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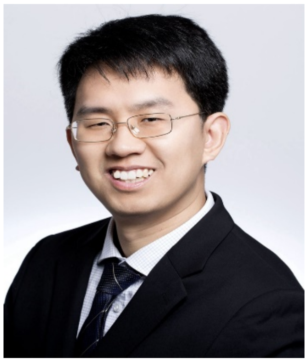

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Robust Topologically Protected Energy-Efficient On-Chip Microlaser for Secure Data Center Communication Systems

Abstract.

Datacenter communication systems are stunningly power inefficient and vulnerable to many external interventions, such as electromagnetic interference and power outages. For example, the cost of even a simple Google™ search is 1kJ of energy; and half of the energy consumption is spent on information transportation inside the data center via copper wires, making it impossible to function with a backup electric generator during severe weather power outages. The ideal way to solve these issues is to manufacture robust, energy-efficient lasers to send data directly between data center units via photons instead of the slow, power-inefficient, and easily perturbed electrons traveling along copper wires. These efforts are currently hindered mainly by the optical performance of on-chip microlasers. The project's **goal** is to develop robust, energy-efficient microlasers with ultracompact size and secure operation. They have revolutionary impacts on our society, saving ~100TWh/year of energy in data centers. Specifically, topologically protected merge ***bound states in the continuum (BIC)*** cavities are proposed. These merge BIC states can be tuned to have an infinite quality factor, thus achieving the theoretically most efficient and compact devices when combined with the best gain materials. These groundbreaking technology in low power consumption will provide enhanced and resilient grid technologies. Low power data centers make it easier to shed load from connection during times of stress (weather, accident, terrorist act) while maintaining the data center's operation or saving the data with remote backup power (batteries, motor-gen). The option to shed a major load center in an emergency, with minor danger, dramatically enhances the reliability and resilience of the power provider. Further, this proposed technology can be migrated and expanded into other communications systems, greatly enhancing the grid's resilience. The first step towards this last reality is the development of the proposed technology.