MATHAUDIT / DETAILED REPORT

Correctness, proof completeness, and novelty audit

Continuous pointwise ergodicity for semigroup actions on locally compact spaces

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Paper	arXiv:2608.14175v1
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Audit date	August 18, 2026
Prompt	Standardized prompt
Novelty cutoff	August 14, 2026
Paper license	arXiv non-exclusive distribution license
Scope	Statements, proofs, and novelty only

Important limitation. AI-generated analysis. This report is not a correctness certificate or a substitute for expert scrutiny. A Correct status may coexist with yellow typos or minor formal corrections that do not affect substantive soundness. It means that this audit found no unresolved substantive error under the stated criteria; it is not formal verification and should remain open to expert challenge and correction.

SUMMARY

01	Statements	Correct
02	Proofs	Correct
03	Novelty	No non-novelty findings

01 / STATEMENTS

Statements

Correct

The compact and locally compact characterizations of continuous pointwise ergodicity, the Følner-average equivalences for bicancellative left-amenable semigroups, and the quotient and proper-factor conclusions are correct under their stated existence and properness hypotheses.

Theorems 3.3 and 4.3: Continuous pointwise ergodicity is equivalent to the mean-ergodic decompositions

Pages 15–16 and 20–21 · Theorems 3.3 and 4.3 · arXiv:2608.14175v1

Correct

In the compact case, continuity of the ergodic map produces a bounded projection P by integration. Its range is exactly $\mathrm{Fix}(\kappa)$ and its kernel is the annihilator of all invariant measures, hence $\overline{\mathrm{Cob}(\kappa)}$. Conversely, the mean-ergodic projection sends each Dirac mass to the unique invariant probability on its orbit closure. The one-point compactification correctly identifies escaping orbits with the fixed mass δ_∞ and converts weak* continuity plus vanishing at infinity into continuity of the compactified ergodic map, yielding the locally compact theorem.

Theorem 5.4: Mean ergodicity, uniform Følner convergence, and weak* mean continuity are equivalent

Pages 24–26 · Theorem 5.4 · arXiv:2608.14175v1

Correct

Bicancellativity makes both left and right translates of a left Følner sequence left Følner. The proved Eberlein-type theorem identifies the closed coboundary space with functions whose averages converge uniformly to zero. This gives uniform convergence from the direct-sum decomposition and reconstructs the same projection from any convergent Følner scheme. Passing to adjoints gives the asserted weak* limits, while continuity on subprobabilities reconstructs a weak* continuous measure-valued map vanishing at infinity.

Theorem 6.5 and Proposition 6.7: The compactified ergodic quotient and proper-factor results hold

Pages 29–31 · Theorem 6.5 and Proposition 6.7 · arXiv:2608.14175v1

Correct

The continuous compactified ergodic map has image exactly the compact set of ergodic invariant probabilities, so the induced quotient is homeomorphic to that set and the invariant-measure simplex is Bauer. Pullback identifies quotient functions with invariant functions, and annihilator duality gives the stated pushforward kernel. For a proper factor, compactification supplies a continuous equivariant surjection; lifting a measure and averaging a lift produces the unique invariant measure on the factor orbit closure. The quotient-map and compactification arguments then transfer continuity, vanishing at infinity, and uniformity.

02 / PROOFS

Proofs

Correct

The proofs are correct and complete. The functional-analytic annihilator identities, measure-valued integration, compactification, Følner translation estimates, quotient duality, and factor-lifting arguments are used with the required hypotheses and with the correct weak, weak*, and norm topologies.

Proposition 2.1 and Theorem 2.3: The dual decompositions and measure-valued operator correspondence are valid

Pages 9–14 · Proposition 2.1 and Theorem 2.3 · arXiv:2608.14175v1

Correct and complete

The pre-annihilator of dual coboundaries is the invariant-function space and the annihilator of primal coboundaries is the invariant-measure space. Closed-range properties of projections justify both direct-sum implications. For the map Ψ, weak* continuity and vanishing at infinity give pointwise boundedness and hence a uniform total-variation bound; Gelfand integration then defines the adjoint operator. Conversely, a weak*-continuous adjoint evaluated on Dirac masses supplies both continuity and the vanishing condition.

Theorems 3.3 and 4.3: The projection and compactification proofs preserve all orbit and measure hypotheses

Pages 14–21 · Sections 3–4 · arXiv:2608.14175v1

Correct and complete

Proposition 3.1 correctly proves that almost every point of an ergodic measure has orbit closure equal to its support, without assuming amenability. Krein–Milman then supplies the weak* span of ergodic measures used to identify the projection kernel. Properness is exactly what extends each action map to the one-point compactification, and a noncompact orbit closure has only δ_∞ as an invariant probability precisely when its original closure carries no invariant probability. These facts close every direction of the two characterization theorems.

Theorems 5.2 and 5.4: The Følner and mean-ergodic arguments are complete

Pages 21–26 · Section 5 · arXiv:2608.14175v1

Correct and complete

Pointwise convergence to an invariant function first gives weak convergence by dominated convergence; Mazur's theorem and the left Følner estimates then upgrade it to norm convergence. Averages of elementary coboundaries converge uniformly to zero, and the converse follows because $f - A_F f$ is a coboundary. Compact orbit closures provide tight empirical measures, whose subsequential limits are invariant. Alternating Følner sequences correctly show independence of the chosen sequence, and the adjoint calculations establish the dual limits.

Theorem 6.5 and Proposition 6.7: The quotient, disintegration, and factor proofs are complete

Pages 26–31 · Section 6 · arXiv:2608.14175v1

Correct and complete

The compact quotient is Hausdorff because it is identified with the compact image of the continuous ergodic map. Invariant functions are constant on equal-measure fibers because the common invariant probability has nonempty support in both orbit closures. The pushforward kernel follows from the annihilator of the pullback range, and the bounded inverse on invariant measures is constructed from the mean-ergodic projection. In the factor proof, every probability on a compact factor orbit closure has a lift; a Følner cluster point of that lift is invariant and uniqueness upstairs forces the desired pushforward downstairs.

03 / NOVELTY

Novelty

No non-novelty findings

No non-novelty findings.

METHOD

Scope and decision rules

This audit addressed only the correctness of central statements, the correctness and completeness of proofs, and evidence-backed non-novelty. It did not evaluate importance, exposition, style, suitability for publication, or author reputation.

An adverse finding is included only where the report can give a direct calculation, counterexample, formal contradiction, or a verifiable source establishing the precise claim. An inability to verify is kept distinct from a demonstrated defect. Technical compression is not treated as incompleteness when the omitted reasoning is recoverable and correct.

Before any finding was recorded, the argument was closed under immediate, mechanically checkable consequences of facts already established. An observation was suppressed when the printed conclusion followed by elementary logic, direct substitution, weakening, inclusion, or verified monotonicity and no substantive proof obligation or textual correction remained.

Typographical errors and minor formal corrections remain fully visible in yellow with their locations and repairs. When such a defect is unambiguous, local, and harmless to the paper's substantive conclusions, it does not lower the overall statements or proofs status from Correct.

The novelty panel reports only central results for which a verifiable primary source predating the earliest public version that contains the result proves the same statement up to notation, or from which the statement follows directly and immediately. It contains no positive novelty certifications and no entries based merely on an unsuccessful literature search.

All mathematical expressions in this report are compiled by LaTeX. The web presentation independently validates and renders the corresponding expressions with KaTeX.

Sources checked

1. Source paper: arXiv:2608.14175v1

arXiv acknowledgement

Thank you to arXiv for use of its open access interoperability. This service was not reviewed or approved by, nor does it necessarily express or reflect the policies or opinions of, arXiv.

APPENDIX

Standardized prompt

You are a mathematical auditor. Evaluate only the correctness of the paper's central statements, the correctness and completeness of its proofs, and evidence-backed non-novelty. Do not make editorial comments or evaluate importance, exposition, style, or suitability for publication. Keep the report neutral, precise, and professional.

PART 1 — CORRECTNESS OF THE MAIN STATEMENTS

Identify the paper's central statements and assess each one separately using exactly one of these outcomes:

- Correct: the statement has a correct, verifiable proof; or, despite a defect in the printed proof, you can give a fully verified repair or independent proof.
- Incorrect: you can give strong formal evidence that the statement as written is false, preferably a counterexample or a complete contradiction.
- Not able to verify: the supplied proof does not establish the statement, and you can neither supply a fully verified proof nor disprove it.

For every adverse or unverified outcome, restate the exact claim and hypotheses, identify its location in the reviewed version, and give the decisive reasoning. Do not infer that a theorem is false merely because its printed proof is defective.

Assign the overall statements status by the following priority:

1. Contains wrong statements, if at least one central statement is Incorrect.
2. Contains unsupported statements, if no central statement is Incorrect but at least one is Not able to verify.
3. Correct, if every central statement is Correct, apart from any typographical or minor formal findings allowed by Part 4.

PART 2 — CORRECTNESS AND COMPLETENESS OF THE PROOFS

Audit the proofs of the central statements and every material internal or cited input on which they depend. For each proof or proof segment, use the narrowest supported outcome:

- Correct and complete: every substantive step is verifiable and no case or crucial nontrivial step is missing.
- Incorrect as written: a displayed calculation, inference, lemma, or cited application is formally false or inapplicable.
- Incomplete as written: a necessary substantive step or case is missing, even though no explicit contradiction has been proved.
- Not able to verify: the available paper and sources are insufficient to decide whether the step is valid.

Do not flag omitted routine details, compressed arguments, or "analogously" steps when the omitted reasoning is recoverable and correct. For every defect, identify its smallest exact location, explain its downstream dependency, and classify any proposed repair as one of:

- Verified repair: supply enough reasoning to verify that the repair works throughout every affected use.
- Plausible repair only: describe the possible repair but do not treat it as established.
- No repair supplied.

Assign the overall proofs status by the following priority:

1. Contains incorrect or incomplete proofs, if at least one proof is Incorrect as written or Incomplete as written.
2. Contains unverified proofs, if there is no proved incorrectness or incompleteness but at least one material proof is Not able to verify.
3. Correct, if all audited proofs are Correct and complete, apart from any typographical or minor formal findings allowed by Part 4.

PART 3 — NOVELTY OF THE MAIN STATEMENTS

This is a one-sided, evidence-only check. Evaluate only central results. Report a result only when a verifiable primary source, publicly available before the earliest public version of the paper that contains the result, proves the same statement up to a change of notation, or when the result follows directly and immediately from such an earlier theorem.

For each non-novelty finding, provide the earlier source, its public date, the exact theorem or proposition, and an explicit hypothesis-and-conclusion mapping. A later source cannot establish non-novelty. Do not flag a result merely because an easier proof exists or because it follows through a nontrivial argument. Do not flag a result that the paper itself explicitly presents as known, a survey item, or an alternative proof.

Mention only statements that meet this non-novelty threshold. Say nothing about statements for which no such evidence was found: do not certify novelty, list unsuccessful searches, or add statement-level "no prior source found" entries. If the list is empty, the section may say only "No non-novelty findings."

PART 4 — TECHNICAL AND EVIDENTIARY RULES

1. Criticism must never be overstated. Call a statement incorrect, a proof incorrect or incomplete, or a result non-new only when strong formal evidence supports that exact judgment. Otherwise use Not able to verify where that outcome exists, or remain silent in the novelty section.

2. Review a specified paper version. Give exact page, theorem, equation, or proof locations; restate relevant quantifiers and hypotheses; and check domains, endpoints, parameter ranges, constants, and dependencies explicitly. Apply a defect only to the regimes and downstream results that actually depend on it.

3. Immediate-consequence closure: when deciding whether a conclusion is supported, treat the argument as including every immediate formal consequence of facts established earlier in the paper and available at that point. An immediate formal consequence is a local, mechanically checkable inference using only definitions already in force, elementary logic, direct substitution or renaming, weakening of an inequality or set inclusion, or a monotonicity or symmetry property explicit in a definition or already proved.

4. Such an inference must introduce no new lemma, estimate, construction, case analysis, limiting or compactness argument, external result, or new issue of uniformity or parameter dependence. Check the direction of monotonicity and the dependence of every threshold or constant explicitly. Do not exchange pointwise and uniform conclusions, change exceptional sets, interchange quantifiers or limits, or extend an endpoint under this rule unless the required fact was already established.

5. If the claimed conclusion follows after immediate-consequence closure, it is fully supported. Do not report a gap, unsupported statement, minor formal correction, or recommendation to add an explanatory sentence, and do not mention the suppressed item in the report. This suppression does not apply to a genuine typographical error as defined below, because a typo is a literal notation defect that still requires a textual correction. For example, if $P(delta)$ is proved for every sufficiently small delta > 0 and P is immediately monotone in the required direction, then the claim that $P(delta)$ holds for every delta > 0 requires no correction; the omitted monotonicity step is exposition rather than an audit finding.

6. Immediate-consequence closure permits reconstruction of an omitted inference; it does not permit silent alteration of the printed domain, hypotheses, or quantifiers of an intermediate statement later invoked outside its stated scope. If formal validity requires changing the text of that statement or its stated range, report the appropriate finding even when the repair is easy. Thus a result stated only for $t > 0$ and subsequently applied at $t = 0$ remains a formal scope mismatch unless the endpoint case was separately established before the application.

7. Apply this mandatory gate before recording any adverse, unverified, typographical, or minor formal finding: (a) identify the exact assertion or inference alleged to be defective; (b) reconstruct the strongest conclusion following from the preceding argument after all admissible immediate formal consequences are added; (c) identify the specific defect that remains — a formally demonstrated falsehood, a concrete nontrivial unresolved proof obligation, or a genuine domain, hypothesis, quantifier, or notation mismatch requiring a textual correction; and (d) state the evidence and minimal repair. If no specific defect remains, or if the only possible addition would be explanatory, suppress the finding entirely. Use Not able to verify only when a precise, nontrivial unresolved obligation can be identified.

8. A typographical error is an incorrect symbol, index, exponent, sign, variable name, or notation mismatch whose unique intended correction is mechanically determined from the surrounding text and does not alter the mathematical argument. Report it in yellow as Typo, with the printed text, correction, exact location, and reason it is harmless. It does not lower an overall status.

9. A minor formal correction is a boundary, endpoint, or displayed parameter-range defect that can be repaired consistently in every affected statement by a local change, without a new argument, without invalidating any related result or application, and without creating another substantive defect. Report it in yellow as Minor formal correction, with the same details. It does not lower an overall status.

10. Do not use either minor category if more than one materially different repair is possible; if the repair changes the substance or scope of a central result; if an excluded case is used later; if the correction fails to propagate consistently; or if a new mathematical idea is required. In such cases use the strongest substantive classification actually supported by evidence.

11. Write every mathematical expression as valid, compilable LaTeX. Use ... for inline mathematics and

...

for displayed mathematics, with balanced delimiters and braces. Do not leave raw LaTeX commands outside math delimiters.

12. Separate theorem truth from the correctness of the printed proof. A theorem can be Correct in Part 1 because of a fully verified independent proof while its printed proof is adverse in Part 2. Conversely, a defective proof alone never licenses an Incorrect theorem classification.

Organize the report under Parts 1–3 and apply Part 4 throughout. Do not add editorial commentary, scores, rankings, recommendations, or a list of suppressed observations.

END OF REPORT

Each claim in this prototype report remains open to independent challenge and revision.