Optical Waveguides and Splicing

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Abstract

ARP or Adiabatic Rapid Passage, and STIRAP, stimulated Raman adiabatic passage are two experiments that study the interstices of light and atomic interaction. The ARP experiment studies optical forces and STIRAP studies single atom electron excitement and the resulting metastable states. Both of these experiments require very specific laser light to induce the correct transition between energy states, requiring the use of optical fibers. These fibers' maintain the incident laser's mode, power, frequency, (For single mode fibers, SM) and polarization (for polarization maintaining fibers, PM), to and from the multitude of optical devices which manipulate, tune, and measure the light. Our goal this summer was to repair the aging fiber networks and get both experiments back into working order. Our tests required the use and complete understanding of optical splicing processes and the used equipment. All splices began with an untouched test fiber, which would be connected to a 1083nm diode laser to test for its initial power throughput. this fiber would then be cut in half and re-spliced to test our proficiency with the machinery, and as it became apparent later, the accuracy of the equipment. Each half of the original fiber would be cleaned, stripped, cleaved to an exact flat edge, and then re-spliced back together. The re-spliced fiber would be tested once more for power throughput and compared to the base laser, and its initial un-spliced throughput. The key results were the abysmal consistency between splices, even on the same day. Factors like the fibers intrinsic bend (view angle), cleave angle (gap angle), and environmental impact most likely are the causes to our findings. Though when plotted and analyzed, we found an R^2 correlation between the view/gap angles and power throughput of 0.029 and 0.082 respectively. Even with, we have masted the splicing process (among other things) and are ready to splice directly onto our optical equipment, to hopefully fully repair ARP and STIRAP.