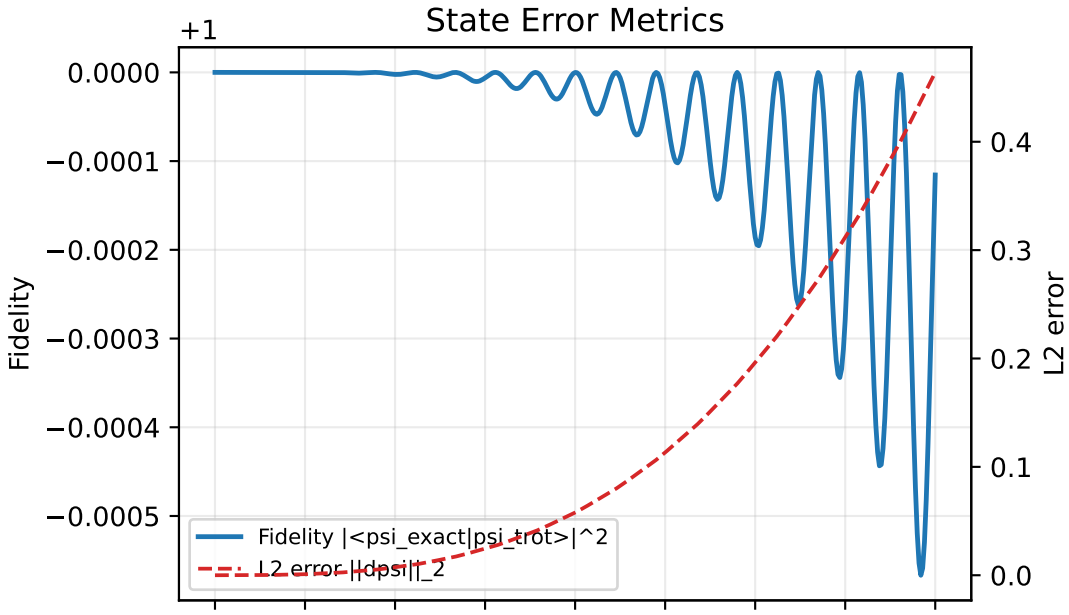
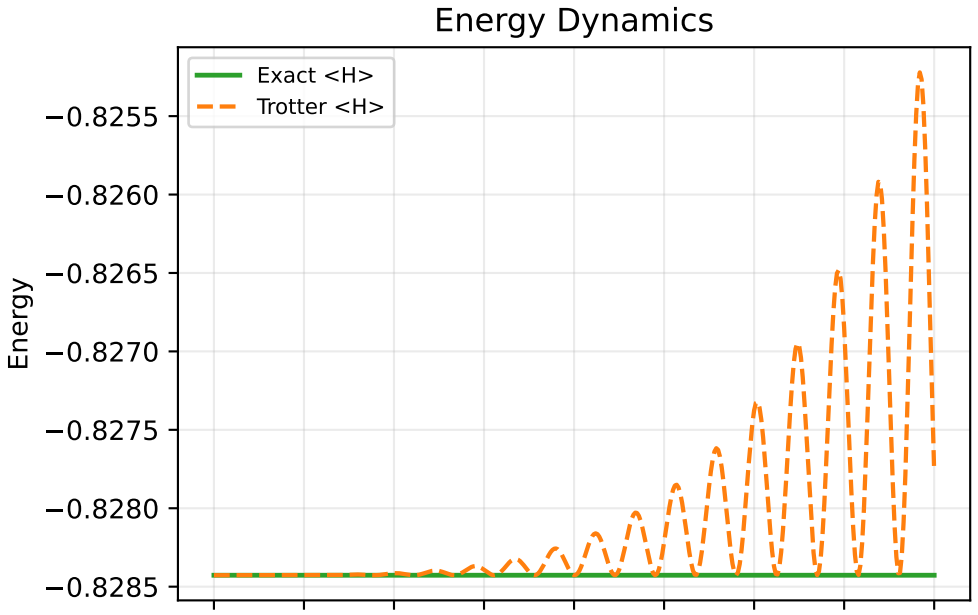
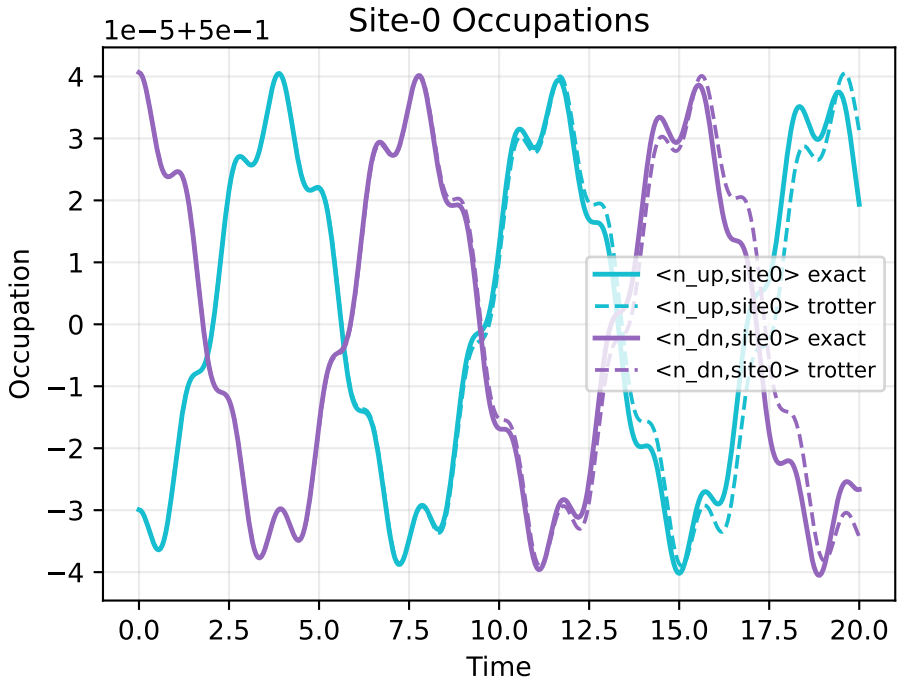
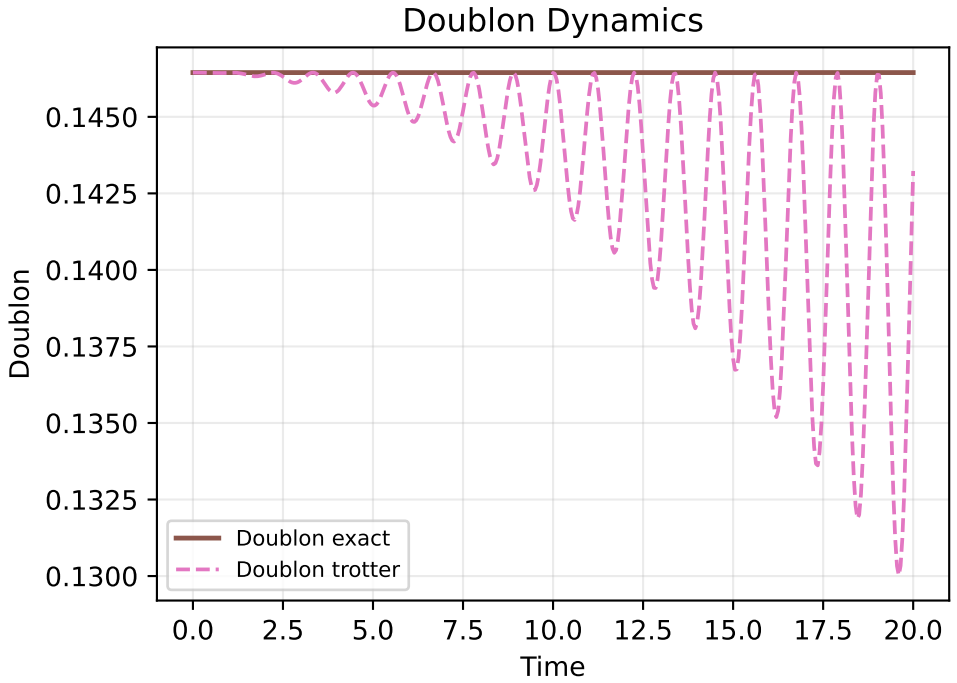
Hubbard Dimer Time Dynamics (Qiskit Built-ins)







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initial_state=vqe_uccsd (superposition)
L=2, t=1.0, U=4.0, boundary=periodic, ordering=blocked
Suzuki order 2, trotter_steps=128, t_final=20.0, num_times=401
Summary: min_fidelity=0.9994332123, final_fidelity=0.9998843364, max_|dE|=3.206e-03
VQE(UCCSD): energy=-0.828427122588, reps=2, params=6, best_restart=1, F(vqe,hf)=0.0732282487
```

Detailed Explanation of Dynamics Results

Key quantitative outcomes
- min fidelity: 0.9994332123
- mean fidelity: 0.9999369216
- final fidelity at t=20.000: 0.9998843364
- max state L2 error: 4.640133e-01
- final state L2 error: 4.640133e-01
- max |energy_exact - energy_trotter|: 3.206043e-03
- mean |energy_exact - energy_trotter|: 3.567799e-04
- max |n_up exact - trotter|: 1.195971e-05
- max |n_dn exact - trotter|: 1.224707e-05
- max |doublon exact - trotter|: 1.642577e-02
- exact-trajectory span in n_up: 8.070119e-05
- exact-trajectory span in n_dn: 8.115834e-05
- exact-trajectory span in doublon: 1.611709e-06

Interpretation and meaning
- The exact curve uses MatrixExponential synthesis and is the reference trajectory.
- The approximate curve uses Suzuki order 2 with reps=128; all deviations from exact come from product-form
- Fidelity close to 1 across the full interval means the Trotterized state remains close to the exact state
- The energy drift between exact and Trotter trajectories quantifies accumulated approximation error.
- For a time-independent Hamiltonian, exact <H> is conserved; any drift in <H>_trotter is numerical/Trotter
- Occupation and doublon agreement indicates that physically relevant observables are preserved well by thi
- Because the initial state is the VQE(UCCSD) ground-state candidate, small exact observable span indicates
- VQE preparation quality marker: F(|psi_vqe>, |psi_hf>)=0.0732282487 (lower means VQE moved away from HF).

How to use this baseline
- This run is a Qiskit built-in reference for later hardcoded-algorithm validation.
- Compare hardcoded trajectories against the exact and Trotter curves with identical Hamiltonian, ordering,
- Matching fidelity/observable error scales indicates the hardcoded implementation reproduces the same dyna