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An ultrafast molecular memory for light PHILIP J. BUSTARD, RUNE LAUSTEN, DUNCAN G. ENGLAND, BENJAMIN J. SUSSMAN, National Research Council, Canada — Photonic devices of the future will require quantum memories capable of temporarily capturing, storing, and releasing photons while preserving the fidelity of quantum information.[1] For example, memories will enable synchronization of distinct photon channels, and compress processing times for algorithms using probabilistic photon sources. Here we discuss a room-temperature memory based on storing photons in the vibrations of molecules.[2] The memory utilizes the large energy level spacings afforded by molecules to allow high-bandwidth operation at room temperature, with no prior preparation of the initial molecular state. Photons are written into the molecular vibrations via a Stokes Raman transition, stored for a period, and read out using an anti-Stokes Raman transition. The ultra-broadband molecular memory has the potential to store femtosecond pulses for times approaching a nanosecond, permitting a large number of operational time bins, and making it a powerful tool for ultrafast local quantum processing, sufficient to build bench-top quantum architectures.

[1]A. Lvovsky *et al.* Nature Photon., **3**, 706 (2009)
[2]This work is under review for publication.

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