

Preliminary Analysis of C ions adding the fragmentation tail to the QB curve

27/05/2020

Contributions of secondary fragmentation by carbon ion beams in water phantom

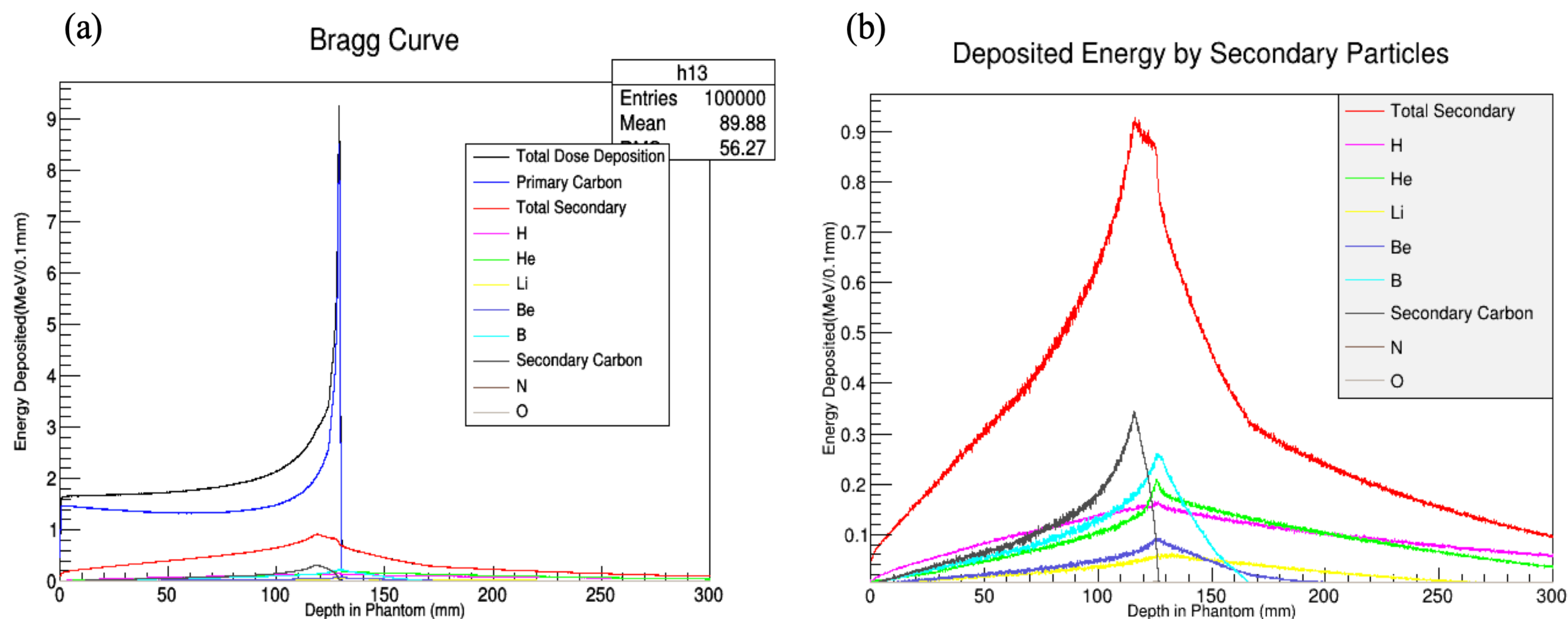
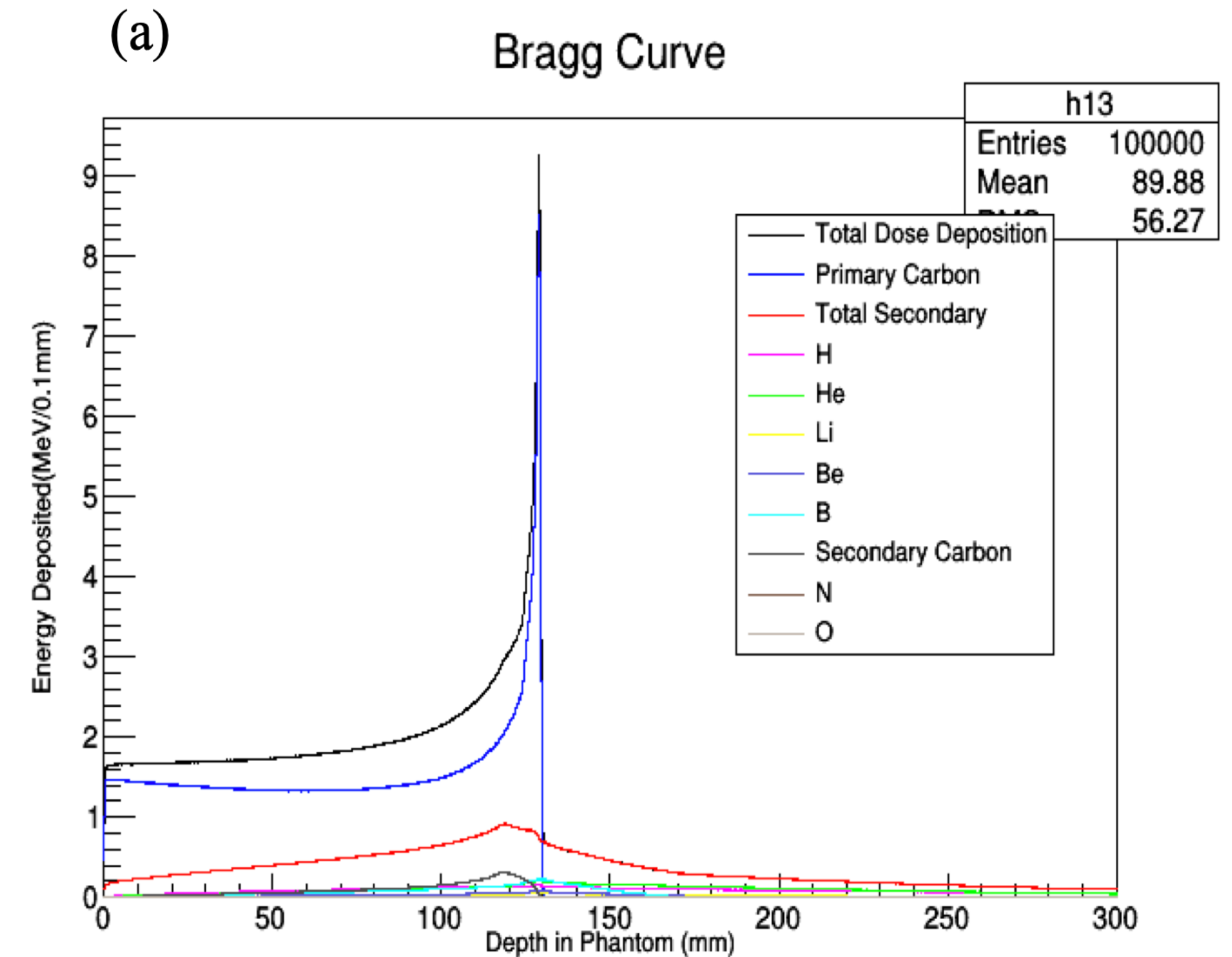


Figure 2. (a) Depth dose distribution deriving from the entire radiation field (Bragg curve) in black, and (b) energy deposition deriving from different components of secondary fragments only

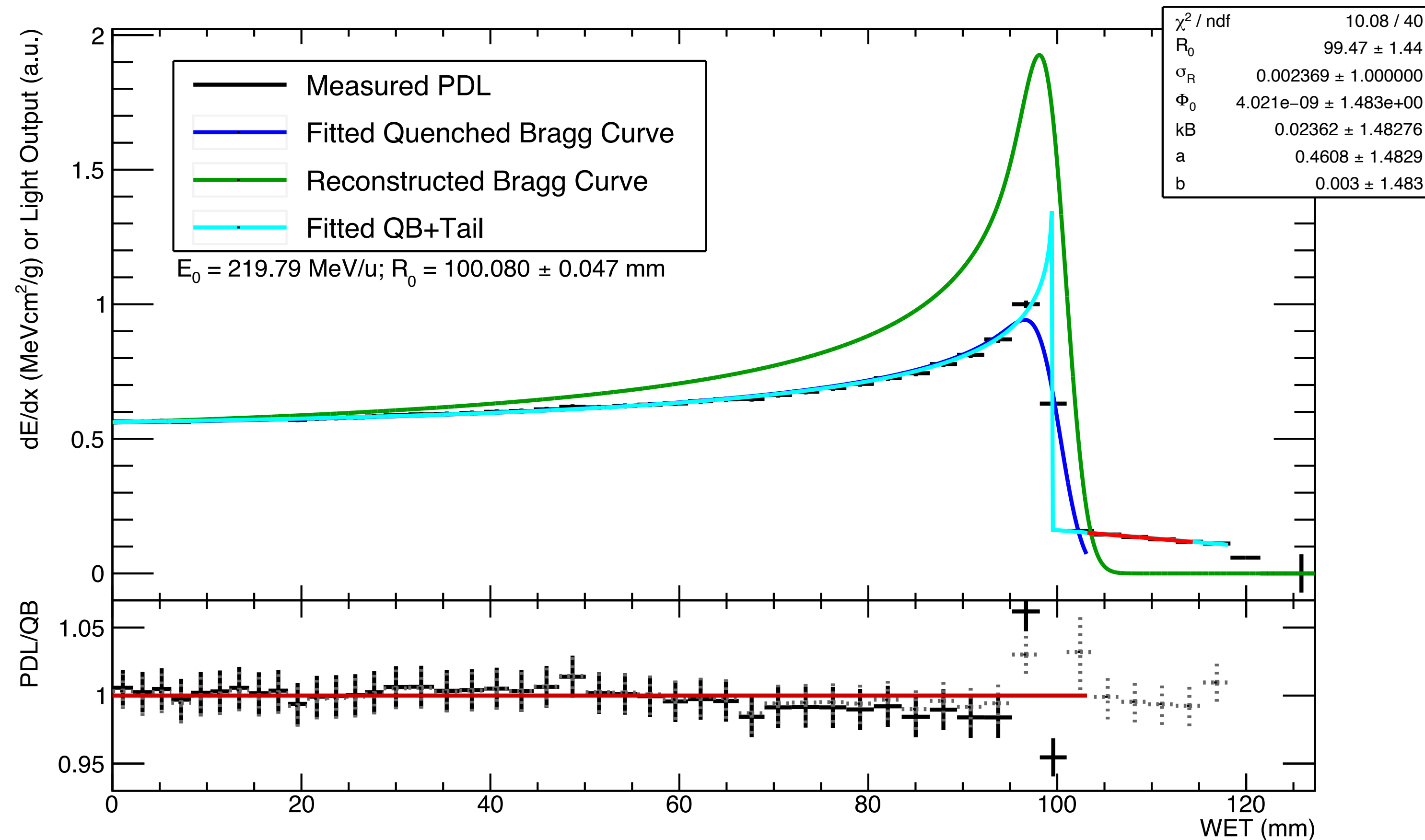
Fit function: Quenched Bragg curve + Tail

Definition

- $\text{if}(z < (R0 + \sigma)) \text{ tot_function} = \text{quenchedBragg}(z, \text{par});$
- $\text{if}(z \geq (R0 + \sigma)) \text{ tot_function} = a - b * z;$
- $R0, \sigma, a, b$: free parameters



Results: April 2019 C data



QB FIT

Birks' constant: 0.0217924 ± 0.0007182

Sigma: 1.94446 ± 0.0451067

R0: $100.08 \pm 0.0465086 \text{ mm}$

Range difference: 0.68243 mm

QB+Tail FIT

Birks' constant: 0.023615

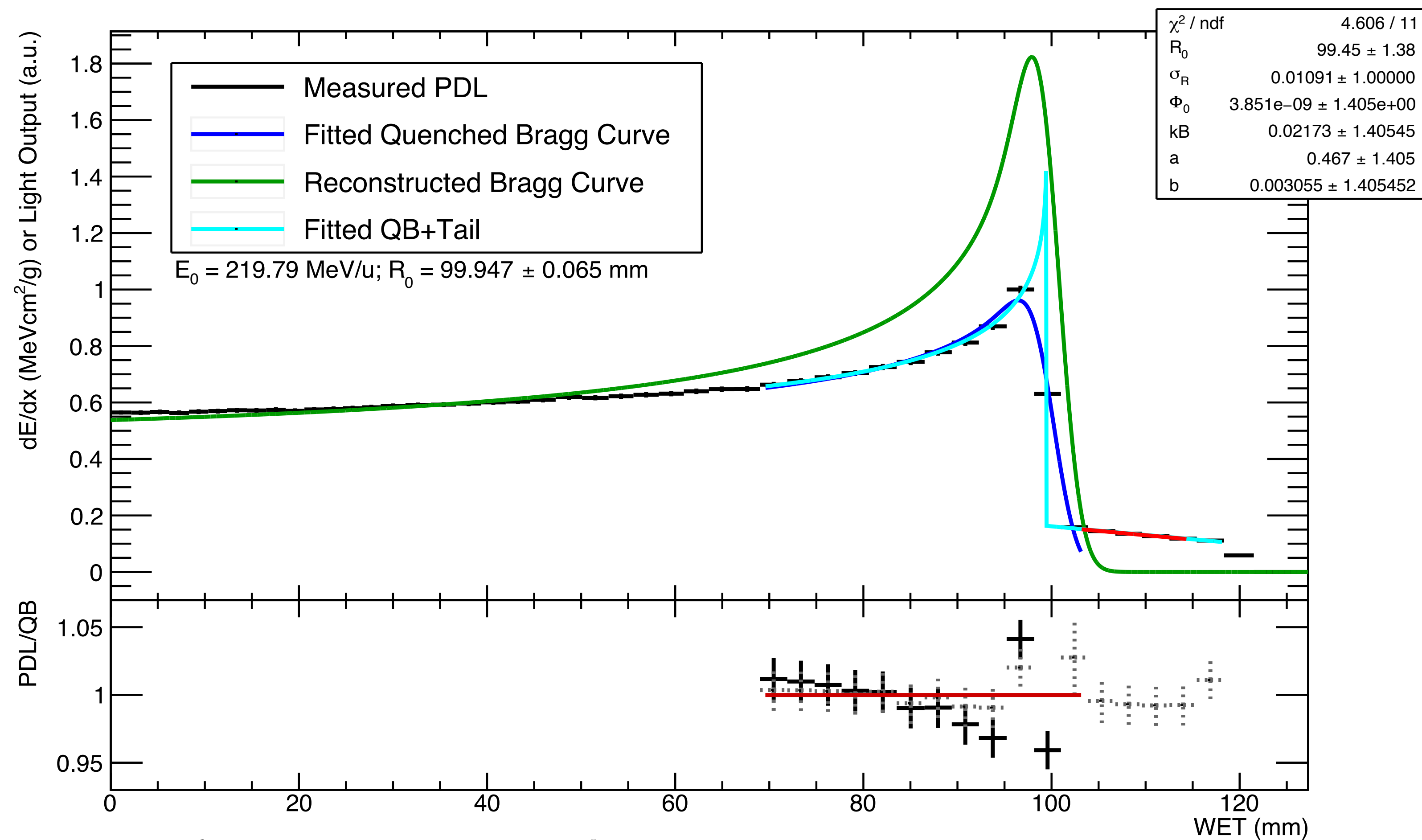
Sigma: 0.00236941

R0: $99.4739 \pm 0.033 \text{ mm}$

Range difference: 0.0768469 mm

QB fit start: 0; end: R0 + sigma

QB+Tail fit start: 0; end: R0 + 5*sigma



QB FIT

Birks' constant: 0.0175341 ± 0.001

Sigma: 2.00968 ± 0.0502555

R_0 : $99.9465 \pm 0.0645227 \text{ mm}$

Range difference: 0.549424 mm

QB+Tail FIT

Birks' constant: 0.0217345

Sigma: 0.0109053

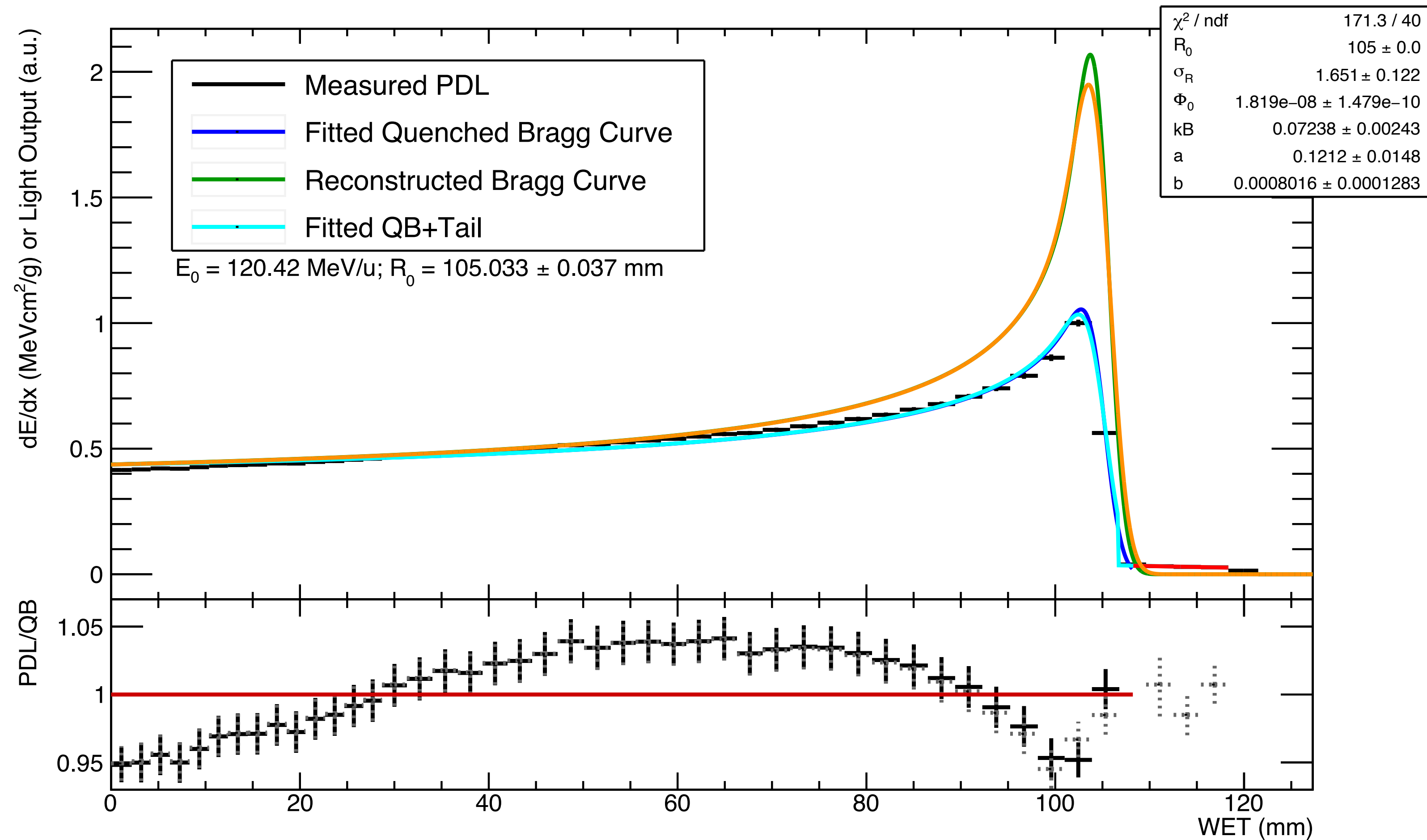
R_0 : 99.4548

Range difference: 0.0577476 mm

QB fit start: $0.7 \cdot R_0$; end: $R_0 + \text{sigma}$

QB+Tail fit start: $0.7 \cdot R_0$; end: $R_0 + 5 \cdot \text{sigma}$

Results: April 2019 He data



QB+Tail FIT

Birks' constant: 0.0723835 ± 0.002

Sigma: 1.65142 ± 0.121557

R0: $105.046 \pm 0.0421177 \text{ mm}$

Range difference: 0.217389 mm

QB FIT

Birks' constant: 0.0744703 ± 0.00224

Sigma: 1.4387 ± 0.0381277

R0: $105.033 \pm 0.0369989 \text{ mm}$

Range difference: 0.20422 mm

Next steps

- Test the simplified model with more E (Nov 2018 data)
- Start implementing the proper fragmentation model from Krämer et al 2000 Phys. Med. Biol. 45 3299
- The model is implemented in the TRiP98 code for treatment plan verification <http://bio.gsi.de/DOCS/trip98.html>. I'm curious to know if cross sections from fragments creation are accessible.