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A Unified Electro-Gravity Theory to Model Accelerated Expansion of the Universe without any Dark-Energy or Dark-Matter

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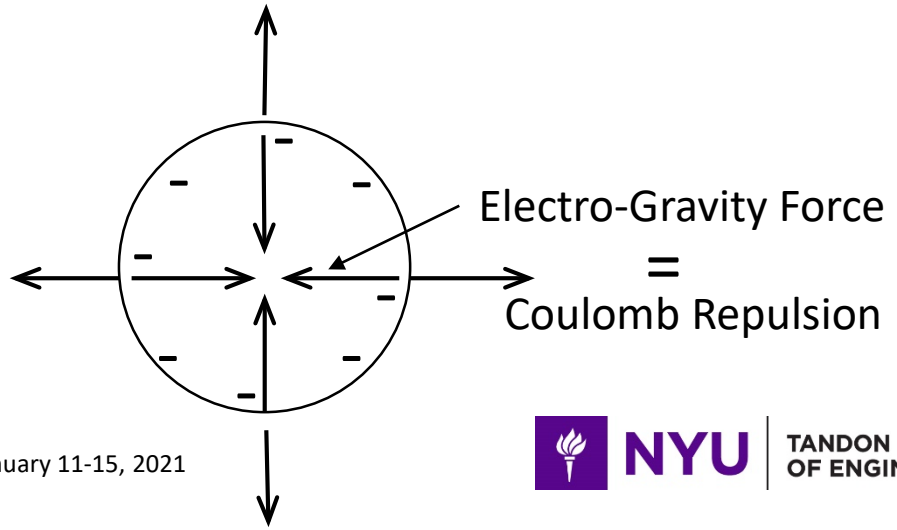
Introduction: Unified Electro-Gravity (UEG) Theory

- Newtonian gravitation is strictly valid only in the external region of a neutral, non-radiating, massive body.
- Gravitation is much stronger in the presence of any electromagnetic field or light radiation, constituting a new modified gravity theory, referred to as Unified Electro-Gravity (UEG) theory.
- The UEG field of a charged elementary particle, such as the electron, would counter the self-repulsive force of the charge, resulting in a self-consistently stable charge structure.



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Unified Electro-Gravity Theory (Continued)

- In the simplest form, for a spherically symmetric structure, the gravitational acceleration $\bar{E}_g$ at a given location due to the UEG field is defined proportional to the electromagnetic energy density W_τ at the location, with the constant of proportionality γ called the UEG constant, and the $\bar{E}_g$ is directed towards the gravitational center.
- The UEG constant is estimated from flat rotation in spiral galaxies, consistent with elementary charged-particle modeling, to be approximately equal to $\gamma \approx 600\ (\frac{ms^{-2}}{Jm^{-3}})$, and is directly related to the dimensionless Fine-Structure Constant $\propto$ of electro-dynamics, in terms of the mass m_e and classical radius r_e of the electron: $(\gamma m_e/r_e^2)=(2/\propto)$.

Unified Electro-Gravity (UEG) Theory: Application to Astrophysical Problems

- The UEG theory is successfully applied to support central acceleration in spiral galaxies, with the UEG field produced due to the energy density associated with stellar light radiation. (Presented in AAS 235 meeting)
- The UEG theory is also applied to model excess gravitational mass in galaxy clusters, with the UEG field produced due to the energy density associated with the cosmic microwave background (CMB) radiation. (Presented in AAS 236 meeting)
- The UEG theory can be similarly applied to cosmology, by considering the UEG field produced due to the energy density associated with the cosmic microwave background (CMB) radiation, to model the accelerated expansion of the current universe.

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Unified Electro-Gravity (UEG) Theory for Cosmology

- The UEG acceleration a_U due to CMB radiation, a fundamental parameter of a UEG cosmological model:

$$\boldsymbol{a_U = \gamma W_{\tau(CMB)} = \gamma \left(\frac{4\sigma}{c}\right) T^4 = 2.5 \times 10^{-11} m/s^2}$$

$$\boldsymbol{\gamma(UEG) = 6 \times 10^2 \frac{(ms^{-2})}{Jm^{-3}}}, T(CMB) = 2.725^0 K$$

σ (Stefan-Boltzman Constant) = $5.670 \times 10^{-8} \frac{W}{m^2 K^4}$

- The a_U is estimated to be about half of the Newtonian gravitational acceleration $a_g \approx 5.179 \times 10^{-11} \left(\frac{m}{s^2}\right) = 0.049 \times (\frac{1}{2}) H^2 R$ at the boundary of the observable universe of radius R, due to conventional (baryonic) matter, which is about 4.9% of the critical density.

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Basic UEG Cosmological Model for the Current Universe

- The velocity of expansion of the current universe is found to be significantly in excess of what can be supported by the total mass (conventional baryonic, plus an equivalent-mass due to the new UEG acceleration)
- As the universe expands and CMB radiation density reduces, the new UEG equivalent-mass, enclosed in a co-moving volume, would reduce, while the enclosed baryonic mass remains constant. .
- The reduction of the total mass would lead to an increase of the excess velocity as the universe expands, in order to properly conserve kinetic energy associated with the excess velocity, enforced as a requirement in the new UEG cosmology.

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Basic UEG Cosmological Model for the Current Universe (Continued)

- This would result in a net acceleration of the expansion, in the current and recent past of the universe ($z<1$).
- Using the above model, we compute the expansion velocity and luminosity distance with red-shift, that compare well with results using the standard model

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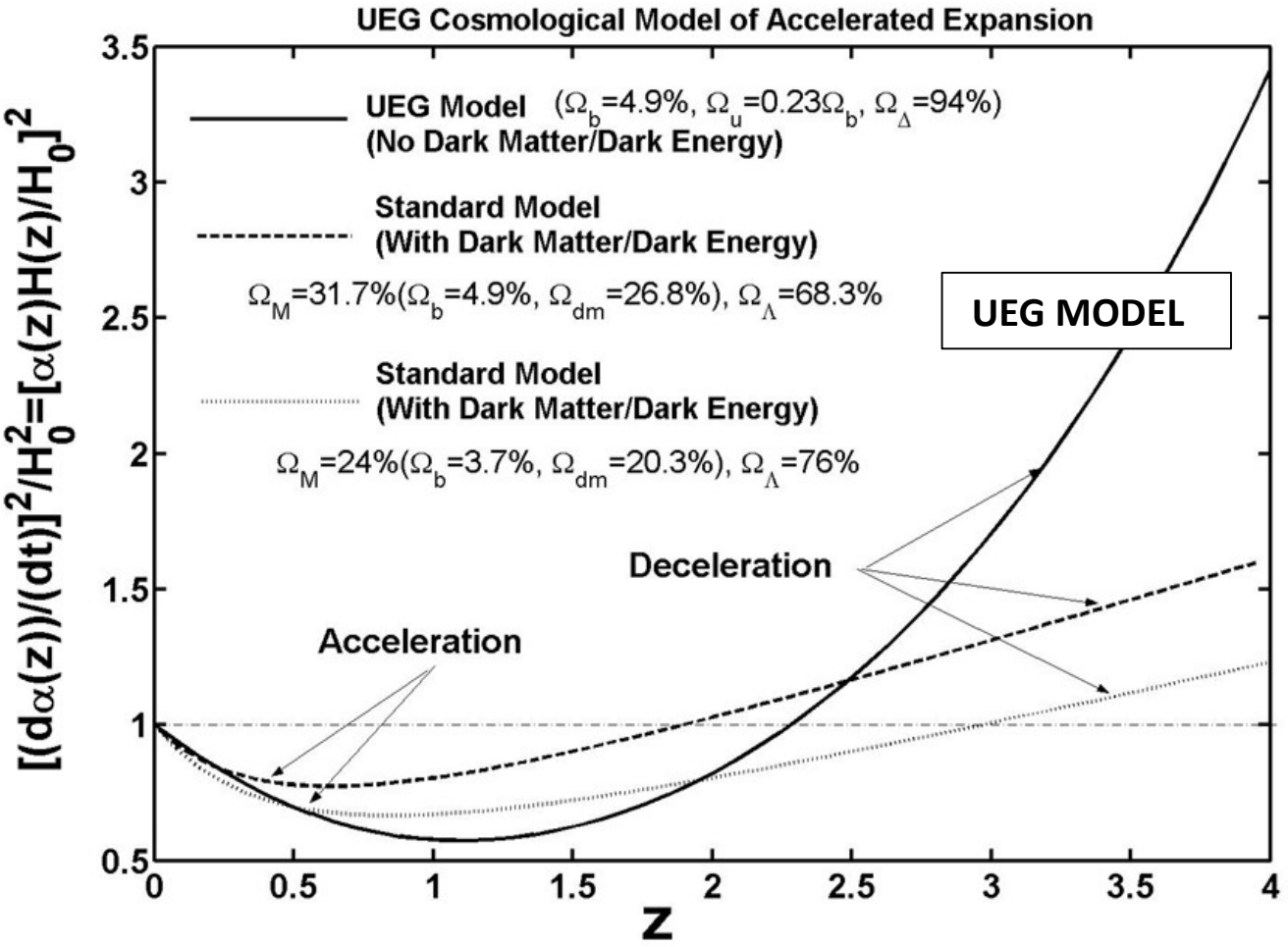
Normalized Squared-Velocity as a Function of Red-Shift, Showing Acceleration in the Current Universe



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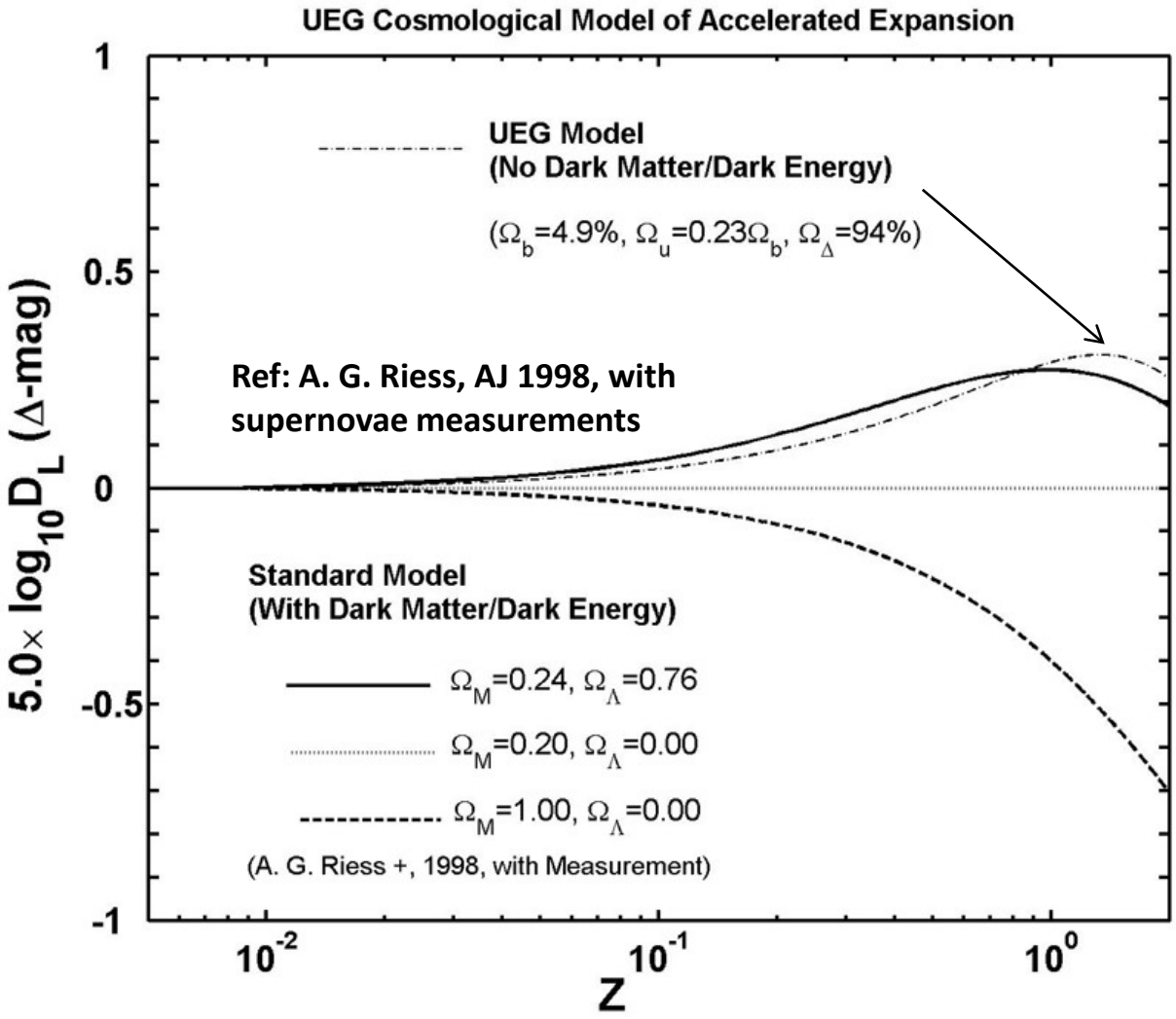
Luminosity Distance (Delta-Magnitude) as a Function of Red-Shift



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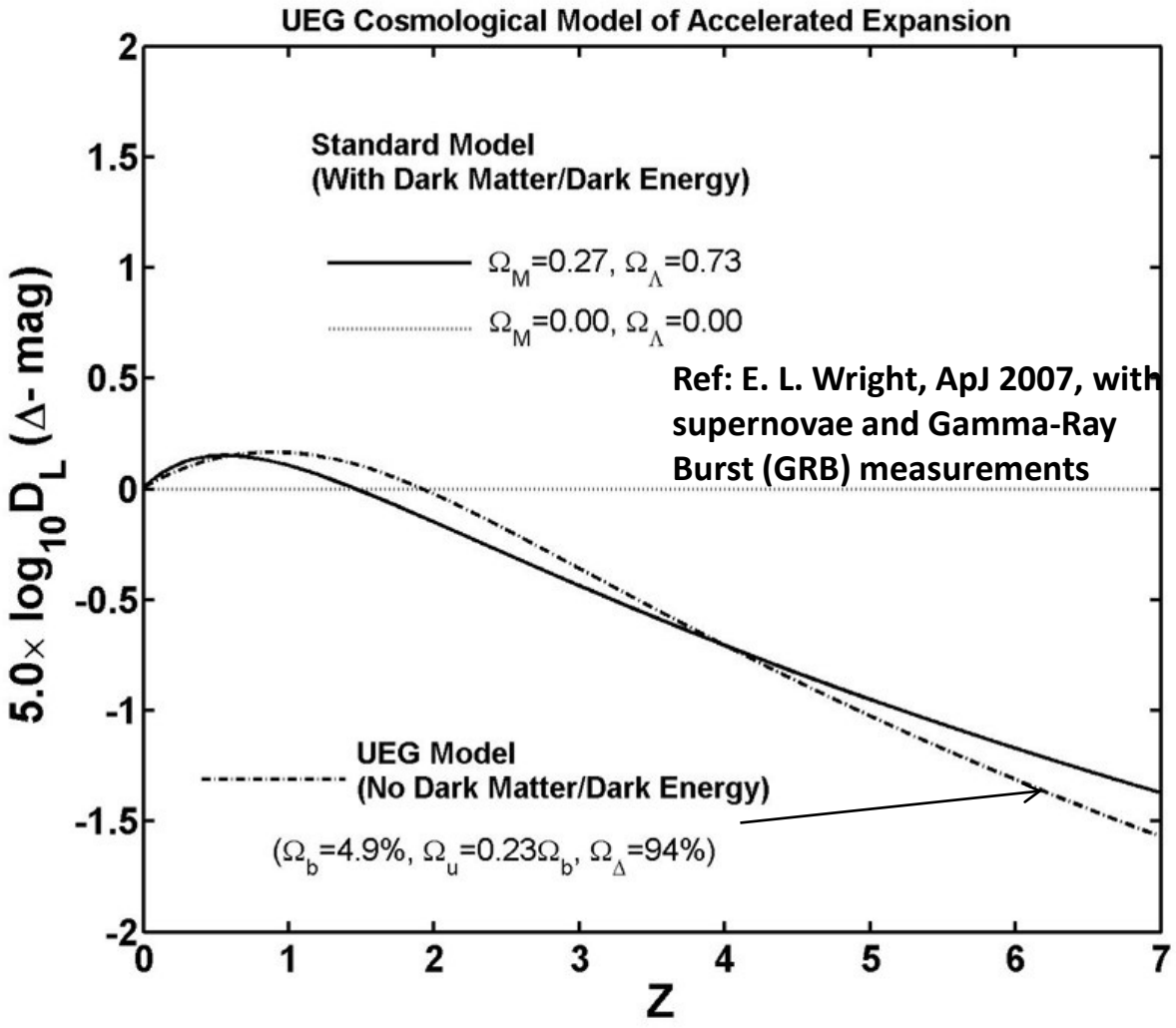
Luminosity Distance (Delta-Magnitude) for Larger Red-Shift



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Conclusion: Unified Electro-Gravity (UEG) Theory for Cosmology

- The accelerated expansion of the current universe can be explained by the new UEG theory, based on only conventional baryonic mass, without need for any hypothetical dark energy or dark matter.
- The UEG theory maybe extended to model the future as well as past universe, possibly explaining other unanswered cosmological questions, including the fate of the universe, the physical basis of an inflating/bouncing universe, and it may also resolve the recently reported tension in the Hubble Constant.

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