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From Quarks to Cosmos

Strong Lensing of a Regular Black Hole with an Electrodynamics Source

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Abstract: We investigate gravitational lensing phenomenon in the strong field regime for a regular, charged, static black hole with non-linear electrodynamics source. We aim to obtain the angle of deflection and graphically study the relativistic image positions and magnifications; and compare our results with a Schwarzschild black hole and Reissner Nordström black hole with similar properties.

Gravitational Lensing of a spherically symmetric regular BH in GR coupled to nonlinear electrodynamics

Line Element:

$$ds^2 = -f(r)dt^2 + \frac{1}{f(r)}dr^2 + r^2(d\theta^2 + \sin^2\theta d\phi)$$

$\mathbf{f(r) = 1 - \frac{2M}{r}\exp\left(\frac{-q^2}{2Mr}\right)}$ [a]; and q denotes the electric charge.

[a] Balart et.al., Phys. Rev. D 90, 124045, (2014)

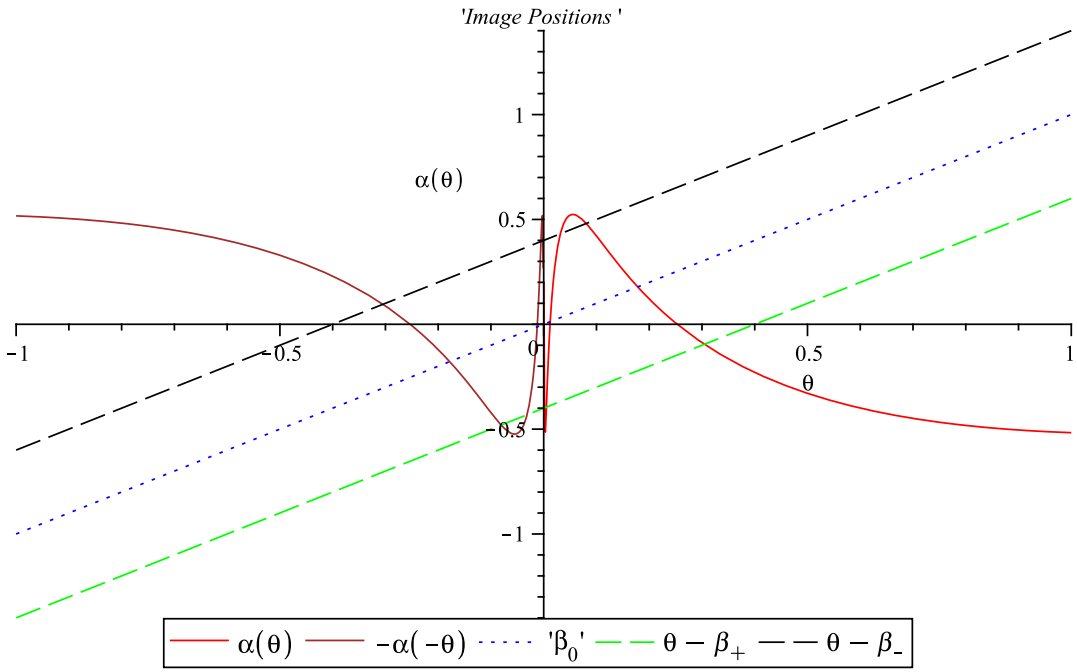
Angle of deflection

$\alpha(\theta) = -\overline{a}\log\left(\frac{\theta D_{ol}}{u_m} - 1\right) + \overline{b}$; where $\theta = u/D_{ol}$ is angular separation of image from lens. [a] .

[a] Bozza, Phys. Rev. D 66, 103001 (2002)

Right:

The angle of deflection $\alpha(\theta)$ with 2 concentric Einstein rings(TCC) on each side of reference axis. β the angular separation between the tangent to the null geodesic at the true source position and the reference axis.



The radial and tangential magnification.