A Fundamental Conservation as a Unification of Quantum Theory and Relativity

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Abstract

A fundamental conservation and symmetry is proposed, as a unification between General Relativity (GR) and Quantum Theory (QT). Unification is then demonstrated across multiple applications. First, as applied to cosmological redshift z and energy density ρ. Then, a local system galaxy rotational curve is examined. Next, as applied to Quantum Mechanics' "time problem": Absolute and relative notions of time are shown to be reconcilable, as well as renormalization values between scales. Finally, as applied to the Cosmological Constant: The discrepancy that exists between the vacuum energy density in GR at critical density: $\rho_{cr} = 3H^2/8\pi G = 1.88(H^2)x10^{-29} g/cm^3$ [1], and the much greater zero-point energy delta value as calculated in quantum field theory (QFT) with a Planck scale ultraviolet cutoff: $\rho_{hep} = M^4c^3/h^3 = 2.44x10^{91} g/cm^3$ [2] is resolved to null orders of magnitude.

1 Introduction

Special relativity (SR) eloquently conforms to $\frac{Mv^2}{2}$ (total kinetic energy) in Noether's theorem as, [3]

$$E_k = \frac{Mc^2}{\sqrt{\frac{1-v^2}{c^2}}},$$

and energy is thus conserved (time-transitionally invariant). However, in GR, energy evolves as spacetime changes. Einstein has shown us that when the space through which particles move is dynamic, the total energy of those particles is not conserved. Moreover, the energy stored in the cosmological constant must expand at a rate of k^3, in proportion to the volume of expanding space. An additional challenge to vacuum energy is the unstable nature of the uneven distribution of matter throughout the universe. The pervading justification for redshift photon energy loss is the lack of an associated symmetry.
Conservation laws conventionally define invariance with respect to time. For example, the Euler-Lagrange equations (in general coordinates), [4]

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}}\right) = \frac{\partial L}{\partial q}$$

Then conservation is shown by the first order derivative of some quantity, with respect to time, being equal to zero,

$$\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_k}\right) = \frac{dp_k}{dt} = 0$$

However, this article proposes a fundamental conservation of total Hamiltonian energy within the entire scope of cosmology.

2 The Supernova Cosmology Project with Einstein-de Sitter Model

The 1998 supernova data [5] have concluded that the observed magnitude of nearby and distant type LA supernovae, as compared with cosmological predictions of models with zero vacuum energy and mass densities (ranging from the critical density ρ_c down to zero), has formally ruled out the Einstein-de Sitter model of closed ordinary matter (i.e. $\Omega_M = 1$) at the 7σ to 8σ confidence level for two different fitting methods. Moreover, the best fit to this divergence implies that, in the present epoch, the vacuum energy density ρ_Λ is larger than the energy density attributable to mass ($\rho_m C^2$). Therefore, cosmic expansion is now accelerating. However, an alternate interpretation of this data is presented, in defiance of a requirement for any dark component of energy density:

Theorem 1 *Time interval Δt contracts (decreases) inversely proportional to the metric expansion of space ar, independent of relative motion (Note that this is distinct from γ time dilation).*

$$\frac{\Delta t_n}{\Delta t} = \frac{\Delta ar_0}{\Delta ar_n} = \frac{\Delta D_0}{\Delta D_n}$$

Normalizing Δt_n from D,

$$\Delta t_n = \frac{1}{1+DK}$$

Where Δt_n is an interval of time at distance D_n, and K is an undetermined minute constant ($\approx 4.000E{-}24$) that becomes significant in a matter-dominated universe.

Thus, accelerating expansion is alternatively explained as being generally constant, such that $\ddot{a} = 0$ (excluding local variation) with a decrease in time interval Δt_n, which has an equivalent effect as an increase in velocity v. Thus,

Corollary 1.1 *Universal expansion, with decreasing time intervals, appears as accelerated expansion.*

Note that this offers an alternative to dark components, as functions with decreasing time intervals are equivalent to functions with an anti-derivative. See figure 1

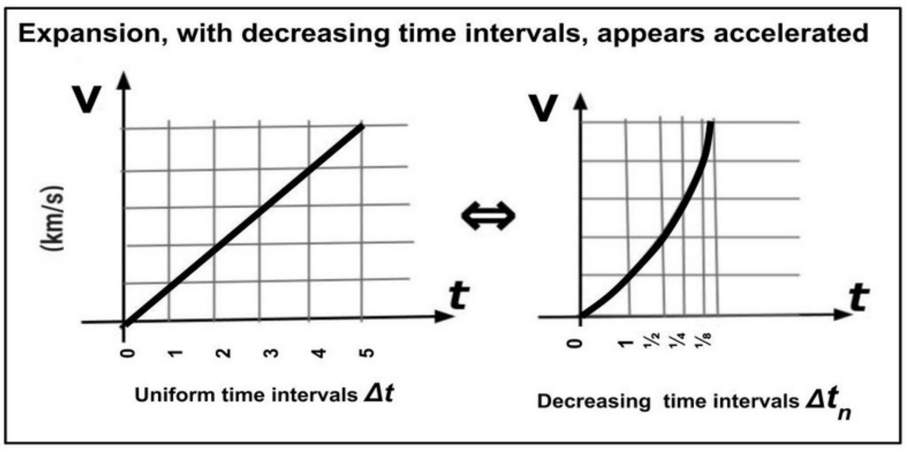

Figure 1: Velocity $\dot{a}(t)$ with decreasing time intervals appears as acceleration $\ddot{a}(t)$

Table 1 lists eleven hypothetical sla points as predicted in the Einstein-de Slitter model with uniform time intervals, compared with contracted time intervals (Δt_n, per theorem 1). The scatter plot in figure 2 (with logarithmic horizontal axis) shows three trend lines with corresponding values of K $\approx (\Omega_M, \Omega_\Lambda) = (0,1), (0.5, 0.5), (1,0)$. Note: $\ddot{a}(t) = 0$.

Table 1: Predicted Einstein-de Slitter model with uniform time intervals, compared with contracted time intervals. In successive columns: $[m_b]$ (magnitude brightness), z (Redshift), Δt_n $[K_a = 0]$, Δt_n $[K_b$=2.000 x $10^{-24}]$, Δt_n $[K_c$=4.000 x $10^{-24}]$

m_b	z	Δt_n $[K_a]$	Δt_n $[K_b]$	Δt_n $[K_c]$
14	0.010	1.000	0.998	0.997
15	0.016	1.000	0.996	0.995
16	0.025	1.000	0.994	0.993
17	0.040	1.000	0.990	0.988
18	0.063	1.000	0.985	0.982
19	0.100	1.000	0.976	0.971
20	0.158	1.000	0.963	0.955
21	0.250	1.000	0.942	0.931
22	0.396	1.000	0.911	0.895
23	0.628	1.000	0.866	0.843
24	0.996	1.000	0.803	0.772

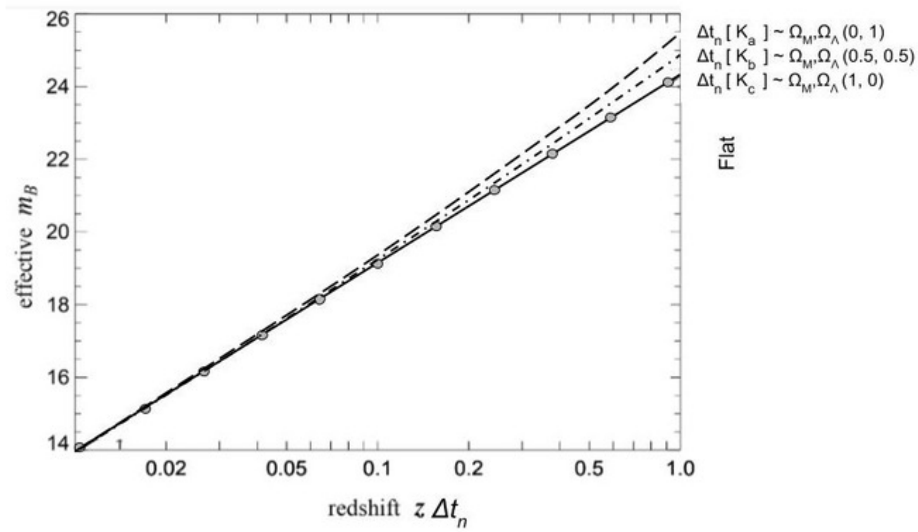

Figure 2: Hypothetical sla points as predicted in the Einstein-de Slitter model with uniform time intervals, compared with contracted time intervals

3 Energy Density Increases with Δt_n

Corollary 1.2 *Per theorem 1, velocity $\frac{\Delta d}{\Delta t_n}$ increases with distance ar. With this proportionate increase in velocity, energy density ρ proportionally increases, due to increased velocities in particle kinetic and internal energies (compression, energy of nuclear binding, etc.). To the observer at ar_0, energy at ar_n [mpc] density measures ρ_n with greater energy per unit of time.*

$$\frac{\Delta \rho_n}{\Delta \rho} = \frac{\Delta t_n}{\Delta t}$$

Conservation of Energy Density Over Flat Space

Einstein had contemplated that his original static model of GR was unstable, and might require the cosmological constant to offset gravity from collapsing. However, this alternate model is inherently more stable:

Corollary 1.3 *For galactic scales, at distance ar_n, the average force of energy density ρ, approaching from below ar_n, is counter-balanced by the average force of increasing energy density ρ_n approaching from above ar_n,*

$$\lim_{r \to -r_n} \frac{\partial \rho}{\partial (ar)} = \lim_{r \to +r_n} \frac{\partial \rho_n}{\partial (ar)}$$

Thus, a fundamental conservation and coordinate symmetry of energy density, with respect to spacetime, is established. See figure 3,

Galaxy Rotation Curve with Increased Density

The discrepancies between theoretical and observed galaxy rotation curves involve both density and velocity. Conventionally, the dependence of circular velocity V_{circ} on radial distance R assumes M, m and velocity to be fixed over large scales in Kepler's law, [6]

$$T^2 = \frac{4\pi^2 r^3}{GM} \Rightarrow T^2 \propto r^3$$

Moreover, gravitational lensing demonstrates the existence of a much greater Mass (density) than the sum of the stars within the galaxy. **However, this alternate model specifically addresses these two issues and provides an explanation,**

Corollary 1.4 *Per theorem 1 and corollary 1.2, velocity $\frac{\Delta d}{\Delta t_n}$ and density ρ_n are measured with increased magnitude per distance ar_n. This directly extends to energy density within galaxies and the effects on rotational velocity, such that: As R increases, centripetal force is perfectly balanced by increases in v ($\frac{\Delta d}{\Delta t_n}$) and, subsequently, ρ_n,*

$$\frac{v^2}{r} = \frac{G}{r^2} M = \frac{G}{r^2} \int \rho_n dt$$

Note: total mass M inside the circle of the radius r can be obtained by doing an integration of mass density in a volume. $M = \int \rho_n dt$ Note:

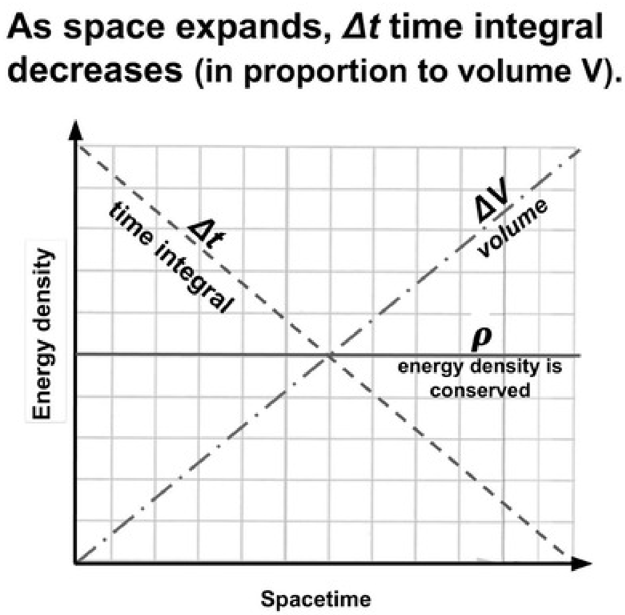

Figure 3: Fundamental conservation and coordinate symmetry of energy density, with respect to spacetime

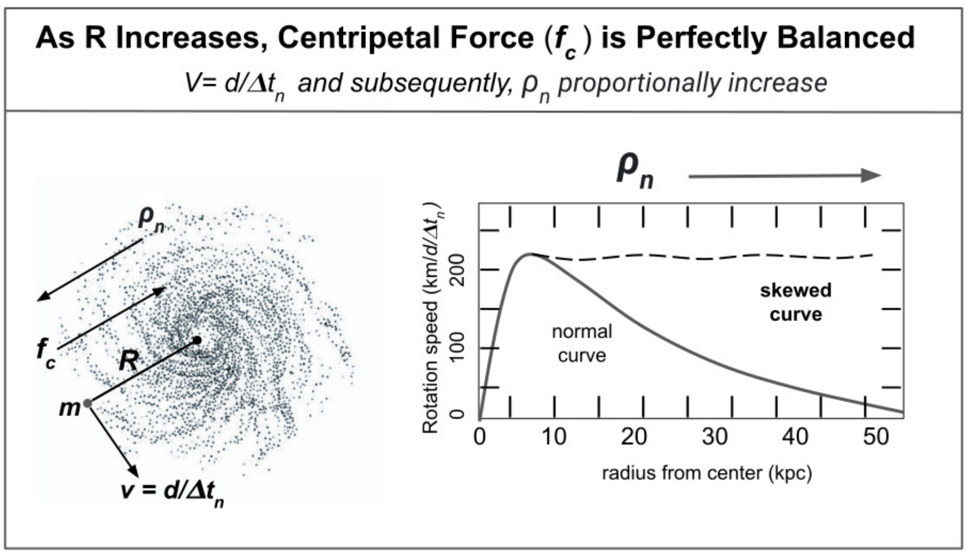

Figure 4: Flat galaxy rotation curve explained with fundamental conservation

- $\rho = \rho_R$ and ρ_M (Dark components are excluded from this model, with the intent of presenting an alternative).
- Along with time dilation γ, time contraction Δt_n is a distinct and necessary factor in deriving proper time
- $\Omega = 1$ (flat space)
- The expanding universe is homogeneous, isotropic, and asymptotically flat.

4 Quantum Mechanics Time Problem

The logical contrapositive of theorem 1 is that the unit of time increases in microspace:

Theorem 2 *As scales approach Planck length, time intervals dilate (independent of their relative motion in SR) to a range, represented as an integral from* $-t_n past$ *to* $+t_n$ *future. Subsequently, corresponding values of position, energy, density, and charge become superimposed within this dilated range.*

Figure 5 shows how both GR and QM are unified by this single basic premise. The entire range of scales, from 10^{26} to 10^{-35}, is illustrated with corresponding time units contracting in macrospace and expanding in microspace. Notice how a familiar projectile in classic-space appears normally orthogonal to the observer, yet a rotating body in macrospace appears skewed along the line of sight, as well as accelerated, as a result of decreased units of time. Also notice that a particle in macrospace **appears to be in a wider range of positions, as a result of increased units of time (similar to a photograph with a delayed shutter).**

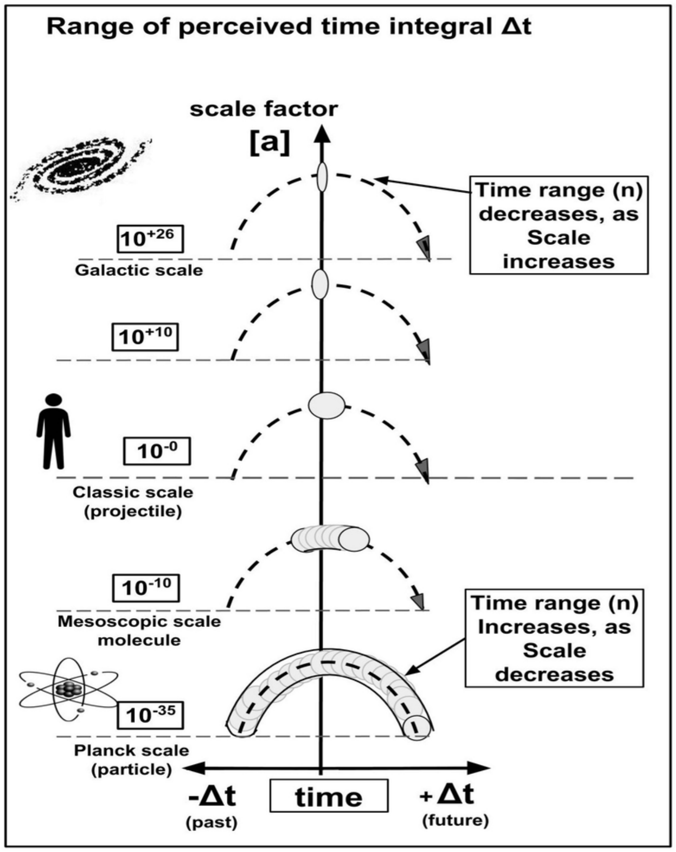

Figure 5: Gr and QM are unified

This assertion also challenges the use of mass in DeBroglie's λ by substituting a unit of length (scale), such as r_e (electron radius) or r_0 (atomic radius), instead of mass:

Hydrogen atom wave function (for plane wave): [7]

$$\Psi_{\vec{k}(\vec{r})} = e^{i\vec{k}\cdot\vec{r}} \tag{1}$$

Using $p = \hbar k$ for momentum, the dominate wave function $Psi_{\vec{k}_0}$ includes wave vector $\vec{k}_0$:

$$k_0 = \frac{2\pi}{\lambda_0} \implies \lambda \propto -d \tag{2}$$

thus,

Corollary 2.1 *wavelength is inversely proportional to distance,*

$$\lambda \propto -d$$

Extending this relationship to superposition,

Corollary 2.2 *From classic space, the observer notices an expanded range (superposition) of time, position, momentum, and energy* { *t, x, p, e* }*. Essentially, observing an integral of past, present, and future in a single instant, (conceptually, like a time-lapse image), appearing as a semi-dense solid.*

So a particular orbit might appear as a torus. If the "range" is subatomic (< the orbit diameter) a projectile might appear as a partial torus. See figure 6

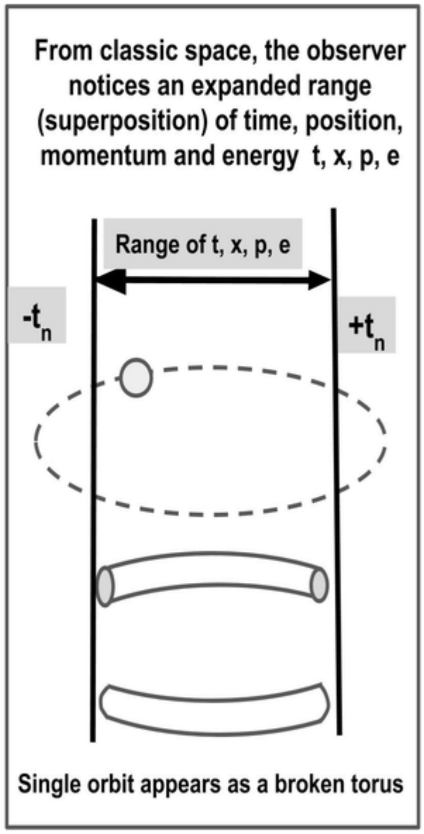

Figure 6: Orbitals with gaps

5 Cosmological Constant Λ (ρ_{cos}) in GR

Per theorem 1, accelerating expansion is shown to be an illusion ($\ddot{a} = 0$). See figure 1. The rate of convergence corresponds to Δt_n. Thus canceling the need for adding Λ to Einstein's field equations. We are left with the original form of: [8]

$$R_{\mu\nu} - \frac{1}{2} R g_{uv} = \frac{8 \times \pi G}{c^4} T_{\mu\nu} \tag{3}$$

6 Vacuum Energy Density (ρ_{hep}) in QM

Theorem 2 ("As scales approach Planck length, time intervals dilate to a range, represented as an integral from -t_n past to +t_n future. As well as corresponding values of position, energy, density, and charge become superimposed within this range".), and corollary 2.1 ("wavelength is inversely proportional to distance") provides a reasonable alternative to the unreasonable sum of vacuum energy (even within a restricted cutoff of photon energy being equal to Planck energy):

Corollary 2.3 *As measured from the classic scale, the Casimir force (U) between plates a distance x micrometers apart represents a much greater range (n) of expanded time interval, along with associated values of position, energy, momentum, and charge.* ***This range (n) increases as*** x ***decreases****.*

$$U_{range} = \int_{-t_n}^{t_n} \int_{-q_n}^{q_n} \frac{U}{\lambda} \, dt$$

Where (q) is general positional coordinates. Thus, the assumed force measured in a unit of volume is instead a much greater integral over, both time (-t_n past to +t_n future) and position (-q_n to q_n). Note that as λ decreases U increases (See figure 7,

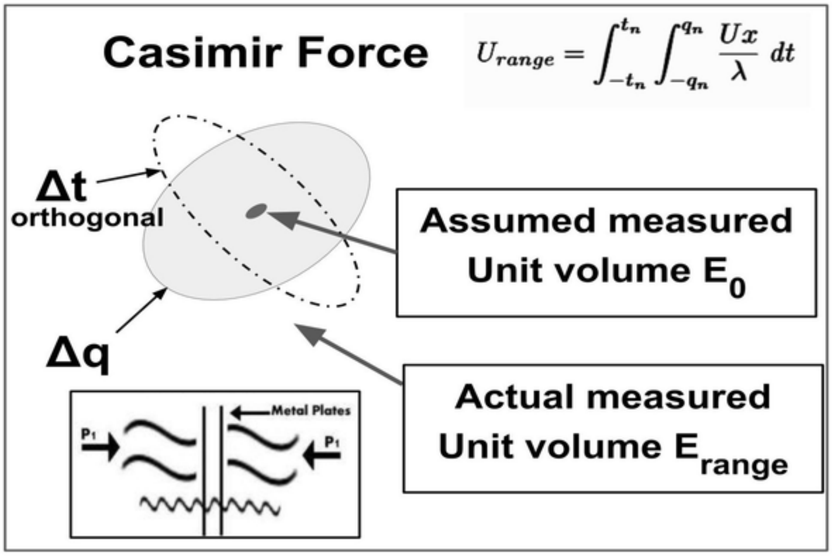

Figure 7: Casimir force energy U represents an integral (range) of both time and position

7 Supportive Evidence

Apparent Deviation From Kepler's Orbital Laws

Theorem 1, is supported by the following correlation study: "On Possible Systematic Redshifts Across the Disks of Galaxies" [9]. This study shows a deviation from Kepler's orbital laws, specifically on the subject of increased velocity on the far sides of multiple galaxies. Although not conclusive, it does justify the consideration of this article.

Note that multiple galaxy surveys with increased velocities across their minor axis. Thus, **velocity within the same body appears to increase per distance.** "Velocity observations in 25 galaxies have been examined for possible systematic redshifts across their disks: a possible origin for the redshifts could be the radiation fields. Velocities increase towards the far sides in most cases. This is so for the ionized gas, for neutral hydrogen, and in some cases for the stars. The effect is seen as velocity gradients along the minor axes, as well as in velocity fields of neutral hydrogen in other parts of the galaxies. Deviation of the kinematic major axis from the optical axis is found for 10 galaxies, and, in 9 of these, the largest velocities occur on the far side. In the central regions of four galaxies are found large velocity gradients in the same direction. While expanding motions provide an explanation for some of these features, it remains difficult to thereby explain all the peculiarities found. The faintness of the data available in this preliminary study should be noticed. Observations specially programmed for this subject would be necessary."

Figure 8 shows 'table 1', on page 258 which lists 25 galaxies, correlation coefficients, and relevant columns (including sources of data):

Prediction as Supportive Evidence

One prediction of decreasing time intervals would be: Galaxies with a negative z value (approaching instead of receding, in our local group) would also correlate with distance, such that the furthest galaxies would appear to approach with the fastest velocity.

8 Conclusions

In order to define the fundamental conservation and symmetry of spacetime, within the broad scope of cosmology, it is necessary to consider some independent parameters representing constant energy. Once this conservation is established, a simple and parsimonious resolution to applications in General Relativity, Quantum Mechanics, and the Cosmological constant becomes both plausible and reasonable.

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Table 1. List of galaxies for which velocities along the minor axis are available. In successive columns: type; distance; angle between rotation axis of galaxy and line of sight; regression and correlation coefficients between velocity and distance; source of data

NGC	Type	d (Mpc)	i	h(kms^{-1} kpc^{-1})	ϱ	Source of data
224	Sb	0.69	77°	0.20	0.272	Gottesman and Davies (1970)
253	Sc	4.0	78	0.13	0.012	Burbidge *et al.* (1963a)
300	Sd	2.4	43	1.03	0.844	Shobbrook and Robinson (1967)
598	Scd	0.72	57	1.51	0.866	Gordon (1971)
613	SBbc	15	47	57.09	0.820	Burbidge *et al.* (1964c)
972	SBc	17	66	−11.31	−0.670	Burbidge *et al.* (1965)
1084	Sc	14	65	− 4.75	−0.338	Burbidge *et al.* (1963b)
1097	SBb	12	50	5.00	0.105	Burbidge and Burbidge (1960)
1365	SBb	15	66	−79.21	−0.976	Burbidge *et al.* (1962a)
1792	Sbc	10	64	10.12	0.587	Rubin *et al.* (1964)
2403	Scd	3.3	55	0.04	0.118	Burns and Morton (1971)
3310	Sbc	11	31	61.27	0.815	Walker and Chincarini (1967)
3521	Sbc	7.6	66	7.18	0.056	Burbidge *et al.* (1964b)
4736	Sab	3.3	40	44.28	0.849	Chincarini and Walker (1967)
4826	Sab	7.3	60	39.16	0.854	Rubin *et al.* (1965)
5194	Sbc	4.0	35	−15.18	−0.758	Burbidge *et al.* (1964a)
5248	Sbc	11	55	−26.94	−0.690	Burbidge *et al.* (1962b)
5457	Scd	3.5	27	− 1.40	−0.403	Rogstad and Shostak (1971)
6574	Sbc	33	45	4.73	0.428	Demoulin and Tung Chan (1969)
7469	Sa	51	49	8.69	0.552	Burbidge *et al.* (1963c)

Figure 8: two vectors, observed at $d = 1mpc$, with different radial velocities

References

[1] R. L. Oldershaw. Self-similar cosmological model: Introduction and empirical tests. *International Journal of Theoretical Physics*, 1989.

[2] S. M. Carol. The cosmological constant. *Annual review of astronomy and astrophysics, Vol 30*, 1992.

[3] R. Brehme. *Introduction to the Theory of Relativity*. Addison-Wesley Series in Physics, 1968.

[4] M Hazewinkel. *Lagrange equations (in mechanics)*. Kluwer Academic Publishers, 2001.

[5] S. Perlmutter. Measurements of omega and lambda from 42 high-redshift supernovae. *arXiv.org*, 1998.

[6] E. Butikov. Motions of celestial bodies. *IOP Publishing*, 2014.

[7] I. R. Afnan. *Quantum Mechanics with Applications*. Bentham Science Publishers, 2010.

[8] S. Weinberg. *Gravitation and Cosmology*. John Wiley and Sons, 1972.

[9] T. Jaakkola, P. Teerikorpi, and K. Donner. On possible systematic redshift across the disks of galaxies. *Astronomy and Astrophysics.*, 1975.