What so Special about $R_0/20$?

D.F. Bartlett
J.P.Cumalat
Press Conference June 12, 2012
Anchorage, Alaska
AAS-220
Sinusoidal Potential

\[ \Phi = -\frac{GM}{r} \cos(k_0r) \]

Contour plot of Sinusoidal potential in cylindrical geometry – dark is potential minima.

Top View of Dust and Stars in the thin disk
Dark Matter or Sinusoidal Potential?

Rotation curve of a typical spiral galaxy: predicted (A) and observed (B). The discrepancy between the curves is attributed to dark matter.

For the experts, Virial Theorem yields:

\[ 2\langle T \rangle = -\left\langle \frac{\partial \phi}{\partial r} \cdot r \right\rangle = \frac{2\pi}{\lambda_0} GmM_{\text{eff}} \left\langle \sin \left( \frac{2\pi r}{\lambda_0} \right) \right\rangle \]
Evidence for $R_0/20$ as Universal Length

Butler Burton (1988) notes in the plot he assumed a distance from the sun to the galactic center of $R_0 = 10$ kpc. The step structure is equal to $R_0/20$ – now should be 400 pc.

CO is an observable substitute for the H2 needed for star formation. There are two dense bands of contours in this plot from Tom Dame et al (1987). These bands are about $+/-\lambda/4$ and are probably related to stall points in the z-motion of matter in the extreme disk.
Do Comets Get a Nudge from the Galaxy?

But Marsden thinks the comet data just aren’t good enough to support Matese’s and Whitmire’s analysis. “I have no problem with [their] theoretical analysis,” he says, “but it’s a miserable, crummy set of data ... I say that having provided a lot of that data myself.” With better data or a different analysis, Marsden says, the effect might disappear—and another way for the galaxy to pluck comets from the Oort cloud might emerge.

—Charles Seife

*Science* Volume 274; 8 November 1996
Chibisov Filament Showing Negative Magnetic Tension

\[ M_{ij} = \frac{1}{4\pi} \left( -\delta_{ij} B^2/2 + B_i B_j + \delta_{ij} k_0^2 A^2 - k_0^2 A_i A_j \right) \]
$H_0t_0$: Coasting = 26% Matter and 74% Dark Energy

$$H_0t_0 = \int_1^\infty \frac{dy}{y \sqrt{\Omega_M y^3 + \Omega_R y^2 + \Omega_\Lambda}}$$

\[\Omega_R = 0\]
\[\Omega_\Lambda = 1 - \Omega_M\]
Summary

Sinusoidal Potential
1) Explain larger features of the Milky Way
2) Agrees with Newtonian gravity in our solar system, long period comets (a problem) Requires Sinusoidal Potential

Non-zero Mass for Photon
1) Needed to bind clusters of Galaxies
2) Controls Cosmological Expansion
3) Mass is still way below the best particle limits.

Both Gravitational and the Magnetic Fields are sometimes attractive and sometimes repulsive.
Backup Slides
Sinusoidal Potential with a Graviton having an imaginary mass - $m = 10^{-25}\text{eV}$

Modified Gravitational Potential

$$\Phi = -\frac{GM}{r} \cos(k_0r)$$

$$\nabla^2 \Phi + k_0^2 \Phi = 4\pi G \rho$$

$$\lambda_0 = \frac{2\pi}{k_0} = 400\text{pc}$$

$$k_0^2 = \frac{E_H^4 4\pi G}{4}$$

Here $\lambda_0$ is a universal wavelength. For $r = 1\text{AU}$, $\cos(k_0r)$ differs from 1 by only 1 part in $10^{-14}$, making it too small a difference to have been detected in the motion of the planets. If $k_0r > 1$, then the sinusoidal potential provides both a gravitational force and a tidal force which fall off as $1/r$. The slow fall off in $r$ can explain the flat rotation curves of stars in disk galaxies.
CO is an observable substitute for the H2 needed for star formation. There are two dense bands of contours in this plot from Tom Dame et al (1987). These bands are approximately +/- \( \lambda/4 \) and are probably related to stall points in the z-motion of matter in the extreme disk.
Additional Evidence for $R_0/20$
1985 CO Data
Observed Filaments Introducing Structure?
Chibisov’s Stress Tensor assuming photon mass, $m_\gamma = 10^{-25}\text{eV}$ ($k_0 = 2\pi/400\text{pc}$)

$$M_{ij} = (1/4\pi)(-\delta_{ij}B^2/2 + B_iB_j + \delta_{ij}k_0^2A^2 - k_0^2A_iA_j)$$

Let $k$ be the wave number of the Fourier decomposition of the field. If $k > k_0$, the B fields dominate. If $k < k_0$, then the vector potential $A$ dominates.
Thanks to Butler Burton, Tom Dame, & Dan Clemens for Permission to use figures from their published work. The Daumier print is “Monsieur Babinet Alerted by his Housekeeper of the Arrival of the Comet.” info@daumier-register.org. Used with permission.