Introductory Astronomy

Week 7: Galaxies

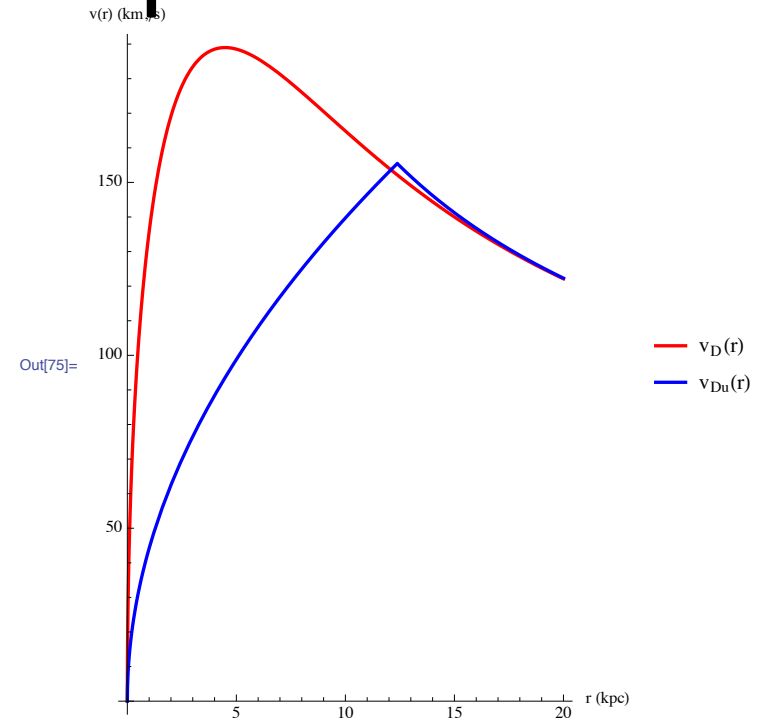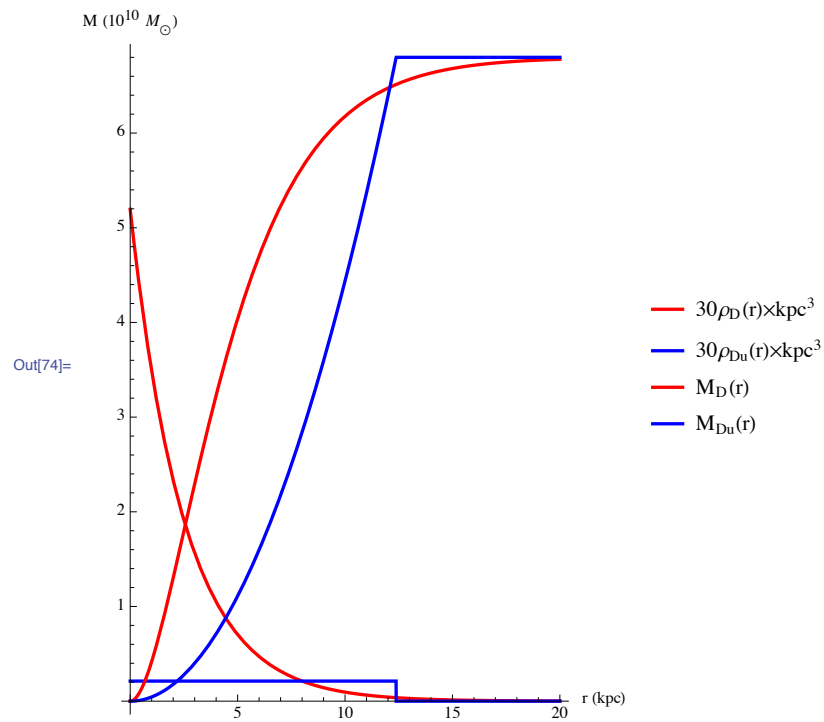## Clip 7: Weighing the Milky Way

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To Weigh a Galaxy

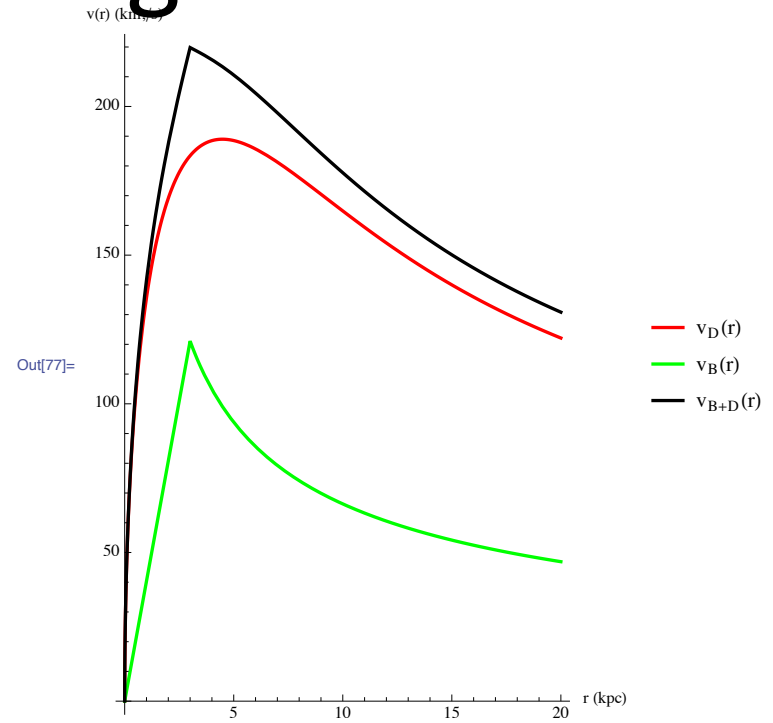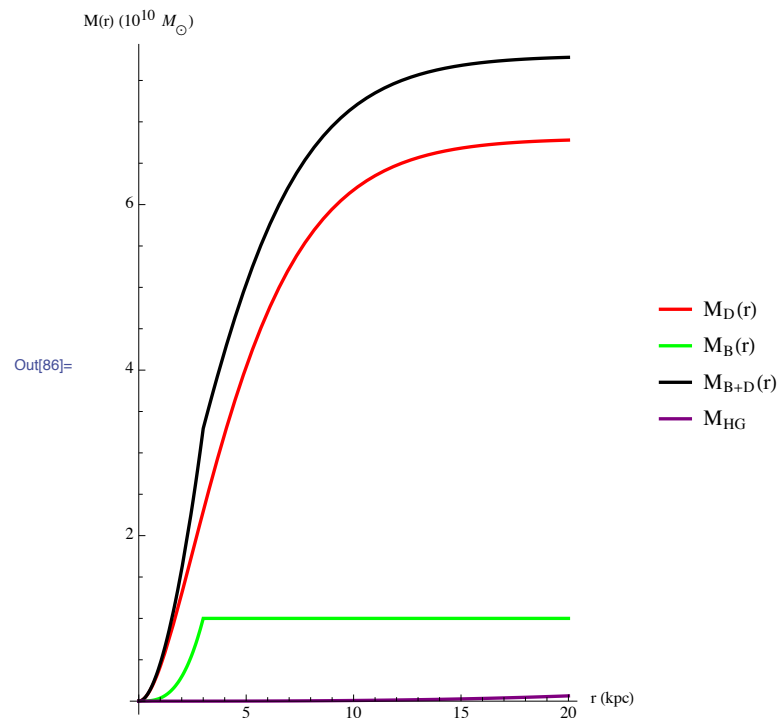- Sun orbits at 220 km/s at 8kpc period 230 My
- Newton: Mass inside Solar orbit is

$$\frac{M}{M_\odot} = \left(\frac{P}{1\,\text{yr}}\right)^{-2}\left(\frac{R}{\text{AU}}\right)^3 = \frac{(8 \times 10^3 \times 206265)^3}{(2.3 \times 10^8)^2} = 8.8 \times 10^{10}$$

- Exceeds our estimate from star counts and other estimates
- Write it usually as $v^2 = GM(R)/R$

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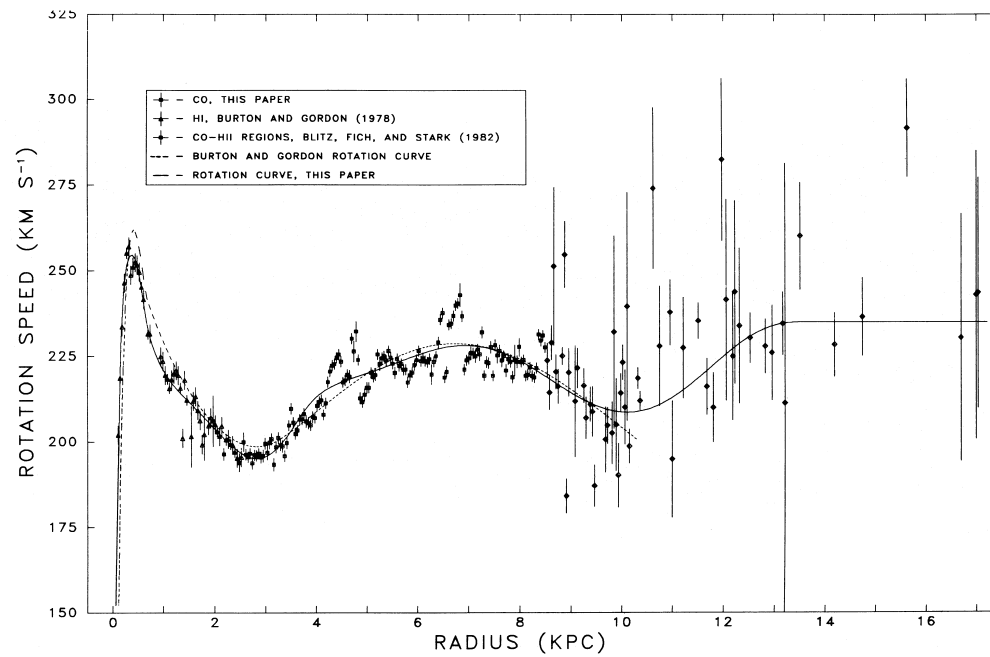
What We Expect

Add a Bulge

What We Find

FIG. 3.—Plots of the rotation speed versus galactocentric radius. The solid lines correspond to the polynomials, and the dashed lines are the BG rotation curve. (*upper panel*)(R_0, θ_0) = (10 kpc, 220 km s^{-1}); (*lower panel*) (8.5 kpc, 220 km s^{-1}).

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Credits

- MW Rotation Curve: D. Clemens, Astrophysical Journal, Part 1 (ISSN 0004-637X), vol. 295, Aug. 15, 1985, p. 422-428, 431-436
  http://adsabs.harvard.edu/abs/1985ApJ...295..422C

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