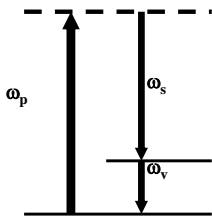
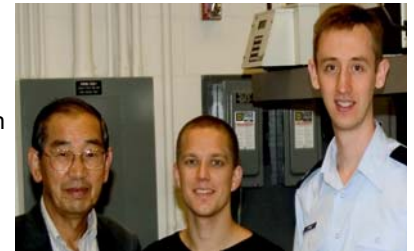




## Stimulated Raman Scattering in a Multi-mode Phosphor Doped Fiber

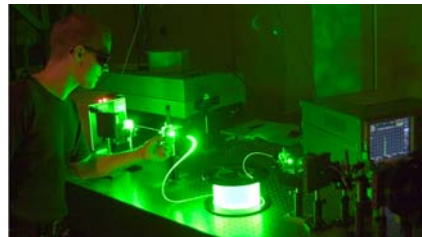
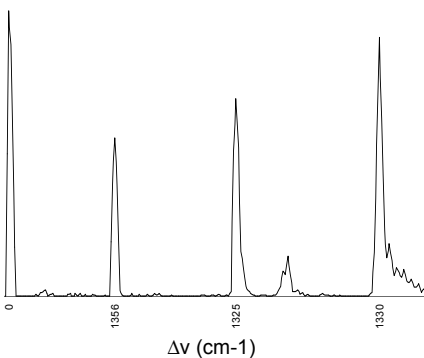
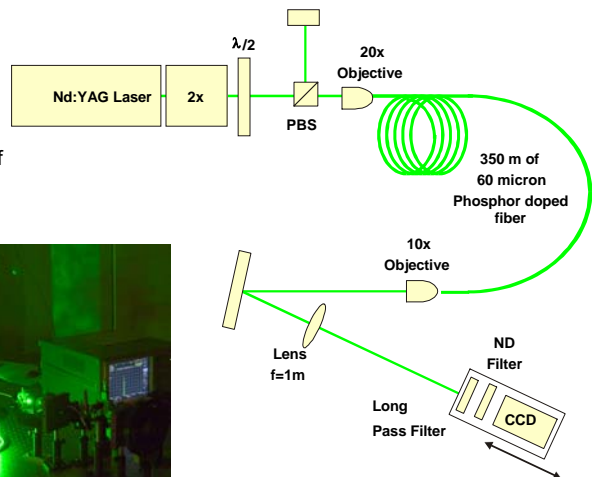
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The goal of the experiment is to use the properties of Stimulated Raman Scattering (SRS) for frequency shifting as well as to clean up the laser beam. Phosphor doped multi-mode fiber can give us unique frequencies which were previously unavailable.

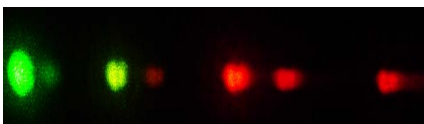


SRS is a nonlinear scattering process in which a pump photon is split into a Stokes photon and an optical phonon (molecular vibration). The light emitted is called the Stokes beam. The SRS process can be used to convert the frequency of the pump laser to that of the Stokes beam. In a multi-mode fiber the beam is cleaned up at the same time.

The laser light is first put through a half wave plate to control the polarization of the laser. Next the polarized laser light goes through a Polarized Beam Splitter (PBS). The PBS transmits some of the light and the rest is reflected the rest at a 90° angle. The light is focused into the fiber using a 20X magnifying lens. The light coming out of the fiber is collimated. Finally the beam is analyzed using a diffraction grating or camera.



The Stokes shift in the P-doped fiber is ~1330 cm-1. The pump generates the first-order Stokes beam, which in turn generates the second-order Stokes beam. Given enough power each Stokes generates the subsequent order Stokes beam. The number of Stokes beams excited can be ascertained using a spectrum analyzer, which produced the spectrum shown on the left.



When reflected off of a diffraction grating the Stokes beams are visible individually. The change of the frequency of the light as it passes through the fiber is shown by the rainbow pattern, on the left. The laser light shifts from a green color, to a red then to the near infrared as more orders of Stokes beams are excited.

To demonstrate beam clean up properties both near- and far-field spot size of the beams must be investigated. For good quality beams, a larger spot size in the near-field is expected to lead to a smaller spot in the far field. Although the pump beam is larger than the first-order Stokes beam in the near-field, the pump beam is larger than the Stokes beam in the far-field. This demonstrates that the Stokes beam is closer to a diffraction limited beam as a result of the beam clean up properties of the SRS process. The false color image to the right shows the size and intensity profile of the beam.

