

Addendum 386: CP on the Family Sector

One $\mathbb{Z}_3$ automorphism realizes both C and P , so $CP = \text{id}$ —
confirming the δ_{CP} refutation and the frame-effect, with one honest tension
(Develops Addendum 385's flag; extends Addenda 364, A344, 356a)

Léon Fernando Vlegels

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Abstract

Addendum 385 flagged that on the $\mathbb{Z}_3$ family sector C (charge conjugation, Addendum 364) and P (the fold orientation flip $L(3,1) \leftrightarrow L(3,2)$) are realized by the same operation, the complex conjugation $\omega \leftrightarrow \bar{\omega}$ — a hint of CP structure, recorded but not developed. This addendum develops it. The family symmetry is $\mathbb{Z}_3 = \{1, \omega, \omega^2\}$, $\omega = e^{2\pi i/3}$, and $\text{Aut}(\mathbb{Z}_3) = \mathbb{Z}_2$: there is exactly *one* nontrivial automorphism, the inversion $\omega \mapsto \omega^2 = \bar{\omega}$. Both corpus operations land on it — P is the orientation flip $T_{\text{cycle}} \leftrightarrow T_{\text{cycle}}^2$, C is complex conjugation $\omega \leftrightarrow \bar{\omega}$, the same inversion — so

$$CP = \text{inversion} \circ \text{inversion} = \text{id}$$

on the $\mathbb{Z}_3$ family sector: the family geometry is **CP -invariant**, with no CP phase available. This confirms two standing corpus results. It explains why the $\delta_{CP} \approx 240^\circ$ prediction was *refuted* (A344): there is no CP phase to predict in the family sector. And it *is* Addendum 364's statement that the matter asymmetry is “not real CP violation, no CP phase generates it” — the family structure cannot supply CP violation, so the asymmetry is the frame-effect. With $CP = \text{id}$, CPT on the sector reduces to T alone — the witness-relative arrow (356a). **The honest tension:** observed CP violation (K and B mesons, real physics since 1964) is *not* captured by $CP = \text{id}$ on the family geometry; if real — it is — it must live outside the $\mathbb{Z}_3$ family sector, in the weak sector proper (Addendum 385's still-open flag 2). This establishes the corpus's internal family-sector CP structure; it does not account for observed meson CP violation, a real open gap. All claims pinned by `verify_P386.py` (8/8).

1 $CP = \text{id}$ on the family sector

Proposition 1.1 (One automorphism, both C and P). *The family symmetry is $\mathbb{Z}_3 = \{1, \omega, \omega^2\}$ with $\omega = e^{2\pi i/3}$ ($\omega^3 = 1$, $\omega^2 = \bar{\omega} = \omega^{-1}$). Its automorphism group is $\text{Aut}(\mathbb{Z}_3) = \mathbb{Z}_2$: the only nontrivial automorphism is the inversion $\omega \mapsto \omega^2 = \bar{\omega}$, an involution. Both corpus operations are this inversion: P (Addendum 385) is the fold orientation flip $T_{\text{cycle}} \leftrightarrow T_{\text{cycle}}^2$, i.e. $\omega \leftrightarrow \omega^2$; C (Addendum 364) is the complex conjugation $\omega \leftrightarrow \bar{\omega} = \omega \leftrightarrow \omega^2$ — the same inversion.*

Theorem 1.2 (CP is the identity on $\mathbb{Z}_3$). *Since C and P are the single nontrivial automorphism of $\mathbb{Z}_3$ (Proposition 1.1), their composite is its square, and an involution squared is the identity: $CP = \text{inversion} \circ \text{inversion} = \text{id}$. The $\mathbb{Z}_3$ family sector is therefore CP -invariant: it carries no CP phase. With $CP = \text{id}$ on the sector, CPT acts there as T alone — the witness-relative arrow of Addendum 356a; the family substrate's full conjugation reduces to the T (frame) effect.*

2 What it confirms, and the tension it leaves

Corollary 2.1 (Consistency with the δ_{CP} refutation and the frame-effect). *$CP = \text{id}$ on the family sector confirms two standing results. (i) The corpus’s $\delta_{CP} \approx 240^\circ$ prediction was refuted (A344, “the CP phase prediction fails on current data”); Theorem 1.2 says there was no CP phase to predict in the family geometry — the structural source the geometric δ_{CP} lacked. (ii) Addendum 364 reads the matter asymmetry as “not real CP violation, no CP phase generates it” (a frame-effect); $CP = \text{id}$ on the sector is that statement — the family structure cannot supply CP violation, so the asymmetry must be the frame-effect, not CP .*

Remark 2.2 (The honest tension: observed CP violation). Observed CP violation — the K - and B -meson results, real physics since 1964 — is *not* captured by $CP = \text{id}$ on the family geometry. If real, and it is, it must live outside the $\mathbb{Z}_3$ family sector, in the weak sector proper (the still-open flag 2 of Addendum 385, the weak-parity-violation $\rightarrow L(3,1)$ identification). So this addendum establishes the corpus’s internal family-sector CP structure (CP -invariant), consistent with its own refuted δ_{CP} and its frame-effect reading; it does *not* account for observed meson CP violation, which remains a real open gap, not closed here. The result is a structural observation with consequences, honestly bounded, not a derivation of Standard-Model CP .

Status

Picking up Addendum 385’s CP flag: on the $\mathbb{Z}_3$ family sector, $\text{Aut}(\mathbb{Z}_3) = \mathbb{Z}_2$ has a single nontrivial automorphism, the inversion $\omega \mapsto \omega^2 = \bar{\omega}$, and both P (385’s orientation flip) and C (364’s charge conjugation) are realized by it (Proposition 1.1), so $CP = \text{inversion}^2 = \text{id}$ (Theorem 1.2). The family geometry is CP -invariant, carrying no CP phase; with $CP = \text{id}$, CPT reduces to T (356a). This confirms the δ_{CP} refutation (A344: no phase to predict) and the frame-effect reading of the matter asymmetry (364: not real CP violation) (Corollary 2.1). **Honest tension** (Remark 2.2): observed meson CP violation is not captured by the family geometry and must live in the weak sector (385’s open flag 2); the internal structure is established, the observed violation is a real open gap. No published number changes. Verifier: `verify_P386.py`, 8/8 pass.