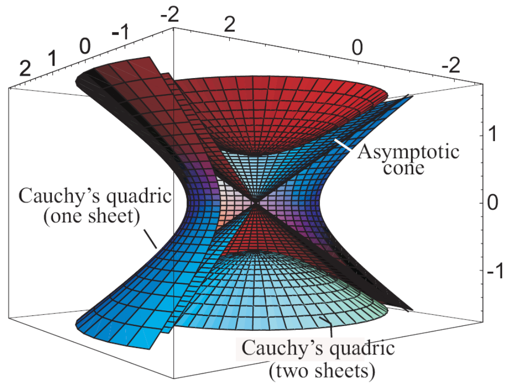

Figure 3. Cauchy's quadric for an *indefinite dielectric media*, where eigenvalues of $\tilde{\varepsilon}$ are not all the same sign. The quadric consists of a two-sheeted hyperboloid and an one-sheeted one. Asymptotic cone, that divides the space into two regions, is also shown.

$\overline{u}_1$ axis, respectively, it is easily shown that:

$$\tan\psi = -\frac{|\varepsilon_3|}{\varepsilon_1}\tan\phi \tag{16}$$

Our proposed alternative method attains the same result (16), by using Cauchy's quadric section given by:

$$\varepsilon_1\, x_1^2 - |\varepsilon_3|\, x_3^2 = -1$$

3. RAY TRACING IN RHM AND LHM INDEFINITE MEDIA WITH DIELECTRIC ANISOTROPY

In [22], it was shown that in uniaxial right-handed media, vector $\overline{\varepsilon_n}$ is collinear with the extraordinary ray direction.

In uniaxial left-handed media, $\overline{\varepsilon_n}$ also lies in the same plane that $\overline{\nu}$, $\overline{\varepsilon_\nu}$ and $\overline{n}$. Since the angle between $\overline{E}$ and $\overline{D}$ is the same as the angle between $\overline{t}$ and $\overline{n}$ and Cauchy's theorem [22] states that $\overline{\varepsilon_n}\cdot\overline{\nu}$ $(=\overline{n}\cdot\overline{\varepsilon_\nu})$ also vanishes, vector $\overline{\varepsilon_n}$ is collinear with $\overline{t}$, but may be antiparallel.

Our method is applied to four media with dielectric anisotropy and magnetic isotropy [4] with the following material parameters:

This kind of media are named *indefinite* because the eigenvalues of their permittivity tensors are not all the same sign.

Figure 3 shows the plot of the two shells (double-sheeted and one-sheeted hyperboloids) of Cauchy's quadric for dielectric parameters of