# A Study of Optical Properties of ZBLAN Microspheres Produced in Microgravity

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ZBLAN, a member of the heavy-metal fluoride family of glasses, transmits light with attenuation rates much lower than those of silica-based materials. Microspheres of ZBLAN therefore have the theoretical potential to form fiber optic transmission lines with very high transmission rates. Experiments, however, have shown that the presence of gravity during the ZBLAN glass transition phase causes crystallization, degrading the optical properties of the glass. Dr. Dennis Tucker of NASA's Marshall Space Flight Center first showed in 1998 that very little crystallization occurs in ZBLAN fibers fabricated in a microgravity environment.

As participants in the Reduced Gravity Student Flight Opportunities Program (RGSFOP), we propose to fabricate microspheres from undoped and erbium-doped ZBLAN aboard NASA's KC-135 reduced gravity aircraft, and later compare their optical properties. The transmission properties can be deduced from the longevity of whispering gallery modes induced in microspheres of the glass. Because of ZBLAN's low attenuation, these microspheres might in fact produce resonators with the highest quality factor ($Q$) produced to date. Since $Q$ is related to the resonator's absorption coefficient, knowledge of the effects of gravity on $Q$ can be used to infer crystallization effects during the solidifying stage of ZBLAN.

Part of our experiment will involve the quantitative comparison of the quality factor of ZBLAN microspheres fabricated in normal earth gravity versus microgravity aboard the KC-135. It highlights a novel approach to characterizing ZBLAN based on cavity QED techniques refined from previous research. The other part of the experiment will focus on how lower crystallization and impurity absorption in ZBLAN microspheres affects their lasing properties. Recent research on low-threshold green lasing with erbium-doped ZBLAN microspheres will be used in this analysis. The lower $Q$ of the microspheres produced in microgravity may improve upon the up-conversion efficiency of the lasing and produce narrower linewidths.

Our total budget for performing the experiment and analyzing the results is $17,275. This includes $10,000 for materials and the experimental setup, $6,275 for travel and operating expenses, and $1,000 for miscellaneous expenses.