Efficiency considerations for Upgrade/Gen2 photon propagation

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Context

- Aside from solving the correct representation of all modules in simulation,
  we also have to address that this will results in overhead for heterogeneous sensors

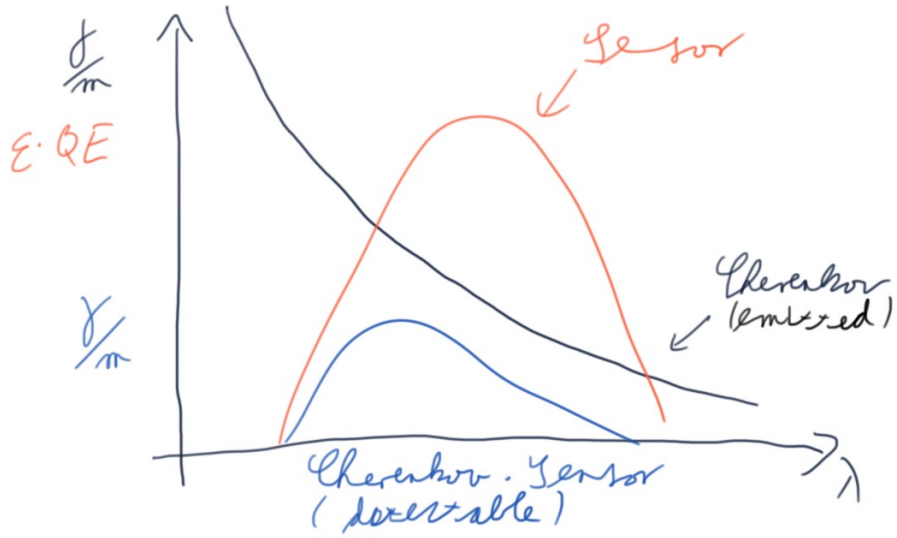
- Here only describing the difference in wavelength acceptance between WOM and LOM,
  as this is probably the most striking example

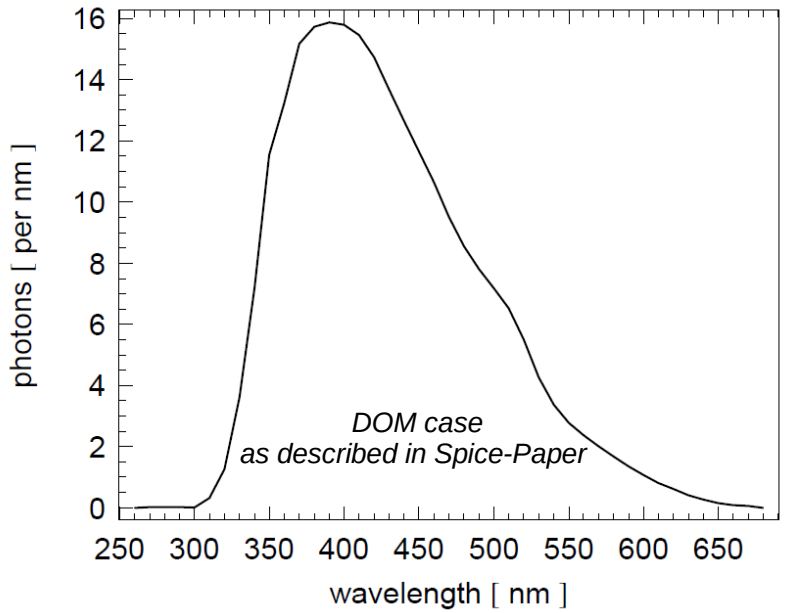
Primar on wavelength sampling

- Simulating the true Frank-Tamm yield, and rejecting to the true DOM efficiency (~10% of pressure vessel are at 400nm (maximum and head-on illumination) is inefficient

- Instead only simulate/inject photons that will get accepted
- Emission and detection are multiplicative
  - → per wavelength only inject the number of photons/meter that results from the product of Frank-Thamm & sensor (reduced by the ratio of geometric & effective area)
  - For the DOM ~2450 photons per meter

- No further rejection sampling needed





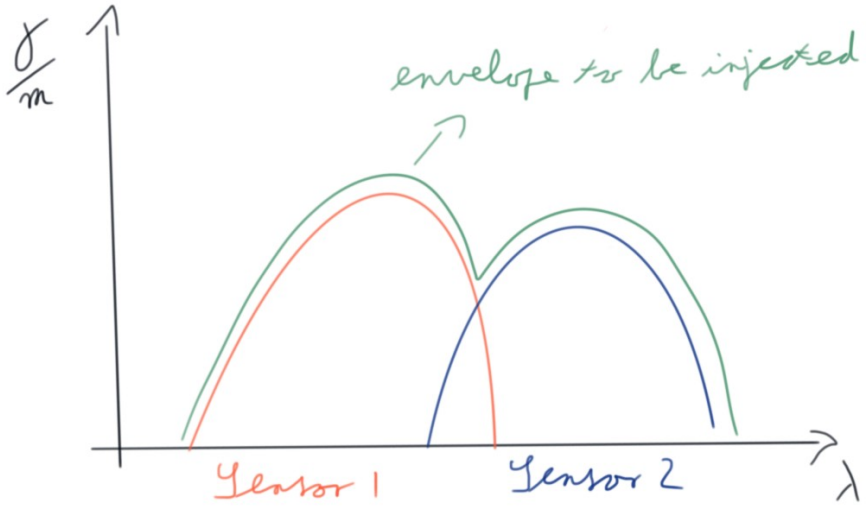
Simulating different wavelength sensitivities

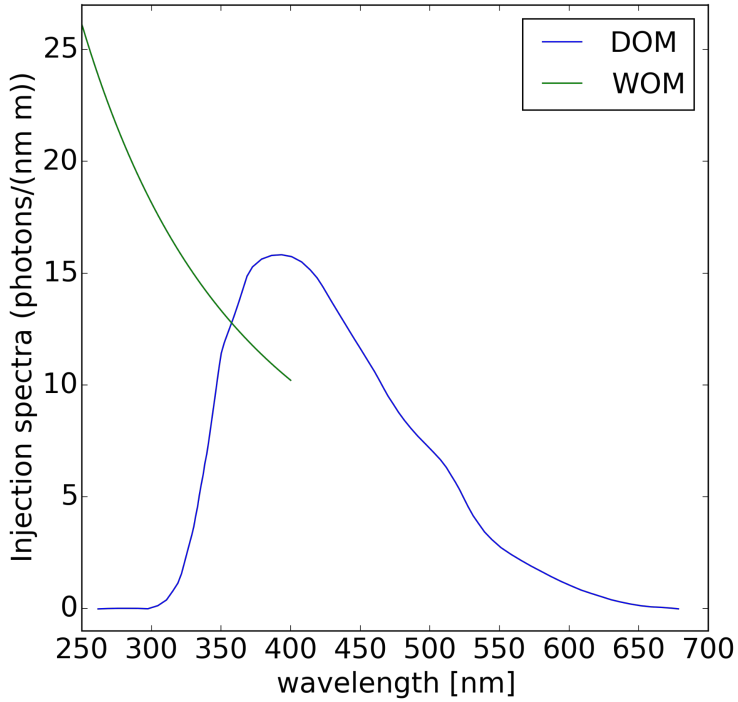
- When simulating multiple OM types the envelope of injection spectra (maximum at each wavelength) has to be injected into the photon propagation

- At each OM a rejection sampling according to sensor_i / envelope has to be performed so to de-weight wavelength this sensor is not sensitive to

- Assumptions for WOM:
  - Same overall Cherenkov weighted effective area (so integral)
  - Uniform acceptance between 250 - 400nm
    → injection spectra follows $1/\lambda^2$ Cherenkov

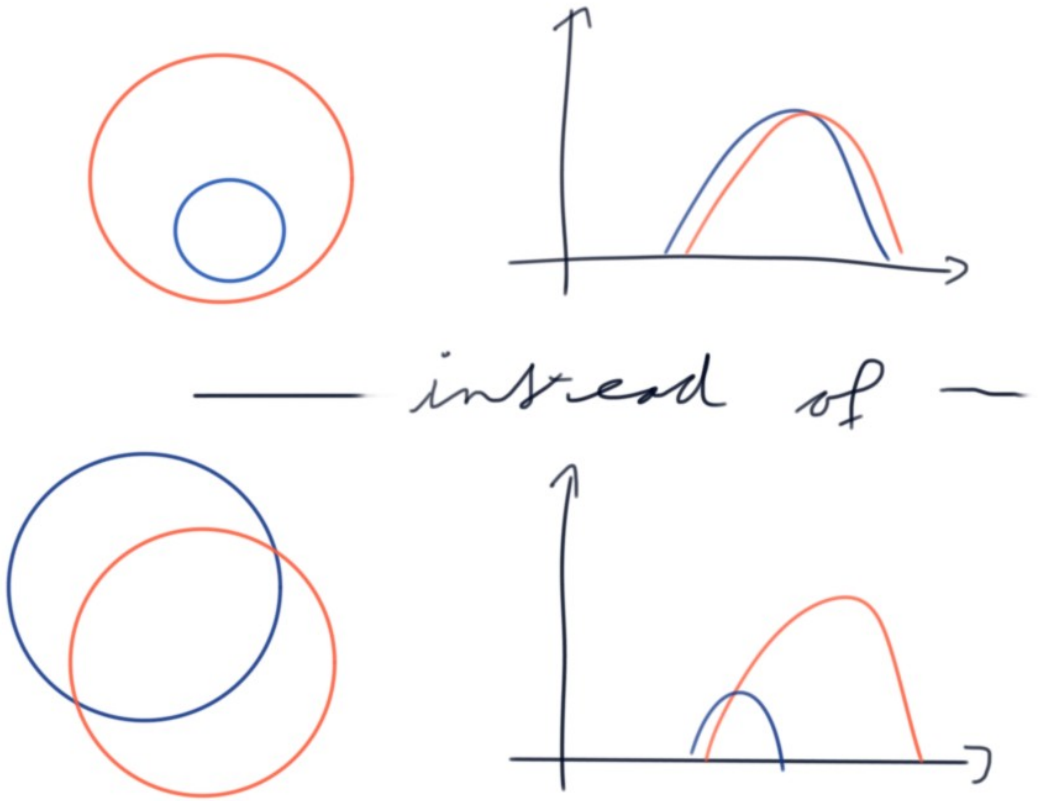
- The envelope contains ~3650 photons/m
  → x1.5 slow-down to simulate 12 modules...





Potential solution?

- As Dima noted earlier the simulated size of the sensor and the integral of the injection spectra can both be used to scale effective area
- So simulate WOM injection spectrum with only let's say 250 photons/m and oversize accordingly
- Caveats being that
  - The WOM simulation becomes less precise
  - Oversizing is limited by sensors starting to overlap each other



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