Experimental Lens Design Parameters for Electromagnetic Implosion

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Early papers discussed addition of a dielectric lens before the second focal point of a prolate-spheroidal IRA to obtain better focusing [S. Altunc and C. E. Baum, "Lens Design for a Prolate Spheroidal IRA", Sensor and Simulation Note 525, Oct 2007]. In this paper, a log-periodic lens design procedure is presented and the attenuation (or loss tangent) of a propagating wave through a multiple layer dielectric lens is calculated. The attenuations for different dielectric materials, and the use of two substitute materials instead of using just one material for a dielectric lens design of a prolate-spheroidal IRA are discussed. Since our lens experiments are still under construction, we performed some initial experiments to obtain more information about the loss, dispersion and focusing characteristics of the electromagnetic-implosion lens.

The attenuation (or loss tangent) of a propagating wave through a 10 layer dielectric lens, for a given loss tangent value $\tan(\delta) < 10^{-3}$, is calculated. The total loss is acceptable at 1 GHz. The loss factors can be calculated at 10 GHz and, they are just 10 times of the loss values at 1 GHz. Therefore, they also are in the acceptable range.

We also discuss using two substitute materials for a two stage lens layer instead of using just one material. In this case, we do not have a log-periodic lens but it may be more practical for fabrication purposes and we will be flexible about the materials that can be used. We obtain better focusing because we shall have a more continuous increasing dielectric lens. While fabricating a log-periodic lens one should consider is how precise a material one can find that has the exact dielectric constant desired. In our case we'll have 10% differences for each layer. Therefore, we come up with a new idea ,i.e., using two materials instead of using just one material for a single layer of a dielectric lens.