QUIZ 4
ECE 816: Spring quarter 2009

A vertically polarized plane wave is incident from free space upon a perfectly conducting rough surface. The plane wave is incident at polar angle θ_i, and the scattered field is observed at polar angles θ_s, ϕ_s. It is known that the surface spectrum $W(p,q)$ vanishes at the origin, i.e. $W(p=0,q=0)=0$. The first order SPM is to be used in this problem.

a) For $\theta_i = 30^\circ$, give a numerical value for σ_{vv} and σ_{hv} in the forward scattering ($\theta_s = \theta_i,\ \phi_s = 0^\circ$) direction.

Forward scattering: $\theta_s = \theta_i, \phi_s = 0^\circ \rightarrow p = q = 0$,
$\sigma_{\mathbf{vv}}(\theta_\mathbf{i}, \theta_\mathbf{s} = \theta_\mathbf{i}, \phi_\mathbf{s} = \mathbf{0}^\circ) = \sigma_{\mathbf{hv}}(\theta_\mathbf{i}, \theta_\mathbf{s} = \theta_\mathbf{i}, \phi_\mathbf{s} = \mathbf{0}^\circ) = \mathbf{0}$

b) For $\theta_i = 45^\circ$, find a set of scattering angles (θ_s, ϕ_s) where σ_{vv} vanishes.

First order SPM:

$$\sigma_{vv} = 4\pi k^4 (\sin\theta_i \sin\theta_s - \cos\phi_s)^2 W(p,q)$$

To obtain $\sigma_{vv} = 0$, we need $\sin\theta_i \sin\theta_s - \cos\phi_s = 0$. Thus, for $\theta_i = 45^\circ$,

$$\cos\phi_s = \frac{1}{\sqrt{2}} \sin\theta_s$$

or $\sin\theta_s = \sqrt{2}\cos\phi_s$. σ_{vv} would also vanish in the specular direction $\theta_s = 45^\circ$, $\phi_s = 0$.