John Thrower

ER at Department for Physics & Astronomy

Aarhus University, Denmark

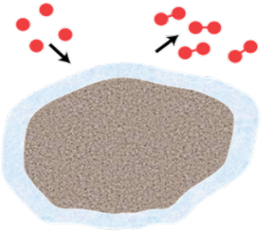
Background

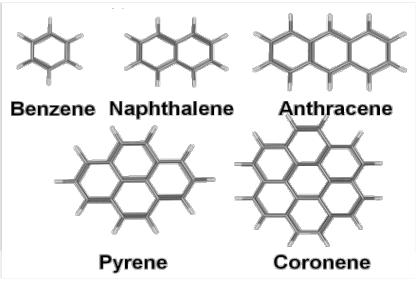
- MSci degree in chemistry and molecular physics from the University of Nottingham (2001-2005)
- PhD in laboratory surface astrochemistry from Heriot-Watt University, UK (2005-2009)
  - "Laboratory investigations of the thermal and non-thermal processing of condensed aromatic hydrocarbons in the interstellar medium"

•Thermal desorption of benzene from model silicate grain and water ice surfaces.
•UV Photon and low energy electron induced desorption of benzene.

Project Background

- H_2 is the most abundant molecule in the ISM
  - H_2 formation under interstellar conditions still not fully understood
- PAHs account for significant amount of interstellar carbon
  - Some evidence that PAHs may play a key role in H_2 formation in some regions





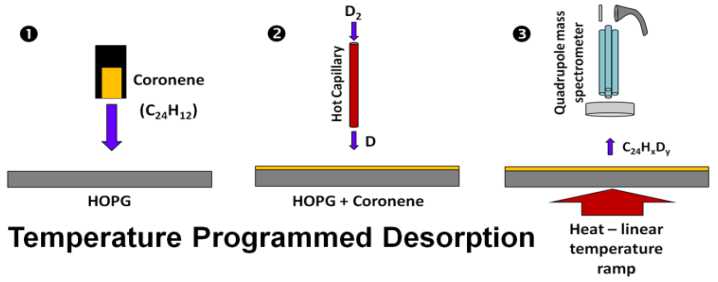
This project aims to investigate the potential role played by PAH molecules in the surface mediated formation of key interstellar species, in particular H_2.

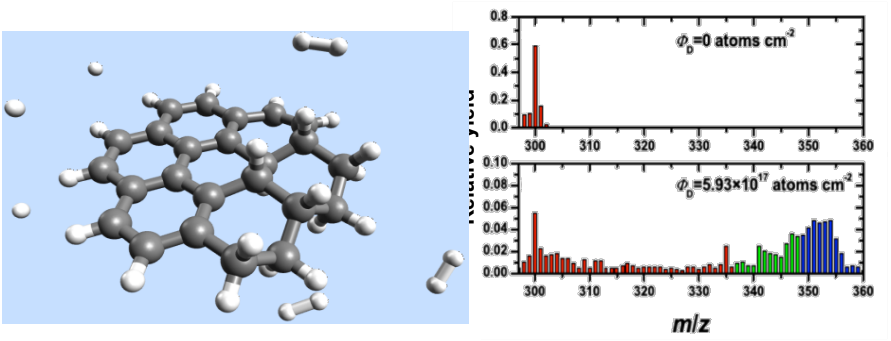
Research Objectives

- Interaction of PAH molecules with carbonaceous interstellar grains.
- Formation of superhydrogenated PAHs (HPAHs) through H atom irradiation.
- Role played by HPAHs in interstellar H_2 formation through abstraction reactions.
- Impact of hydrogenation on the electronic spectra of PAH.
- Interaction of HPAHs with ultraviolet photons as a possible mechanism for H_2 ejection.
- XUV induced physical and chemical processes in PAH containing low temperature.

Research Achievements

- Thermal desorption of coronene from HOPG
  - Complicated desorption behaviour
- Formation of HPAHs
  - Exposure of coronene to D atoms
  - Formation of highly superhydrogenated coronene
  - Evidence for abstraction leading to HD (D_2) formation





Experiments have revealed the formation of highly superhydrogenated PAH molecules and provided evidence for a catalytic role in H2 formation.

J. Thrower *et al.*, 2011, EAS Publications Series, **46**, 453.
V. Menella *et al.*, submitted.

Training Objectives & Achievements

- Knowledge of UHV and application to surface astrochemistry
- Training in scanning tunneling microscopy
- Research secondment to Leiden Observatory
  - Optical spectroscopy of fullerenes in water ice matrix
  - Future collaborative work involving benzene discussed
- External collaborative work
- Scientific conferences and network activities
- Organisation of last years YAM at UCL
- Professional development
- Presentation skills – training and experience
  - Conference talks, posters, publications
- Supervision of students (PhD, masters, bachelor)
- Public outreach
  - Training
  - Edinburgh international science festival “Stars R Us”.
- Writing research proposals
  - Training
  - Beam time proposal involvement

Energetic Processing in the Interstellar Medium

LASSIE Project Overview

Farahjabeen Islam

Experienced Researcher

INAF – Osservatorio Astrofisico di Catania

farah@oact.inaf.it

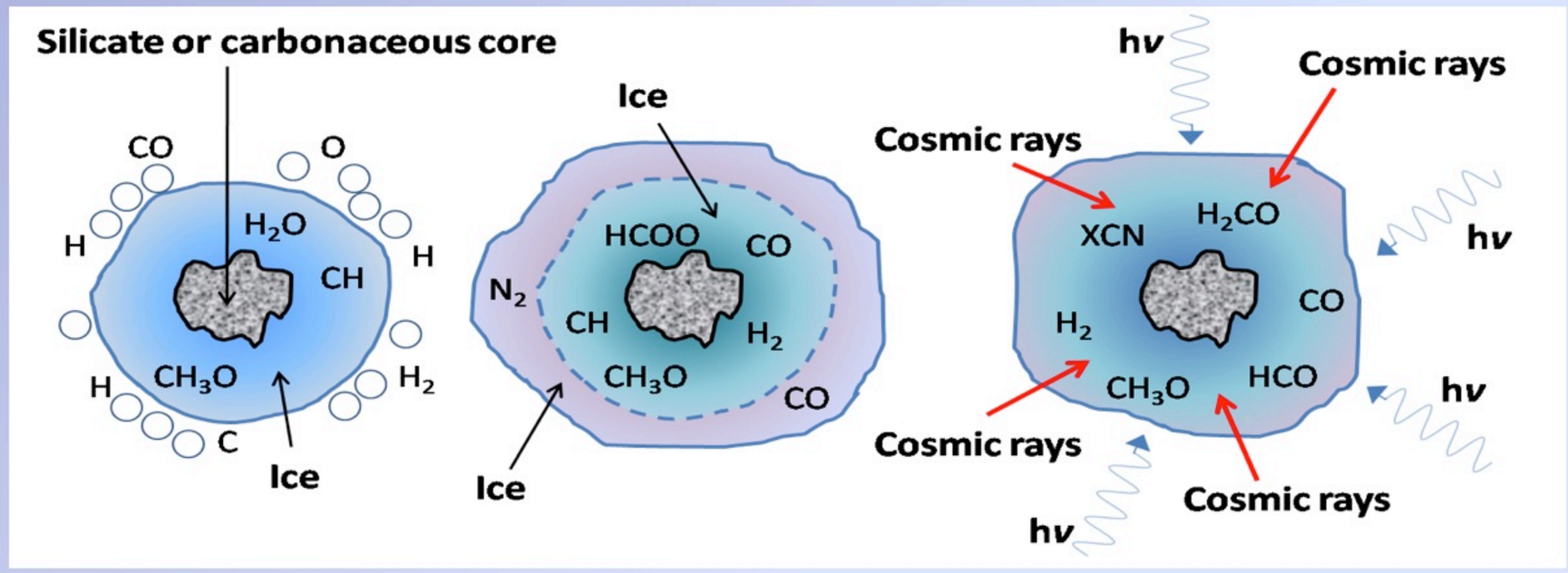
Advisor: M. E. Palumbo

Start Date: 1st June 2011

Mid-Term Review
Observatoire de Paris
14th November 2011

Energetic Processing in the ISM

Even in dense regions, which are shielded from starlight, cosmic rays still penetrate interstellar clouds to generate a rich chemistry.



Interaction of cosmic rays with molecular clouds

low-energy cosmic rays → **E = keV – MeV**

electrons → **E = eV – keV**

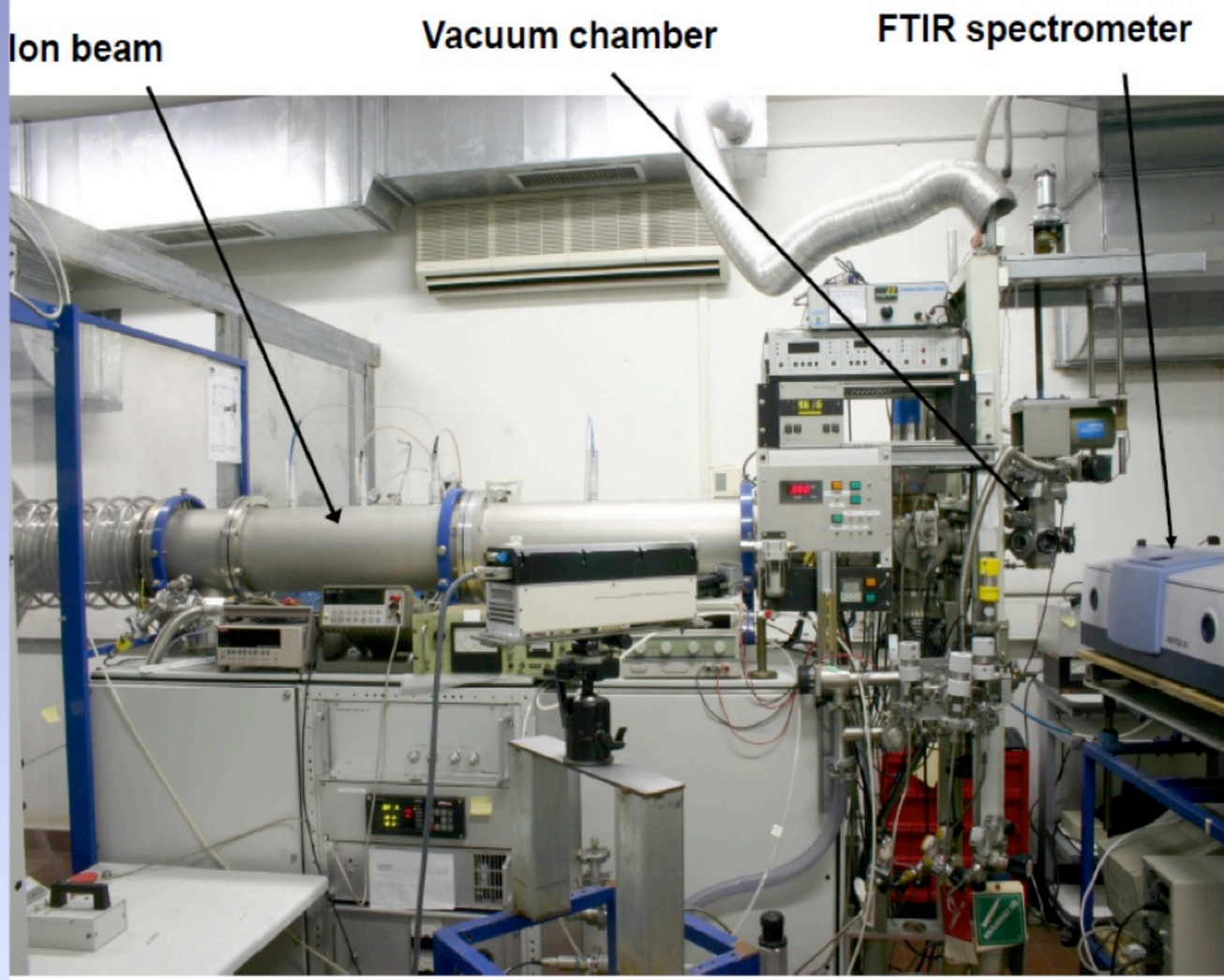
UV photons → **E = 6.9 – 13.6 eV**

Our group mainly investigates the effects induced by fast ions and UV Lyman-alpha photons in solids of astrophysical interest (e.g. frozen gases, carbonaceous materials and silicates).

Training Received

Experimental set-up of LASp

- ‘in-situ’ IR spectroscopy
- high vacuum techniques
- surface science techniques
- ion and UV irradiation
- cooling of substrates to astrophysically-relevant temperatures



Data analysis software

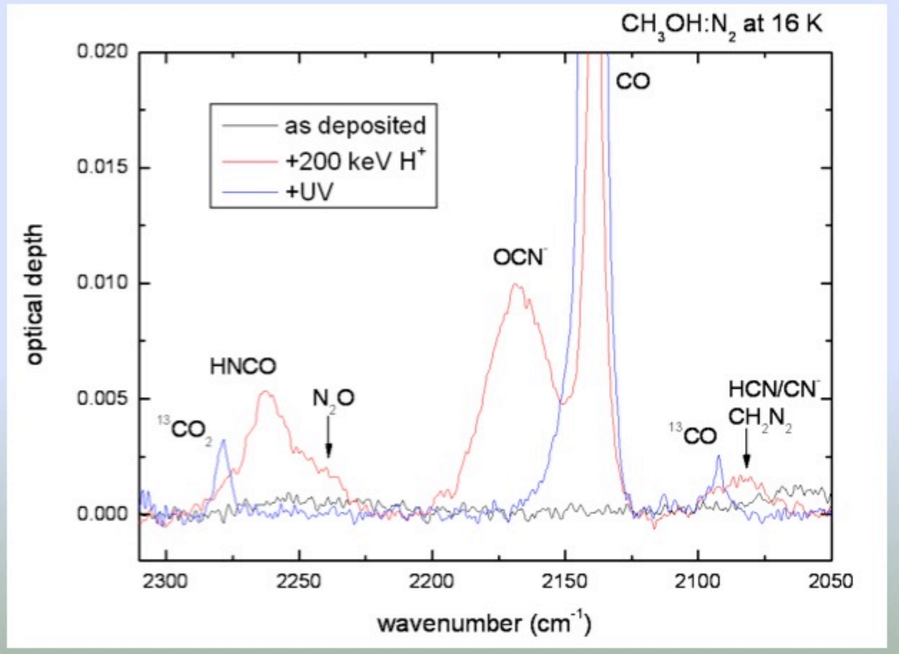
- OPUS 86 and Origin 7 for spectral analysis

Laboratory for Experimental Astrophysics (LASp),
Osservatorio Astrofisico di Catania - INAF

Summer School on ‘Astrochemistry with ALMA’ held on 13-17 June 2011 in Bologna, Italy

Communication skills

- talks given at conferences (COST & YAM)
- seminars given at INAF-OACT
- currently undertaking a 40-hour course in Italian



Projects

Synergy:

Investigating the effect of combining both ion and UV irradiation in order to identify if synergy takes place. This study entails the analysis of experiments involving infrared spectroscopy of the simultaneous irradiation of CH_3OH:N_2 ice by H^+ ions and UV photons.

Observational work:

Compare laboratory spectra with ISO and Spitzer observations of molecules in the interstellar medium.

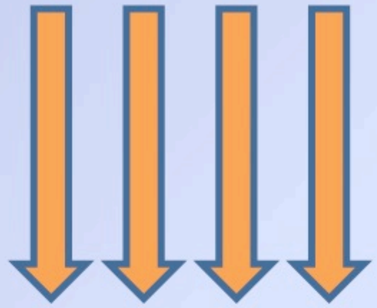
Industrial secondment:

Jan/Feb 2012 at **HITEC2000** - precision engineering, developing systems and equipment, advanced services and products in various hi-tech sectors, particularly manufacturing and testing processes in the cleanroom in microelectronics, pharmaceutical, scientific research and in all other high technology activities.

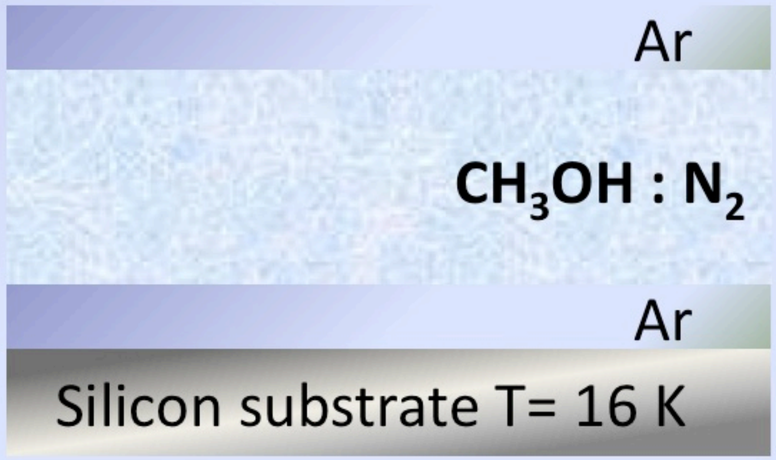
Possible collaborations:

- Investigation of the IR spectra of CH_3CN to compare with electron-stimulated processing studies carried out by the group of Martin McCoustra (Heriot-Watt).
- Analysis of JCMT observations of hot cores, working in collaboration with Serena Viti (UCL).

Initial Results on Synergy



200 keV H^+ and/or **10.2 eV photons**

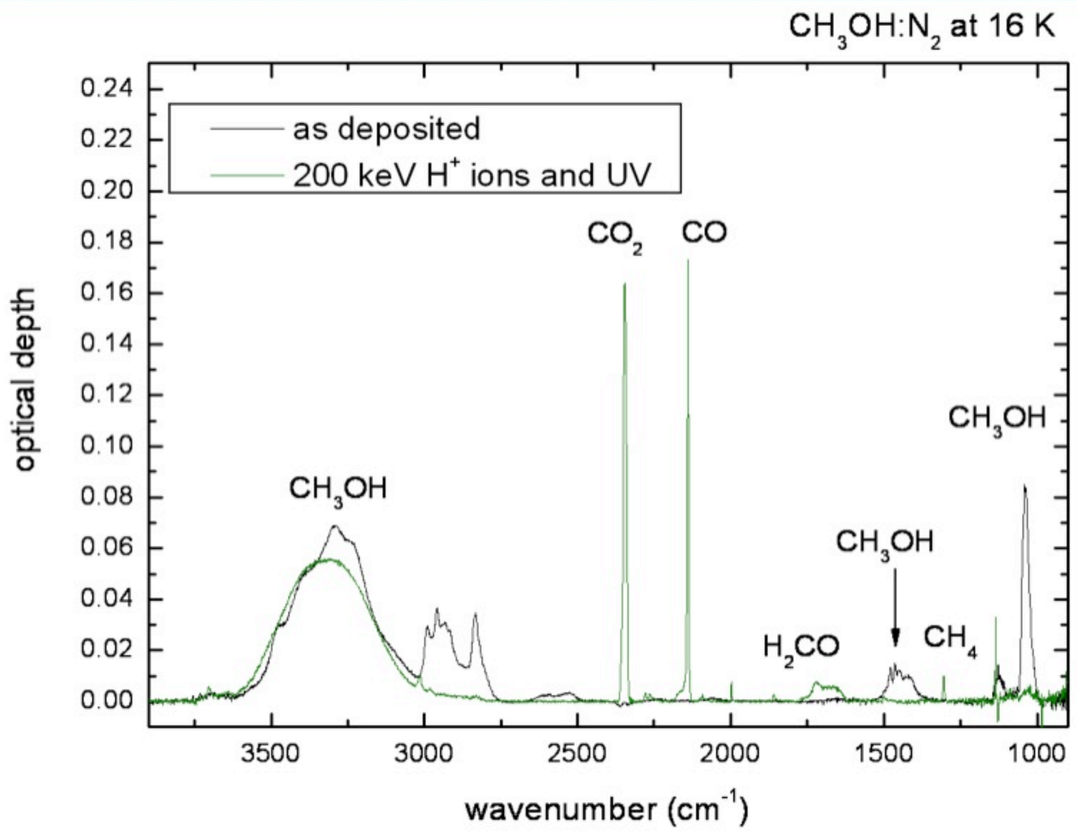


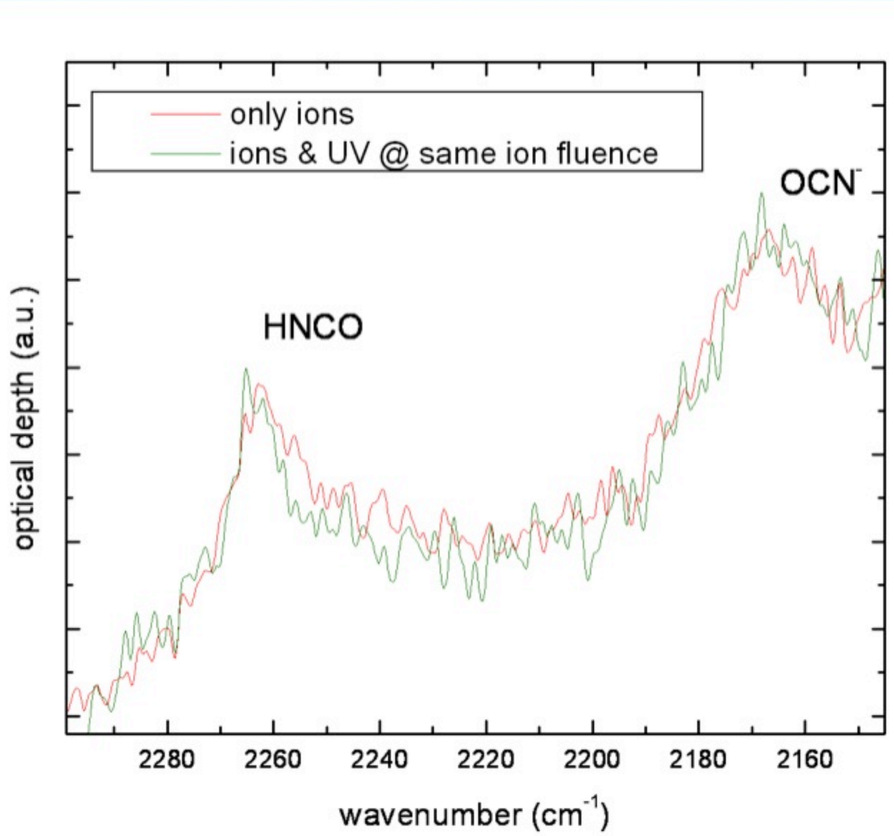
IR spectra taken after the simultaneous irradiation of $CH_3OH:N_2$ ice by H^+ ions and UV photons

Only ions produce N-bearing species

Presence of UV does not increase band area of N-bearing species or change band profile

→NO SYNERGY!





Computational study of Photochemistry and Spectroscopy of Polycyclic aromatic hydrocarbons (PAHs) in model interstellar ices.

Divya Sharma
Early Stage Researcher (ESR) , LASSIE ITN
Heriot Watt University, Edinburgh
Start Date: 13 April, 2011

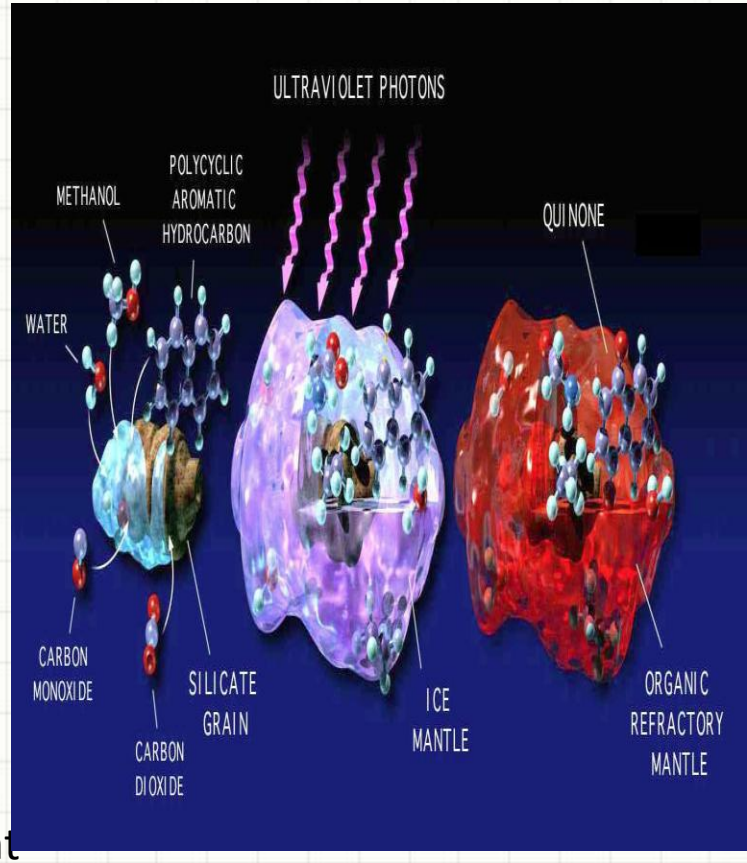
Supervisors: Dr. M.J. Paterson & Prof. M.R.S McCoustra

Project Overview

➢ What is the project about?

Interstellar Medium

- It is the region situated between stars within our galaxy containing mixture of dust and grain.
- It is the reservoir of resources that forms stars.



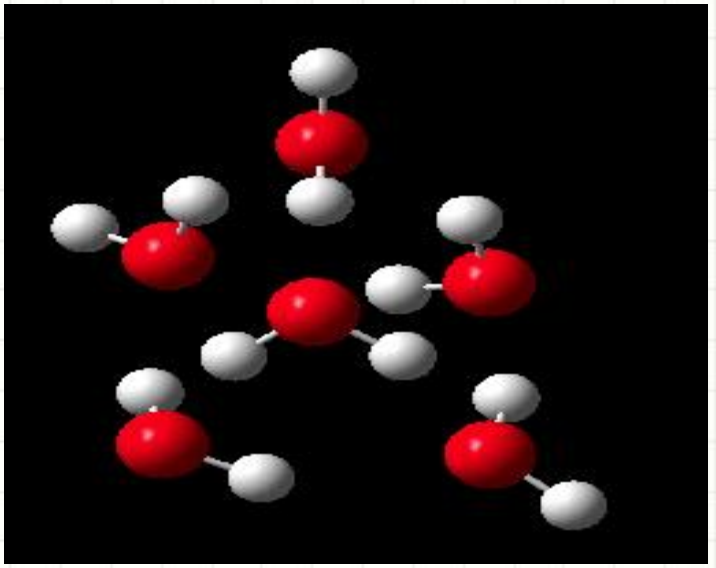
Polycyclic aromatic hydrocarbons (PAHs)

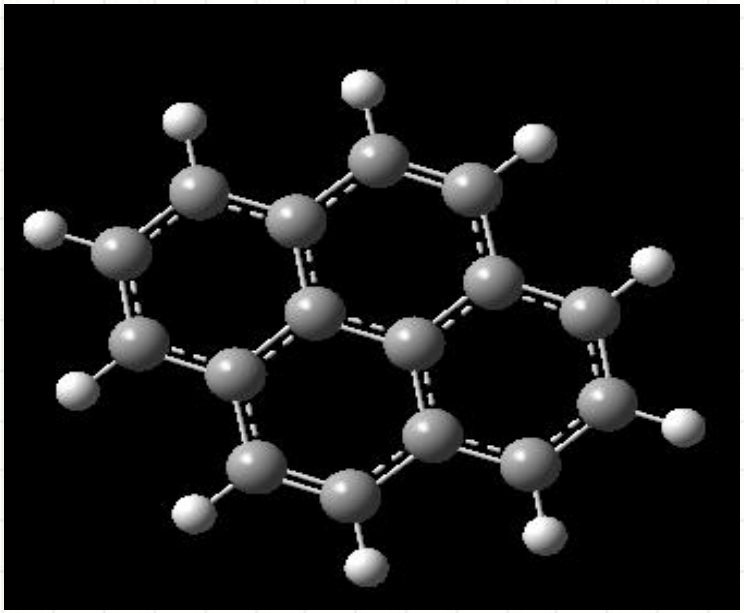
- PAHs accounts for 20 % of the galactic carbon.
- They are likely to exist in the presence of water ice either as part of the carbonaceous component of dust grain itself or as a component of icy mantles.
- UV irradiation of water ice containing PAHs may play an important role in the formation of complex organic species such as alcohols, Quinone and ethers.

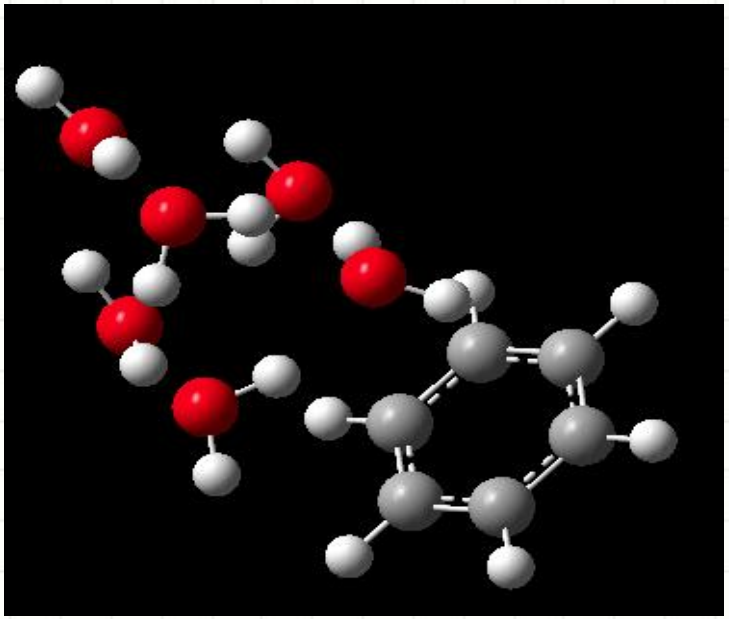
Project Overview

➢ Model System

- Water $(H_2O)_n$ clusters
- Isolated PAHs
- Benzene-Water Clusters







Project Overview

➢ Computational implications

- To extract both Ground and Excited states properties of complex systems.
- The excited states of the complex systems are difficult to treat computationally.
- High level computational methods will be employed.

- **Density Functional Theory (DFT) methods** inclusive of ***long range corrected functionals.***
- **Time-Dependent Density Functional Theory (TDDFT)**
- **Complete Active Space Self-Consistent field (CASSCF) Method**
- **Hybrid Quantum mechanics/ Molecular Mechanics (QM/MM)**

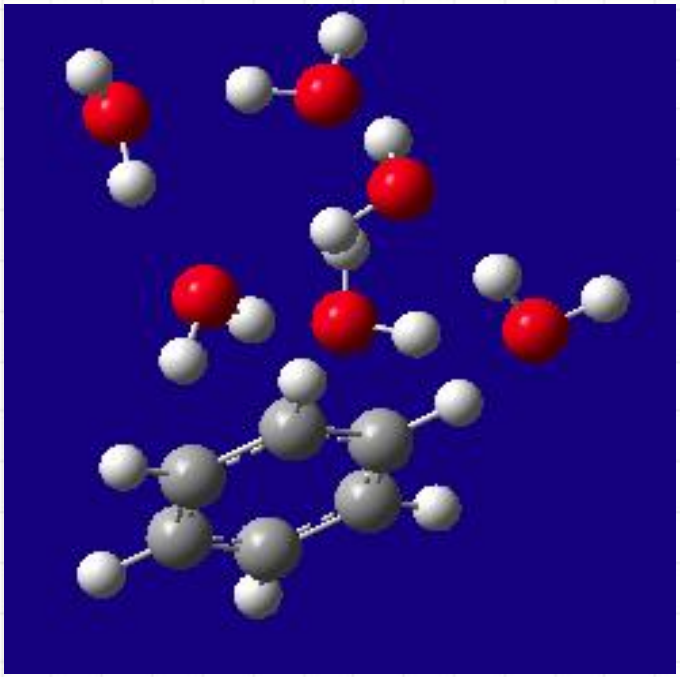
Present Work:

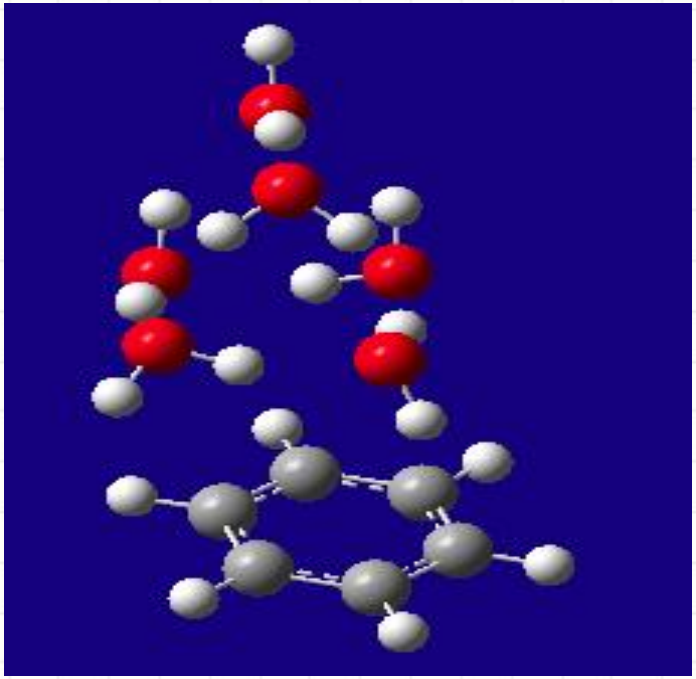
Initial Model

Benzene-water$(H_2O)_6$ cluster

Cage

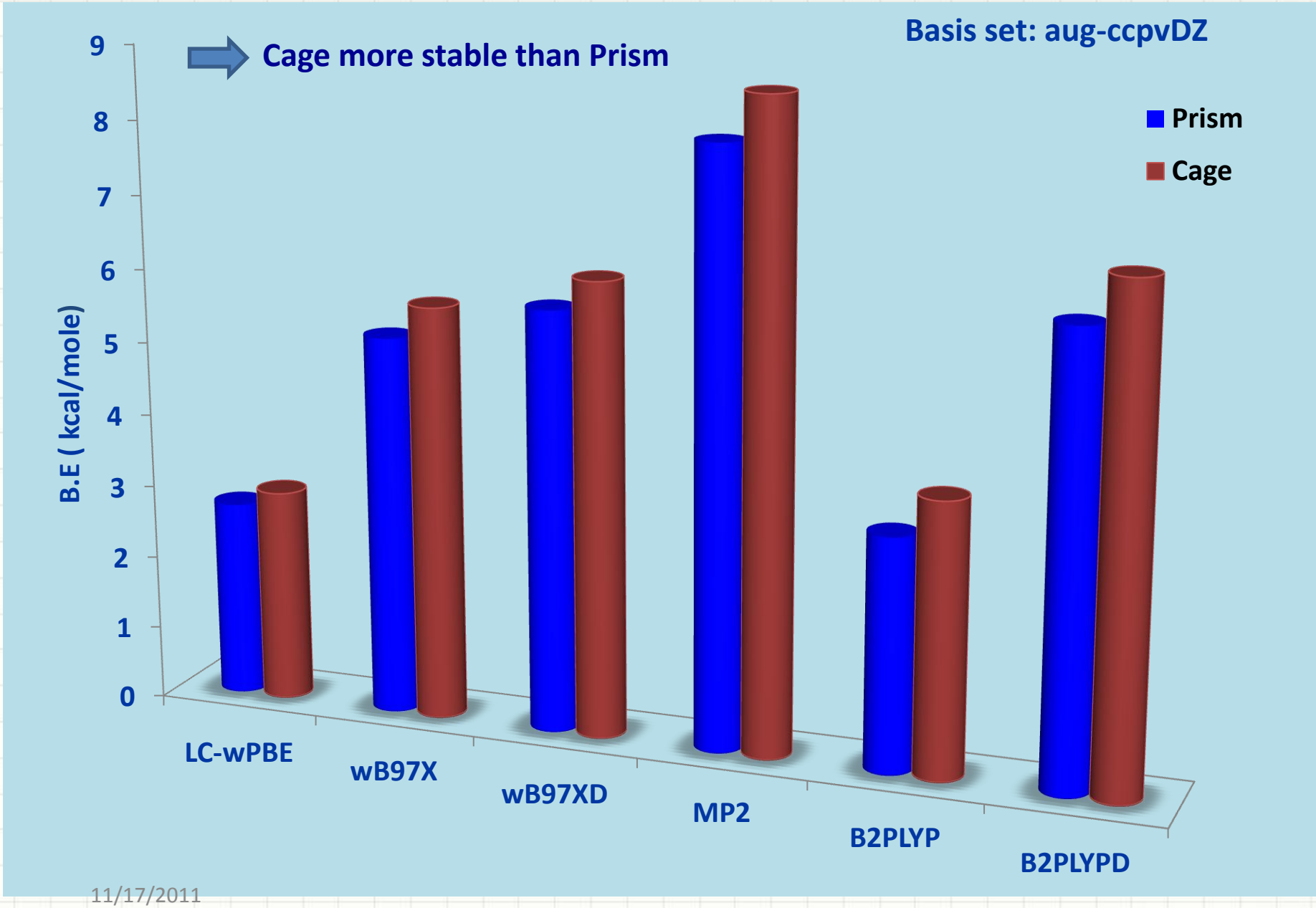
Prism





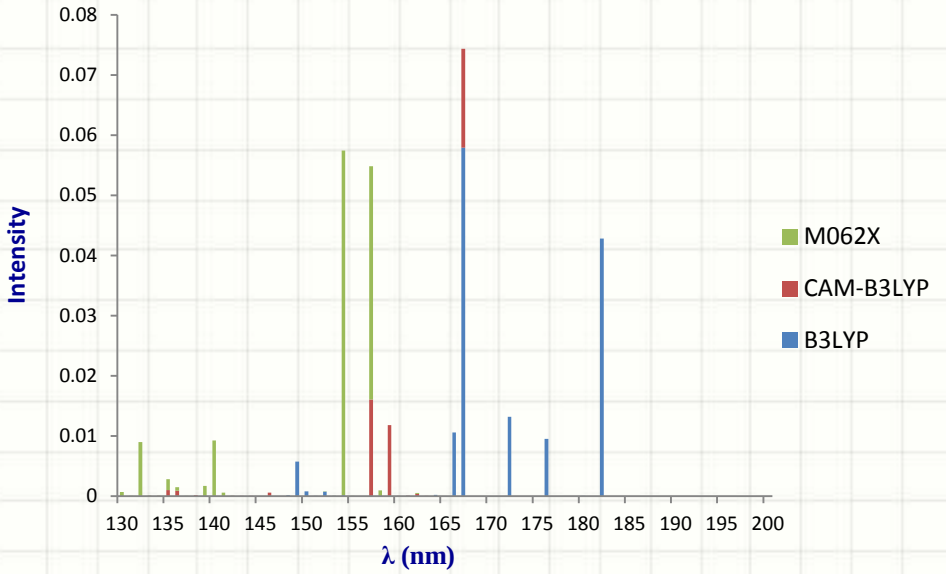
MP2/ aug-ccpvDZ optimized geometries

Results

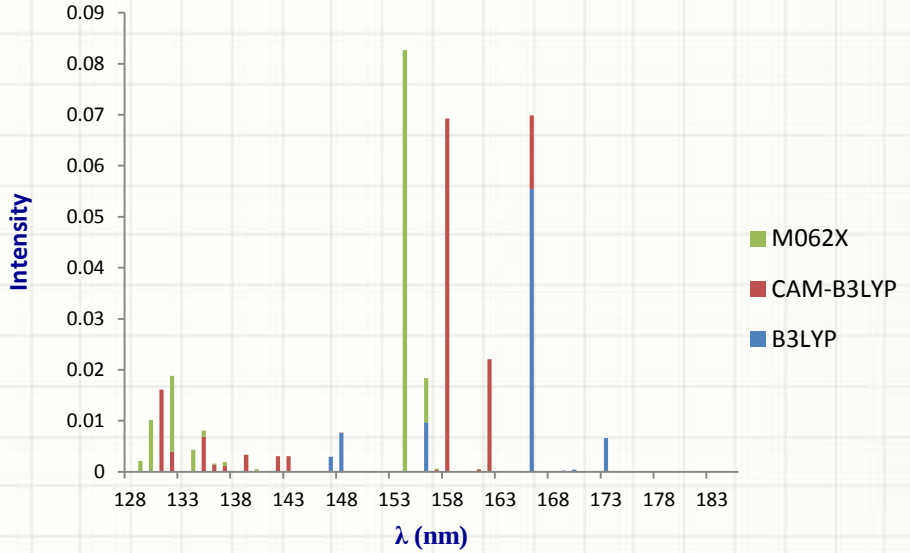

Basis set: aug-ccpvDZ
Cage more stable than Prism
Prism
Cage
B.E (kcal/mole)
9
8
7
6
5
4
3
2
1
0
LC-wPBE
wB97X
wB97XD
MP2
B2PLYP
B2PLYPD

UV Spectra Results from TD-DFT

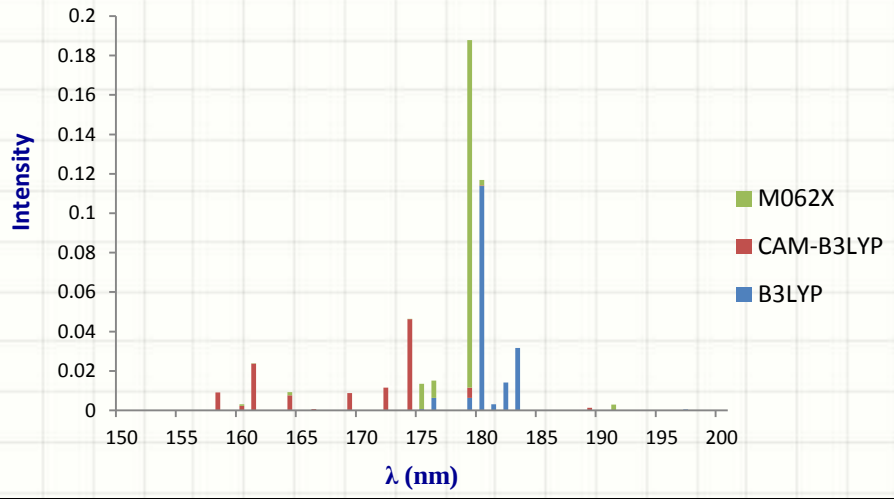
W_6 Cage cluster



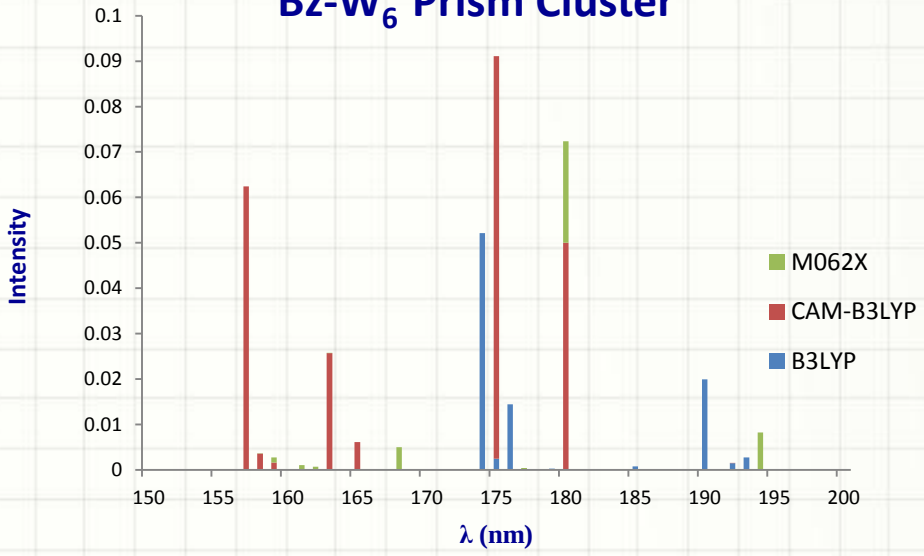
W_6 Prism Cluster



Bz-W_6 Cage Cluster



Bz-W_6 Prism Cluster



CONCLUSIONS

- Several Conformations possible (conformation affects UV spectra).
- The peak intensities in W_n clusters are low as compare to Bz-W_n clusters.
- Benzene enhances the excitations in Bz-W_n clusters.

Future Work

- Spectoscopy and Photochemistry of Larger Bz-W_n clusters/ Isolated PAHs/ Extended Systems.
- MD simulation for sampling multiple conformations.
- Hybrid QM/MM methods for reactive photochemistry.
- Calibrating problem with different computational methods (complex systems to model: non-covalent ineteractions, diffuse states, charge-transfer etc.)
- Analysis of results and comparison with experiments and observations.

LASSIE Training & Conferences attended:

- Astro-Chemistry summer school in Leiden, Netherlands,2011
- Time and Project Management Training
- Presentation Skills Training
- Outreach events

- ALMA Astrochemistry in Bologna, Italy, 2011.
- Research Proposal writing
- AstroSurf Conference , Edinburgh, 2011

Introducing myself:

Demian Marchione

22th of July 1987

Eurobachelor degree (three years) and **Master degree** (two years) in Chemistry (Physical Chemistry) at the university of Perugia.

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Uv-Vis spectroscopy
Synthesis
NMR
Computations

Introducing myself:

Demian Marchione

22th of July 1987

Supervisor Professor Martin McCoustra

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

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LASSIE

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Introducing myself:

Demian Marchione

22th of July 1987

LASSIE

Supervisor Professor Martin McCoustra

HERIOT WATT UNIVERSITY

PhD/ESR at the Heriot Watt University.

Starting date: 08/08/2011

Expiration date: 07/08/2013

extendable to 31/01/2014

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Mid-Term Review

LASSIE
Laboratory Astrochemical Surface Science In Europe

OBJECTIVES:

- Formation of grains, small molecules and ices.
- Physical processes in and on icy grains.
- Chemical transformations in and on icy grains.
- Modelling the gas-grain interaction.
- Observation and astronomical models involving dust and ices.

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

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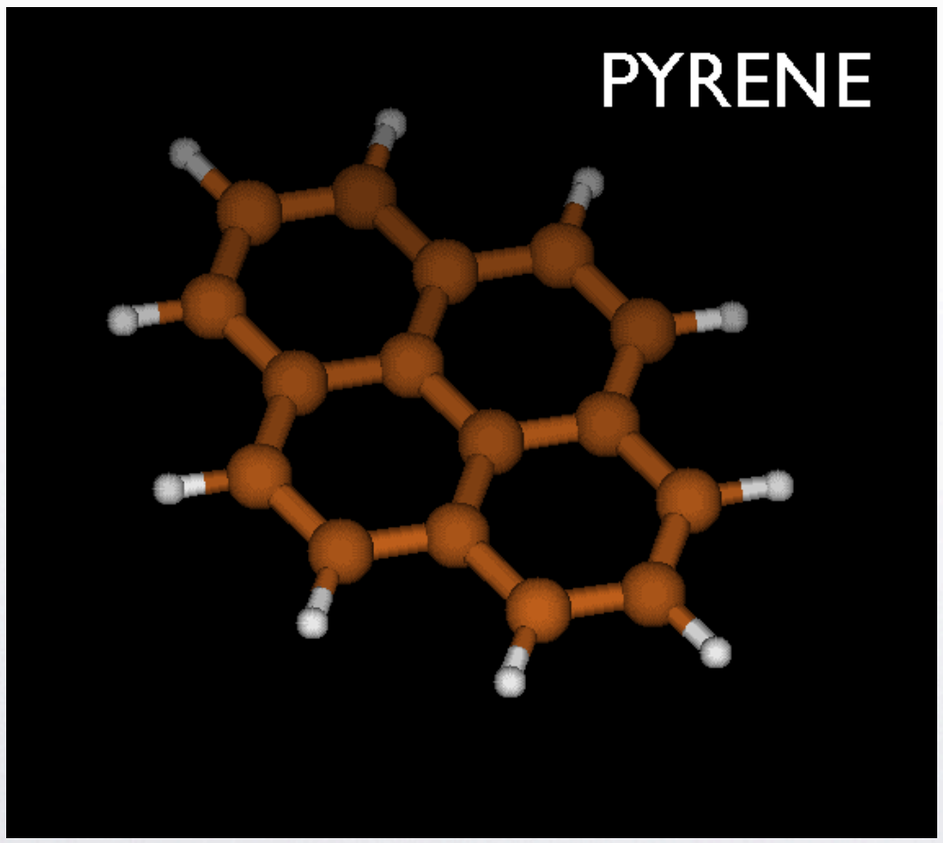
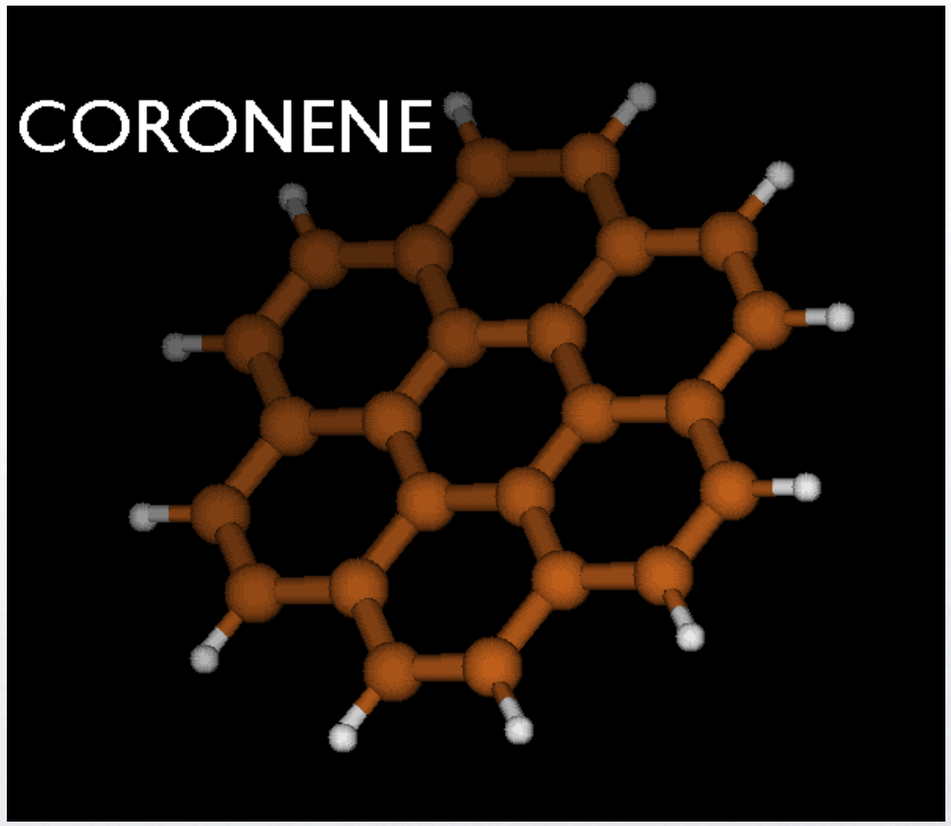
My research project

Making an icy grain analogue





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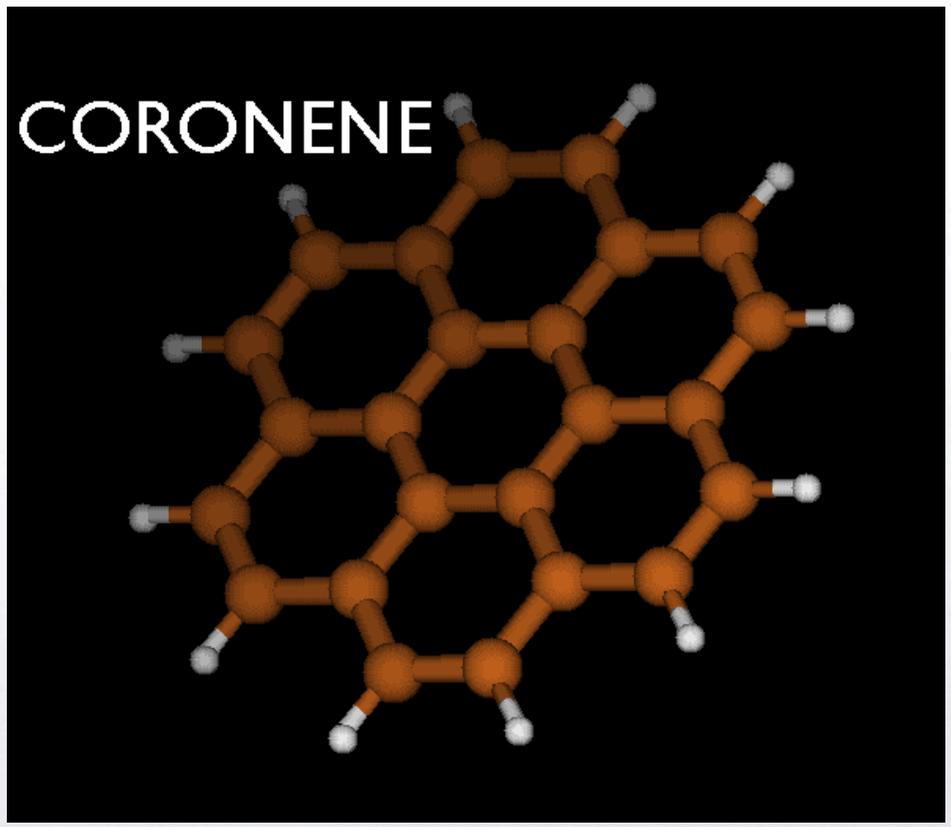

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My research project

Making an icy grain analogue

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My research project

Making an icy grain analogue

Temperature Programmed Desorption

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

My research project

Making an icy grain analogue

Temperature Programmed Desorption

Electron stimulated desorption

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

My research project

Making an icy grain analogue

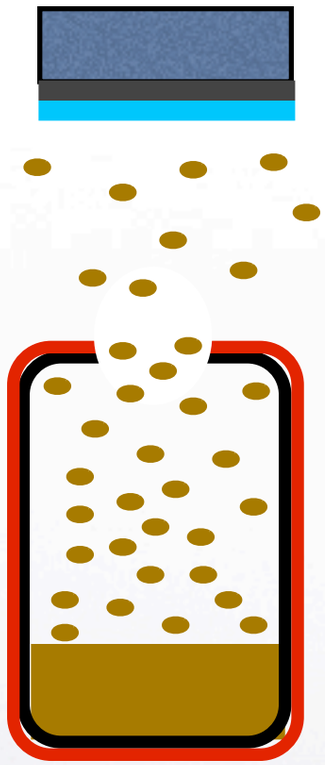
Temperature Programmed Desorption

Electron stimulated desorption

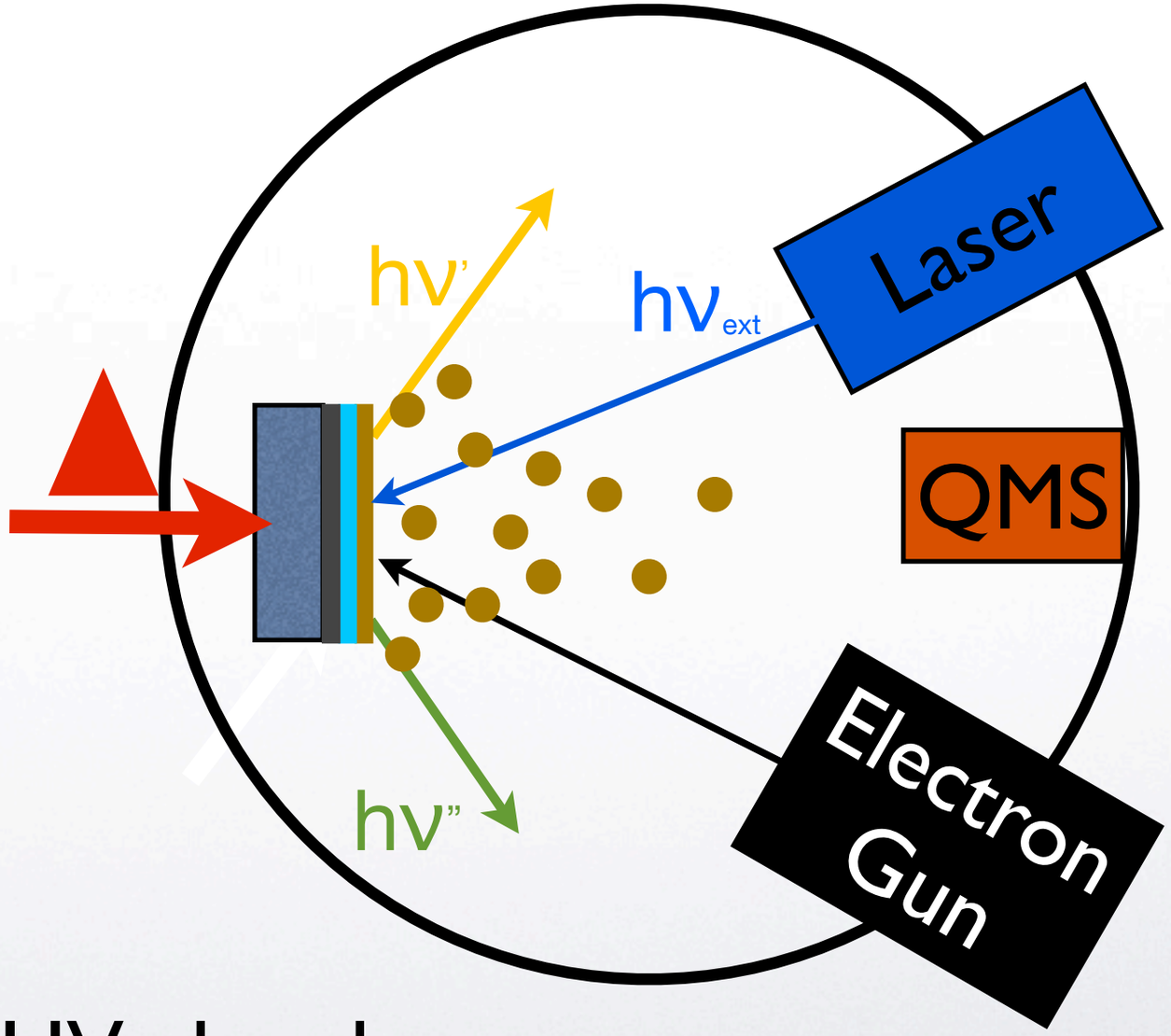
Photostimulated desorption

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Mid-Term Review



Knudsen cell



UHV chamber

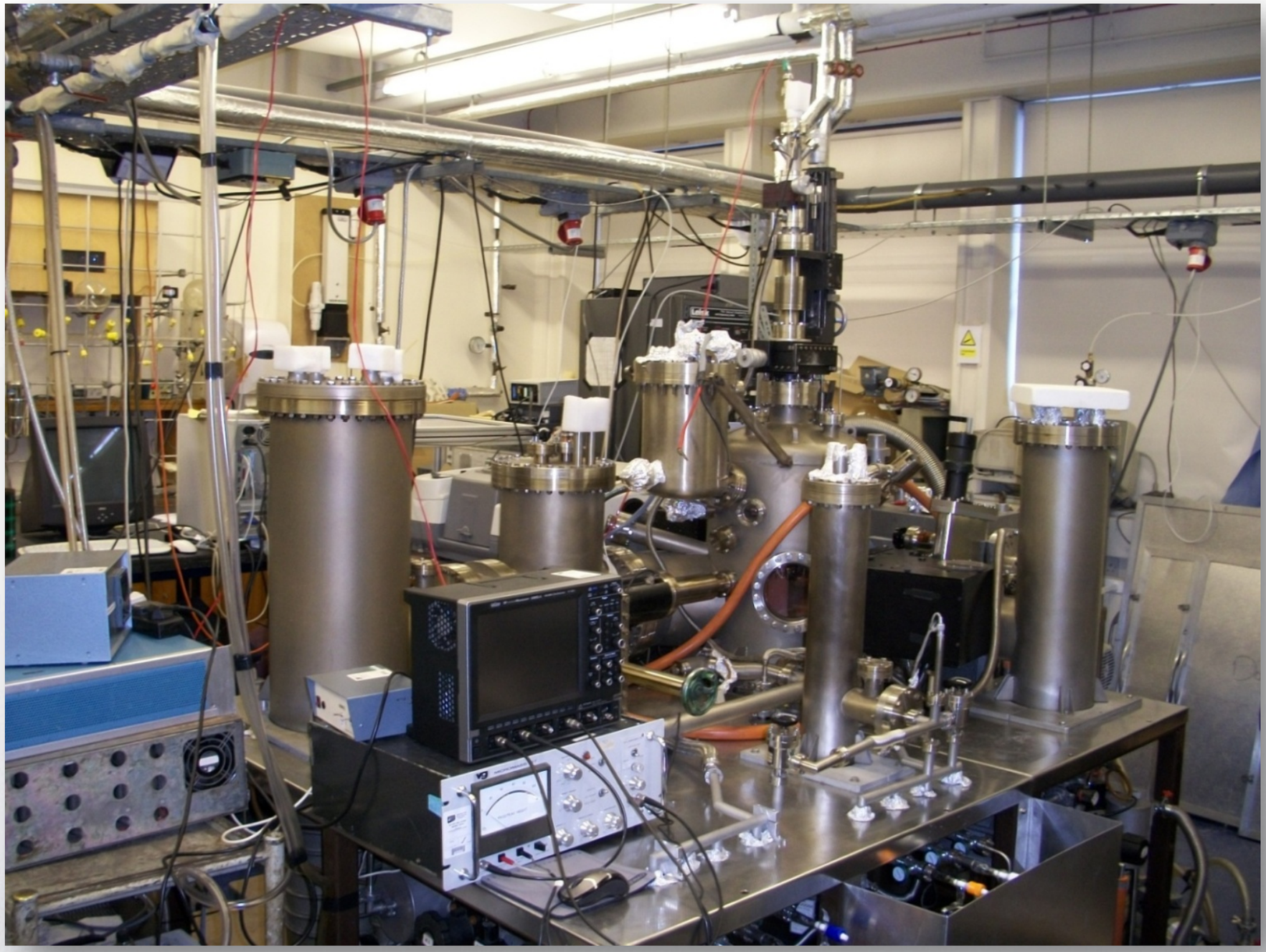
This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Training

- Vacuum Technology course (SUPA)
- Surface Science block (UG)
- Group activities
- PhD suggested courses
- Staff suggested courses
- LASSIE activities

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Mid-Term Review



This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Mid-Term Review

Thanks for the attention!

This project is fully funded by LASSIE FP7 Marie Curie Initial Training Network (ITN)

Andrew Cassidy

ESR at Department for Physics & Astronomy

Aarhus University, Denmark

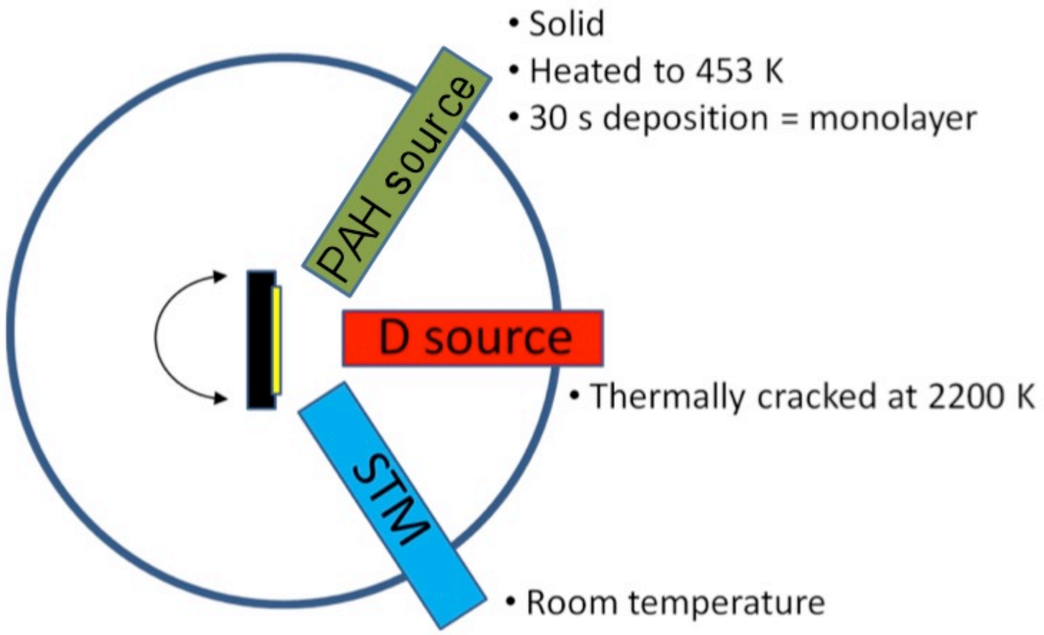
Background

- B.Sc degree in chemistry from the University College Dublin (2002-2006)
- PhD in physical chemistry from University of Cambridge, UK (2006-2010)
  - "Probing Pharmaceutical Materials with Atomic Force Microscopy"

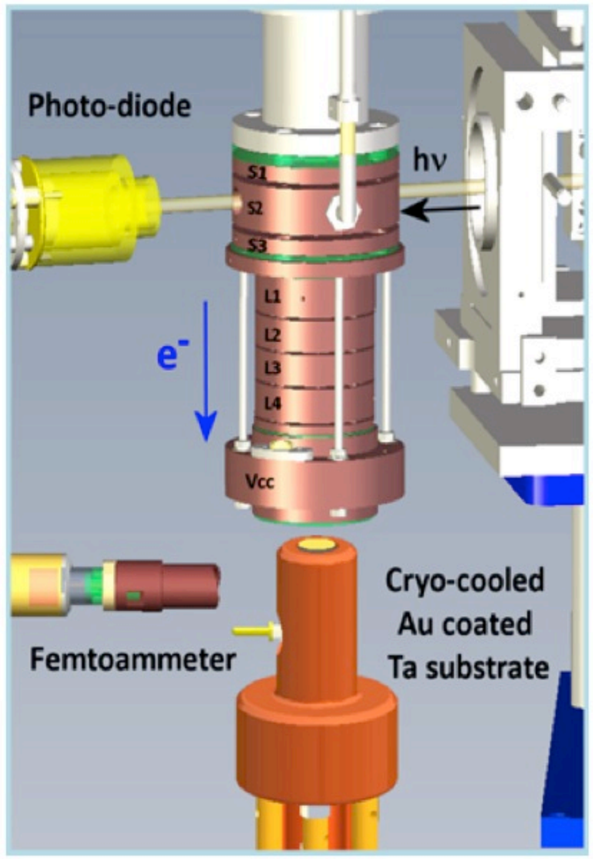
•Characterising organic crystal surfaces using atomic force microscopy
•Studying solid-state reactions between pharmaceutical materials

Project Backgrounds

- Small molecule formation on carbon surfaces
  - Studied using scanning tunnelling microscopy



- The interactions between cold ice films and low energy electrons



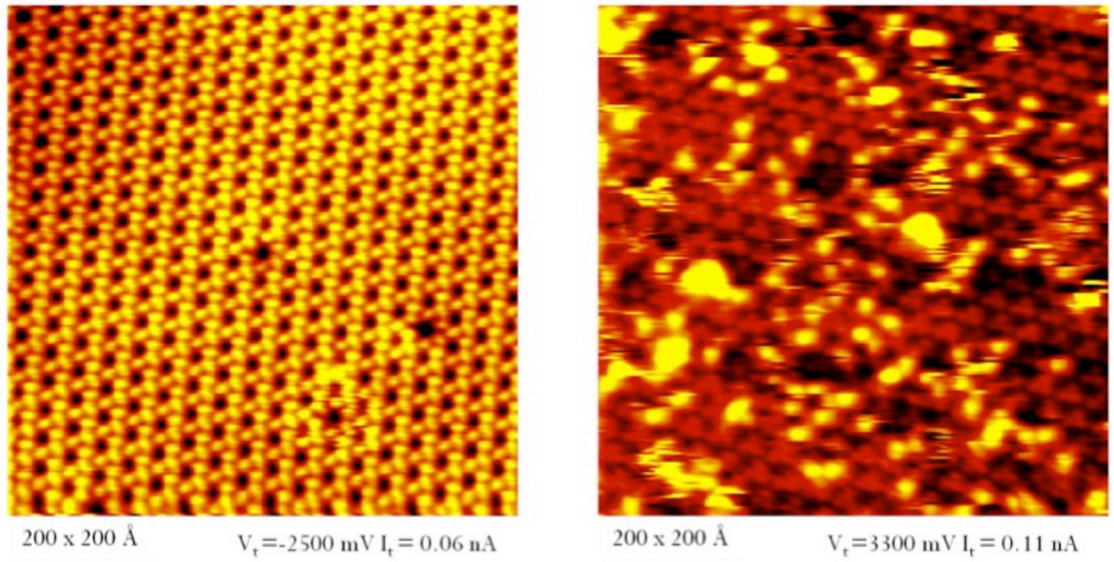
Research Objectives

- Understanding the role that PAHs play in H_2 formation
  - The interaction between PAHs and a model dust grain surface (HOPG)
  - The hydrogenation of PAHs following exposure to D atoms
- The formation of water on HOPG
  - Reactions between O and D atoms

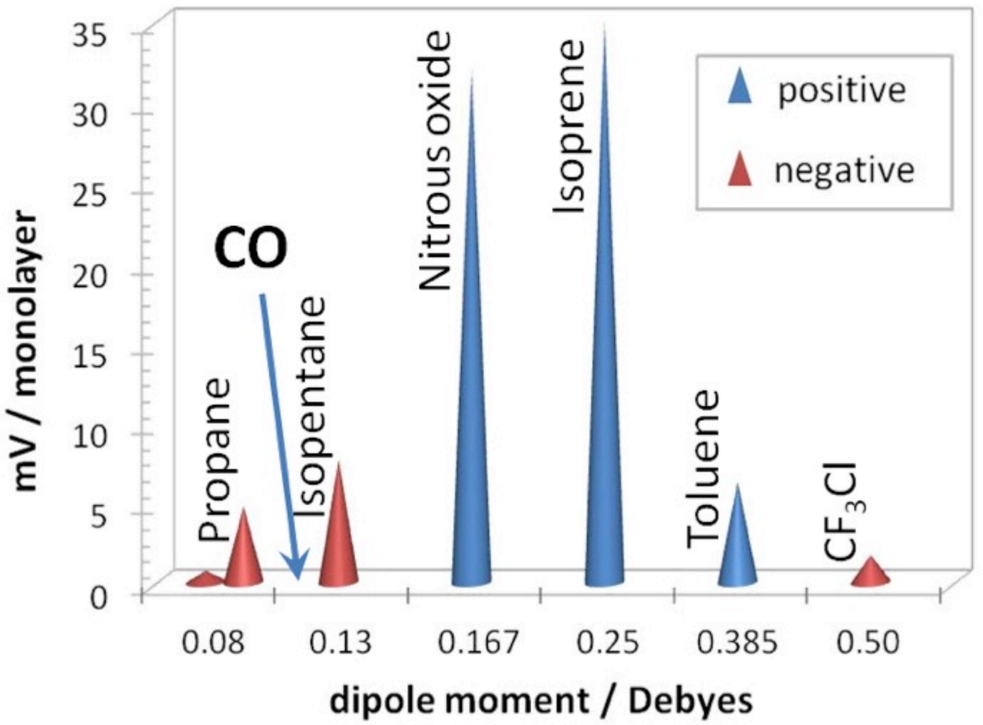
- The interactions between low energy electrons and astrophysical ices
  - Characterise the physical properties of ices using a low energy electron beam
  - Investigate electron-induced chemistry within the ices

Research Achievements

- Hydrogenation of a stable layer of PAHs
  - STM imaging shows how coronene molecules pack on a HOPG surface
  - Subsequent exposure to atomic D shows hydrogentation



- Polarization of ice films leads to the development of surface potentials
  - Interrogation of a ice films, for a range of different molecules, shows that potentials spontaneously develop at the film-vacuum interface
  - There is evidence to suggest that this process might also occur for CO ices condensed on dust grain surfaces



O. Plekan *et al.*, 2011, PCCP, 10.1037/c122310k.

Training Objectives & Achievements

- Training in new instrumental techniques
  - UHV techniques
  - Synchrotron techniques
  - Scanning tunnelling microscopy
  - Mass spectrometry
  - Low energy electron sources
  - **XPS and NEXAFS**
- Introduction to Astrochemistry
  - "The Interstellar medium and the formation of stars and planets" lecture course at AU
  - "Astrochemistry with ALMA" Summer school
  - **"Surface and solid state astrochemstry" Summer school**
  - LASSIE and other international conferences

  (e.g. IAU, Toledo 2011)

- Professional development
  - Paper writing workshop, ECCL 2010
  - Co authored publication, PCCP 10.1039/ c1cp22310k
  - Supervision of students
  - Beamtime applications
  - **Grant writing workshop**
  - Presentations and posters at conferences
  - Public outreach, Brussels 2011
  - Danish language lessons
- **Placements**
  - University of Cargy-Pontoise, Spring 2012
  - SPECs, Berlin, Jan-Feb 2012

To do = Objectives

Laboratory Studies on H_2 formation in the ISM

Lisseth Gavilan (LASSIE ESR, Paris Observatory)
Advisor: Prof. Jean Louis Lemaire

FORMOLISM (Cergy, France)

Goal:

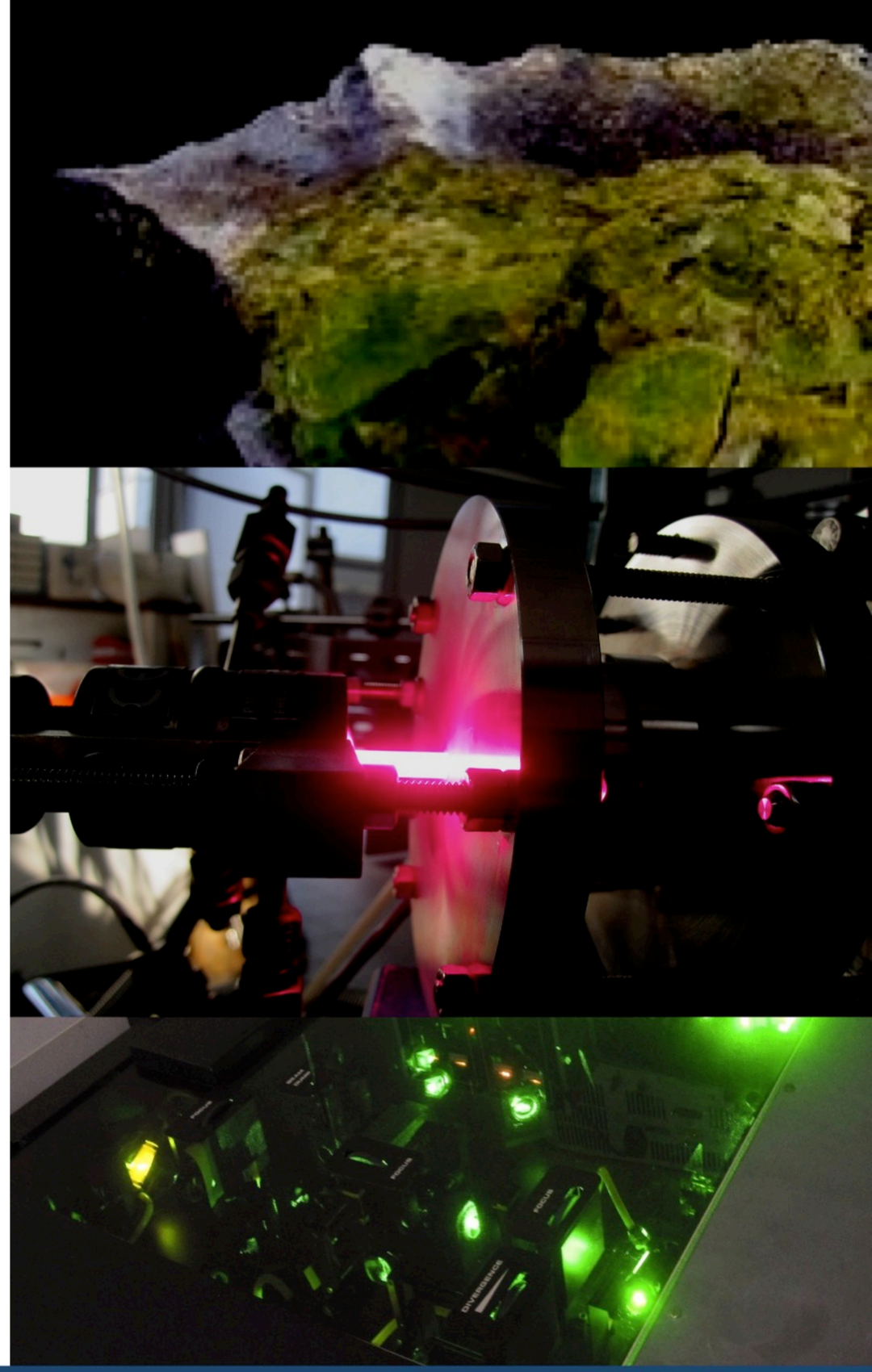
• To study the formation of H_2 (and other molecules) on a variety of silicate surfaces in conditions simulating ISM ones.

Progress:

• Study of deuterium recombination on an amorphous silicate surface using REMPI (2+1) laser diagnostic and TPD.

Results:

• Preliminary findings on the positive effect of D_2 molecular coverage on D_2 recombination at low surface temperatures.



SOLEIL synchrotron (St. Aubin, France)

Goal:

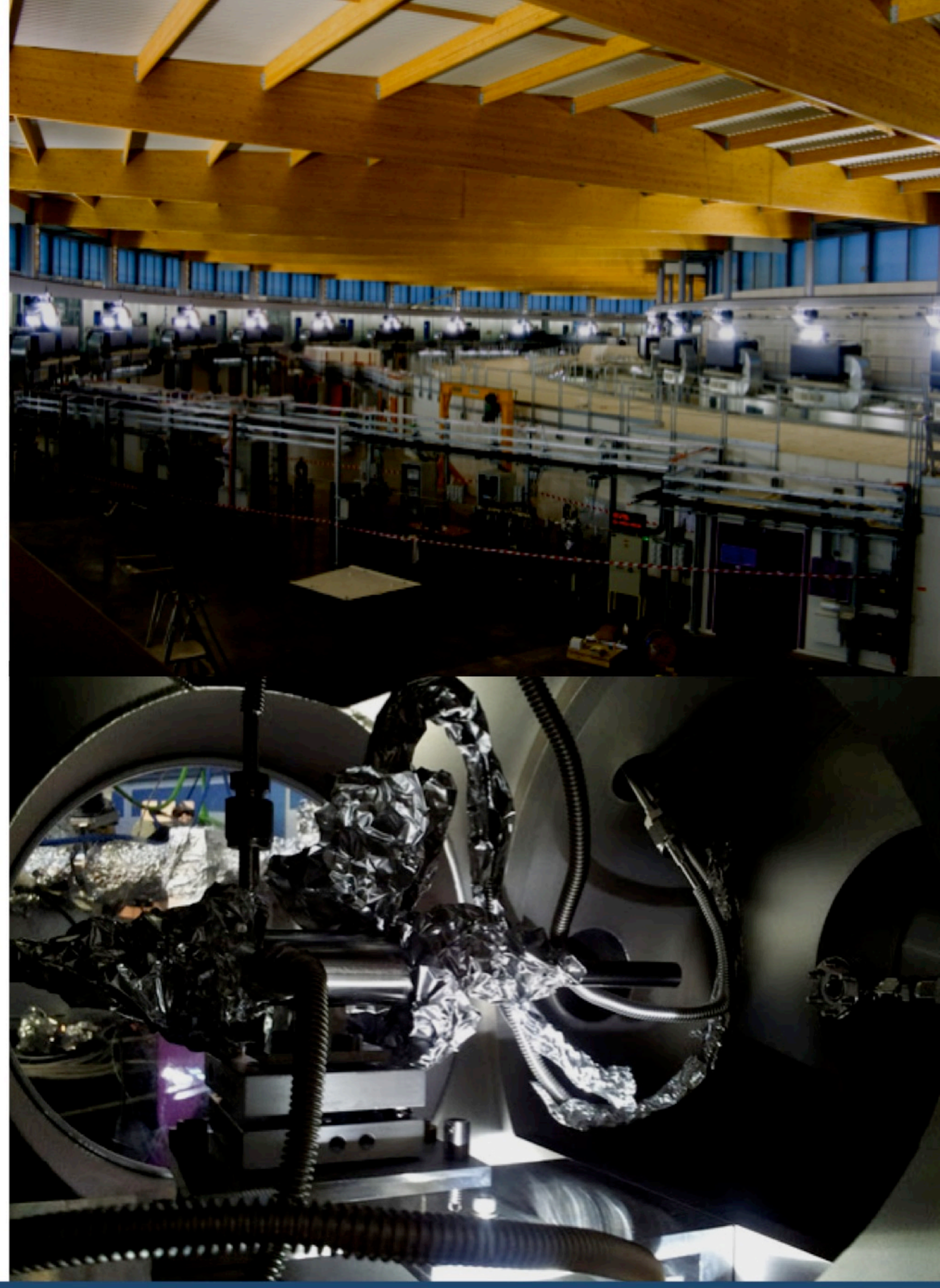
• Study the feasibility of detecting H_2 formation with a synchrotron source via REMPI(1+1).
In addition, to record the VUV spectra using an FTS (high resolution spectrometer) of CO isotopologues (France-USA collaboration).

Progress:

• Current proposal sent to SOLEIL.
• Recorded the A-X band of the astrophysically relevant CO isotopologue $^{13}C^{16}O$.

Results:

• "High-resolution study of oscillator strengths and predissociation rates of $^{12}C^{16}O$ Rydberg transitions: W - X bands and interacting bands between 92.9 and 93.8 nm". (A&A)



Academic secondment (Jena, Germany)

Goal:

- To study the effect of different silicate surfaces on molecular hydrogen formation. Collaboration with Tolou Sabri (ESR) supervised by Prof. Cornelia Jager at the Jena Astrophysical Laboratory.

Progress:

- Visit in september 2011 to Jena to begin preparation of fayalite and forsterite silicate samples with amorphous and crystalline morphologies. Obtained 2 forsterite silicate samples via laser ablation coating and then baking for annealing.

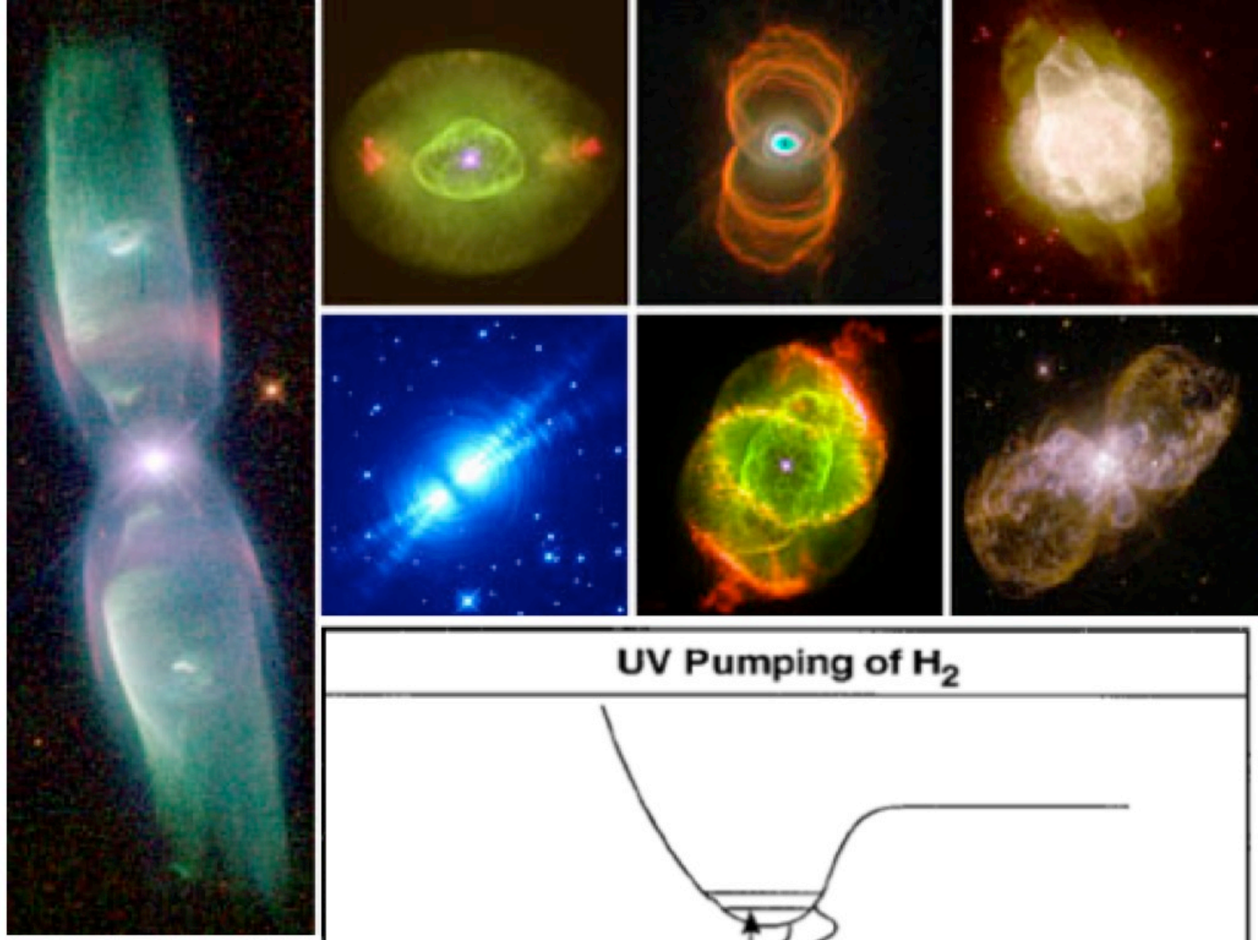
Observations of H_2 formation

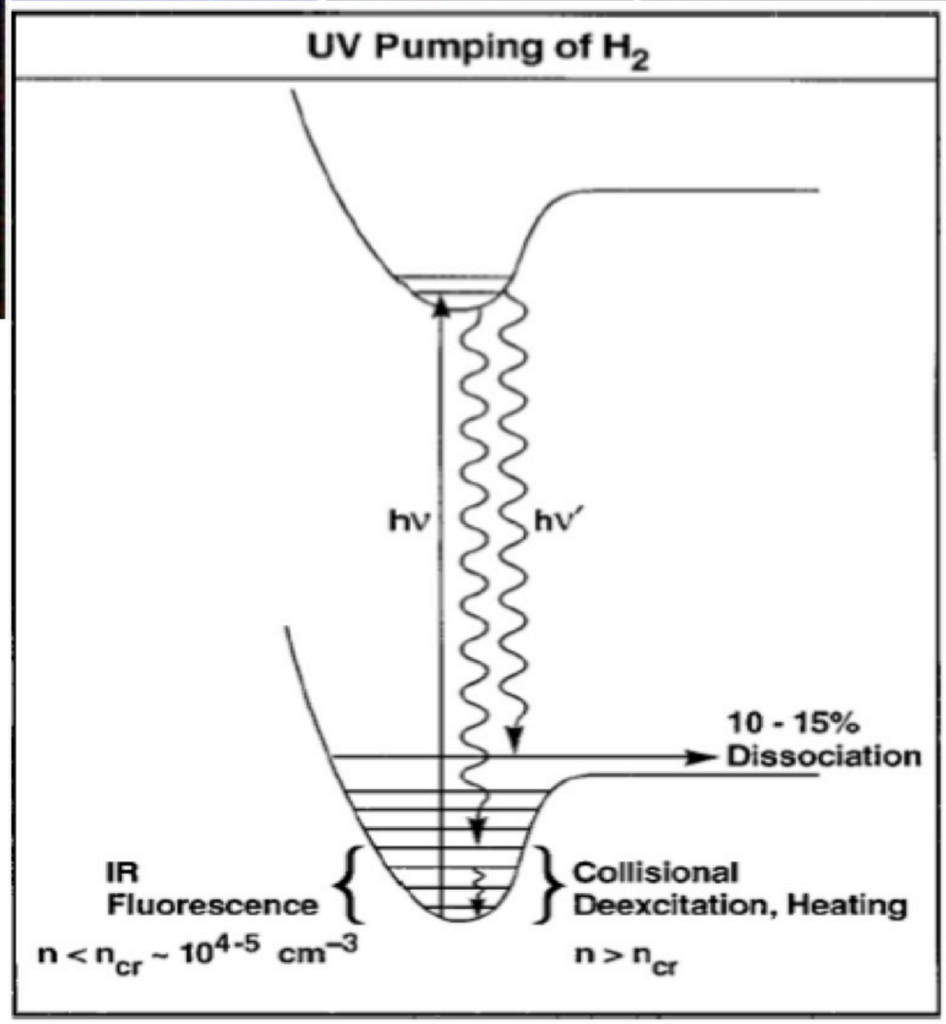
Goal:

• Because H_2 is rovibrationally excited after formation, and since it fluoresces in the IR, this can be used as a signature of its formation. The caveat is the identification of ISM environments where this signature can be extricated.

Progress:

• Sent proposals to NOAO and ESO to detect this process using long slit spectroscopy of PNe rings in collaboration with David Field (Aarhus) and Gianfranco Vidali (USA).





Hollenbach & Tielens (1999)

Training

Leiden (May 2011): Astrochemistry lectures

Toledo (May 2011): IAU The Molecular Universe

Bologna (June 2011): Asrochemistry with ALMA

Edinburgh (August 2011): AstroSurf

Training

- GDR CNRS ARCHES (Adsorption, Réactivité et Contrôle de l' Hydrogène En interaction avec des Surfaces). South of France. October 3-6th 2011.

- The Chemical Cosmos. Malta. October 10-15th 2011.

- CNES Atelier Photochimie en Orbite. Paris. November 8th 2011.

- Weekly meetings with my advisor to discuss thesis progress.

- Courses & Seminars by the Observatoire de Paris' Ecole Doctorale.

- Language: Cours de langue et civilisation Française. La Sorbonne, Paris. August 2011.

THEORETICAL STUDY OF MOLECULAR HYDROGEN FORMATION IN THE INTERSTELLAR MEDIUM

I. Oueslati[1], B. Kerkeni[1], L. Tchang-Brillet[2], and A. Spielfiedel[2]

[1]Laboratoire Physico-chimie moléculaire, Tunis
&
[2]Laboratoire d'Etude du Rayonnement et de la Matière en Astrophysique, Paris

LASSIE-ITN Mid-Term Review Meeting

14th November 2011

Introduction

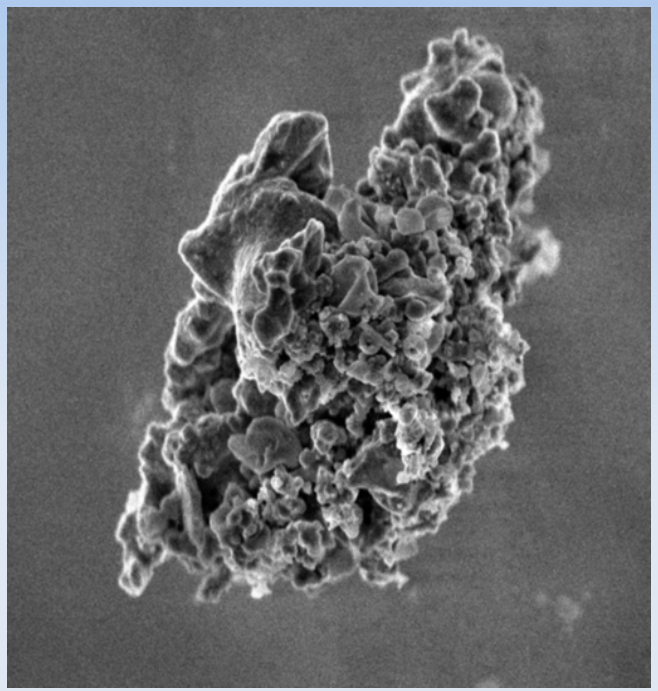


Figure 1. Dust grain

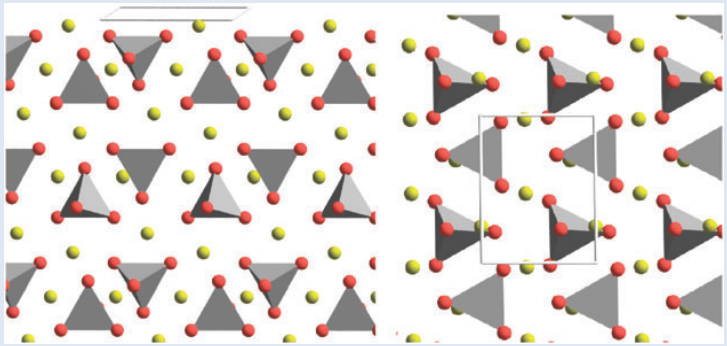


Figure 2. Forsterite (010) surface Mg_2SiO_4 [3]

- In the interstellar medium, dust grain has a major role in molecule formation [1].
- Olivine grains, whose compostions range from forsterite (Mg_2SiO_4) to fayalite (Fe_2SiO_4) [2].
- Investigate the H_2 formation on this surface.

[1] Goumans T.P.M. et al., 2009, *Mon. Not. R. Astron. Soc*, **393**, 1403.
[2] Braithwaite J.S. et al., 2002, *J. Phys. Chem*, **116**(6), 2628.
[3] Goumans T.P.M., et al., 2009, *Phys Chem Chem Phys*, **11**, 5431.

QM/MM calculations of the H_2 formation in the ISM

- Determination of the rovibrational excitation of H_2 formed on these surfaces at the low temperatures of the ISM.
- <u>Project steps</u>
- Characterize the most stable surface for this models.
- Identify the physisorption and chemisorption sites.
- Reproduce Energy diagram for the olivine surface [1,4].
- Activation and desorption energies of H atoms and potentiel energy surface (PES) will be investigated computationally.

[1] Goumans T.P.M. et al., 2009, *Phys Chem Chem Phys*, **11**, 5431.
[4] Kerkeni B., and Goumans T.P.M., 2011, in preparation

Dynamics of H_2 (and other molecules) formation

- Quantum dynamics techniques [6] will be used to extract :
  - Desorption probabilities of small molecules formation on silicate grains.
  - The internal energy distributions.
  - Formation rates.

[6] Kerkeni B., and Clary D.C., 2007, *Chem. Phys*. **338**, 1.

Interaction and reactivity of (H/H2 ;O/O2)on surfaces simulating the interstellar grains (Si, SiC , graphène)

Presented by :

TCHALALA Mohamed Rachid

Supervisors

Hamid OUGHADDOU(ISMO)
Hanna ENRIQUEZ(ISMO)
Mustapha AIT ALI (FSSM)
Abdelkader OUTZOURHITE(FSSM)

- Objectives:

- Control in UHV conditions of surfaces simulating interstellar grains
- Study of the interaction and reactivity of (H/H2;O/O2) on this surfaces

- Experimental tools :

- **AFM-STM**: Atomic Force Microscopy- Scanning Tunneling Microscopy
- **PES** : photoemission spectroscopy
- **TPD**: temperature programmed desorption

Mid-Term Review Meeting

14th November 2011

Guillem Aumatell Gómez

Universität Münster/ Universität Duisburg-Essen

Westfälische Wilhelms-Universität Münster

Universität Duisburg Essen

Physik E=

Who am I?

- Born in Spain, near Barcelona.
- Studied Physics in Universtitat Autònoma de Barcelona.
- Specialized in Astrophysics in Universidad de La Laguna (Tenerife, Spain) and Universität Jena (Germany).
- Master in Astrophysics, Particle Physics and Cosmology in Universitat de Barcelona.
- I worked 4 years in Cosmocaixa, the new Science Museum in Barcelona.
- Actually doing my PhD on Planetary Formation in Universität Duisburg Essen, subsidized by Universität Münster under LASSIE project.

What have I done thanks to LASSIE?

- We do experiments in order to know how planets form and concretely I have spezialized in water ice collisions.
- We have been the first group to observe (sub-)mm ice aggregates collisions thanks to a process called „Knudsen effect“.
- We published a paper in MNRAS (Monthly Notices of the Royal Astronomy Society).
  - „Breaking the Ice: Planetesimal at the Snowline“, Aumatell & Wurm 2011
- I have had the opportunity to learn much about topics related with interstellar ices (very important for my work).

What have I done thanks to LASSIE?

- We stablished scientific collaboration with other „planetarists“ on Japan.
- I assisted to the following conferences and trainings:
  - LASSIE & Astrophysical Chemistry Group: Young Researchers Meeting, October 2010, UCL London (England).
  - 7th Planet Formation Workshop, February 2011, Göttingen (Germany).
  - Astrochemistry lectures, Time Management and Outreach techniques, May 2011, Leiden (Netherlands).
  - International Summer School: Astrochemistry with ALMA, June 2011, Bologna (Italy).
  - AstroSurf meeting, September 2011, Edinburgh (Scotland).
  - EPSC-DPS Joint Meeting on Planet Formation, October 2011, Nantes (France).
  - The Chemical Cosmos: Annual Conference, October 2011, Valletta (Malta).
  - I am here!!
- I am assisting to astrophysics courses at the university.
- I am studying german level C1 and practicing it everyday.

What do I still expect from LASSIE?

- Test new techniques to achieve higher velocity collisions.
- Work at lower temperatures to avoid ice sublimation if necessary.
- Test collisions with different types of ices.
- Do experiments on parabollic flights.
- Acquire good communication and investigation skills in order to work, communicate and share knowledge with other colleagues.
- Outreach and science education.


THANK YOU !!
LASSIE

Tushar Suhasaria

AG Zacharias

Physikalisches Institut

Westfälische Wilhelms-Universität Münster

2011 Young Astronomers' Meeting (YAM)
November 15th 2011, Paris, France

ABOUT ME

Westfälische Wilhelms-Universität Münster

❖Born in Berlin, Germany.

❖ Bachelors in Chemistry from University of Burdwan, India.

❖ Masters from Indian Institute of Technology Roorkee.

❖Summer internship project on "Studies on some catalytically important Vanadium Phosphorus Oxide Phases"

❖Masters Thesis on "Removal of Vanadium from aqueous Solutions using Red Mud- an Aluminium industry waste as Adsorbent".

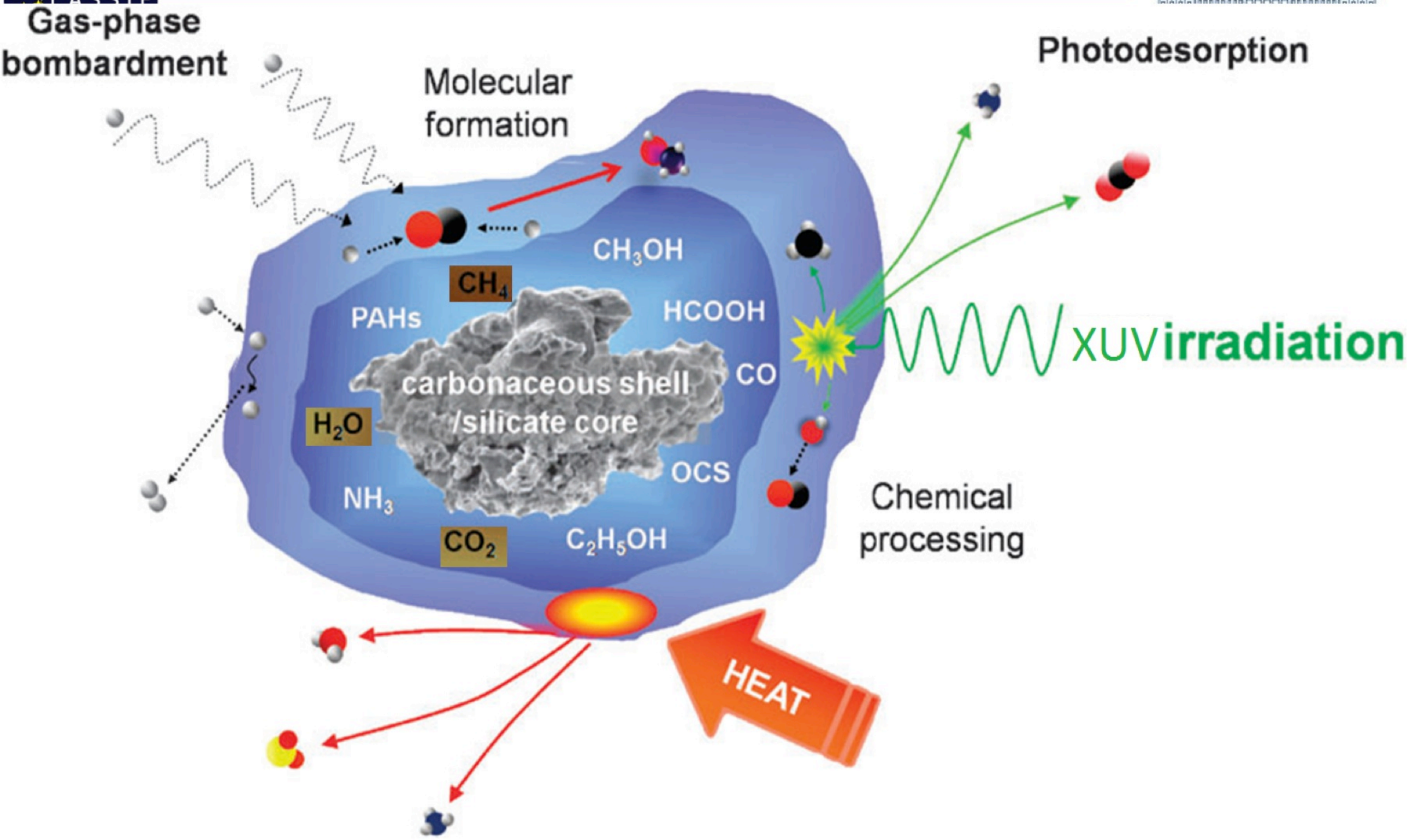
❖Currently doing my PhD on "XUV photochemistry in doped ice films on astrophysically relevant substrates" in Universität Münster under LASSIE project.

MOTIVATION

Westfälische Wilhelms-Universität Münster

- ❖ Chemistry as modern astronomy's best tools.
- ❖ Probing the processes of molecule formation in ISM.
- ❖ Potential to cite the origin of biologically relevant molecules.
- ❖ 140 different types of molecules in the ISM have been found.
  - ❖ Simple diatomics such as H_2 to large saturated organics such as $HC_{11}N$.
  - ❖ Initially thought low temperatures (10–20 K) and pressures (10^4–10^8 hydrogen atoms cm^3) not conducive to chemistry.

OVERVIEW OF MY PROJECT



Daren J. Burkew and Wendy A. Brown,Phys. Chem. Chem. Phys., **2010**, 12, 5947–5969

OVERVIEW OF MY PROJECT

Westfälische Wilhelms-Universität Münster

- Ice Substrates: H_2O, D_2O & CH_4 .

- Doping molecules: CO, NH_3, CO_2 and small PAH's like coronene, hexapericoronene, may be also some perylenes or pyrenes.

- Substrates: Olivines, forsterite ($MgSiO_4$) single crystals, graphite and graphene.

- Source of light: Visible and UV from femtosecond laser source.

- Extreme UV light (XUV) available at a Free Electron Laser called FLASH in Hamburg, Germany.

- Characterization of surface: FT-IR spectroscopy and TDS (or TPD).

- Possible desorbing reaction products: Time-of-flight mass spectroscopy.

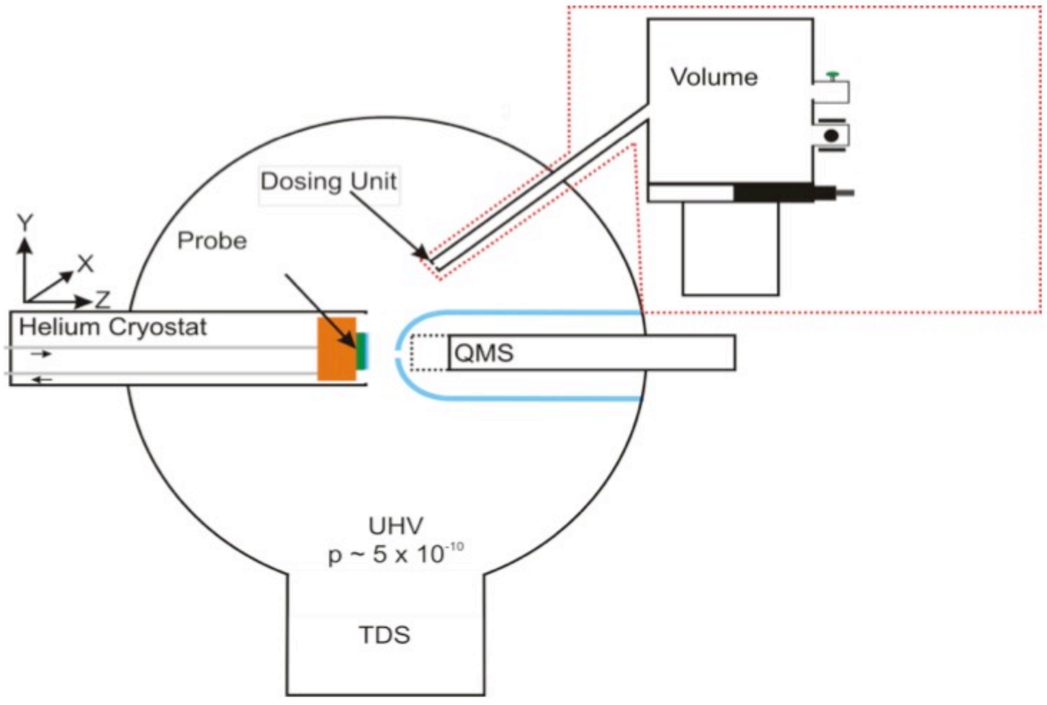
PLAN OF MY WORK/PROGRESS

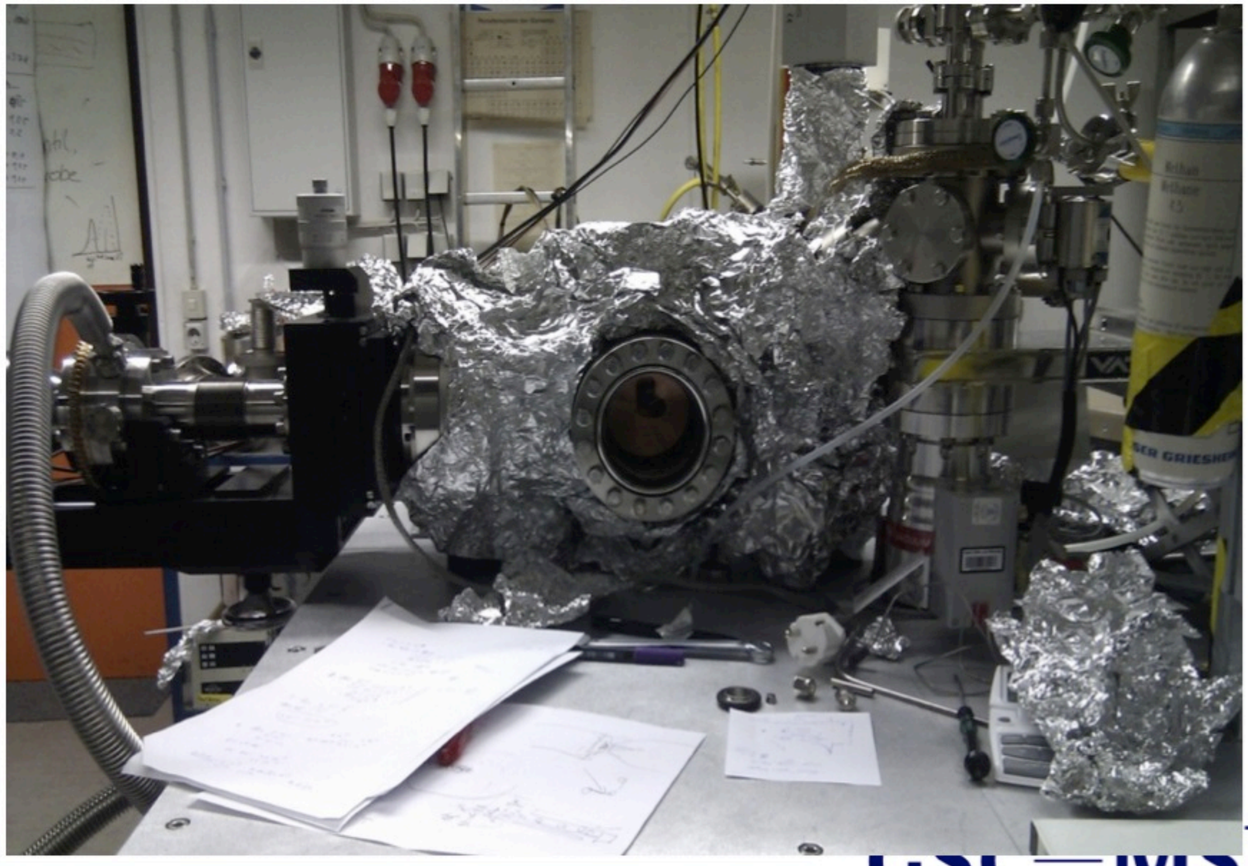
Westfälische Wilhelms-Universität Münster

I can divide my plan of work in three categories:

A] Characterization of the prepared surface.
B] Experimentation with appropriate doping molecules.
C] Interaction of desired surfaces with light source in our lab and the FEL FLASH in Hamburg.

❖ Started taking measurements on TPD (or TDS) with olivine surface covered with H_2O ice and CO_2 ice.





ACKNOWLEDGEMENTS

Robert Frigge,
Nadine Hemming
Björn Siemer
Prof. Helmut Zacharias(Supervisor) [Member of GSC- MS]

The entire project is funded by **LASSIE**(**L**aboratory **A**strochemical **S**urface **S**cience **i**n **E**urope) **FP7** (Seventh **F**ramework **P**rogramme) **ITN** (**I**nitial **T**rainning **N**etwork).

Additional funding is provided by **BMBF** via FSP 301 “FLASH”

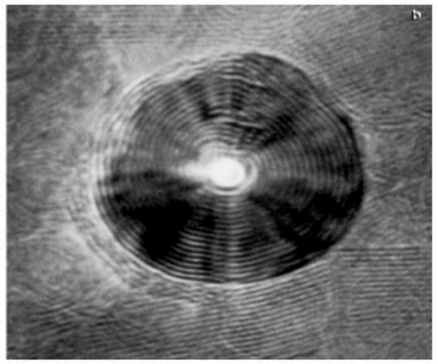
Experimental Study on Condensation and Processing of Cosmic Dust in Astrophysical Environments

Tolou Sabri

Supervisors: Dr. Cornelia Jaeger
Prof. Thomas Henning

Early stage researcher of LASSIE network
Laboratory Astrophysics and Cluster Physics Group
of the Max Planck Institute for Astronomy, Heidelberg
at the Institute of Solid State Physics, FSU Jena

Cosmic dust analogues from the laboratory



Carbonaceous grains

Elements in the interstellar medium in order of abundance

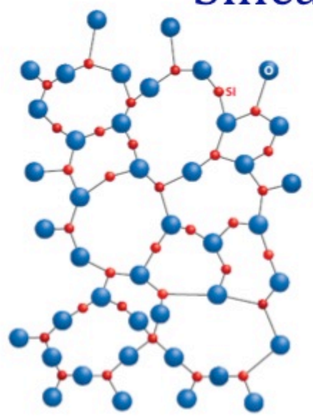
O C Fe Si Mg S

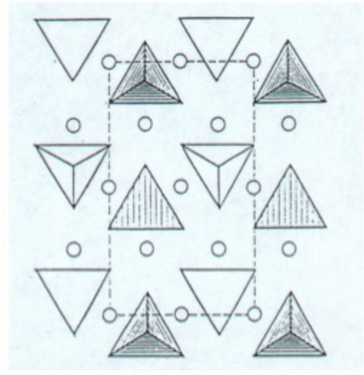
Silicate grains

- Graphite
- Diamonds
- Onions
- Hydrogenated amorphous carbon grains

Carbon, Silicates, Oxides, Carbides, Sulfides , Ices

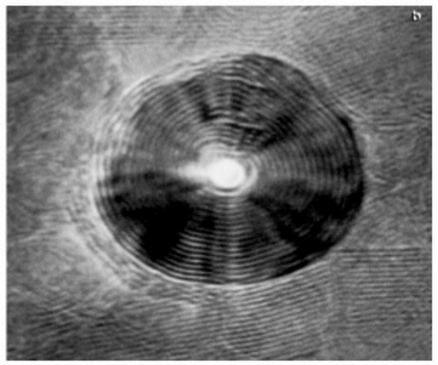
~ 1nm – 1µm





- Pyroxene $(Mg/Fe)SiO_3$
- Olivine $(Mg/Fe)_2SiO_4$

Cosmic dust analogues from the laboratory



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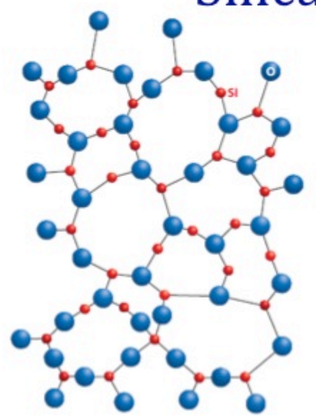
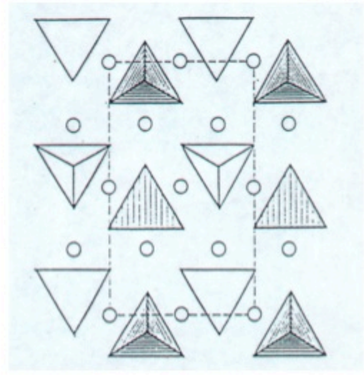


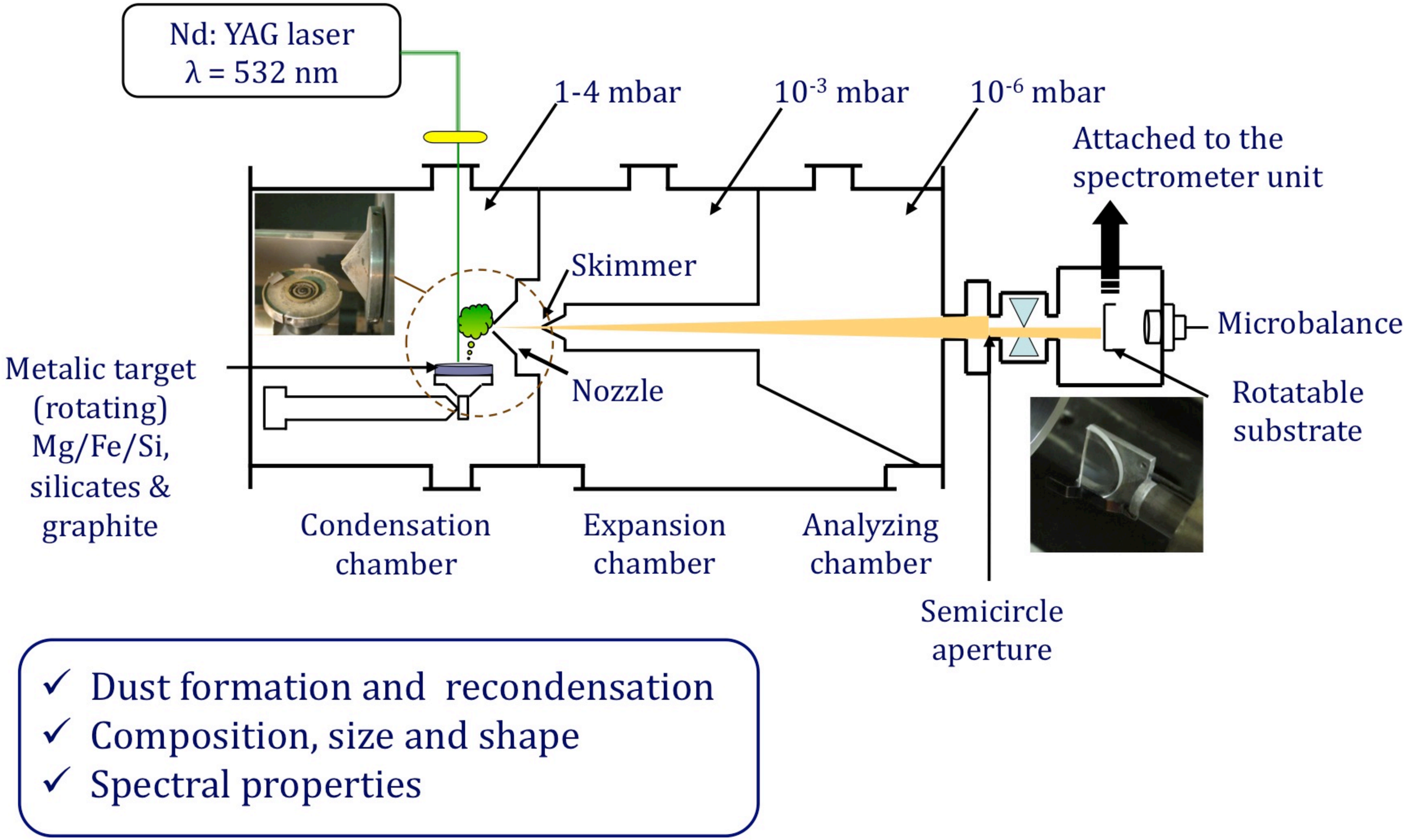


- Pyroxene (Mg/Fe)SiO3
- Olivine (Mg/Fe)2SiO4

Gas-phase condensation of dust grains

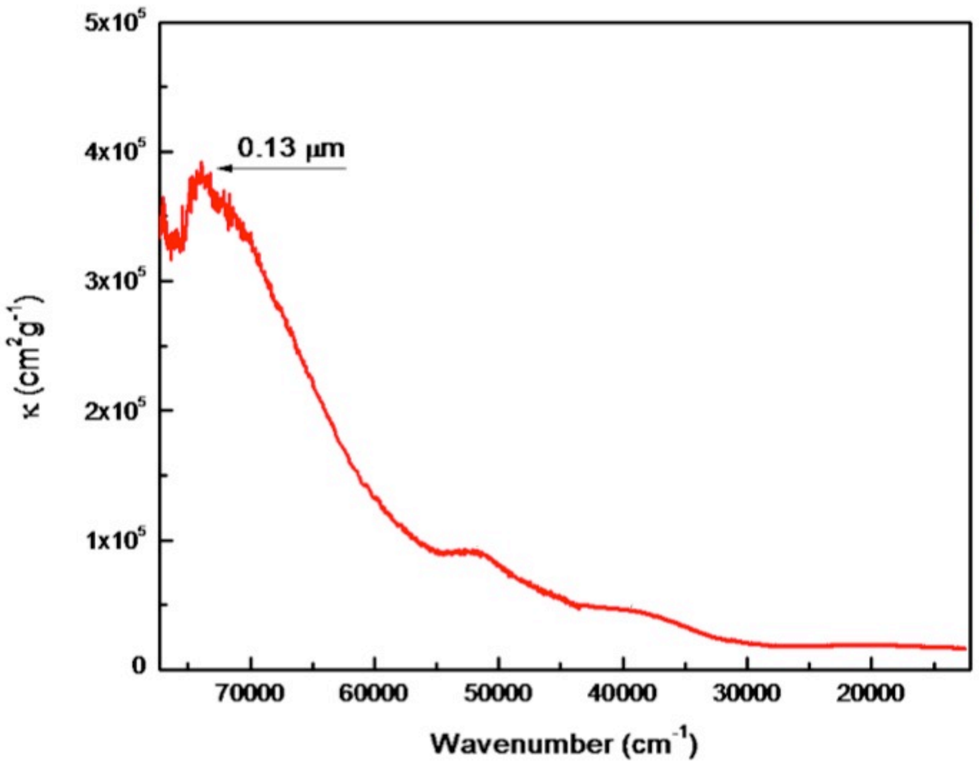
Processing of dust by UV irradiation, Ion irradiation and annealing

Gas-Phase condensation studies

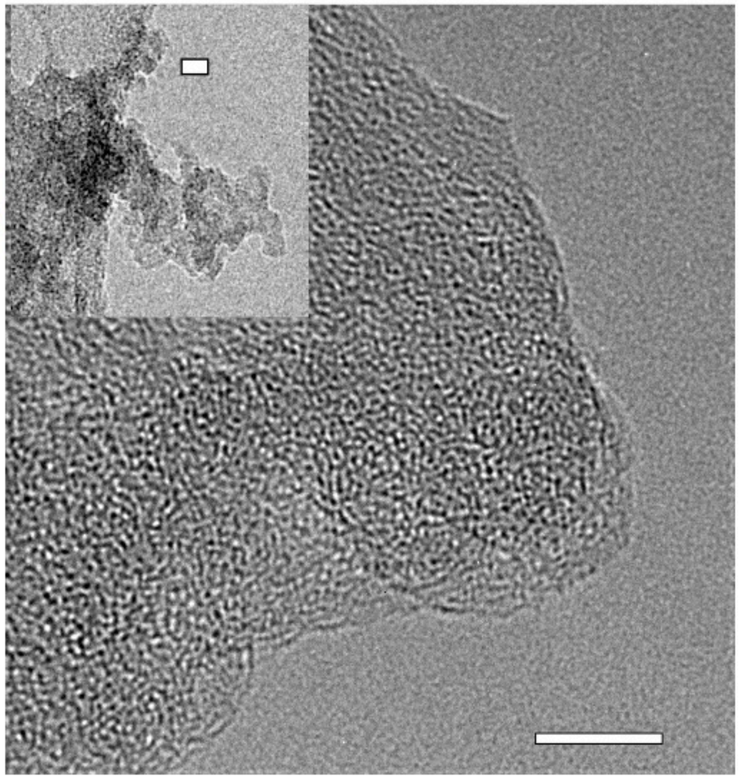


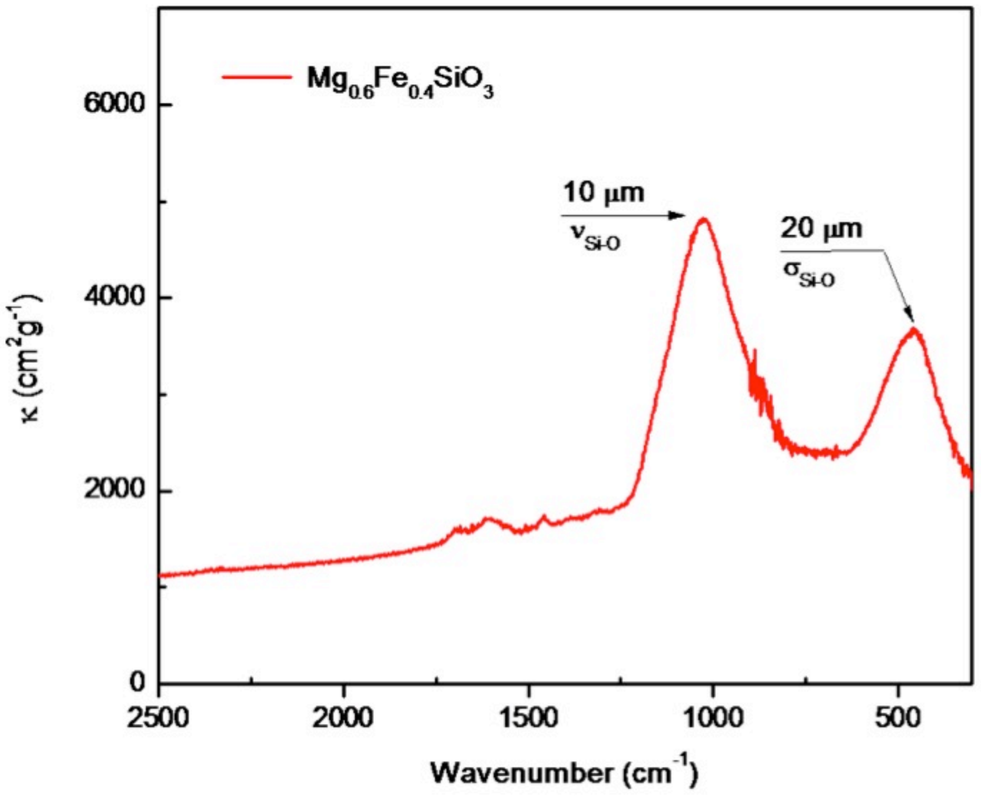
- ✓ Dust formation and recondensation
- ✓ Composition, size and shape
- ✓ Spectral properties

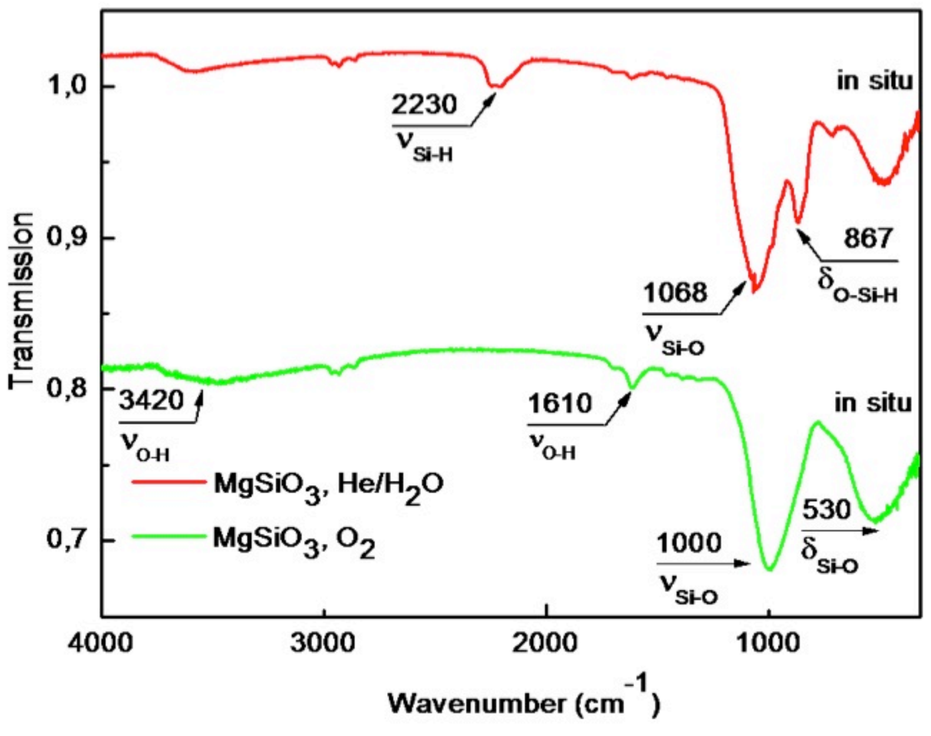
Gas-phase condemsation of siliceous materials



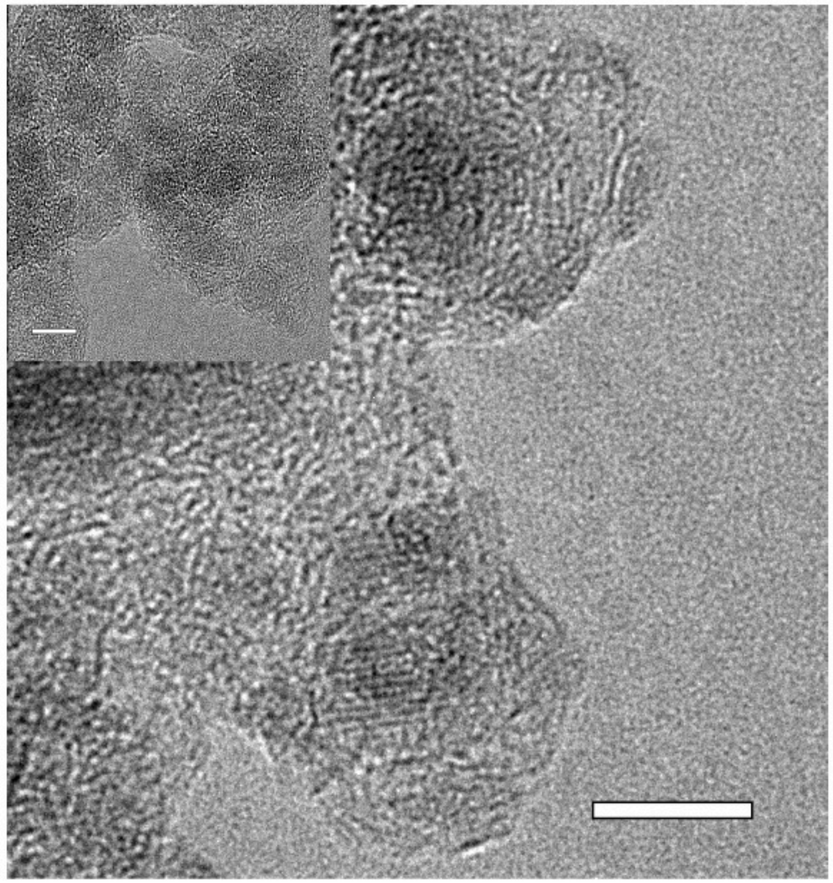
$Mg_{0.6}Fe_{0.4}SiO_3$

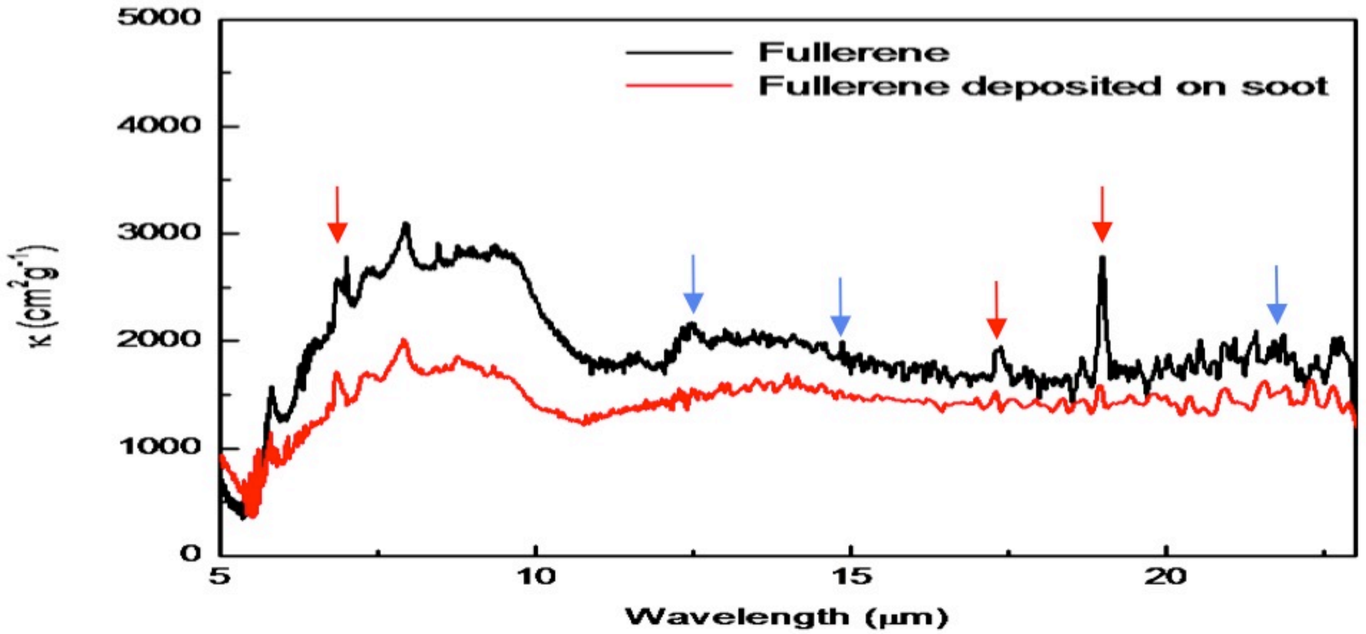


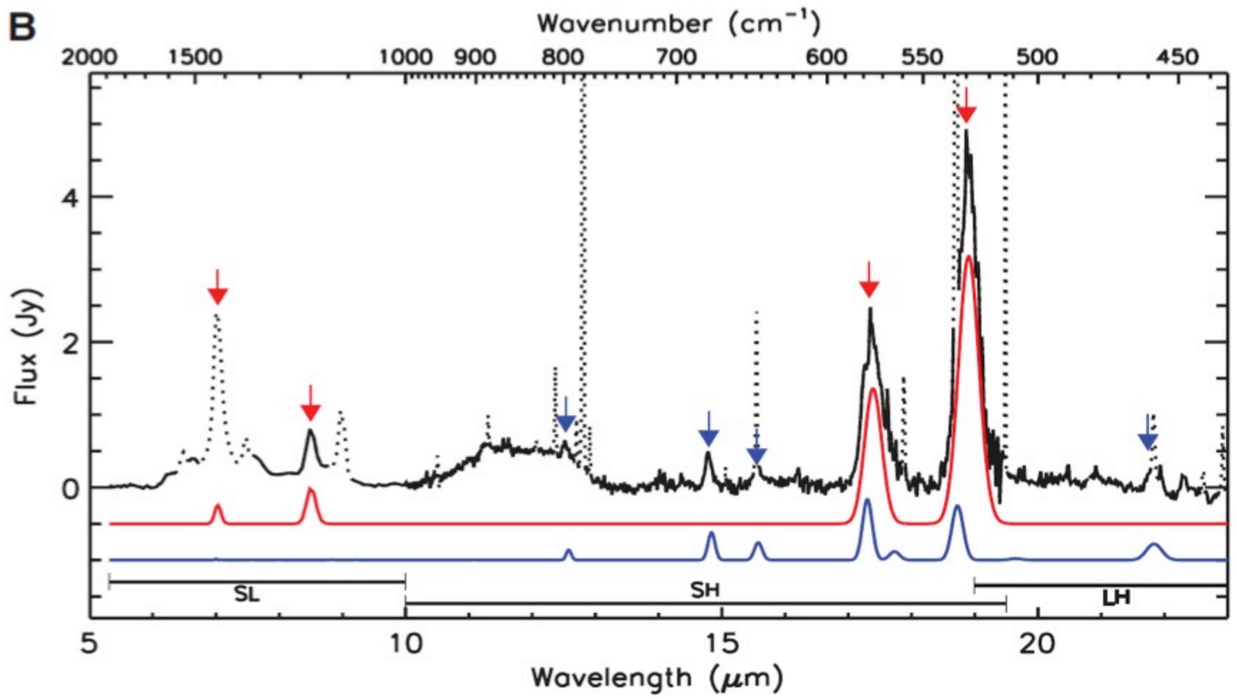




Gas-phase condensation of carbonaceous material



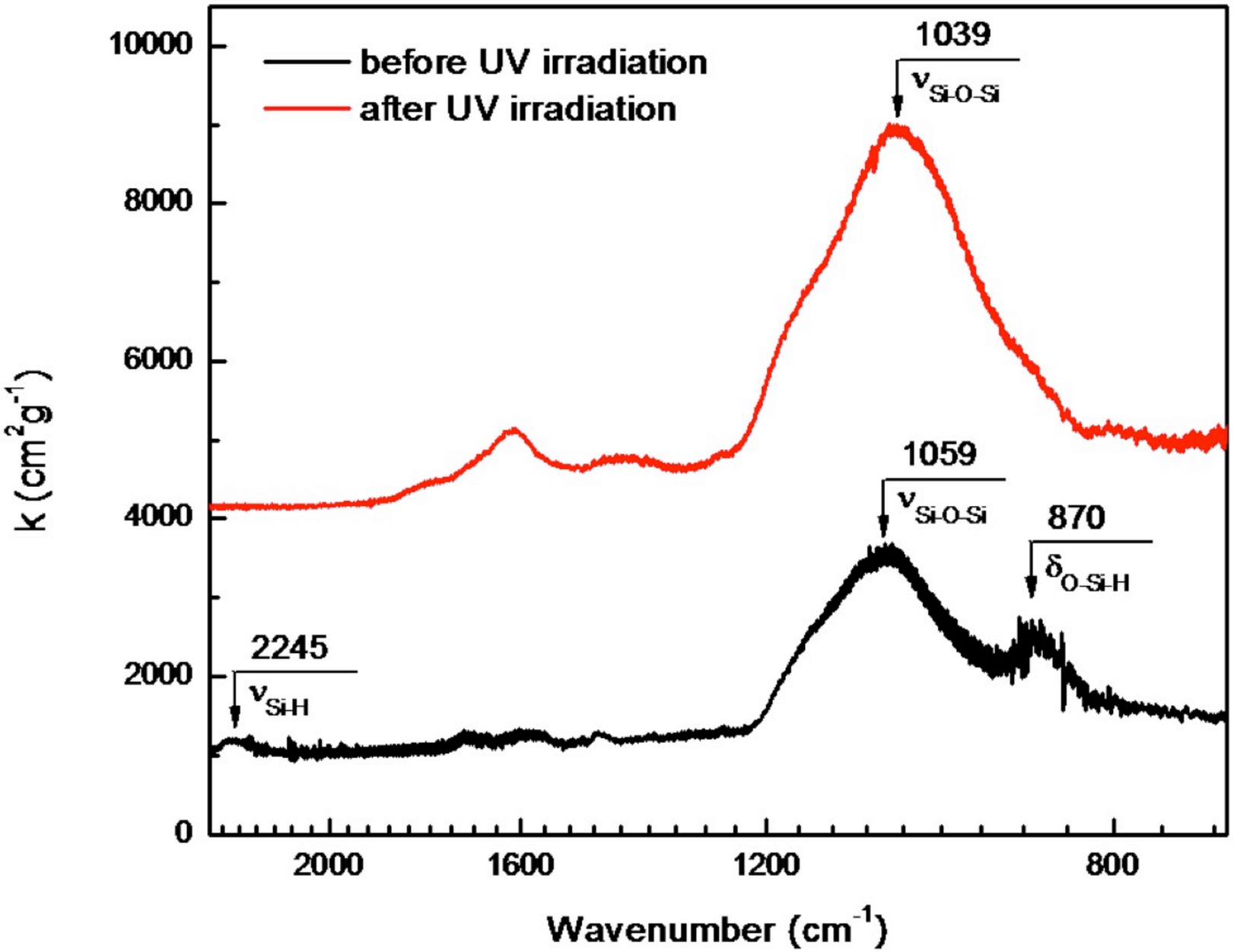




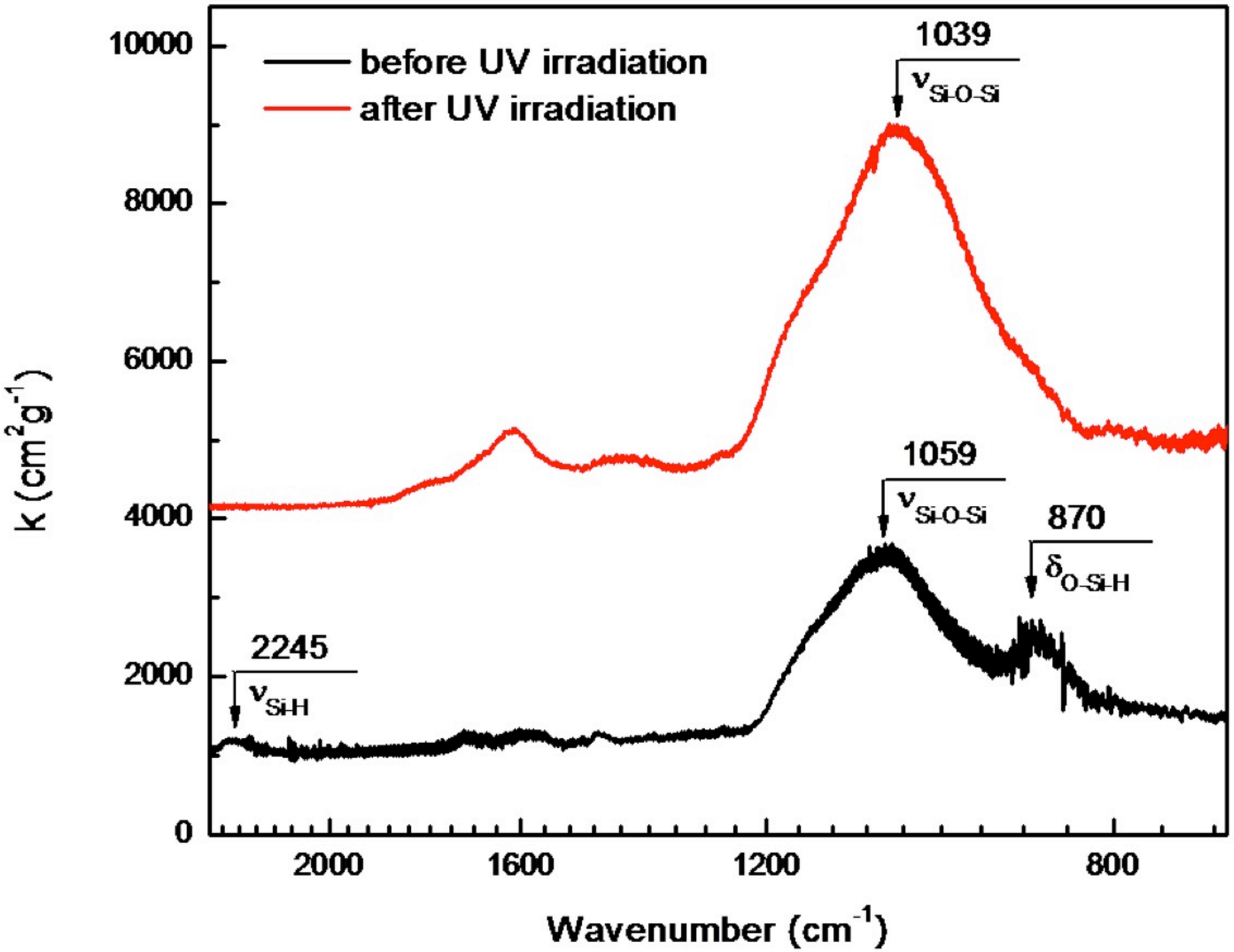
J. Cami *et al.*, Science 329, 1180 (2010)

- Blue arrows denote those of the four strongest, isolated C_{70} bands
- Red arrows mark the wavelengths of all infrared active modes for C_{60}
- The broad plateau between 11 and 13 mm is attributed to emission from SiC dust

Processing of cosmic dust



Processing of cosmic dust



Paper on gas-phase condensation and processing of silicates /ApJ (in progress)

Training activities and future prospects

Training Activities		
Summer schools	LASSIE summer school, Leiden, Netherlands Astrochemistry with ALMA, Bologna, Italy	May2011 June 2011
Attended lectures	Cluster and nanoparticles I & II Introduction to astronomy	2010 2010
Conferences and meetings	Student-oriented LASSIE meeting, London, UK (Poster) AstroSurf 2011, Edinburgh, UK (Poster)	Oct. 2010 Aug. 2011
Seminars	Formation and processing of dust (Talk) Condensation experiments on silicates (Talk)	June 2010 Jan. 2011
Skills	HRTEM, EDX, Spectroscopy from FUV to FIR UV and ion irradiation	

- Production of icy-mantel-covered hydrogenated carbon grains and processing of the produced material by ion irradiation (in collaboration with Dr. M. Palumbo, Catania)

- Cooperation with OBS on the formation of H_2 on Silicate grains (Prof. J. L. Lemaire & Lisseth Gavilan)

Last Slide

Acknowledgments

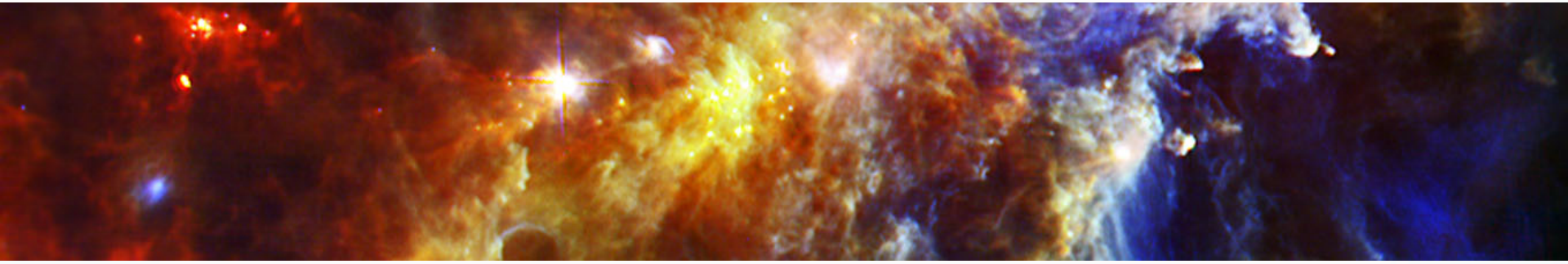
http://www.astrolab.uni-jena.de

Thanks for your attention!

Isotopic Studies of the Interstellar Medium and Solar Nebula

T. Albertsson, D. A. Semenov & Th. Henning

MPI Astronomy, Heidelberg



Max-Planck-Institut für Astronomie Heidelberg
Max Planck Institute for Astronomy Heidelberg

PSF Department

International Max Planck Research School for Astronomy & Cosmic Physics at the University of Heidelberg
I M P R S

SEVENTH FRAMEWORK PROGRAMME

LASSIE

The road so far

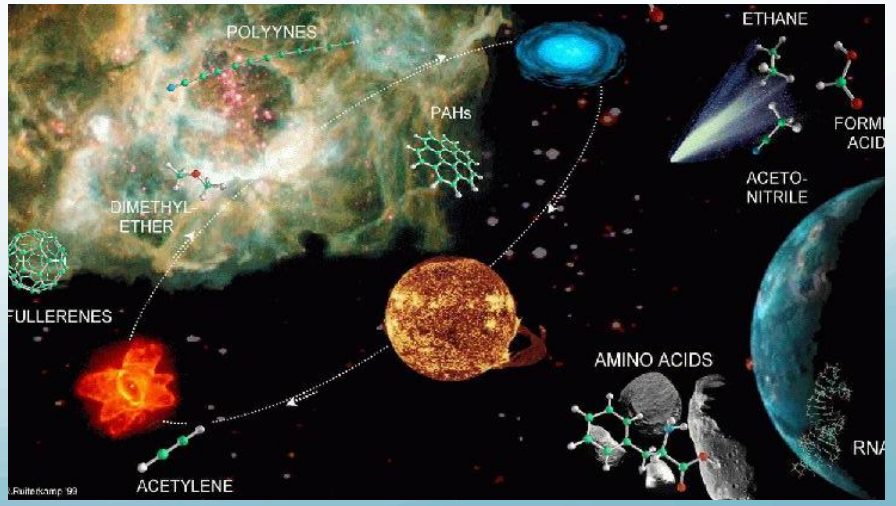
PhD study, Sep 2010, Heidelberg, Germany

- Advanced IDL skills
- Application of chemo-dynamical models
- Teaching: Statistical methods
- Courses Heidelberg University:
  - Theoretical astrophysics
  - Observational astronomy
  - Scientific writing
- Summer school – Astrochemistry, Leiden
- Summer school – Astrochemistry with ALMA, Bologna

Astrochemistry – Isotopic Studies

- Astrochemistry - interdisciplinary study: from atoms to molecules, and to life
- Molecules are tracers of physics & chemistry
- Isotopologues provide unique constrains on environment
- New observational facilities: ALMA & JWST

(Left) Observational facilities JWST Herschel, Spitzer, ALMA. Image credit NASA.
(Right) Molecules in the evolution of the intestellar medium



Deuterium Chemistry in the ISM

- Albertsson, Semenov & Henning (2011), ApJ, submitted
- Atomic & Molecular initial chemistry
- Density, temperature range
- Good agreement with observations and previous models
- Next step: Origin of water in Solar system

Dark cloud and various protostellar environments. Images credit: NASA

siyifeng

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Siyi Feng's Homepage
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siyifeng@msn.com
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EDUCATION

Master of Science in Astrophysics *Sep.08-Jun.11*
Nanjing University, Jiangsu, China

- Major: Astrophysics
  Astrophysics GPA: 91/100
  Cumulative GPA: 90/100
- Member of the Chinese Astronomy Society

Bachelor of Science in Astronomy *Sep.04-Jun.08*
Nanjing University, Jiangsu, China

- Major: Astrophysics
  Physics & Mathematics GPA: 88/100 (rank: 2/40)
  Cumulative GPA: 86/100 (rank: 3/40)

  Thesis for degree: Late Internal Shock Model for the X-ray Flares of GRB Afterglow
  Committee: Z.G. Dai (Chair), Y.F. Huang , X.D. Li, and Y. Chen.
- President of the Undergraduate Students' Union of the Department of Astronomy
- President of the Astronomy Amateur Association of Nanjing University

RESEARCH EXPERIENCE

PhD Candidate *Sep.11-present*
-Planet and Star Formation Group@Max Planck Institute for Astronomy, Germany
- Research on Chemical Sub-structure of High-mass Star-forming Region

Research Advisor: Priv.-Doz. Dr. Henrik Beuther

Graduate Research Assistant *Sep.08-Jun.11*
-High Energy Group@Department of Astronomy, Nanjing University

- Research on Multiband Fitting Models to the Fermi/LAT-Swift Gamma Ray Burst (GRB) Afterglows Data

  We constructed a novel model of structured ejecta sweeping up the density-jump medium. This model can universally well reconcile the discrepancy that simple-power law is too conservative to the flares or bumps on the late lower energy band afterglows, as well as the early steep rising of GeV lightcurve; Meanwhile, it supports the external origin of the GeV photons observed by LAT;
- on Relativistic Wind Bubble Model in predicting Polarization of the Gamma Ray Burst (GRB) Afterglows

  We analytically and numerically simulated the temporal polarization in the "magnetar origin" relativistic bubble model, explain the shallow decay of GRB afterglows, and fit it to the observation data;

Research Advisor: Prof. Z. G. Dai, Director of the Chinese Astronomy Society, Chair of the High Energy Group

Summer School Student Researcher *Jul.-Aug.07*
-@Department of Applied Mathematics, University of Sheffield, UK

- Research directly with Prof. Róbert von Fay-Siebenburgen on Helioseismology

  We revisited the models of solar internal f/p/g-modes, including the combined effects of an atmospheric magnetic field, temperature and steady state changes during a solar cycle.
  The demonstration of our work was honored as the Best Oral Presentation of the 2007 International High energy and Astrophysics Summer School

Undergraduate Advanced Project Student Researcher *Sep.06-Sep.08*
-@Department of Astronomy, Nanjing University

- Research on Late Internal Shock Model to the X-Ray Flare of the Gamma Ray Burst (GRB) Afterglows

  We built computer codes for calculating the Late Internal Shock dynamic and radiation process, analytically and numerically, and fit this model to observational data, indicating the "magnetar origin" X-ray flares.
  The work was honored as the Excellent Thesis for the Bachelor Degree

Sep.04-Jun.08

Sep.08-Jun.11

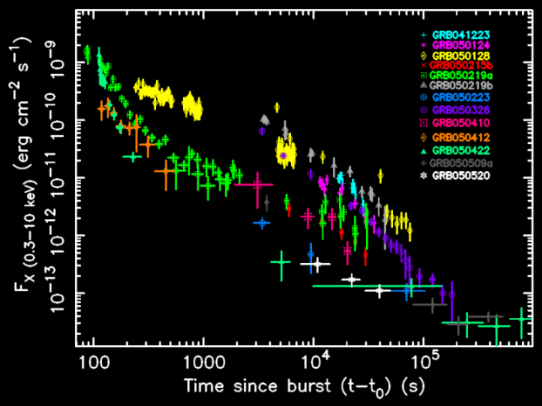
Research

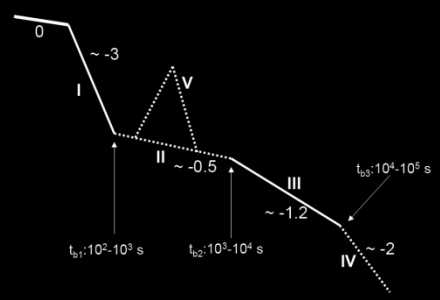
Here are all the presentations I made (2007-present),

Please click the links and enojoy the animations

Works:

- **Relativistic Wind Bubble Model to the Polarization of the Gamma Ray Burst(GRB) Afterglows** *(Oct. 2010-present)*
- **Multiband Afterglow Fitting to Three Fermi Long GRBs: Structured Ejecta Sweeping the Density- Jump Medium** *(paper submitted to ApJ, Arxiv:1011.3103)*
- **Analytical Results Modeling for the Differential Rotation Neutron Star** *(May.-Jun. 2010)*
- **The Analytical and Numerical Results of the GRB Afterglows** *(Presented at Nanjing University, "Work Summary for the Qualify of Graduate Research", 2009-2010)*





Seminar Talks:

- **Study on the Gamma-ray Bursts in the Fermi Era** *(Presented at Nanjing University, "Thesis Oral Defense for Master Degree", May. 2011)*
- **Multiband Fitting to 3 Long GRBs with Fermi/LAT Data: Structured Ejecta Sweeping up a Density-Jump Medium** *(Presented at Nanjing University, "Mini Workshop for the Frontier of GRB Research" , Oct., 2010)*
- **Presentations at Nanjing University, "Colloquium on the Research of Gamma-ray Afterglows in the Fermi Era"**
  - **New Observational Discoveries Beyond GRBs in Fermi Era** *(Apr., 2011)*
  - **New Observational Properties of GRBs Prompt Emission in Fermi Era** *(Mar., 2011)*
  - **Typical GRBs Observed by Fermi-LAT** *(Apr., 2010)*
  - **Klein-Nishina Effects** *(Mar., 2010)*
  - **Polarization of the GRB Afterglows (I) .(II)** *(Feb. 2010)*
  - **Soft Gamma-ray Repeaters (SGRs) and their giant flares** *(Dec., 2009)*
  - **Ultra-high energy particles in Astrophysics** *(Oct., 2009)*
  - **Models for GRB afterglows feature: X-ray flare** *(Apr., 2009)*
  - **Models for GRB afterglows feature: Shallow decay** *(Feb., 2009)*
  - **tudy of the GRB afterglows theory** *(Presented at Nanjing University, "2009 Frontier of strophysics Summer School", Aug., 2009)*
  - **ate-internal Shock model for X-ray flares of the GRB afterglow** *(Presented at anjing University, "Thesis Oral Defense for Bachelor Degree", Outstanding Graduation hesis, Jun. 2008)*
  - **Brief Review of the Helioseismology** *(Presented at the University of Sheffield,UK, '2007 International High Energy and Astrophysics Summer School", Sheffield U, UK, Aug., 2007)*

B. Zhang 2007

Former projects

(2008-2011)

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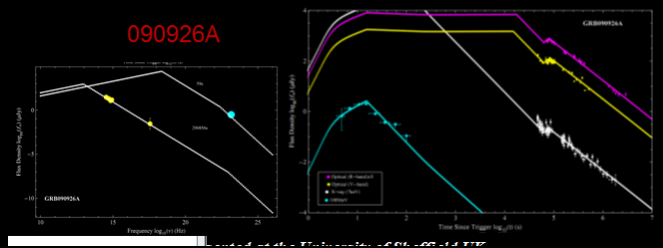

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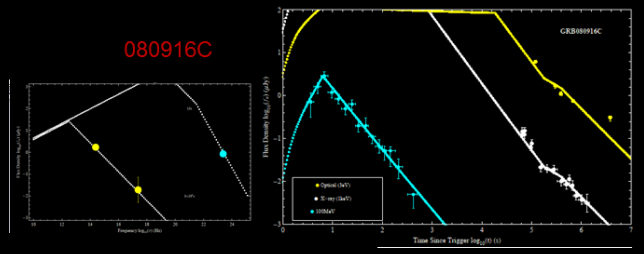

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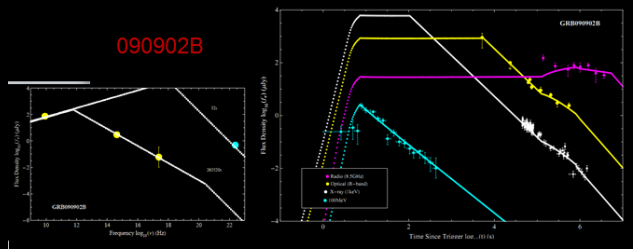
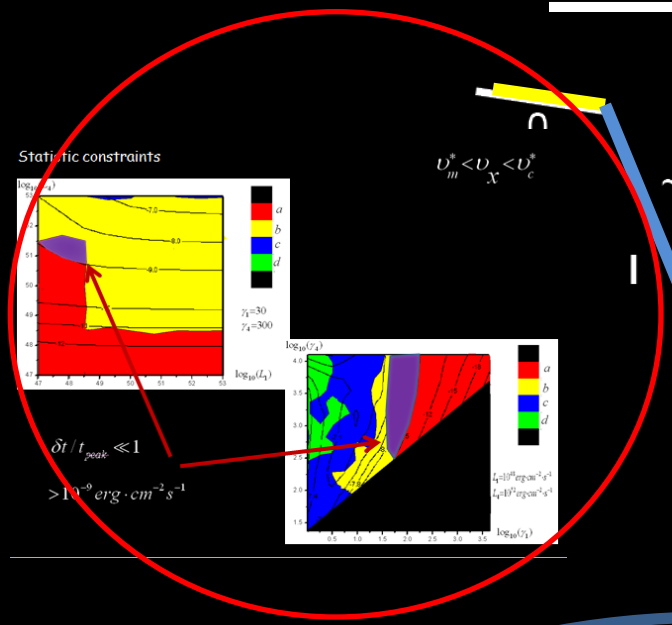
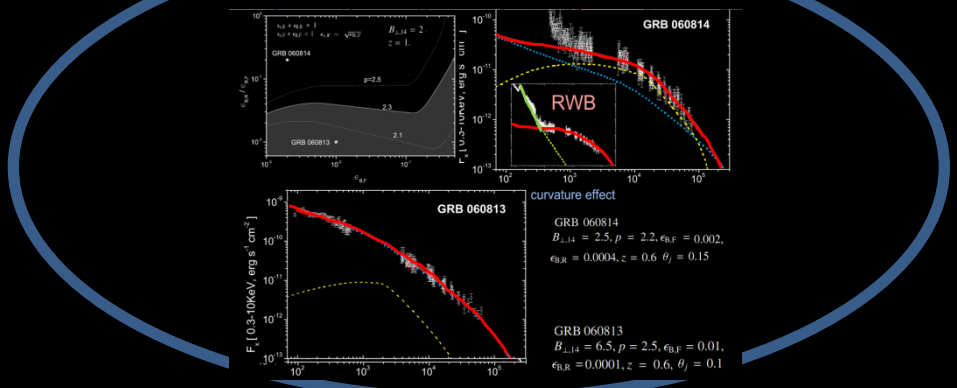
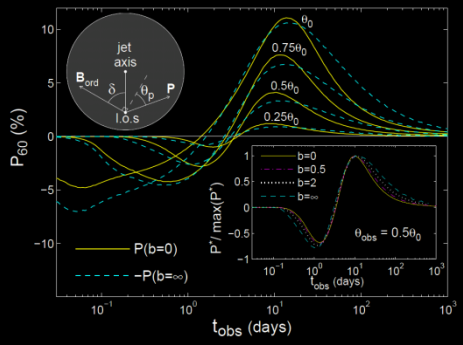






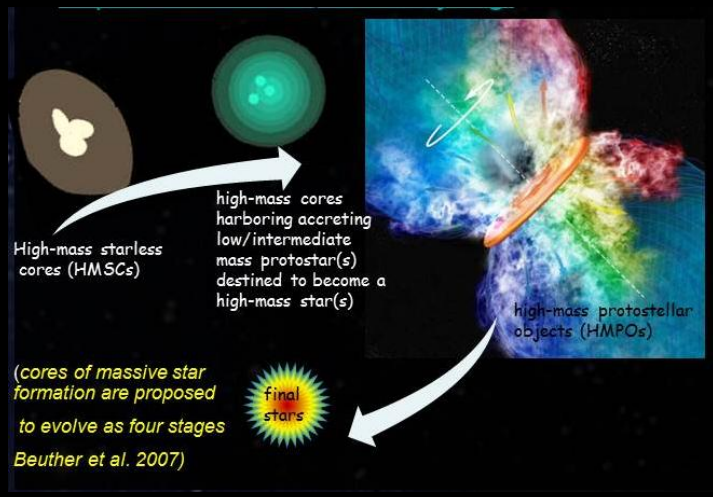


Projects ahead

(Sep. 2011-)

International Max Planck Research School for Astronomy & Cosmic Physics at the University of Heidelberg
I M P R S

High-mass star formation



Interferometry

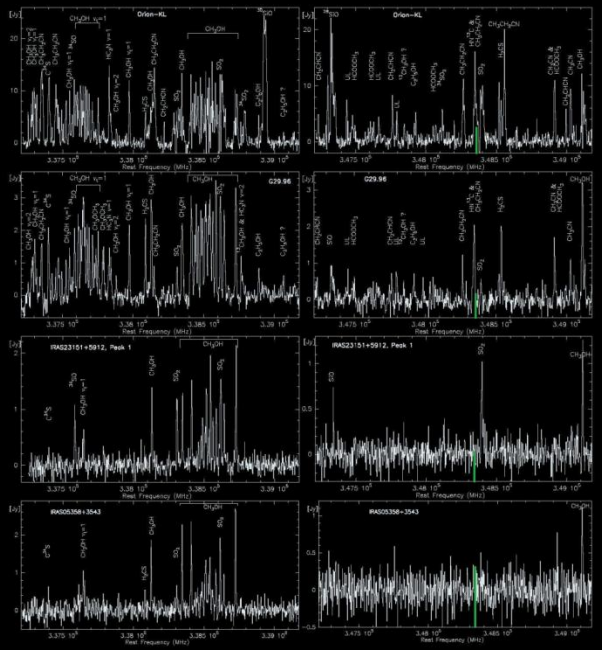
SMA: Submillimeter Array

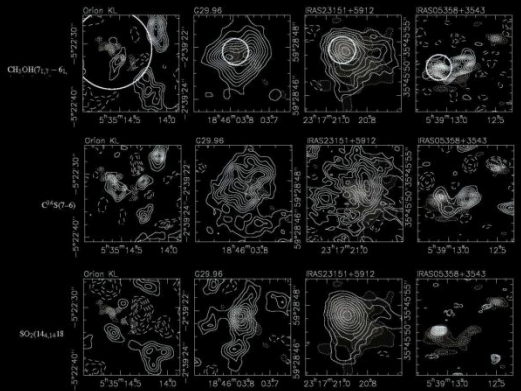
PdBI: Plateau de Bure Interferometer

ALMA: Atacama Large illimeter/submillimeter Array

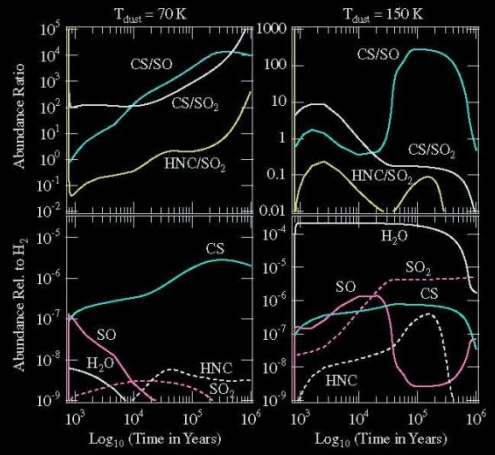
Henrik. Beuther

Astrochemistry





H. Beuther 2009a



Projects ahead

(Sep. 2011-)

To be continued…

IRAM :interferome try summer school in fall 2012 @Grenoble

IMPRS yearly summer school & Soft skill courses

Courses @ U Heidelberg

EPoS 2012:The Early Phase of Star Formation @Kreuth, Germany

LASSIE network