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# (G*) Deterministic Construction of Arbitrary States in Permutationally-Invariant Spin Ensemble

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Atomic and solid-state spin ensembles are promising quantum technological platforms, but practical architectures are incapable of resolving individual spins. The state of an unresolvable spin ensemble must obey the condition of permutational invariance, yet no method of generating general permutationally-invariant (PI) states is known. In this work, we develop a systematic strategy to generate arbitrary PI states. Our protocol involves first populating specific effective angular momentum states with engineered dissipation, then creating superposition through a modified Law-Eberly scheme. We illustrate how the required dissipation can be engineered with realistic level structure and interaction. We also discuss possible situations that may limit the practical state generation efficiency, and propose pulsed-dissipation strategies to resolve the issues. Our protocol unlocks previously inaccessible spin ensemble states that can be advantageous in quantum technologies, e.g. more robust quantum memory.

## Keyword-1

Permutational Invariance

## Keyword-2

Engineered Dissipation

## Keyword-3

Spin Ensemble

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