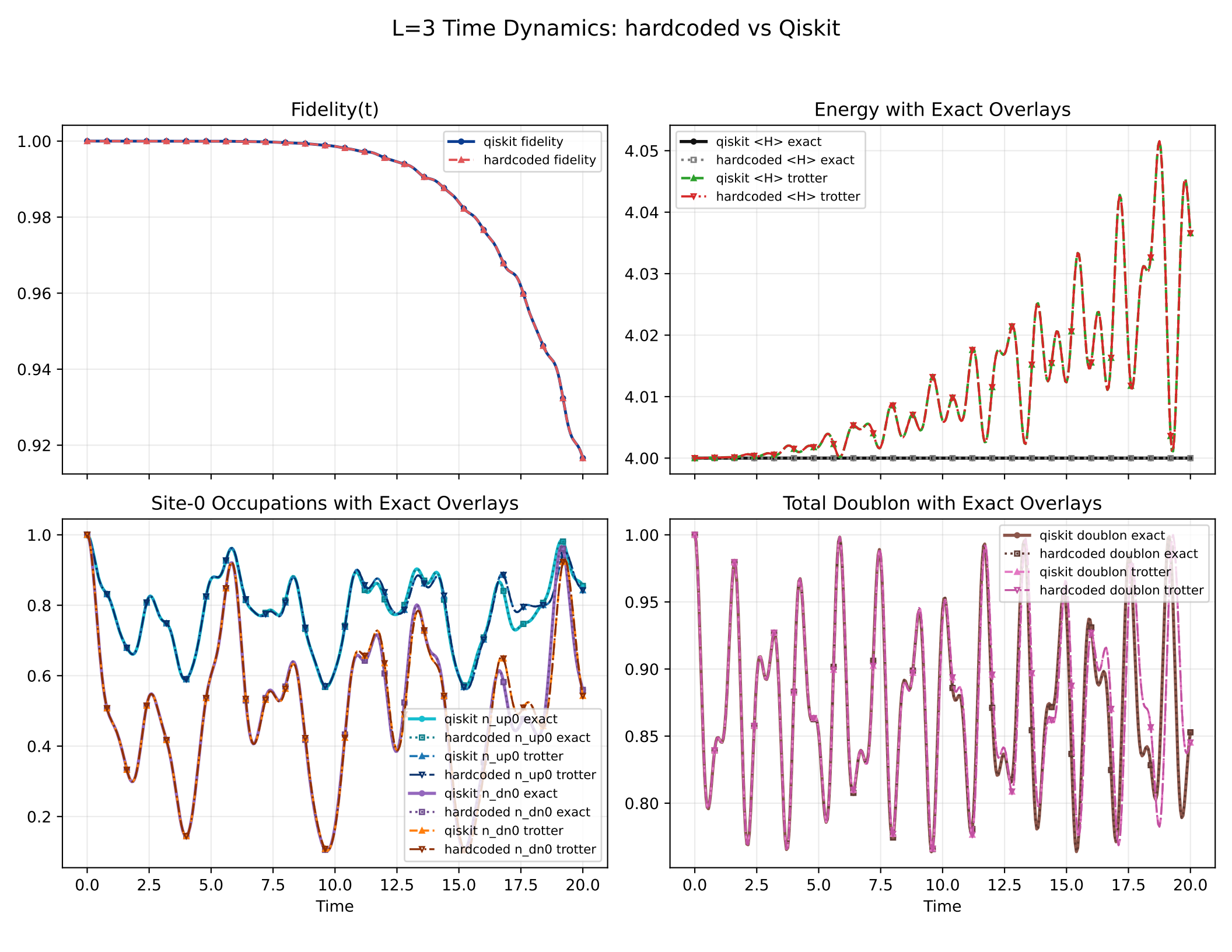
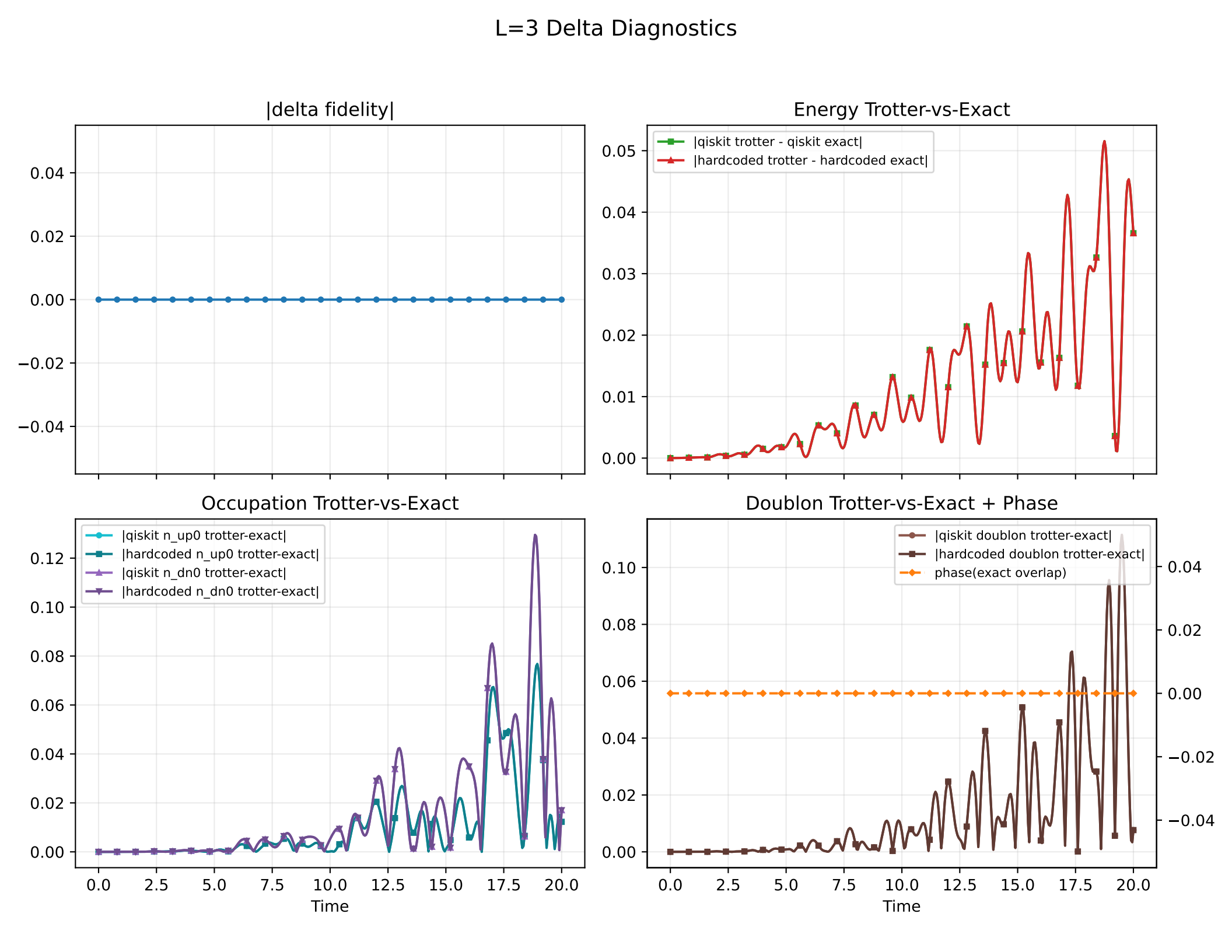

L=3 Time Dynamics: hardcoded vs Qiskit
Fidelity(t)
qiskit fidelity
hardcoded fidelity
1.00
0.98
0.96
0.94
0.92
Energy with Exact Overlays
qiskit <H> exact
hardcoded <H> exact
qiskit <H> trotter
hardcoded <H> trotter
4.05
4.04
4.03
4.02
4.01
4.00
Site-0 Occupations with Exact Overlays
qiskit n_up0 exact
hardcoded n_up0 exact
qiskit n_up0 trotter
hardcoded n_up0 trotter
qiskit n_dn0 exact
hardcoded n_dn0 exact
qiskit n_dn0 trotter
hardcoded n_dn0 trotter
1.0
0.8
0.6
0.4
0.2
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Time
Total Doublon with Exact Overlays
qiskit doublon exact
hardcoded doublon exact
qiskit doublon trotter
hardcoded doublon trotter
1.00
0.95
0.90
0.85
0.80
Time


L=3 Delta Diagnostics
|delta fidelity|
Energy Trotter-vs-Exact
|qiskit trotter - qiskit exact|
|hardcoded trotter - hardcoded exact|
Occupation Trotter-vs-Exact
|qiskit n_up0 trotter-exact|
|hardcoded n_up0 trotter-exact|
|qiskit n_dn0 trotter-exact|
|hardcoded n_dn0 trotter-exact|
Time
Doublon Trotter-vs-Exact + Phase
|qiskit doublon trotter-exact|
|hardcoded doublon trotter-exact|
phase(exact overlap)
Time

```
L=3 validation summary

ground_state_energy_abs_delta = 0.000000000000e+00
fidelity max/mean/final delta = 0.000000000000e+00 / 0.000000000000e+00 / 0.000000000000e+00
energy_trotter max/mean/final delta = 0.000000000000e+00 / 0.000000000000e+00 / 0.000000000000e+00
n_up_site0_trotter max/mean/final delta = 0.000000000000e+00 / 0.000000000000e+00 / 0.000000000000e+00
n_dn_site0_trotter max/mean/final delta = 0.000000000000e+00 / 0.000000000000e+00 / 0.000000000000e+00
doublon_trotter max/mean/final delta = 0.000000000000e+00 / 0.000000000000e+00 / 0.000000000000e+00

Checks: {'ground_state_energy_abs_delta': True, 'fidelity_max_abs_delta': True, 'energy_trotter_max_abs_delta': True, 'n_up_si
PASS: True

Locked settings:
{
  "hopping_t": 1.0,
  "onsite_u": 4.0,
  "dv": 0.0,
  "boundary": "periodic",
  "ordering": "blocked",
  "t_final": 20.0,
  "num_times": 401,
  "suzuki_order": 2,
  "trotter_steps": 128
}
```

L=3 interpretation notes

1) 'exact' means exact state propagation exp(-i H t) from diagonalization.
   'qiskit exact' and 'hardcoded exact' use the same definition but each path's own H coefficients.

2) Site-0 occupations show n_up(site0) and n_dn(site0).
   Each has four curves: qiskit exact, qiskit trotter, hardcoded exact, hardcoded trotter.

3) Fidelity is F(t)=|<psi_exact(t)|psi_trotter(t)>|^2 within each path.

4) Delta diagnostics are absolute errors:
   |qiskit trotter - qiskit exact| and |hardcoded trotter - hardcoded exact|.

5) The phase overlay is an extra diagnostic: angle(<psi_exact_qiskit|psi_exact_hardcoded>).
   It does not redefine doublon; it is shown on a secondary y-axis.