

Ojas Singh  
Department of Chemical Sciences  
Indian Institute of Science Education and Research Mohali  
Punjab India-140306  
☎ +91 7007 607 810  
✉ ms16084@iisermohali.ac.in

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**Subject: Application for the PhD Position (QSpec-NewMat ERC project)**

Dear Prof. Dr. Angel Rubio,

I am Ojas Singh, currently in the final semester of my BS-MS (chemistry) dual degree program at the Indian Institute of Science Education and Research Mohali. I am interested in the project regarding quantum spectroscopy and exploring new states of matter out of equilibrium. I am writing this to express my sincere interest in joining your lab as a doctoral student this coming semester.

Presently, I am working on Time-Dependent Configuration Interaction for my master's thesis at my institute under the supervision of Dr. P. Balanarayan. Thus far, I have successfully implemented an efficient CI algorithm with high-performance data structures in Rust, which is the fastest implementation for our case. I am currently working on quantum dynamics using the  $(t, t')$  method.

As part of a summer project, I have previously developed a spectral clustering based fragmentation method for estimating the electronic energy of large molecules. The approach predicts the best possible fragments and overlaps heuristically, by utilizing the key features of graphs. The energy estimates showed excellent agreement with those obtained from actual computations of the complete molecules.

I look forward to employing theoretical and computational tools to aid first-principle computational modeling of light-matter interactions. I am interested in working with the principles of TDDFT and many-body methods as well as QED. I have perused your publication bridging quantum optics and electronic structure theory and found your research quite intriguing. Having this prior experience as well as an inquisitive mind and flexibility to explore new horizons, I am genuinely excited at the prospect of working under your supervision in this project and firmly believe that I would be a valuable asset to your team.

Thank you for your time and kind consideration. I would be highly obliged to hear from you.

Sincerely yours,

**Ojas Singh**