Low-loss hybrid energy systems for quantum communication

Article Overview

Low-loss hybrid systems combine superconducting circuits, photonic interfaces, and quantum transducers to enable efficient, long-distance quantum communication with minimal energy dissipation.

Superconducting Resonators for Low-Loss Quantum Devices

Superconducting resonators, particularly niobium (Nb) circuits with thin gold (Au) capping layers, are key components in hybrid quantum systems. These devices exhibit high internal quality factors (Q_i), which reduce electromagnetic energy loss and enhance signal-to-noise ratios, crucial for quantum communication and computing applications. The Au layer mitigates two-level system (TLS) defects, which are a major source of decoherence, and increases kinetic inductance at low temperatures, improving device responsivity. Such resonators can integrate molecular spin qubits, forming hybrid platforms for solid-state quantum devices .

Microwave-to-Optical Quantum Transducers

A critical challenge in quantum networks is connecting superconducting qubits (microwave domain) with optical fiber networks. Low-loss microwave-to-optical transducers convert microwave signals into optical photons with minimal energy dissipation. Recent designs using pure crystalline silicon avoid piezoelectric materials, achieving continuous conversion rates 100 times faster than previous technologies while maintaining low noise. These transducers are scalable and can b...

Article Content

Ultra-low loss quantum photonic circuits integrated with single

In this work, we report a significant advance towards this goal, in demonstrating the hybrid integration of ultra-low loss

Hybrid integrated quantum photonic circuits | Nature Photonics

Photonic quantum systems provide implementation paths for all of the essential areas of modern quantum technology,

[2406.04492] Quantum Communication: From Fundamentals to

With the recent advancements and developments in quantum technologies, the emerging field of quantum

[2502.07298] Hybrid classical-quantum communication networks

Over the past several decades, the proliferation of global classical communication networks has transformed various

Low-loss interconnects for modular superconducting quantum

Low-loss superconducting aluminium cables and on-chip impedance transformers can be used to link qubit modules

Hybrid classical-quantum communication networks

This paper aims to provide a comprehensive review of ongoing research endeavors aimed at integrating quantum

Hybrid quantum systems with circuit quantum electrodynamics

Hybrid quantum systems combine heterogeneous physical systems for the implementation of new functionalities at the

Innovations for 24/7 Low Carbon Energy: The Power of Hybrid Energy Systems

As the share of intermittent renewable systems has increased in power grids to ensure a supply of low carbon energy 24/7, nuclear

Quantum technologies with hybrid systems

This article reviews some of the driving theoretical ideas and first experimental realizations of hybrid quantum systems

A hybrid integrated quantum key distribution transceiver chip

Here, we overcome this choice by using hybrid integration of ultra-low-loss silicon nitride waveguides with indium phosphide electro

Quantum Technologies for Beyond 5G and 6G Networks: Applications ...

Abstract As the world prepares for the advent of 6G networks, quantum technologies are becoming critical enablers of the next

Low Loss Hybrid Nb/Au Superconducting Resonators for Quantum

To address this challenge, a superconducting device combining a 100 nm niobium (Nb) circuit with a 10 nm gold (Au)

(PDF) Comprehensive Review of Hybrid Energy

This paper provides a comprehensive review of hybrid energy systems (HESs), focusing on

Large-scale quantum dot–lithium niobate hybrid integrated photonic ...

Hybrid integrated quantum photonics offers a scalable route to chip-based quantum networks by combining solid

Hybrid classical-quantum communication networks

Recurring themes throughout this review have emphasized the value of leveraging existing technology from classical lightwave

Hybrid classical-quantum communication networks

This prompts a fundamental question: rather than constructing quantum networks from scratch, can we harness the

Compact free-electron lasers as enablers of beyond-6G and quantum ...

However, conventional FEL facilities are large-scale and complex, limiting their integration into communication systems. This study

Multi-objective optimization of hybrid energy systems using ...

The depletion of fossil fuel reserves, increasing environmental concerns, and energy demands of remote communities

Loss-tolerant architecture for quantum computing with quantum emitters

We develop an architecture for measurement-based quantum comput-ing using photonic quantum emitters. The

Architecting Quantum-Classical Hybrid Systems A Blueprint for Next ...

Abstract Quantum-classical hybrid systems represent a transformative step in the evolution of computing, combining

A hybrid lightweight and post-quantum communication ...

This paper presents a comprehensive hybrid secure communication framework that fully integrates three distinct

Long-distance coherent quantum communications in deployed

A twin-field quantum key distribution protocol based on optical coherence is deployed over a 254-kilometre

Low loss hybrid Nb/Au superconducting resonators for quantum circuit ...

Abstract Superconducting resonators play a crucial role in developing forthcoming quantum computing schemes. The

Network-ready quantum communication transceivers using hybrid ...

Abstract: Using hybrid integration, we overcome usual limitations inherent to specific photonic integration materials and

A review of optimization strategies for hybrid renewable energy systems ...

In the long-term scheduling of hydro-wind-PV systems, a hierarchical scheduling model minimises curtailment, output

Towards efficient and secure quantum-classical communication networ

Abstract—The rapid advancement of quantum technologies calls for the design and deployment of quantum-safe

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