Supplementary Information for

Tunable Quantum Beam Splitters for Coherent Manipulation of a Solid-State Tripartite Qubit System

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Supplementary Figures (Fig. S1, Fig. S2 and Fig. S3)

Supplementary Figures

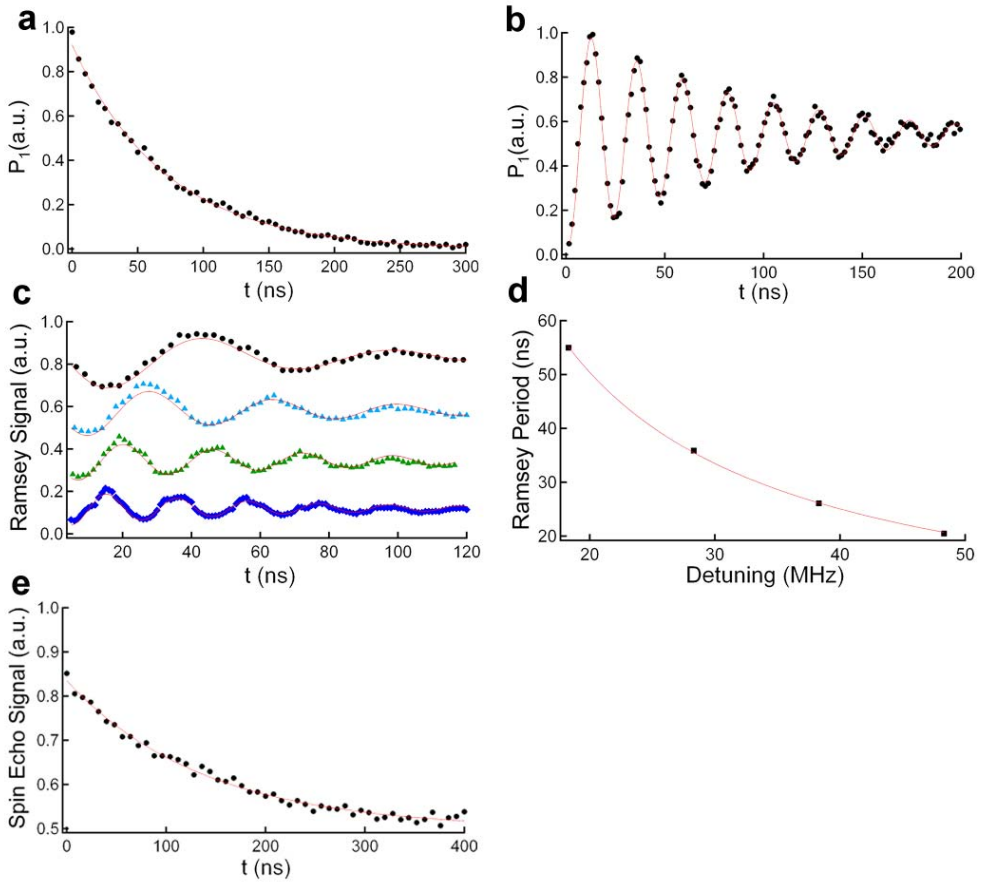

Fig. S1 **Dynamics in the region free of qubit-TLS coupling. a**, Energy decay from the excited state to the ground state. $T_1 \simeq 70$ ns. **b**, Rabi oscillation. $T_R \simeq 80$ ns. **c**, Ramsey fringes with different microwave power. Curves are shifted vertically for clarity. **d**, Ramsey fringes period *vs* detuning frequency. $T_2^* \simeq 60$ ns. **e**, Spin-echo signal. $T_2 \simeq 137$ ns. The symbols are the experimental data and the solid lines are theoretical fittings.

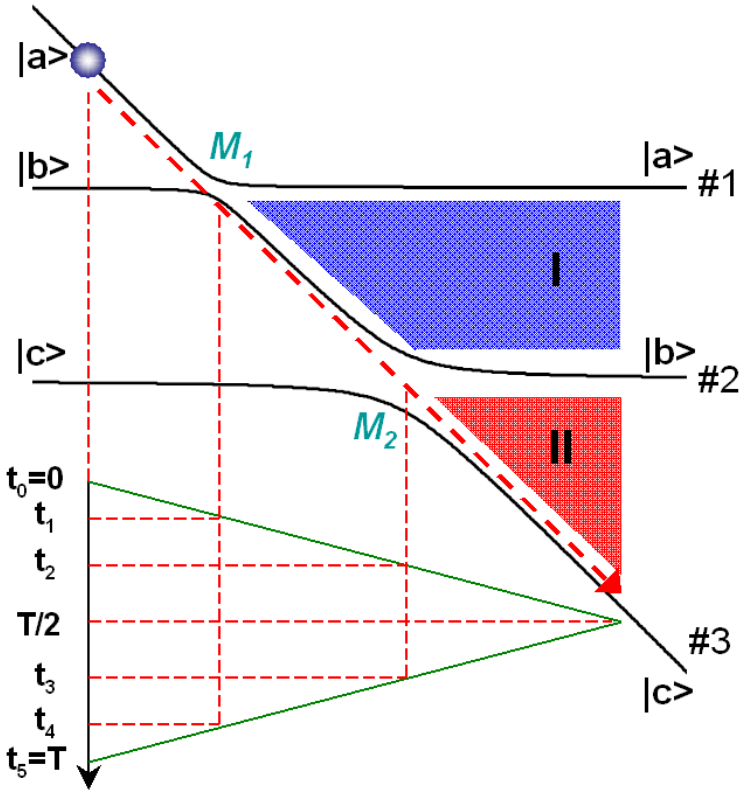

Fig. S2 **Schematic of generating LZS interference with tunable beam splitters in a phase qubit coupled to two TLSs.** $|a\rangle$, $|b\rangle$ and $|c\rangle$ are the instantaneous eigenstates of the time-dependent Hamiltonian (14).

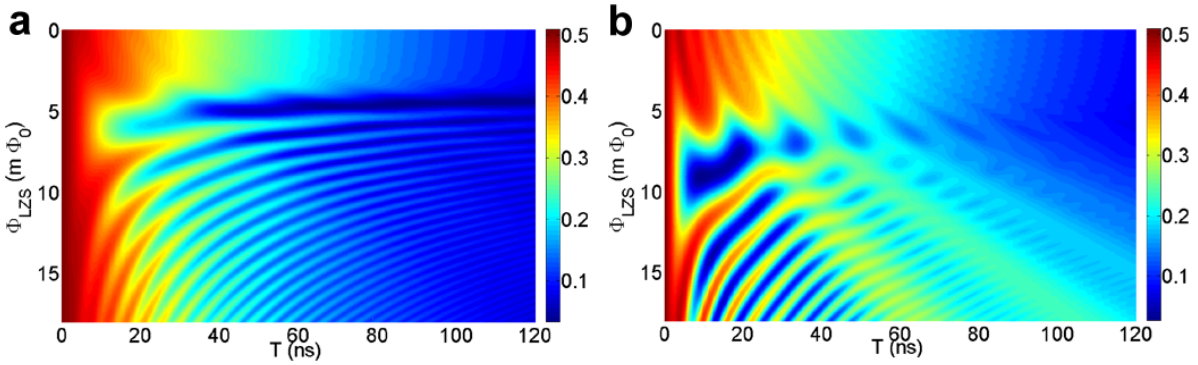

Fig. S3 **LZS interference in qubit-TLS system. a**, Numerically simulated LZS interference pattern in the qubit-first TLS system. **b**, Numerically simulated LZS interference pattern in the qubit- second TLS system.