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Being arguably the most massive binary black hole merger event observed to date, GW190521 deserves special attention. The exceptionally loud ringdown of this merger makes it an ideal candidate to search for gravitational wave echoes, a proposed smoking gun for the quantum structure of black hole horizons. We perform an unprecedented multi-pronged search for echoes via two well-established and independent pipelines: a template-based search for stimulated emission of Hawking radiation, or Boltzmann echoes, and the model-agnostic coherent WaveBurst (cWB) search. Stimulated Hawking radiation from the merger is expected to lead to post-merger echoes at horizon mode frequency of ~ 50 Hz (for quadrupolar gravitational radiation), repeating at intervals of ~ 1 second, due to partial reflection off Planckian quantum structure of the horizon. A careful analysis using dynamic nested sampling yields a Bayesian evidence of 7 ± 2 (90% confidence level) for this signal following GW190521, carrying an excess of $10^{+9}_{-7}\%$ in gravitational wave energy, relative to the main event. Similarly, the reconstructed waveform of the first echo in cWB carries an energy excess of $13^{+16}_{-7}\%$. Accounting for the "look-elsewhere" effects, we estimate a p-value for false detection probability of 5.1×10^{-3} (or 2.6σ) using cWB pipeline, although the verdict on the co-localization of the post-merger echo and the main event in the sky is inconclusive. While the current evidence for stimulated Hawking radiation does not reach the gold standard of 5σ, our findings are in line with expectations for stimulated Hawking radiation at current detector sensitivities. The next generation of gravitational wave observatories can thus draw a definitive conclusion on the quantum nature of black hole horizons.