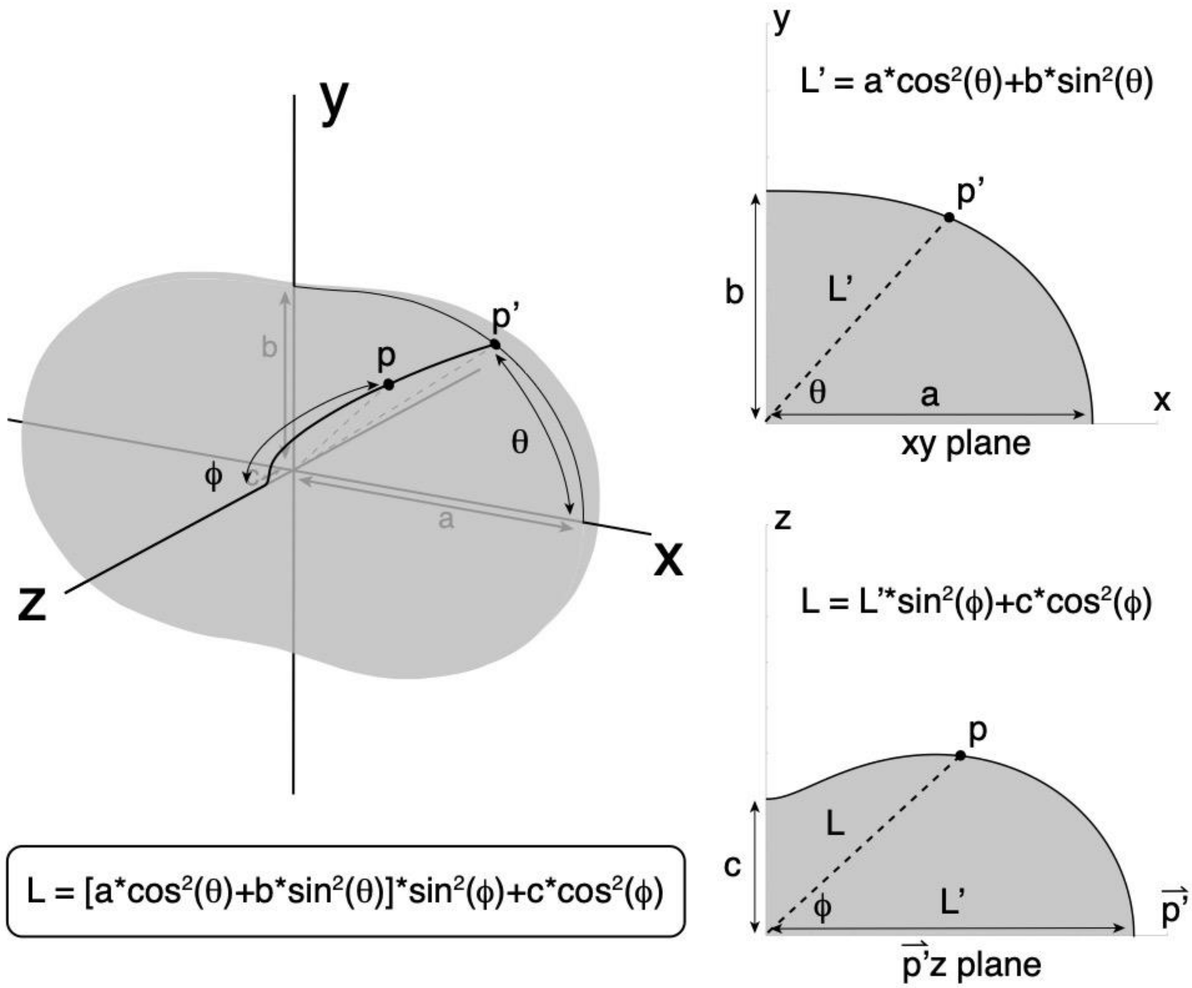
Appendix 1



Geometric derivation of the absorption indicatrix

For a shape that varies as a function of $\cos^2\theta$ from one axis to another, a segment from the origin to a point on the surface p will have a length L equal to $a*\cos^2\theta + b*\sin^2\theta$ in 2D, where a and b are the characteristic lengths in the section, and θ is the angle from the direction of a (x axis) towards the direction of b (y axis) for the segment p.

To retain this relationship in 3D, the length of a segment from the origin to any point on the surface of the absorption indicatrix can be related to the characteristic lengths, a, b, c, their respective directions x, y, z, and polar angles θ (azimuth), and ϕ (zenith). The zenith ϕ is the angle between a vector and the z axis and the azimuth θ is the angle of the orthogonal projection of the vector from the x axis. For an arbitrary point p on the surface of the indicatrix, the projection of p to the xy plane gives p', a point with the same θ as p, but with a ϕ of 90˚. The xy-plane gives the length of L' as L' = $a*\cos^2\theta+\sin^2\theta$. Again, to retain the $\cos^2$ relationship, the length of L in the section containing the direction of L' and z will be L = $L'*\sin^2\phi + c*\cos^2\phi$. Therefore, substituting $a*\cos^2\theta+\sin^2\theta$ for L', the length of L (or absorption magnitude) in polar form is $L = [a*\cos^2\theta+b*\sin^2\theta]*\sin^2\phi+c*\cos^2\phi$.

See also two video files displaying many graphs in sequence.