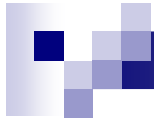


# Fusion by QED Confinement?

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# Purpose

Explain why fusion by irradiating submicron targets in a heavy water spray with compact milli-Joule lasers at LLNL and MBI is easier than with pea-sized targets and large scale mega-joule lasers in proposed ICF reactors.

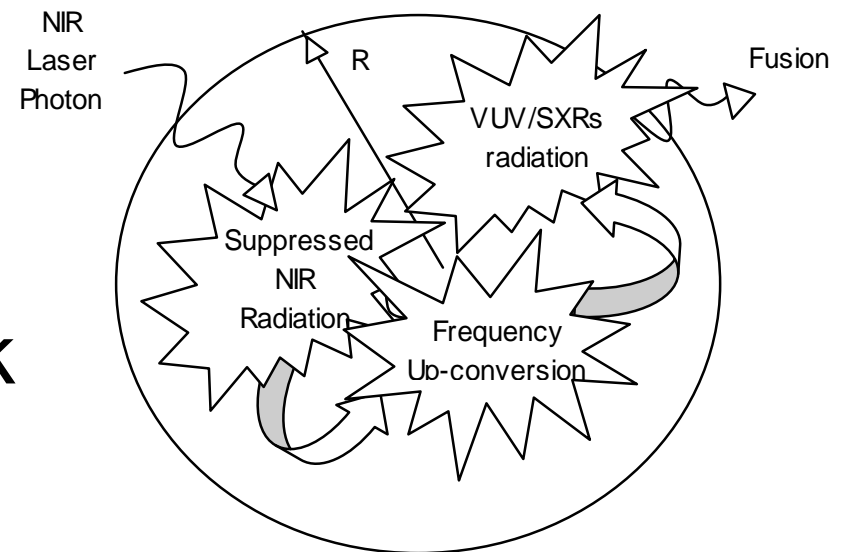


# Extensions

Consistent with the theme of ICENES 2007, extend the explanation of fusion in submicron targets to the **unthinkable idea** of violating the 2<sup>nd</sup> law by producing light at ambient temperature thereby obviating the need for commercial reactors to produce the electricity that otherwise powers the lighting.

# Physical Principles

- Submicron targets impose VUV and SXR boundary conditions on the absorbed NIR photon to induce frequency up-conversion to high Planck energies.
- In pea-sized targets, the NIR photon is conserved by an increase in temperature.

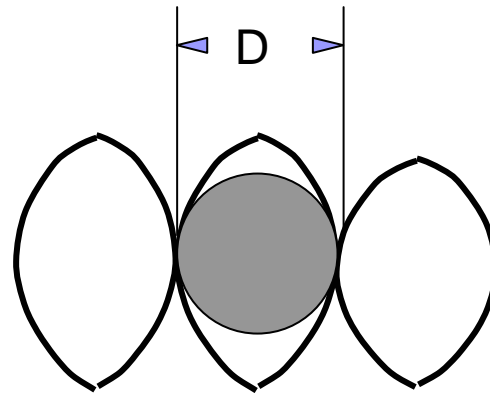




# NIR Photon Absorption

- By Mie theory, submicron targets having diameters far smaller than the NIR photon wavelength fully absorb the NIR radiation.
- Pea-sized targets having diameters larger than the NIR photon wavelength only absorb a fraction of the NIR radiation by surface ablation.

# EM Confinement by Target



EM confinement wavelength:  $\lambda/2 = Dn_r$ ,  $n_r = 1$

EM confinement energy:  $E = hc/2D$

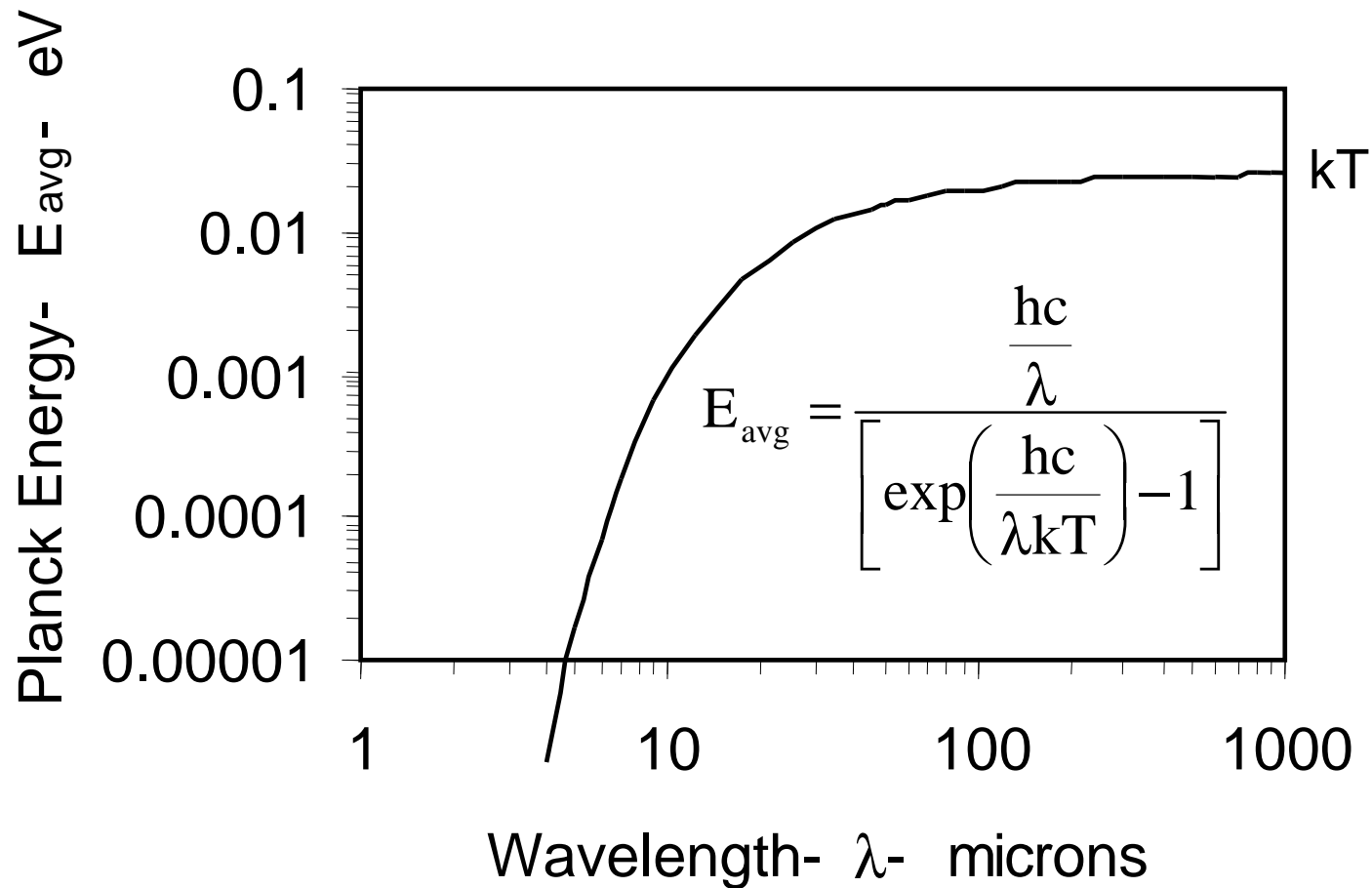
$h$  – Plancks Constant  $c$  – L<sub>1</sub>ght speed



# Specific Heat

- The geometry of pea-sized targets imposes FIR frequencies on the absorbed NIR photon that provide finite specific heat to allow EM energy conservation by an increase in temperature.
- But the submicron target cannot conserve the absorbed NIR photon by an increase in temperature because the specific heat vanishes at the VUV and higher frequencies imposed by the EM confinement by the target.

# Einstein Hopf Harmonic Oscillator at 300 K





# Target as an Einstein Solid

$$U = 3N_A \frac{\frac{hc}{\lambda kT}}{\left[ \exp\left(\frac{hc}{\lambda kT}\right) - 1 \right]}$$

$N_A$  = Number of Atoms in Target

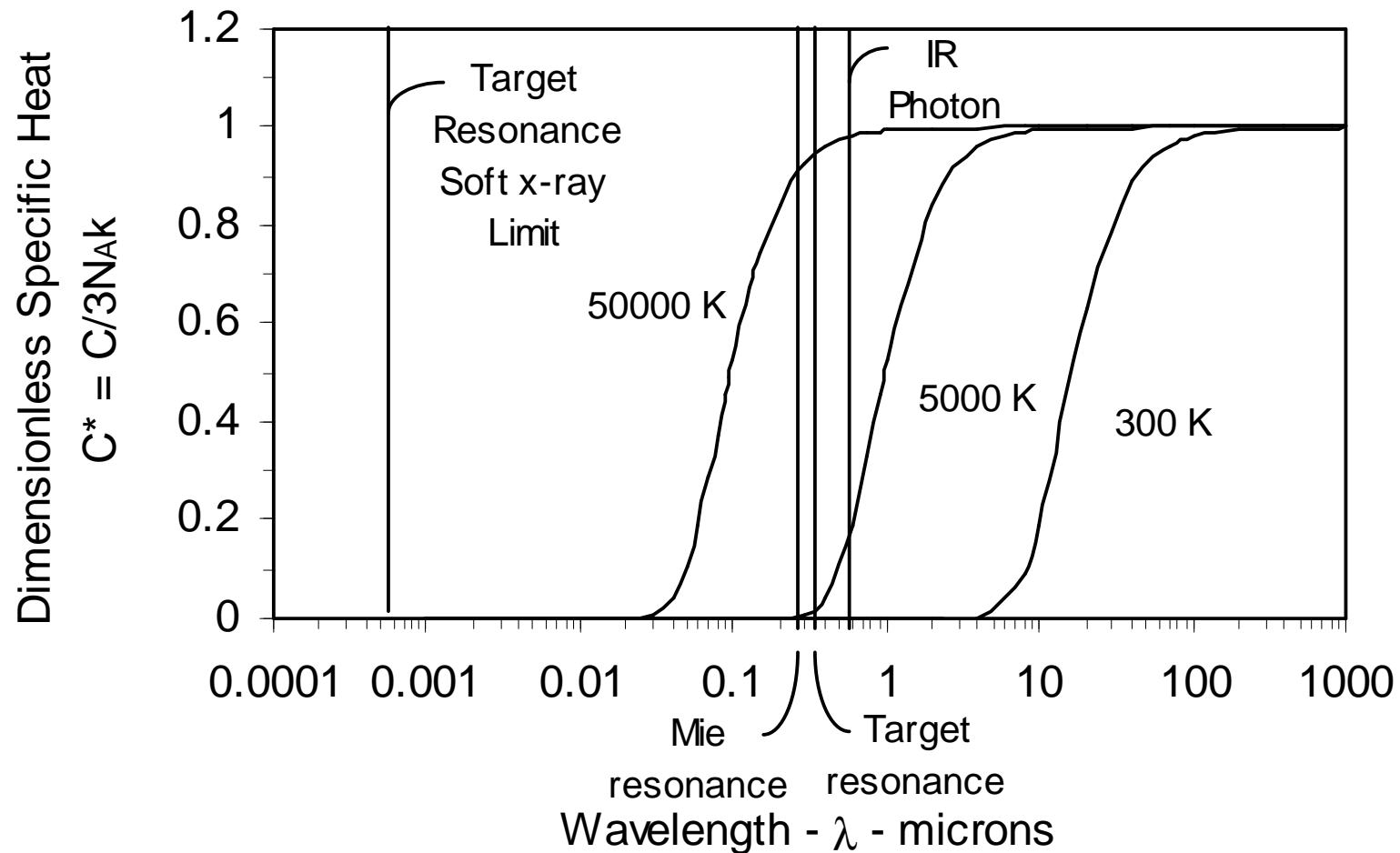
$3N_A$  = Number of Degrees of Freedom

# Einstein Specific Heat

$$C = \frac{\partial(U / n)}{\partial T}$$

$$C^* = \frac{C}{3N_A k} = \frac{\left(\frac{hc}{\lambda kT}\right)^2 \exp\left[\frac{hc}{\lambda kT}\right]}{\left[\exp\left(\frac{hc}{\lambda kT}\right) - 1\right]^2}$$

# Specific Heat and EM Confinement

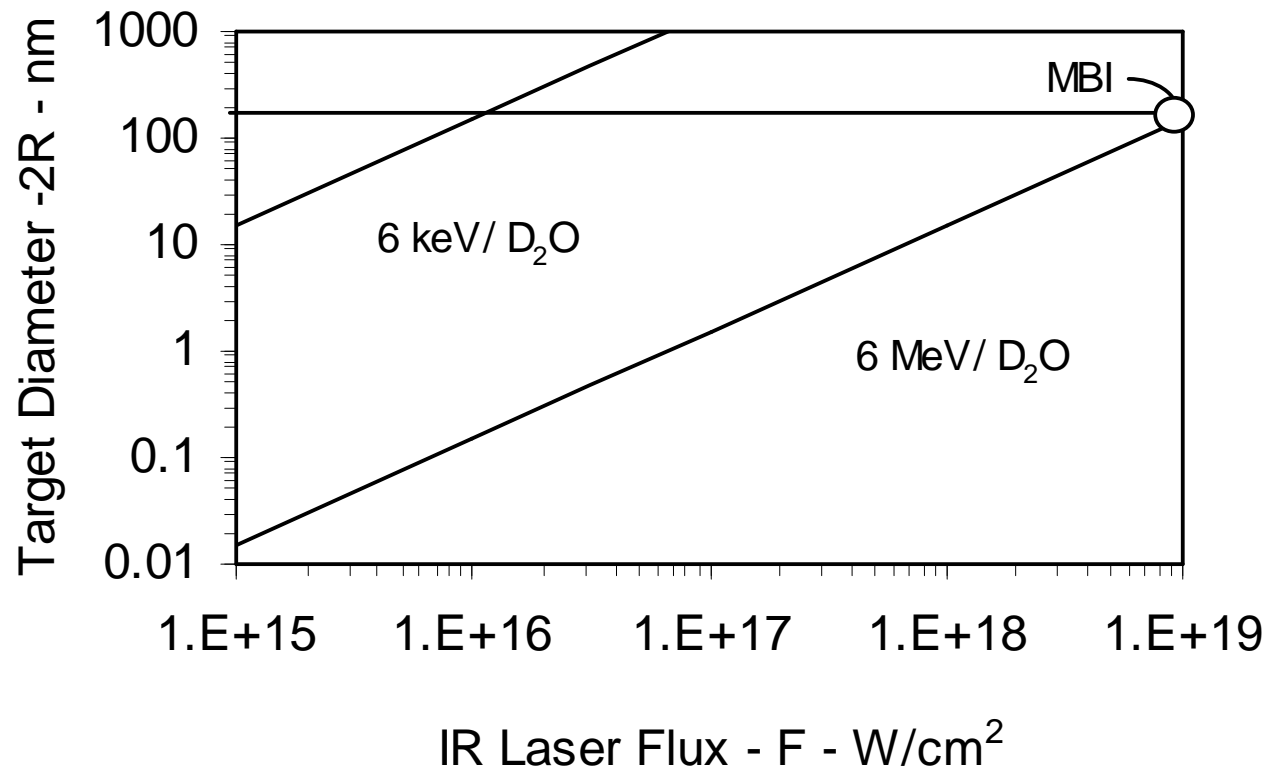
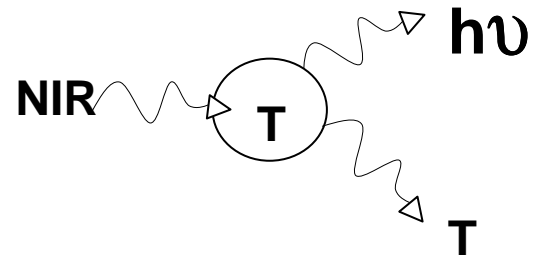




# Fusion Mechanisms

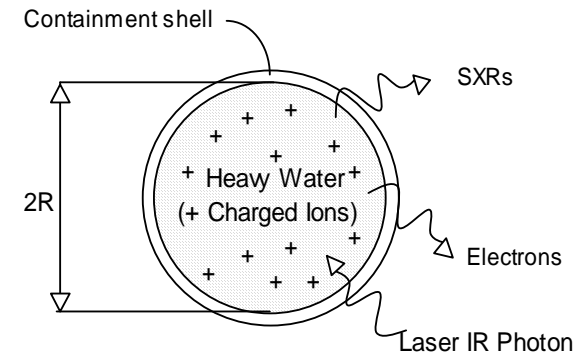
- Fusion in submicron targets is initiated by high Planck energies as the absorption of many NIR photons raises the EM energy to SXR levels of  $\sim 1$  keV.
- In pea-sized targets, fusion is initiated by high temperatures of  $\sim 10$  million degrees equivalent to  $\sim 1$  keV.

# Heavy Water Spray Target



# Target – Containment Shell

- The EM confinement in the 150 nm diameter target produces 4eV photons that accumulate to ionize the heavy water. Electrons escape leaving highly charged Coulomb state.
- The containment shell remains intact at ambient temperature as the Coulomb pressure increases. A 10 nm SiC shell allows pressures of ~ 7000 bar before fracture.



$$P = 2 \frac{t_w}{R} \sigma_P$$



# Conclusions

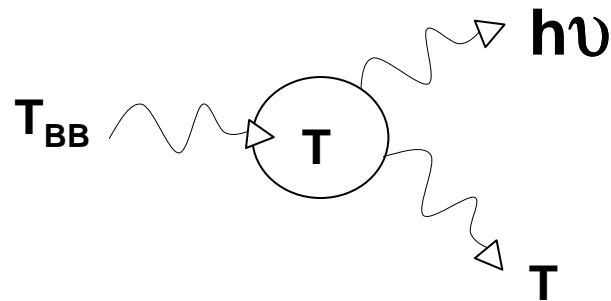
- Fusion by high Planck energy with submicron targets far easier to achieve than by high temperature in pea-sized targets.
- Containment shells in submicron heavy water targets allow fusion at low NIR laser flux intensity compared to a heavy water spray.



# Extensions

- Replace ICF reactor heavy water targets with submicron targets of light water doped with Rhodamine or Luminol
- Irradiate with BB radiation from ambient to produce artificial lighting.

# Ambient Light Source



Stefan-  
Boltzmann

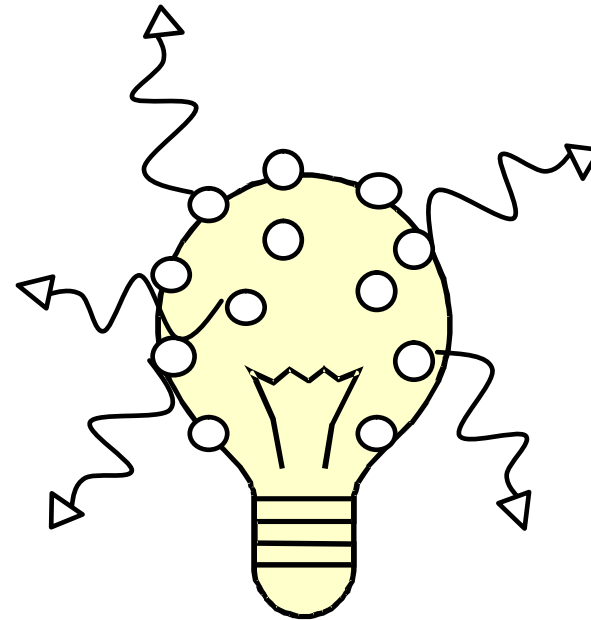
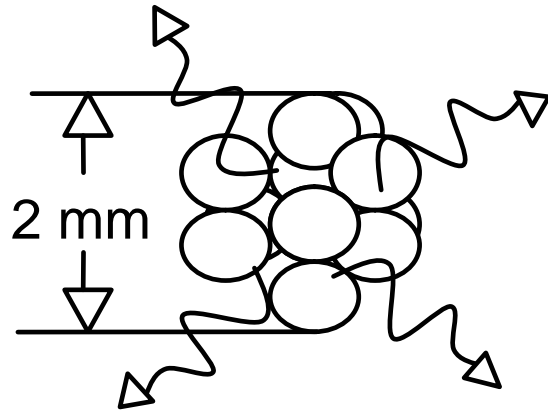
$$Q = \sigma A (T_{BB}^4 - T^4) = E \frac{dN}{dt}$$

Zero Specific Heat  $\rightarrow T \rightarrow 0$

$$\frac{dN}{dt} = \frac{Q}{E} = \frac{2\pi\sigma T_{BB}^4 D^3}{hc}$$

# Artificial Lighting

Compact 100 W Light  
Bulb



Light Bulb Coating

# Interstellar Medium (ISM)

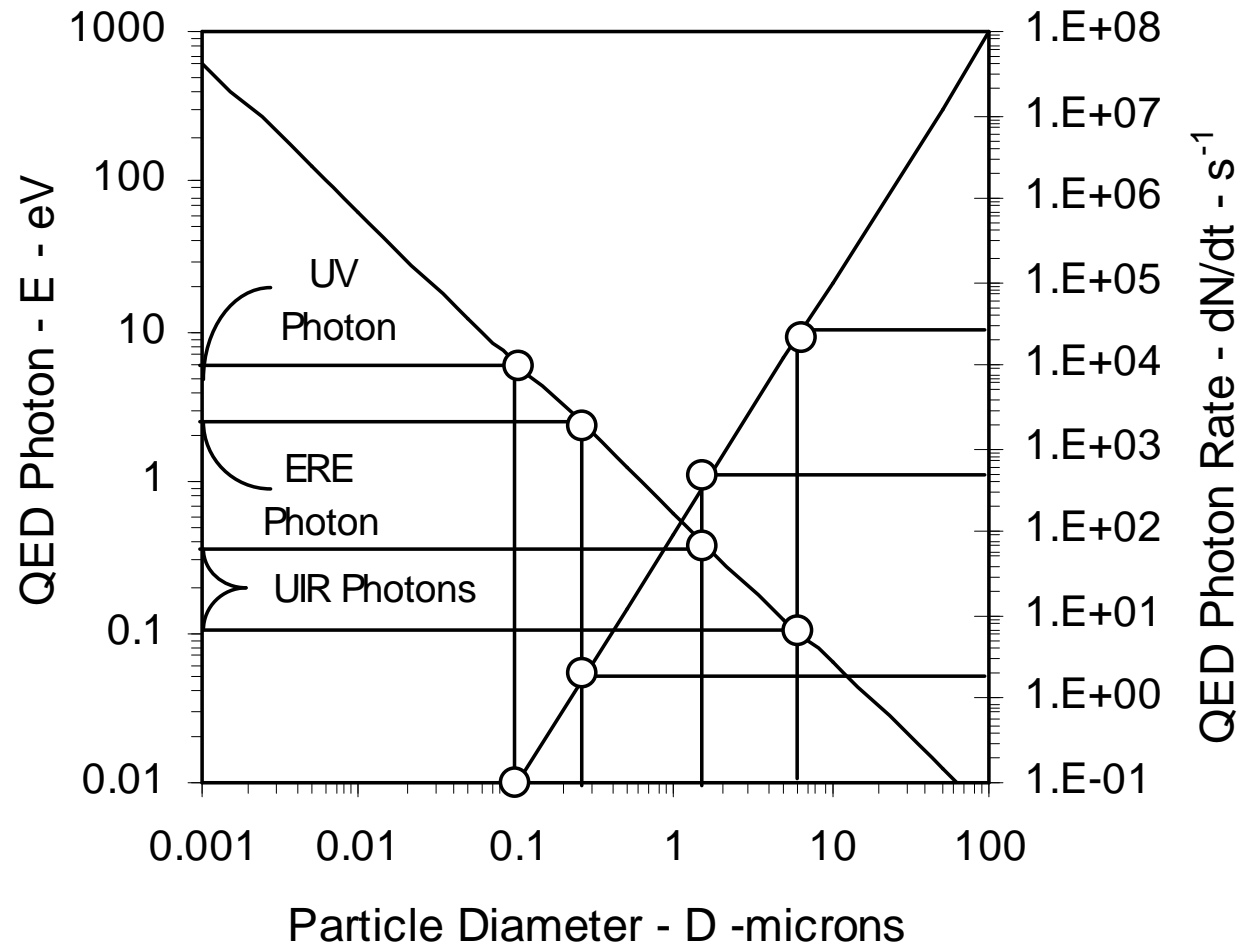




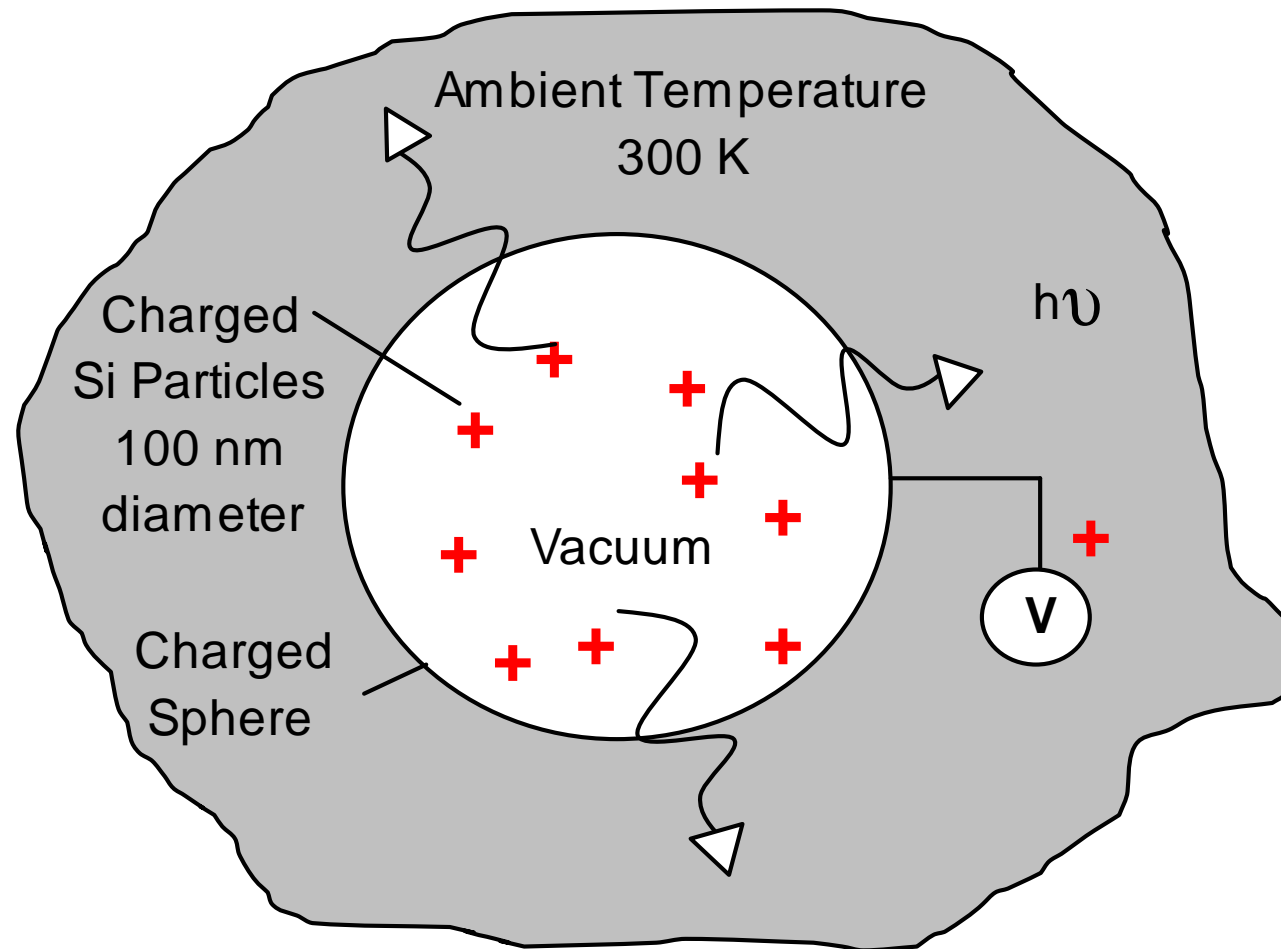
# ISM Light Hypothesis

The VIS light is produced from submicron dust irradiated with BB radiation from the surroundings at 2.7 K?

# ISM Spectrum from BB Radiation at 2.7K



# Earth Lights from Ambient BB Radiation?





# Conclusions

- Prospects for producing light from the ambient with submicron targets of light water doped with Luminol and Rhodamine.
- ISM light driven by BB radiation at 2.7 K suggests that evacuated glass shells with 100 nm Si particles charged to avoid agglomeration should produce a red light.