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# Effect of the spatial curvature on light bending and time delay in a curved Einstein-Straus–de Sitter spacetime

A method of general applicability has been developed, whereby the null geodesic equations of the Einstein-Straus-de Sitter metric can be integrated simultaneously in terms of the curvature constant k. The purpose is to generalize the computation of light deflection and time delay by a spherical mass distribution. Assuming a flat Universe with most recent measurements of the Hubble constant $H_0$ and the cosmological constant $\Lambda$, five time delays between four bright images of the lensed quasar SDSS J1004+4112 have been forecasted and compared to others in the field, Δt_{DC}=(3250±64)days (8.90yr ), Δt_{DA}=$2049_{-58}^{+59}$days (5.61yr ), Δt_{AC}=(1269±77)days (3.47yr ), Δt_{BC}=$1176_{-77}^{+78}$days (3.22yr ), and Δt_{AB}=(93±70)days . This set of time delays constrains the galaxy cluster mass to be M=(2.447±0.73)·$10^{13}$M_{⊠}. In addition, I have reviewed the question of the possible contribution of a positive Λ to reduce the light bending and concluded that the changes are seemingly too small to be appreciable on cosmological scale. The same conclusion has been reached regarding the time delay. Having addressed the question of the effect of spatial curvature in both closed and open Universe, I have found that the strong lensing is slightly affected by the expected small curvature density Ω_{k0} of the current Universe within its error bar |Ω_{k0}|⊜0.001, in such a way that it may safely be neglected. However, it's only if Ω_{k0} gets quite larger that the effect being noticeable. While it is only theoretically possible for Ω_{k0} to be higher, it's worthwhile to stress that this should impact the light bending and time delay, causing them to decrease or increase depending upon whether the spatial curvature is positive or negative. Furthermore, one can infer that the observed light deflection and time delay independently, which are found to be significantly deviated from from those of the flat Universe, may serve as a useful means to provide constraints on Ω_{k0}, thus making the approach employed in this work more promising than others.

## Secondary track

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