

Crystallography for Space Sciences

A Cospar Capacity Building Workshop INAOE and BUAP, Puebla, Mexico.

April 17-29, 2016

The first International School/Workshop on Crystallography for Space Sciences organized in collaboration of COSPAR, the International Union of Crystallography (IUCr) and the International Astronomical Union in Puebla, Mexico in April 2016 was a great success.

The aim of the Workshop – stellarly directed by Juanma García-Ruiz (CSIC-University of Granada) was to prepare a selected number of participants for the next generation of projects in search of a deeper knowledge and understanding of extraterrestrial minerals and rocks, either large solid bodies or interstellar dust particles, using in-situ and remote analytical techniques.

27 PhD students, postdocs and young staff members took part in the workshop, mostly from Latin America. They learned about modern crystallographic techniques in the fields of diffraction, imaging, spectroscopy and remote sensing. They also learned about the formation of mineral growth patterns in the early Earth, our Moon, Mars and other planets and moons, meteorites and interstellar dust, as well as about the relevance of crystals with origin of life and detection of primitive life forms. During this workshop the students were also taught about sample preparation techniques. They analyzed their own data but as well as the data from the missions Discovery and Curiosity and they learned about data collection on the forthcoming Exomars mission. Portable diffractometers and spectrophotometers designed for these missions were used during the field trip for remote analysis of volcanic rocks. Last but not least all the participants learned about COSPAR (presentation by Mariano Mendez) and IUCr (by Hanna Dabkowska).

The detailed program of the workshop, with the most important talks included, can be found at the (<http://www.inaoep.mx/cospar2016>) website.

On the first day of the venue the nearby Popocatepetl volcano erupted, providing the students with ample amount of volcanic ashes to be analyzed - just at their doorsteps. The planned excursion to this volcano, lead by the volcanologist Claus Siebe, was moved to less dangerous locations - still at the lava deposits (from previous eruptions).

The crystallographic and crystal growth lectures (presented by Jim Britten, Juan Rodriguez Carvajal, Hanna Dabkowska, Yuki Kimura, Jose Antonio Manrique, Chris Mavris, Maria Eugenia Mendoza, Teresa Pi Puig, Juan Manuel Garcia Ruiz and Fernando Rull) were at very high level and very much enjoyed by the students. So were the inspiring talks about the Mars missions (presented by Dave Blake on Curiosity, Jorge Vago on Exomars and Pablo Sobron on future missions), about the Hayabusa mission (by Tomoki Nakamura), about meteorite investigations, (by Rafael Navarro-Gonzalez, Fernando Ortega and Jaime Urrutia), about early minerals by Mark van Zuilen and about some interesting crystals (by Wulf Depmeier and David Page).

In the afternoons the students worked with the instructors preparing samples, analyzing them using portable diffractometer, Raman and infrared spectrophotometer and optical microscopy and applying methods discussed earlier at lectures.

The local organizers team lead by Guillermo Tenorio Tagle, Maria - Eugenia Mendoza, Raul Mujica, Teresa Pi Puig and Ulises Salazar went out of their way to have the group entertained, well fed with delicious food and taught about the impressive local historical sites. We visited Puebla City, ancient pyramids in Cholula and Teotihuacan and we had the opportunity to participate in two very active public events, one the lecture of Jorge Vago in Puebla about the mission Exomars, and the other one a round table discussion on Life on Mars in the Museo UNIVERSUM. We also had an opportunity to observe the crystal growth competition organized by Raul Mujica and Maria Eugenia Mendoza for Puebla school children accompanied by the public lecture of Juanma Garcia-Ruiz on Giant Crystals of Naica, to watch the movie The Martian, discuss it with the experts involved in Mars exploration and participate in the concert performed by the very professional, young Esperanza Azteca orchestra.

The school ended with the presentation of the practical works performed by the students on their own samples or samples provided by the organizers. The most excellent presentations were awarded with IUCr provided prizes. The awards went to: Isai Castillo, Gilgamesh Raya, Patricia Hernandez (Mexico), Ilectra Kotopoulou (Spain), Pamela Such (Chile), Chris Mavris (UK), Santiago Fort (Uruguai), 8. René Cabrera and Elias Nakouzi (USA)

All the participants – students and teachers alike - found this workshop very educational, very effective and expectation is that this very successful COSPAR-IUCr collaboration will be repeated in the near future.

Submitted by Hanna A. Dabkowska

Here some comments:

From the lecturers:

Juan Rodriguez-Carvajal, Institute Laüe-Langevin , Grenoble

Thank to all of you for the wonderful School on Crystallography for Space Sciences. It has been a remarkable meeting from all points of view. I hope to have the opportunity to see you again in a similar workshop.

David Blake, NASA:

I want to echo Juan Rodriguez-Cavarjal's comments;

I had a thoroughly good time getting to know and working with you and working with the students. The workshop was a professional undertaking throughout, but more than that, there was a very personal and human warmth that made itself felt during the two weeks. More like a meeting of friends describing their favorite things than of crystallography classes. It is especially rewarding to me that I was able to speak to and advise some of the brightest minds of the generation that will take over from us. I am grateful for having been invited, and I look forward to future opportunities like this (and seeing you all again soon).

Besides that, I have a strong urge to buy a good bottle of tequila and get my guitar out of its case.

From Chris Mavis, Natural History Museum, London, U.K

My turn to put some thoughts together, after an extensive post-workshop travel schedule. For the ones who do not know, I am not back home yet!

I would like to thank everyone for the outstanding workshop. The organizers have done a majestic job putting together an intensive - although impressive - program, and the lecturers worked hard to deliver high quality presentations on a variety of very important topics.

A special thank must be said to the students, that have worked very hard to achieve a good data interpretation: many were working on the presentations until 3am on the last nights of the workshop, this must be noted. This shows dedication and passion. And we could all admire the results.

As for me, this workshop has been a very special experience. Lots of positive energy, ideas, smiles and potential for upcoming collaborations, plus many friends made during those two weeks.

Soon I will go through the pictures and share them. I look forward to seeing all of yours as well!

Once again, thanks again for the wonderful experience, fruit of hard work from all sides!
Let's keep in touch!

From Jorge Vago, European Space Agency

Already back in the office, I would like to thank you all for one of the most enjoyable and fruitful workshops I have taken part in.

I enjoyed the lectures immensely, as I did the chance to come into contact with the various measurement techniques.

You are a very nice group of people. Thank you so much for your companionship and friendliness.

I wish you all much success in your work and hope we will have the chance to meet again sometime.

From some of the students:

Electra Kotopoulou, PhD student, Spain

Thank you once more for organizing this wonderful School that combined high-level science, top-lectures, hands-on state of the art instruments and excellent social and cultural experiences!

I would like to stress that this was the first time that a 'Crystallography in Space Science' school took place, it is a totally new subject and I hope it will be a series of tr. Schools in the future!

Amalia Escobar, Honduras

Thanks for the opportunity of being part of this wonderful school, I'm really grateful for everything. here's my presentation, ImageJ for Diffraction Patterns Analysis. Greetings to all!!

Patricia Hernández Reséndiz, Mexico

Thank you for everything! The school was amazing in all ways!

Leonardo Tamborrino, Spain

I am very glad that I have shared with you this amazing workshop experience. I really enjoyed being part of this very nice group of people: lecturers, students, organizers, panaderos. All of you are nice people and I am really happy and flattered to have met you.

The COSPAR workshop was a real opportunity to broaden our skills, our knowledge, our culture over our identities and passions. It was more than a scientific experience!

I want to express my deep gratitude with all of you for this enthusiastic experience. So enthusiastic, that I made 2000 pictures!!!

Hugo Beraldi, Mexico

Thanks for the great meeting!

Elias Nakouzi, USA

This was a fantastic workshop both from an academic and social point of view. I truly learned a lot on so many different and exciting research topics. Many thanks for your lecture as well. I also wanted to extend my gratitude to the IUCr regarding the nice gesture at the end of the workshop. I will really cherish this Crystallography dictionary book.

Ericson Lopez, Ecuador

The School was really amazing!

I would like to express my congratulations to the organizers of the School and their whole team for made possible a successful and fruitful meeting. My gratitude and recognition to the lecturers for their brilliant contributions, who made a huge effort to come to the INAOE to sharing with us their specialized knowledge, helping to promote the development of science in our countries.

This was really an unforgotten meeting in which we expend valuable time not only immersed in science, but also with our new friends sharing precious and pleasant moments.

Great organizers, great scientific director, great lecturers, great people, great venue.