Final Assembly and Goldbach Handoff Packet

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Review request

Please check the global assembly and final handoff only. This is not a request to review the technical branch estimates themselves. The CKP/X10, X16/Shiu/BRS, and GoodAWACK/E10 inputs are being reviewed in separate targeted packets.

The exact question is:

> Assuming the stated terminal branch estimates, does the active proof tree correctly assemble them into
>
> $$R_\Lambda(N) = \mathfrak{S}(N)N + o(N),$$
>
> and does the prime-power handoff then give a genuine prime representation for all sufficiently large even N?

A positive review should confirm the final implication

$$I1 + G2 \Longrightarrow G1 \Longrightarrow G0.$$

Conventions

All Goldbach sums in this packet use ordered positive pairs:

$$R_\Lambda(N) := \sum_{\substack{n_1+n_2=N \\ n_1,n_2\geq 1}} \Lambda(n_1)\Lambda(n_2).$$

The genuine prime-prime weighted sum is

$$R_{pp}(N) := \sum_{\substack{p_1+p_2=N \\ p_1,p_2 \text{ prime}}} \log p_1 \log p_2,$$

again over ordered pairs. This is the convention used by B1, I1, G2, G1, and G0H.

For even N, the Goldbach singular series is normalized as

$$\mathfrak{S}(N) = 2C_2 \prod_{\substack{p|N \\ p>2}} \frac{p-1}{p-2}, \qquad C_2 = \prod_{p>2} \left(1 - \frac{1}{(p-1)^2}\right) > 0.$$

Hence $\mathfrak{S}(N) \geq 2C_2 > 0$ for every even N.

Assumed branch inputs

The final assembly packet assumes the following branch inputs.

1. B1 exact decomposition:

$$R_\Lambda(N) = \sum_{\mathcal{B} \in \mathfrak{B}_{J_0}} c_{\mathcal{B}} R_{\mathcal{B}}(N).$$

2. B3/F3/F4 exact tagged terminal partition:

$$R_{\mathcal{B}}(N) = \sum_{\tau \in \mathcal{T}(\mathcal{B})} R_{\mathcal{B},\tau}(N).$$

   The terminal tags are disjoint at the routing-history level.

3. Edge estimate:

$$R_{\mathrm{Edge}}(N) = o(N).$$

4. LongAP/Local projection:

$$R_{\mathrm{LongAP}}(N) = M_{\mathrm{LongAP}}(N) + o(N).$$

5. CKP projection and error:

$$R_{\mathrm{CKP}}(N) = M_{\mathrm{CKP}}(N) + o(N).$$

6. GoodAWACK estimate:

$$R_{\text{GoodAWACK}}(N) = o(N).$$

7. Local/Main compatibility:

$$M_{\text{local}}(N) = \mathfrak{S}(N)N + o(N).$$

This packet checks that these inputs are assembled correctly; it does not reprove them.

Terminal assembly in I1

The exact terminal partition used by I1 is

$$\begin{aligned} R_\Lambda(N) = R_{\text{Edge}}(N) + R_{\text{LongAP}}(N) + R_{\text{CKP}}(N) \\ + R_{\text{GoodAWACK}}(N) + R_{\text{LocalDiag}}(N). \end{aligned}$$

The local/main terms are gathered as

$$\begin{aligned} M_{\text{local}}(N) = M_{\text{LongAP}}(N) + M_{\text{CKP}}(N) \\ + M_{\text{LocalDiag}}(N). \end{aligned}$$

There is no fourth local summand. Auxiliary local-looking terms created by controlled CRT absorption, fixed-divisor quotienting, or primitive local slicing are tagged refinements of one of the three displayed classes, while endpoint and smooth-boundary localizations are C1 Edge errors.

The important normalization rule is H4-admission:

$$M^{\text{local}}_{\mathcal{B},\tau}(N) = \text{Loc}_Q\, R_{\mathcal{B},\tau}(N) + o_{\mathcal{B},\tau}(N).$$

Thus H4 does not accept arbitrary local-looking main terms. It accepts only canonical local projections attached to a parent B1 block and a unique routing tag.

In the proof-source layer this is formulated as a single-local-model normalization lemma. The same operation

$$\Lambda(n) \mapsto \Lambda_Q(n \bmod Q)$$

is applied inside the original tagged Goldbach convolution for every admitted local/main source. The branch checks are:

- LongAP/Local: F3P gives the positive local-coefficient predicate, and D1.2A expands the resulting AP/local algebra as $\mathrm{Loc}_Q\, R_{\mathcal{B},\tau}$.
- CKP $h = 0$: G8a.5 and B1LD identify the zero Fourier mode with the same $\mathrm{Loc}_Q\, R_{\mathcal{B},\tau}$; $h \neq 0$ is CKP/X10, not local.
- LocalDiag: the diagonal cell is admitted only when it is a canonical tagged projection; noncanonical degeneracies are routed elsewhere.
- Controlled CRT, quotient, and slicing refinements: the parent B1 tag and the Λ_Q-replacement rule must be preserved inside one of the three displayed local classes.
- Endpoint or smooth-boundary localizations: these are routed to C1 as $o(N)$, not assembled as local main terms.

Using the branch estimates and the H4 identity,

$$R_\Lambda(N) = M_{\mathrm{local}}(N) + o(N) = \mathfrak{S}(N)N + o(N).$$

This is Theorem I1.

The global summability of the displayed $o(N)$ terms is recorded in GEB: strict Edge savings, CKP derivative losses, TC1 Davenport/AP losses, X16/BRS carrier-slice losses, and local boundary terms are checked after the polylogarithmic terminal summations. GEB handles terminal branch summability; G2 separately handles the prime-power error.

No double counting in H4

The no-double-counting mechanism is tag-based:

1. B1 gives an exact sum over parent blocks $\mathcal{B}$.
2. F3/F4 give an exact partition of each parent block into routing tags τ.
3. H4 sums local terms indexed by $(\mathcal{B}, \tau)$, not by their visual algebraic shape.
4. Two local-looking expressions that coincide algebraically but come from distinct tags remain distinct complementary summands of the exact partition.

Therefore LocalDiag, LongAP/Local, and CKP zero-frequency contributions are not double counted when they are passed through H4.

Prime-power removal in G2

The von Mangoldt function is supported on primes and prime powers:

$$\Lambda(n) = \begin{cases} \log p, & n = p^k,\ k \geq 1, \\ 0, & \text{otherwise.} \end{cases}$$

The difference $R_\Lambda(N) - R_{pp}(N)$ is the nonnegative contribution of ordered pairs in which at least one coordinate is a nontrivial prime power p^k, $k \geq 2$.

The number of such prime powers up to N is $O(N^{1/2})$, and for each selected coordinate the other coordinate is uniquely determined. Since $\Lambda(n) \leq \log N$, the total contribution is

$$R_\Lambda(N) - R_{pp}(N) = O(N^{1/2}(\log N)^2) = o(N).$$

Combining this with I1 gives

$$R_{pp}(N) = \mathfrak{S}(N)N + o(N).$$

Final positivity in G1/G0H

Since $\mathfrak{S}(N) \geq 2C_2 > 0$ for even N, the $o(N)$ error is eventually smaller than C_2N. Hence for all sufficiently large even N,

$$R_{pp}(N) \geq C_2N > 0.$$

Every summand in $R_{pp}(N)$ is nonnegative and is strictly positive exactly for an ordered prime representation $N = p_1 + p_2$. Therefore $R_{pp}(N) > 0$ implies the existence of at least one genuine prime pair.

The result is the sufficiently-large binary Goldbach statement. No finite verification for small even N is included in this packet.

What a positive check would confirm

> Assuming the stated branch estimates and external inputs, I1 assembles the terminal tagged partition into $R_\Lambda(N) = \mathfrak{S}(N)N + o(N)$, G2 removes the nontrivial prime-power support at $o(N)$ cost, and G1/G0H correctly convert positivity of $R_{pp}(N)$ into a genuine prime representation for all sufficiently large even N.

Failure modes to look for

A negative check should identify the first concrete failure, for example:

1. B1 is not exact or introduces an unrecorded truncation error;
2. F3/F4 terminal routing is not an exact disjoint tagged partition;
3. a terminal class is omitted from I1;
4. a branch error is summed over too many descendants and no longer remains $o(N)$;
5. H4 double-counts or loses a local/main term;
6. the singular-series normalization does not match the ordered R_{pp} convention;
7. the prime-power removal misses a non-prime Λ-support case;
8. positivity of R_{pp} is used before nontrivial prime powers are removed.