

# Probing ultrafast solvation dynamics using pump-probe spectroscopy and fluorescence-detected pump-probe spectroscopy

A Thesis submitted for the partial fulfilment of the requirements for the degree of

**BS-MS DUAL DEGREE PROGRAM**

in

CHEMICAL SCIENCES

By

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to the

DEPARTMENT OF CHEMICAL SCIENCES

INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH MOHALI

April 2018

## Certificate of Examination

This is to certify that the dissertation titled “**Probing ultrafast solvation dynamics using pump-probe and fluorescence detected pump-probe spectroscopy**” submitted by **Ms. Shreya Khandal** (Reg. No. MS13095) for the partial fulfilment of BS-MS dual degree programme 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.

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## **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 or 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.

Shreya Khandal

(Candidate)

Dated: April 20, 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)

## **Acknowledgements**

First and foremost, I would like to express my thanks to Dr. Arijit K. De who gave me an opportunity to explore this exciting field.

I would like to thank Ms. Anita Devi for all her help in experimentation, discussion and the constant support. I would also like to thank Ms. Yogita Silori, Mr. Pankaj Seliya and Ms. Pragya Verma for their help in experimental set-up and discussions.

Further I would like to thank Ms. Shaina Dhamija, Ms. Monika Dahiya for the engaging discussions and support.

I would also like to thank my committee members for their time and suggestions.

IISER Mohali for all of the instrumental facilities. The library access for the plethora of Journals.

Lastly, I thank my friends and family for their constant motivation.

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## **Abbreviations**

TRFSS: Time Resolved Fluorescence Stokes Shift

FWHM: Full Width Half Maxima

BBO: Beta barium borate (second harmonic generator)

FA: Field Autocorrelation

TPA: Two Photon Absorption

SHG: Second Harmonic Generation

PMT: Photo Multiplier Tube



## Abstract

So far, the time resolution for probing polar solvation dynamics has been limited to, from few tens of picoseconds using fluorescence lifetime measurement (by TCSPC technique) down to ~200 femtoseconds using fluorescence time-gating measurement (by fluorescence up-conversion technique). However, a substantial part (nearly 80%) of solvation completes within ~200 femtoseconds which demands probing early time solvation dynamics. We probed solvation dynamics using non-collinear pump probe spectroscopy by measuring the stimulated emission signal and collinear pump-probe spectroscopy by measuring only the fluorescence signal. We will present solvation dynamics studies of an NIR dye (DNTTCI) in two polar solvents (ethanol and ethylene glycol) using degenerate pump probe spectroscopy at 800 nm as well as fluorescence detected pump-probe spectroscopy. Our results show that much of the difference in solvation correlation function is observed within 1 picosecond.