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(57) Abstract :

A polaritonic integrated system for energy-efficient high-speed computing comprising an exciton-polaritons generation arrangement, a 2D Quantum material 101 that hosts tightly bound excitons at room temperature, two highly reflective mirrors as an optical microcavity for confining photons, a photonic layer topologically with protected polariton waveguides and nonlinear resonators 102 to enable polariton routing and signal processing, a silicon-based circuitry 103 for memory storage and slower, deterministic tasks, and ultra-thin, high-conductivity graphene Interconnects channels linking photonic and electronic layers, a low-heat photonic layer for thermal management 104 and energy efficiency, a plurality of polariton detectors 105 for convert polariton signals into electrical or optical outputs, and an energy consumption per operation is reduced to attojoules (10^{-18} J) due to the photonic nature of polaritons and efficient 2D material 101 properties, enabling dense integration without thermal throttling.

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