

Presentation Charts for
**ANISOTROPIC LIGHT-VELOCITY
AND (FAR FIELD) GRAVITATION
IN EXPANDING SPACETIME**

Given at the Annual AAASPD Conference (June 2016) in San Diego

While demonstration of the multi-state character of classical physics was a primary intent at the 2015 AAAS-PD conference in San Francisco, theoretical derivation of the purely empirical *Milgrom's law* for far-field star dynamics (e.g., asymptotically external to spiral- and spheroidal-galaxies) was a primary intent at the next annual AAAS-PD conference (San Diego, 2016 June). Because the present theory is functionally equivalent to Milgrom's empirical law in the far-field limit, we may conclude a meaningful degree of empirical confirmation is immediately obtained.

An explanation of the key idea underlying (classical) multi-state physics in the derivation of Milgrom's law is appropriate. We first observe that one-way infinite light speed (inward) is essentially germane. This, however, immediately introduces an *apparent* contradiction: photons transfer information, and the instantaneous transmission of information over any finite distance is not supported in our experience (although this is possible in principle—see the San Francisco paper and charts). Notwithstanding this (apparent) contradiction, instantaneous information transfer via one-way infinite light-speed is normal function across the cosmos—and indeed also across the hierarchy of distances germane to our local experience, including within the laboratory.

To see how this might be possible, consider a photon pulse directed inward from the outer fringe of the Milky Way galaxy. We recognize that each photon of the pulse flies against a positive time-gradient $dt/d\xi = -dt/dr = 1/c$, where we should be open to the idea of time-gradients across space-time inasmuch as finite time-gradients have been an essential part of relativity physics since Einstein's 1905 paper—albeit regarding relatively moving observers rather than (relatively) stationary observers. In its flight each photon (instantly) traverses each length segment on its way to the center, but since there are corresponding time gains the nominal light-speed is recovered as a measurable quantity.

As part of this scenario we may further imagine that the light-pulse enters the window of a laboratory on Earth wherein the light-speed is measured by some suitable apparatus. Once again the normal $3E5$ km/s speed is obtained—i.e., the same time-gradient over the (now greatly reduced) finite distance applies.

Returning to the AAAS-PD/San Diego charts to follow, theoretical derivation of Milgrom's non-theoretical relationship for far-field star dynamics is the objective. Because Milgrom's relationship is duplicated, its important empirical successes are, to reiterate, immediately shared or acquired by the present theory. This in turn promotes multi-state classical theory, as the consequence of one-way infinite light-speed.

As another note, there are two inductive advances leading to the theoretical duplication of Milgrom's empirical relationship: (1) One-way infinite light-speed (inward) combined with the Hubble expansion; and (2) Connecting or uniting the time-dilation attending Hubble expansion with the time dilation attending Schwarzschild's solution thereby yielding the invariant circular-orbit velocity (in the far-field). These inductive advances within the context of state-of-the-art relativity physics permit the following theoretical derivation of Milgrom's law in the far-field limit.

ANISOTROPIC LIGHT-VELOCITY AND (FAR FIELD) GRAVITATION IN EXPANDING SPACETIME

15 June 2016

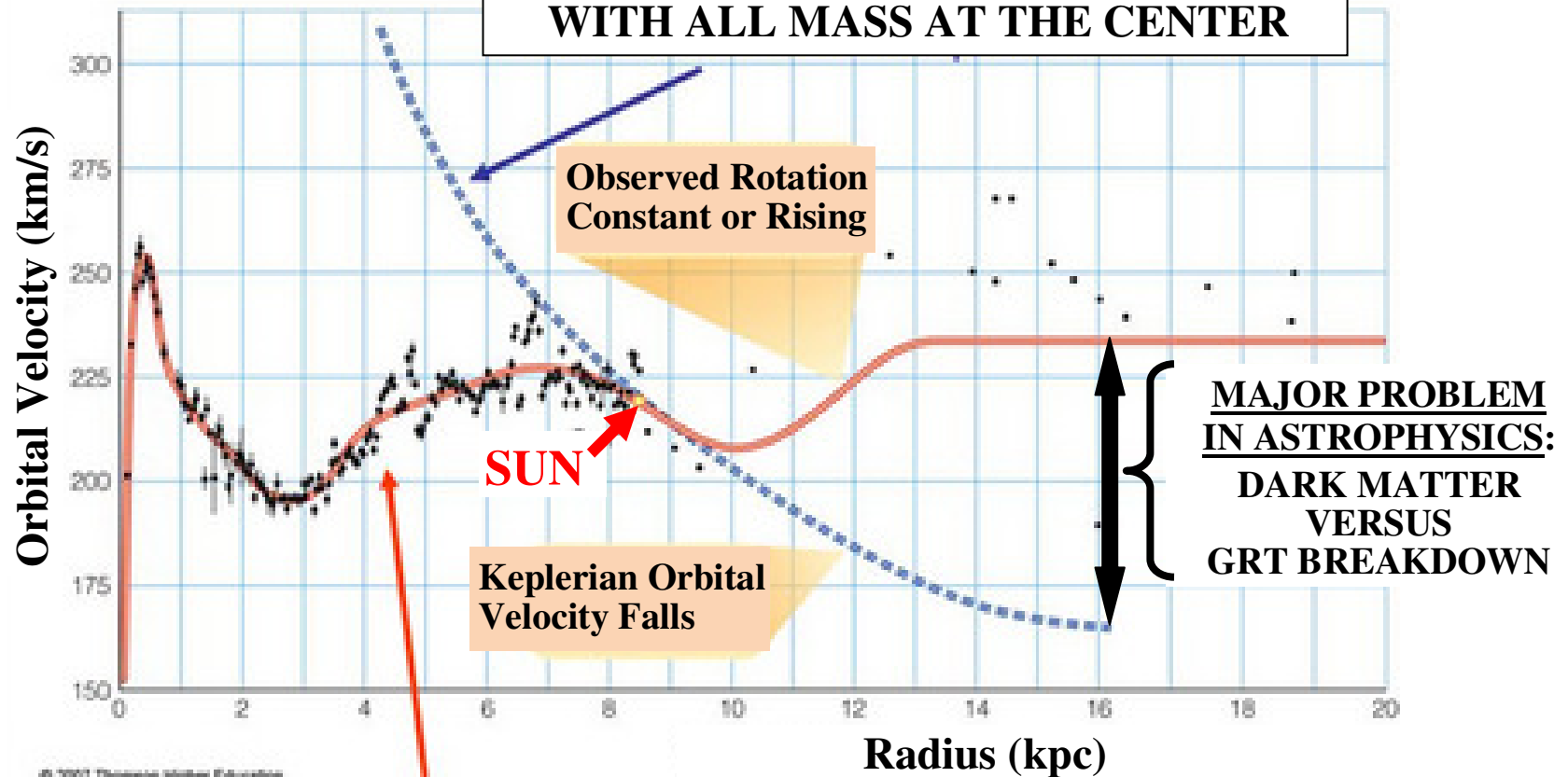
“Even if [dark matter] particles are detected directly in the near to far future, the success of MOND on galaxy scales as a phenomenological law, as well as the associated appearance of a universal critical acceleration constant $a_0 \simeq 10^{-10} \text{ m/s}^{-2}$ in various, seemingly unrelated, aspects of galaxy dynamics, will still have to be explained and understood by any successful model of galaxy formation and evolution.”

Benoit Famaey and Stacy S. McGaugh, 2012.

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(Rev 1, 11 July 2016)

MILKY WAY

**KEPLER'S THIRD LAW—
WITH ALL MASS AT THE CENTER**



**ROTATION CURVE—
SHOWING MEASUREMENTS**

MAIN THEORETICAL RESULTS

- The **Purely Empirical** Milgrom Relationship $V_f = (GMa_0)^{1/4}$ is Given a Relativistic Derivation

$$V_f = (GMcH)^{1/4}$$

in the Galactic and Binary Star Far-Field Domain.

- Indicated “Breakdown” of GRT in the Gravitational Intermediate-to-Far Field

RHETORICAL QUESTIONS:

- **Is Light Speed Necessarily Isotropic?**

No—The Minkowski Metric of GRT Accommodates Anisotropic Light Speed (Including Near Singular—One-Way Infinite).

- **Is GRT Accepted in the Present Work?**

Yes and No:

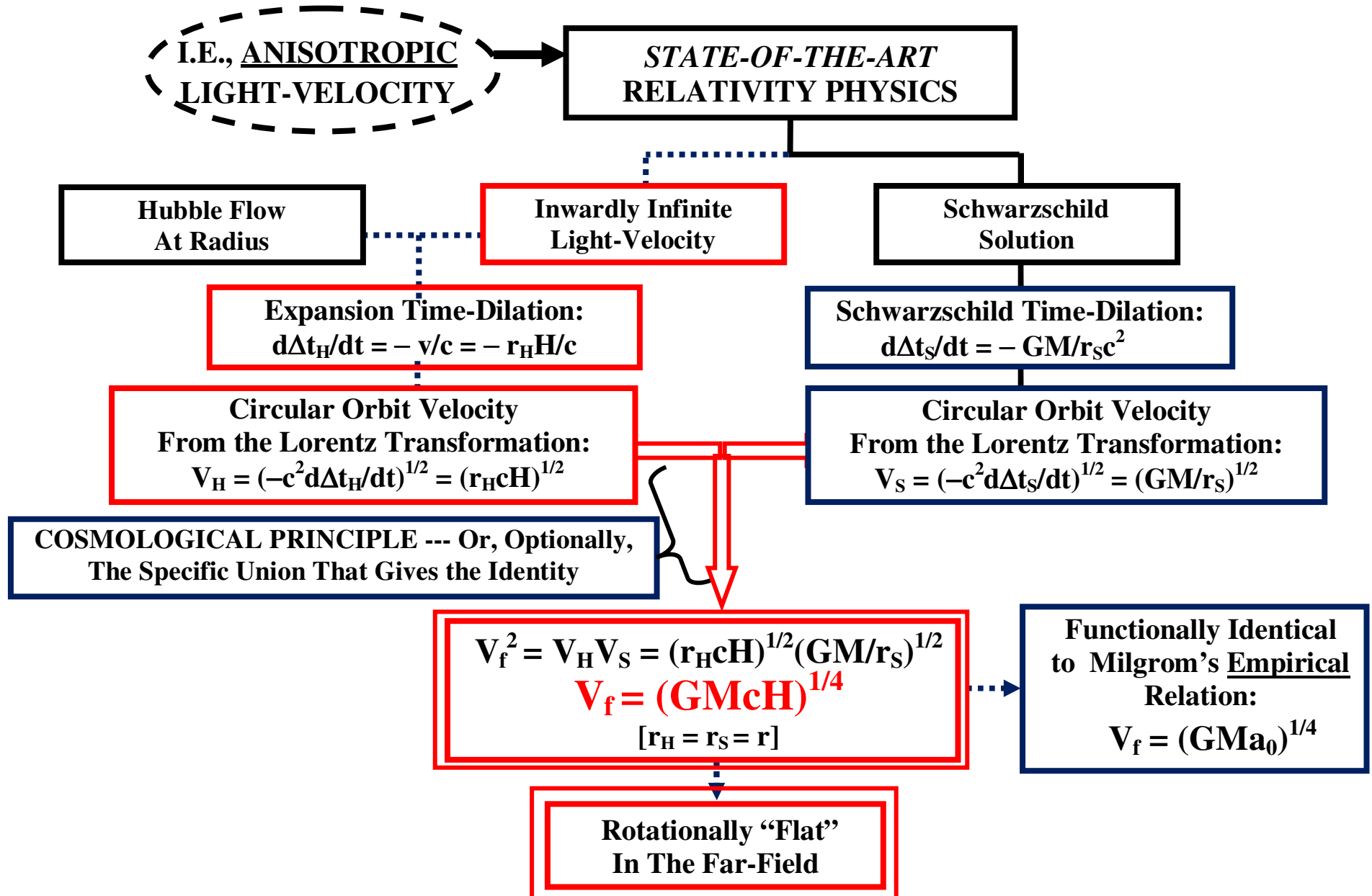
Yes—GRT Must and Will Be Recognized as Highly Accurate Within the Gravitational “Near-Field” (e.g., Solar System).

No—Due To Breakdown in the Gravitational “Far Field” ($a < a_0$).

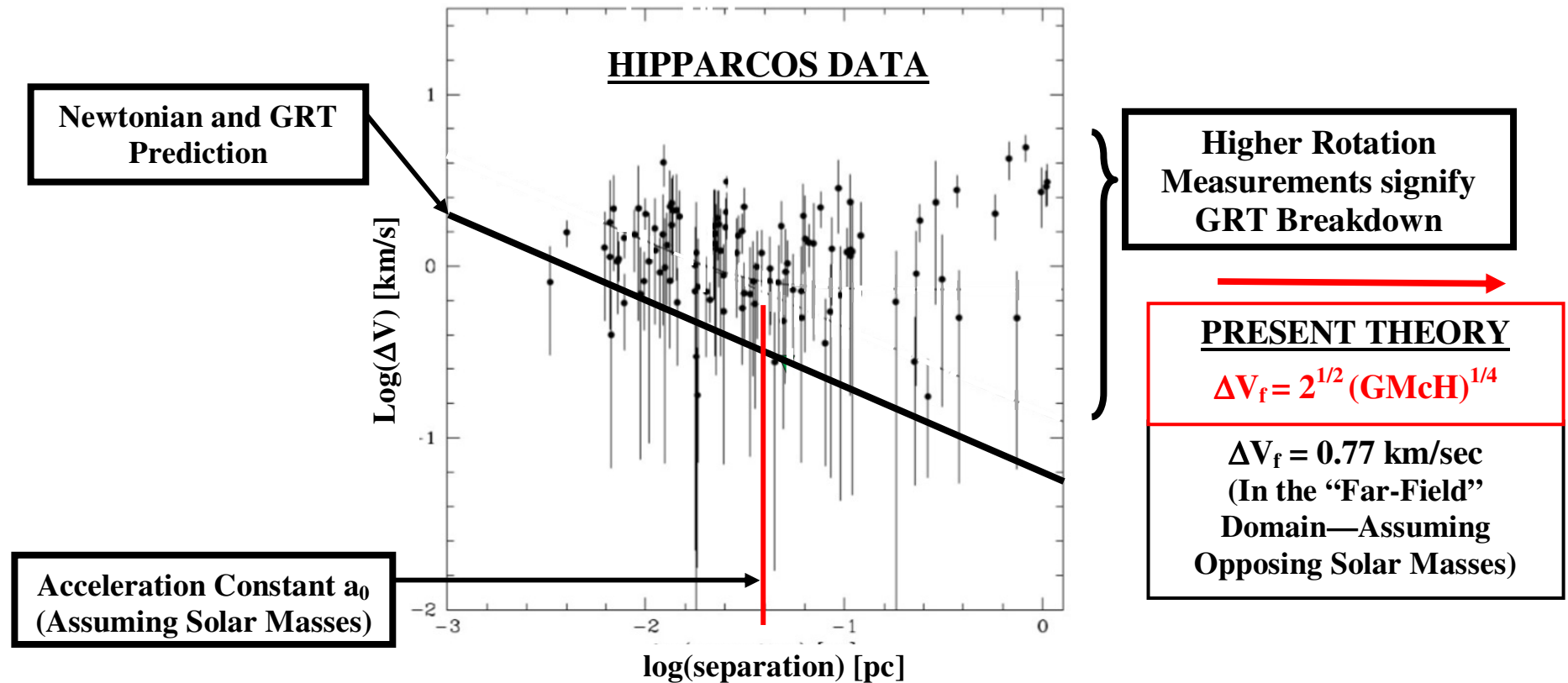
ONE-WAY INFINITE LIGHT-VELOCITY
WITHIN THE HUBBLE EXPANSION IS THE
GATEWAY TO DEEPER SPACETIME THEORY

- A. One-Way (Very-Near) Infinite Light-Velocity:**
- **With $H=0$ ---of No Predictive Consequence in Special and General Relativity**
- B. Hubble Expansion:**
- **With $c=\text{Constant}$ ---of No Predictive Consequence in Special and General Relativity**
- HOWEVER---**
- C. A and B Taken Together:**
- **A Deeper Theory Becomes Possible (Within Relativity Theory)**
 - **Because---It Enables Prediction and Explanation of Far-Field Star-Velocity Flattening**

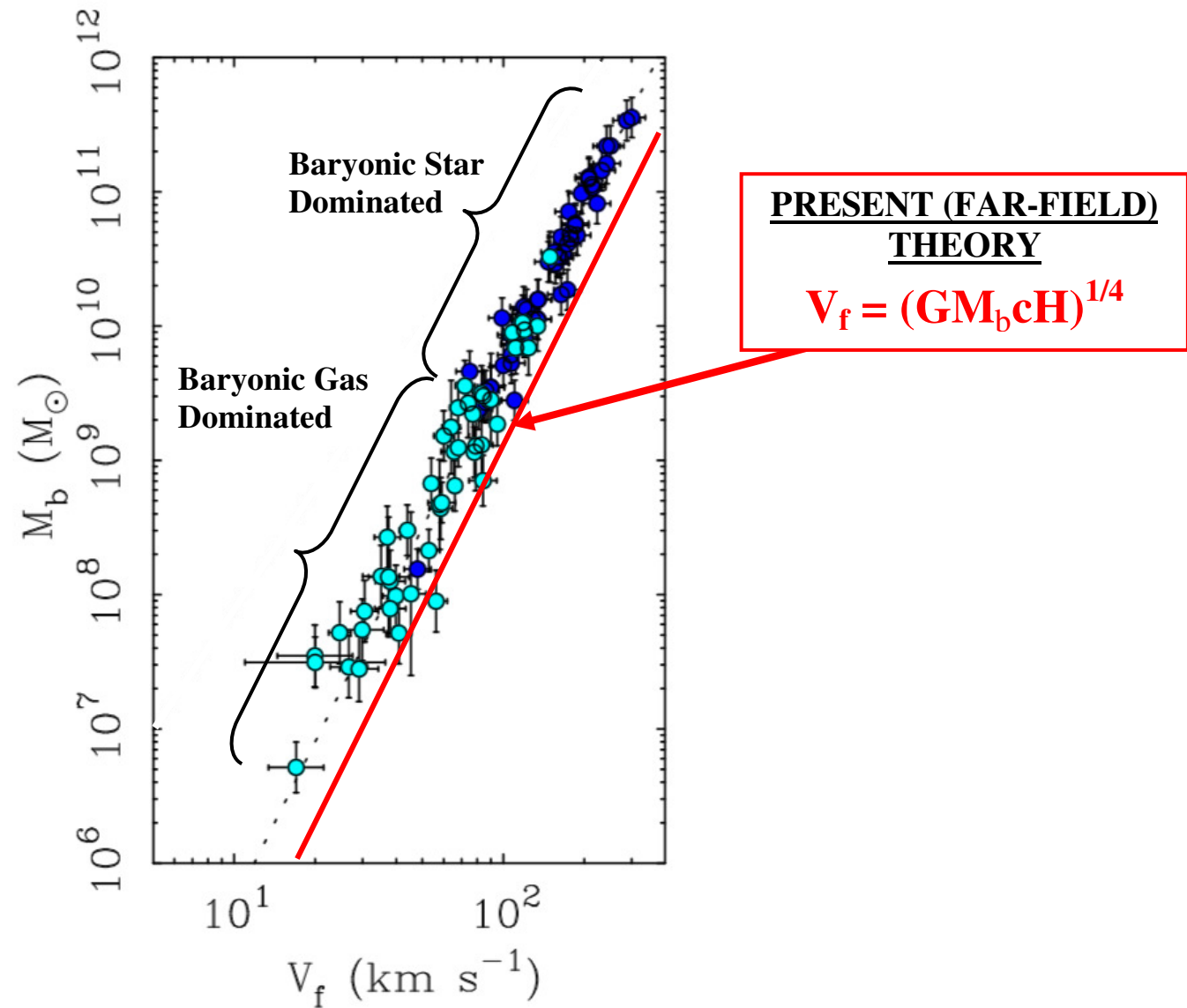
FAR-FIELD GRAVITATION THEORY



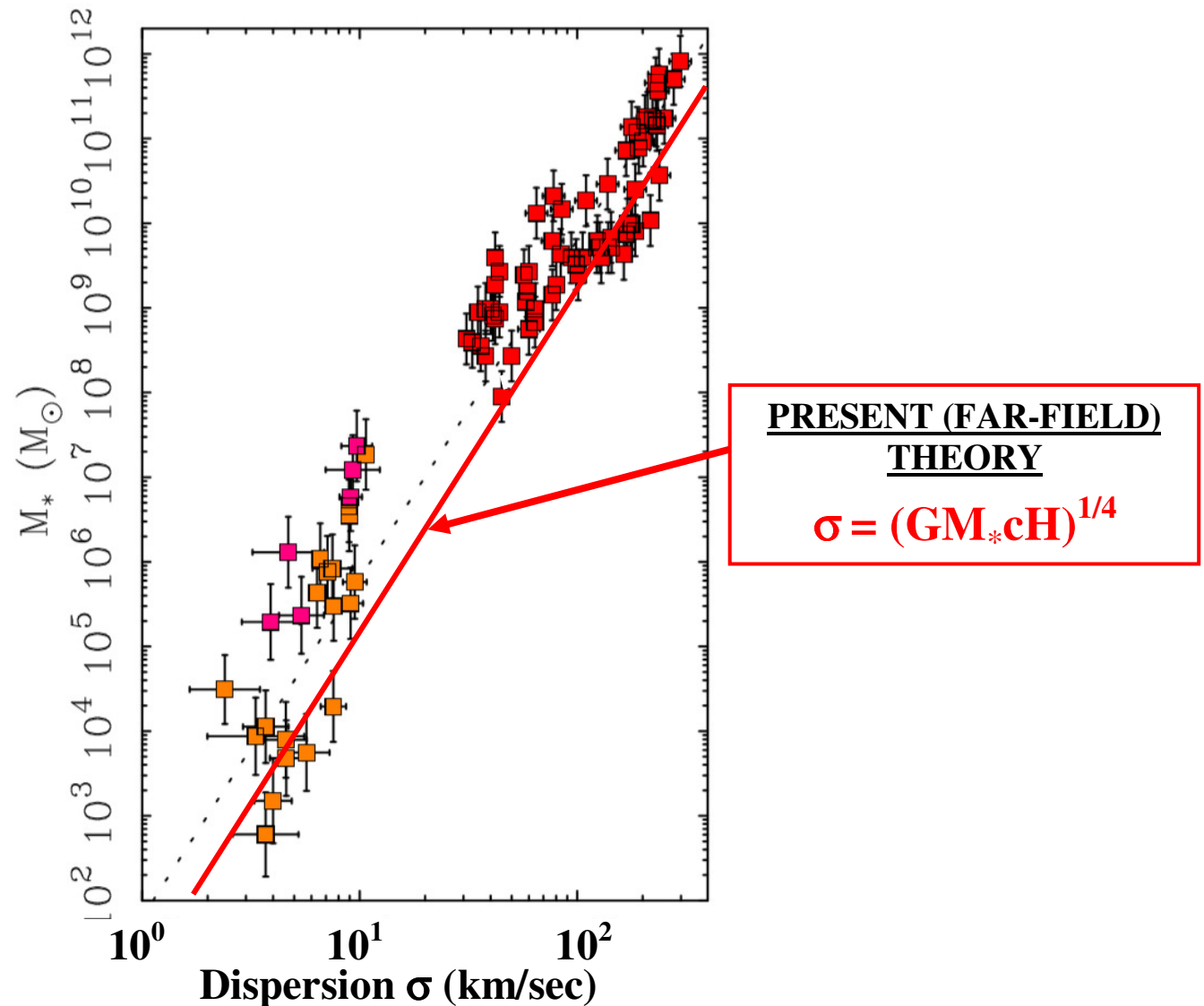
NEAR-FIELD ← INTERMEDIATE-FIELD → FAR-FIELD



Binary Star Rotation—Showing Newtonian/General Relativity Theory Breakdown



Outer (Intermediate-to-Far Field) Mass-Rotation Velocities for Spiral Galaxies



The Faber–Jackson relation for spheroidal galaxies, including both elliptical galaxies (red squares) and Local Group dwarf satellites (orange squares are satellites of the Milky Way; pink squares are satellites of M31. From Famaey and McGaugh (2012)

CONCLUSIONS

REVISED GRT (FAR-FIELD):

- **One-Way infinite Light-Velocity—Necessarily Coupled With Hubble Expansion (Otherwise of no Empirical Consequence)**
- **Far-Field Gravity “ $g=(g_N c H)^{1/2}$,” Is Then Derived in Accord With the Cosmological Principle—Functionally Equivalent to Milgrom’s Empirical Law “ $g=(g_N a_0)^{1/2}$,” (Using Extensive “Background” Theory:**

SRT

Einstein’s 1907 Paper “Principle of Relativity and Gravitation”

GRT By Way of the Schwarzschild Solution

Cosmological Principle

Hubble Expansion)

EMPIRICAL COMPARISONS:

- **Wide-Binary Star Rotation**
- **Spiral Galaxy Rotation**
- **Spheroidal Galaxy Star-Velocity Dispersion**

THEORETICAL CONCLUSIONS:

- **Galactic Rotation and Dispersion Flattening Is Due To Conjunction of One-Way Infinite Light-Velocity (Inward) and the Hubble Flow.**
- **Necessary to Revise General Relativity—To Accommodate the Intermediate-to-Far Field (While Saving the Highly Accurate Near-Field—e.g., Within the Solar System)**