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Design of a Monolithic, Solid-State Dye Laser

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Solid-State Monolithic Dye Laser

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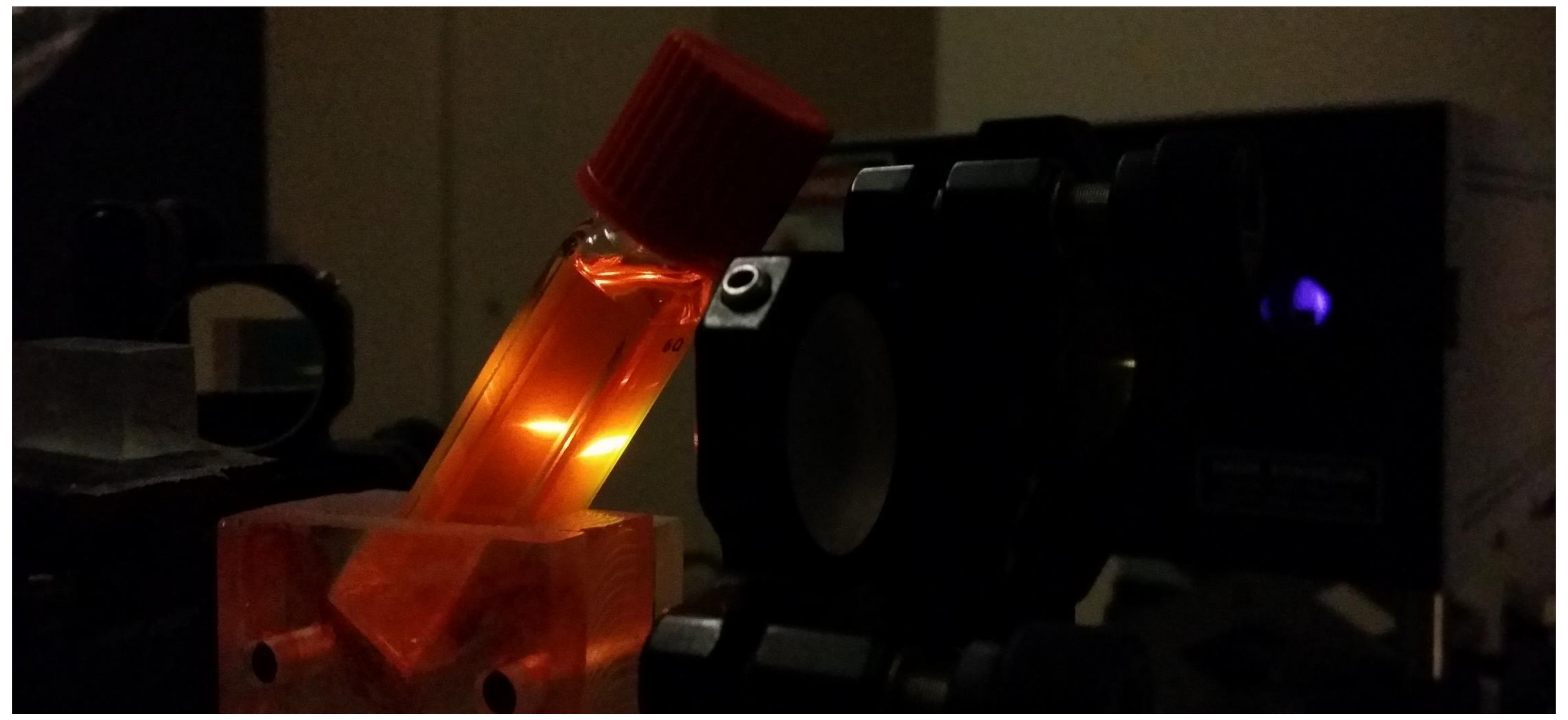
Abstract and Introduction

Traditional liquid dye lasers provide stable, tunable light which finds many applications in medicine, industry, and scientific research. They are also messy, require particular disposal for the dye, and rely on expensive optics (below is an example of a simple dye cell, excited by a violet laser).

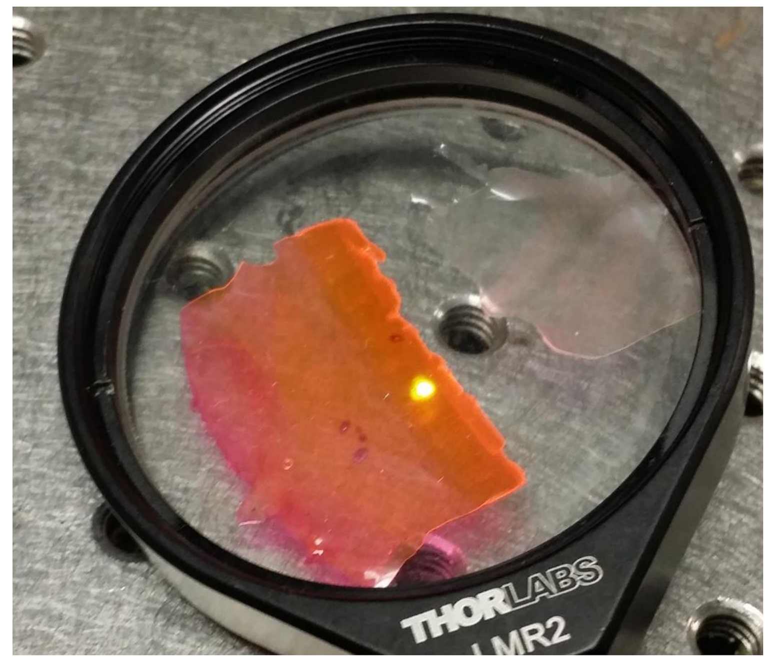


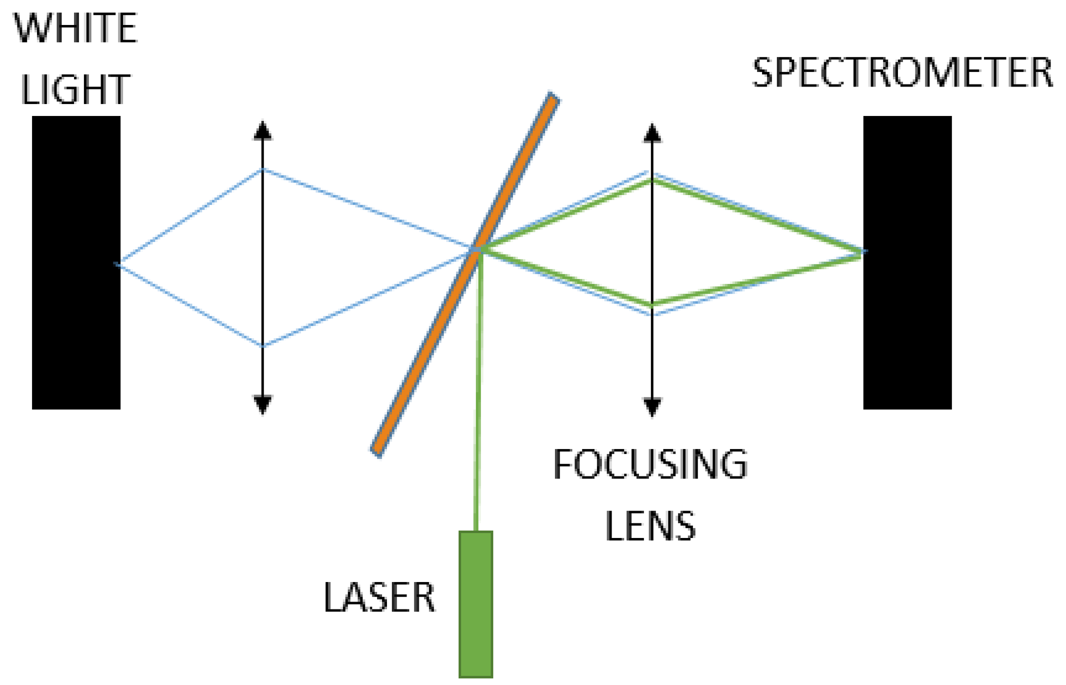
We aim to design a monolithic, solid-state dye laser, in which the liquid dye is replaced with a dyed plastic and the laser cavity is created by total internal reflection within an acrylic block. This provides a similarly useful light source while eliminating the hassles of liquid dye and decreasing cost associated with optics.

We investigate methods for creating dye targets and the fluorescence spectra of those targets when excited by a diode laser. Future work is discussed, including implementation of those dye targets as the gain medium in the monolithic laser cavity.

Target Production

Thus far, attempts at spin-coating targets by dropping dyed poly-methyl methacrylate onto a rotating glass substrate have proven ineffective; if the drop is too thin, a high enough dye concentration for lasing cannot be achieved. If the drop is too viscous, the coating is non-uniform, making for a poor optical element. For fluorescence studies, dried dyed PMMA from the insides of mixing vessels have been satisfactory. These are generally smooth and consistent enough for such studies.

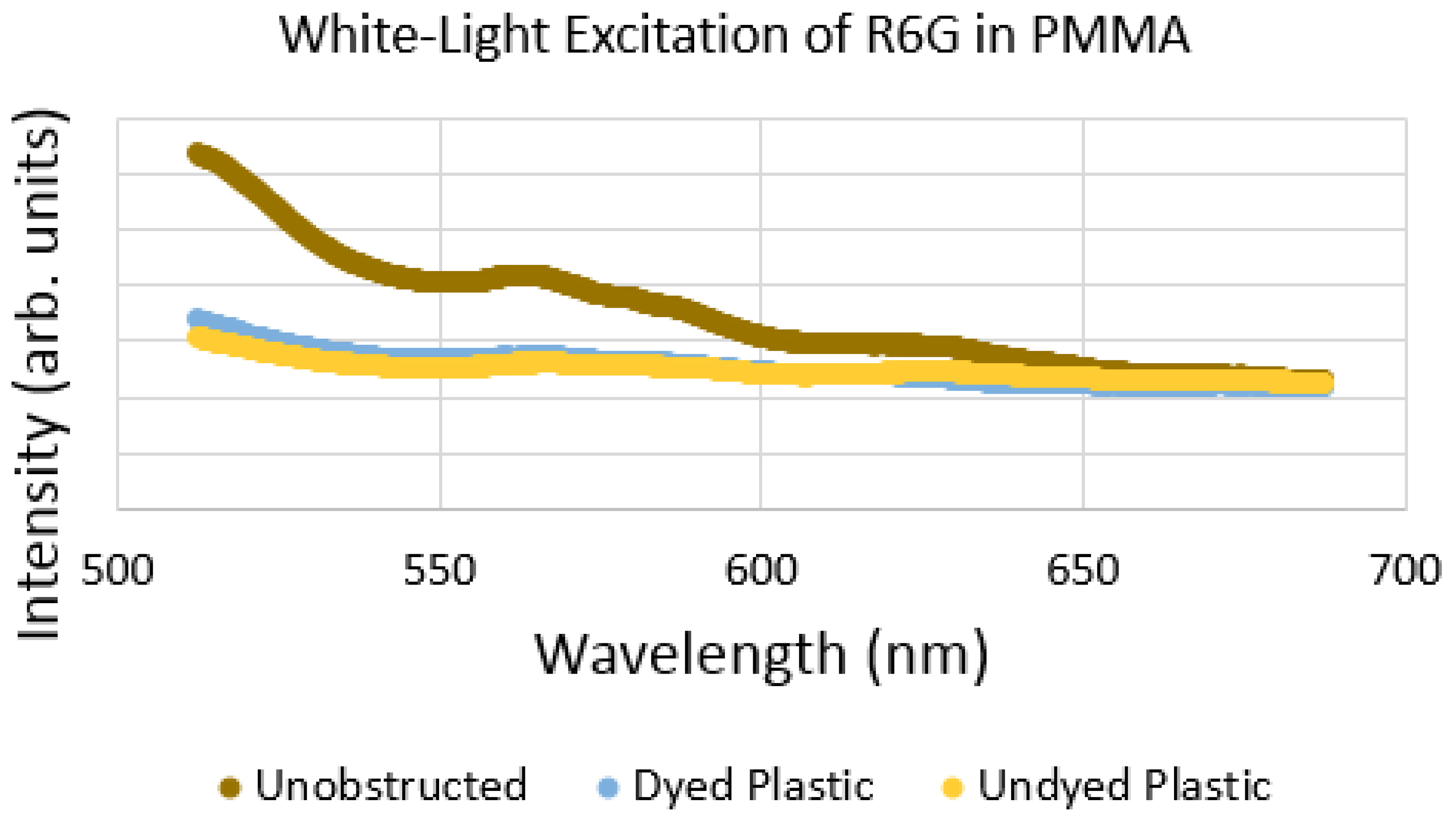




An example dye target (excited by a green laser) and the spectroscopy setup.

Spectroscopy

Using a CCD camera and a spectrometer, we are able to obtain fluorescent emission spectra, as seen below (after a healthy lesson in ancient data transfer rituals). Based on these spectra, we can determine appropriate conditions for lasing and determine when lasing occurs.



The Future

Significant effort is still required to realize dye targets appropriate for our purposes; spin-coating will be abandoned in favor of some casting process. Design of the monolithic cavity will come when we are able to produce appropriately-formed dye plastic.