

Wavization, Gaussian Beams and Caustic Avoidance

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Abstract:

Geometric optics limit is known to be a good-enough approximation for the calculation of distances and image distortions in the Universe. However, this approximation fails at caustics. In this talk, I will first outline the analogies between the paraxial ray optics of the Newtonian theory and the thin bundles in general relativity. I will then propose a method adopted from the paraxial wave optics in order to study the wave-like effects of light propagation in general relativity. This method is sometimes referred to as "wavization" due to its resemblance to some semi-classical quantization techniques. The idea is to use certain phase space methods to superpose two bundles initiated from a small yet finite size source. With this, we will explore the possibility of obtaining inhomogeneous intensity profiles on the transverse plane associated with the fundamental Gaussian mode. We will see that caustics can be avoided with this method which has important consequences in distance estimations in cosmology. In addition, the extended source effect can be studied on any curved background on account of Gaussian beam decomposition techniques.