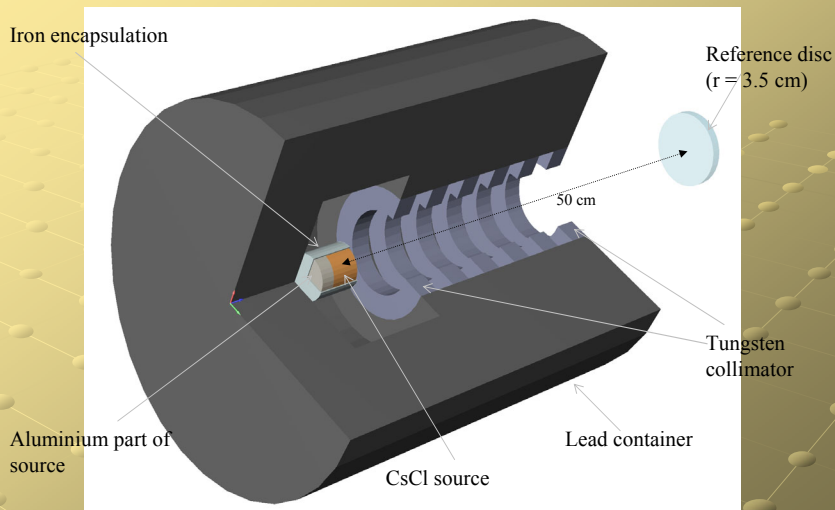


# Photon irradiation facility Question 2

Helmut Vincke  
CERN SC/RP

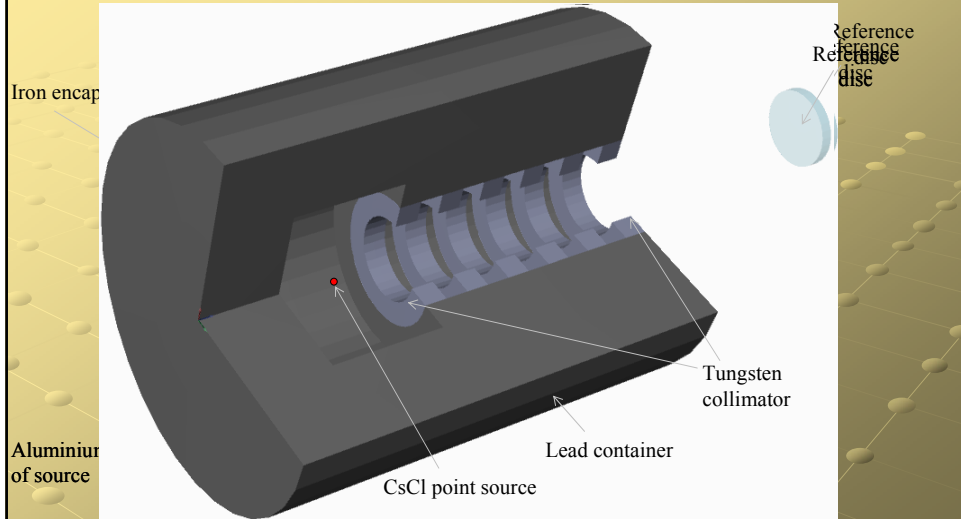
## Question 2

How strong is the influence of source geometry simplifications on the air kerma seen in the reference disc?



## Scenarios simulated

Standard irradiator    No encapsulation    No self absorption in volume source    Point source



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Photon irradiation facility: Question 2



## Simulation procedure

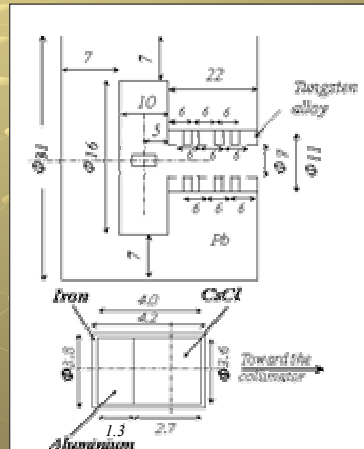
Program: FLUKA version 2005

Particle thresholds:  $e^-$  and  $\gamma$ : 10 keV

Calculation procedure of air kerma: Calculated fluence was folded with  $K_a/\Phi$  of ICRU 57

### Geometry parameter and material compositions

Material	Composition [atom-%]	Density [g/cm <sup>3</sup> ]
CsCl	Cs: 50% Cl: 50%	4.0
Iron	Fe: 100%	7.87
Aluminium	Al: 100%	2.70
Tungsten alloy	W: 90% Ni: 6% Cu: 4%	16.9
Lead	Pb: 100%	11.34
Material	Composition [wt-%]	Density [g/cm <sup>3</sup> ]
Dry air	N: 75.5267 % O: 23.1781 % Ar: 1.2827 % C: 0.0124 %	1.20484E-3



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## Analysis for Standard irradiator

### Irradiator video

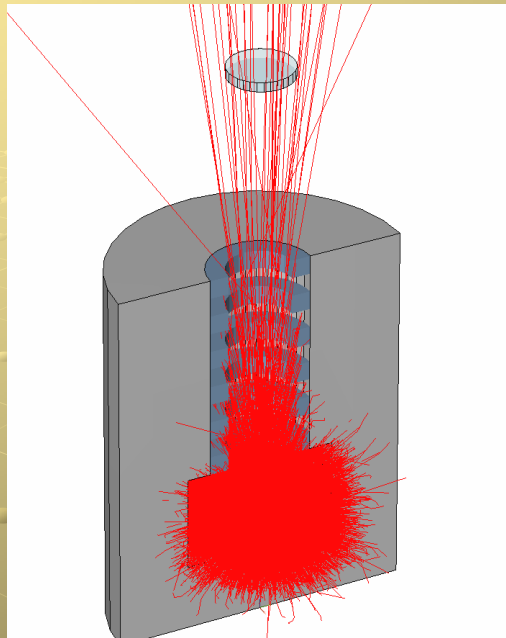


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### Track history of 10000 photons emitted by the standard Cs- source

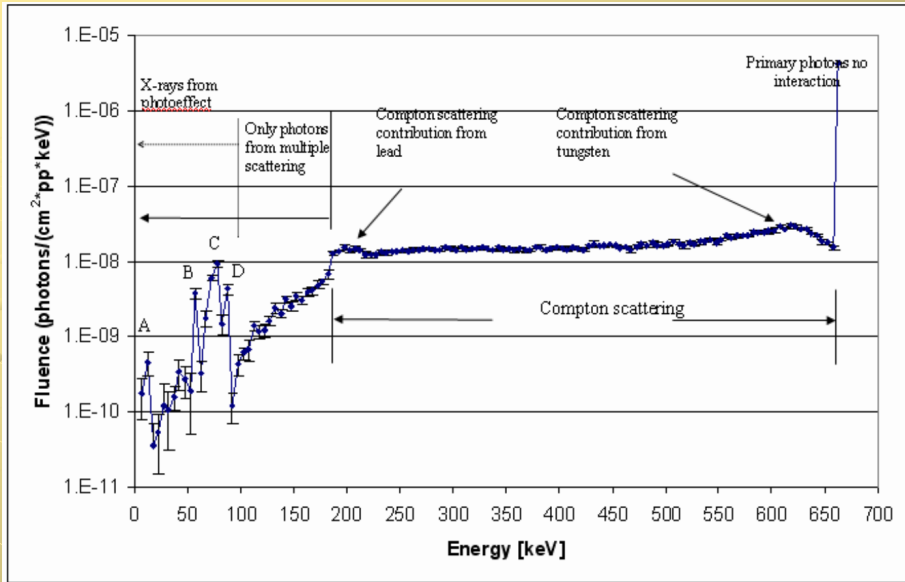
- ~ 0.08% of photons started are hitting the disk
- only ~ 70% have an energy of 662 keV
- rest of the particles originate from interactions with material



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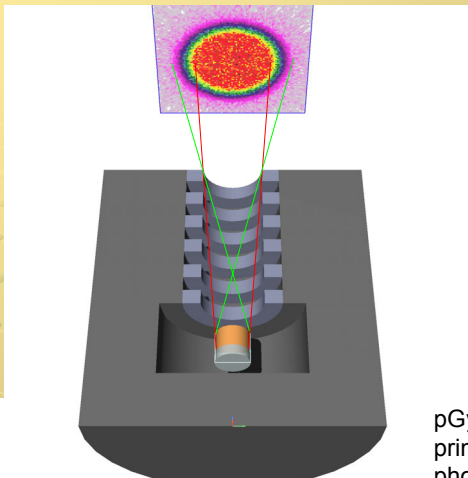
### Fluence seen in the reference disc in case of the standard irradiator



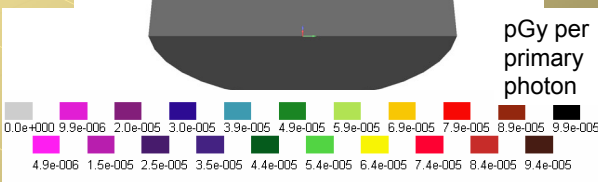
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### Air Kerma distribution at a distance of 50 cm to the source centre of standard irradiator



Air kerma seen in the reference disc is  $(8.24 \pm 0.02)E-5$  pGy per primary history



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## Analysis of the differences between standard irradiator the various simplifications

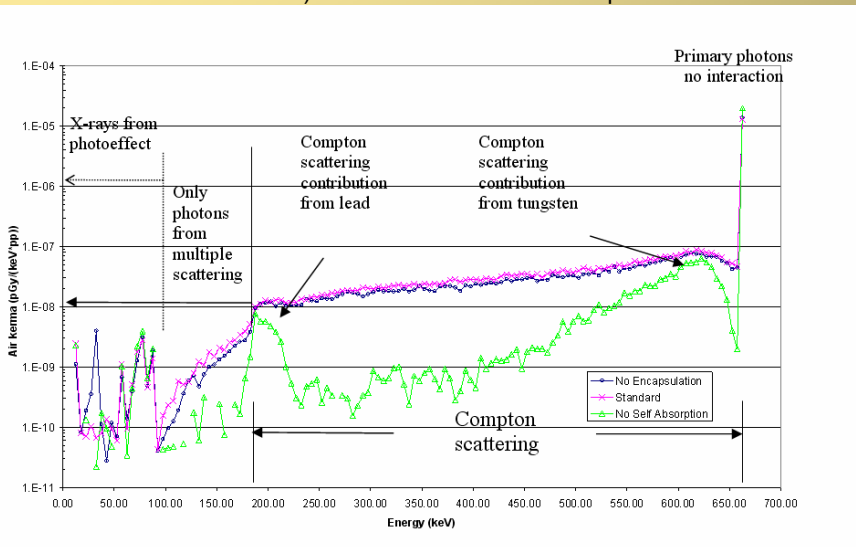


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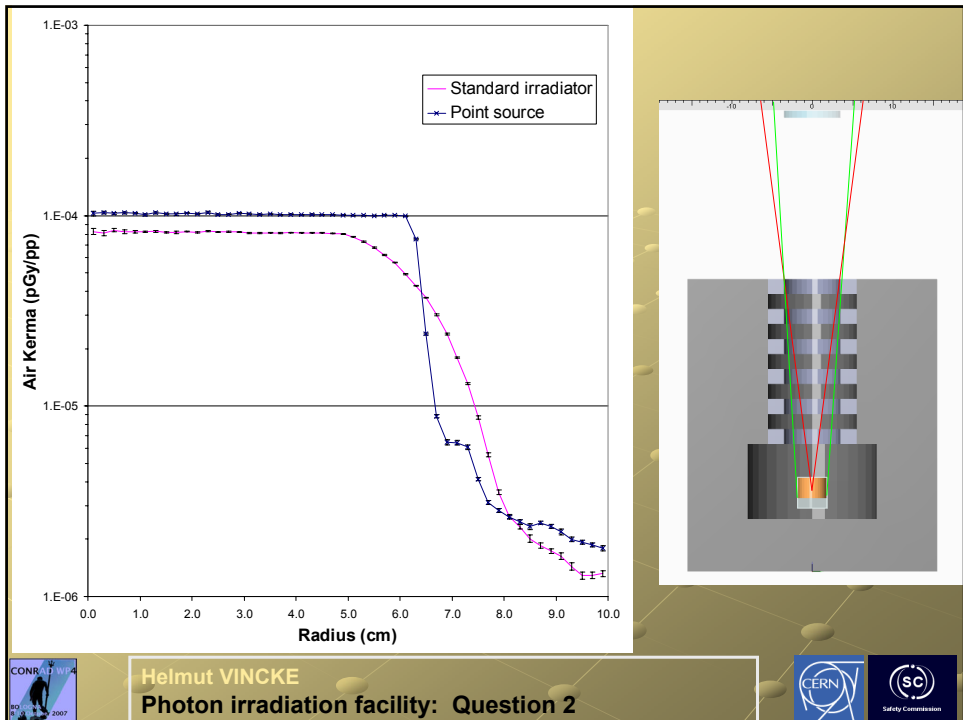
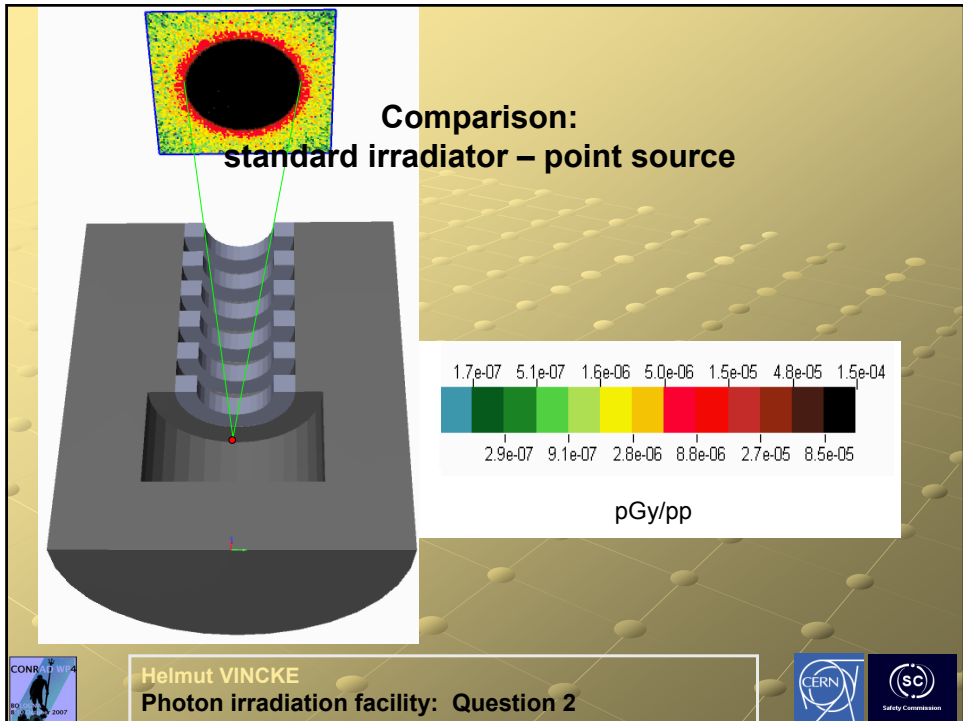
- Air kerma spectra for:
- ) Standard irradiator
  - ) irradiator without iron encapsulation and
  - ) irradiator without self-absorption



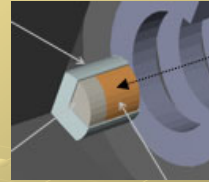
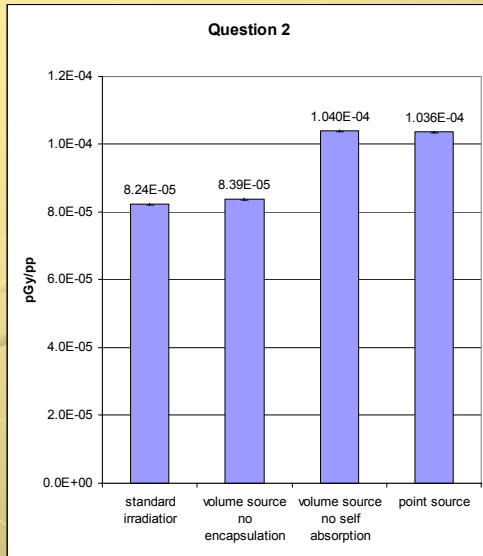
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## Final answers to question 2



### Influence of simplifications in %

Iron encapsulation: ~2%

Source without self absorption: ~26%

Point source (no self absorption): ~26%

Air kerma contributions in case of the point source scenario and the volume source without self absorption

Source:  
~96%

Container:  
~4%



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## Summary

- Simplifications on the simulated geometry can have a strong influence on the air kerma result
- The 1 mm iron encapsulation absorbs 2 % of the air kerma emitted from the source
- The air kerma seen in the reference disc is 26% higher in case of neglecting the self absorption in the source and the encapsulation
- The contribution of the lead irradiator container to the air kerma seen in the reference disc was found in the range of 4%.

↓ ↓ ↓  
Simplification of geometric parameters at the source or close to the source have to be done very carefully.



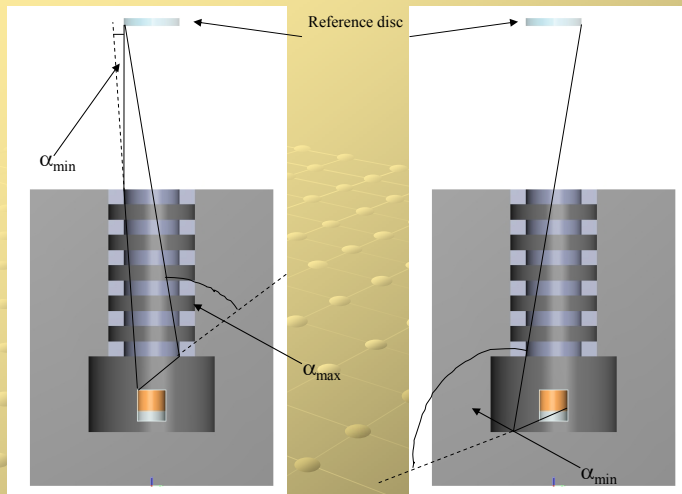
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END



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$$h \cdot \nu' = \frac{h \cdot \nu}{1 + \frac{h \cdot \nu}{m_e c^2} \cdot (1 - \cos \alpha)}$$



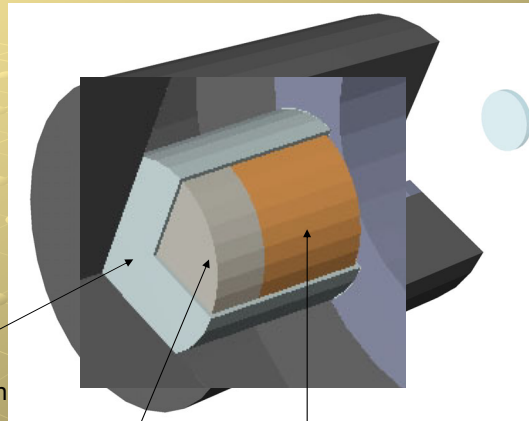
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## Scenarios simulated

- Standard irradiator
- No encapsulation
- Volume source without self absorption
- Point source

Iron  
encapsulation



Aluminium support

CsCl source



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