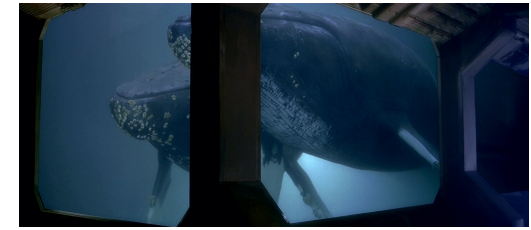




Exercise Week 1 Review

Where's the Bragg peak ?

Where's the Bragg peak ?



The Geometry:

- An ALON (aluminium alloy $\text{Al}_{23}\text{O}_{27}\text{N}_5$) container of dimensions 50 x 50 x 50 cm with 1 mm wall thickness, open on the top and filled with water.
- Our ALON uses a fancy home made Nitrogen ^{14}N : '*Nitro14*'

The Beams:

- Proton beam with a kinetic energy of 200 MeV and a Gaussian shape of 2cm x 2cm (X&Y FWHM), hitting the container centred from the side.
- Electron beam with a kinetic energy of 50 MeV and a Gaussian shape of 2cm x 2 cm (X&Y FWHM), hitting the container centred from the side.

The Question:

- At which depth is the Bragg peak located ?

Instructions – Level 2

Start from scratch with an empty template [FLAIR → New → empty] and give it a meaningful title.

Add bodies [INPUT/GEOMETRY]

- `blckbody` (sphere of suitable size)
- `void` (sphere of suitable size)
- `contout` (cube with 50cm side length and centred at 0,0,0)
- `contin` (this will be used for the inner volume, filled with water, wall thickness of 1 mm) - you may use a single rectangular body or alternatively with five planes

Build regions [INPUT/GEOMETRY]

- `BLKBODY` (all around the void)
- `VOID` (all around the container)
- `CONTAINR` (this is the empty container)
- `PHANTOM` (this is the water inside the container)

Add materials [INPUT]

- ALON material with a density of 3.69 g/cm³
- A custom Nitro14 material, Z=7, A=14, density = 1 g/cm³
- Assign the correct low energy neutron cross section to the custom Nitro-14 material (*Hint: LOW-MAT card*)
- Create the ALON compound: Al₂₃O₂₇N₅, using the custom Nitro-14 material

Instructions – Level 2

Assign material to regions [INPUT/ GEOMETRY]

- BLCKHOLE → BLKBODY
- AIR → VOID
- ALON → CONTAINR
- WATER → PHANTOM

Define two beam types, inside preprocessor cards [INPUT]

- Add two DEFINE cards: 'energy' and 'electrons'
- Add an IF .. ELSE .. ENDIF clause, to chose between the two beam types
- Add an electron beam with beam size 2cm x 2cm (gaussian, FWHM)
- Add a proton beam with beam size 2cm x 2cm (gaussian, FWHM)
- Define the beam position at Z=-50cm in positive Z direction

Define dose and energy deposition scoring [INPUT]

- Add two USRBIN (X-Y-Z) scoring for DOSE and ENERGY scoring, covering the container volume with 60 bins in X and Y and 120 bins in Z direction
- Add one USRBIN (X-Y-Z) scoring for BEAMPART scoring, covering the space of [-40..40, -40..40, -80..80] with 80 bins in X and Y and 160 bins in Z direction

Instructions – Level 2

Define the runs [RUN]

- Define a run for the proton beam: Set the energy, 5000 primaries, give it a name
- Define a run for the electron beam: Set the energy, 5000 primaries and select electron beam type, give it a name
- Run 5 cycles each ... it should take less than 1 minute to complete the run

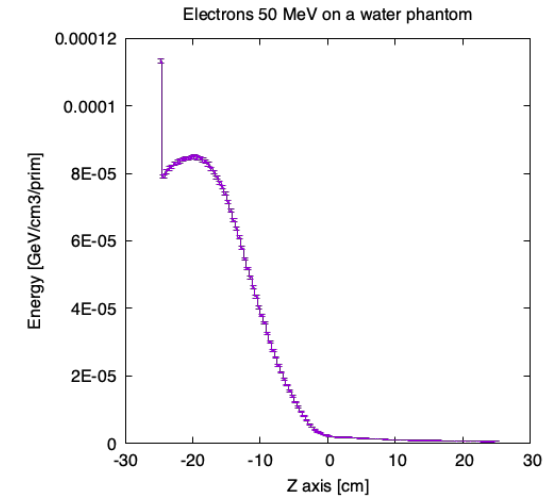
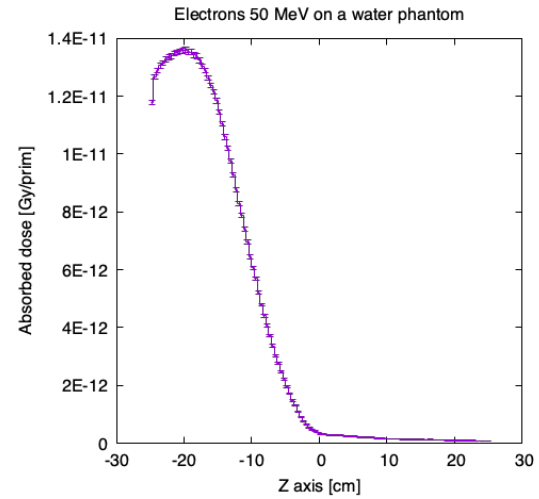
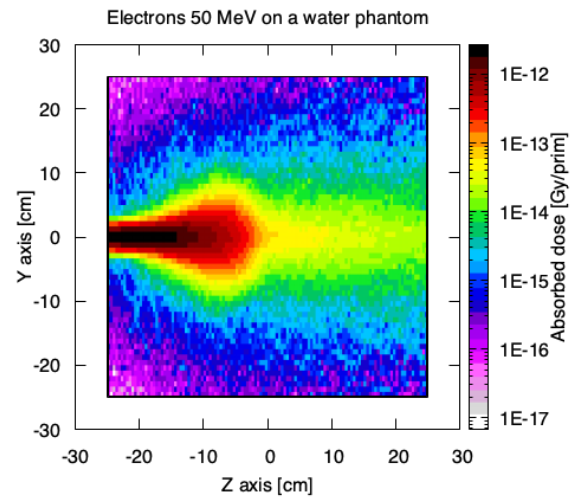
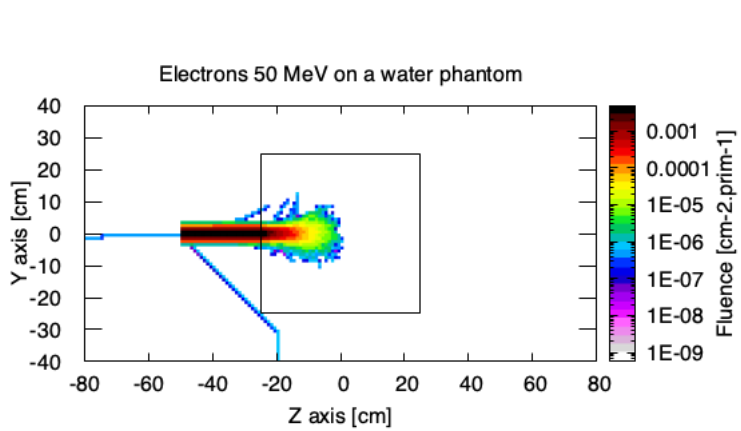
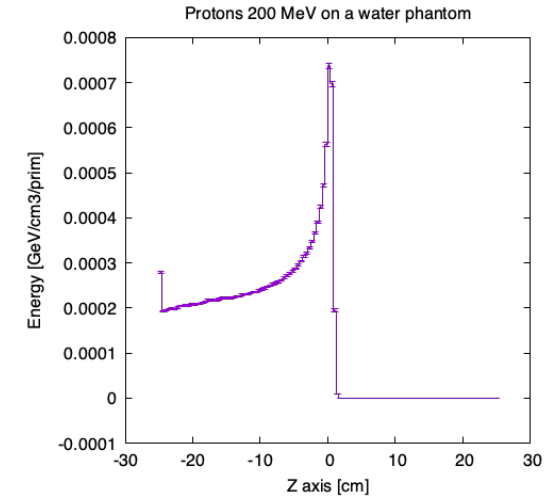
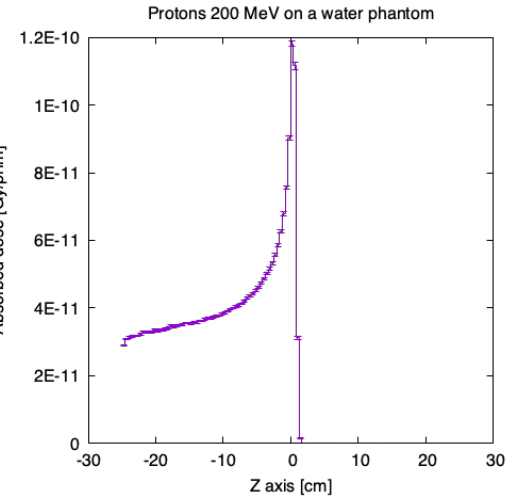
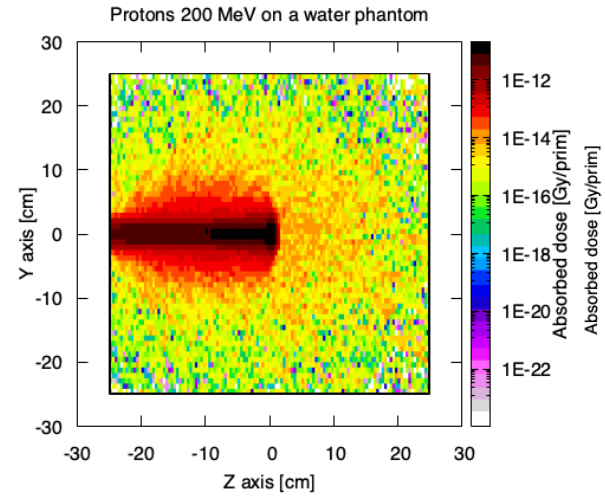
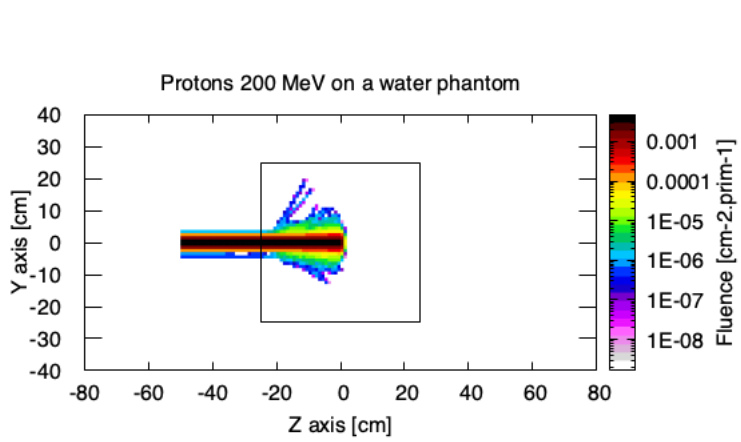
While it is running ... prepare the plots [PLOT]

- Protons, 2 D beam particles plot (X or Y projection)
- Protons, 2 D dose plot (X or Y projection)
- Protons, 1 D dose plot (Z projection, X and Y averaged over [-2.5,2.5])
- Optional: Protons, 1 D energy plot (Z projection, X and Y averaged over [-2.5,2.5])
- Electrons, 2 D beam particles plot (X or Y projection)
- Electrons, 2 D dose plot (X or Y projection)
- Electrons, 1 D dose plot (Z projection, X and Y averaged over [-2.5,2.5])
- Optional: Electrons, 1 D energy plot (Z projection, X and Y averaged over [-2.5,2.5])

Hint: Use the factor $1.602176462E-7$ to convert dose from GeV/g to Gy (Manual USRBIN, Note 5)

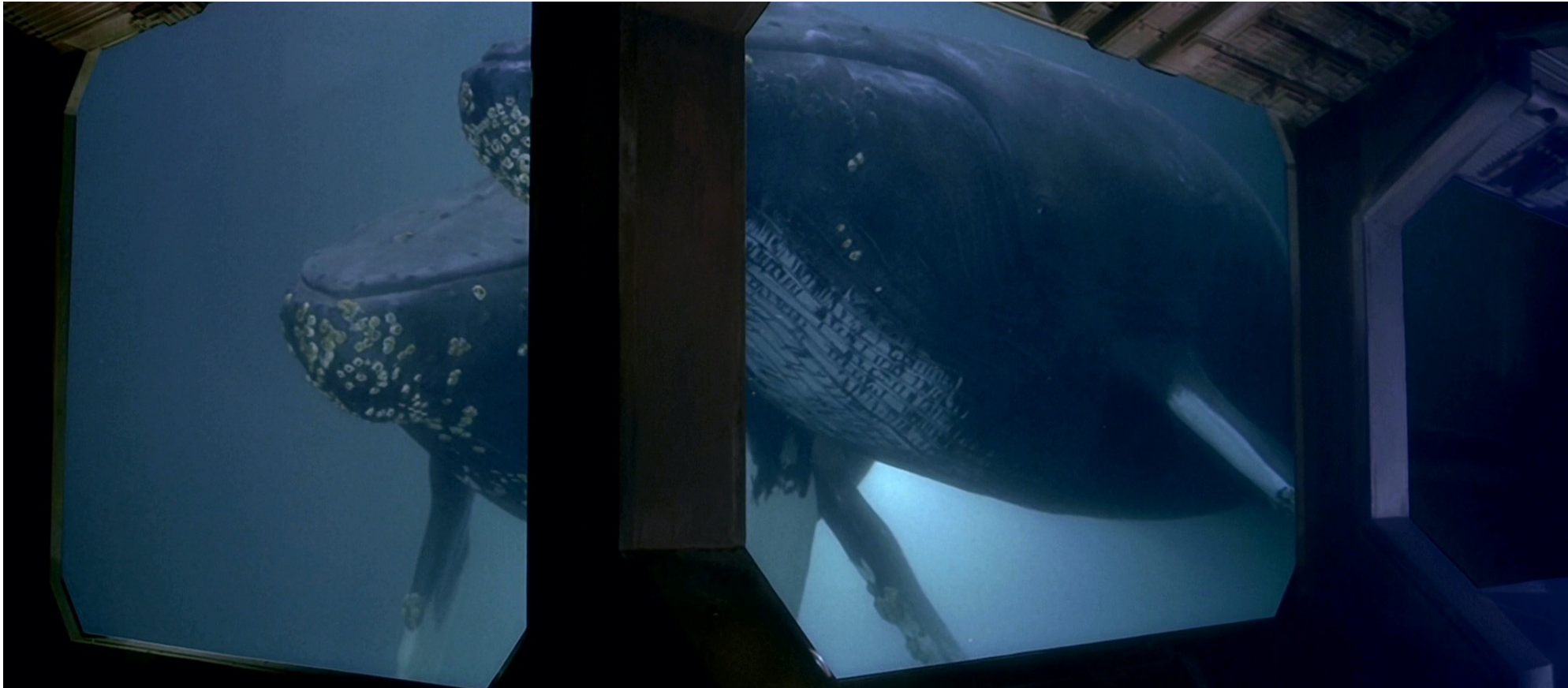
Process the output files [RUN] & select the result files (*.bnn) and plot [PLOT]

Results



Optional for the fast and furious ones ... Save The Whales

Unfortunately, our whales have contracted a nasty cancer in the polluted seas of 1986 ...
... could we treat them in our water tank with a high energy proton or electron beam ?



Instructions – Level 2

Prepare the whale treatment:

- Add another DEFINE card named: *whalefac* with value 1
- Use the *whalefac* variable to adapt your geometry to be able to host the whales. All tank and scoring dimensions should be increased by this *whalefac*. Don't forget to adapt the beam position and dimension as well. (*Hint: FLAIR manual chapter 3.6*)
- Add two more run scenarios:
 - Protons at 1 GeV (1000 primaries), set *whalefac* to 10
 - Electrons at 250 MeV (1000 primaries), set *whalefac* to 10
 - Launch the machine !
- Do the plotting as before (2D/1D)

Results

