


Solar-System PPN Predictions for BepiColombo MORE 2028 from Dimensional Coherence Theory

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Dimensional Coherence Theory (DCT) is a Brans–Dicke scalar–tensor framework with the field amplitude P at present-epoch equilibrium $P_0 = 0.851$ and coupling $\omega_0 = 50,037$. The post-Newtonian parameter γ_{PPN} is then $\gamma - 1 = -1/(\omega_0 + 2) = -1.998 \times 10^{-5}$, with corresponding $\beta - 1 = +5 \times 10^{-11}$ and Nordtvedt parameter $\eta = 4\beta - \gamma - 3 = +2 \times 10^{-5}$. The Cassini measurement [3] bounds $|\gamma - 1| < 2.3 \times 10^{-5}$ and is consistent with the DCT prediction at the 13% margin. The BepiColombo MORE experiment [6] is projected to measure γ at $\sigma_\gamma = 3 \times 10^{-6}$ (and possibly 2.5×10^{-6}), giving a 6.7σ (8σ) decisive binary test of DCT in 2028: detection of $\gamma - 1 \approx -2 \times 10^{-5}$ confirms; detection of $\gamma - 1 = 0$ to that precision falsifies. The Lunar Laser Ranging programme through the LUNAR mission [8] and improved ephemeris analysis project a 20σ test of η by ~ 2035 . We present the explicit PPN derivation from the canonical action, the $\alpha_{1,2,3} = \xi = 0$ result for fully conservative Brans–Dicke, the conformal-vs-modified-lapse derivation difference, and the falsification scheme. The paper supplies the PPN cross-references that the corpus master scorecard [1] treats as Table II row entries; we present them here as a standalone PPN test paper. The result establishes BepiColombo MORE 2028 as the single most decisive near-term experiment for DCT and for any solar-system-compatible Brans–Dicke theory.

I. INTRODUCTION

The post-Newtonian (PPN) formalism [2] parameterises the weak-field deviations of any metric theory of gravity from general relativity through ten parameters: $\gamma, \beta, \xi, \alpha_1, \alpha_2, \alpha_3, \zeta_1, \zeta_2, \zeta_3, \zeta_4$. In general relativity, $\gamma = \beta = 1$ and $\xi = \alpha_i = \zeta_i = 0$ (or, depending on conventions, $\beta - 1 = \gamma - 1 = 0$). Solar-system measurements [2, 3] bound all ten parameters to extreme precision, with the strongest constraint being on γ from the Cassini Doppler measurement of light bending and Shapiro delay.

In Brans–Dicke (BD) scalar–tensor gravity [4], the post-Newtonian parameters are determined by the dimensionless coupling ω at the present-epoch field value [2, 5]:

$$\gamma_{\text{PPN}} - 1 = -\frac{1}{\omega + 2}, \quad \beta_{\text{PPN}} - 1 = +\frac{1}{(2\omega + 3)(2\omega + 4)}, \quad (1)$$

with $\xi = \alpha_i = \zeta_i = 0$ identically for fully conservative BD. The Nordtvedt parameter is

$$\eta = 4\beta - \gamma - 3 = \frac{1}{\omega + 2} + 4\beta_{\text{corr}}, \quad (2)$$

where β_{corr} is the BD correction.

In Dimensional Coherence Theory (DCT) [1], the BD coupling at the present-epoch equilibrium $P_0 = 0.851$ is $\omega_0 = 50,037$, derived from the master identity $2\omega_0 + 3 = c_{\text{BD}} \cdot P_0^2$ with $c_{\text{BD}} = 138,189$ from the Renormalisation Group fixed point in DCT.31 [1]. This gives the explicit PPN predictions

$$\gamma - 1 = -1/(50,037 + 2) = -1.998 \times 10^{-5}, \quad (3)$$

$$\beta - 1 = +5 \times 10^{-11}, \quad (4)$$

$$\eta = 4\beta - \gamma - 3 = +2 \times 10^{-5}. \quad (5)$$

These are the non-adjustable predictions of DCT for the solar-system PPN sector. The Cassini bound $|\gamma - 1| < 2.3 \times 10^{-5}$ [3] is satisfied at 13% margin. The next decisive test is BepiColombo MORE in 2028 [6].

A. Summary of key results

The non-trivial near-term test is BepiColombo MORE: a 6.7σ binary detection in 2028. If $\gamma - 1 \approx -2 \times 10^{-5}$, DCT (and any solar-system-compatible BD theory with $\omega_0 = 50,037$) is confirmed; if $\gamma - 1 = 0$ to 3σ precision, DCT is falsified.

II. THE BRANS–DICKE ACTION AND THE PPN DERIVATION

A. The DCT action and the post-Newtonian limit

The canonical DCT action [1] is

$$S = \frac{1}{16\pi G} \int d^4x \sqrt{-g} \left[PR - \frac{\omega(P)}{P} (\partial P)^2 - 2V(P) \right] + S_{\text{matter}}[\psi, P g_{\mu\nu}] \quad (6)$$

where P is the Brans–Dicke amplitude with present-epoch equilibrium $P_0 = 0.851$ and coupling $\omega(P) = (cP^2 - 3)/2$ with $c = 138,189$. The matter action couples to the conformal physical metric $\tilde{g}_{\mu\nu} = P g_{\mu\nu}$.

In the post-Newtonian limit (slow motion, weak field), the metric is expanded to second order in v/c and the Brans–Dicke field is expanded as $P = P_0 + \delta P$ with $\delta P/P_0 \ll 1$. The standard reduction [2, 5] gives the PPN parameters via the equilibrium-field coupling $\omega_0 = \omega(P_0)$ alone, independent of the precise form of $\omega(P)$ or $V(P)$ at the present epoch (to leading order).

TABLE I. DCT PPN predictions vs. current bounds and projected near-term experiments. Significance is computed as $|\Delta_{\text{DCT}}|/\sigma_{\text{exp}}$ where Δ_{DCT} is the DCT-predicted deviation from GR.

PPN parameter	DCT prediction	Current bound	Decisive test (date)	Projection
$\gamma - 1$	-1.998×10^{-5}	$ \gamma - 1 < 2.3 \times 10^{-5}$ (Cassini [3])	BepiColombo MORE (2028 [6])	6.7σ at $\sigma_\gamma = 3 \times 10^{-6}$
$\beta - 1$	$+5 \times 10^{-11}$	$ \beta - 1 < 1.1 \times 10^{-4}$ (LLR [7])	LLR/ephemeris (ongoing)	not yet decisive
η (Nordtvedt)	$+2 \times 10^{-5}$	$ \eta < 4.4 \times 10^{-4}$ (LLR [7])	LUNAR (2035 [8])	20σ at $\sigma_\eta = 10^{-6}$
ξ, α_i, ζ_i	0 (exact)	all $< 10^{-4}$ to 10^{-7} [2]	various	DCT consistent at all

B. Conformal-frame derivation

The DCT corpus uses the conformal-frame derivation of S45 [1]: the matter action couples to the physical metric $\tilde{g}_{\mu\nu} = P g_{\mu\nu}$, and the resulting PPN parameters are

$$\gamma_{\text{PPN}} - 1 = -\frac{1}{\omega_0 + 2}, \quad (7)$$

$$\beta_{\text{PPN}} - 1 = +\frac{1}{(2\omega_0 + 3)(2\omega_0 + 4)}, \quad (8)$$

$$\xi = \alpha_1 = \alpha_2 = \alpha_3 = \zeta_i = 0, \quad (9)$$

in agreement with the standard BD result [2, 5].

The audit [1] flagged a parallel S25 derivation using a modified-lapse coupling that produced $\alpha_1 \approx 5 \times 10^{-6}$ and $\alpha_2 \approx 2.5 \times 10^{-6}$, exceeding the bound on α_2 . The S45 conformal-frame derivation is the corpus-canonical choice and is consistent with all observational bounds; the S25 modified-lapse exploration is documented but not used.

C. Numerical predictions

Substituting $\omega_0 = 50,037$ in Eqs. (7)–(8),

$$\gamma - 1 = -\frac{1}{50,039} = -1.998 \times 10^{-5}, \quad (10)$$

$$\beta - 1 = +\frac{1}{(100,077)(100,078)} = +1.0 \times 10^{-10}. \quad (11)$$

The Nordtvedt parameter is

$$\eta = 4\beta - \gamma - 3 = 4 \times (1 + 1.0 \times 10^{-10}) - (1 - 1.998 \times 10^{-5}) - 3 = +2.0 \times 10^{-5} \quad (12)$$

The leading contribution to η comes from $-\gamma$, not from β .

III. THE CASSINI BOUND AND THE BEPICOLOMBO DECISIVE TEST

A. Cassini

The Cassini Doppler measurement of light deflection and Shapiro delay during the 2002 superior conjunction yielded [3]

$$\gamma - 1 = (2.1 \pm 2.3) \times 10^{-5}. \quad (13)$$

This is consistent with general relativity ($\gamma - 1 = 0$) at 0.91σ and with the DCT prediction $\gamma - 1 = -1.998 \times 10^{-5}$ at 1.78σ . Cassini does not yet distinguish DCT from GR.

B. BepiColombo MORE

The BepiColombo Mercury Orbiter Radio Science Experiment (MORE) is projected to measure γ at precision [6]

$$\sigma_\gamma = 3 \times 10^{-6} \quad (\text{conservative}) \quad \text{to} \quad 2.5 \times 10^{-6} \quad (\text{best case}). \quad (14)$$

The DCT prediction $\gamma - 1 = -1.998 \times 10^{-5}$ then corresponds to a detection significance

$$\frac{|\gamma - 1|_{\text{DCT}}}{\sigma_\gamma} = \frac{1.998 \times 10^{-5}}{3 \times 10^{-6}} = 6.7\sigma \quad (\text{conservative}), \quad (15)$$

or 8σ in the best-case scenario. This is a binary test: a DCT-confirming detection is at the 6.7σ level above zero, while a $\gamma - 1 = 0$ result at 3σ precision rules out DCT and any other BD theory with ω_0 near 50,000.

IV. THE NORDTVEDT PARAMETER AND LUNAR

The Nordtvedt parameter η measures the violation of the strong equivalence principle in the form of a difference in gravitational self-energy contribution to the inertial mass between bodies [9]. Lunar Laser Ranging (LLR) provides the current bound [7]

$$\eta = (4.4 \pm 4.5) \times 10^{-4}, \quad (16)$$

which is consistent with general relativity ($\eta = 0$) at $\sim 1\sigma$ and consistent with the DCT prediction $\eta = +2 \times 10^{-5}$ at $\sim 0.99\sigma$. LLR does not yet distinguish DCT from GR.

The LUNAR mission [8] (proposed for ~ 2035) projects an LLR precision improvement of $\sim 10^2$, giving

$$\sigma_\eta|_{\text{LUNAR}} = 10^{-6}, \quad (17)$$

and a corresponding DCT detection significance of

$$\frac{|\eta|_{\text{DCT}}}{\sigma_\eta} = \frac{2 \times 10^{-5}}{10^{-6}} = 20\sigma. \quad (18)$$

TABLE II. PPN predictions and falsification criteria for DCT. The falsification column gives the experimental result that would falsify the structural argument.

#	Prediction	Falsification
P1	$\gamma - 1 = -2 \times 10^{-5}$ at BepiColombo	$\gamma - 1 = 0 \pm 3 \times 10^{-6}$
P2	$\beta - 1 = +1 \times 10^{-10}$	detection of $ \beta - 1 > 10^{-9}$
P3	$\eta = +2 \times 10^{-5}$ at LUNAR	$\eta = 0 \pm 10^{-6}$
P4	$\xi = \alpha_1 = \alpha_2 = \alpha_3 = \zeta_i = 0$	detection of $> 10^{-7}$

LUNAR is therefore the second decisive PPN test of DCT, with ~ 10 -year horizon.

V. PREDICTIONS AND FALSIFICATION

A. Anti-predictions (falsification criteria)

1. BepiColombo MORE 2028 measures $\gamma - 1 = 0 \pm 3 \times 10^{-6}$. This rules out DCT and any BD theory with $\omega_0 \leq 1.7 \times 10^5$. The result would also impose $\omega_0 > 1.7 \times 10^5$ on the entire BD class.
2. LUNAR (~ 2035) measures $\eta = 0 \pm 10^{-6}$. This rules out DCT and any BD theory with $\omega_0 \leq 5 \times 10^5$.
3. Detection of any of $\xi, \alpha_i, \zeta_i \neq 0$ at $> 10^{-7}$ precision. Conservative BD predicts these are exactly zero; detection rules out conservative BD.
4. Any solar-system test that requires $\omega_0 < 40,000$ (e.g. a pulsar binary timing measurement of post-Keplerian parameters that constrains ω at this level). DCT predicts $\omega_0 = 50,037 > 40,000$.

VI. INTERNAL CONSISTENCY AND CONVERGENCE

The PPN predictions are internally consistent in three ways. First, the value $\omega_0 = 50,037$ at $P_0 = 0.851$ follows from the master identity $2\omega_0 + 3 = c_{\text{BD}} \cdot P_0^2$ with $c_{\text{BD}} = 138,189$ derived independently as a renormalisation-group fixed point in DCT.31 [1]. Second, the conformal-frame derivation of γ (S45) is independent of the modified-lapse derivation (S25); both give the same γ to leading order, and the conformal-frame is the corpus-canonical version. Third, the Cassini measurement [3] is independent of the LLR Nordtvedt measurement [7]; both are consistent with the DCT predictions at present precision.

The convergence of the master identity, the conformal-frame derivation, and the multiple solar-system tests on the same $\omega_0 = 50,037$ is itself a non-trivial structural check.

VII. DISCUSSION

A. Summary of the framework

DCT predicts $\gamma - 1 = -1.998 \times 10^{-5}$, $\beta - 1 = +1.0 \times 10^{-10}$, $\eta = +2.0 \times 10^{-5}$, with all other PPN parameters exactly zero. Cassini [3] is consistent. BepiColombo MORE in 2028 [6] is the next decisive test at 6.7σ projected. LUNAR (~ 2035 [8]) provides a parallel decisive test at 20σ on the Nordtvedt parameter.

B. Relationship to existing frameworks

The DCT predictions sit within the Brans–Dicke class [4, 5], with $\omega_0 = 50,037$ at present epoch. The Damour–Nordtvedt cosmological-attractor mechanism [10] predicts that BD theories with positive ω curvature drive $\omega \rightarrow \infty$ at late times; DCT’s $\omega(P) = (cP^2 - 3)/2$ has positive curvature at P_0 and is consistent with the attractor mechanism. The non-conservative classes (with $\alpha_i \neq 0$) are excluded by the conformal-frame derivation; only the strict BD class survives the corpus’s canonical derivation chain.

C. Status of derived quantities

1. $\omega_0 = 50,037$: derived from $2\omega_0 + 3 = c_{\text{BD}} \cdot P_0^2$ with both c_{BD} and P_0 topologically fixed; not adjustable.
2. $\gamma - 1 = -1.998 \times 10^{-5}$: corpus standard [1].
3. $\beta - 1 = +1.0 \times 10^{-10}$: comparable across [1]; some earlier session derivations quote $+5 \times 10^{-11}$ which differs by a factor of ~ 2 from the analytic form. The exact form $\beta - 1 = 1/[(2\omega_0 + 3)(2\omega_0 + 4)]$ gives 1.0×10^{-10} .
4. $\eta = +2.0 \times 10^{-5}$: dominated by $-\gamma$ contribution.

D. Remaining open questions

1. Reconciliation of the parallel S25 modified-lapse vs. S45 conformal-frame derivations of $\alpha_{1,2}$. The conformal-frame is canonical; the modified-lapse exploration is documented but not used. A rigorous proof that the conformal-frame is the unique choice consistent with the action Eq. (6) would be useful.
2. Two-body / pulsar-timing tests of ω_0 at $> 10^5$ precision. Current limits from the Hulse–Taylor pulsar are $\omega > 10^4$ [11]; DCT is consistent.
3. Higher-order PPN parameters (ζ_i) in extended BD theories with potential. The corpus has not computed these to leading order in DCT’s potential

$V(P)$; for the conservative purposes of this paper, we take $\zeta_i = 0$.

E. Computational implementation

A reproducible Python implementation of the DCT PPN predictions, taking the canonical $\omega_0 = 50,037$ as input and outputting γ, β, η with explicit error analysis, is available at the companion code repository [12]. The script also computes the projected detection significance for BepiColombo MORE and LUNAR under various σ_γ and σ_η scenarios.

VIII. CONCLUSION

Dimensional Coherence Theory predicts the post-Newtonian parameters $\gamma - 1 = -1.998 \times 10^{-5}$, $\beta - 1 = +1.0 \times 10^{-10}$, and Nordtvedt $\eta = +2.0 \times 10^{-5}$, with all other PPN parameters exactly zero in the conservative Brans–Dicke class. These predictions are non-adjustable, derived from the master identity $2\omega_0 + 3 = c_{\text{BD}} \cdot P_0^2$ that fixes the present-epoch coupling at $\omega_0 = 50,037$.

The Cassini bound [3] is consistent with the DCT prediction at 13% margin. BepiColombo MORE 2028 [6] is the next decisive test, projecting a 6.7σ (8σ best-case) binary detection of $\gamma - 1 = -2 \times 10^{-5}$. LUNAR (~ 2035 [8]) provides a parallel decisive test at 20σ on the Nordtvedt parameter. The PPN sector is therefore the most decisive near-term test of DCT, and the BepiColombo MORE 2028 measurement is the single most consequential experiment for the theory.

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