Front-End Lattice Update

Chris Rogers,
ASTeC,
Rutherford Appleton Laboratory
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Front End 5.1

- Added IDS120k target
- Realistic target aperture
- Realistic coil geometries
- Added RF windows back into RF capture region
  - Same as old windows
- Old beam file (would it change?)
- Still anomalous low G4BL throughput
  - Not tried to tidy this up

Capture/Drift

Capture/Drift (G4BL)

Capture/Drift (ICOOL)

In target region fields are defined by a coil set

Beampipe radius in target area follows

$$r^2 = \frac{(r_1^2 - r_0^2)\,z}{z_1} + r_0^2$$

with

R_0 = 75 mm

r_1 = 300 mm

z_1 = 15000 mm

In G4BL this is implemented as a volume of rotation with rotation surface found by linear interpolation off grid points every 5 mm in r. In ICOOL a series of cylinders are used with inner edge every ~ 5 mm in r.

The chicane consists of a bend and reverse bend through 12.5° with radius of curvature 22917 mm to the centre of the beam pipe. In ICOOL this is simulated using an idealised B_s ~ 1/r; in G4BL this is simulated using coils arranged periodically on the toroid.

Note due to the "cartoon" nature of the schematic the transverse displacement in the chicane looks deceptively small – it is in fact a little more than 1 beam pipe diameter.

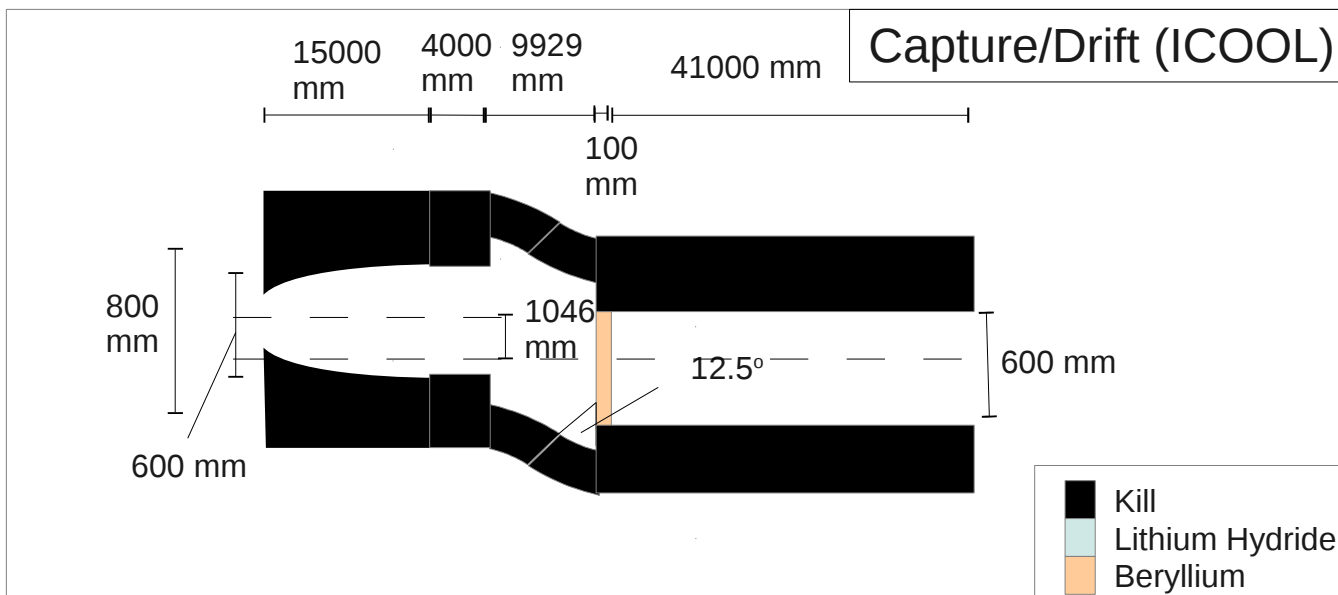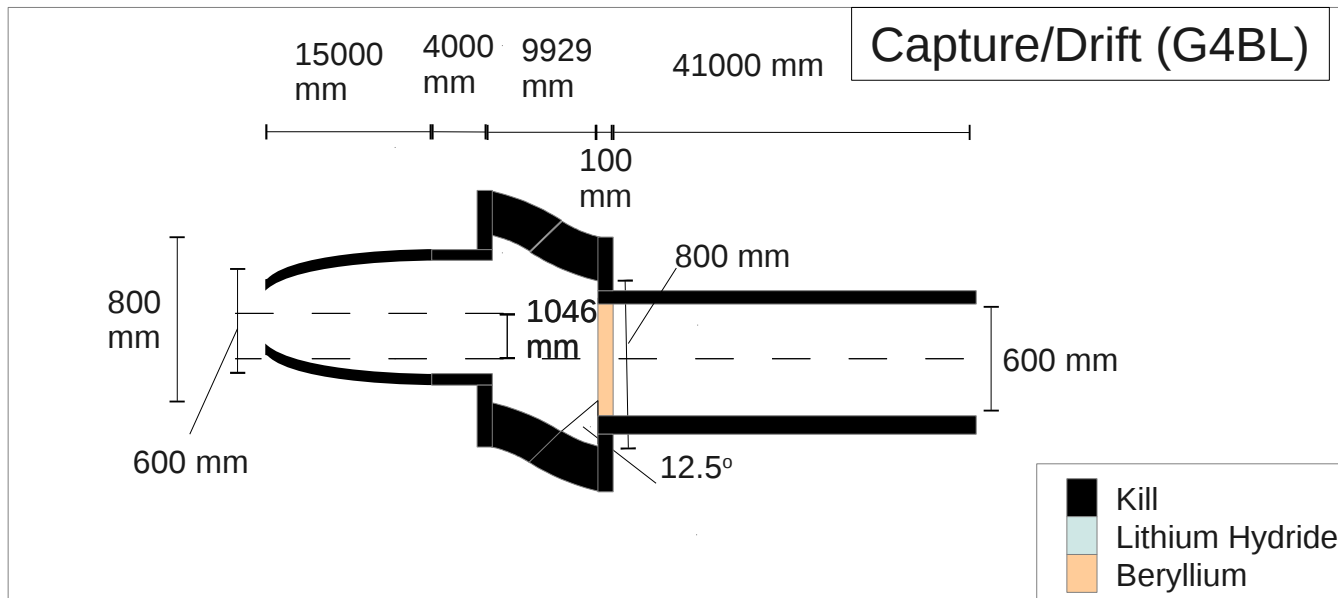G4BL chicane coils have:
Inner radius: 430 mm
Outer radius: 530 mm
Length: 180 mm
Current Density: 16.57 A/mm²
Placed at 0.625° intervals (250 mm in *s*)

From the end of the chicane onwards both lattices use constant 1.5 T field

2

Coil designation	Units	1	2	3	4	5	6	7
Current density	kA/cm2	2.20	2.07	1.41	1.20	1.06	1.93	2.18
Coil length	cm	100.18	123.64	207.15	212.02	215.63	352.32	77.78
Upstream end	cm	-87.56	-111.03	-120.98	-125.85	-129.46	-240.93	111.39
Downstream end	cm	12.62	12.61	86.17	86.17	86.17	111.39	189.17
Inner radius	cm	18.34	23.85	29.58	36.21	43.30	120.00	120.00
Outer radius	cm	23.10	28.76	35.52	42.64	50.16	195.83	184.34
Coil designation	Units	8	9	10	11	12	13	14
Current density	kA/cm2	2.67	3.35	4.12	4.07	4.50	4.67	4.64
Coil length	cm	45.20	31.23	255.37	15.45	13.00	341.31	10.96
Upstream end	cm	276.47	470.24	575.75	914.32	1034.76	1085.07	1454.28
Downstream end	cm	321.67	501.46	831.12	929.76	1047.76	1426.38	1465.24
Inner radius	cm	120.00	119.96	89.65	118.28	72.36	69.92	69.94
Outer radius	cm	195.83	175.59	93.81	170.31	86.91	72.38	86.39

G4BL uses coil designations 1 through 14; beyond coil 14 a series of match coils are used with following parameters to match into chicane

| Centre z [mm]	J scale	Centre z [mm]	J scale
15000	0.90	17000	0.97
15250	0.80	17250	0.97
15500	0.80	17500	0.97
15750	0.90	17750	0.97
16000	0.95	18000	1.00
16250	0.95	18250	1.00
16500	0.95	18500	1.00
16750	0.95	18750	1.00

Match coil current: 16.57*(J scale) A/mm^2
Match coil inner radius: 430 mm
Match coil outer radius: 530 mm
Match coil length: 180 mm

Coil designation	Units	15	16	17	18	19	20
Current density	kA/cm2	4.64	4.64	4.64	4.64	4.64	4.64
Coil length	cm	14.12	320.34	14.12	14.12	320.34	14.12
Upstream end	cm	1536.00	1589.83	1949.88	2036.00	2089.83	2449.88
Downstream end	cm	1550.12	1910.17	1964.00	2050.12	2410.17	2464.00
Inner radius	cm	71.88	50.08	71.88	71.88	50.08	71.88
Outer radius	cm	90.00	52.42	90.00	90.00	52.42	90.00

ICOOL uses the full coil pack 1 through 20 to generate a field map but only in the region up to 15000 mm. Beyond 15000 mm a constant 1.5 T field is used. Fields are generated from 5 current sheets spaced equally across the coil area.

RF Capture

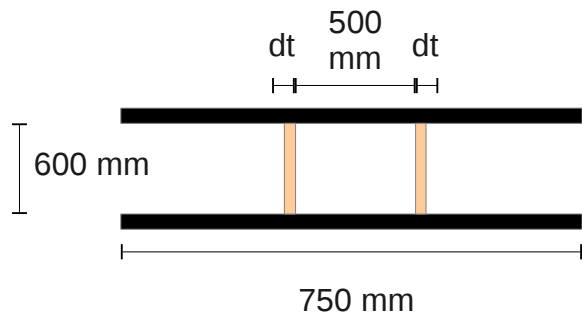## Capture Cell (G4BL)

500 mm
5 mm

600 mm

750 mm

dt
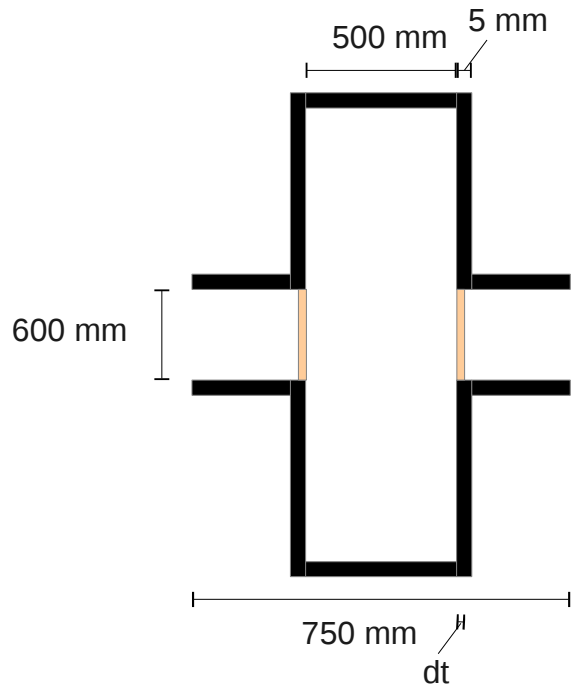
Field is constant 1.5 T (no coils simulated)

Window thickness dt in buncher: 0.2 mm
Window thickness dt in phase rotation: 0.4 mm
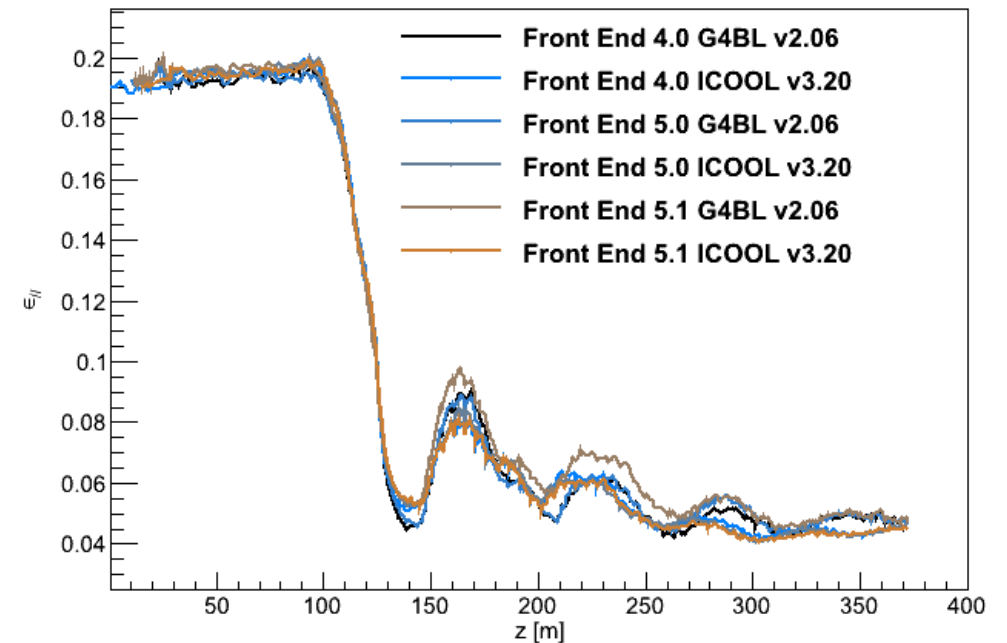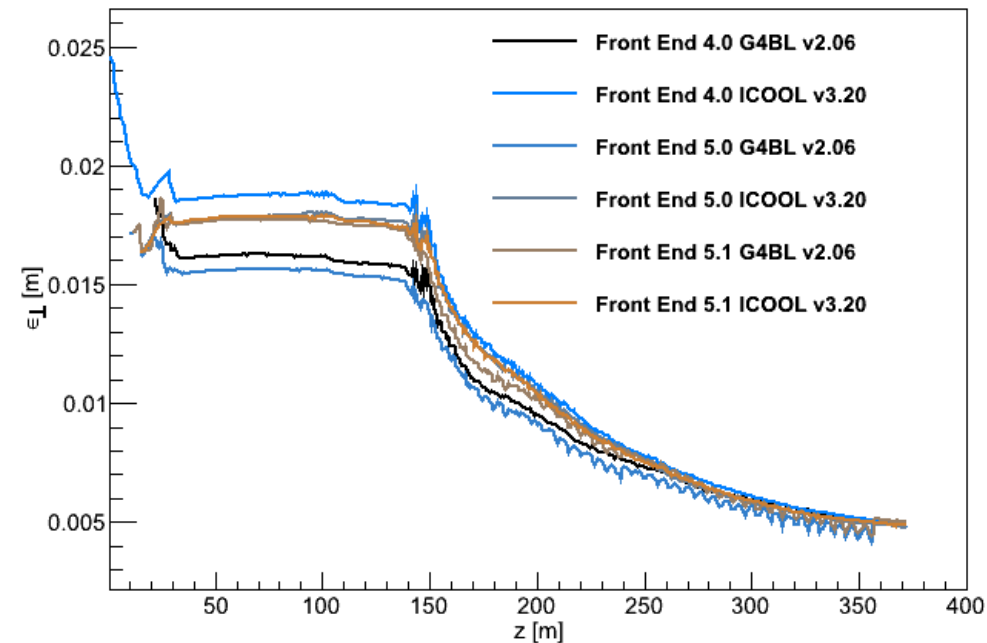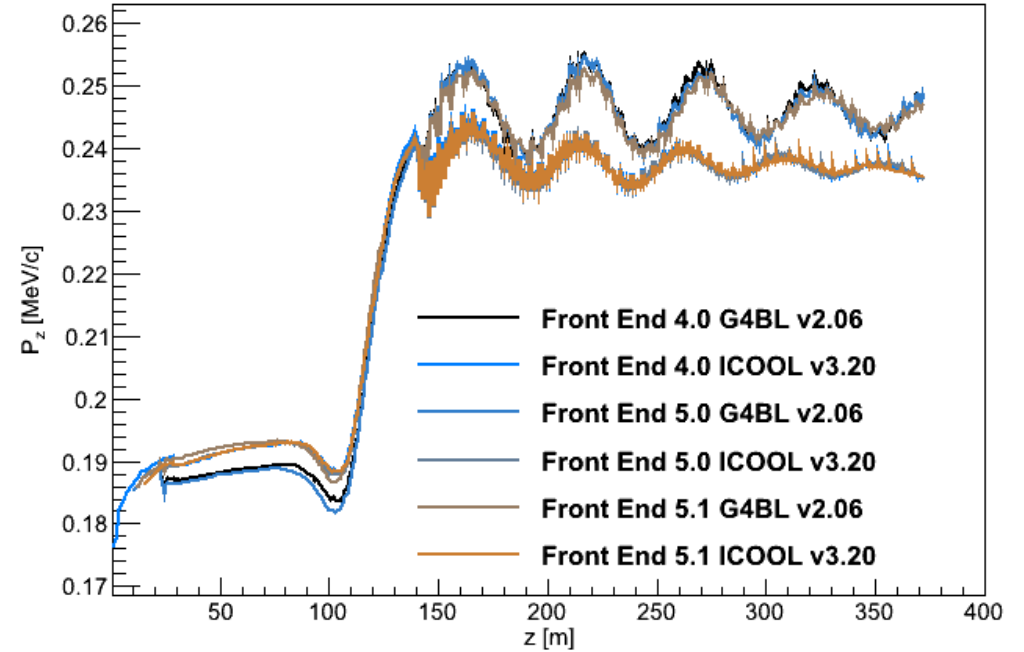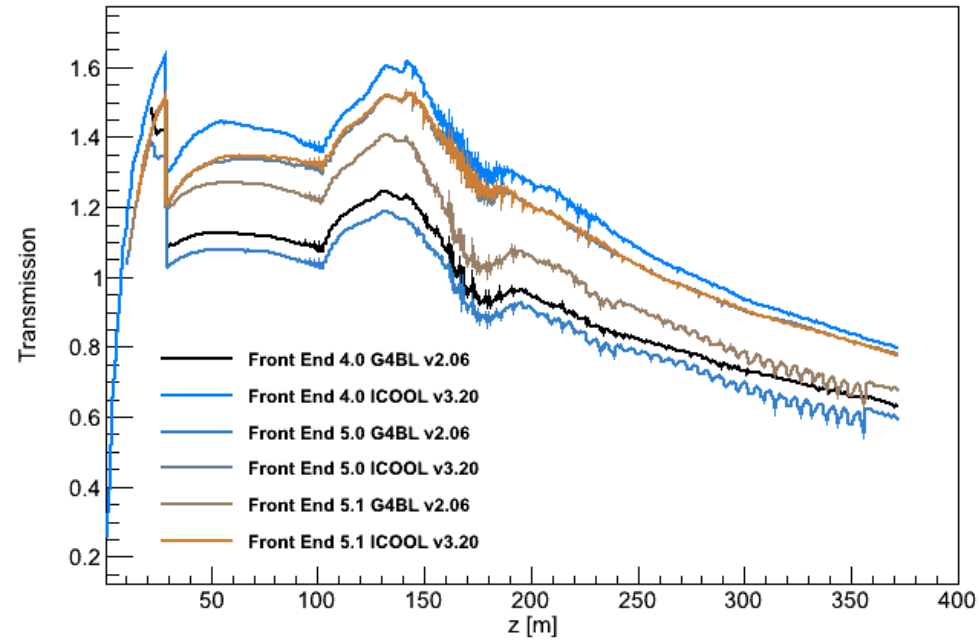
"Buncher" refers to variable voltage section

"Phase rotation" refers to fixed voltage section

■ Kill
■ Lithium Hydride
■ Beryllium

Capture Cell (ICOOL)

dt
500 mm
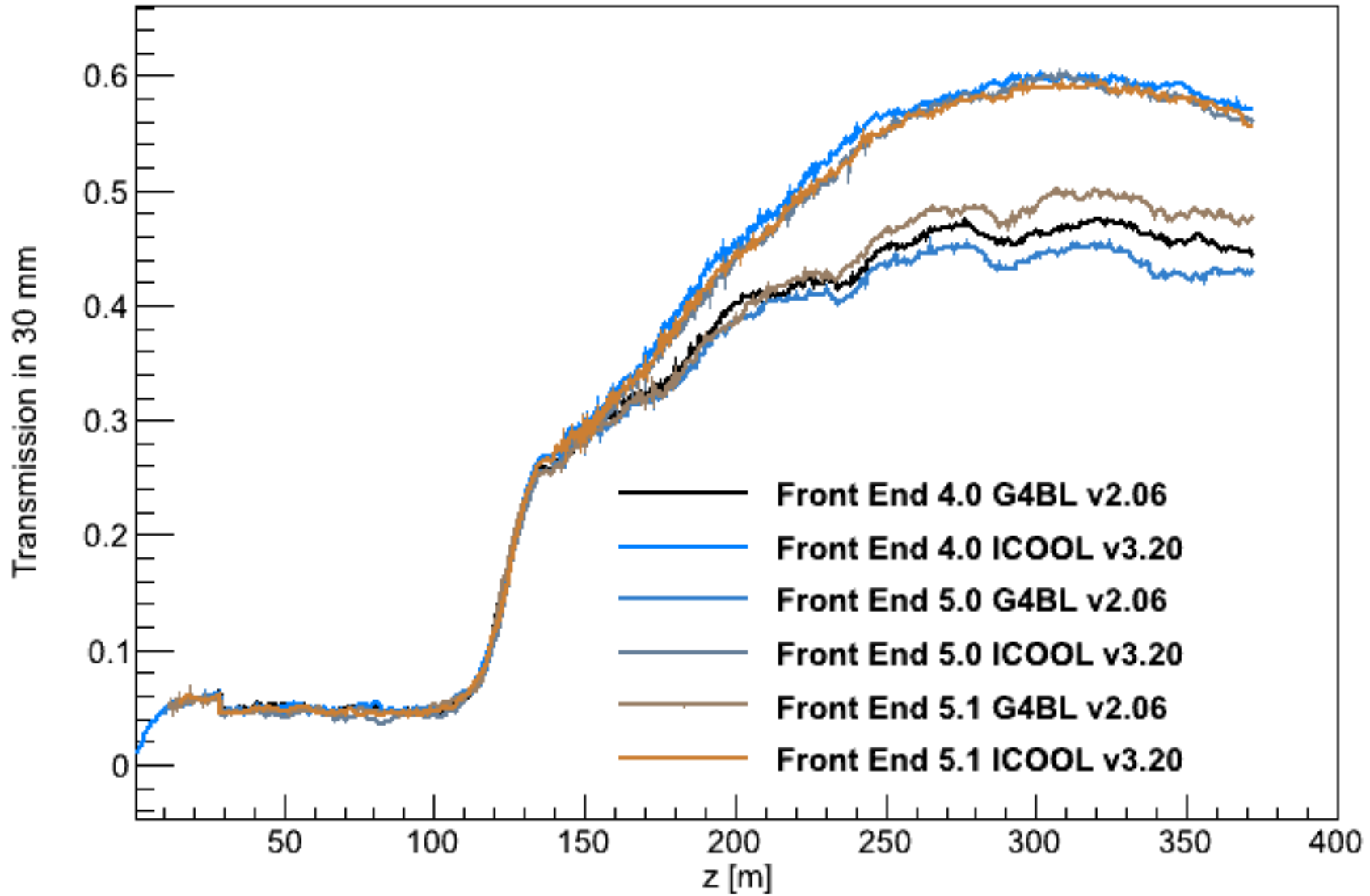dt

600 mm

750 mm

■ Kill
■ Lithium Hydride
■ Beryllium

Capture Performance (400k pot)

Capture Performance (400k pot)

Plan towards new baseline
From IDS #9

1. Implement new coil/cooler geometry in current deck (Diktys)

    - Make a "release" of the lattice files

    - Use as basis for cooling channel selection

2. Implement G4BL version of chicane/proton absorber/RF capture (Rogers)

    - Use with ICOOL deck as basis for documentation of the chicane/proton absorber

    - Using current baseline (i.e. not including engineering modifications)

3. Merge chicane etc into the new coil/cooler geometry

    - Make a "release" of the lattice files

4. Merge new target

    - Make a "release" of the lattice files

- Not happy with anomalously low G4BL capture results – needs study