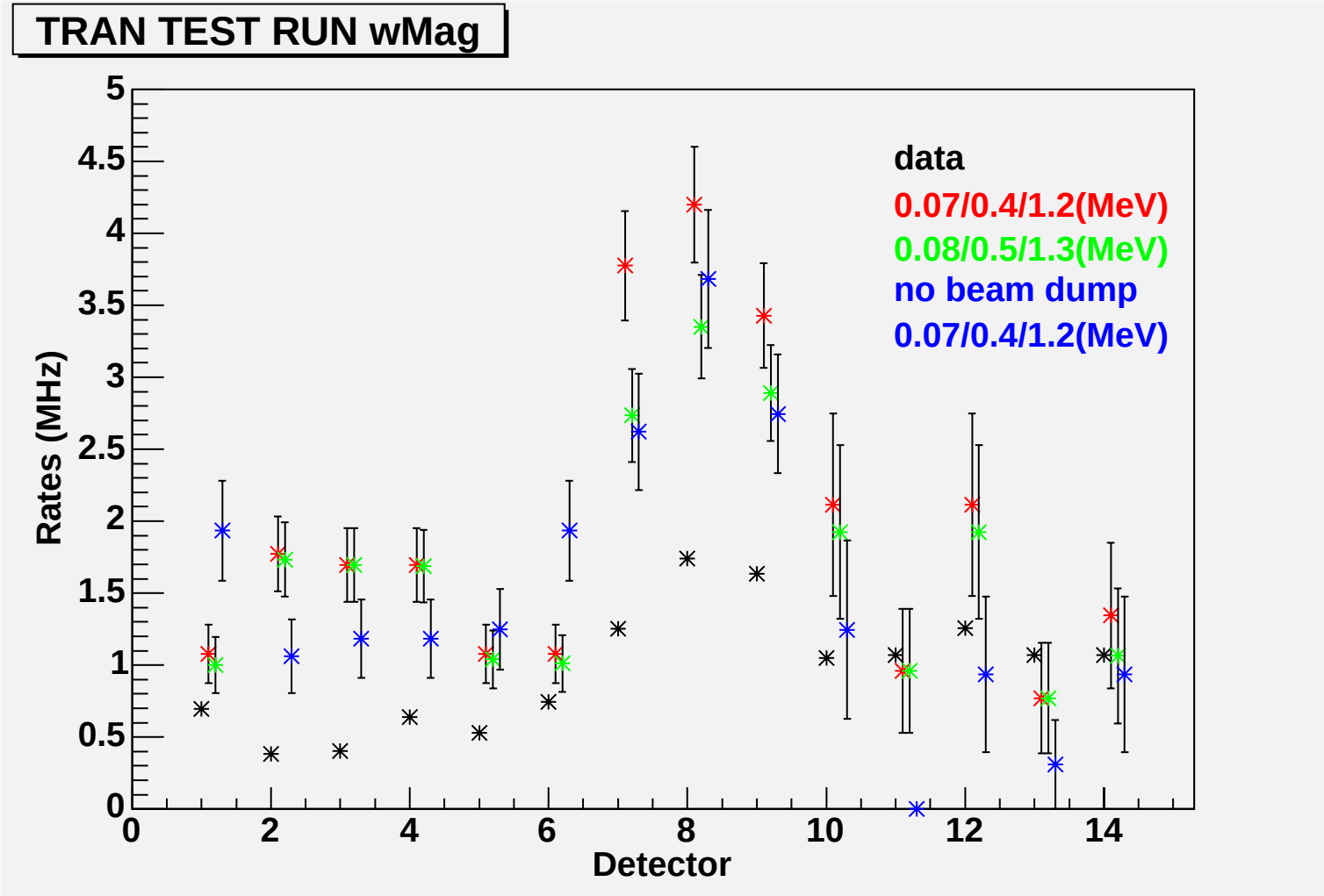
Energy loss cut:

Aux: 0.07 MeV dE: 0.4 MeV

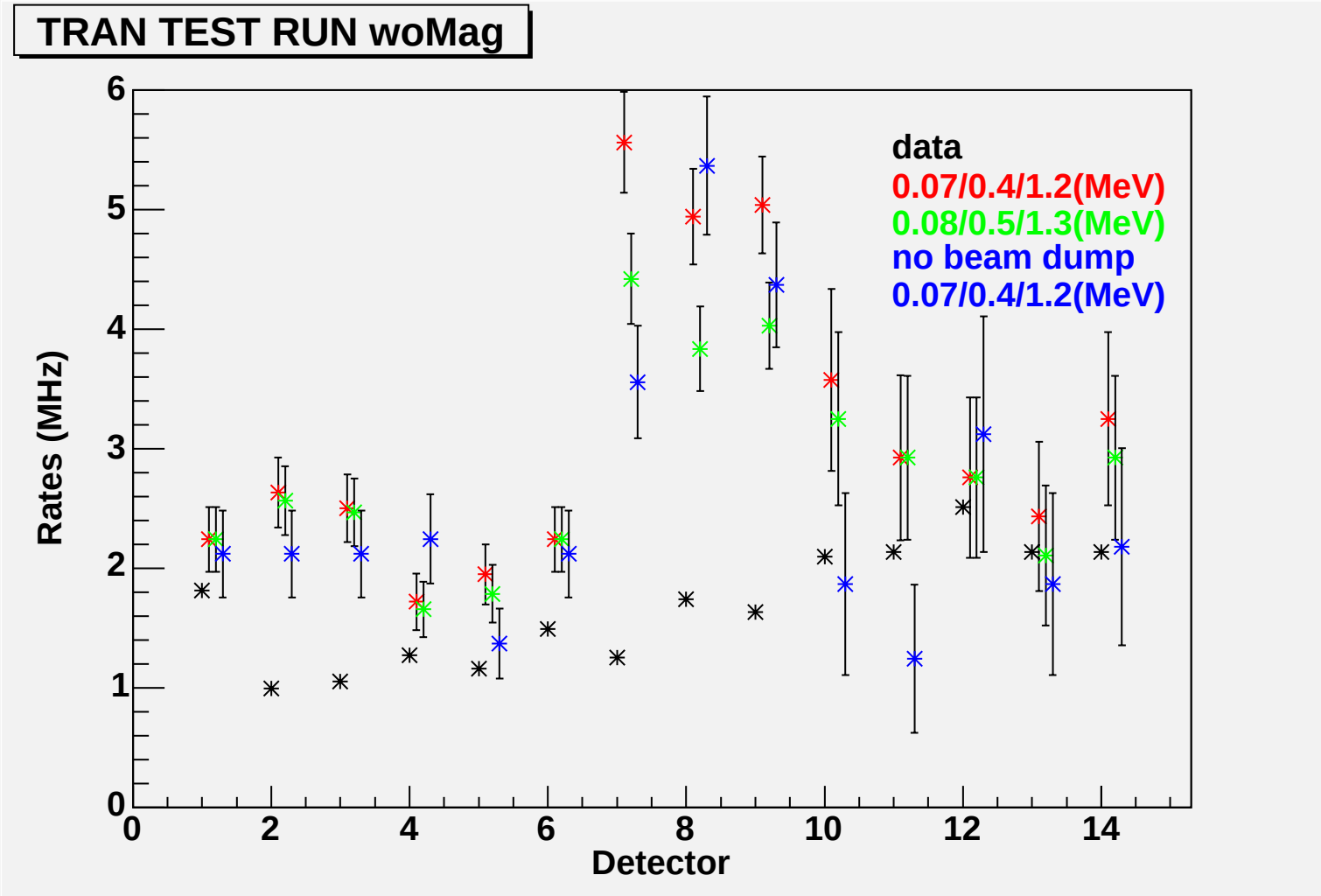
E: 1.2 MeV



TRAN test run comparison

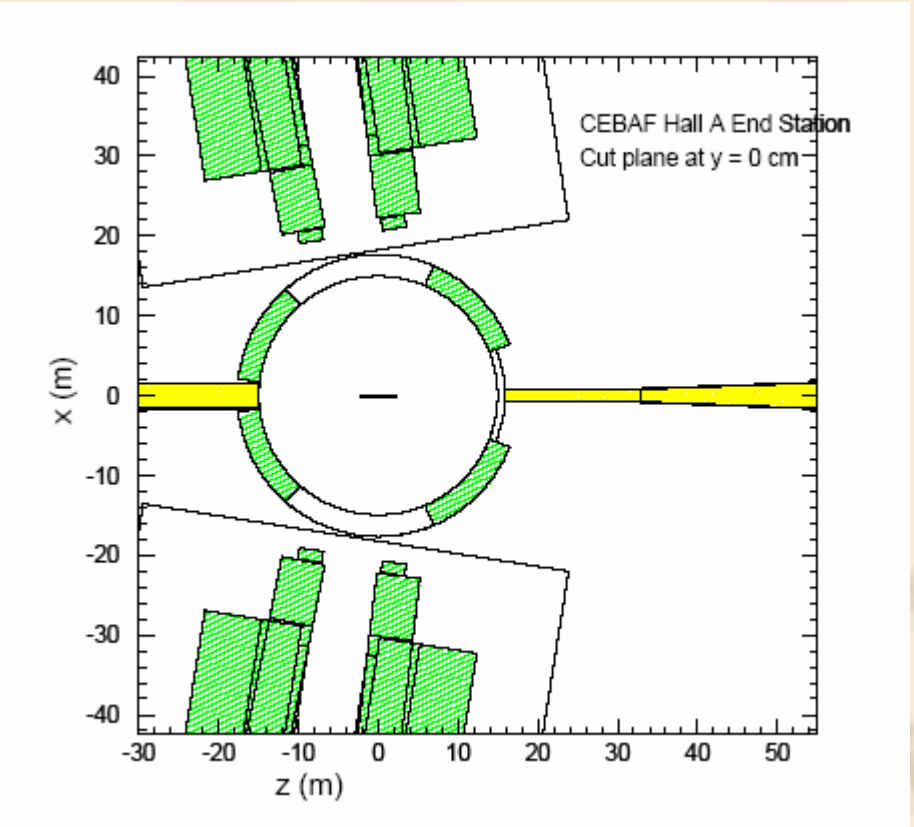


TRAN test run comparison



Update on TRAN test run

- Add vacuum chamber.
- Add copy of detector to increase statistics.
- Remove part of beam dump to reduce running time.
- Still need to confirm geometry carefully.
- Need systematic error on the threshold.



Comparison with N20 run

- LH2 target, 40 degree, 15 m.

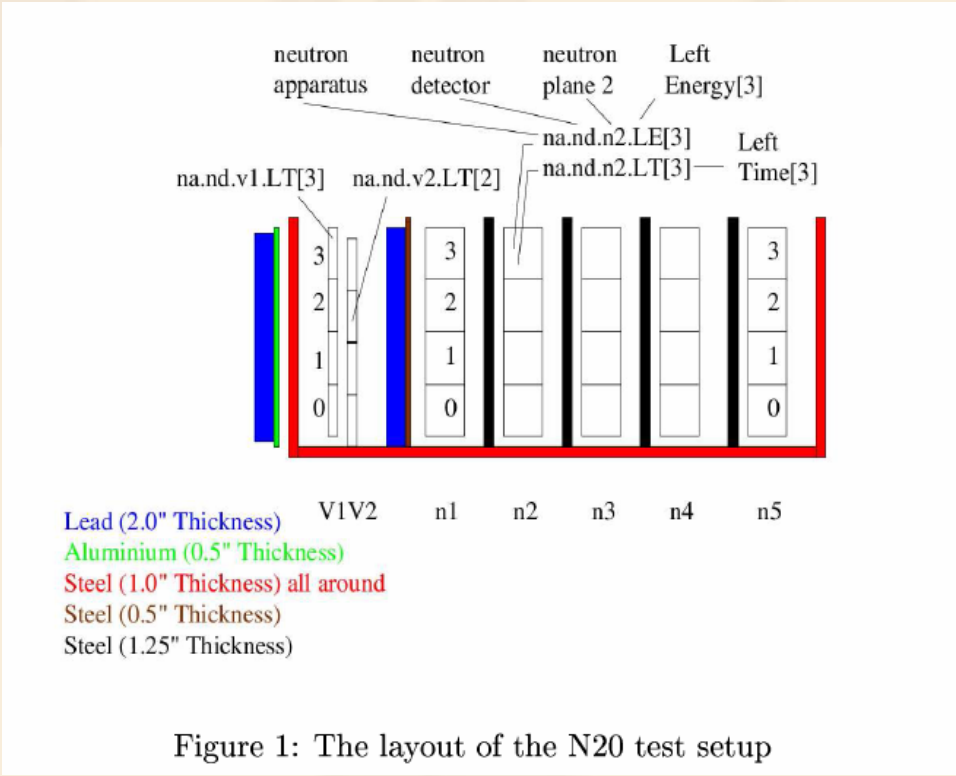
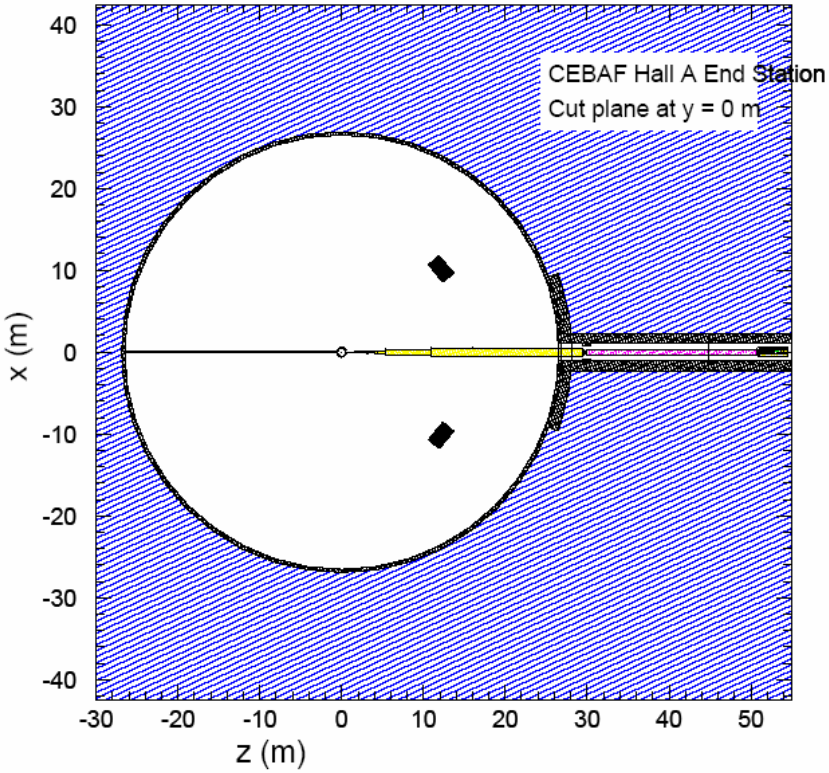
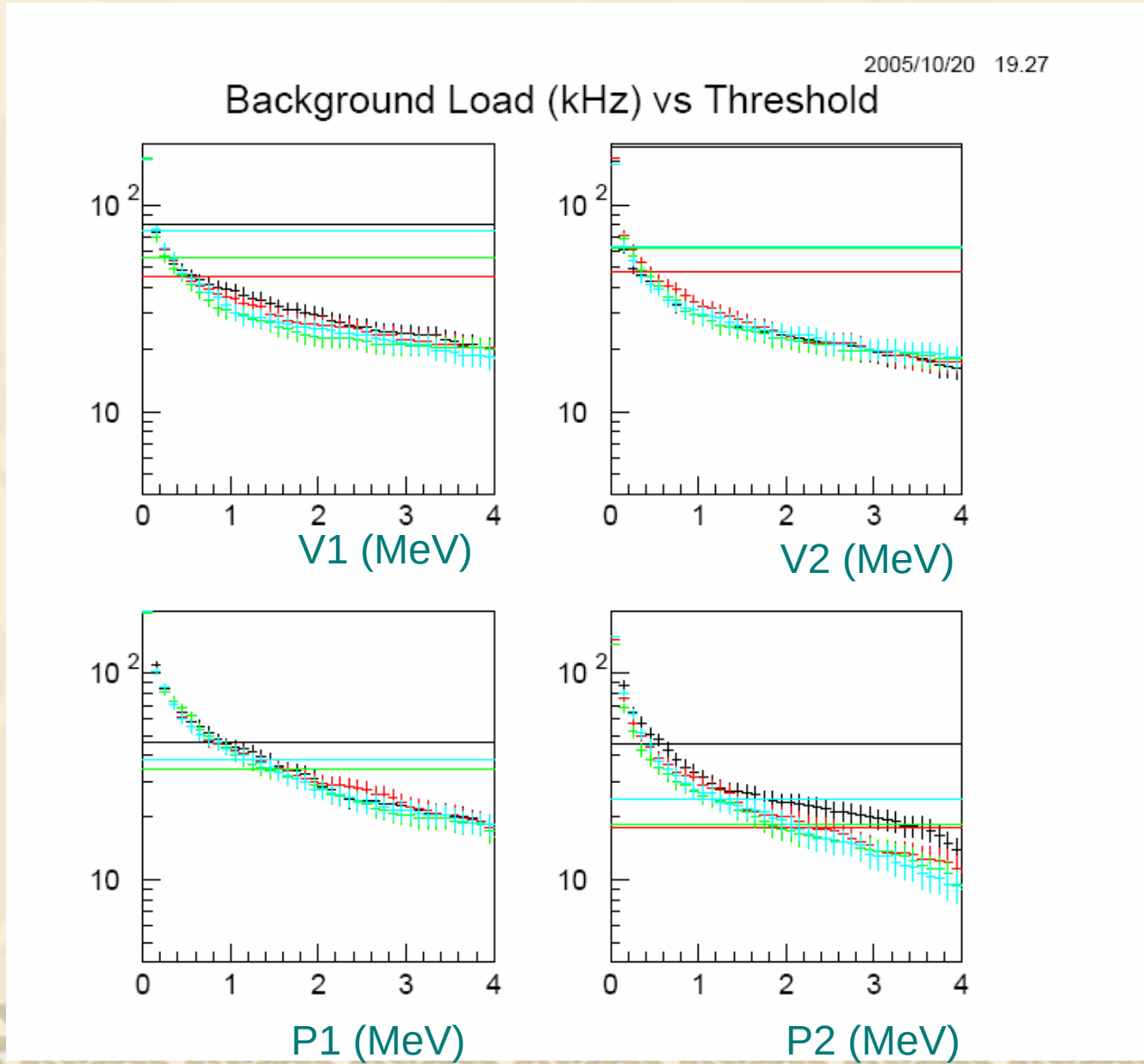


Figure 1: The layout of the N20 test setup



Comparison with N20 data

- Threshold unknown.
- Expect 2 ~ 3 MeV for Pn?



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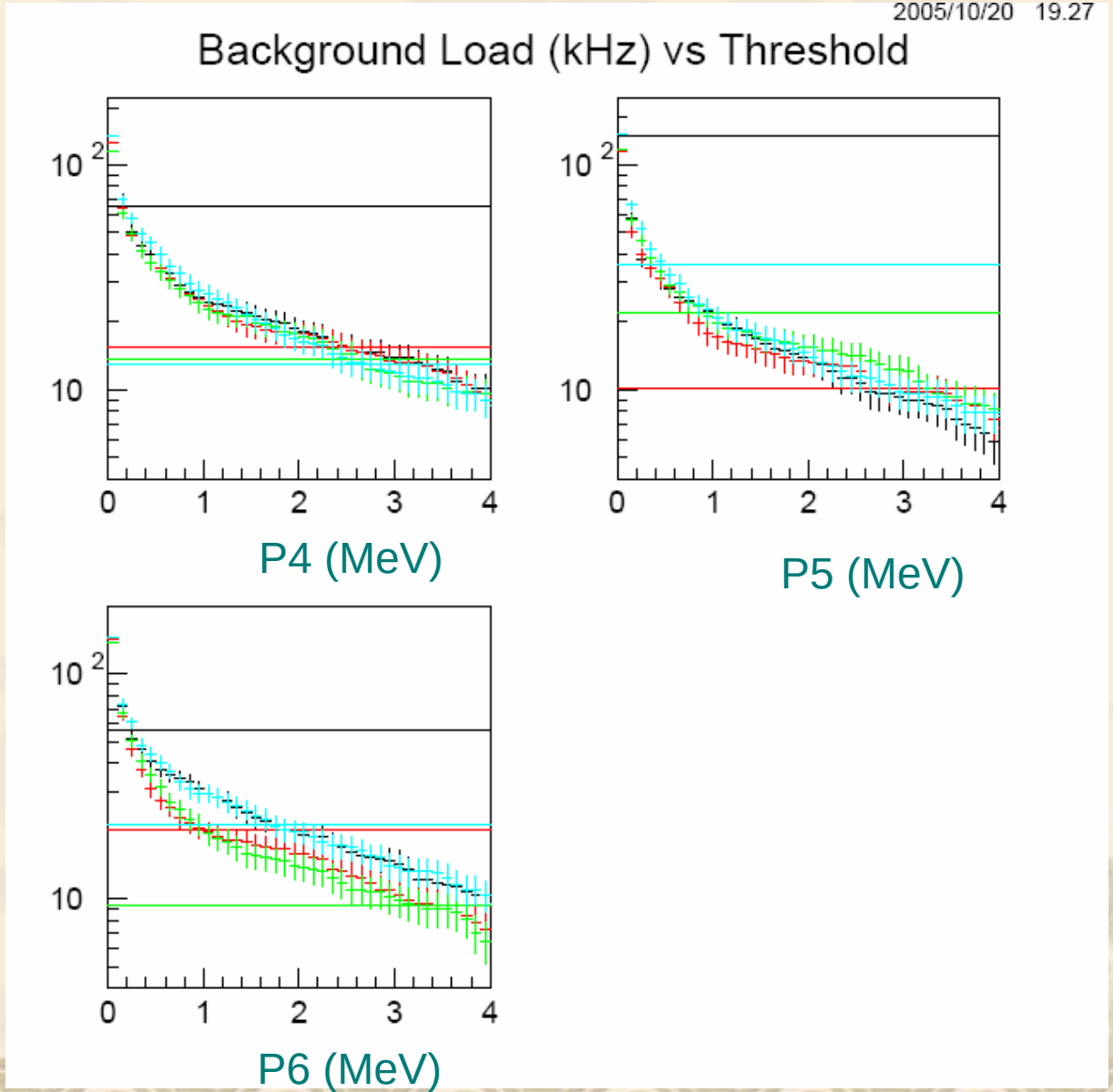
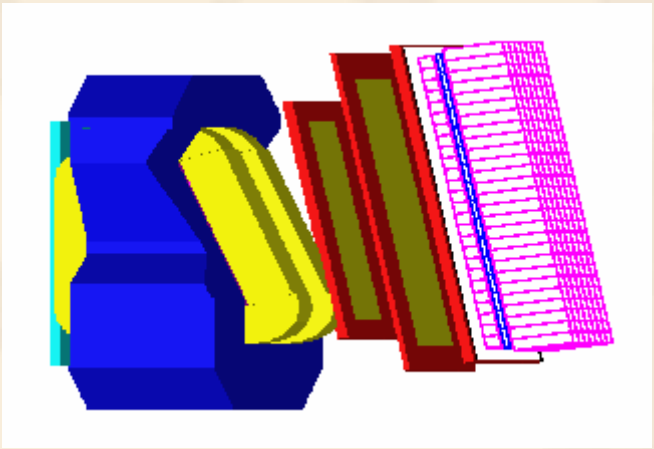
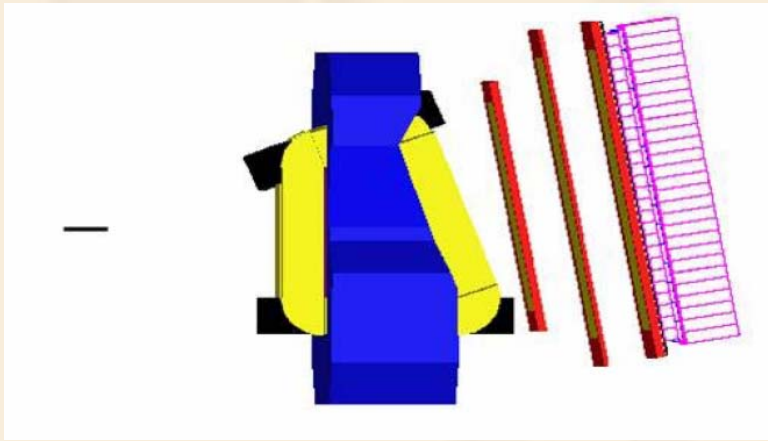


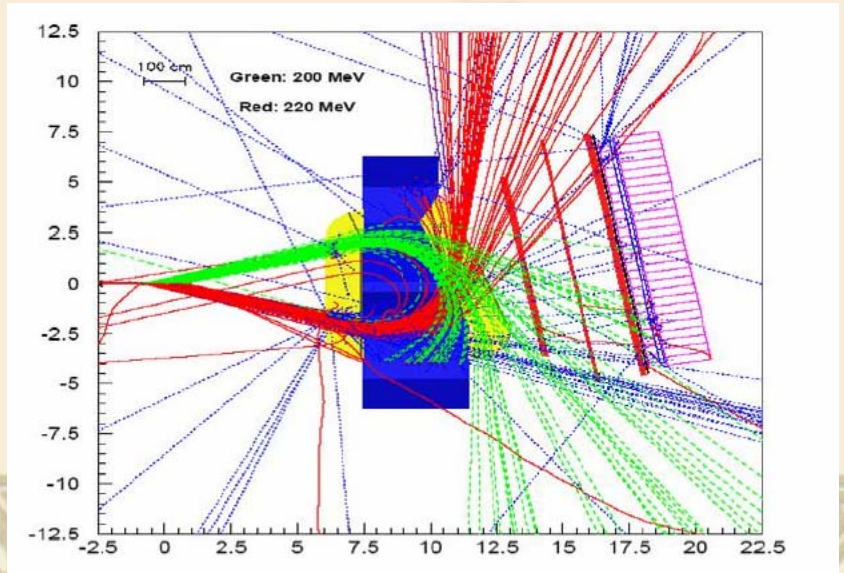
Comparison with SRC data & bare wire chamber data

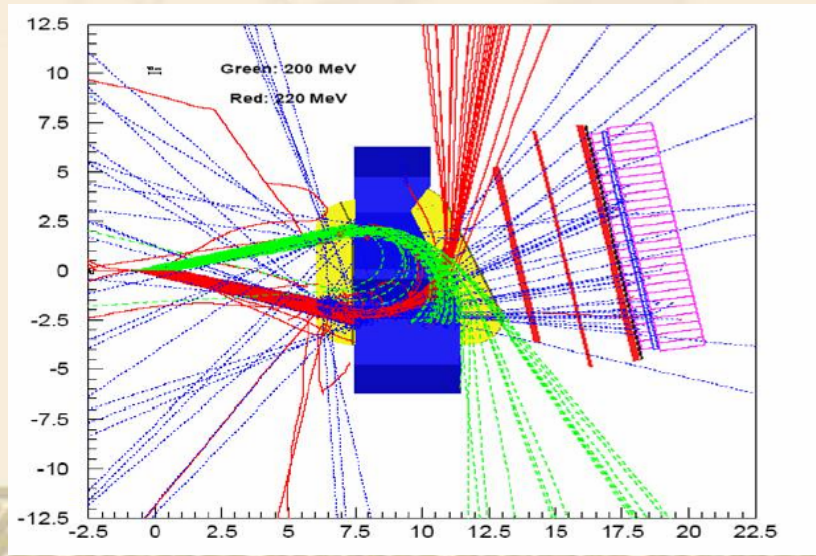
- Still need more information on the geometry, threshold, rates, position.
- Will provide more comparisons in the near future.

Extend to TRANSVERSITY and GEN case









Extend to TRANSVERSITY and GEN case.

- 3.2 GeV 54 degree
  - * for black box model
  - Threshold 0.06 keV

settings	DC1	DC2	DC3
Pavel's simulation	31 ± 6	119 ± 12	-
with new beam line	38.4 ± 9.6	168 ± 20.08	-
new BigBite model	154.3 ± 8.5	349.1 ± 12.8	348.6 ± 12.8
settings	DC1*	DC2*	DC3*
new BigBite model	181.75 ± 28.7	364.4 ± 39.8	408.821 ± 47.2

- 6.0 GeV 30 degree
  - * for black box model
  - Threshold 0.06 keV

settings	DC1	DC2	DC3
new BigBite model	61.3 ± 5.35	103.9 ± 6.97	82.3 ± 6.2
settings	DC1*	DC2 *	DC3 *
new BigBite model	98.1 ± 11.145	120.4 ± 12.8	119.7 ± 12.9

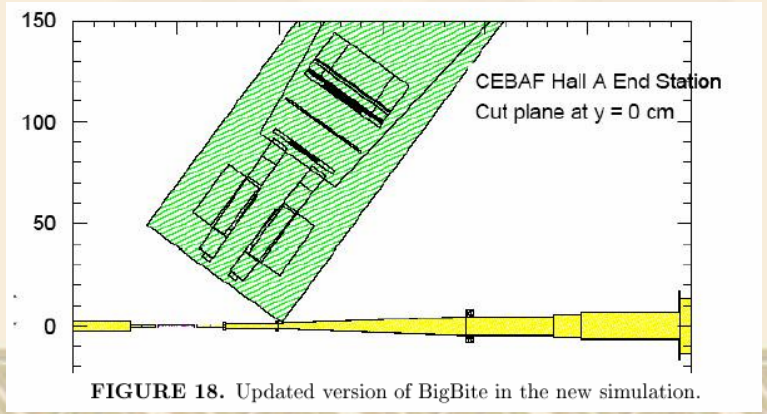
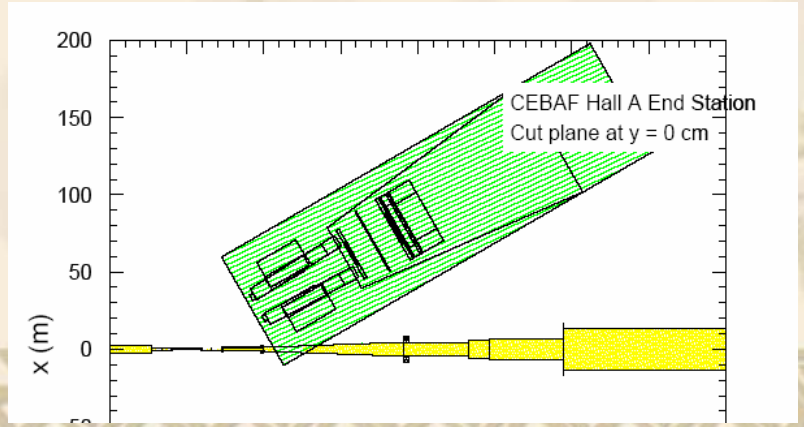


FIGURE 18. Updated version of BigBite in the new simulation.



Extend to TRANSVERSITY and GEN case.

- GEN case:
  - Photon conversion factor is 0.6%. Using black box model

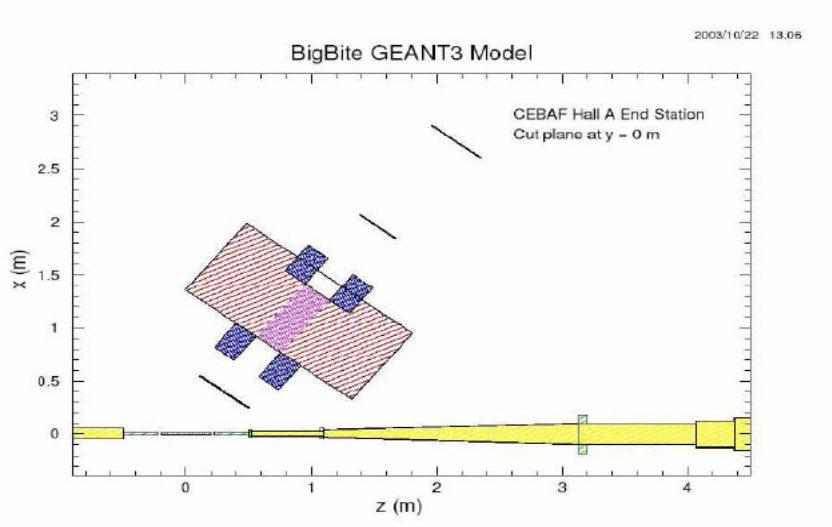
particle	layer	γ	e^+	e^-	π^+
rates	BD1	19.5 ± 0.66	3.7 ± 3.7	157 ± 24.3	0.11 ± 0.000779
particle	layer	π^-	n	p	-
rates	BD1	0.0551 ± 0.000551	19.55 ± 0.0103	1.43 ± 0.00281	-
particle	layer	γ	e^+	e^-	π^+
rates	BD2	25.55 ± 0.75	3.74 ± 3.74	333.3 ± 35.3	0.165 ± 0.00095
particle	layer	π^-	n	p	-
rates	BD2	0.0551 ± 0.00055	26.9 ± 0.012	1.702 ± 0.00306	-
particle	layer	γ	e^+	e^-	π^+
rates	BD3	21.8 ± 0.7	26.2 ± 9.9	359.5 ± 36.6	0.11 ± 0.0007788
particle	layer	π^-	n	p	-
rates	BD3	0 ± 0	23.9 ± 0.011	1.211 ± 0.000258	-

Extend to TRANSVERSITY and GEN case.

- TRANSVERSITY case:
  - Photon conversion factor is 0.6%. Using black box model

particle	Rates at BD1	Rates at BD2	Rates at BD3	Rates (simple)
γ	28.6±0.54	30.13±0.56	28.2±0.54	2.16
e^+	0	0	0	0.06
e^-	65.88±10.6	86.68±12.2	88.4±12.4	0.06
π^+	0.51±0.0012	0.534±0.0012	0.455±0.0011	0.66
π^-	0.588±0.0012	0.588±0.0012	0.588±0.0012	0.6
p	2.54±0.0026	2.54±0.0026	2.09±0.0023	2.4
n	28.64±0.0081	40.5±0.01	42.58±0.01	6.8

Comparison with Pavel's old simulation



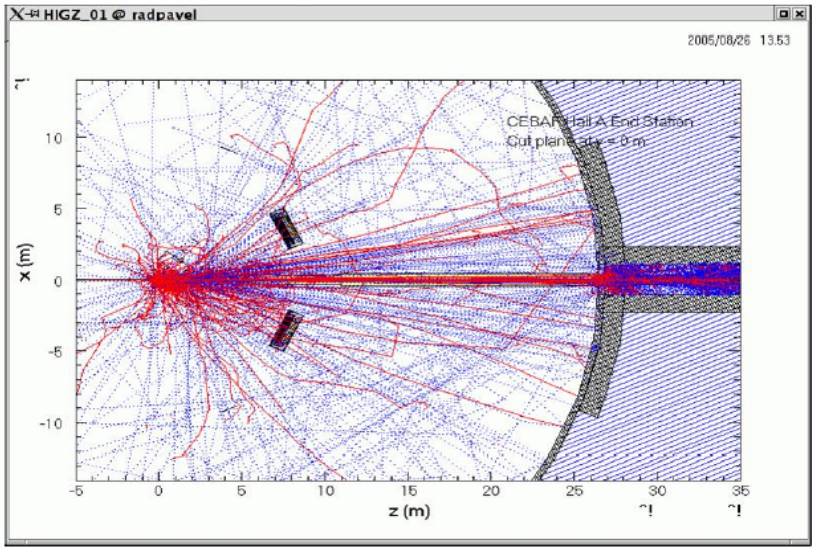
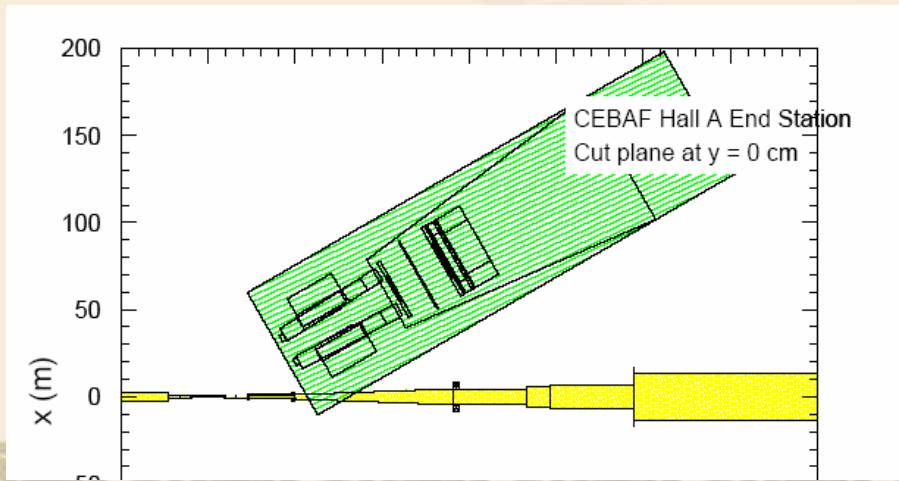


FIGURE 16. Old beam line.



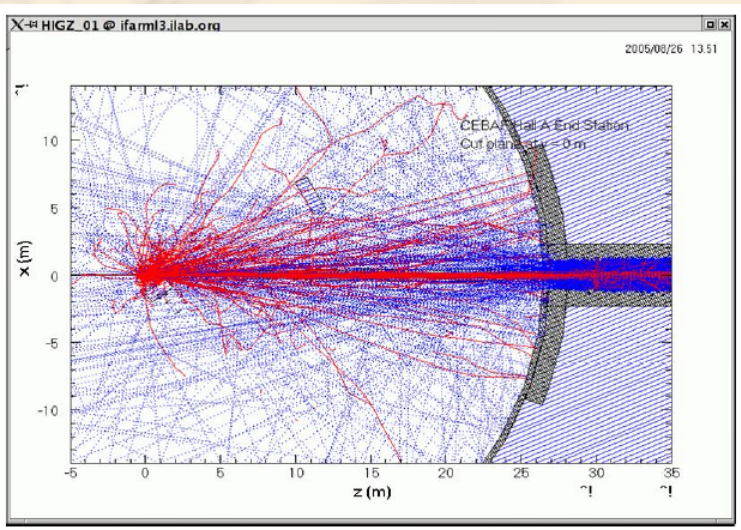


FIGURE 17. New beam line.

Extend to TRANSVERSITY and GEN case.

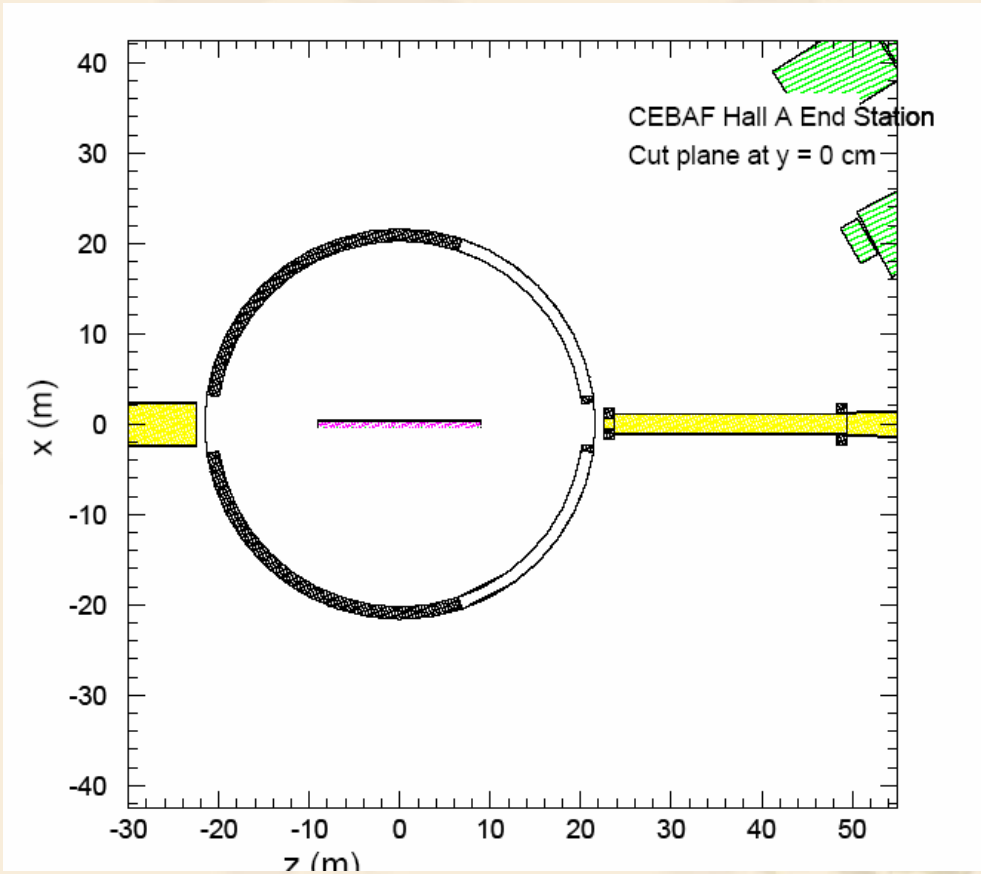
- GEN case
  - First wire chamber:
    - With Dump:
      - 154.3 +- 8.5 MHz
    - No Dump:
      - 72 +- 5.8 MHz
    - Block in the middle of BigBite magnet by Lead & No dump:
      - 61 +- 5.3 MHz

40 cm long Lead block

- TRANSVERSITY
  - First wire chamber:
    - With Dump:
      - 61.3 +- 5.35 MHz
    - No Dump:
      - 65 +- 5.5 MHz
    - Block in the middle of BigBite magnet by Lead & No dump:
      - 44.4 +- 4.5 MHz

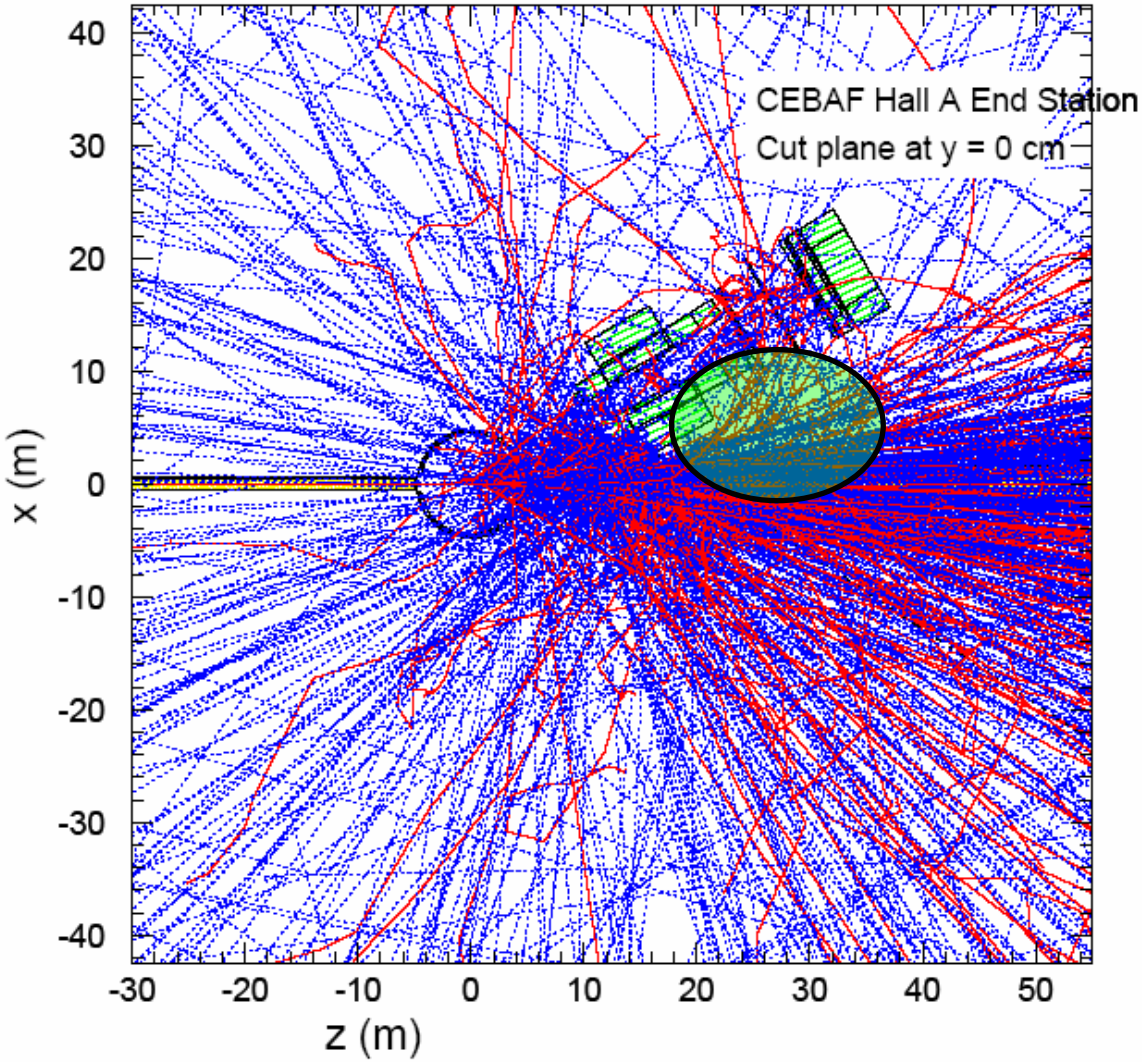
New model for TRANSVERSITY

- A new model is recently build for TRANSVERSITY condition.
- Still need to check the geometry.



Study Shielding possibility

- Currently developing software for this motivation. There still are some bugs in the program.



Conclusion & Future Work

- In TRANSVERSITY test run comparison, the simulation rates is higher than data by a factor of 1~3. With new modified model, we can see a clear reduction in simulation rates (still collecting statistics).
- In N20 test run comparison, need threshold information to do the comparison. The difference should be within factor of 3 with a raw guess of threshold.
- Need more information to carry out simulation for SRC data and bare wire chamber comparisons.
- With same model of beam line, GEN and TRANSVERSITY background is in the same level (TRANSVERSITY is less by a factor of 2).

Conclusion & Future Work

- The minimum rates of TRANSVERSITY and GEN are around 20 MHz within this model.
- Our simulation is almost consistent with Pavel's old simulation and the simple model with only the target (working on the surprising increase of electron rates).
- New TRANSVERSITY model is being developed.
- New TRANSVERSITY test run model is being developed.
- SRC data and bare wire chamber models will be developed. (Need more information)
- A program to study shielding probability is being developed. (search for bugs)
- Hope to finish everything before the resubmission of proposal.