Exercise: Simple sources & preprocessor

Exercise objectives

- Setting up different simple beams
  - Point source with **BEAM** and **BEAMPOS** card
  - 2D source with **BEAM**, **BEAMPOS** and **BEAMAXES** card
  - Volumetric source with a **BEAM**, two **BEAMPOS** and a **BEAMAXES** card
- Using conditional preprocessor
- Using separate runs
- Visualizing the beams
- Plotting the predefined scorings

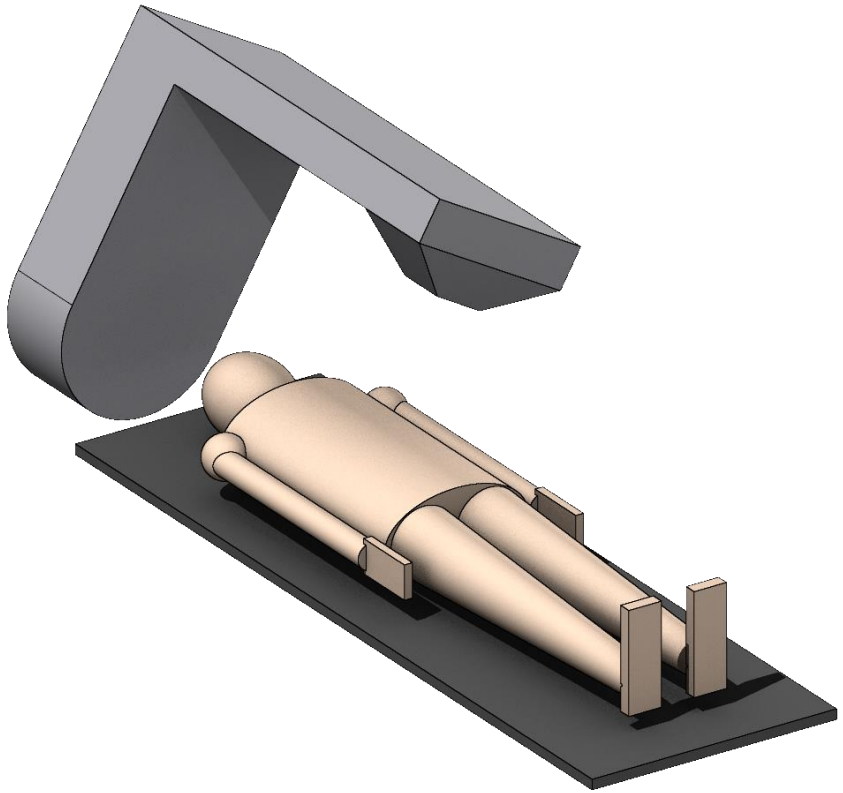
Problem to solve

We want to set up a simulation for radiation therapy

The beams should start in the gantry:

(x = 22.5, y = 38.97114317, z = 0),

and directed towards the origin



The scorings already set up:

- Unit 21: Sideview of the beam
- Unit 22: Shape of the beam close to the patient
- Unit 31: Energy spectrum

1. Point source

- Set up a 10 MeV photon beam, with a Gaussian momentum distribution (FWHM: 10%), and a flat 0.3 rad angular divergence
- Use the Geometry tab (Geoviewer) to see if the direction and angular divergence is correct
- Create a separate run called "*point*" and run the simulation
- Create appropriate plots to see the beam particles
  - Side plot: USRBIN plot, File: point_21.bnn
  - Source plot: USRBIN plot, File: point_22.bnn (*Geometry*: Use: -No-)

    (Adjust the aspect ratio and color bar to have nicer plots)
  - Spectrum: USR-1D plot, File: point_31_tab.lis

2. Rectangular source

- Set up a 10 MeV photon beam, with a flat energy spectrum between 5 and 10 MeV
  Zero beam divergence
  X-Y beam shape as a 10x10 cm rectangle (Hints on slide 8)
- Use conditional directives to be able to switch between the point and rectangular beam
- Create a separate run called "*rectangular*" and run the simulation
- Create separate plot for the rectangular beam
  - Side plot: USRBIN plot, File: rectangle_21.bnn
  - Source plot: USRBIN plot, File: rectangle_22.bnn (*Geometry*: Use: -No-)

    (Adjust the aspect ratio and color bar to have nicer plots)
  - Spectrum: USR-1D plot, File: rectangle_31_tab.lis

3. Volume source

- Create a doughnut shaped beam with Volumetric sources
  Keep the parameters from the rectangular source
  Add a cylindrical source 5 cm high, with a 5 cm outer and 3 cm inner radius
- Use conditional directives to be able to switch between all three beams
- Create a separate run called “*volume*” and run the simulation
- Create separate plot for the volumetric beam
  - Side plot: USRBIN plot, File: volume_21.bnn
  - Source plot: USRBIN plot, File: volume_22.bnn (*Geometry*: Use: -No-)

    (Adjust the aspect ratio and color bar to have nicer plots)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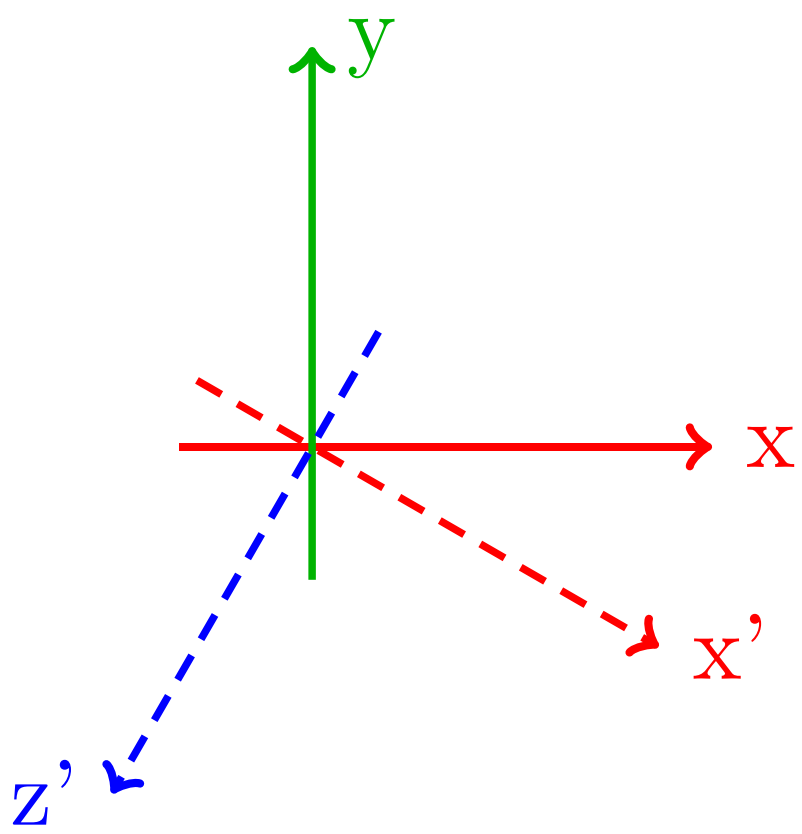
2. Rectangular source – Hints

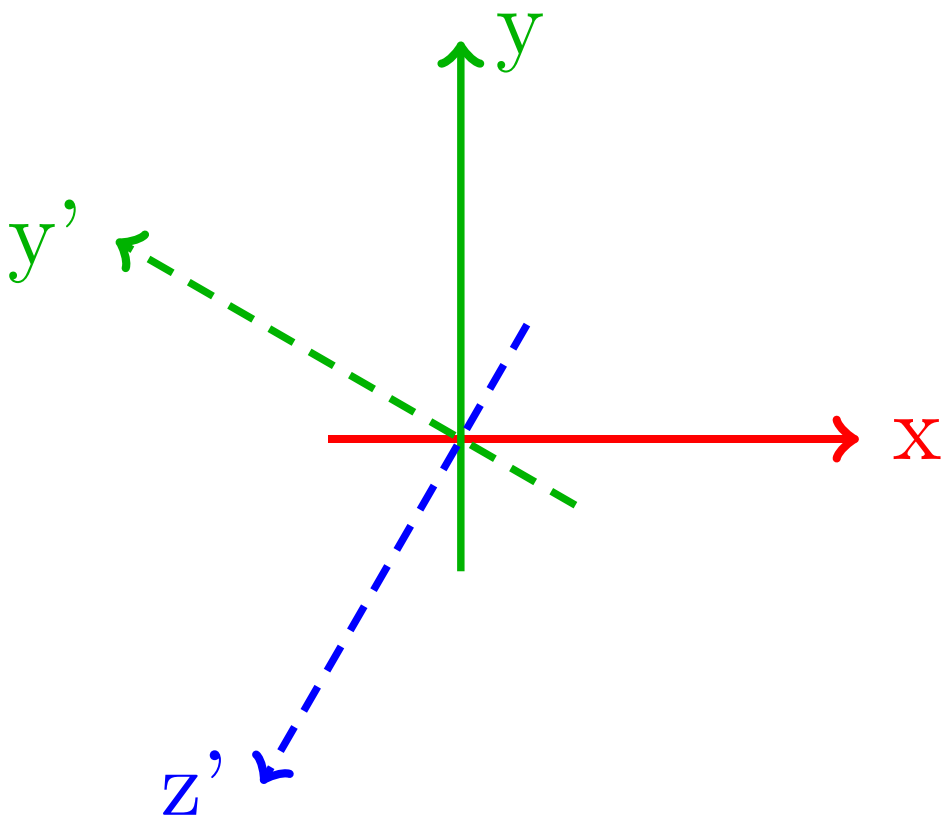
1. A **BEAMAXES** card is necessary
2. Drawing the relation between the geometry and beam coordinate system helps
3. Which plane contains the new z' axis (beam direction)?
4. Place x' (or y') in the same plane, perpendicular to z'
5. Direction of x' (or y') doesn't matter, due to the symmetry of the beam spot
6. The direction cosines on the **BEAMPOS** card must be zero

2. Rectangular source – Hints

Two solutions:



y' = z



x' = z