



California Science Center
CALIFORNIA STATE SCIENCE FAIR
2001 PROJECT SUMMARY

Your Name (List all student names if multiple authors.) Lara A. Injeyan	Science Fair Use Only <h1 style="margin: 0;">J0616</h1>
Project Title (Limit: 120 characters. Those beyond 120 will be ignored. See pg. 9) Crosstalk in Wavelength Division Multiplexed (WDM) Optical Fibers	Division <u>X</u> Junior (6-8) _ Senior (9-12)
Preferred Category (See page 5 for descriptions.) 6 - Electricity & Electronics	
Abstract (Include Objective, Methods, Results, Conclusion. See samples on page 14.) Use no attachments. Only text inside these boxes will be used for category assignment or given to your judges.	
<p>Objective: to investigate cross-talk in WDM optical fibers. WDM is when two or more light beams of different wavelength propagate in the same fiber and carry different information. Cross-talk is when information from one wavelength leaks to another wavelength reducing the fidelity of information. I hypothesized that in a WDM optical fiber cross-talk takes place and the amount of cross-talk depends on the separation of the wavelengths and the intensity of light injected into the fiber.</p> <p>Method: My procedure consisted of assembling a wavelength division multiplexed fiber transmission line using two lasers and observing cross-talk between them as a function of wavelength separation. I coaligned the two beams with a beamsplitter, then I focussed them into the fiber using a microscope objective (lens). When the beams came out of the fiber I collimated them using another lens and then used a grating to separate them. Since the two beams are unequal in power, the leakage from one beam onto the other was normalized by multiplying it with the ratio of the powers of the two beams. Cross-talk is calculated by taking the ratio of the normalized leakage through the slit and the unmodulated beam as a function of wavelength separation.</p> <p>Results: My results indicate that cross-talk takes place. The graphs of cross-talk vs. wavelength separation show two slopes. For small wavelength separations (< 1.5 nm) cross-talk dropped rapidly with wavelength separation (slope of -19 ± 3 dB/nm) while for larger separations it dropped more slowly (slope of -3 dB/nm). My results also indicate that the normalized cross-talk between the two beams (beam 1 onto beam 2 vs. beam 2 onto beam 1) were similar.</p> <p>Conclusion: My hypothesis was correct; cross-talk takes place in WDM fiber networks and decreases as a function of wavelength separation. The two different slopes indicate that there may be two processes responsible for cross-talk. Two possible sources are broadband fluorescence from the laser and scattering from the grating. Of these, fluorescence is likely to have a stronger wavelength dependence. My results also indicate that cross-talk due to amplitude dependent (nonlinear) effects was not a factor for optical powers <1 mW because the two beam amplitudes were different by an order of magnitude but the normalized cross-talk between them was similar.</p>	
Summary Statement (In one sentence, state what your project is about.) A study of cross-talk in wavelength division multiplexed (WDM) optical fiber communication	
Help Received in Doing Project (e.g. Mother helped type report; Neighbor helped wire board; Used lab equipment at university X under the supervision of Dr. Y; Participant in NSF Young Scholars Program) See Display Regulation #8 on page 4. Father helped with identifying the project, getting equipment for experiments and collecting data	