Department of Electrical and Computer Engineering
North South University

Senior Design Project

Optical Force Reversal using Parallel Waveguides

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Faculty Advisor:

Dr. Mahdy Rahman Chowdhury
Associate Professor

ECE Department

Spring, 2023

LETTER OF TRANSMITTAL

July, 2023

To

Dr. Rajesh Palit
Chairman,
Department of Electrical and Computer Engineering
North South University, Dhaka

Subject: **Submission of Capstone Project Report on "Optical Force Reversal using Parallel Waveguides"**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on **"Optical Force Reversal using Parallel Waveguides"** as a part of our BSc program. The report deals with pulling or pushing nanoparticles using a nano structural light. This project was a great prospect to learn about optical force. The project deals with nanoparticles but in future days it can be used for more bigger particles.

We will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

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Tafsir Hossain
ECE Department
North South University, Bangladesh

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Taha Chowdhury
ECE Department
North South University, Bangladesh

APPROVAL

Tafsir Hossain (1921890043) & Taha Chowdhury (1921404043) from Electrical and Computer Engineering Department of North South University, have worked on the Senior Design Project titled "**Optical Force Reversal using Parallel Waveguides**" under the supervision of Dr. Mahdy Rahman Chowdhury partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor's Signature

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Dr. Mahdy Rahman Chowdhury

Associate Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

Chairman's Signature

…….

Dr. Rajesh Palit

Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

DECLARATION

This is to declare that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. All project related information will remain confidential and shall not be disclosed without the formal consent of the project supervisor. Relevant previous works presented in this report have been properly acknowledged and cited. The plagiarism policy, as stated by the supervisor, has been maintained.

Students' names & Signatures

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1. **Tafsir Hossain**

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2. **Taha Chowdhury**

ACKNOWLEDGEMENTS

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ABSTRACT

Optical Force Reversal using Parallel Waveguides

Using light to control particle has been of great interest for quite a long time. Pulling different nanoparticles using a nonstructural light can be a novel approach in the field of optical manipulation. In most of the set ups pull-push phenomena is observed either for Rayleigh particle of for Mie particle. In this work, we demonstrated how a simple plane wave can pull and push a particle situated between substrates. We have used two setups here. The force reversal for the same wavelength occurs when there is substrate present in the setup. Dielectric particles experience pull-push phenomena because of induced multipole expansion. On the other hand, reversal of optical force acting on plasmonic particle can be explained by transferred momentum of photon. In the proposed setup, optical force acting on the particle is calculated using Maxwell Stress Tensor