University of Zurich[UZH] | USZ Universitäts Spital Zürich

Exercise class – Ex6

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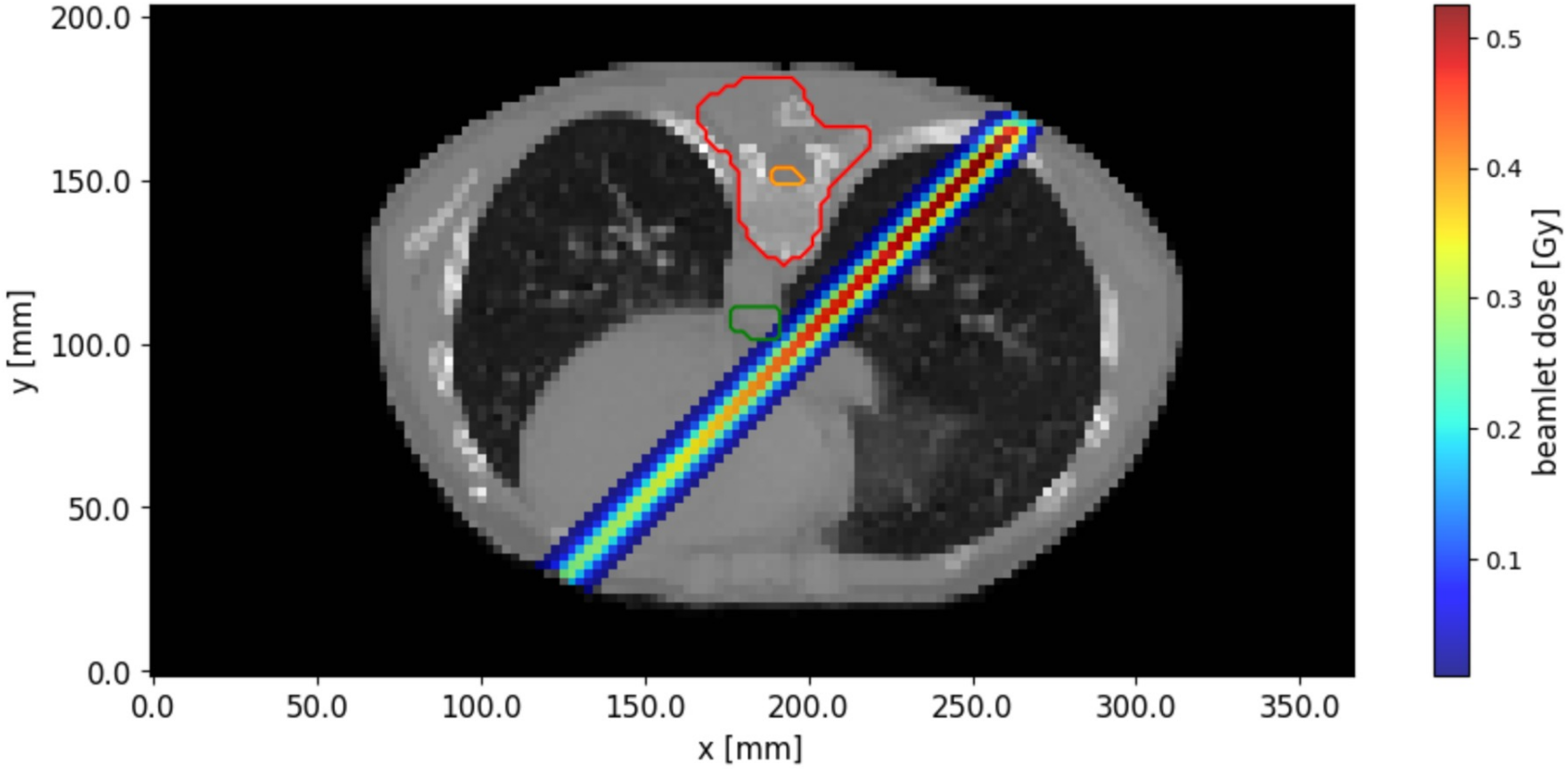
Exercise 4

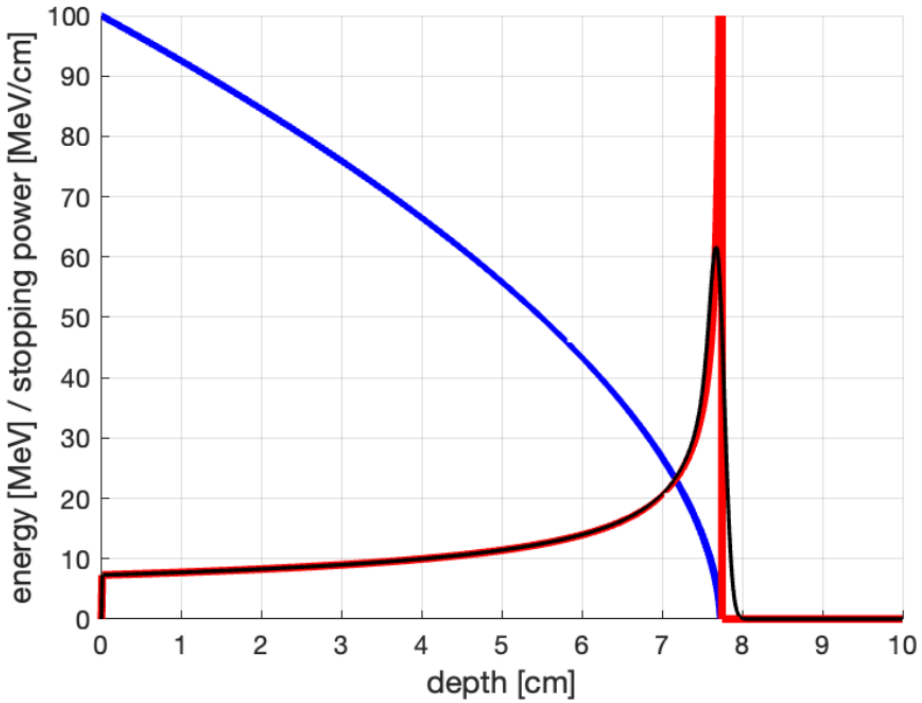
Mostly well solved, some difficulties…



Student solution for ex. 4

Exercise 5

Bethe-Bloch equation in water



Energy E

Energy loss dE/dz

Range straggling

Any questions regarding ex.5?

Exercise 6

Implement a proton pencil beam dose calculation algorithm!

Write a function:

```
calculate_proton_pencil_beam_dose(angle,energy,latpos,raddepth)
```

`angle` the angle of the incident beam,
`energy` the initial proton energy,
`latpos` the lateral position of the beam's central axis relative to the isocenter,
`raddepth` the radiological depth matrix for that beam angle.

Exercise 6

We've seen in the lecture that:

$$D(x,y,z) = D_0(z_{rad}(z), E_0)\frac{1}{2\pi\sigma^2(z_{rad}(z), E_0)}\exp\left(-\frac{x^2+y^2}{2\sigma^2(z_{rad}(z), E_0)}\right)$$

$D_0(z, E_0)$: depth dose curve in water

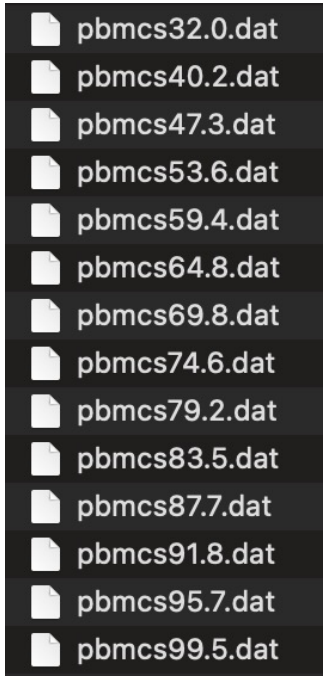
$\sigma(z, E_0)$: width of the beam

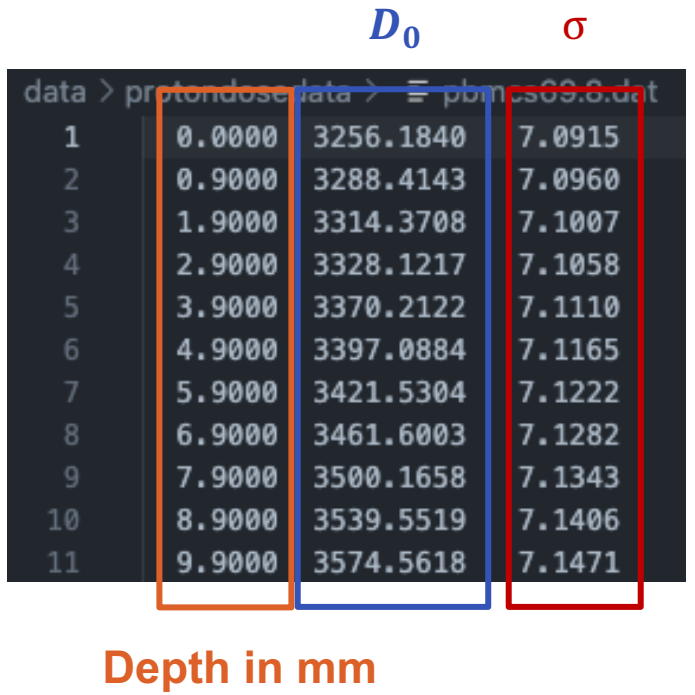
→ dose defined by radiological depth and x-coordinate!

Exercise 6

The beam width $\sigma(z, E_0)$ and the depth dose curve $D_0(z, E_0)$ in water are provided in *protondosedata.zip*.

Dose distributions for different initial energies





edata.dat : available proton energies

rdata.dat : corresponding ranges

Exercise 6

Same steps as in ex. 4:

1. Calculate radiological depth matrix
2. Compute the distance to the beam central axis
3. Compute dose with radiological depth and lateral distance
   → additionally extract D_0 and σ of the corresponding depth and E_0

Remark: it is sufficient to calculate the dose to the centre of the voxel!

Exercise 6 – What we expect!