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UV Laser Pulse Trains for Raman Spectroscopy.[1] DUSTIN SWANSON, PHILLIP SPRANGLE, University of Maryland, College Park — The theoretical framework for Raman spectroscopy using a UV probe laser pulse train consisting of multi femtosecond pulses is developed. We show selective excitation of a single Raman mode by tuning the pulse parameters. The use of UV radiation for the probe has a number of advantages for this application. The pulse train consists of multiple pulses of the form, $I_1(\tau) = I_0 \sin^2(\pi\tau/\tau_L)\left(\Theta(\tau) - \Theta(\tau - \tau_L)\right)$, where τ_L is the duration of a single pulse, $\tau_{FWHM} = \tau_L/2,\ I_0 = n_0 c \varepsilon_0 E_{peak}^2 \big/ 2$, is the peak intensity and $\Theta(\tau)$ is the Heaviside function. The analysis is performed in the group velocity frame, where $\tau = t - z/\mathrm{v}_G$ and $\eta = z$. The reduced propagation equation for the probe pulse field is $\partial E_P(\eta,\tau)/\partial\eta = i(\mu_0\omega_0^2/2k_0)P_{NL}(\eta,\tau)$ where P_{NL} is the non-linear polarization field. The probe intensity is modulated and grows approximately linearly with the interaction distance. We simulate the detection of the COVID-19 pathogen with a laser pulse train consisting of 10 micro-pulses, each with a duration of $\approx$ 32 fs, peak intensity of $10^{10}\,\mathrm{W/cm^2}$ and central wavelength of 250 nm (frequency tripled Ti:Sapphire). The micro-pulse duration is chosen to match the vibrational period of the smallest Raman shift resonance of the pathogen, $\omega_V/(2\pi c) = 1032\mathrm{cm}^{-1}$. This simulation showed the selective excitation of a single Raman mode.

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