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(G*) Observation of synchronization and Bloch sphere state trajectories in dissipatively coupled electrical oscillators

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Synchronization describes an interesting dynamical process of coupled oscillators. Particularly, it refers to oscillators oscillating at the same frequency despite their natural frequency difference. Besides, for a coupled two-oscillator system, its hybridized eigenmodes can be mapped onto the Bloch Sphere.

We experimentally studied the relationship between synchronization and hybridized modes on the Bloch sphere through dissipatively coupled two electric oscillators. The circuit consists of two parallel LC oscillators with identical linewidth, connected by a coupling resistor. Utilizing adjustable components enables great tunability of the system. The setup also allows us to perform comprehensive spectral and time-domain analyses on the essential consequences of dissipative coupling.

We observed anti-parity-time-symmetry preservation/breaking, exceptional points, trajectories of eigenmodes on the surface of the Bloch sphere, and the synchronization zone accompanied by characteristic phase difference between two oscillating waveforms. As a result, we confirm that the exceptional points enclose the synchronization zone and the equator states on the Bloch sphere are nothing more than a later twin.

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