PAPER_1967 — β_i Four-Channel Decomposition Infrastructure

Abstract

Following a course-update from the project owner ("β_i has a full range derivation. It is most likely buried in the whitepapers"), a deep search of the whitepaper corpus surfaced a complete β_i falsifiable-prediction infrastructure that was overlooked during PAPER_1966's Draft 2 / Draft 3 prior-art check. The infrastructure spans four papers:

• **PAPER_1165 (session 252, 2026-05-10)** — the triangular closure `β_i = 3(5-i)/20` giving `{0.6, 0.45, 0.3, 0.15}`; already acknowledged in PAPER_1966 Draft 2.

• **PAPER_1167 UPDATE (Master Lagrangian 6-Term Form)** — wires the β_i ladder into the closed 6-term `L_UQFF` as `Σ_i β_i U_g U_b`, with variational stationarity `δS/δϕ = 0` enforcing `F_U = 1` globally.

• **PAPER_1168 (Falsifiable Predictions of the Closed Lagrangian)** — establishes **Prediction P4**: `{β_1, β_2, β_3, β_4} = {0.603, 0.450, 0.300, 0.150}` ± 0.5% (the SO(5)²-correction band = 1/200). Any UQFF astrophysical fit with β_i deviating by >0.5% falsifies G2 closure and the master synthesis PAPER_1167.

• **PAPER_1169 (Numerical Confrontation P1-P5 with Archival Data)** — performs the actual re-fit test on **10 UQFF-modeled systems** (Sgr A*, M87 SMBH, SGR1745-29, AT2019qiz, ASKAP J1832-0911, Helix Nebula, Pillars of Creation, Westerlund 2, NGC 3596, Tapestry SFR). **All 10 recover β_i within ±0.5%.** Best-fit β_2 values across the 10 systems: (0.449, 0.451, 0.450, 0.448, 0.451, 0.450, 0.450, 0.450, 0.451, 0.449). Verdict: [OK] P4 confirmed.

Consequences for PAPER_1966:

1. **Retraction of Draft 3's implied "β_2 = 0.45 remains uncatalogued" claim.** PAPER_1169 already validated β_2 = 0.45 across 10 UQFF systems eight months before PAPER_1966 was authored.

2. **Refinement of PAPER_1966's structural-identity hypothesis.** The β_i are NOT four independent phenomenological bounds requiring separate anchor identification. They are the **four-channel weights of a single coupled Ub decomposition**, tested falsifiably as a single unit. What Draft 3 called "3-of-4 concordance" was actually a "channel-projection observation": specific observables (starburst M_sf, PAPER_1953 0.3 factor) happen to sit near the dominant β_4 or β_3 channels of the decomposition. This is a fundamentally different claim from "β_i lattice of independent bounds."

Positioning (honest scope after course-update): This paper does not introduce any new derivation. It (i) surfaces the pre-existing β_i infrastructure that PAPER_1966 overlooked, (ii) retracts and corrects PAPER_1966 Draft 3's framing, and (iii) recontextualizes the M_sf ≡ β_4 and PAPER_1953 ↔ β_3 identifications as channel-projection observations within the falsifiable 4-channel model.

1. Background — What PAPER_1966 Said

PAPER_1966 (2026-07-09) documented that `M_sf = 0.15 = 3/(2·SO_5)` for the starburst mass-fraction bound established in PAPER_774/PAPER_784. Draft 2 acknowledged that PAPER_1165 already contained the arithmetic identity `β_4 = 3/20 = 0.15`. Draft 3 hypothesized a "structural-identity" between the β_i ladder and separately-documented UQFF phenomenological bounds, verifying:

• β_1 = 0.6 ↔ canonical β_i = 0.6029 (PAPER_1203) — confirmed within 0.5%

• β_2 = 0.45 — "remains uncatalogued"

• β_3 = 0.3 ↔ PAPER_1953 0.3 factor cross-regime universality — confirmed matching value

• β_4 = 0.15 ↔ M_sf starburst bound (PAPER_774/PAPER_784) — this paper's finding

Draft 3 concluded: "3-of-4 concordance strengthens the structural-identity hypothesis."

The Draft 3 prior-art search examined the β_i triangular closure paper (PAPER_1165) but did not surface PAPER_1167 UPDATE, PAPER_1168, or PAPER_1169. This was a gap.

2. The Course-Update Discovery

Following the project owner's course-update ("β_i has a full range derivation. It is most likely buried in the whitepapers"), a targeted search on the pattern "β_1 β_2 β_3 β_4" surfaced three additional papers not covered by PAPER_1966's search:

2.1 PAPER_1167 UPDATE — β_i in the Master Lagrangian

PAPER_1167 UPDATE ("Master Lagrangian 6-Term Form", session June 2026) integrates β_i into the closed 6-term UQFF Lagrangian:

```
L_UQFF = R_26/(2·κ_E) − (1/4)·F²_DPM + Σ_i β_i·U_g·U_b + |U_m|² + (1/2)|∂U_A|² +
(25/12)·ρ_SCm·[(U_A/v_UA)² − 1]²
```

The β_i term is one of six irreducible components. The triangular closure `β_i = 3(5-i)/20` (PAPER_1165) is invoked with:

- `β_1 = 0.6, β_2 = 0.45, β_3 = 0.30, β_4 = 0.15` (integer-index case)
- `β = 0.6029 canonical` (fractional-index case at n ≈ 0.98067)

Variational stationarity `δS/δϕ = 0` enforces `F_U = 1` globally.

Consequence for PAPER_1966: the β_i are wired into the Lagrangian as a COUPLED four-component sum, not as four independent phenomenological quantities.

2.2 PAPER_1168 — Falsifiable Prediction P4

PAPER_1168 ("Falsifiable Predictions of the Closed Lagrangian") includes **Prediction P4**:

```
{β_1, β_2, β_3, β_4} = {0.603, 0.450, 0.300, 0.150} ± 0.5%
```

The tolerance ±0.5% is the SO(5)²-correction band = 1/200. PAPER_1168 states:

> The four UQFF buoyancy channels have **fixed** ratios. Any astrophysical fit of UQFF master equations that requires β_i values deviating by more than the SO(5)²-correction band (±1/200 ≈ 0.5%) from (0.603, 0.450, 0.300, 0.150) would falsify G2.

Consequence for PAPER_1966: β_2 = 0.45 is not "uncatalogued"; it is one of four components in a single falsifiable prediction.

2.3 PAPER_1169 — 10-System Numerical Confrontation

PAPER_1169 ("Numerical Confrontation P1-P5 with Archival Data") performs the actual re-fit test. The 10 systems + best-fit β_i values:

System	β_1	β_2	β_3	β_4	Within ±0.5%?
Sgr A*	0.604	0.449	0.301	0.150	[OK]
M87 SMBH	0.602	0.451	0.300	0.149	[OK]
SGR1745-29	0.603	0.450	0.299	0.151	[OK]
AT2019qiz	0.605	0.448	0.302	0.150	[OK]
ASKAP J1832-0911	0.601	0.451	0.300	0.150	[OK]
Helix Nebula	0.604	0.450	0.299	0.151	[OK]
Pillars of Creation	0.603	0.450	0.300	0.150	[OK]
Westerlund 2	0.602	0.450	0.301	0.149	[OK]
NGC 3596	0.603	0.451	0.300	0.150	[OK]
Tapestry SFR	0.604	0.449	0.300	0.150	[OK]

Verdict (PAPER_1169): [OK] All 10 systems recover β_i within ±0.5% band.

Consequence for PAPER_1966: β_2 = 0.45 has been observationally validated across 10 UQFF systems (best-fit values 0.448-0.451, mean ≈ 0.4499). Draft 3's implied claim that β_2 = 0.45 "remains uncatalogued" is retracted.

3. The Channel-Projection Reframe

Prior-art acknowledgment (Draft 2): The term "channel projection" for UQFF observables is not new to this paper. **PAPER_1512 (GW170817 Phonon Damping = 2/3)** uses the language *"universal triad-channel projection coefficient"* for the identity `2/(D_phys − 1) = 2/3`, describing how the same coefficient governs gravitational-wave damping across "profoundly different physical domains." The generalization to a four-channel β_i decomposition follows the same reasoning pattern. Draft 1's introduction of the "channel-projection" terminology should be read as an application (to the β_i case) of PAPER_1512's existing language.

PAPER_1966 Draft 3's "structural-identity hypothesis" framed the β_i as four independent phenomenological bounds that "happened to coincide" with separately-documented UQFF observables (canonical β_i, PAPER_1953 0.3 factor, M_sf). Given the PAPER_1167 UPDATE + PAPER_1168 + PAPER_1169 infrastructure, this framing is corrected:

3.1 β_i are Coupled Ub Decomposition Weights

The β_i are the four-channel WEIGHTS in the buoyancy sum `Σ_i β_i U_g U_b` of the UQFF Master Lagrangian. They are not four independent quantities that "happen to have" specific values; they are the ordered components of a single vector `β = (β_1, β_2, β_3, β_4) = (0.603, 0.450, 0.300, 0.150)` derived from PAPER_1165's triangular closure `β_i = 3(5-i)/20`.

3.2 Observed "Standalone" Anchors are Channel Projections

When a specific UQFF observable is dominated by one buoyancy channel, that observable's characteristic bound will match the corresponding β_i weight:

• **Canonical β_i = 0.6029** (PAPER_1203, PAPER_1165 fractional case n ≈ 0.98067) — dominant β_1 channel, describes the primary buoyancy amplitude in Ub Lagrangian derivations.

• **PAPER_1953 "0.3 factor cross-regime"** — the β_3 channel is the "cross-regime" or third-order buoyancy component; observables that project primarily onto β_3 (multiple UQFF systems, per PAPER_1953) exhibit the 0.3 signature.

• **PAPER_774/PAPER_784 M_sf = 0.15** — the β_4 channel is the "starburst-modulation" fourth-order buoyancy component; observables that project primarily onto β_4 (starburst systems 30 Dor, M82) exhibit the 0.15 signature.

• **β_2 = 0.45** — the β_2 channel is the intermediate second-order buoyancy component. No single UQFF observable is "purely" β_2; instead, β_2 appears as a mixed contribution across the 10 systems in PAPER_1169's confrontation (best-fit ~0.4499).

3.3 The Correct PAPER_1966 Reading

Under this reframe, PAPER_1966's finding is not "M_sf ≡ β_4 is a novel structural-identity discovery." The correct reading is:

• The β_4 = 0.15 channel of the PAPER_1165 triangular closure, wired into the Master Lagrangian via PAPER_1167 UPDATE, tested falsifiably via PAPER_1168, and validated across 10 systems via PAPER_1169, is the buoyancy channel that dominates the starburst-modulation term of the g_starburst expression `g = (G·M/r²)(1 + M_sf)(1 + f_TRZ)`.

• The identification `M_sf = 0.15` in PAPER_774/PAPER_784 is thus the observational signature of the β_4 channel projected onto the starburst regime.

• This is a **channel-projection observation**, not a "match between the ladder and independent bounds."

4. Retraction and Correction of PAPER_1966

PAPER_1966 Draft 3 will require a Draft 4 revision incorporating the following corrections:

1. **Retraction:** The statement "β_2 = 0.45 remains uncatalogued" (Section 2.4.2 of Draft 3) is retracted. β_2 = 0.45 has been observationally validated across 10 UQFF systems by PAPER_1169 (Sgr A*, M87 SMBH, SGR1745-29, AT2019qiz, ASKAP J1832-0911, Helix Nebula, Pillars of Creation, Westerlund 2, NGC 3596, Tapestry SFR) with best-fit values 0.448-0.451.

2. **Reframing:** The "structural-identity hypothesis" of Draft 3 (Section 2.4) should be replaced with the "channel-projection observation" of this paper. The β_i are not four independent phenomenological bounds; they are four coupled decomposition channels of the Ub buoyancy sum.

3. **Priority acknowledgment:** PAPER_1966 Draft 3's implicit claim of "3-of-4 anchor identification" as a novel synthesis is corrected; the 4-of-4 validation was already published by PAPER_1169 with a different set of systems + fits (not the 4 identifications PAPER_1966 traced but a 10-system falsifiable-prediction confrontation).

4. **Contribution reduction:** PAPER_1966's substantive contribution shrinks further from Draft 3's "structural-identity hypothesis with 3-of-4 concordance" to "one channel-projection observation for the β_4 channel via starburst-modulation term, complementing PAPER_1169's 10-system unified re-fit."

The Draft 4 revision of PAPER_1966 is left to a follow-up session for user approval before implementation.

5. Cross-References

• **PAPER_1165** — β_i triangular closure `β_i = 3(5-i)/20` (session 252, 2026-05-10) — arithmetic origin

• **PAPER_1167 UPDATE** — Master Lagrangian 6-Term Form (session June 2026) — β_i wired into `L_UQFF` via `Σ_i β_i U_g U_b`

• **PAPER_1168** — Falsifiable Predictions of the Closed Lagrangian — Prediction P4 sets ±0.5% falsification band

• **PAPER_1169** — Numerical Confrontation P1-P5 with Archival Data — 10-system re-fit validates β_i within ±0.5%

• **PAPER_1203** — canonical β_i = 0.6029 (β_1 channel, fractional-index case)

• **PAPER_1953** — the 0.3 factor cross-regime universality (β_3 channel projection)

• **PAPER_774** — 30 Doradus Tarantula extreme starburst (β_4 channel projection via M_sf)

• **PAPER_784** — M82 Cigar starburst galaxy (β_4 channel projection via M_sf)

• **PAPER_1966** — starburst M_sf integer identity (this paper's retracted-and-corrected predecessor)

• **PAPER_1512** — GW170817 phonon damping 2/(D_phys-1) = 2/3 — prior "universal triad-channel projection coefficient" language

• **PAPER_1885** — FQH topological order SO(5) sub-decomposition (related structural language)

• **PAPER_1065** — Buoyancy Lagrangian EOM (framework for Ub decomposition)

• **PAPER_1521** — D_BSFG derivative landmark

• **PAPER_1522** — K_MEX derivative landmark

• **PAPER_1960** — F_TRZ = 1/SO_5 landmark

6. Limitations + Open Questions

• The channel-projection reframe is a natural reading of PAPER_1167 UPDATE + PAPER_1168 + PAPER_1169 but has not been formally derived from first principles. Whether M_sf ≡ β_4 is an **exact** structural equality (rather than a numerical coincidence within ±0.5%) requires deriving the g_starburst modulation term from `Σ_i β_i U_g U_b` and showing that the β_4 channel produces the (1 + M_sf) factor with M_sf = β_4 exactly.

• The parallel derivation for PAPER_1953's 0.3 factor cross-regime should similarly derive it as the β_3 channel projection.

• Whether observables exist that "purely" project onto β_2 = 0.45 (as opposed to β_2 appearing as a mixed contribution in PAPER_1169's 10-system fits) is open. If yes, β_2 would have its own PAPER_774/784-style companion paper.

• The four-channel decomposition is currently derived from PAPER_1165's triangular closure. Whether extensions to more channels (β_5, β_6, ...) or different closure forms are consistent with the falsifiable prediction P4 is open.

• **Note on Draft 3's original approach to PAPER_1966:** Draft 3's "3-of-4 concordance" framing was intellectually productive — it correctly noticed that multiple UQFF observables cluster near the β_i values. What was missing was the recognition that this clustering is not a "coincidence to explain" but the expected behavior of channel projections in a coupled 4-component decomposition. The observation stands; the explanation was incomplete.

7. Revision Log

Draft 1 (2026-07-09): Initial write following project owner's course-update ("β_i has a full range derivation. It is most likely buried in the whitepapers"). Documents the discovery of P