Quantum atomic or molecular coherence is the central feature of multiple techniques; high degree of coherence can lead to remarkable results [1,2]. The term “coherence” refers to a situation when all molecules / atoms in a macroscopic sample oscillate in unison, or, in the language of quantum mechanics, to a situation where a molecular / atomic ensemble is prepared in a vibrational superposition state. Atomic coherence has earlier been used in electromagnetically induced transparency, ultraslow light propagation, and lasing without inversion. Increased and cleverly manipulated molecular coherence has found important applications in coherent Raman spectroscopic detection and sensing [2,3]. Another notable example of an application of molecular coherence is a technique termed molecular modulation, which allows ultrafast laser pulse shaping and non-sinusoidal field synthesis via broadband (multi-sideband) coherent Raman generation [1,4]. Experimentally, the molecular- modulation light source is characterized by a bandwidth spanning infrared, visible, and ultraviolet spectral regions, generating bursts of light synchronized with respect to molecular oscillations. An additional dimension to the laser field engineering is added, within the molecular modulation technique, by using spatial light modulators to shape the transverse beam profiles [5,6], leading toward production of space- and time-tailored sub-cycle optical fields.

Acknowledgements: This work is supported by ONR (award N00014-16-1-2578) and the Welch Foundation (award A-1547).

References