Axial Backscattering from a Wide Angular Sector

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In testing the physical-optics (PO) approximation for axial backscattering from cones it has been observed that for a circular perfectly conducting cone the PO result is quite good, at least asymptotically for small (near zero) and wide (near $\pi/2$) cone angles. [C. E. Baum, "The Physical Optics Approximation and Early-Time Scattering," Interaction Note 563, October 2000] [J. J. Bowman, T. B. A. Senior, and P. L. E. Uslenghi, *Electromagnetic and Acoustic Scattering by Simple Shapes,* Hemisphere Publishing (Taylor & Francis), 1987]. However, for noncircular cones the disagreement can be large as shown for the thin angular sector (perfectly conducting), and more generally for the thin elliptic cone (perfectly conducting) [C. E. Baum, "Axial Scattering from Thin Cones," Interaction Note 565, November 2000]. The present paper (using a completely different technique) considers the wide angular sector for ψ near $\pi/2$ (ψ' near 0). The angular sector lies on the xz plane (y=0) with the z axis as the sector bisector (symmetry axis).

The solution here has some interesting properties. It is proportionality to $\cot(\psi')$. This can be contrasted to the $\cot^2(\psi')$ dependence for the wide circular cone. The difference between these two can be ascribed to the fact that the angular sector has an integral over the surface current density using only one transverse coordinate, while the circular cone has an integral over two transverse coordinates. As an alternate view consider that for $\psi' \to 0$ the angular sector tends to a half plane which scatters field proportional to $r^{-1/2}$ while the circular cone tends to a plane which scatters field proportional to r^0 (which requires a more singular behavior of the r^{-1} term as $\psi' \to 0$).

So now we have solutions for the axial backscattering from both thin and wide perfectly conducting angular sectors. This leaves the intermediate angles ψ to be solved. There exists a solution in terms of an infinite series of eigenfunctions. However, this does not give simple analytic insights. Further development of "exact" analytical and numerical results would be helpful.