Spectral Compression using Time Varying Cavities

Time-varying cavity design increases spectral compression, conserving photonic energy for quantum and AI applications.

Researchers at Purdue University have developed a novel spectral compression technique that adapts to linear and nonlinear cavities to conserve more light energy. Spectral compression facilitates a more effective interfacing of broadband photons with narrowband quantum memories; it will be vital in harnessing energy as the world shifts to favor the more energy-efficient photonics devices over electronics. While other approaches to quantum computing opt to modulate the inter-cavity phase (nonlinear optics), the spectral shift to lower frequencies still experiences high reflectivity and significant insertion loss. To combat this, Purdue researchers focused on an alternative electro-optics method of rapidly switching input coupling that works independent of if input is linear or nonlinear. By switching the input mirror's reflectivity right as the pulse enters (zero to unity) the cavity, it's possible to prevent insertion loss and hold on to more power. This power then can only exit through the designated partial-reflective output mirror, resulting in multiple temporal copies of comparable energy even as amplitude decreases. To actualize this concept, Purdue researchers suggested a ring resonator cavity paired with rapid-switch coupler (adapted from a Mach-Zehnder Interferometer). This time-varying, linear optical approach increases spectral compression, resulting in greater output, or greater photonic energy conserved and available long enough for researchers to harness for other applications. Technology that works to advance quantum computing power could revolutionize the same industries that computers run on bits have: telecommunications, machine learning, pharmaceuticals, and more.

Technology Validation: Spectral compression performance was validated through metrics on cavity loss, switch speed, and mirror reflectivity.

Advantages:

-Higher light energy conserved than inter-cavity modulation

Technology ID

2021-WEIN-69190

Category

Computing/Quantum Technologies

Computing/Photonic & Optical Computing Technologies

Authors

Karthik Myilswamy

Andrew M Weiner (DECEASED)

Further information

Parag Vasekar

psvasekar@prf.org

View online

-Time-varying / Adaptable to variable pulses

Applications:

-Artificial Intelligence/Machine Learning

-Data Security

-Product Failure Research (Marketing/Manufacturing)

-Optical/Photonic Computing

-Drug Discovery/Synthesis

TRL: 4

Intellectual Property:

Provisional-Gov. Funding, 2021-10-07, United States

Utility-Gov. Funding, 2022-10-06, United States

Keywords: Integrated Photonics, Optical Cavities, Optical Resonance, Optoelectronics, Quantum Computation, Quantum Optics, Spectral Range, Telecommunications