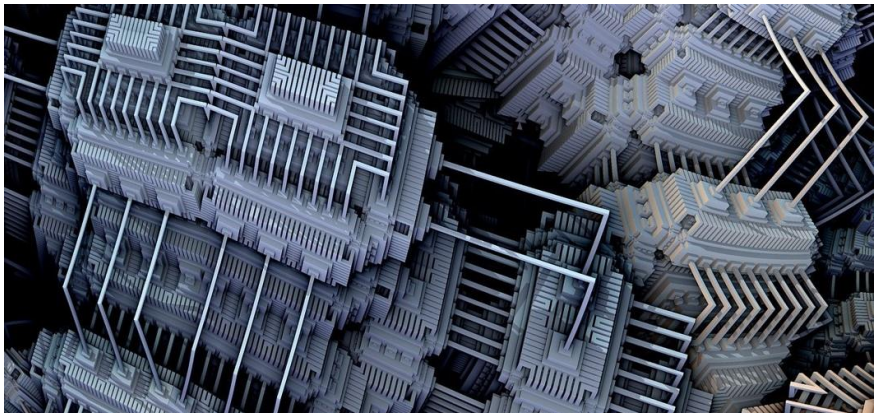
Technology Offer CSIC/PT/068

Directional amplifier for quantum computer



The amplifier consists in a novel array of Josephson junctions and other superconducting elements that give rise to parametric amplification of microwave radiation with all desired properties for quantum computation: large gain, directional, broadband, near quantum-limited noise, tolerant to fabrication disorder and stable.

Intellectual Property

Priority patent application filed

Stage of development

Technology ready for test in an industrial environment

Intended Collaboration

Licensing and/or co-development

Contact

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Market need

Quantum technologies promise to revolutionize our capacity to process information by exploiting physical principles of microscopic world: quantum superpositions and entanglement. One of the biggest current bottlenecks is the measurement lines, which require bulky elements such as amplifiers and circulators to detect the weak quantum signals generated by each qubit. A big challenge in the field is to build new quantum microwave amplifiers that can be integrated on-chip without affecting the qubit, and thus allowing for a high-quality measurement that is scalable to a large number of qubits.

Proposed solution

We designed superconducting device fully integrable on-chip that amplifies microwave radiation directionally, i.e. it amplifies only in the direction of the signal and attenuates in the opposite direction, protecting the quantum source (qubit) from the amplifier itself and any parasitic radiation. Due to the topological origin of the amplification, the gain and attenuation grow exponentially with the size of the system, and the device is tolerant to fabrication disorder. Moreover, the directional amplification is broadband, and the low added noise is near quantum-limited, fulfilling all desired conditions to measure weak signals in a quantum chip, without the need of external circulators and thus improving scalability.

Competitive advantages

- This amplifier is designed to efficiently detect the state of a qubit at the end of a computation with the superconducting quantum computer. The directionality property allows to place it next to a qubit, ensuring a good readout and that the amplifier perturbs minimally the qubit. The broad bandwidth allows one to measure multiple qubits simultaneously.
- Further uses are in Astrophysics, where it can be used to detect astronomical signals