Emphasizing On Excitation: Theoretical Estimation of Optimal Parameters for Maximum Fluorescence & Ultrafast Pulse Shaping and Characterization

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Certificate of Examination

This is to certify that the dissertation titled "**Emphasizing on excitation: Theoretical estimation of optimal parameters for maximum fluorescence and Ultrafast pulse shaping and characterization**" submitted by **Mr. Meghanad Kayanattil** (Reg. No: MS13048) for the partial fulfilment of the BS-MS dual degree program of the Institute, has been examined by the thesis committee duly appointed by the Institute. The committee finds the work done by the candidate satisfactory and recommends that the report be accepted.

Dr. P. Balanarayan Dr. Kamal P. Singh Dr. Arijit K. De (Supervisor)

Dated: 20-04-2018

Declaration

The work presented in this dissertation has been carried out by me under the guidance of Dr. Arijit K. De at the Indian Institute of Science Education and Research Mohali.

This work has not been submitted in part or in full for a degree, a diploma or a fellowship to any other University of institute. Whenever contributions of others are involved, every effort is made to indicate this clearly with due acknowledgement of collaborative research and discussions. This thesis is a bonafide record of original work done by me and all sources listed within have been detailed in the bibliography.

Meghanad Kayanattil

(Candidate)

Dated: 20-04-2018

In my capacity as the supervisor of the candidate's project work, I certify that the above statements by the candidate are true to the best of my knowledge.

Dr. Arijit. K. De

(Supervisor)

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Abbreviations

CW – Continuous Wave

AOPDF – Acousto-Optic Programmable Dispersive Filter

FROG – Frequency Resolved Optical Gating

BBO – Beta Barium borate (BaB_2O_4)

SHG – Second Harmonic Generation

ISC – Intersystem Crossing

ESA – Excited State Absorption

IVR – Intramolecular Vibrational Energy Redistribution

Abstract

We have conducted two studies with a common theme, giving focus on the excitation processes. In the initial part of the work, using a comprehensive theoretical model, we have shown the optimum excitation parameters required for a specific system to produce maximum fluorescence. We conclude that depending upon the excitation intensity the excitation parameters will vary. This approach can be extended to more complex models without much difficulty.

In the second part of our work, we have implemented an ultrafast pulse shaping and pulse characterization setup. The shaping is done by the commercially available AOPDF (Dazzler®) pulse shaper and the characterization is carried out using autocorrelation and SHG-FROG setups. These setups can be used to carryout shaped pump–probe quantum control experiments and multidimensional spectroscopy in the near future.