

# **GAS LENSING IN A HEATED ROTATING PIPE**

by

COSMAS MAFUSIRE

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## ABSTRACT

When a heated pipe is axially rotated, the dynamics of the gas inside exhibit properties reminiscent of a positive lens. These are the result of a parabolic distribution of refractive index in the pipe, which is caused by a special mixing of hot and cold gases. When a laser beam was propagated, along the pipe's axis, a focal spot was observed.

In this report, results of a numerical model are presented using the basic equations of a graded refractive index (GRIN) lens provided a tool to visualize a Gaussian beam propagating through such a lens. Experimental data are presented to demonstrate how the lensing properties depend on the rotation rate and pipe temperature. The lens is essentially a graded refractive index (GRIN) lens whose power is a result of both of these variables. The data show that, if either is increased, the power of the lens increases. An empirical formula relating focal length, temperature and rotation rate is derived.

Future research, which could not be done in time, can look at measuring aberrations generated by the gas lens, the beam quality factor and analyzing the intensity profile of its output beam. This will help understand how a laser beam can be used to take measurements of aberrations in the atmosphere.

## **PREFACE**

The work in this thesis was carried out at the National Laser Centre (NLC) in Pretoria, South Africa on behalf of the University of Zimbabwe (UZ), from December, 2005 to April 2006.

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## **DEDICATION**

I dedicate this report to my loving wife, Shingi, for her devotion and support. She encouraged me to carry on when I could have given up. God bless her.

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