Journal club, 12 May 2016
Dark Matter in the Milky Way
MITP, 2-13 May 2016

1. Huang et al
   "The Milky Way's rotation curve out to 100 kpc and its constraint on the Galactic mass distribution"
   http://arxiv.org/abs/1604.01216

2. Lu et al
   "The connection between the host halo and the satellite galaxies of the Milky Way"
   https://arxiv.org/abs/1605.02075

3. Lin & Ishak
   "Ultra faint dwarf galaxies: an arena for testing dark matter versus modified gravity"
   http://arxiv.org/abs/1604.00950

4. Nipoti
   "On the origin of Sérsic profiles of galaxies and Einasto profiles of dark-matter halos"
   https://arxiv.org/abs/1605.00680

5. Relativistic treatment of galactic rotation curves
   Magalhaes & Cooperstock, http://arxiv.org/abs/1508.07491
   Carrick & Cooperstock, http://arxiv.org/abs/1101.3224
   Rowland, http://www.worldscientific.com/doi/abs/10.1142/S0218271815500650
   Cooperstock, http://www.worldscientific.com/doi/abs/10.1142/S0217732316500371
   [Aaron Dutton's slides attached]

Galactic Mapping with general relativity and the observed rotation curves

1508.07491 Magalhaes & Cooperstock

Metric in cylindrical coordinates, r, z

$$ds^2 = -e^{\nu}(dr^2 + dz^2) - (r^2 - N^2)d\phi^2 - 2Ncd\phi dt + c^2dt^2,$$

Rotation velocity, V $V(r,z) = r\omega(r,z) \approx \frac{cN(r,z)}{r}.$ **Metric function, N**

Einstein Eqs. $N_{rr} + N_{zz} - \frac{N_r}{r} = 0.$ $\frac{N_r^2 + N_z^2}{r^2} = \frac{8\pi G\rho}{c^2},$

New variable $\Phi = \int \frac{N}{r}dr, \quad V = c\frac{\partial \Phi}{\partial r}.$

Poisson Eq. $\Delta\Phi = 0,$

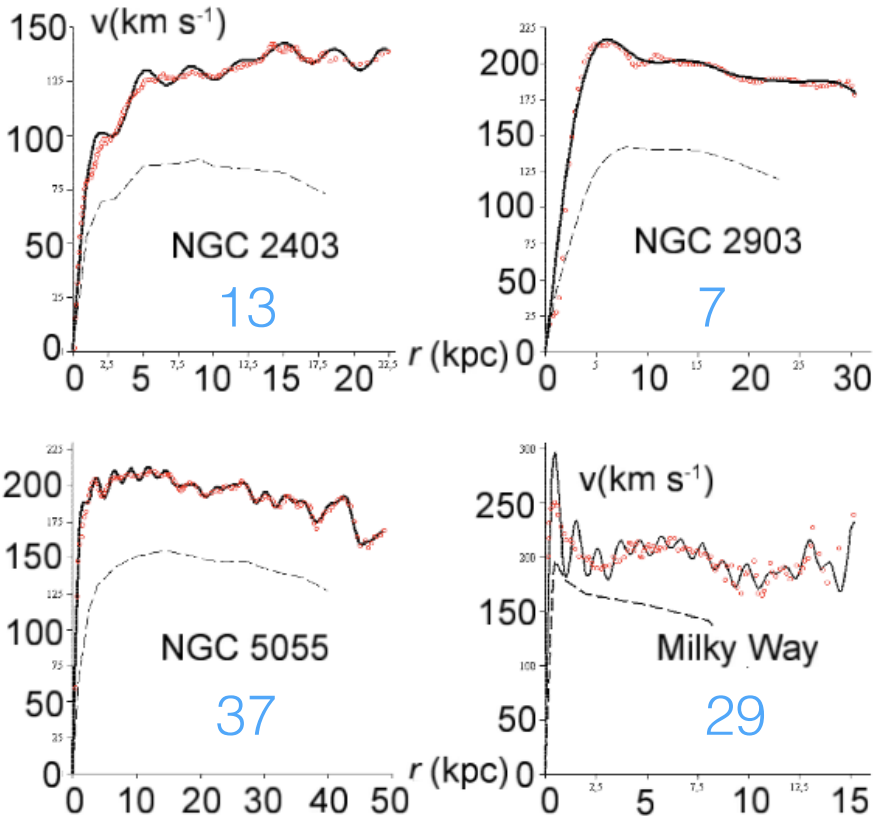
Solution: sum of bessel functions (n is arbitrary)

$$\Phi = \sum_n C_n e^{-k_n|z|} J_0(k_n r),$$

$$V = -c\sum_n k_n C_n e^{-k_n|z|} J_1(k_n r),$$

compute density

$$V = -c \sum_n k_n C_n e^{-k_n |z|} J_1(k_n r),$$



Rotation Velocity [km/s]

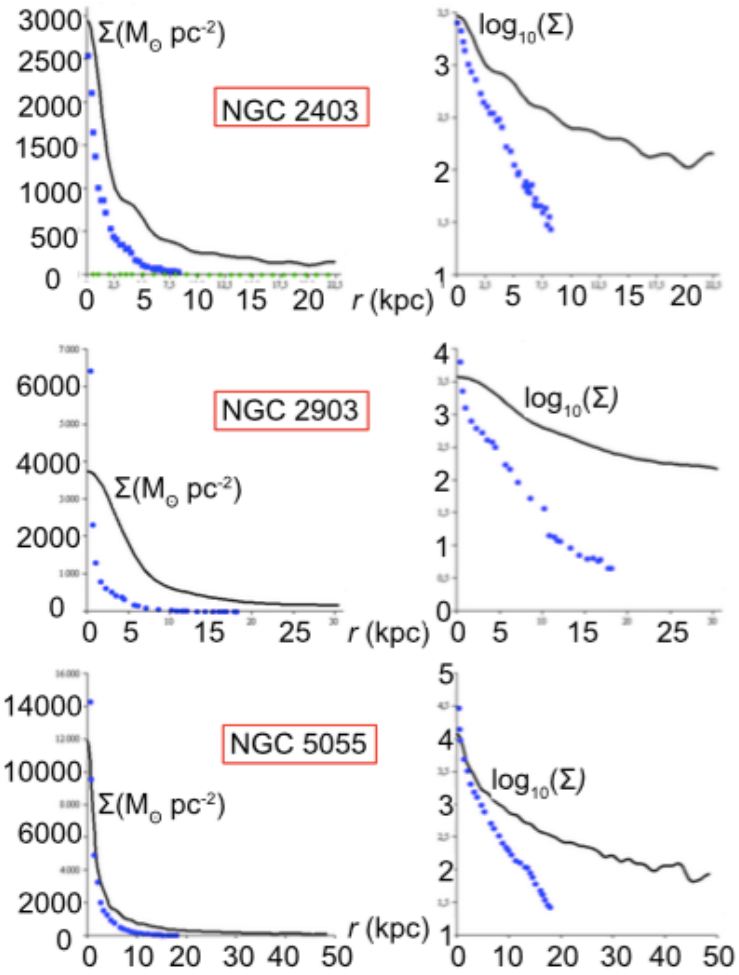
Radius [kpc]

Observations

GR model

Newtonian

Surface Density Profiles



Observations

GR model

GR model has much more (baryonic) mass at large radii than observed