University of Zurich[UZH] | USZ Universitäts Spital Zürich

Exercise class – Ex7

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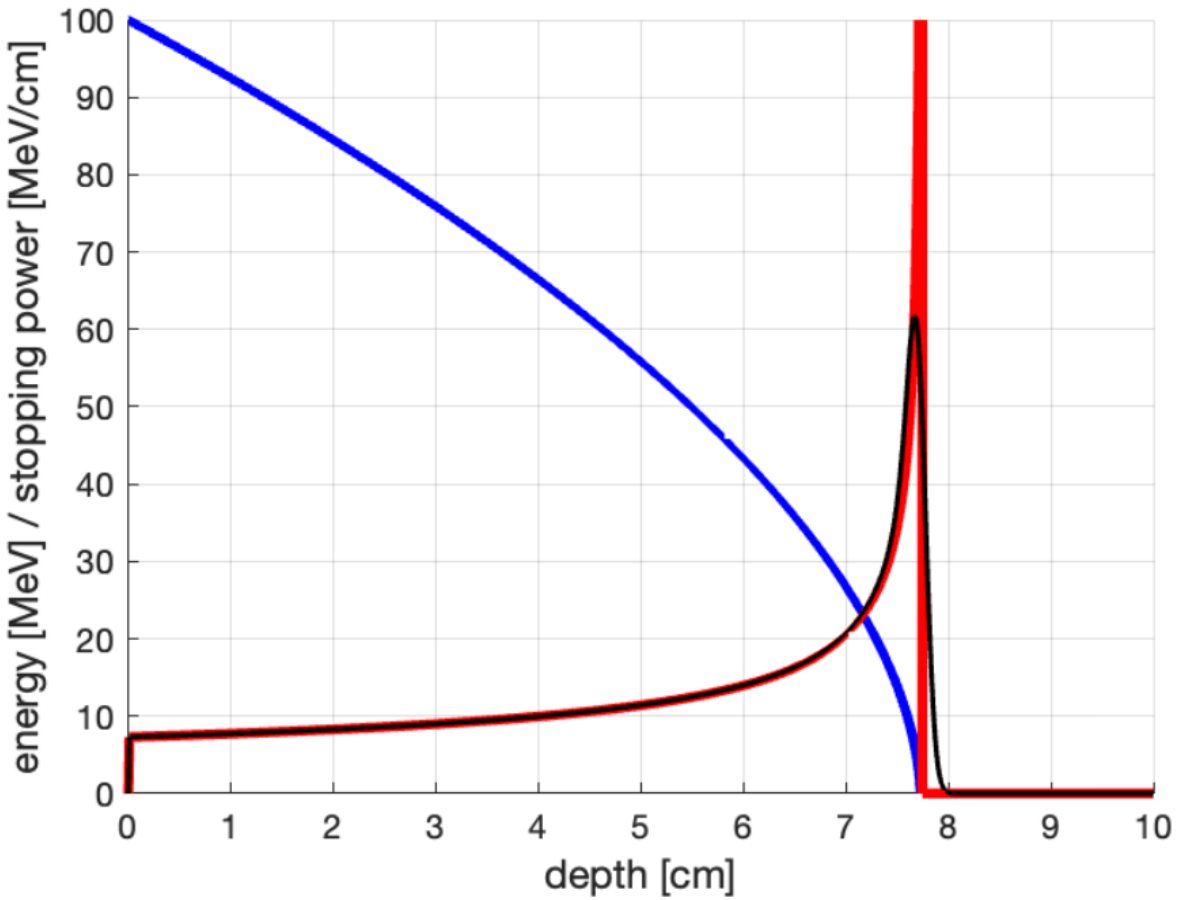
Exercise 5

Well solved by all of you!



Energy E

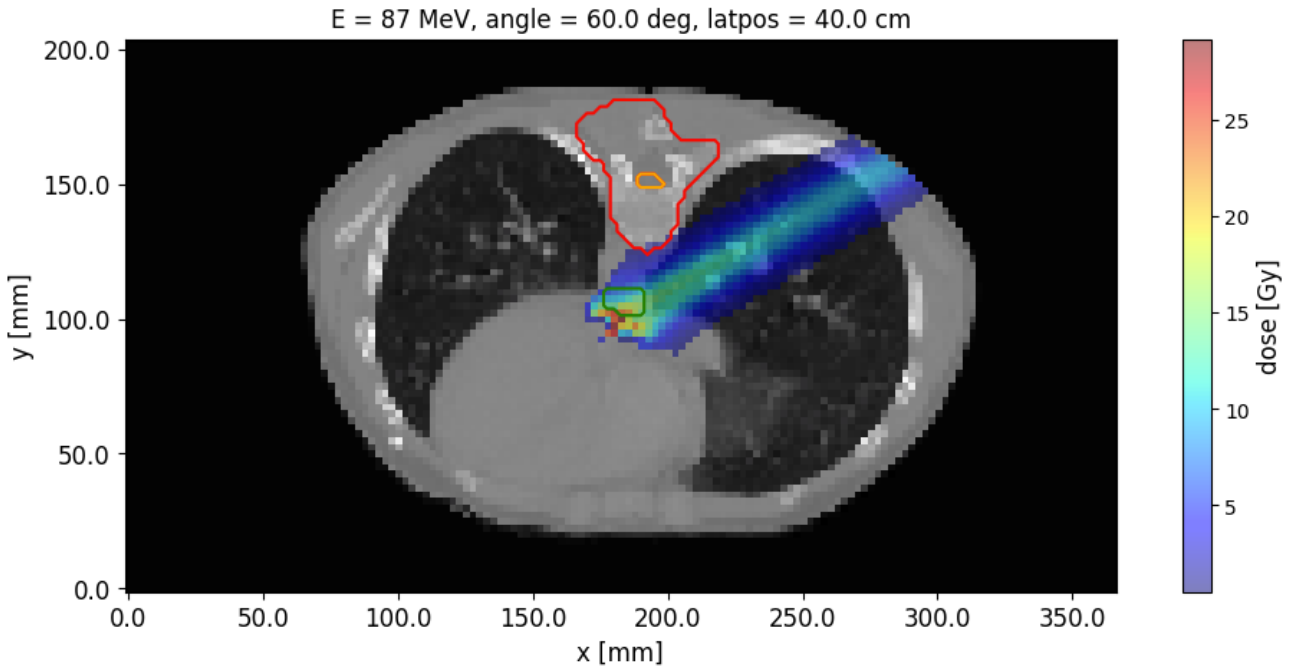
Energy loss dE/dz

Range straggling

Student solution for ex. 5

Exercise 6

Implement a proton pencil beam dose calculation algorithm!



Any questions regarding ex.6?

Exercise 7

Compute the photon dose-influence matrix!

- Total dose is delivered using multiple **beams** from different **incident angles**
- Each beam is divided into **beam segments** of 5mm, called **beamlets**
- Compute dose-influence matrix $\boldsymbol{D_{ij}}$:
  - $\boldsymbol{D_{ij}}$ stores the dose contributions of beamlets j to voxels i
  - The matrix has shape: (# of voxels, # of beams * # of beamlets per beam)

Exercise 7

Step 1

Write a function `create_beams(angles)`

which takes a vector of beam angles and returns a dictionary

```
beams[beamNo] = {
    'angle': angle, # the incident beam angle
    'nBeamlets': len(beamletpos), # number of beamlets
    'beamletpos': beamletpos, # array of beamlet positions
    'raddepth': raddepth, # radiological depth of all voxels
    'pb': pb # dictionary of pencil beams
}
```

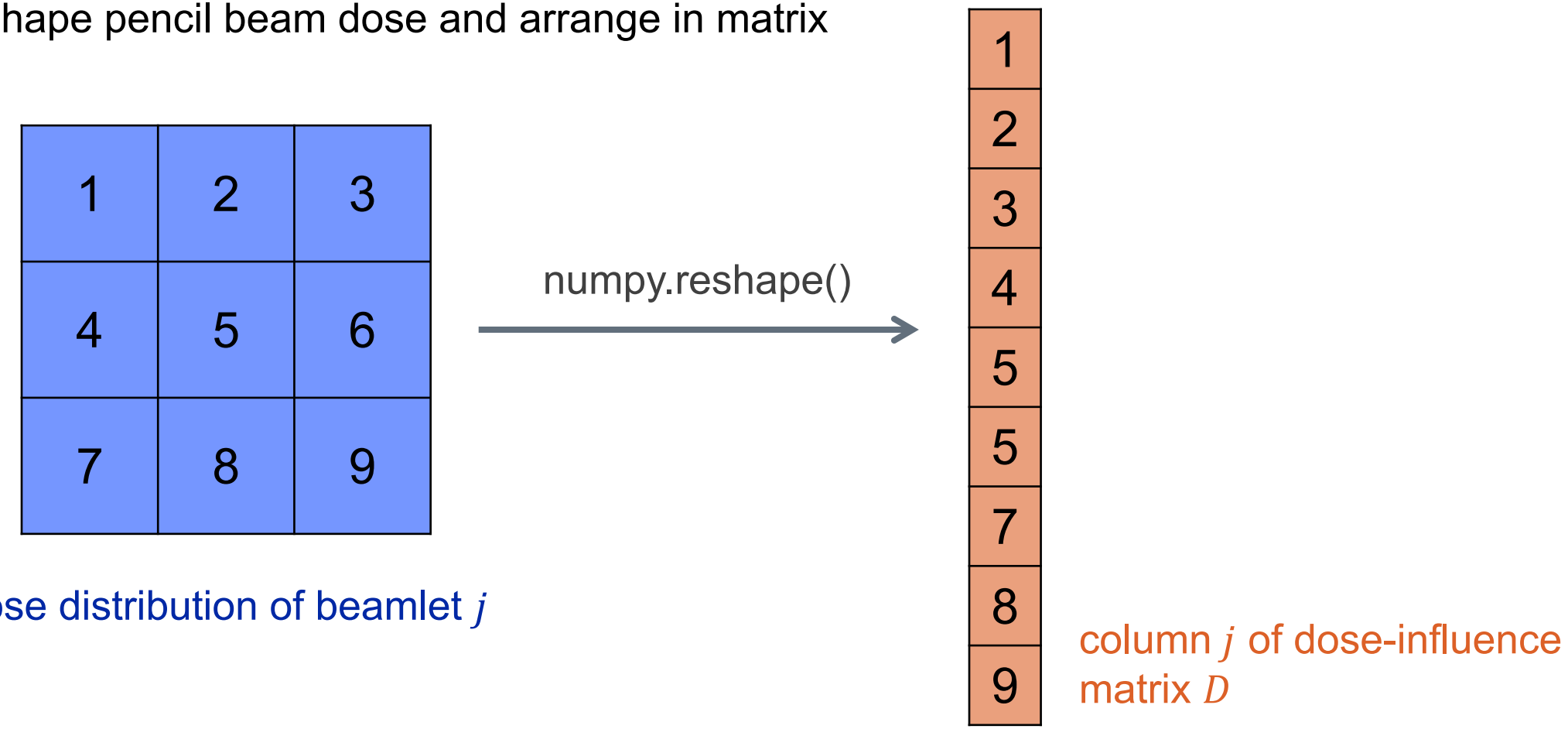
where `beamNo` is the number of the beam

→ **Calling pencil beam function multiple times and storing output!**

Exercise 7

Step 2

Write a function `create_Dij_matrix(beams)` that computes the D_{ij} matrix
→ reshape pencil beam dose and arrange in matrix

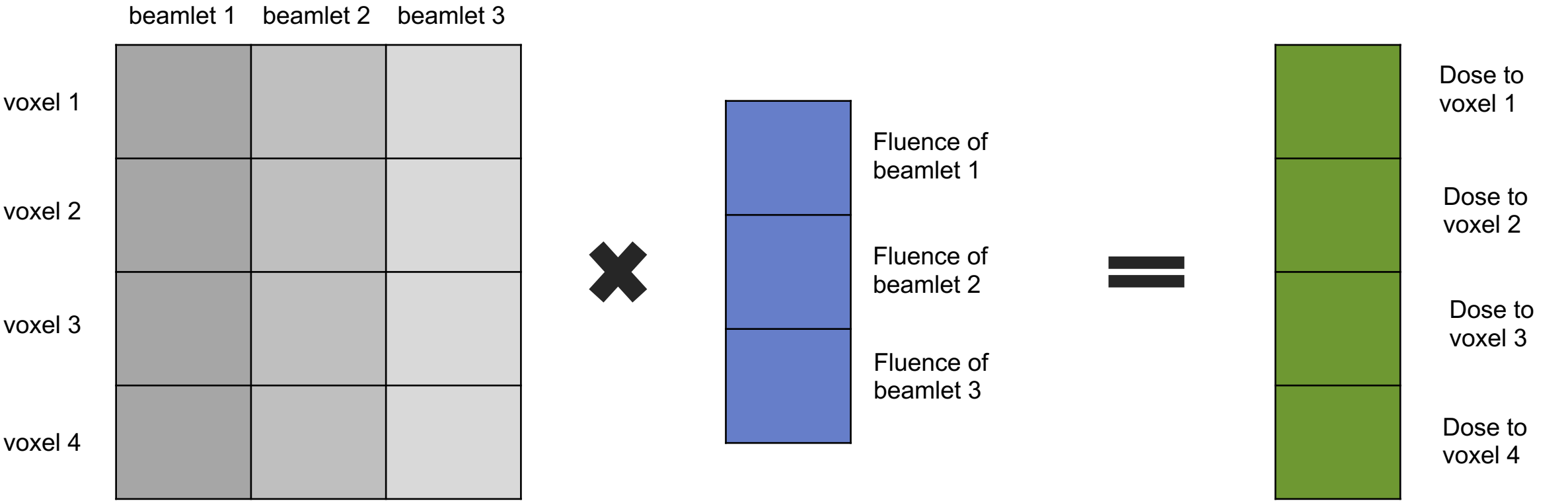


Exercise 7

Step 3

Calculate dose-influence matrix for 9 beams and plot the dose distribution

$d = D\ x$ with D dose-influence matrix and x fluence of all beamlets



D_{ij} with 3 beamlets

Fluence vector x

Total dose to every voxel d

Exercise 7 – What we expect!