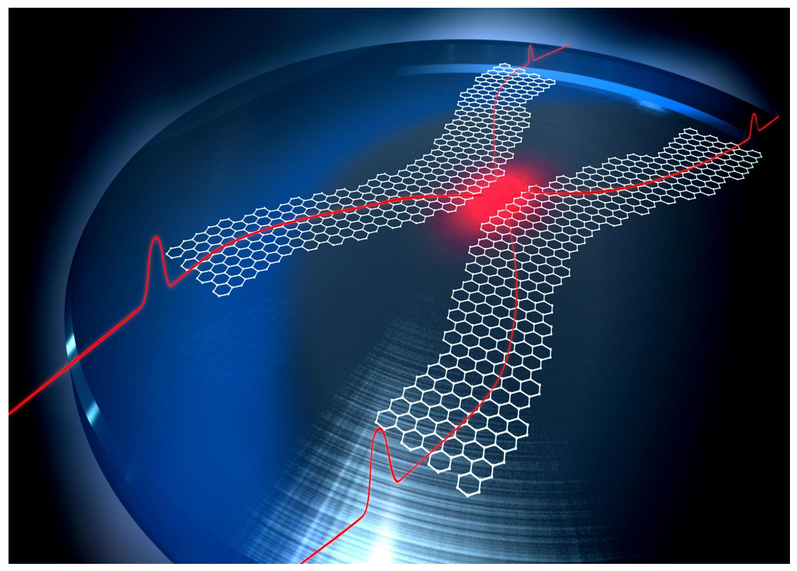
High-Speed and Room Temperature Plasmonic Quantum Computers

Challenges and objectives

The current noisy intermediate-scale quantum computers built by companies such as IBM, Google, and Microsoft utilize superconductor qubits as quantum processors. Superconductor qubits operate at very low temperatures, close to -273 ℃. This restricts their scalability and integration with photonic technology. In addition, the maximum clock speed of a superconductor qubit reaches up to 5 GHz, and overcoming the error-correction problem is a serious challenge for this technology. Quantum photonic processors based on plasmonic waves have the potential to circumvent these significant challenges.



Technical goals

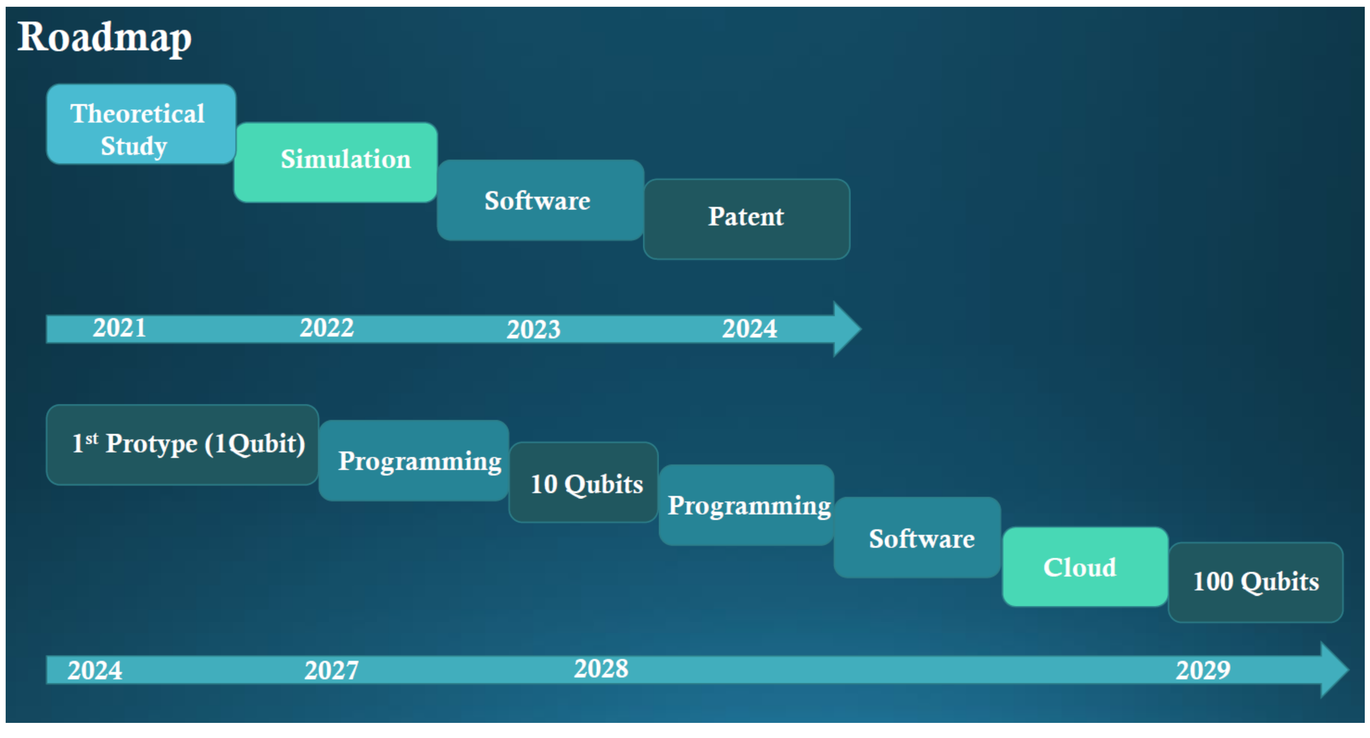
Plasmonic quantum processors (PQP) developed on single-layer quantum materials such as graphene have the following advantages over superconductors technology.

- Operating at room-temperature
- 200 times faster (1000 GHz)
- No need for error-correction
- Easy to integrate with optical fiber technology
- Easily scalable to million qubits

Expected impact

This project includes developing several hybrid classical-quantum software and hardware as well as patents and publications as follows:

- **Software:** **a)** Designing and simulating plasmonic quantum processors **b)** simulating linear and nonlinear transport and optical properties of novel quantum nanostructures **c)** A comprehensive numerical library of linear and nonlinear transport and optical properties of quantum materials
- **Hardware:** The first 1-PQP qubit prototype by 2025, the second 10-PQP qubit by 2028, and the 100-PQP by 2029.
- **Services:** Cloud base Quantum Computing, Programming, and Machine learning
- **Employment:** In the first phase of the project, 10 persons will be working on the project. For the second phase, between 6 or 8 scientific groups from universities and research institutes will participate in the project, and about 50 persons will be working in this step. A factory will be built to have a line of products of plasmonic quantum processors.



Partners:

- **Bita Quantum AI Inc.**
- **ACET Banque Nationale**
- **Ministère de l'Économie et de l'Innovation**

Needed profiles:

- Technology partners
- Venture capital

- **Awarded**: The Best Quantum Technology in the DemoDay of the Quantum Bootcamp by Québec Quantique by IBM Quantum
- **Grant :** Ministère de l'Économie et de l'Innovation
- **Publication:** i) Influence of Impurity Scattering on Surface Plasmons in Graphene in the Lindhard Approximation
  ii) Inhomogeneous linear responses and transport in armchair graphene nanoribbons in the presence of elastic scattering

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