

Unprotect[Integrate]; (* Core in yellow *)

$\int \omega_{-} . \mathbb{E}[L_{-}] \, d(vs_List) :=$

Module[{n, L0, Q, Δ, G, Z0, Z, λ, DZ, DDZ, FZ,
a, b},

n = Length@vs; L0 = L /. ε → 0;

Q = Table[(-∂<sub>vs[[a]], vs[[b]] L0) /. Thread[vs → 0] /.
(p | x) → 0, {a, n}, {b, n}];</sub>

If[(Δ = Det[Q]) == 0, Return@"Degenerate Q!"];

Z = Z0 = CF@\$π[L + vs.Q.vs / 2]; G = Inverse[Q];

FixedPoint[{ DZ = Table[∂_vZ, {v, vs}];

DDZ = Table[∂_uDZ, {u, vs}];

FZ = Sum[G[[a, b]] (DDZ[[a, b]] + DZ[[a]] × DZ[[b]]),
{a, n}, {b, n}] / 2;

Z = CF[Z0 + ∫₀^λ \$π[FZ] dλ] &, Z];

PowerExpand@Factor[ω Δ^{-1/2}] ×

ℰ[CF[Z /. λ → 1 /. Thread[vs → 0]]];

Protect[Integrate];