Abstract Submitted
for the TSS15 Meeting of
The American Physical Society

Solar peak color in human eye[1] LIANXI MA, Blinn College — There are two forms of Wien's displacement law that can be derived from Planck's equation. They are: $\lambda_m T =$ constant (1) and $\frac{f_m}{T} =$ constant- (2) Suppose that we have known a black body's temperature, then λ_m and f_m can be obtained from Eqs. (1) and (2). For example, the Sun's surface temperature, $T = 5778$ K, then according to Eq. (1) $\lambda_\mathrm{m} = 500$ nm which is green; but according to Eq. (2) $f_\mathrm{m} = 3.40 \times 10^{14}$ Hz which is near-infrared. While the inequality $\lambda_m f_m \neq c$ can be explained mathematically by substituting $\lambda f = c$ into Planck's radiation function, the question lingers: what color of sun light "really" peaks in human eye? The answer is that Planck's function, or Wien's law, can't answer this question. Planck's function, $I(\lambda)$, or $I(f)$, is the radiation intensity per $d\lambda$ (meter) or df (Hz) and, $d\lambda$ and df don't have same interval. For a spectrometer, it peaks at green if λ changes evenly; peaks at near-infrared if f changes evenly. For human eye, its peak's location depends on $I(\lambda)$, or $I(f)$, and, how much each type of cone is excited. We can naively represent any color as a triplet of numbers: (red, green, blue), where each is the degree to which the associated type of cone is excited. Then red $= \int d\lambda I(\lambda) S_r(\lambda) = \int df I(f) S_r(f)$ -(3) where $S_r(\lambda)/S_r(\lambda)$ is the sensibility of red cone. For green and blue we have same equations. Then the peak is determined by the value of integral.

[1]Thanks to D. Goldhaber-Gordon, and D. Zimmerman

Lianxi Ma
Blinn College

Date submitted: 06 Feb 2015 Electronic form version 1.4