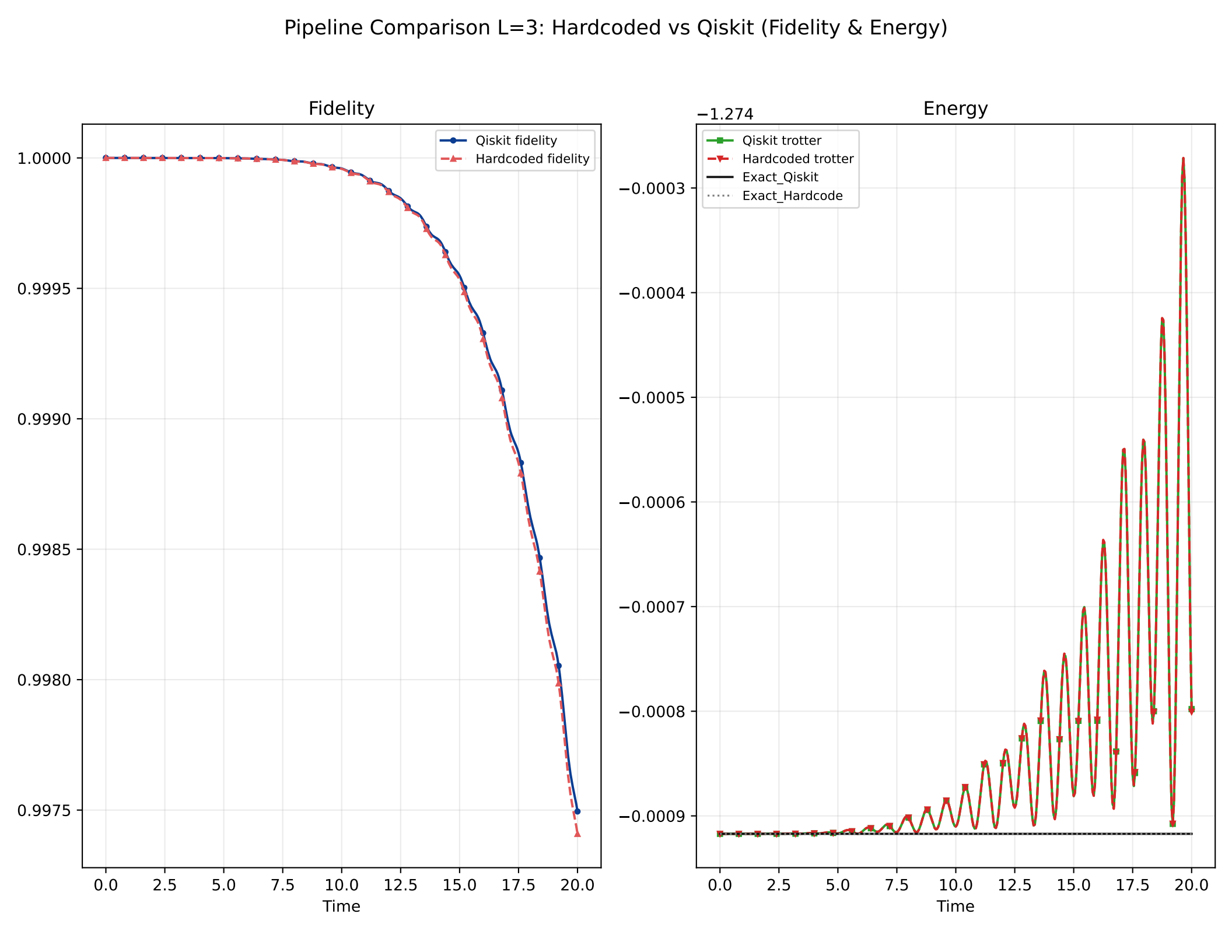
Executed Command

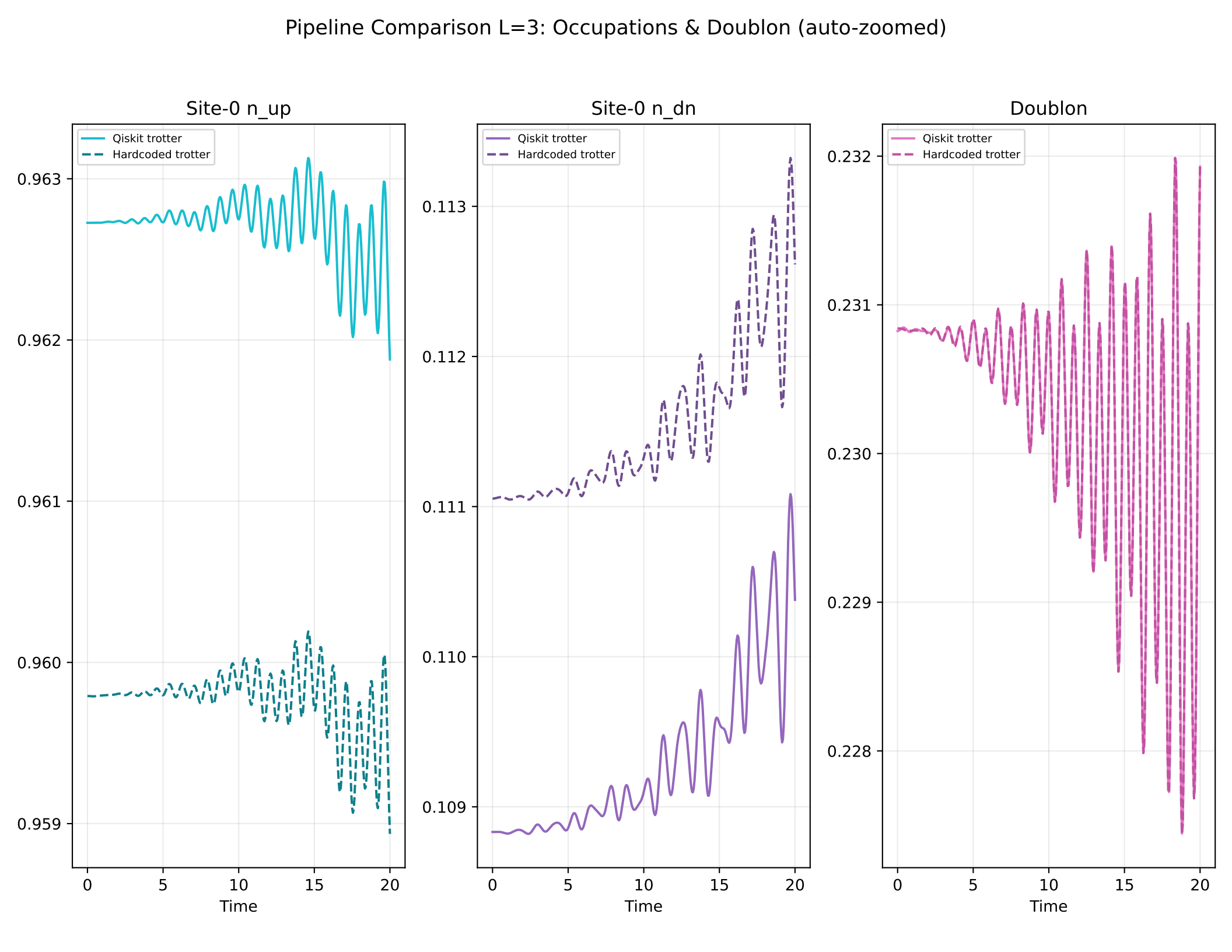
Reference: pipelines/PIPELINE_RUN_GUIDE.md
Script: pipelines/compare_hardcoded_vs_qiskit_pipeline.py

```
/opt/anaconda3/bin/python3 pipelines/compare_hardcoded_vs_qiskit_pipeline.py --l-values 2,3 --no-run-pipelines
    --with-per-l-pdfs --skip-qpe
```

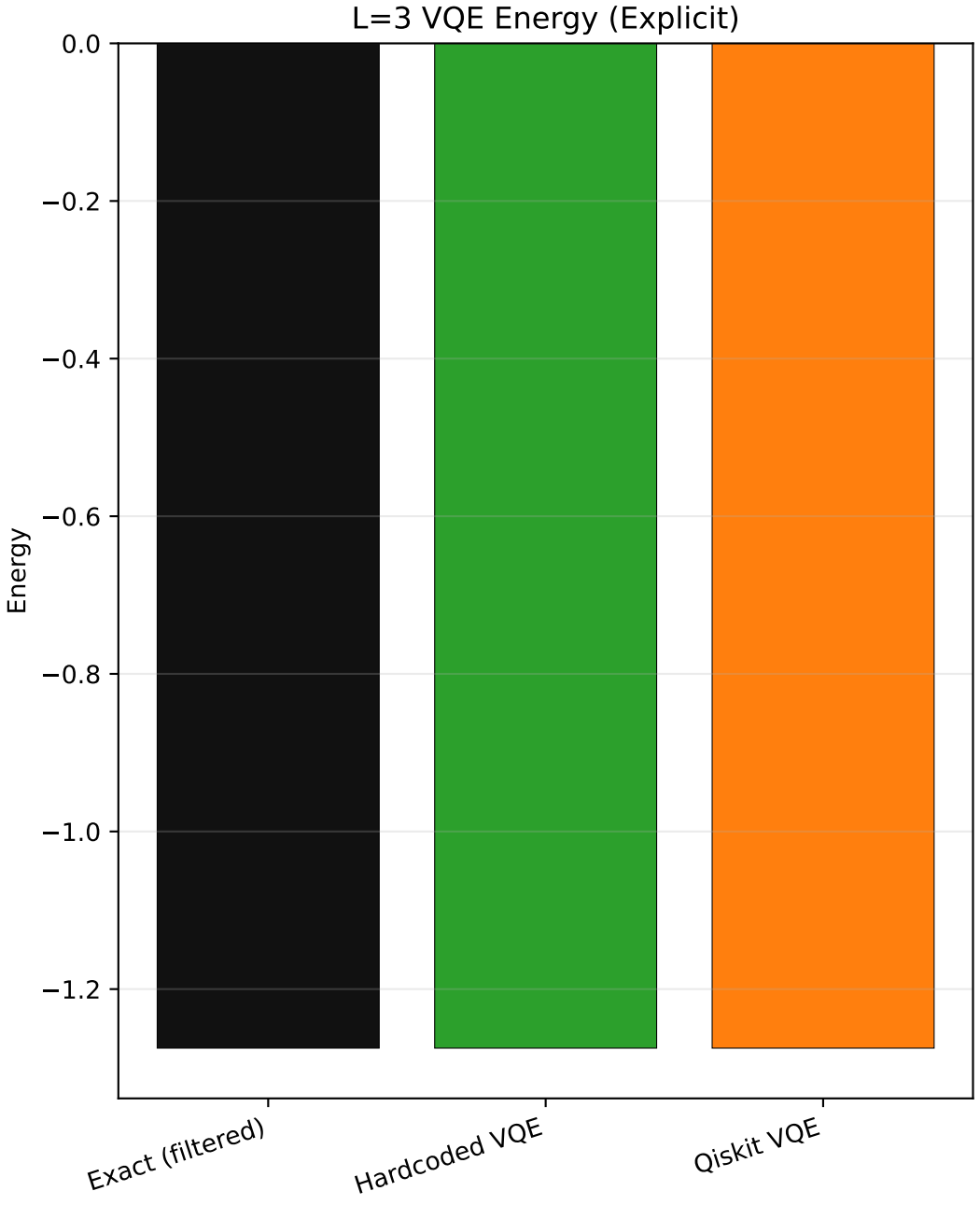
L=3 Run Settings & Metrics Summary

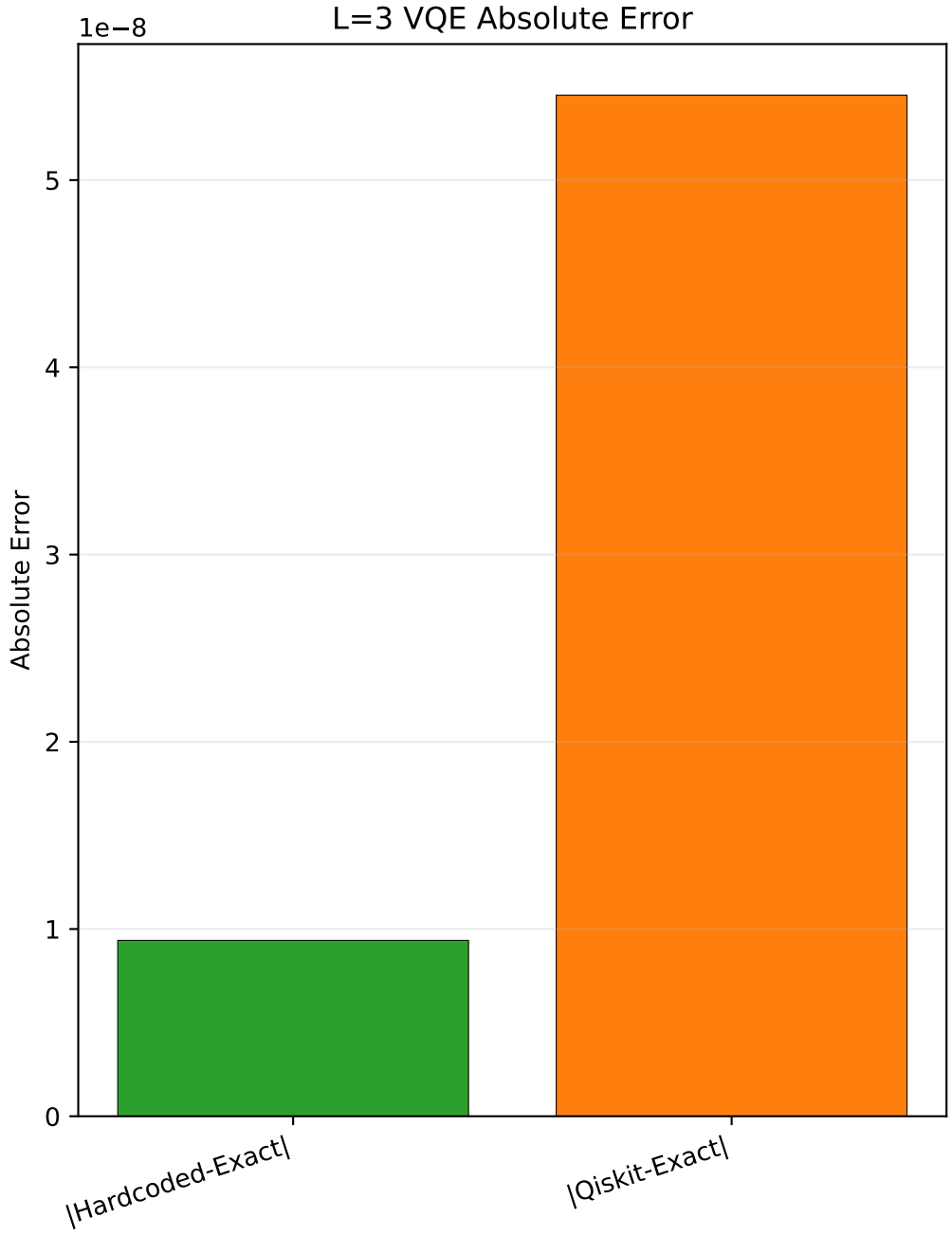
```
L=3  t=1.0  u=4.0  dv=0.0  boundary=periodic  ordering=blocked  initial_state_source=vqe  t_final=20.0  num_times=401  suzu

thresholds:
  doublon_trotter_max_abs_delta: 1.00e-03
  energy_trotter_max_abs_delta: 1.00e-03
  fidelity_max_abs_delta: 1.00e-04
  ground_state_energy_abs_delta: 1.00e-08
  n_dn_site0_trotter_max_abs_delta: 5.00e-03
  n_up_site0_trotter_max_abs_delta: 5.00e-03

max |Δ|:
  gs_energy: 0.00e+00
  doublon_trotter: 1.93e-05
  energy_trotter: 2.57e-06
  fidelity: 8.59e-05
  n_dn_site0_trotter: 2.25e-03
  n_up_site0_trotter: 2.97e-03
result: PASS
```


Pipeline Comparison L=3: Hardcoded vs Qiskit (Fidelity & Energy)
Fidelity
Qiskit fidelity
Hardcoded fidelity
1.0000
0.9995
0.9990
0.9985
0.9980
0.9975
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Time
Energy
−1.274
Qiskit trotter
Hardcoded trotter
Exact_Qiskit
Exact_Hardcode
−0.0003
−0.0004
−0.0005
−0.0006
−0.0007
−0.0008
−0.0009
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
Time


Pipeline Comparison L=3: Occupations & Doublon (auto-zoomed)
Site-0 n_up
Site-0 n_dn
Doublon
Qiskit trotter
Hardcoded trotter
0.963
0.962
0.961
0.960
0.959
0.113
0.112
0.111
0.110
0.109
0.232
0.231
0.230
0.229
0.228
0
5
10
15
20
Time

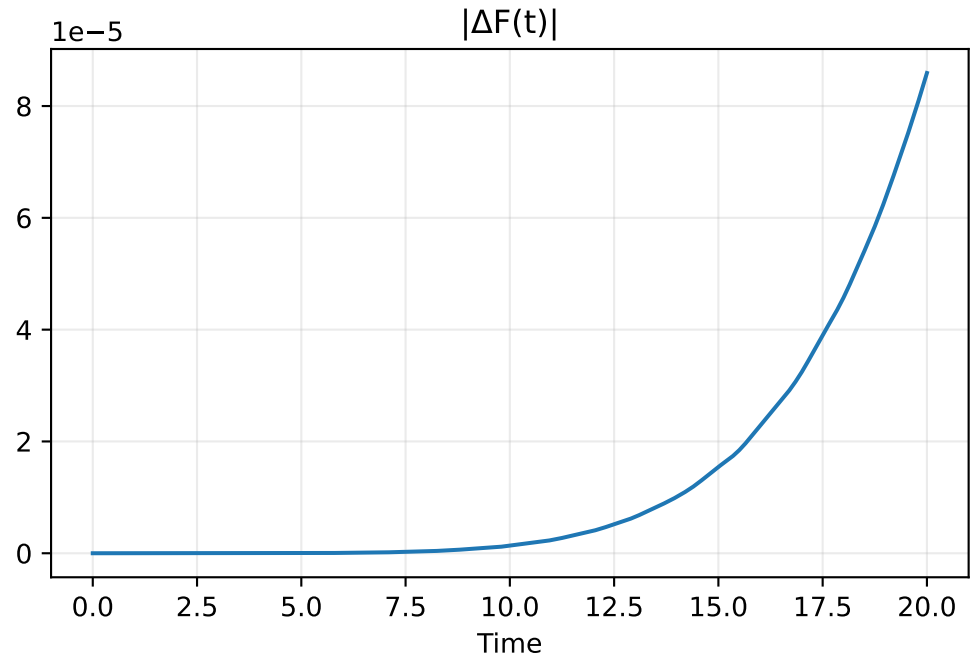
When initial_state_source=vqe, Trotter E(t=0) = ⟨ψ_vqe|H|ψ_vqe⟩ = VQE energy.
VQE energy ≠ exact ground state energy unless VQE fully converged.

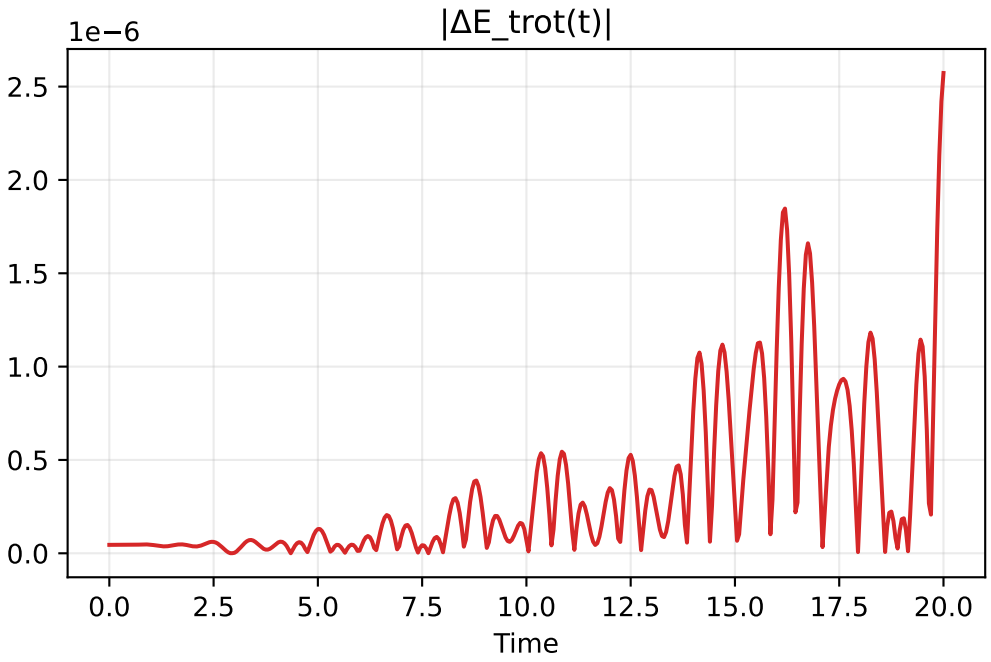


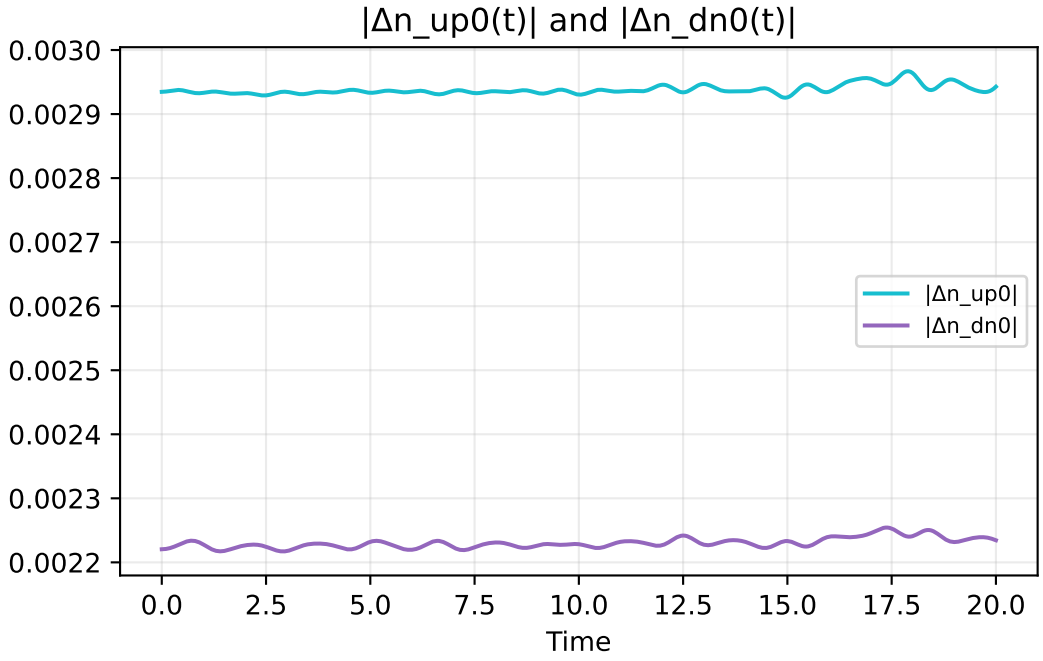


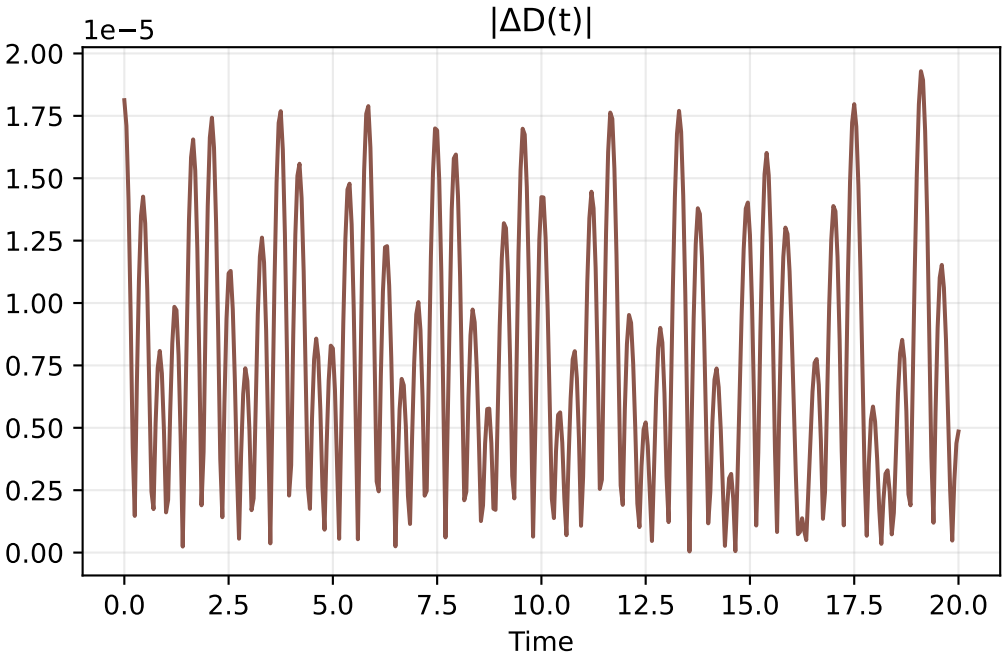
Delta Diagnostics L=3

ΔX(t) = |X_hc(t) − X_qk(t)|, where X_pipeline(t) is that pipeline's stored trajectory value.









```
L=3 metrics summary

Delta metric definitions:
ΔF(t)      = |F_hc(t) - F_qk(t)|
ΔE_trot(t) = |E_trot_hc(t) - E_trot_qk(t)|
Δn_up0(t)  = |n_up0_hc(t) - n_up0_qk(t)|
Δn_dn0(t)  = |n_dn0_hc(t) - n_dn0_qk(t)|
ΔD(t)      = |D_hc(t) - D_qk(t)|
F_pipeline(t) is the pipeline's stored trajectory fidelity value (as computed internally vs that pipeline's exact
    evolution).

ground_state_energy_abs_delta = 0.0
fidelity max/mean/final = 8.590937577102054e-05 / 1.2397428124140835e-05 / 8.590937577102054e-05
energy_trotter max/mean/final = 2.572693202526325e-06 / 3.272323027216911e-07 / 2.572693202526325e-06
n_up_site0_trotter max/mean/final = 0.0029669176457719493 / 0.002937995165993819 / 0.00294272903376791
n_dn_site0_trotter max/mean/final = 0.002254321495447492 / 0.002230267735052105 / 0.0022344932649621674
doublon_trotter max/mean/final = 1.928841137227577e-05 / 7.901033142319897e-06 / 4.8501852527027545e-06

checks:
{'doublon_trotter_max_abs_delta': True,
 'energy_trotter_max_abs_delta': True,
 'fidelity_max_abs_delta': True,
 'ground_state_energy_abs_delta': True,
 'n_dn_site0_trotter_max_abs_delta': True,
 'n_up_site0_trotter_max_abs_delta': True}

PASS = True
```