

GRAVITATIONAL LENSING

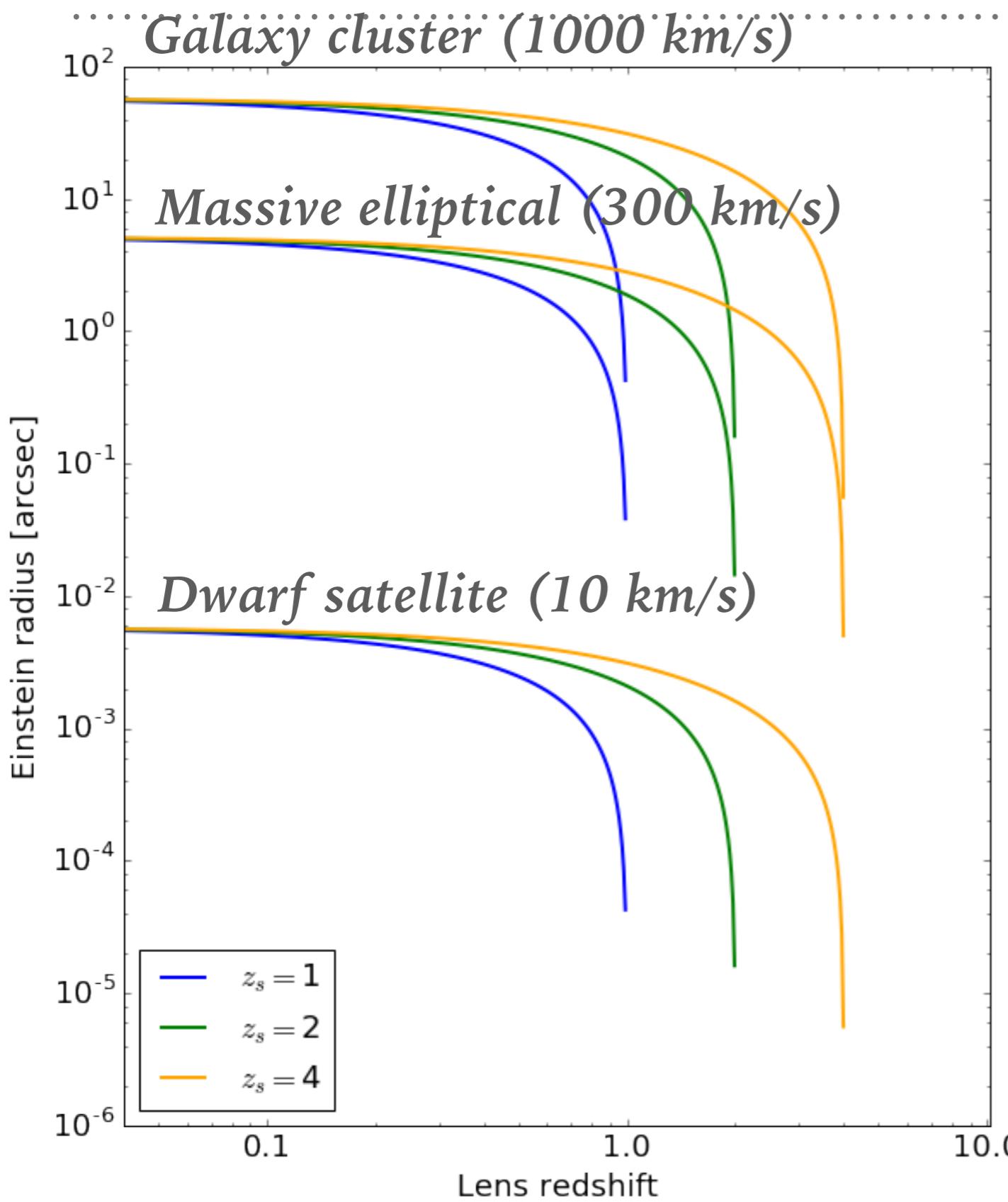
22 - STRONG LENSES

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THE STRONG LENSING REGIME

- Strong lensing is commonly defined as that regime of lensing by galaxies, groups, and clusters which manifests through
 - **the appearance of multiple images:** this implies the existence of critical lines and caustics
 - **large distortions/magnification:** lens mapping is highly non linear in the strong lensing regime! Existence of critical lines and caustics also imply that there are regions of very high magnification.
- To be able to produce critical lines and caustics, **the lens must be compact enough!** A sufficient condition for strong lensing is that the **surface density exceeds the critical surface density somewhere in the lens.**
- Critical lines form where the combination of convergence and shear is of order unity, i.e. in the center of galaxies, groups, or galaxy clusters

THE SIZE OF THE STRONG LENSING REGION



We have seen that strong lensing occurs near the critical lines!

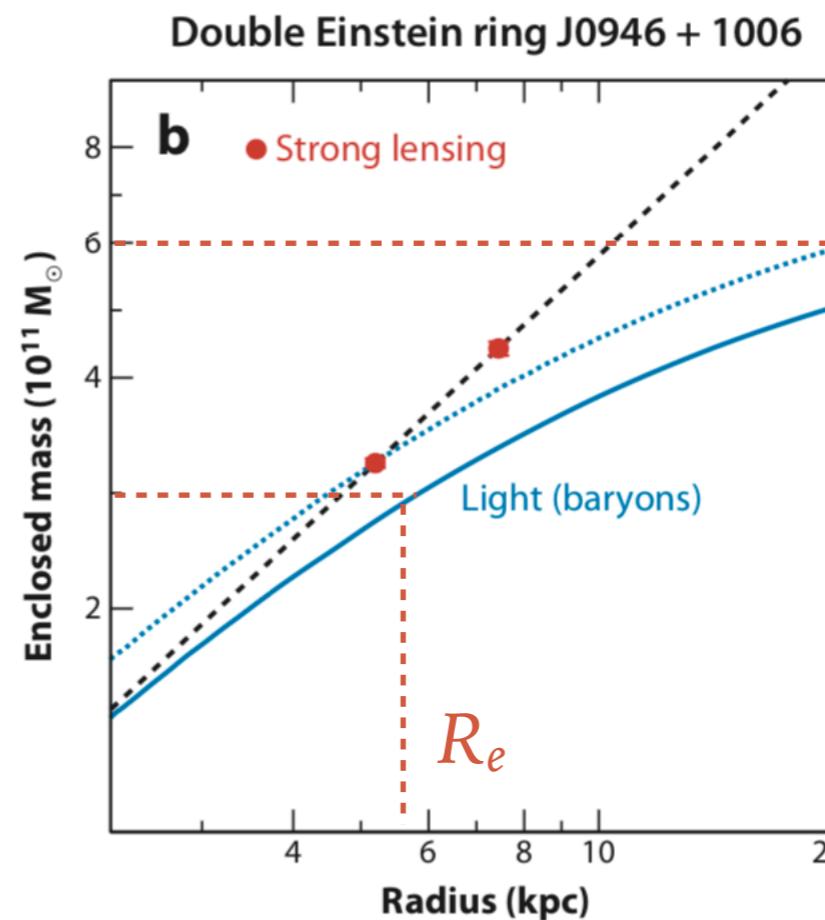
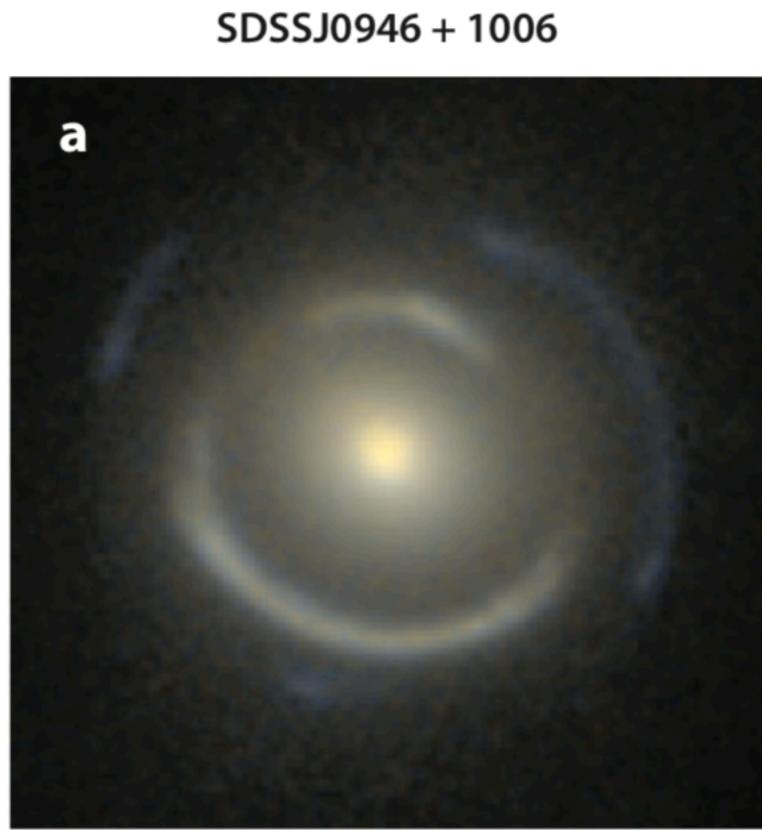
As an order of magnitude the size of the critical lines is given by the size of the Einstein radius:

$$\theta_E = \sqrt{\frac{4GM(\theta_E)}{c^2} \frac{D_{LS}}{D_L D_S}}$$

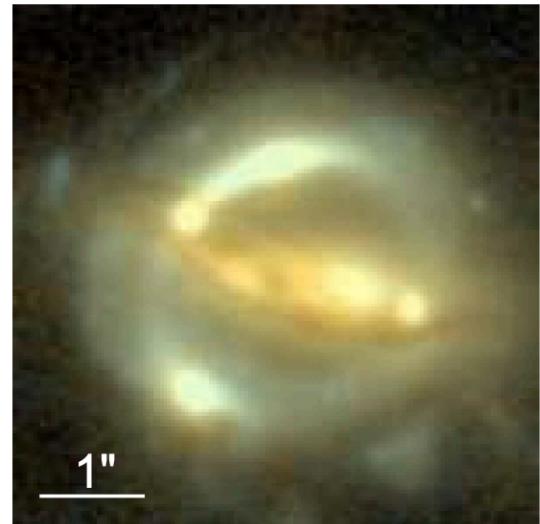
NB: to make the figure, I assumed a SIS model!

SOME EXAMPLES:

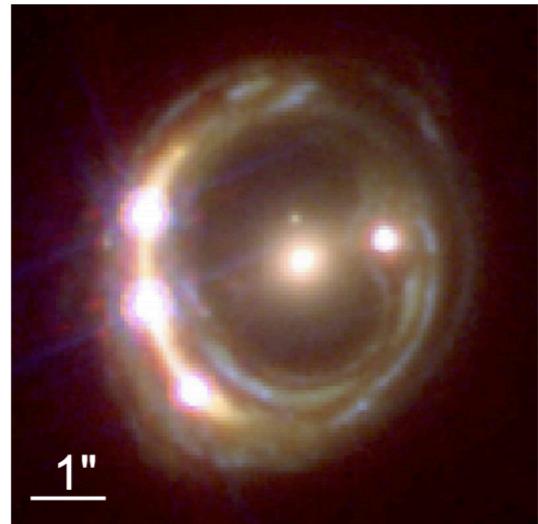
$$\begin{aligned}z_L &= 0.222 \\z_{s1} &= 0.609 \\z_{s2} &\sim 3\end{aligned}$$



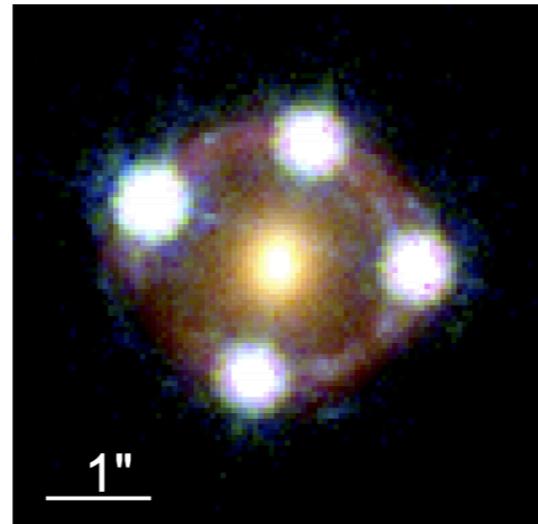
B1608+656



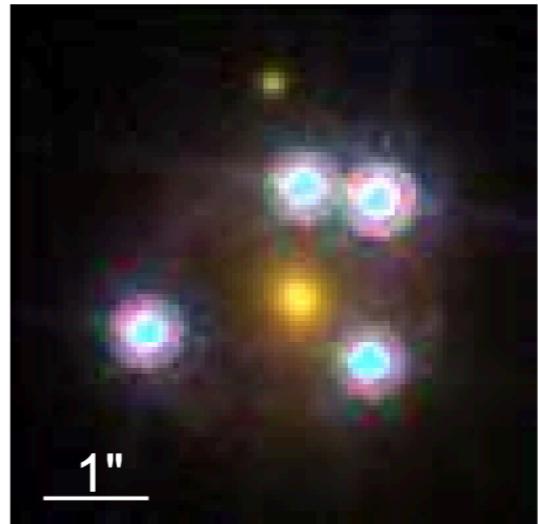
RXJ1131–1231



HE 0435–1223



WFI2033–4723



HE 1104–1805

