

Ragav Ramachandran, ^{PhD}

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*In a broader sense, my interest lies in the characterisation and energetic processing of exotic molecules which have either been discovered or awaiting discovery in the ISM or similar cold conditions (like comets or icy satellites....). During my 2 year PDF tenure, the main focus of my work was to prove the **etching of ISM cold dust by the molecular ices** depositing on the dust. It is a novel process in the cold astrochemical conditions and if proven, it would account for the discrepancies in the dust destruction rates in such conditions.*

1. Educational Qualifications

- **Doctor of Philosophy**

Thesis Title : Collisional Excitation of NH and ND molecules by H₂:
Theory, Comparison with Experiments and Astrophysical applications.

Institute : Université du Havre, Le Havre, France.

Year : November 2016 - February **2020**.

- **Master of Sciences (Integrated 5 year program)**

Subject : Physics (Specialisation: Electronics)

CGPA : 7.64 (out of 10)

Institute : Pondicherry Central University, Pondicherry, India.

Year : May 2010 - May 2015

2. Employment/Academic History



3. Programming Languages

Fortran, Python, MATLAB

4. Technical Skills

LaTeX, MS-Office, LabView, Ansys workbench (including AUTODYN), Comsol Multiphysics, Wolfram Mathematica, and great with creative designing.

5. Publications

(1) **Amorphous 1-propanol interstellar ice beyond its melting point**

*R Ramachandran**, A Hazarika, S Gupta, S Nag, JK Meka, Tejender S Thakur, S Yashonath, G Vishwakarma, S-L Chou, Y-J Wu, P Janardhan, BN Rajasekhar, Anil Bhardwaj, NJ Mason, B Sivaraman, Prabal K Maiti (2024), Monthly Notices of the Royal Astronomical Society 530 (1), 1027-1034

(2) **A systematic mid-infrared spectroscopic study of thermally processed H₂S ices**

D V Mifsud, P Herczku, **R Ramachandran**, P Sundararajan, KK Rahul, S TS Kovács, B Sulik, Z Juhász, R Rácz, S Biri, Z Kaňuchová, S Ioppolo, B Sivaraman, R W McCullough, N J Mason (2024), Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 319, 124567.

(3) **BASECOL2023 scientific content**

M.L. Dubernet, C. Boursier,..., **R Ramachandran**,....(2023), Astronomy & Astrophysics 683, A40.

(4) **Ultraviolet spectrum reveals the presence of ozone on Jupiter's moon Callisto**

R Ramachandran*, J K Meka, K K Rahul, W Khan, J-I Lo, B-M Cheng, D V Mifsud, B N Rajasekhar, A Das, H Hill, P Janardhan, Anil Bhardwaj, N J Mason, B Sivaraman (2023), Icarus (Special Issue: Ices in the Solar System), 410, 115896.

(5) **Detection of polycyclic aromatic hydrocarbons on a sample of comets**

V Venkataraman, Arijit Roy, **R Ramachandran**, H M Quitián-Lara, H Hill, B N RajaSekhar, Anil Bhardwaj, N J Mason, B Sivaraman (2023), *Journal of Astrophysics and Astronomy* 44 (2), 89.

(6) **Stability and morphology of cyanonaphthalene icy mantles on ISM cold dust analogues**

R Ramachandran*, KK Rahul, JK Meka, S Pavithraa, A Roy, BN Rajasekhar, P Janardhan, Anil Bhardwaj, NJ Mason, B Sivaraman (2023), *Journal of Chemical Sciences* 135 (3), 77.

(7) **Interstellar Carbonaceous Dust and Its Formation Pathways: From an Experimental Astrochemistry Perspective**

Arijit Roy, VS Surendra, **R Ramachandran**, JK Meka, S Gupta, P Janardhan, BN Rajasekhar, H Hill, Anil Bhardwaj, NJ Mason, B Sivaraman (2023), *Journal of the Indian Institute of Science*, 1-20.

(8) **Etching of ISM Cold Dust—A Conceivable Dust Destruction Process in Astrochemical Icy Conditions**

R Ramachandran*, JK Meka, A Ravindran, SV Singh, S Gupta, W Khan, A Roy, V Thiruvengatam, BN Rajasekhar, P Janardhan, H Hill, A Bhardwaj, NJ Mason, B Sivaraman (2023), *LPI Contributions* 2806, 2043.

(9) **Shock Induced Formation of Cosmic Mineral Dust Analog in Laboratory Using High Intensity Shock Tube for Astrochemistry**

A Roy, V S Surendra, J K Meka, **R Ramachandran**, D Sahu, W Khan, S Gupta, V Thiruvengatam, J Cami, V Venkataraman, H Hill, P Janardhan, Anil Bhardwaj, N J Mason, B Sivaraman (2023), *LPI Contributions* 2806, 2517.

(10) **A systematic mid-infrared spectroscopic study of thermally processed SO₂ ices**

Duncan V Mifsud, Péter Herczku, KK Rahul, **R Ramachandran**, Pavithraa Sundararajan, Sándor TS Kovács, Béla Sulik, Zoltán Juhász, Richárd Rácz, Sándor Biri, Zuzana Kaňuchová, Robert W McCullough,

Bhalamurugan Sivaraman, Sergio Ioppolo, Nigel J Mason (2023), Physical Chemistry Chemical Physics 25 (38), 26278-26288.

- (11) **Vacuum ultraviolet photoabsorption spectra of icy isoprene and its oligomers.**

R Ramachandran, S Pavithraa, JK Meka, KK Rahul, J-I Lo, SL Chou, BM Cheng, BN Rajasekhar, Anil Bhardwaj, NJ Mason, B Sivaraman (2022), *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 268, 120586.

- (12) **Vacuum ultraviolet photoabsorption spectra of an *in-situ* synthesized peptide precursor: hydroxylamine on a cold astrochemical dust analogue.**

R Thombre, D Gupta, S Pavithraa, J-I Lo, S-L Chou, Y-J Wu, **R Ramachandran**, KK Rahul, B-M Cheng, H Hill, Anil Bhardwaj, BN Rajasekhar, NJ Mason, B Sivaraman (2022), *The European Physical Journal D* 76(3), 53.

- (13) **VUV photoabsorption of thermally processed carbon disulfide and ammonia ice mixtures–Implications for icy objects in the solar system.**

S Pavithraa, **R Ramachandran**, Duncan V Mifsud, Jaya K Meka, JI Lo, SL Chou, Bing-Ming Cheng, BN Rajasekhar, Anil Bhardwaj, NJ Mason, B Sivaraman (2022), *Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy* 283, 121645.

- (14) **Shock-induced transformation of non-magnetic to magnetic ISM dust analogue.**

Arijit Roy, S V Singh, JK Meka, **R Ramachandran**, D Sahu, A Gautam, T Vijay, Jayaram Vishakantaiah, P Janardhan, BN Rajasekhar, Anil Bhardwaj, NJ Mason, B Sivaraman (2022), *Monthly Notices of the Royal Astronomical Society* 517 (4), 4845-4855.

- (15) **Shock processing of amorphous carbon nanodust.**

Arijit Roy, S V Singh, M Ambresh, D Sahu, J K Meka, **R Ramachandran**, P Samarth, S Pavithraa, V Jayaram, H Hill, J Cami, BN Rajasekhar, P Janardhan, Anil Bhardwaj, NJ Mason, B Sivaraman (2022), *Advances in Space Research* 70 (8), 2571-2581.

(16) The Diyodar meteorite fall in India.

Y. srivastava, A. Kumar, A. Basu Sarbadhikari*, D. Ray, V. M. Nair, A. Das, A. D. Shukla, S. Sathiyaseelan, **R Ramachandran**, B. Sivaraman, S. Vijayan, N. Panwar, A. J. Verma, N. Srivastava, A. Rani, G. Arora, R. R. Mahajan, A. Bhardwaj (2023), *Current Science* 124(2):152.

(17) Collisional excitation of NH by H₂: Potential energy surface and scattering calculations.

P Pirlot, Y N Kalugina, **R Ramachandran**, G Raffy, P J Dagdigian, F Lique (2021), *J. Chem. Phys.* 155, 134303.

(18) Collisional excitation of NH(³Σ⁻) by Ar: A new ab initio 3D potential energy surface and scattering calculations.

D Prudenzeno, F Lique, **R Ramachandran**, L Bizzocchi, P Caselli (2019), *J. Chem. Phys.* 150(21), 214302.

(19) A new ab initio potential energy surface for NH-He complex.

R Ramachandran, J Klos, F Lique (2018), *J. Chem. Phys.* 148, 084311.

6. Publications in pipeline

Submitted / Under review:

(20) Infrared spectroscopy reveals ethylene glycol is an anti crystallizer in water-mixed astrochemical ices

W Khan, **R Ramachandran***, S Gupta, J K Meka, V Venkataraman, H Hill, B N Rajasekhar, P Janardhan, Anil Bhardwaj, N J Mason, B Sivaraman* (Under Review), *Monthly Notices of the Royal Astronomical Society.*

(21) Experimental and computational study of ethanolamine ices at astrochemical conditions

R Ramachandran*, M Sil, P Gorai, J K Meka, S Pavithraa, J -I Lo, S -L Chou, Y -J Wu, P Janardhan, B -M Cheng, Anil Bhardwaj, V M Rivilla, N J Mason, B Sivaraman, and Ankan Das (Accepted), *The Astrophysical Journal.*

7. Research Work/Projects

- *VUV and electron irradiation experiments of amino acids under astrochemical conditions* using the synchrotron facility (TLS) from May 19 - June 10, 2024 at **National Synchrotron Radiation Research Center (NSRRC), Taiwan.**
- *X-ray irradiation experiments of meteorites and analogous materials* using the synchrotron facility (INDUS-2) from December 10 - 16, 2023 at **RRCAT, Indore.**
- Carried out experiments as a part of the Europlanet Translational access (TA) project titled *Hypervelocity impact on low-temperature astrochemical ices containing amino acids*, from 26th June - 07th July 2023 within the framework of Europlanet 2024 research infrastructure project at **University of Kent, Canterbury, UK.**
- Carried out experiments as a part of the Translational access (TA) project titled *Converting one amino acid to the other containing sulfur via ion irradiation: Implications to the chemical evolution on Europa surface ices*, from 8th November - 20th November 2021 within the framework of Europlanet 2024 research infrastructure project at **Institute of Nuclear Research (ATOMKI), Hungary.**
- *Visiting scientist* in the *Astrochemistry lab* from August 2021 to March 2022 under the J.C Bose fellowship grant of **Prof. Anil Bhardwaj, Director, Physical Research Laboratory, India.**
- PhD Thesis titled *Collisional Excitation of NH and ND molecules by H₂ : Theory, Comparison with Experiments and Astrophysical Applications* under the supervision of **François Lique.**
- **Research Staff** in the *Low temperature Astrochemistry lab* under **Dr. Bhalamurugan Sivaraman** from October 2015 to August 2016 at **Physical Research Laboratory, India.**
- **Final year dissertation project** titled *Study and characterization of PVDF thin films* under the guidance of **Dr. G. Ramesh Babu**, in partial

fulfillment of the requirements of the M.Sc degree at **Pondicherry University, India**.

- **Group project** titled *Physico-chemical characterization of impactites* during the 15th PLANEX workshop (January 2015), under the guidance of **Prof. J. K. Pati and Mr. Deepak Panda**, at **Physical Research Laboratory, India**.
- **Summer internship project** titled *Impact studies on icy surface* under the guidance of **Dr. Bhalamurugan Sivaraman** during May - July, 2014 at **Physical Research Laboratory, India**.
- **Summer project** titled *Interfacing Instruments using Lab view* under the guidance of **Dr. G. Ramesh Babu** during May - July, 2013 at **Pondicherry University, India**.
- **Mini project** titled *Spatial Filtering and Optical Trapping* under the supervision of **Dr. Alok Sharan** during the academic year 2012 - 2013 at **Pondicherry University, India**.

8. Conferences/Workshops Participation

- Invited talk titled **Converting One Amino Acid to the Other Containing Sulfur Via Ion Irradiation: Implication to Chemical Evolution on Europa Surface Ices**, at the **DIG Astrochemistry - 2: Icy Dust - Astrochemistry Workshop** held on June 25, 2024 at Aarhus University, Denmark
- Oral presentation titled *Converting one amino acid to the other containing sulfur via ion irradiation: Implications to the chemical evolution on Europa surface ices*, at the **55th Lunar and Planetary Science Conference** held from March 11 - 15, 2024 at The Woodlands, Texas, US.
- Talk titled *Etching of ISM cold dust – A conceivable dust destruction process in astrochemical icy conditions* at the **National Space Science Symposium** to be held from February 26 - March 1, 2024 at Goa, India.

- Talk titled *Discovery of Ozone on Callisto and its implication to the Jovian system* at the **National Space Science Symposium** to be held from February 26 - March 1, 2024 at Goa, India.
- Invited talk titled *S⁺ Ion Irradiation of Aspartic acid: A case study for conversion of N-containing amino acid to S-containing amino acid in Space* presented at the **1st Organics in Space** symposium held from January 18 - 20, 2024 at Thiruvananthapuram, India.
- Paper titled *Thermal and electron induced chemistry of the three-ringed PAH under astrochemical condition* presented at the **MetMess-2023** conference held from November 1 - November 3, 2023 in Ahmedabad, India.
- Abstract titled *Etching of ISM cold dust – A conceivable dust destruction process in astrochemical icy conditions* selected for the **Astrochemistry at high resolution Faraday Discussion 2023** to be held from May 31 - June 2, 2023 in Maryland, US.
- Abstract titled *Etching of ISM cold dust – A conceivable dust destruction process in astrochemical icy conditions* selected for the **54th Lunar and Planetary Science Conference (LPSC-2023)** held from March 13 - 17, 2023 in The Woodlands, US.
- Poster titled *Time-dependent infrared spectra of ammonium thiocyanate ices* at the conference on **Spectroscopy, Dynamics of Molecular Clusters - 2022** held from November 10 - 13, 2022 in Udupi, India.
- Poster titled *IR spectroscopy of Icy Mantles of 1- and 2-Cyanonaphthalene* at the symposium on **Life cycle of cosmic PAHs** held from September 5 - 9, 2022 at Aarhus, Denmark.
- Poster titled *Collisional Excitation of NH molecules by He and H₂* at the **Physique et Chimie du Milieu Interstellaire 2018**, held from June 25 - 29, 2018 in Marseille, France.
- Summer School on **PAHs in ISM: Observational, Experimental and Computational tools** during April 2 - 6, 2018 in Les Houches, France.

- Won the best Oral presentation for the presentation titled ***Collisional Excitation of NH molecules by He*** at the **Astrochemistry in THz domain** conference, held from October 30 - 31, 2017 in Chennai, India.
- Presented a poster titled ***Collisional Excitation of NH molecules by He and H₂*** at the **Astrochemical conference KIDA 2017**, conducted between September 26 & 29, 2017 in Bordeaux, France.
- Winter School on **Chronology of the formation of the Solar System VI: The Outer Solar System and its relationship with the Interstellar Medium**, 12-17 February, 2017 in Les Houches, France.
- 15th PLANEX Workshop on **Mars and Moon: Remote Sensing and Analogue studies** held from 4 -10 January 2015 at PRL, India.
- Seminar on **National Instruments** on 22nd May 2013, conducted by National Instruments, India.
- **100th Indian Science Congress** conference, held in Kolkata, India during 3 - 7 January, 2013.
- **99th Indian Science Congress** conference, held at KIITS, Bhubaneswar, India during the period 3 - 7 January, 2012.

9. Organizational Activities

- Moderator of the Astrobiology and Exobiology session at the **55th Lunar and Planetary Science Conference** to be held from March 11 - 15, 2024 at The Woodlands, Texas, US.
- Member, National Working Group of **1st symposium on Organics in Space** to be held from January 18 - 20, 2024 at Thiruvananthapuram, India
- Co-Convenor of the **1st Vikram Discussions on Astrobiology and Astrochemistry** held from January 5 - 6, 2024.
- **PRL DST Vritika Astrobiology Internship** program for Post-graduation students from July 25 - August 21, 2023 with Field visit to Kutch region and analysis at Physical research Laboratory and Indian Institute of Technology, Gandhinagar.

- Co-organised ***National symposium on Shock Waves (NSSW-2023)*** held from February 15 - 17, 2023 at Physical Research Laboratory, India.
- Co-organised a DST funded workshop on ***Astrochemistry and Cratering in the Solar System*** held from July 4 - 10, 2022 at Physical Research Laboratory, India.
- Secretary of “***Association des Doctorants et Docteurs des Écoles Doctorales (ADDED)***” of the Normandy region from November 2017 - November 2019.
- Co-organised ***Astrochemistry in THz domain*** conference, held from October 30 - 31, 2017 in Chennai, India.
- Organised the 9th edition of ***Journées Des Doctorants (JDD)***, a conference for all the universities of the Normandie region held at Université du Rouen during 13 - 14 June, 2017.
- Student President of ***Reflections 2014*** held at Pondicherry University, Pondicherry during 21 - 28 February, 2014.
- Volunteered for ***OSI National Symposium*** held at Pondicherry University, Pondicherry during 23 - 25 January, 2013.
- Volunteered for ***Plasma-2012*** held at Pondicherry University, Pondicherry during 10 -13 December, 2012.
- Winner of ***Funskool: The Science Exhibition*** conducted during Reflections, held at Pondicherry University, Pondicherry for three consecutive years (2012 - 2014).

10. References

- Prof. **Bhalamurugan Sivaraman**, PRL, India. - bhala.acsi@gmail.com
- Prof. **Nigel J Mason**, Univ of Kent, UK. - N.J.Mason@kent.ac.uk
- Prof. **Anil Bhardwaj**, Director, PRL, India. - bhardwaj_spl@yahoo.com
- Dr. **Ankan Das**, IASES, India. - ankan.das@gmail.com
- Dr. **Yu -Jong Wu**, NSRRC, Taiwan. - yjwu@nsrrc.org.tw