Abteilung für Medizinische Strahlenphysik
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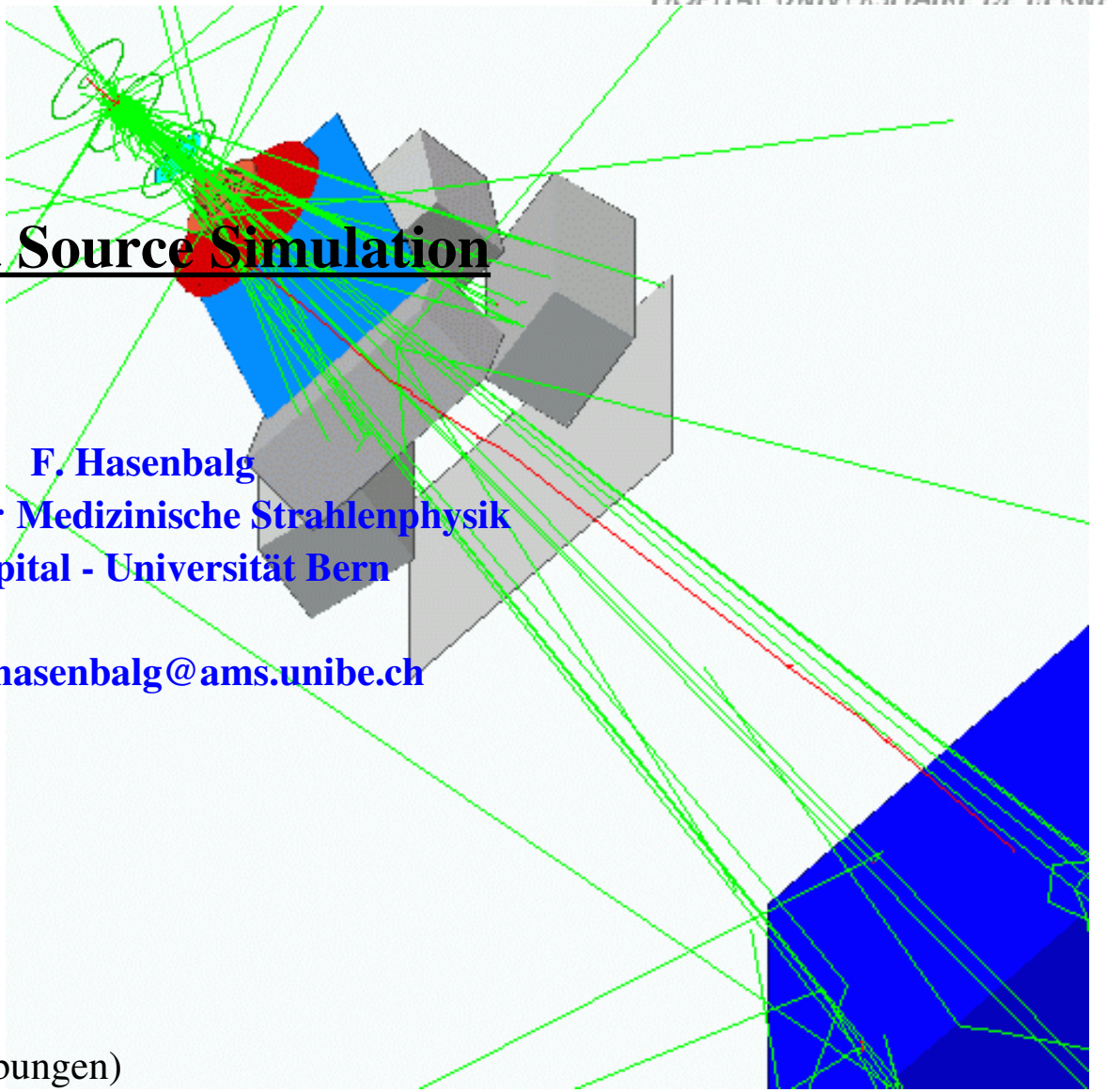
Beta Source Simulation



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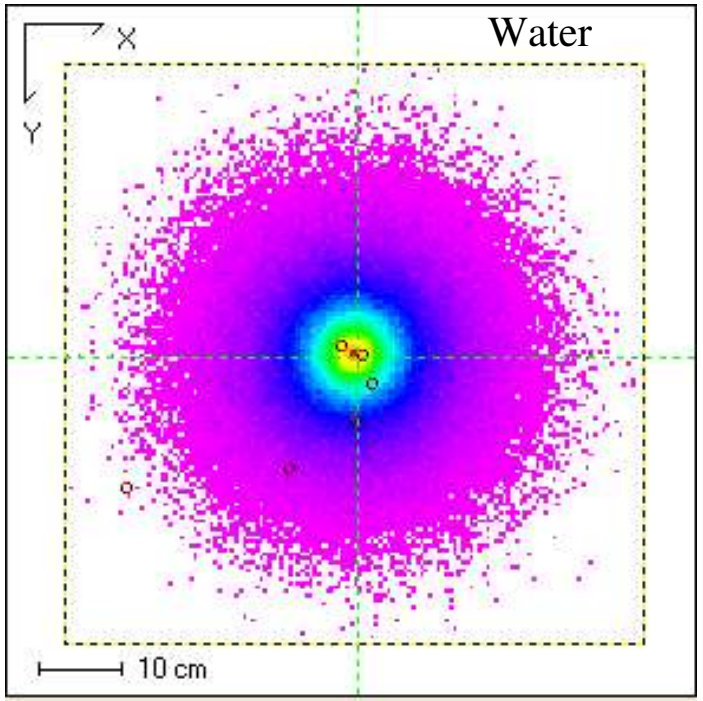
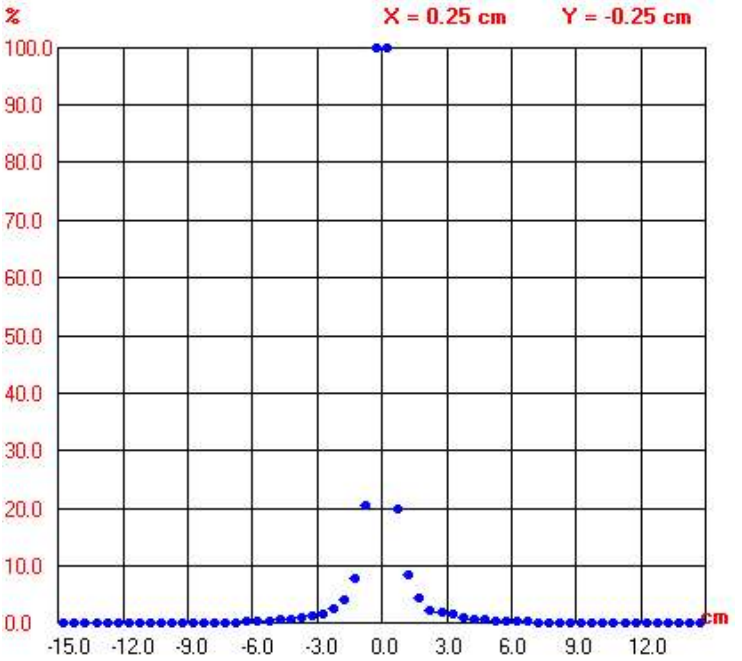
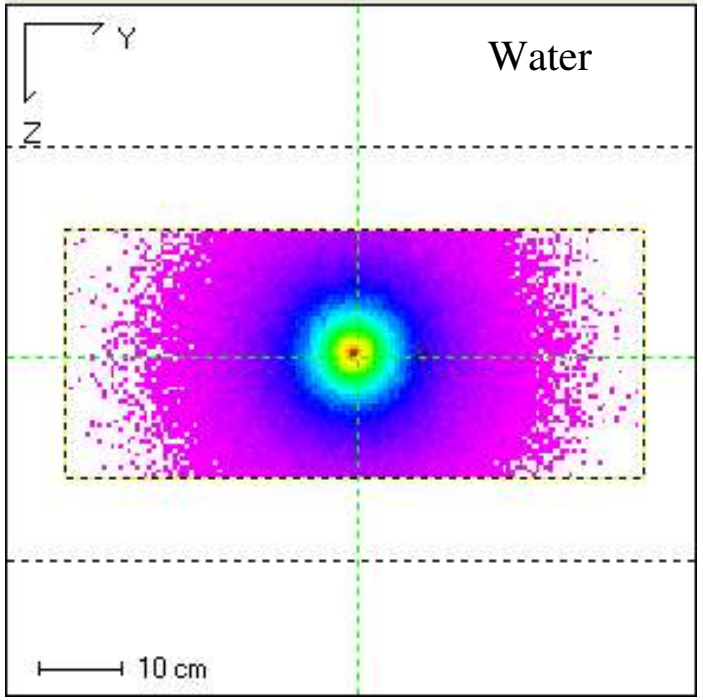
Results: ^{192}Ir gamma point source

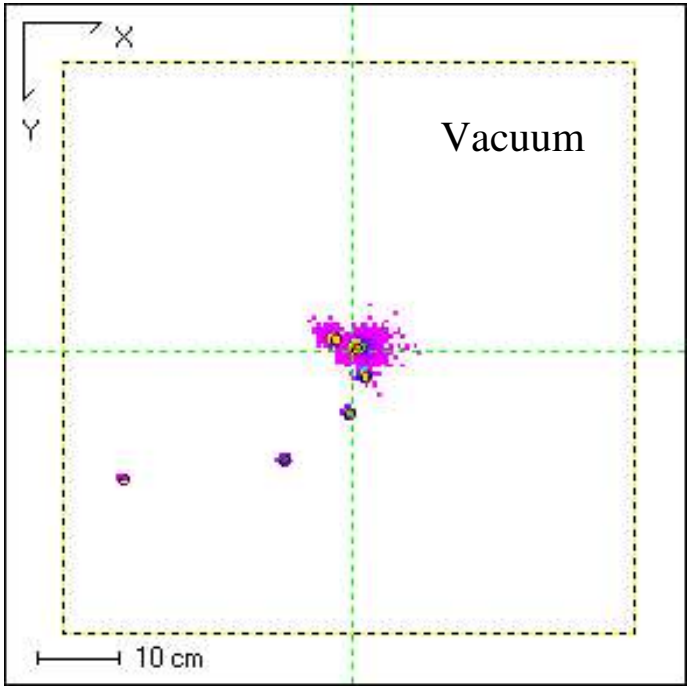




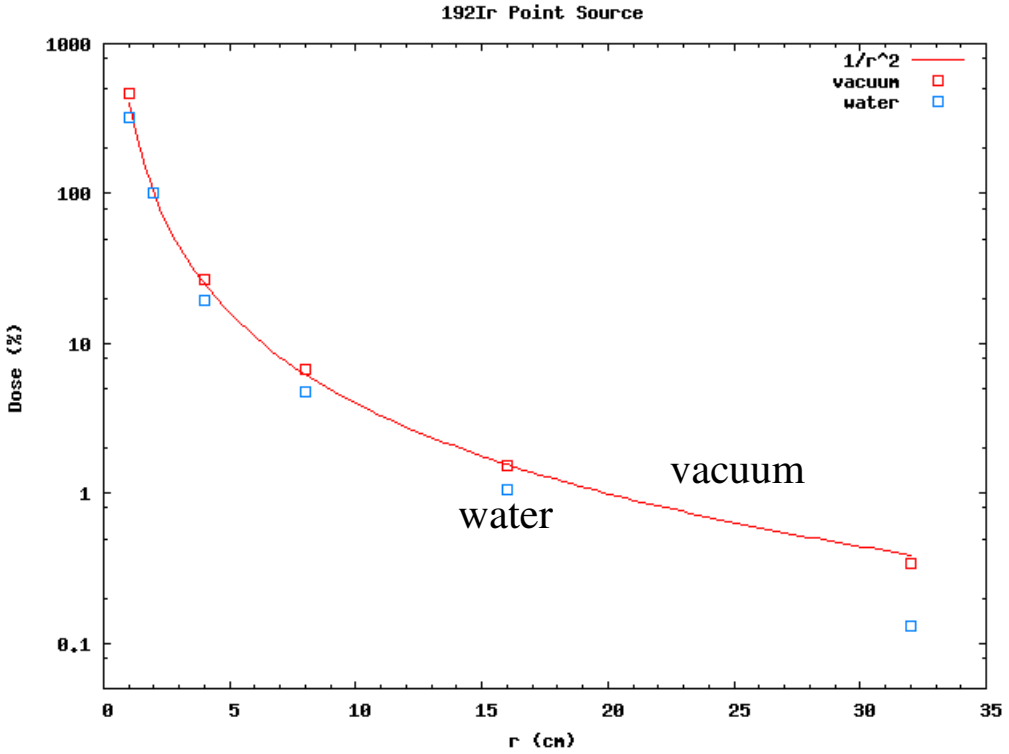
Profile
in water

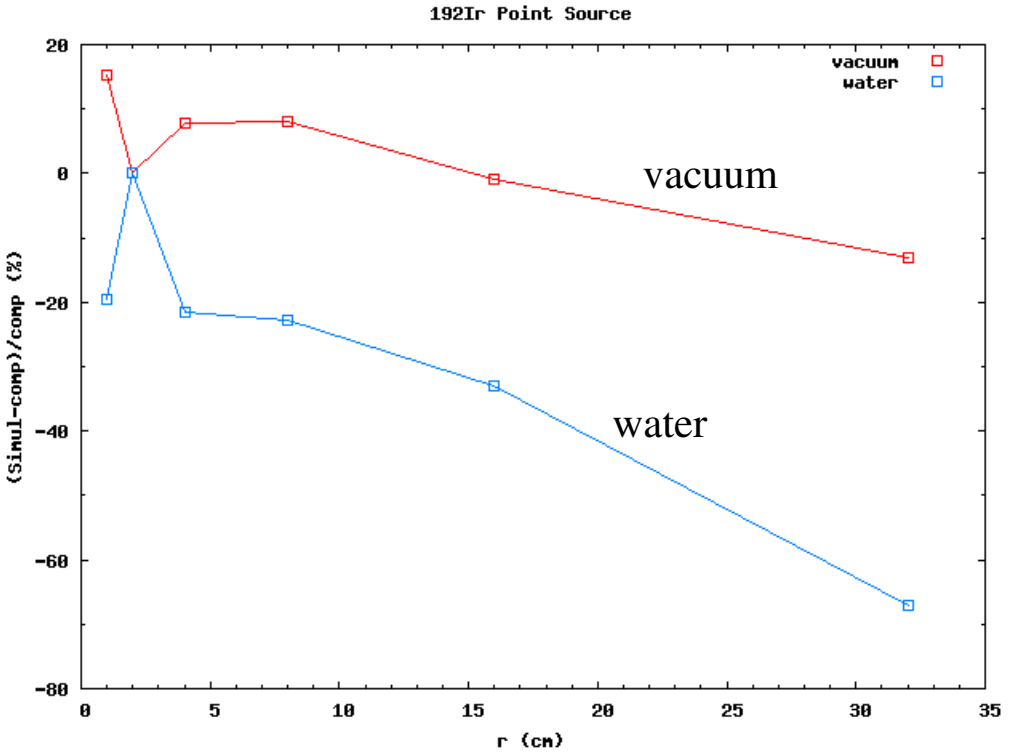
$1/r^2$ behavior





Results: ^{192}Ir gamma point source





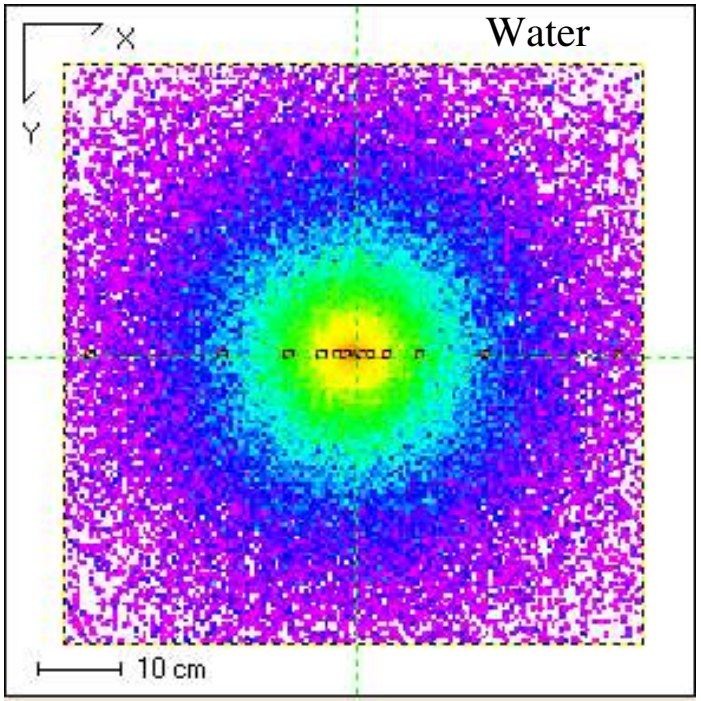
percentage depth dose

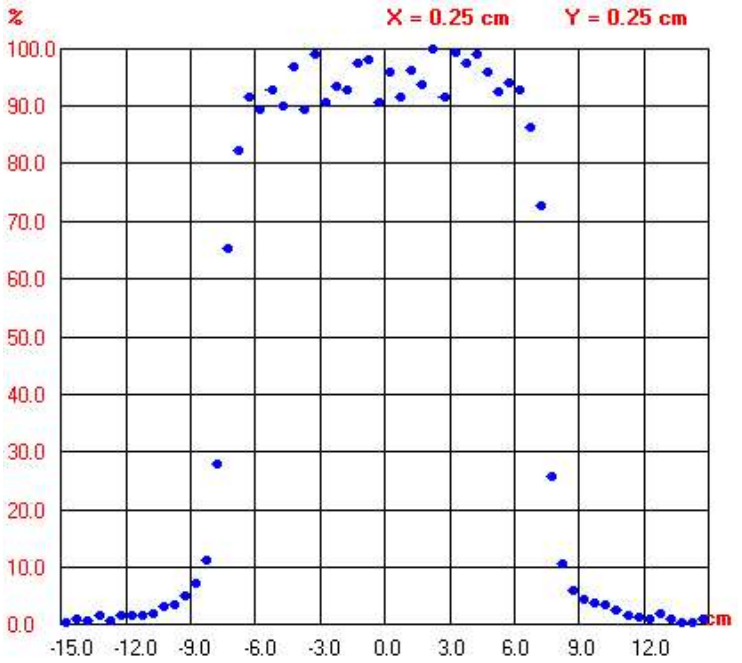
(normalized to r = 2 cm)

deviations from ideal ($1/r^2$) case

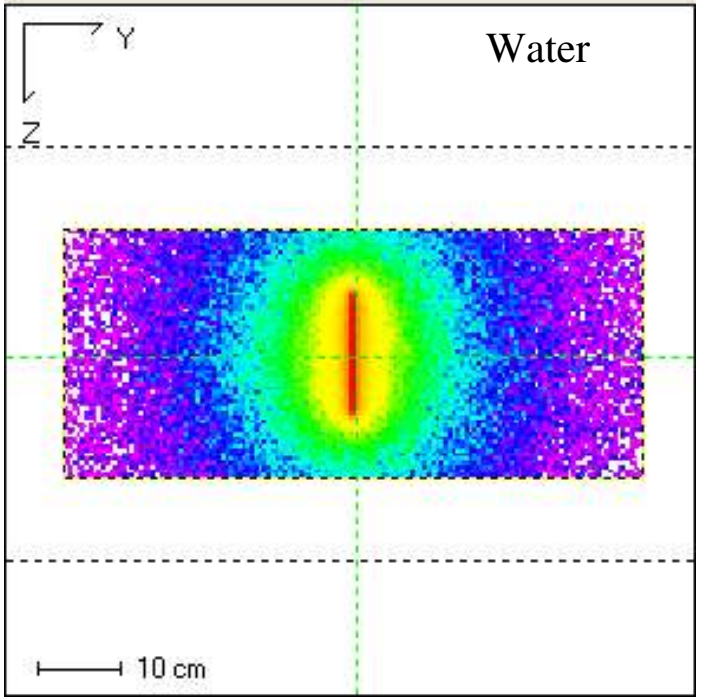
100*(simulation – computed) / computed

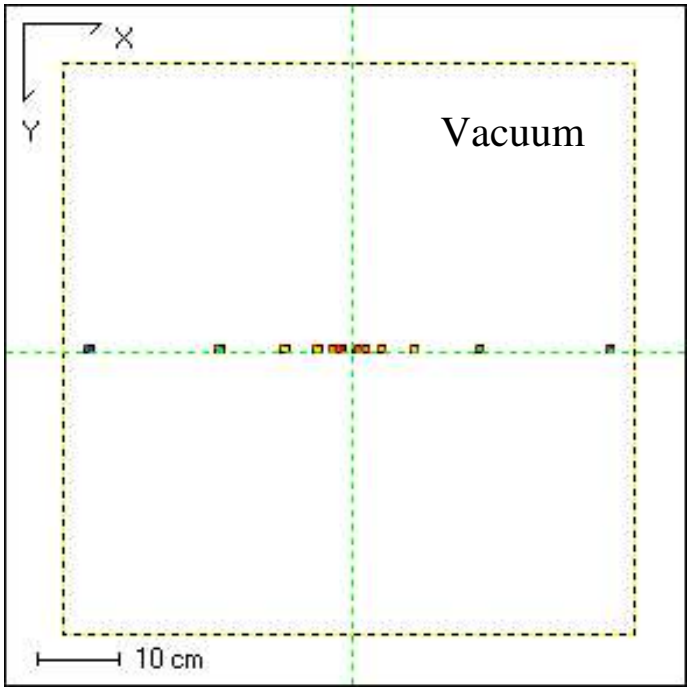
Results: ^{192}Ir gamma line source



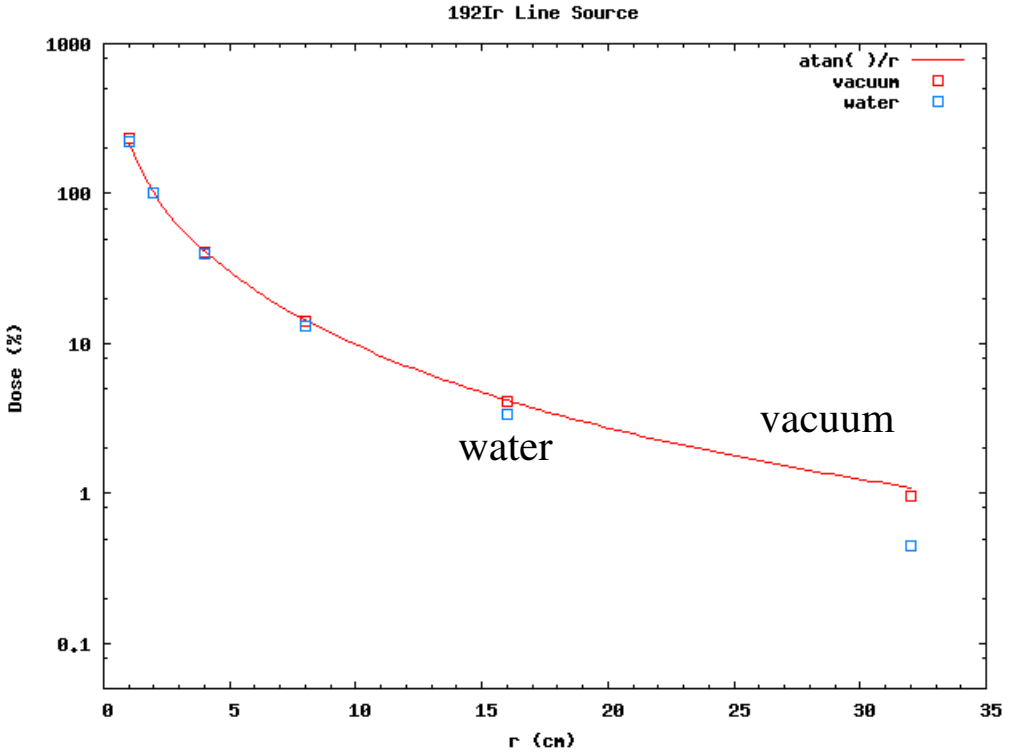


Profile in water
along the source axis

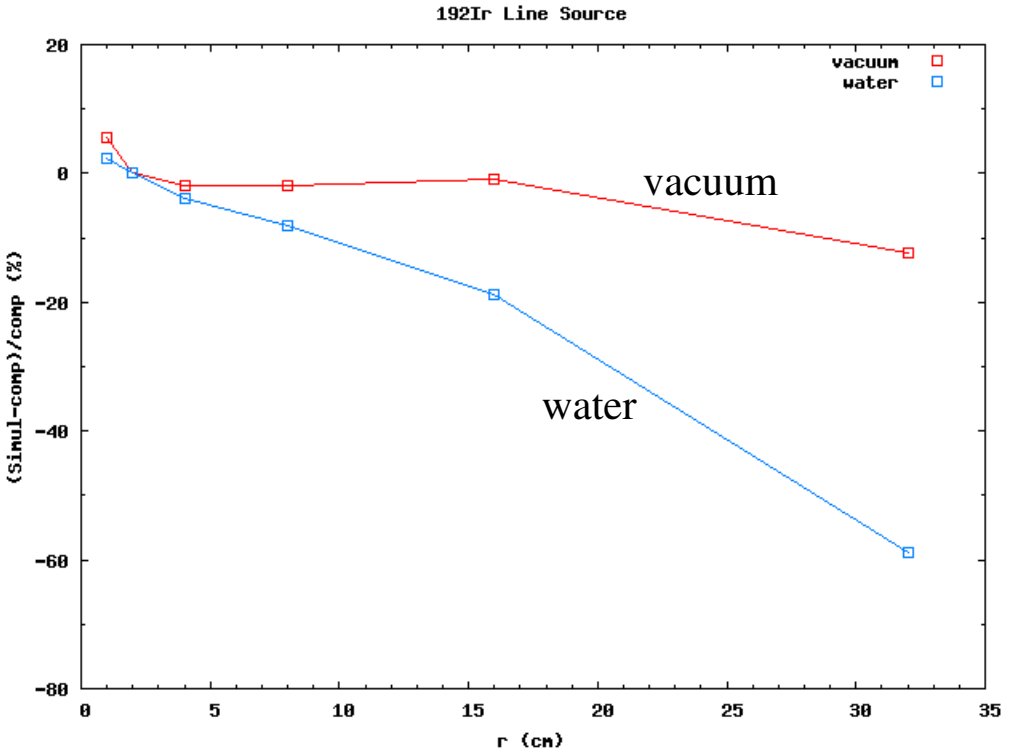




Results: ^{192}Ir gamma line source



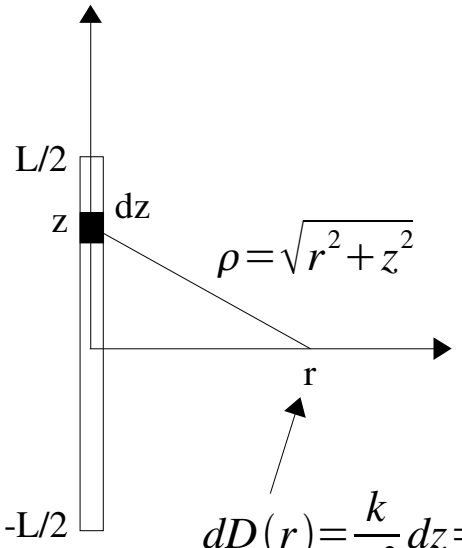
percentage depth dose
(normalized to r = 2 cm)



deviations from ideal case
[atan(L / 2r) – atan(-L / 2r)] / r

100*(simulation – computed) / computed

Comparison between point and line sources in vacuum

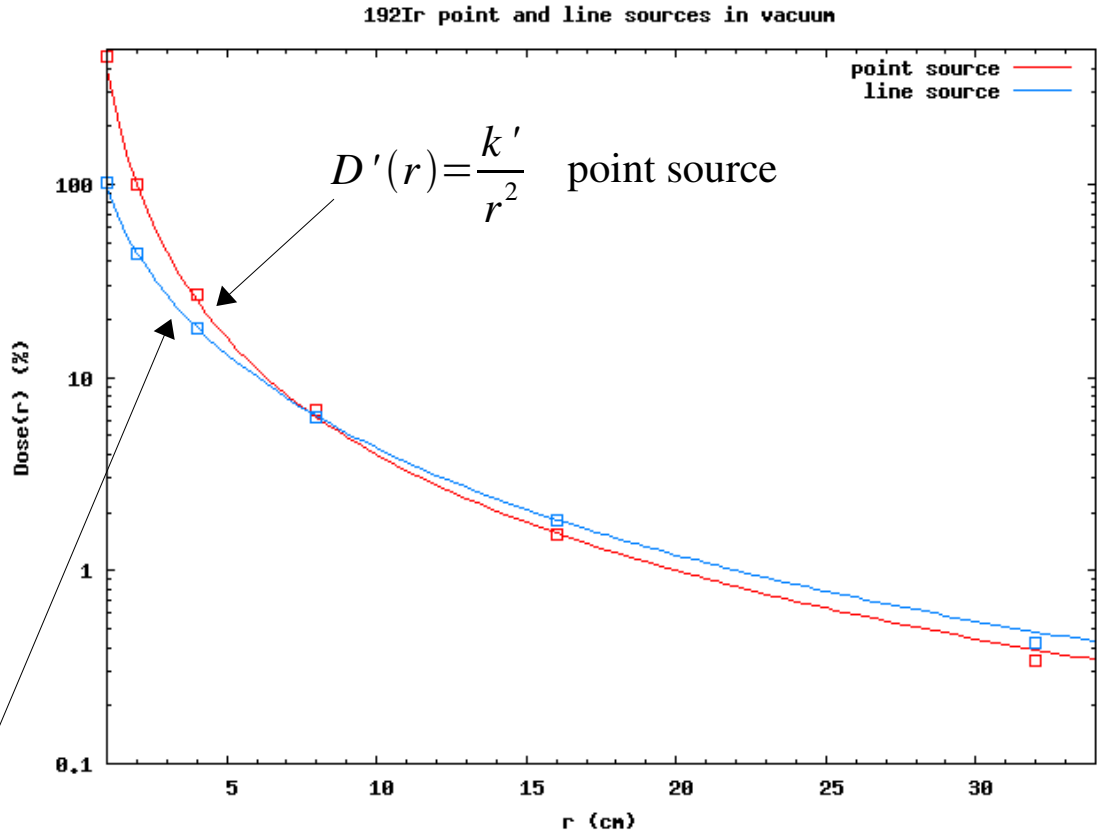


$$\rho = \sqrt{r^2 + z^2}$$

$$dD(r) = \frac{k}{\rho^2} dz = \frac{k\,dz}{r^2 + z^2}$$

$$\Rightarrow D(r) = k \int_{-L/2}^{L/2} \frac{dz}{r^2 + z^2}$$

$$D(r) = \frac{k}{r}\left[\arctan\left(\frac{L}{2r}\right) - \arctan\left(-\frac{L}{2r}\right)\right]$$



$$D'(r) = \frac{k'}{r^2}$$ point source

line source

Assignment 10: Beta source

1) Simulate: a ^{32}P planar source (E_{max} = 1.7 MeV, 5x5 cm^2) located on the surface of a 7x7x2 cm^3 water phantom.

Analysis: study the dose distribution, percentage depth dose and profiles.

2) Simulate: a parallel mono energetic electron beam (5x5 cm^2) impinging on the same water phantom.

Analysis: study the dose distribution, percentage depth dose and profiles.
What differences do you observe with the previous case?
What electron energy should you choose to obtain a similar dose distribution as the ^{32}P planar source.

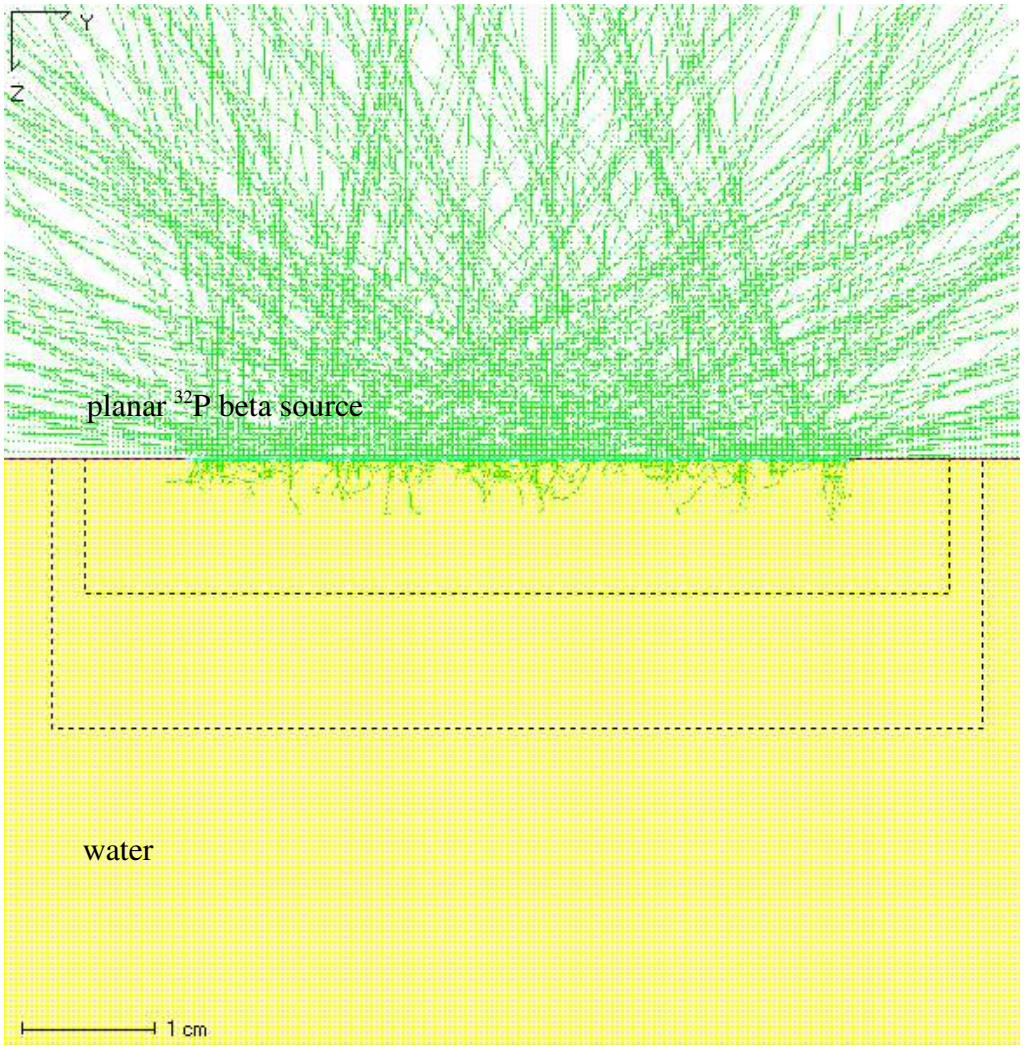
Scoring dimensions and voxel size adapted to each case. Enough statistics.

Planar ^{32}P beta source

Isotropic in all directions

```
Daten
D:\...\521icru.dat
Randomseed
1802 9375
Histories
2000000
aktiv
Box
-2.5  -2.5  -0   2.5   2.5  0.00001
Elektronen
Spektrum
D:\...\P-32_spectrum.spc
Halbraum
H2O521ICRU
2 0 1
Rechenraum
-3.5  -3.5  -0  3.5  3.5  2
Scoringraum
-3.25  -3.25  0  3.25  3.25   1
Voxelgrösse
0.5  0.5  0.02
Presta
```

planar beta source
5x5 cm^2
δ = 0.1 µm



^{32}P energy spectrum

energy (MeV)	spectrum intensity (arb. units)
P-32 spectrum	
0.611	48
0.711	63
0.811	78
0.911	87
1.011	94
1.111	97
1.211	97
1.311	94
1.411	88
1.511	79
1.611	64
1.711	49
1.811	35
1.911	22
2.011	13
2.111	06
2.211	01

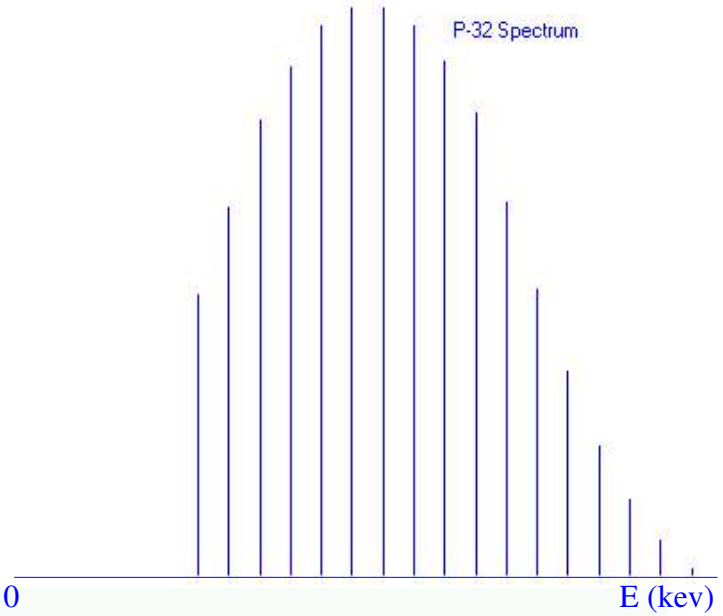
E + 0.511 MeV!

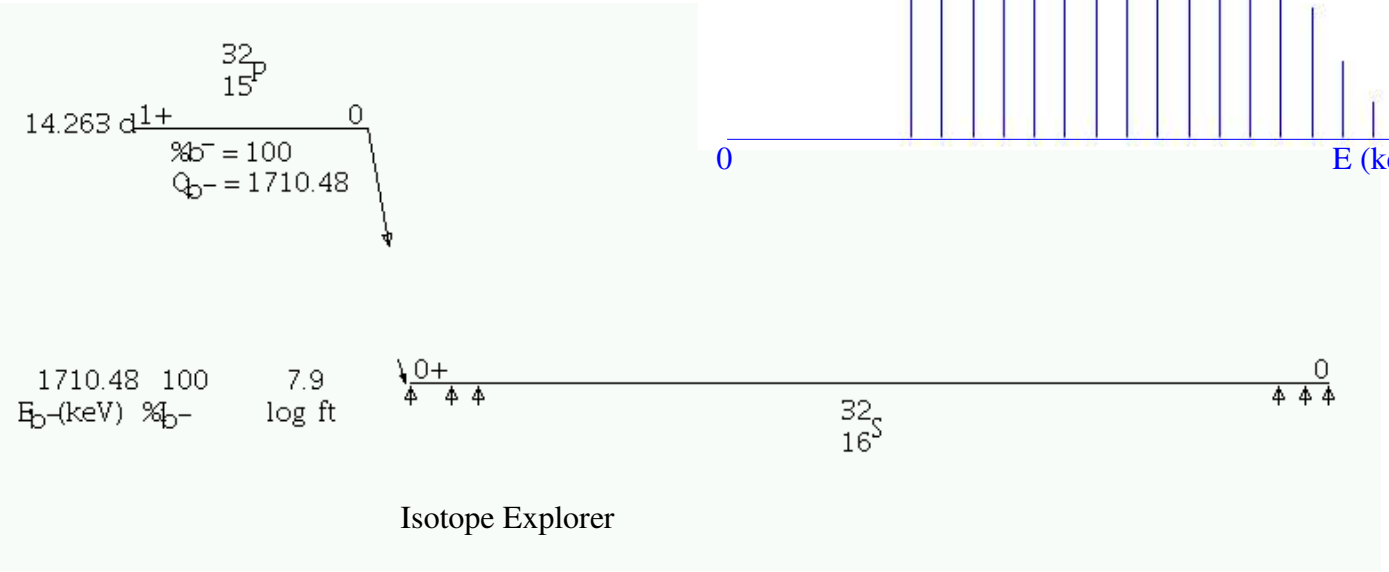
$T_{1/2}$ = 14.26 d

Decay: β-

E_{max} = 1.7 MeV

Continuous spectrum





Isotope Explorer

http://ie.lbl.gov/ensdf/

daughter

nuclide: 32S

Data set: all

Database: ENSDF (Get List)

Data set: 32S 32P b- decay (14.263 d)

Display: Level drawing

needs Java!

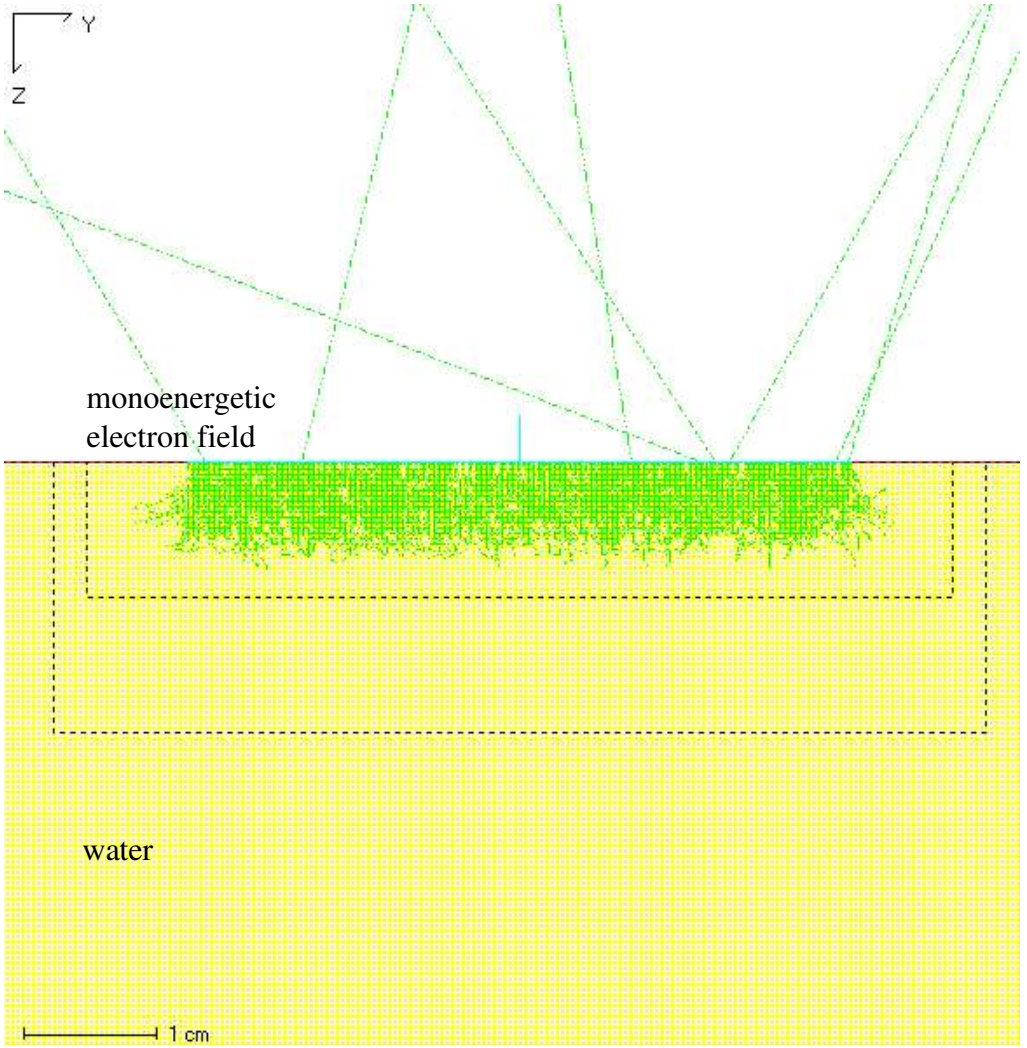
Equivalent electron field

Daten
D:\...\521icru.dat
Randomseed
1802 9375
Histories
1000000
Feld
0 0 0
5 5 0
Elektronen
Richtung
0 0 1
Energie
X.X
Halbraum
H2O521ICRU
2 0 1
Rechenraum
-3.5 -3.5 0 3.5 3.5 2
Scoringraum
-3.25 -3.25 0 3.25 3.25 1
Voxelgrösse
0.5 0.5 0.02
Presta

monoenergetic
electron field
5x5 cm^2

Try several values

Do not forget to add
0.511 MeV!



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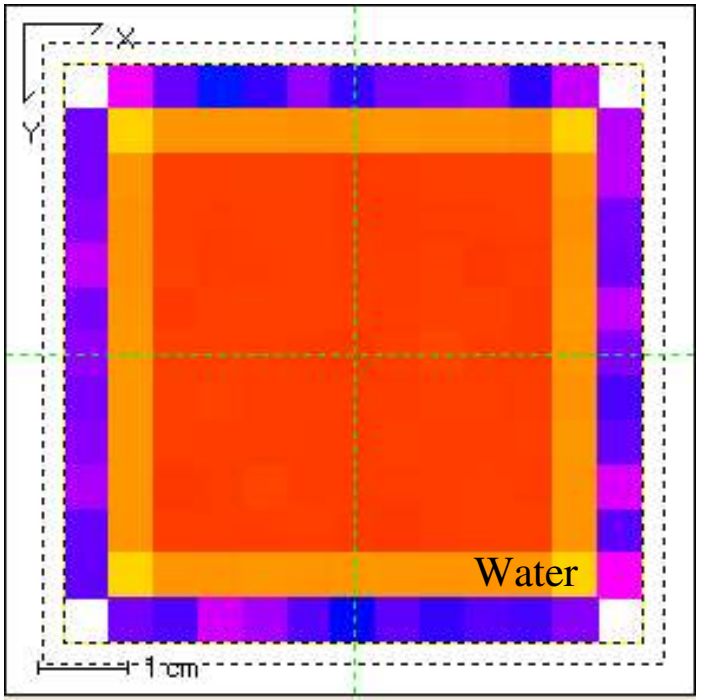
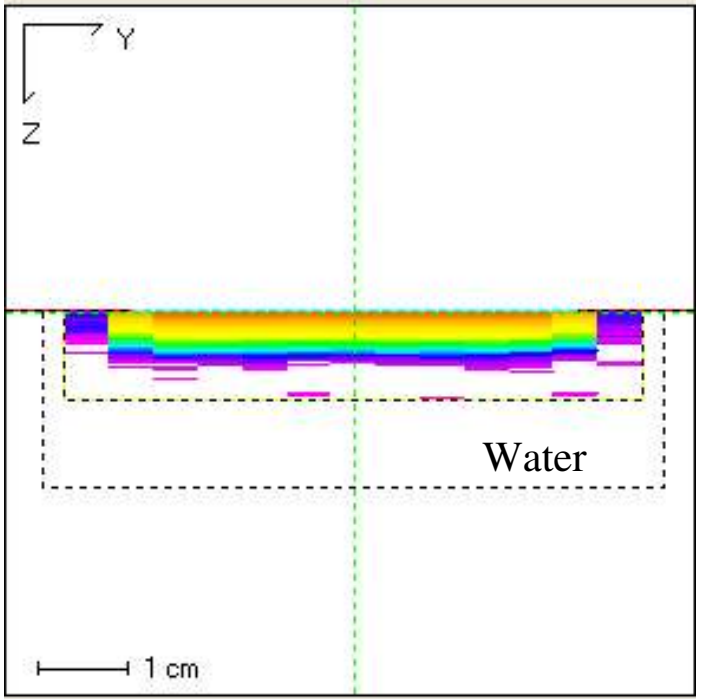
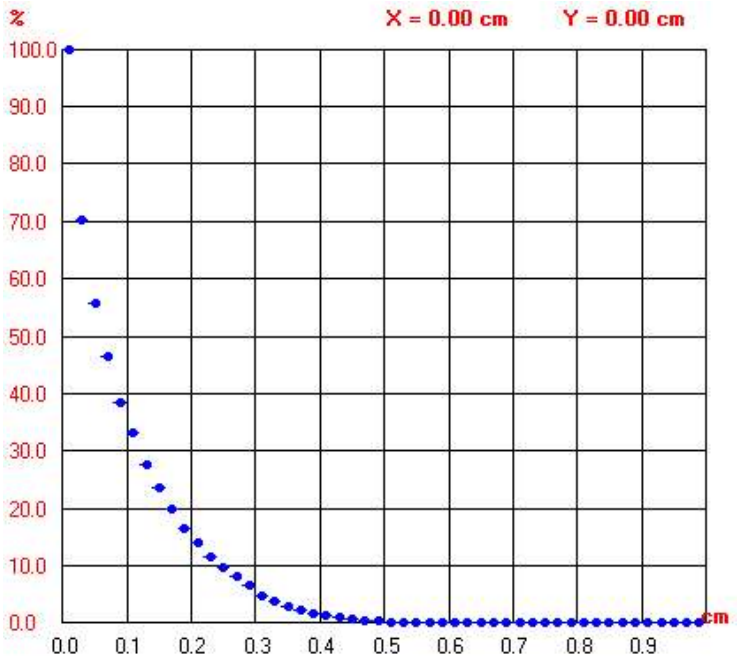
What differences do you observe with the previous case?
What electron energy should you choose to obtain a similar dose distribution as the ^{32}P planar source.

Scoring dimensions and voxel size adapted to each case. Enough statistics.

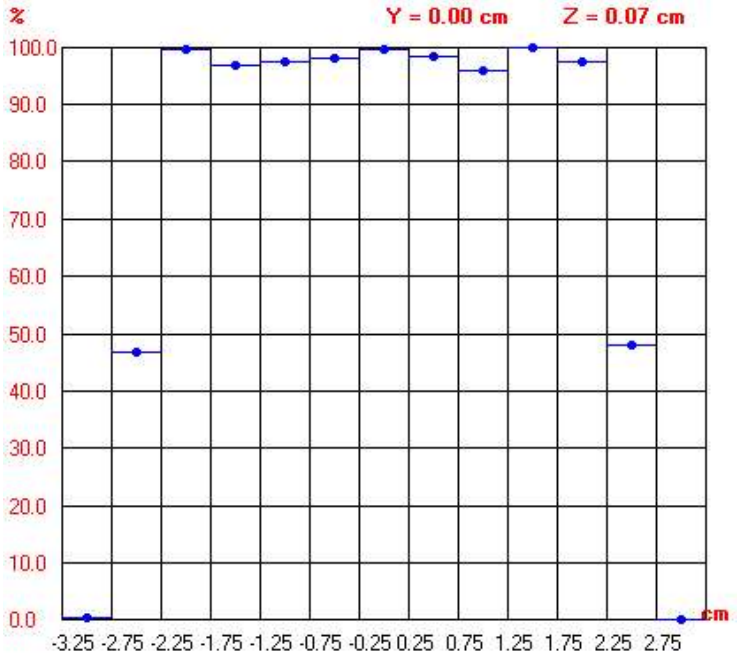
Results: ^{32}P electron planar source (5x5 cm^2)





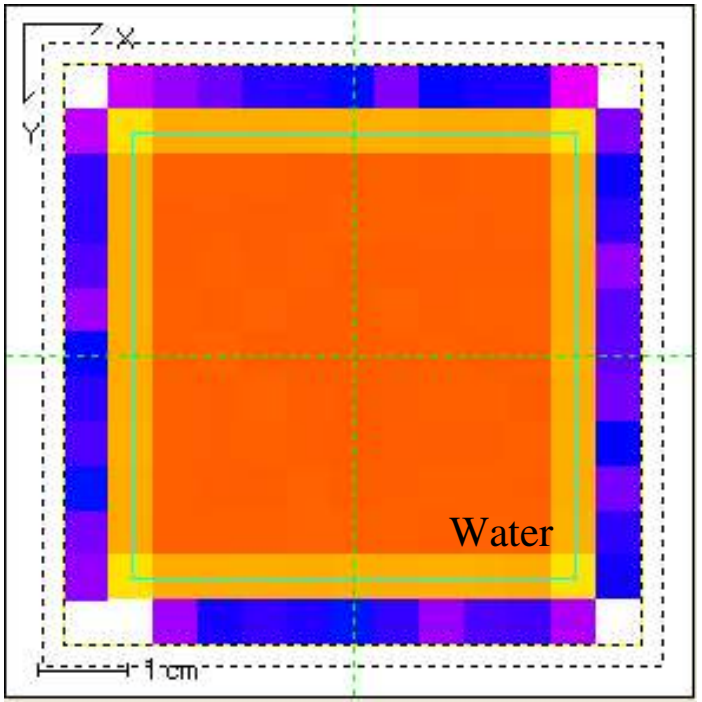


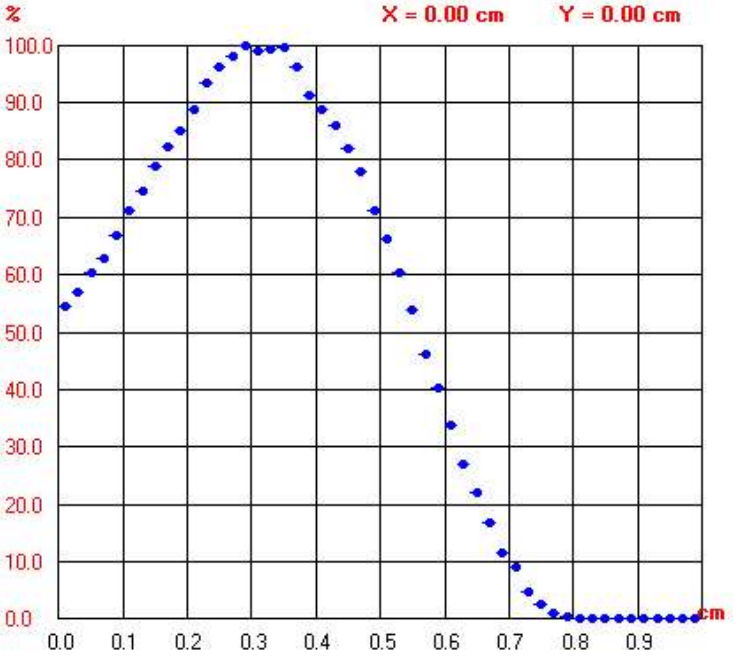
Percentage depth dose in water



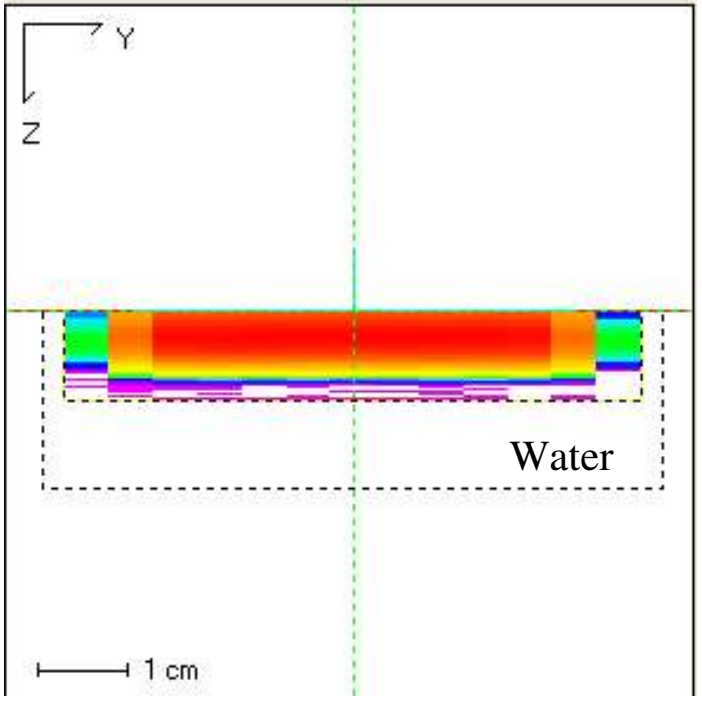
Profile in water

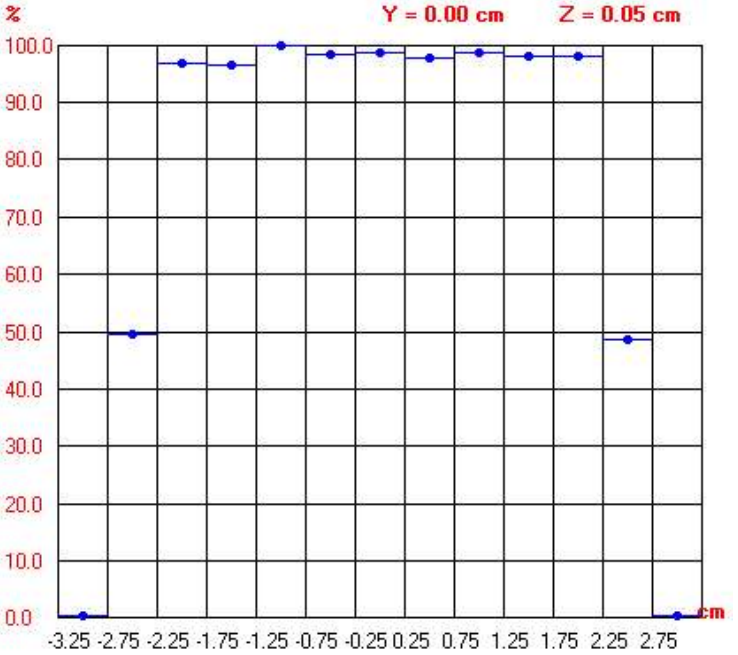
Results: equivalent electron field E = 1.7 MeV (5x5 cm^2)





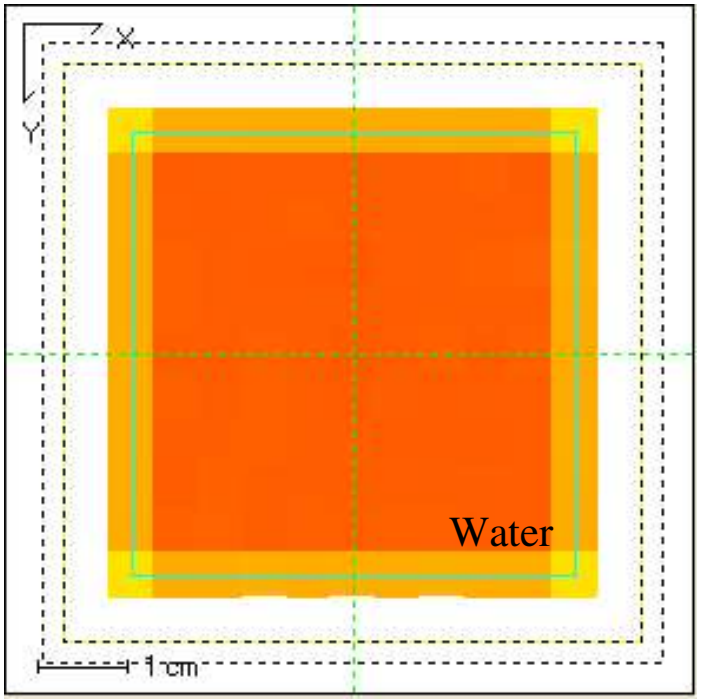
Percentage depth dose in water

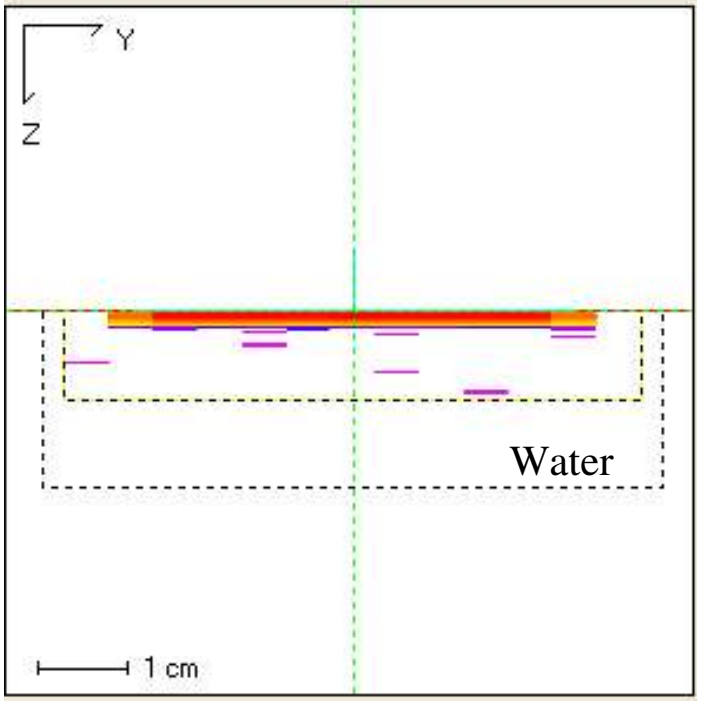


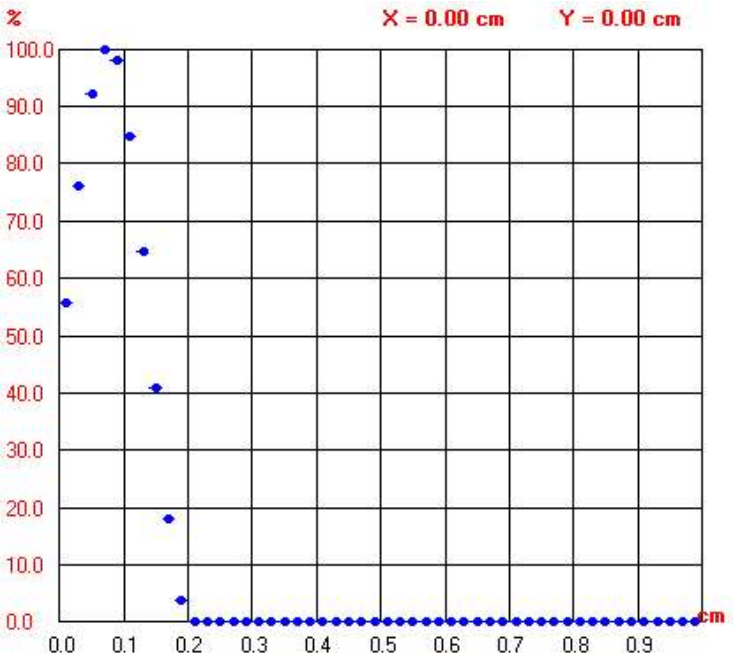


Profile in water

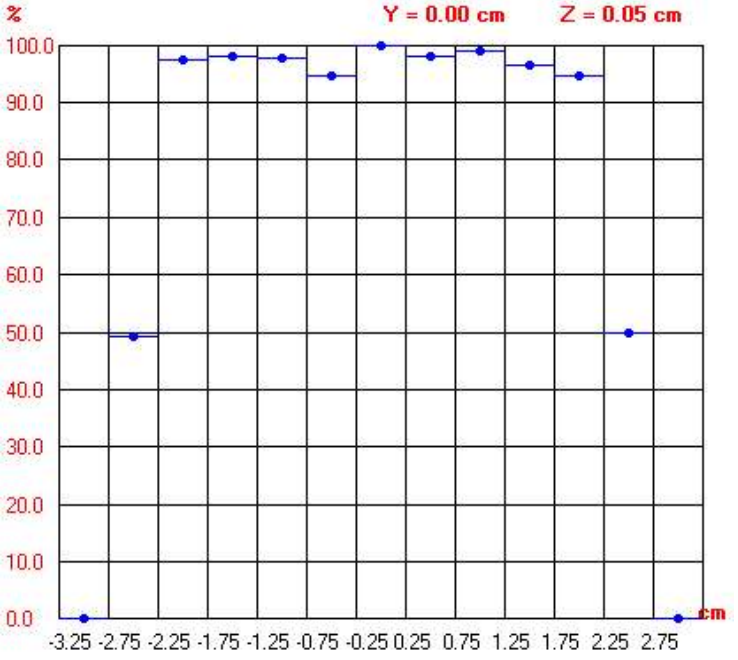
Results: equivalent electron field $E = E_0/3 = 0.57$ MeV (5x5 cm^2)







Percentage depth dose in water



Profile in water