

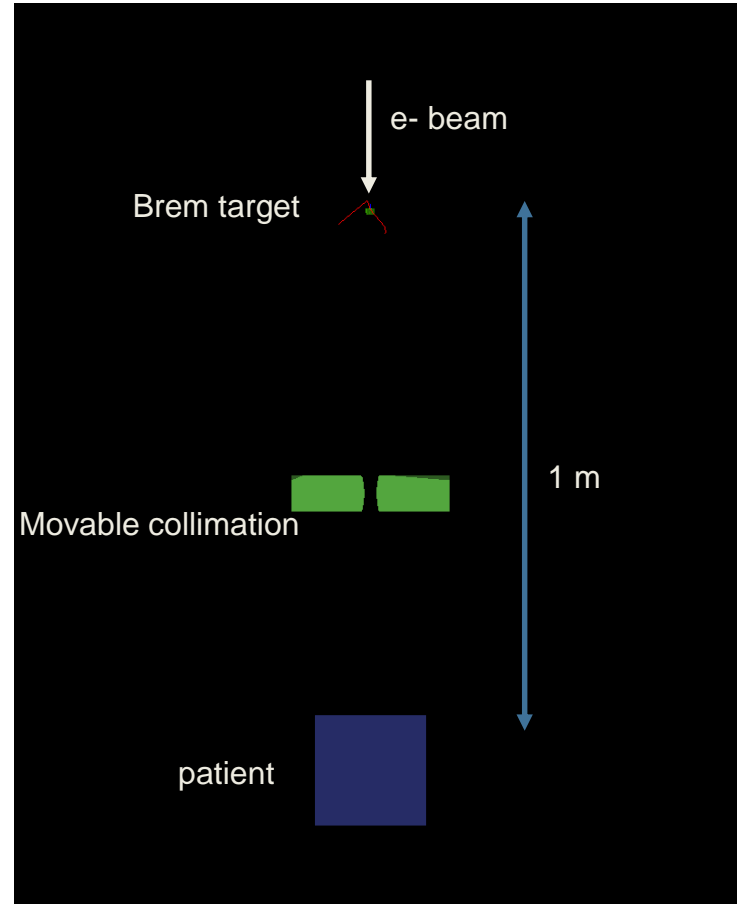
# Importance splitting for more than one particle type: a use case

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Geant4 Collaboration Meeting

# RADIOTHERAPY PHOTON BEAM

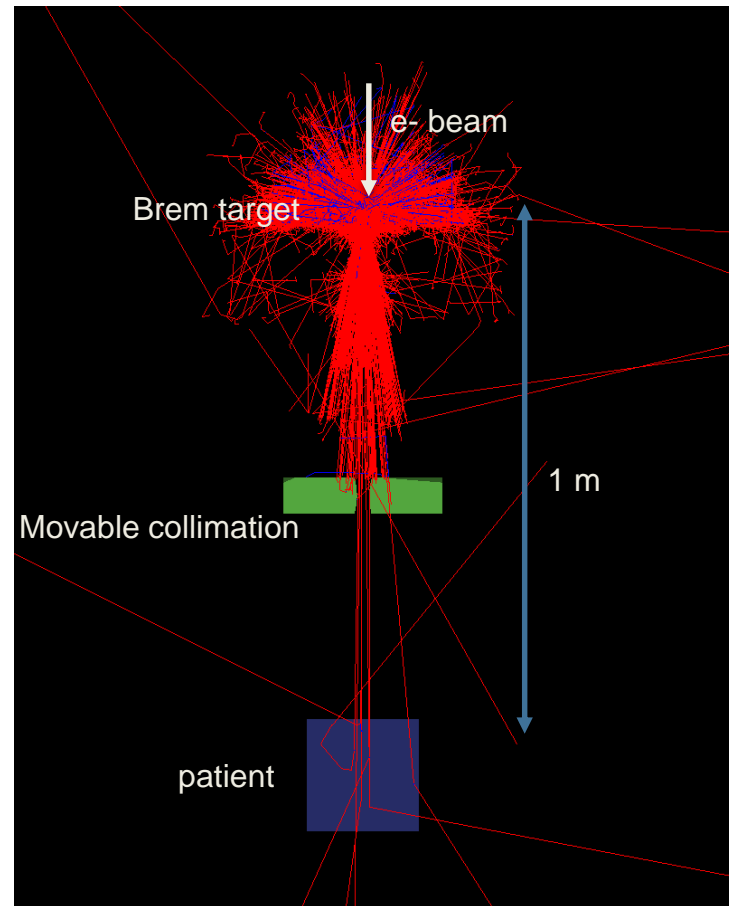
- 5-20 MeV e<sup>-</sup> incident on brem target
- Patient 1 m away
- A few cm<sup>2</sup> aperture in shielding



# VARIANCE REDUCTION

- Reuse photons incident on patient
  - Use importance splitting
- Play Russian Roulette on secondaries produced in shielding

Red: photons  
Blue: electrons

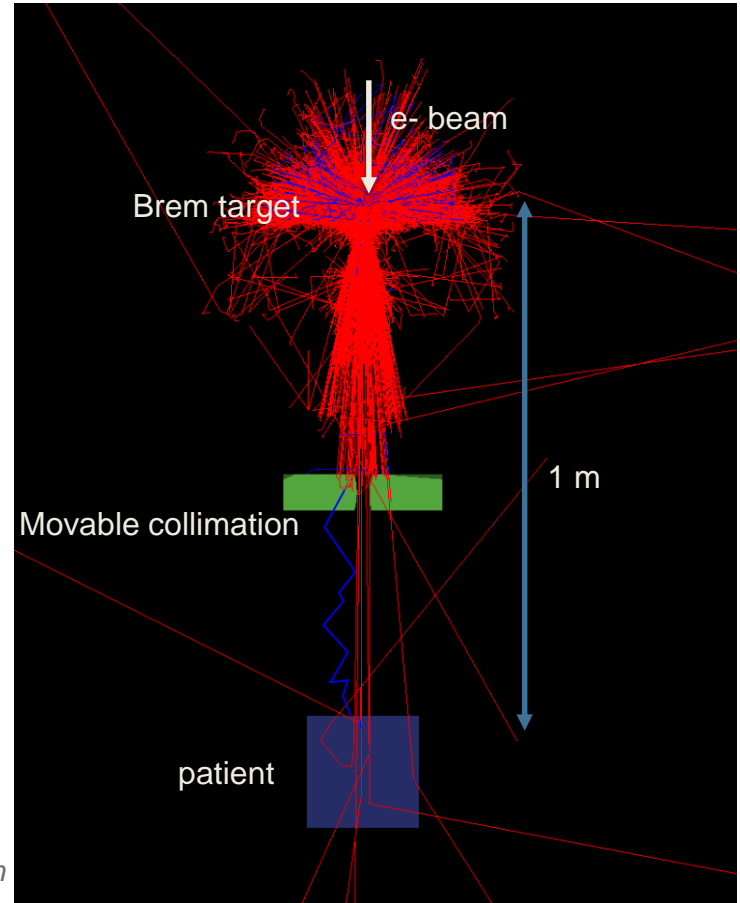


# A PROBLEM

- Problem!
- Survivors of Russian Roulette have high weight (aka “fat” electrons”.)
- Statistical uncertainty of dose distribution can be dominated by these particles.

Red: photons  
Blue: electrons

*Fat electron is an illustration*



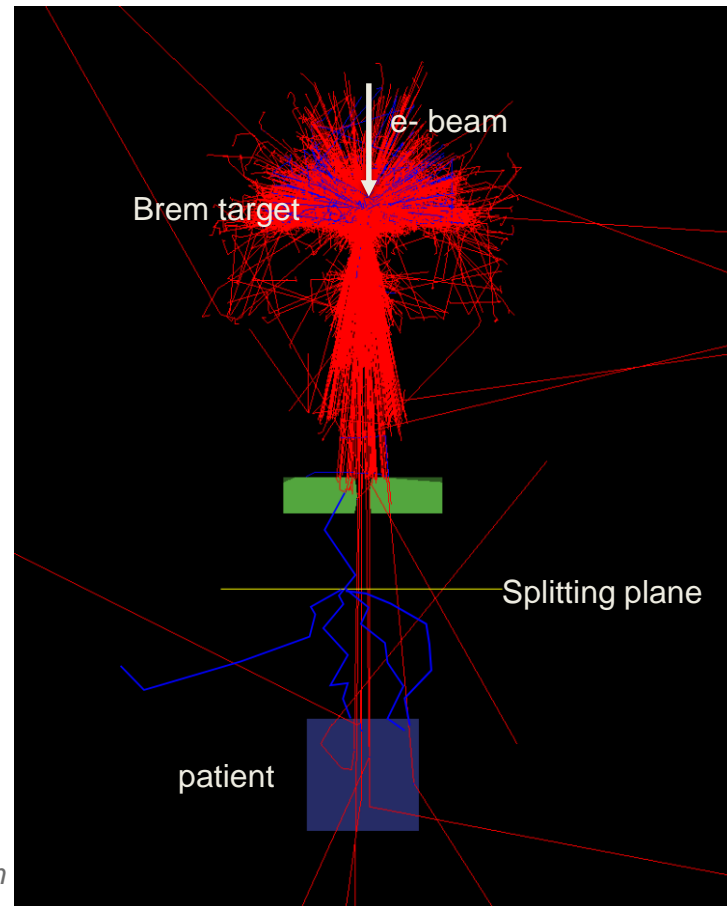
# POTENTIAL SOLUTION

Solution:

Split the RR survivors at a plane upstream of patient.

Scattering in air distributes dose

(EGSnrc/BEAMnrc solution)



*Fat electron is an illustration*

# IMPORTANCE SPLITTING FOR $>1$ PARTICLE TYPE

- Simulation time dominated by photon stepping in patient
- 2 HyperNews requests:
  - biasing and scoring #197 and followup
- BEAMnrc/EGSnrc implementation/results described in:
  - I Kawrakow, DWO Rogers, BRB Walters, Med. Phys. 31, 2883 (2004)