Limits on the invisible mass in the inner Galaxy from the microlensing in the thin disk model

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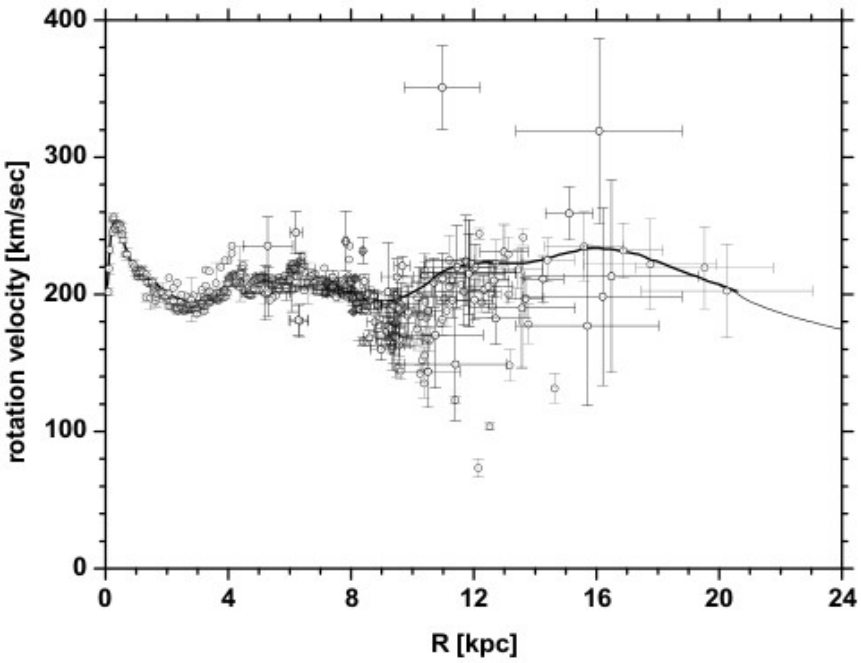
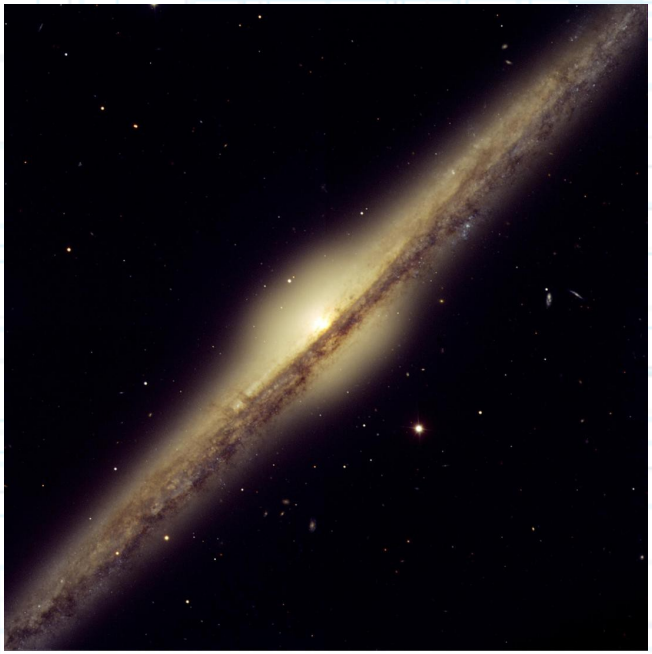
Outline

- The global disk model of a spiral galaxy
- The microlensing as a method of measuring the mass of compact objects along a line of sight
- The microlensing towards Galactic bulge: the dark matter limit in the global disk model framework

The standard model of spiral galaxies





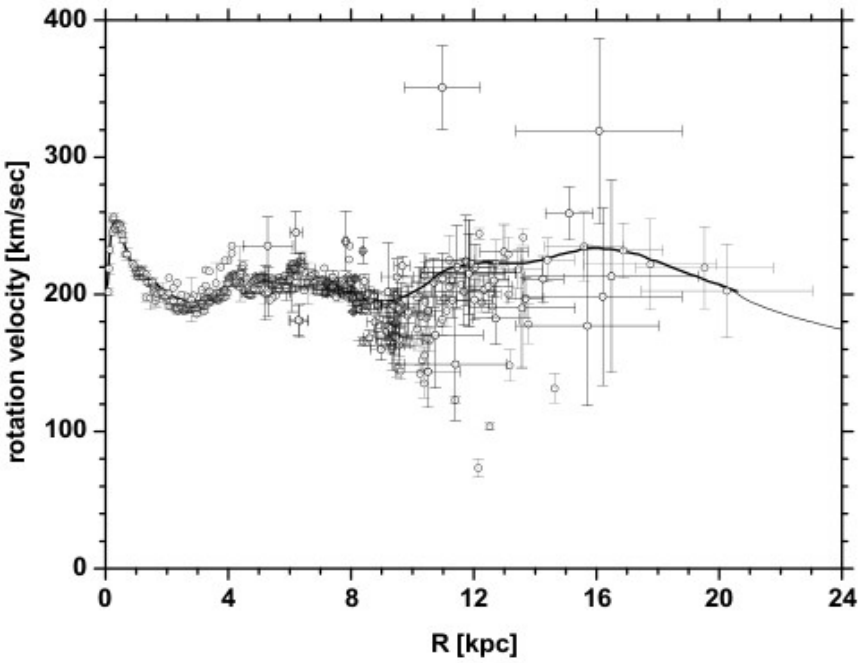
Spiral Galaxy NGC 4565
(FORS / VLT)

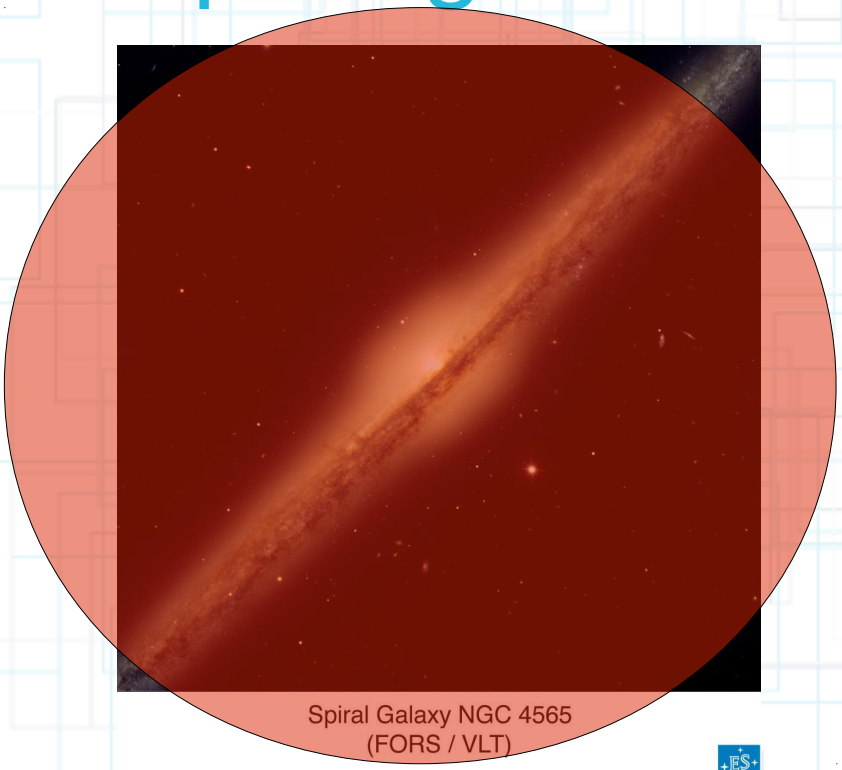
ESO PR Photo 24a/05 (August 10, 2005)

The standard modeling of a spiral galaxy takes into account:

- the rotation curve
- the brightness prifile
- M/L - the mass to light ratio
- analytical formulas with some free parameters, describing the mass density in a various components: bulge, disk, halo

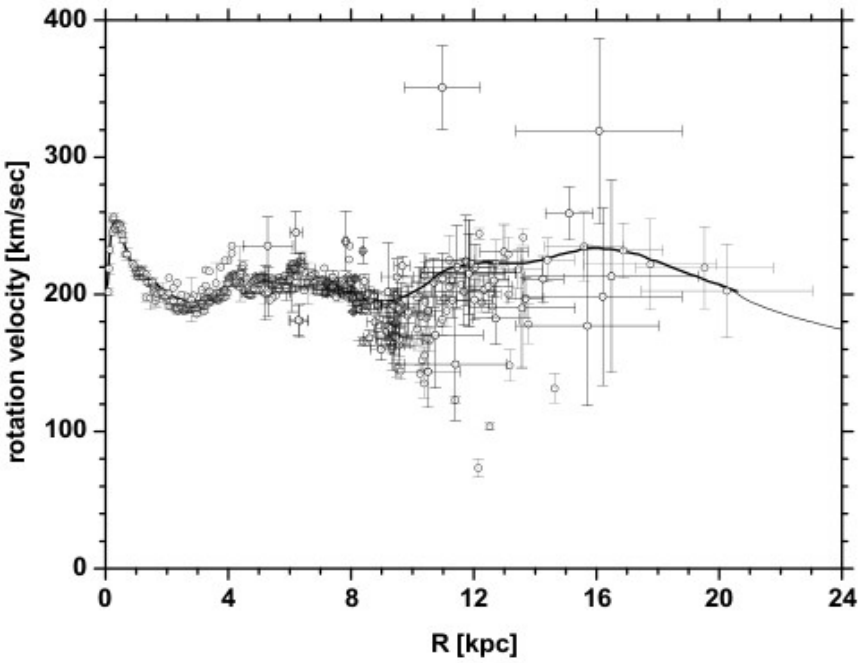
The standard model of spiral galaxies

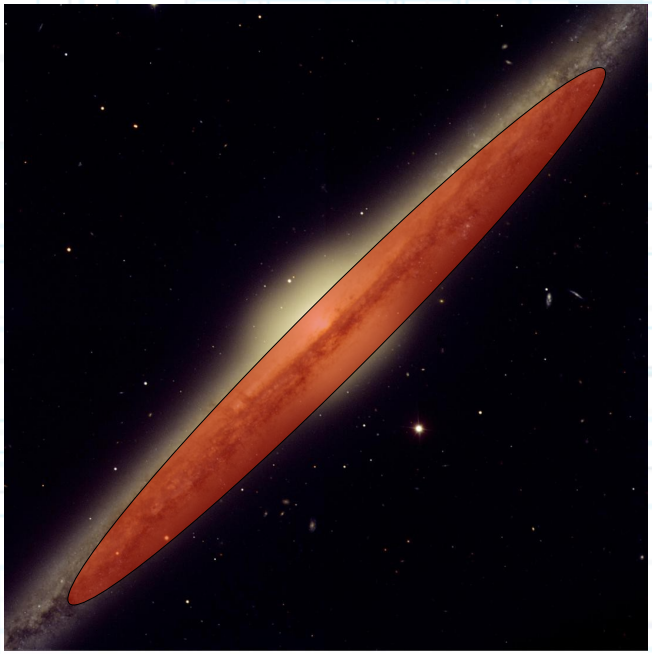




The result of a fitting the free parameters is that the dominating contribution to the gravitational potential gives a dark matter halo

The global disk model





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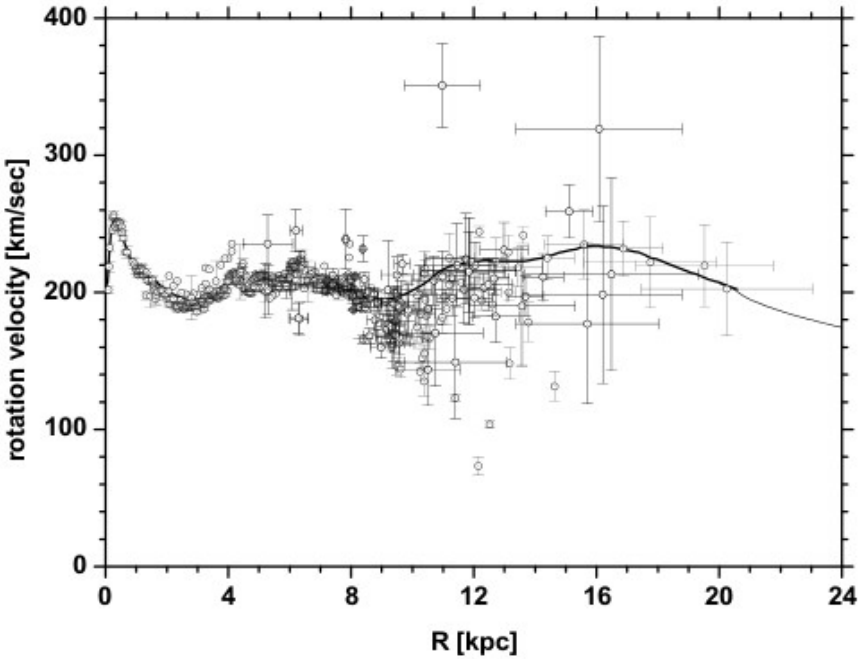
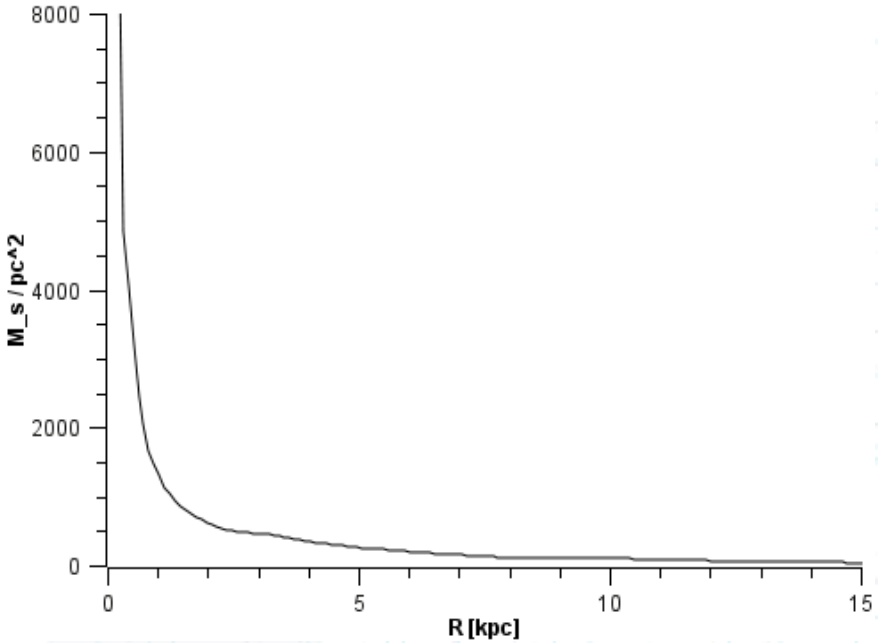
$$\sigma(R) = \frac{1}{\pi^2 G}\mathcal{P}\left[\int_0^R v^2(\chi)\left(\frac{K(\chi/R)}{R\,\chi} - \frac{R}{\chi}\frac{E(\chi/R)}{R^2-\chi^2}\right)\mathrm{d}\chi + \int_R^\infty v^2(\chi)\frac{E(R/\chi)}{\chi^2-R^2}\,\mathrm{d}\chi\right]$$

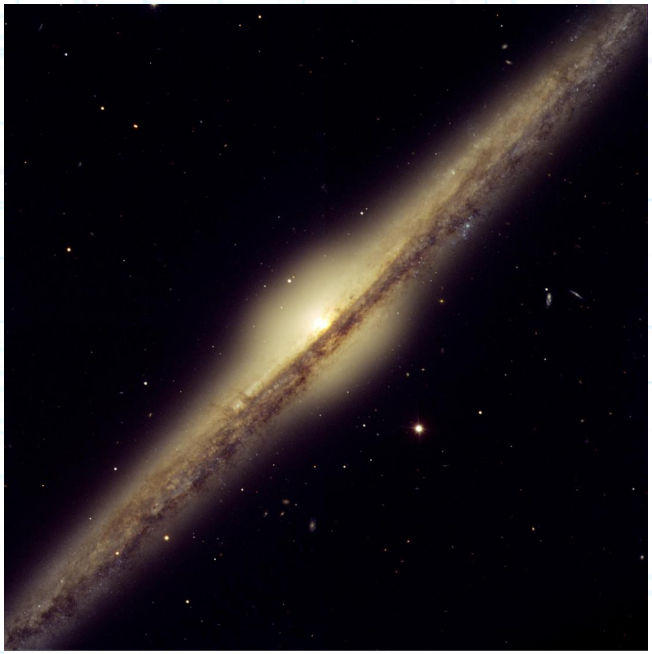
Bratek Ł., Jałocha J., Kutschera M., 2008, MNRAS, 391, 1373

The global disk model





The microlensing



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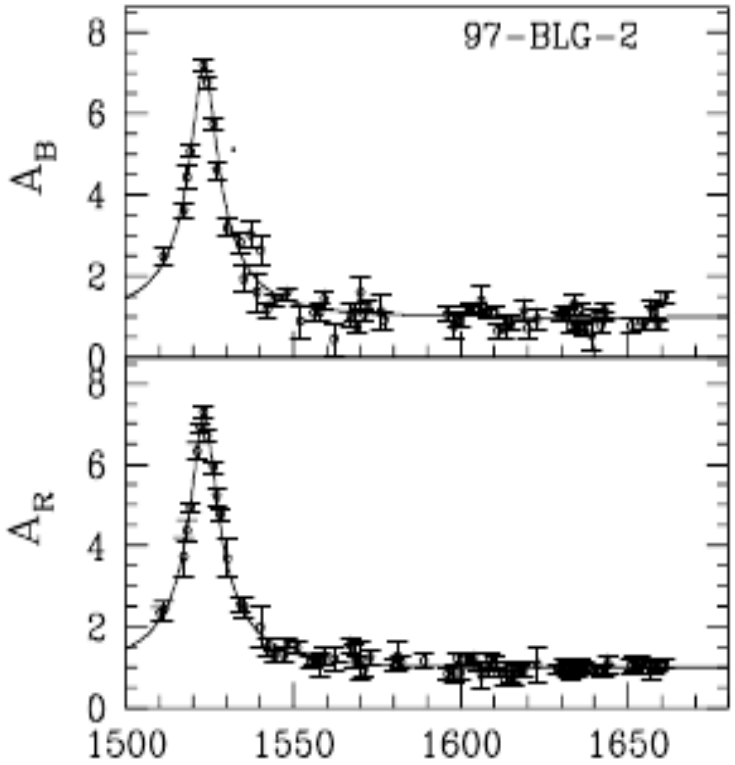


From: MACHO project:
arXIv:astro-ph/0002510v2

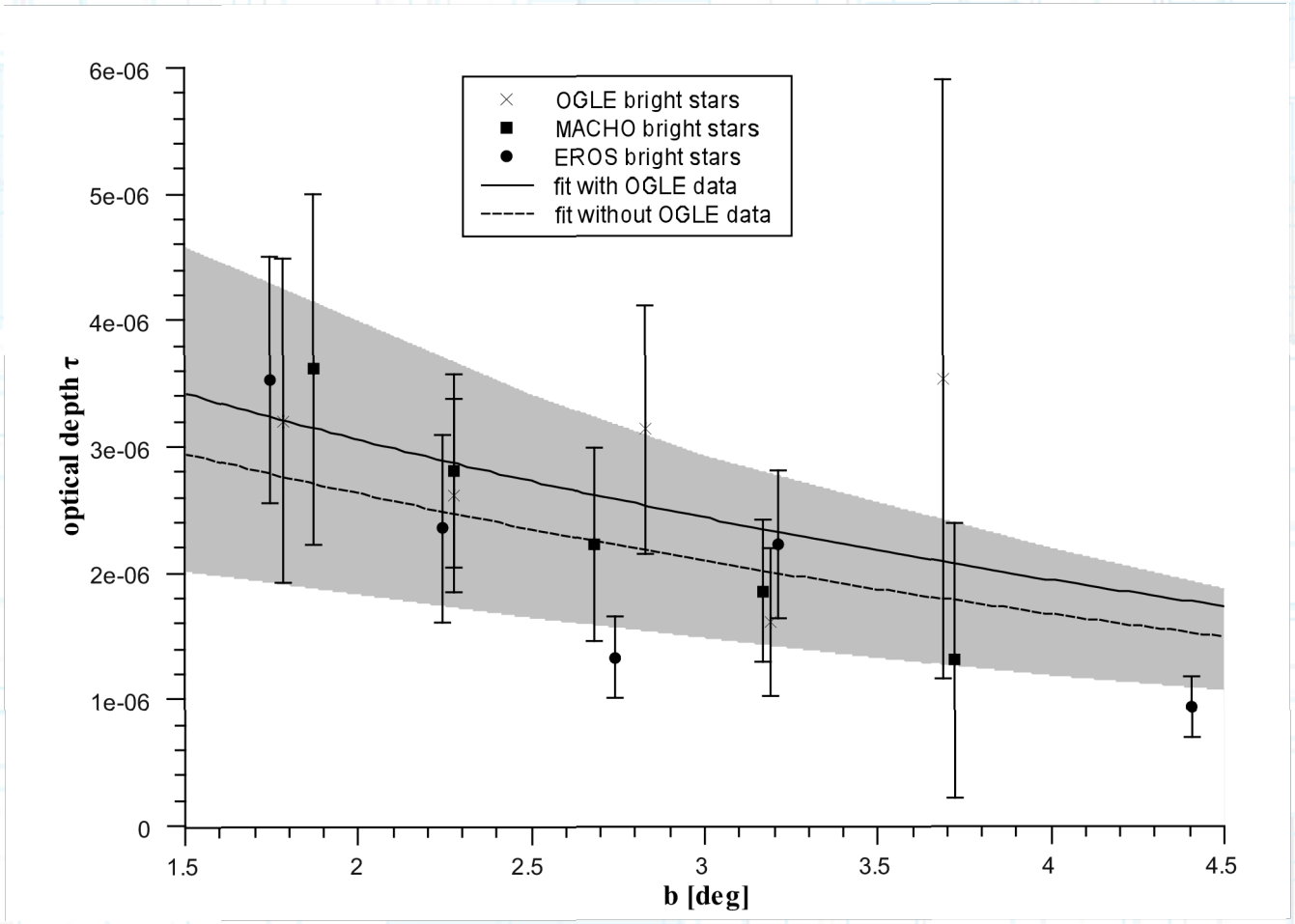
$$\tau = \int_0^{D_S} \frac{4\pi G}{c^2 D_L} \left(1 - \frac{D_L}{D_S}\right) \rho_{co}\left(\vec{r}(D_L)\right) D_L^2 \mathrm{d}D_L$$

The microlensing

Within the global disk model we take into account:

- Various vertical density distribution profiles:
  - single exponential
  - double exponential
  - 1/cosh(z/a)
- The structure of central bulge:
  - spherically symmetric bulge
  - three-axial G2 bulge/bar model by Dwek et al.
- Subtraction of a gas contribution
- The Monte Carlo simulation of a sources distribution
- The blending effect – we restrict to the bright sources only

The results



Dark matter limit: $(0.11 \pm 0.41) \times 10^{10} M_{\odot}$

Additional dynamical mass: $(0.86 \pm 0.36) \times 10^{10} M_{\odot}$

The references

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