

Mond



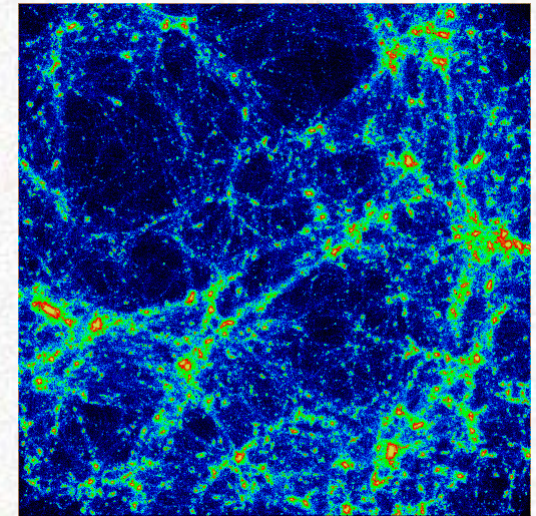
Origins



Testing

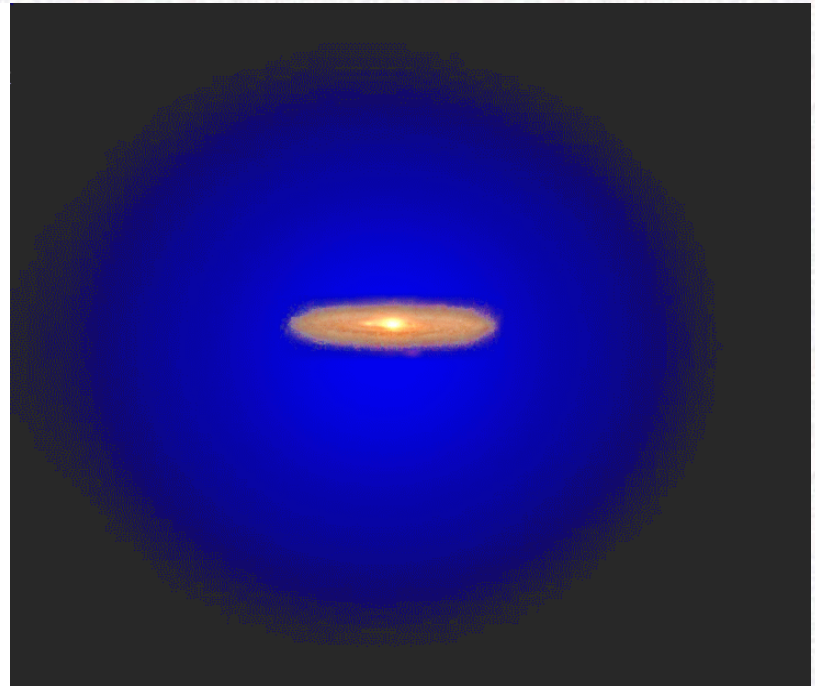
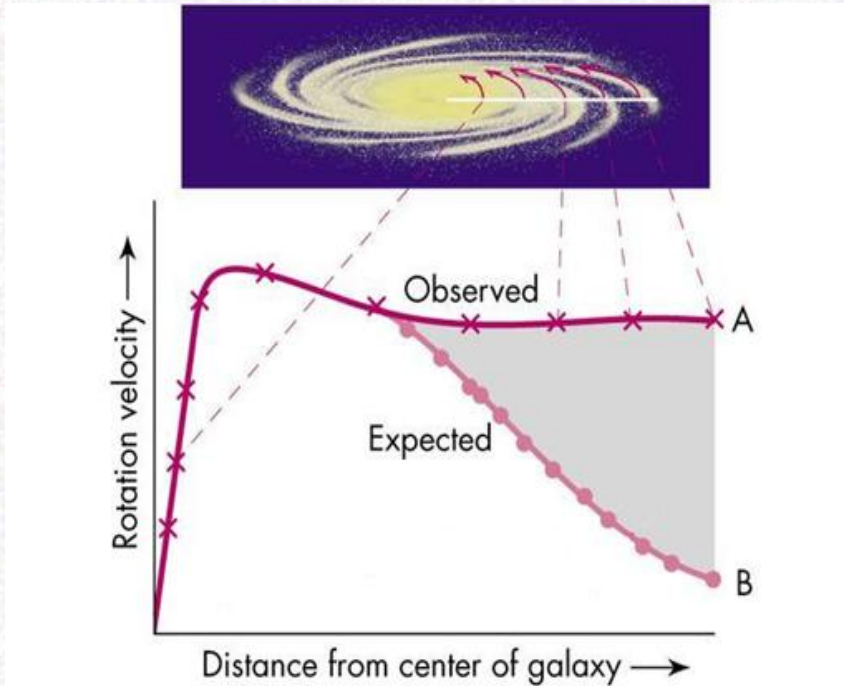


Future?





Phenomenology



Bizarre matter or ordinary field?



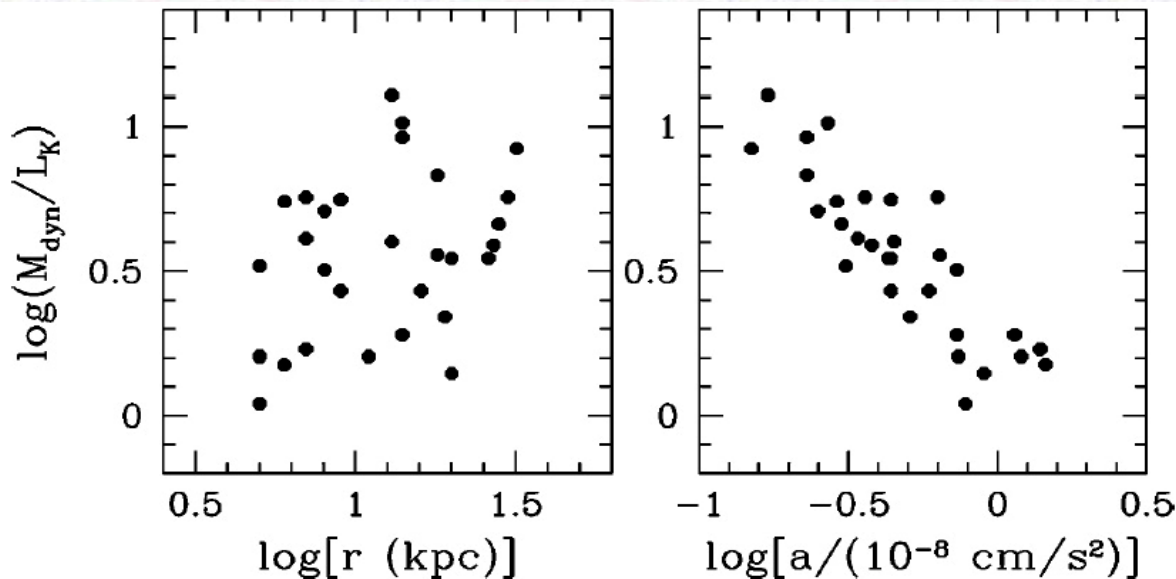
Algorithm

Historical issues

$$F = (GM/R^2) f(R/R_0) \quad f(x) = 1 \text{ for } x \ll 1 \text{ or } f(x) = x \text{ for } x \gg 1$$

Tully-Fisher: $L \sim v^4$ larger galaxy/larger discrepancy

Slope of Tully-Fisher: not length but acceleration scale modification



$$M/L \sim 1/a$$



Consequences

$m(r/a_0) = F$ or $g_m(|g|/a_0) = g_N$ where $m(x)=1$ for $x \ll 1$ or $m(x)=x$ for $x \gg 1$

By design: $v^4 = GMa_0$

Easily falsified by observation.

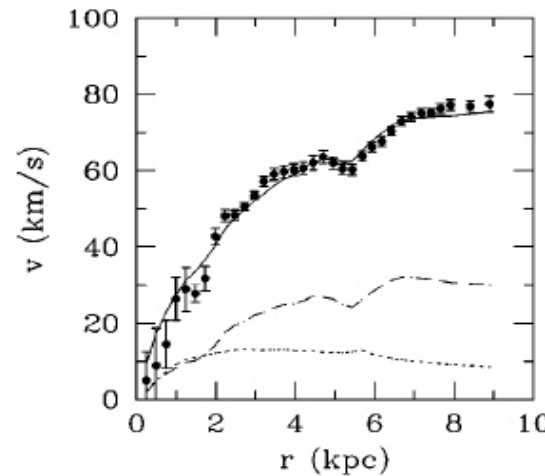
$S_m = a_0/G$ - surface density

LSB prediction

Automatic LSB/HSB distinction

Freeman's law : brightness limit

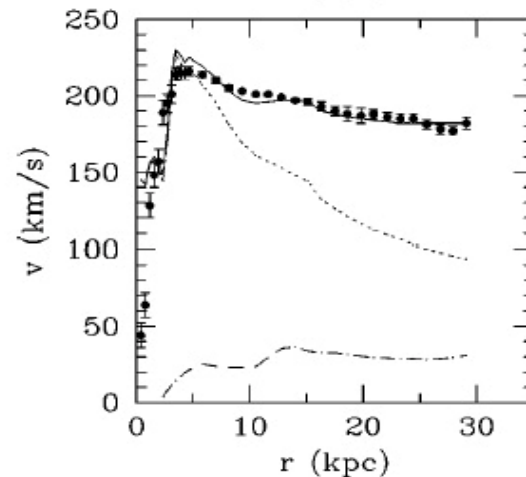
Faber-Jackson : $L \sim v^4$



NGC 1560

$\langle \mu_B \rangle = 23.2 \text{ mag/arcsec}^2$

$(M/L_B)_{\text{disk}} = 0.4$



NGC 2903

$\langle \mu_B \rangle = 20.5 \text{ mag/arcsec}^2$

$(M/L_B)_{\text{disk}} = 1.9$



Here Lay Dragons

External field effect is required by Mond:

$$m(|g_e + g_i|/a_o) g_i = g_{Ni}$$

Relation to the Hubble constant

$$a_o = cH_o$$



Galactic scale

Light traces mass (M/L constant for one galaxy)
 H_0 at best known value 75 km/s Mpc

$$a_0 = 1.2 \pm 0.27 \cdot 10^{-8} \text{ cm/s}^2$$

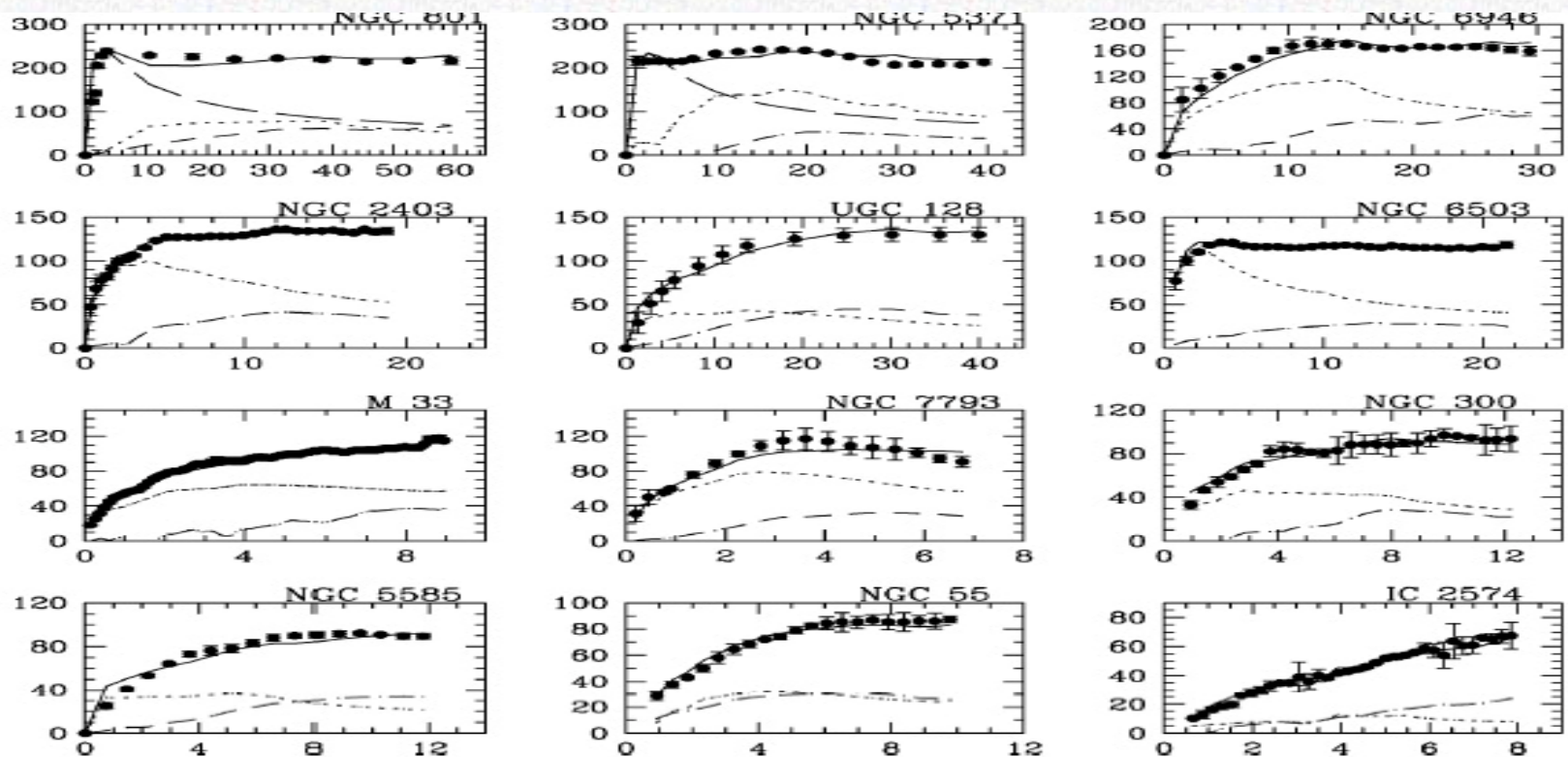


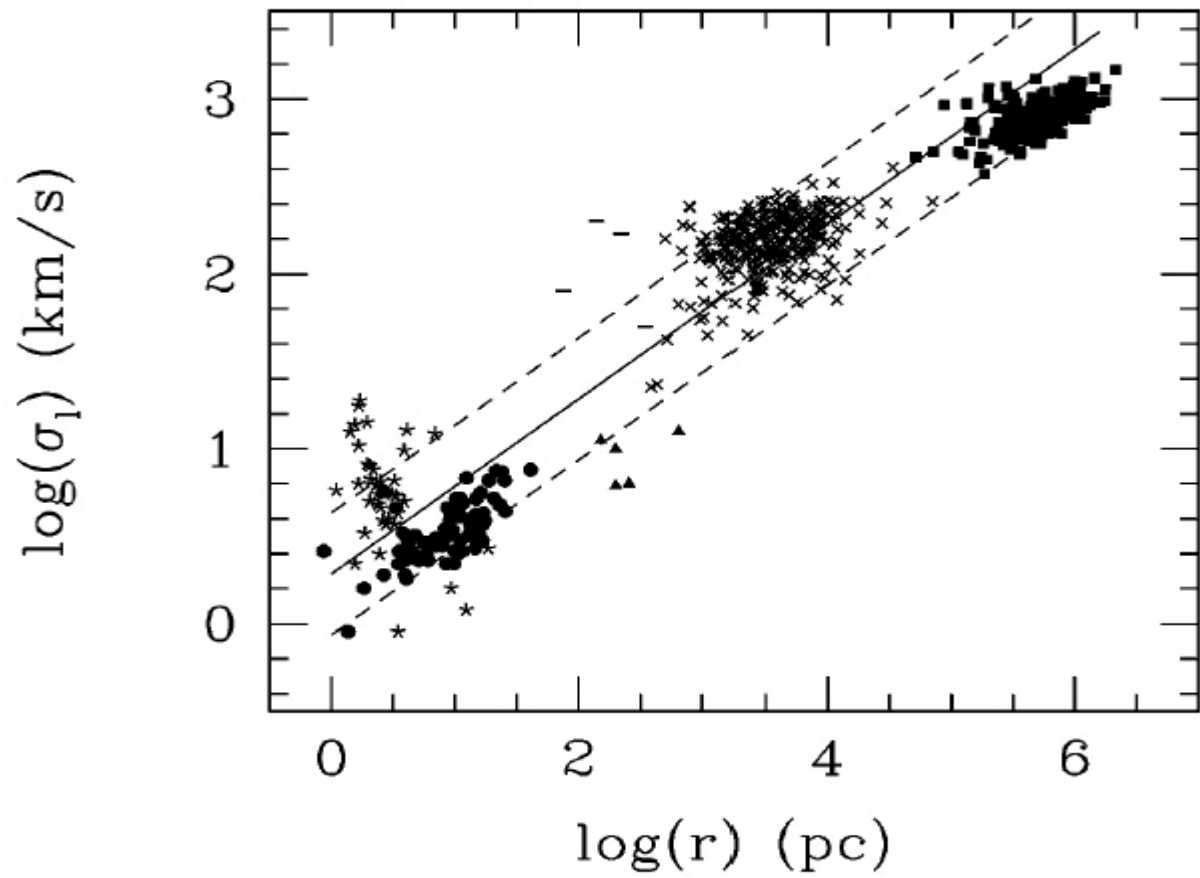
Figure 5 MOND fits to the rotation curves of spiral galaxies with published data, from



Smaller than galactic scales



Pioneer anomaly: $a_p = 8 \cdot 10^{-8} \text{ cm/s}^2$





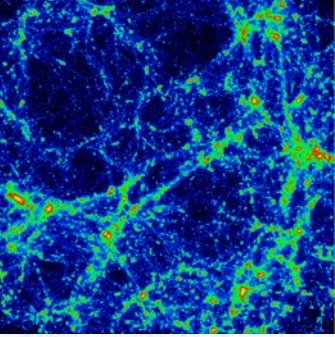
Larger than galactic scale



Mond predicts more mass in clusters

Strong lensing observations in clusters

However Faber-Jackson still applies



State of theory

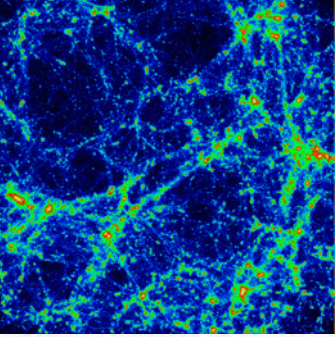
Non-relativistic theory: conservation of momentum and energy
As well as no dependence of the external field on the inner structure

$$\nabla \cdot \left[\mu \left(\frac{|\nabla\phi|}{a_0} \right) \nabla\phi \right] = 4\pi G\rho$$

Relativistic theory: Evolving. After this paper where
Scalar-tensor theory is proposed, more advanced TeVeS
Treatment have been published. Problems still exist:

Lensing

MOND as modified inertia?

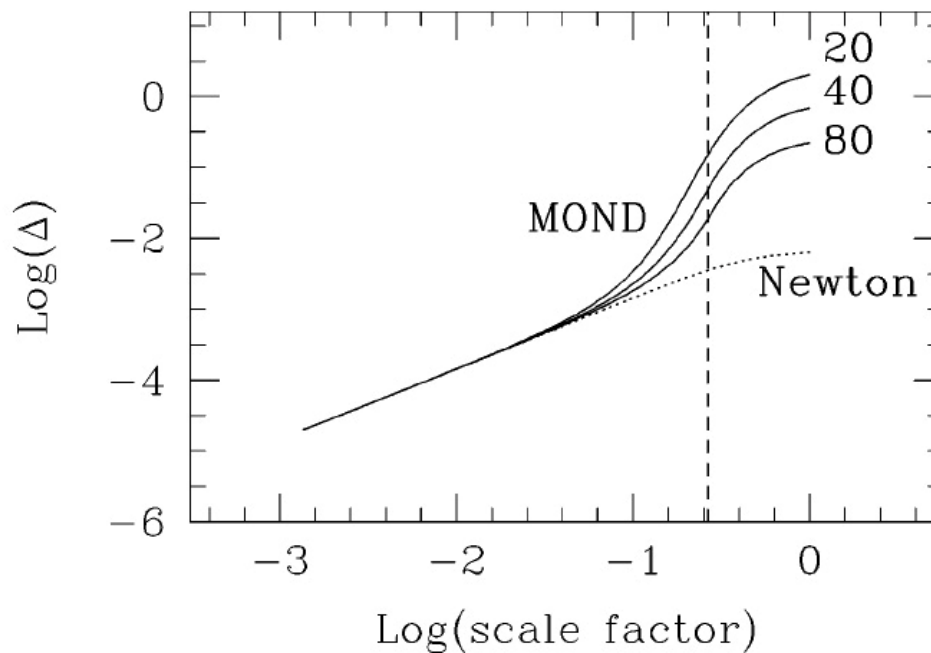


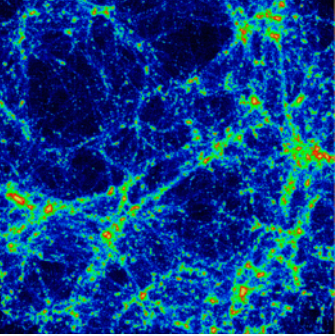
Cosmology

No complete theory, so no real Cosmology.

However, speculative MONDIAN-like Friedmann equation:

$$\dot{r} = u_i^2 - [2\Omega_m H_o^2 r_o^3 a_o]^{1/2} \ln(r/r_i),$$





Conclusion

Single parameter

Preferred surface density

Pressure supported isothermal systems on vast range of scales

Luminosity-velocity dispersion relation

Problems: not well developed, lensing, large scale

Future: Does MOND represent influence of Cosmology
On the local particle dynamics?