Lunar and Planetary Laboratory
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Memorandum

Subject: **Signal Computations for Modelling the Plasmasphere**	
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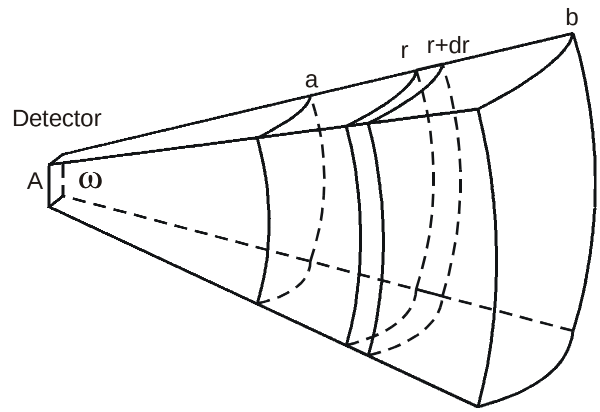
Consider a detector of area A that accepts radiation from a solid angle ω. The detector views a volume containing He^+ ions that extends from $r=a$ to $r=b$ and the number density of emitters $n(r)$ depends on the distance r from the detector to the source. We suppose that the number density is uniform in the planes perpendicular to the line of sight. The emission rate for a single ion is g. Then the emission rate for all ions in the region between r and $r+dr$ is



$$E(r) = g\, n(r)\, \omega\, r^2 dr \,. \tag{1}$$

For isotropic scattering, the probability that a photon emitted by an ion at distance r will reach the detector is

$$p = \frac{A}{4\pi\, r^2} \,. \tag{2}$$

The rate at which photons from the region between r and $r+dr$ reach the detector is

$$D(r) = pE(r) \;, \tag{3}$$

or, using (1) and (2),

$$D(r) = \frac{A\omega}{4\pi}\, g\, n(r)\, dr. \tag{4}$$

The rate at which the detector receives photons from the entire emitting volume is

$$D_T = \int_a^b D(r)\, dr = \frac{A\omega}{4\pi}\, g \int_a^b n(r)\, dr = \frac{A\omega}{4\pi}\, g\, L \tag{5}$$

where L is the line integral of the ion number density along the line of sight. Thus gL represents a surface brightness defined in the same way as the Rayleigh. An important implication of Equation (5) for using a model He^+ distribution to compute the signal seen by EUV is that one need compute only the column density along the line of sight for each pixel. No explicit integration over the entire volume defined by the solid angle of acceptance ω is necessary.