Fibre Trapping Efficiencies

Overview

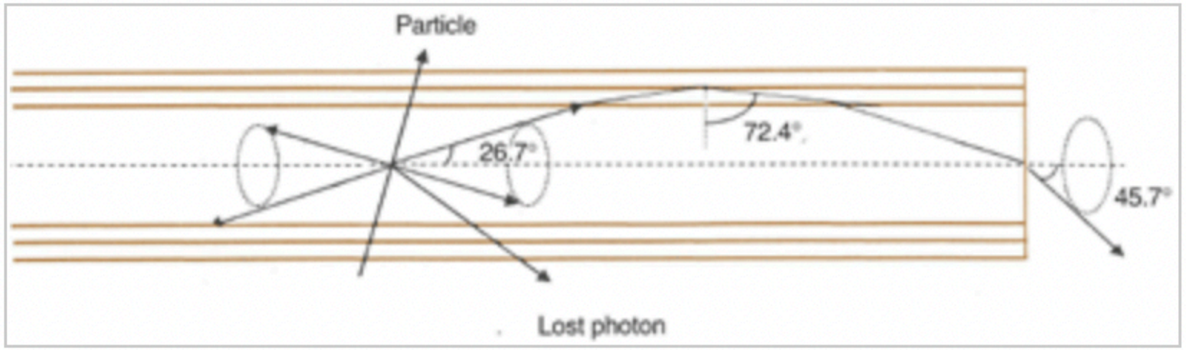
- Fiber: double cladding, coated with TPB (rough outer surface)
- Core: EJ-280
- Claddings: FP, PMMA

- Trapping efficiency for:
  - Geometric lower limit (provided by manufacturer)
  - With perfect WLS processes
  - With realistic WLS
  - With absorption lengths and WLS

Geometric

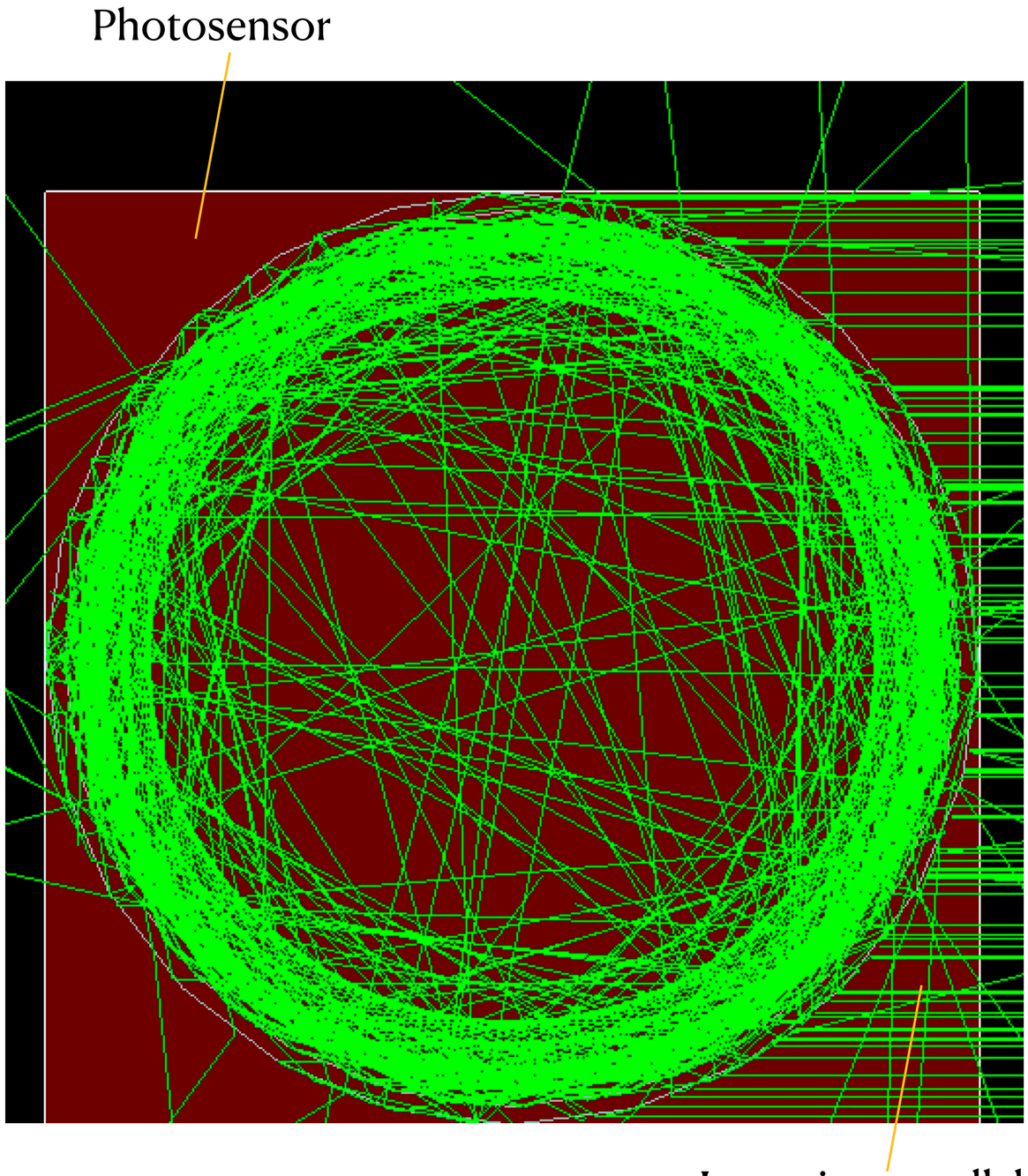
(Sanity Check)

- No absorption length or WLS
- Photons generated in the fibre center
- Fraction of trapped photons can be analytically calculated -> 5.4%
- Simulation (1e5 photons)-> 5.5%
- All results are given *per side!*



With perfect WLS

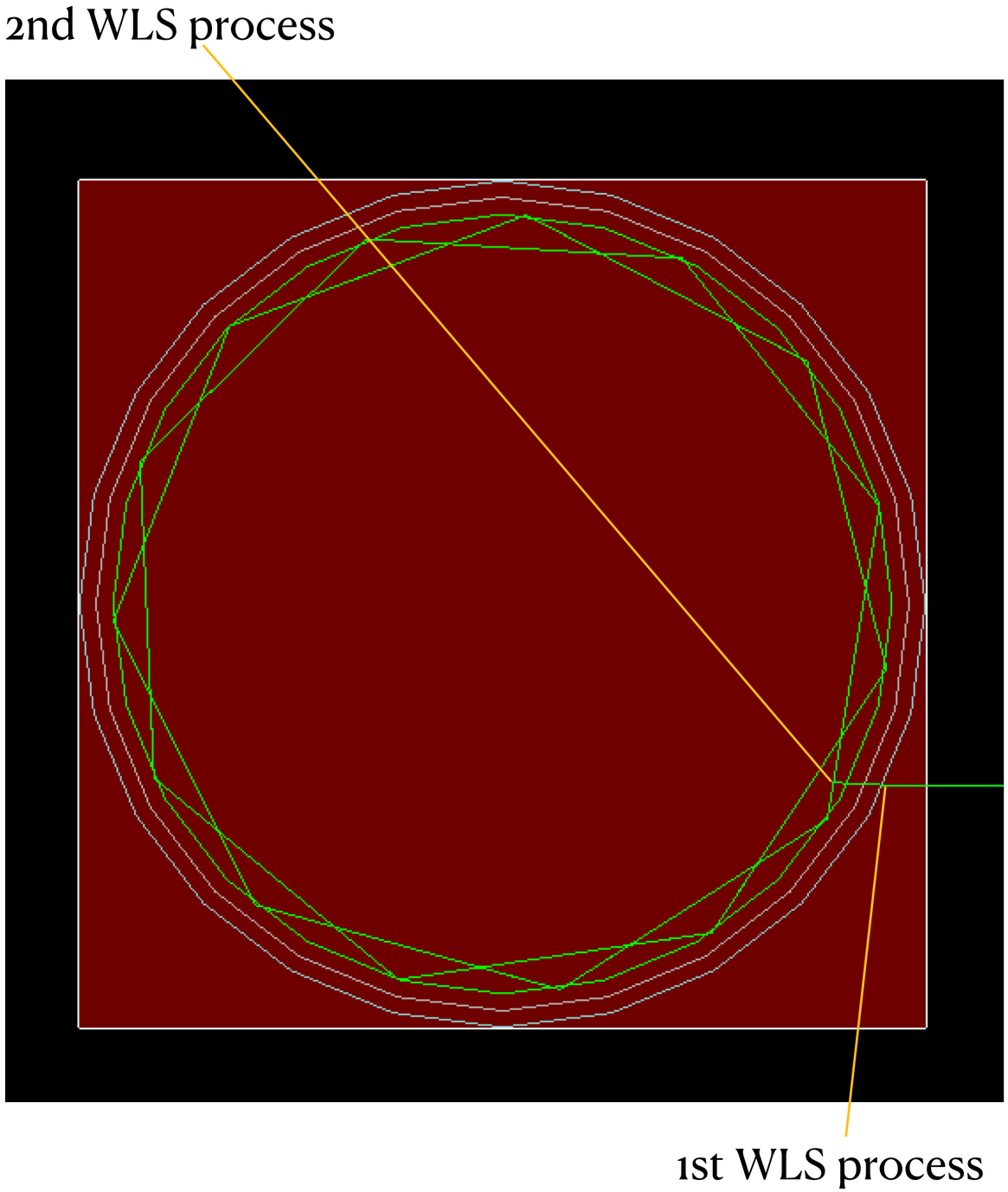
- Photons travelling in parallel generated outside fibre
- Energy: 7.08 eV (175 nm), as if from a Xe event
- Trapping efficiency: 3.6%
- Not much worse than geometric due to introduction of *skewed rays*[1]



- [1] https://halldweb.jlab.org/DocDB/0009/000918/002/SciFi-TrappingEfficiency.pdf, page 3

Realistic WLS

- Two WLS steps: TPB (Quantum efficiency 0.65) and fibre core (QE 0.86)
- Trapping efficiency now 1.95%



With Abs. Lengths

- Fibre core abs. lengths: 3 m
- Inner cladding (FP): 5 m
- Outer cladding (PMMA): Strongly energy dependent
- Trapping efficiency for 1 m fibre: 0.81%

-> 58.5% of trapped photons lost per meter of fibre