Report on IAU Symposium 332
Astrochemistry VII – Through the Cosmos from Galaxies to Planets

20-24 March 2017

Puerto Varas, Chile

(i) Scientific Programme, Invited Reviewers, Session Chairs

Scientific Program

Monday 20th March 2017

Legend: K = Keynote Address; I = invited Talk; C = Contributed Talk

09:00 Ewine van Dishoeck (K) Opening Address
09:40 Manuel Aravena (K) The interstellar medium revealed by molecular line spectroscopy in high redshift galaxies
10:20 Sergio Martin (C) Ultra-luminous Extragalactic Chemistry

10:40 COFFEE/TEA

11:10 Takashi Shimonishi (C) Observations of a hot molecular core in a low metallicity dwarf galaxy
11:30 Javier Goicoechea (C) The ALMA view of UV-irradiated molecular cloud edges: unexpected structures and processes
11:50 Nanase Harada (I) High-Temperature Chemistry in External Galaxies

12:20 LUNCH

14:00 Suzanne Madden (I) Metallicity, dust and chemistry
14:30 Jonathan Tan (K) Fire from Ice – Massive Star Birth from Infrared Dark Clouds
15:10 Gary Fuller (C) Tracing the Evolution of Massive Protostars

15:30 COFFEE/TEA

16:00 Yoko Oya (C) Chemical Change in the Disk Forming Region of IRAS 16293-2422 Studied with ALMA
16:20 Al Wootten (C) A Molecular Outflow-Prestellar Core Interaction in L1689N
16:40 John Black (C) The excitation and emission spectrum of the hydrogen molecular ion
17:00 Harvey Liszt (C) The Molecular Inventory of Diffuse Clouds
17:20 Maryvonne Gerin (C) Barnard 1b: a template core for star formation and astrochemistry
17:40 Hans Zinnecker (C) Astrochemistry of light hydrides with SOFIA: some key examples

18:00 Finish
18:00 Welcome reception

Tuesday 21st March 2017

08:40 Herma Cuppen (I) Surface astrochemistry: a computational chemistry perspective
09:10 Leen Decin (I) Molecule and dust formation in late-type stars
09:40 Thomas Henning (C) Dust Formation at Cryogenic Temperatures
10:00 Rob Garrod (C) Simulations of branched carbon-chain chemistry in star-forming regions.
10:20 Els Peeters (C) The photochemical evolution of the interstellar PAH family

10:40 COFFEE/TEA

11:10 Allan Cheung (C) Laboratory astrochemistry: catalytic reactions of organic molecules over olivine-type silicates and SiC
11:30 Arnaud Belloche (I) Exploring molecular complexity in the Galactic Center with ALMA
12:00 Merel van 't Hoff (C) Imaging the water snowline in protostellar envelopes

12:20 LUNCH

14:00 Satoshi Yamamoto (K) Chemical tracers of dynamics in low-mass protostellar objects
14:40 Jes Jorgensen (C) Protostellar Interferometric Line Survey (PILS): ALMA insights into the complex chemistry of young stars
15:00 Pedro Garcia-Lario (C) Herschel Observations of Molecular Emission Lines in Low- and Intermediate-Mass Evolved Stars
15:20 Brett McGuire (C) Interstellar Reaction Screening via Microwave Spectral Taxonomy

15:40 COFFEE/TEA

16:10 Kenji Furuya (I) Isotopic fractionation in interstellar molecules
16:40 POSTERS (C)
18:20 Finish

Wednesday 22nd March 2017

08:40 Kathrin Altwegg (K) Insights into astrochemistry – highlights from the Rosetta mission
09:20 Vianney Taquet (C) On the origin of O2, N2, and other volatile species in comets
09:40 Martin Cordiner (C) ALMA observations of Titan's atmospheric chemistry and seasonal variation
10:00 Maria Drozdovskaya (C) The chemical connection between 67P/C-G and IRAS16293
10:20 Eva Wirstrom (C) Nitrogen fractionation in star-forming regions and primitive Solar System materials

10:40 COFFEE/TEA

11:10 Karin Oberg (C) Spatially resolved organic chemistry in protoplanetary disks
11:30 Ke Zhang (C) Unveiling the mid-plane temperature and mass distribution in the giant-planet formation zone

11:50 LUNCH

13:00 Conference Tour

Thursday 23rd March 2017

08:30 Ilse Cleeves (I) Zooming in on the Physics and Chemistry of Protoplanetary Disks with ALMA
09:00 Stefano Facchini (C) Different dust and gas radial extentsin protoplanetary disks: consistent models of grain growth and CO emission
09:20 Catherine Walsh (C) ALMA detection of gas-phase methanol in a planet-forming disk
09:40 Melissa McClure (C) Measuring gas masses and carbon depletion in young disks
10:00 Simon Casassus (I) Chemistry and dust in transition disks
10:30 Viviana Guzman (C) Nitrogen fractionation in protoplanetary disks from the H13CN/HC15N ratio

10:50 COFFEE/TEA

11:20 Ruud Visser (C) Models of nitrogen isotope fractionation in protoplanetary disks
11:40 Mark Hollands (C) Chemistry and evolution of the oldest white dwarf planetary systems
12:00 Mohamad Ali-Dib (C) What does the chemical composition of giant planets tells us about their formation?

12:20 LUNCH

14:00 Nikku Madhusudhan (I) Chemical Characterization of Exoplanetary Atmospheres
14:30 Stefanie Milam (I) JWST: The role of observing facilities in setting the agenda
15:00 Oscar Morata (I) ALMA Band 1 and astrochemistry

15:30 COFFEE/TEA

16:00 Pierre Cox (I) An Update on ALMA and its Science
16:30 John Carpenter (I) ALMA Capabilities in Cycle 5

17:30 POSTERS (C)
19:00 Finish

20:00 Conference Dinner

Friday 24th March 2017

08:40 Sergio Pilling (K) Processing of interstellar ices by soft X-rays and swift ions
09:20 Susanna Widicus-Weaver (C) Laboratory measurements of methanol photolysis branching ratios to guide astrochemical models
09:40 Sean Ayling (C) Acetaldehyde and carbonaceous dust: surface science experiment and theory in the context of the interstellar medium
10:00 Ilsa Cooke (C) Photodestruction of astrophysically relevant ice species: a new laboratory survey at Lyman-alpha
10:20 Lisseth Gavilan (C) Synchrotron X-ray irradiation of N-rich organics: a new pathway to Deuterium enrichment in protoplanetary disks

10:40 COFFEE/TEA

11:10 Ian Sims (I) Gas phase studies of astrochemical importance
11:40 Chris Arumainayagam (C) Photochemistry and Radiation Chemistry of Cosmic Ice Analogs of Ammonia
12:00 Ewen Campbell (I) Electronic spectroscopy of fullerene ions and the diffuse interstellar bands

12:30 LUNCH

14:00 End of Conference

Invited Keynote Speakers (40 mins):

Ewine van Dishoeck (F)
Manuel Aravena (M)
Jonathan Tan (M)
Satoshi Yamamoto (M)
Karin Altwegg (F)
Sergio Pilling (M)

Invited Speakers (30 mins):

Nanese Harada (F)
Suzanne Madden (F)
Herma Cuppen (F)
Leen Decin (F)
Arnaud Belloche (M)
Kenji Furuya (M)
Ilse Cleeves (F)
Simon Casassus (M)
Nikku Madhusudhan (M)
Stefanie Milam (F)
Oscar Morata (M)
Pierre Cox (M)
John Carpenter (M)
Ian Sims (M)
Ewen Campbell (M)

21 invited speakers, 13 male, 8 female

Session Chairs:
Monday March 20
Session 1: Pierre Cox (M)
Session 2: Paola Caselli (F)
Session 3: Monica Rubio (F)
Session 4: Maria Cunningham (F)

Tuesday March 21
Session 5: Tom Millar (M)
Session 6: Anne Dutrey (F)
Session 7: Steven Charnley (M)

Wednesday March 22
Session 8: Ted Bergin (M)
Session 9: Jes Jørgensen (M)

Thursday March 23
Session 10: Thomas Henning (M)
Session 11: Dominique Bockelée-Morvan (F)
Session 12: Satoshi Yamamoto (M)
Session 13: Hans Olofsson (M)

Friday March 24
Session 14: Karin Öberg (F)
Session 15: Farid Salama (M)

Summary: 15 session chairs, 9 male, 6 female

In addition to the keynote and invited speakers mentioned above there were 36 oral contributions (20 mins each) from 22 males and 14 females and 116 posters presented and discussed over two specially-dedicated sessions.

(ii) Scientific Highlights (1 page for IAU website)

The Symposium opened with a Keynote address from Ewine van DIshoeck (Leiden) in which she noted that astrochemistry is in a very healthy state across the world with new facilities coming on-line and new groups joining the community on a regular basis. There was, however, a need to ensure that current successes lead to future challenges that will be met by the community of astronomers, spectroscopists, chemists and physicists that undertake astrochemical research. To that end, she reviewed some recent highlights, noting the increasing complexity of molecules detected in space, the use of molecules to probe new regimes in diffuse gas, supernovae, external galaxies, protoplanetary disks (PPDs) and exoplanet atmospheres. She asked the audience to provide reasons why national agencies should invest in astrochemistry over the next 20-30 years. What are the big questions to be answered? Responses have informed her written article in the Symposium proceedings.

Manuel Aravena (Universidad Diego Portales) noted in his Keynote talk that the number of molecular lines detected in galaxies had increased by almost two orders of magnitude in the last decade and that sub-millimetre lines, particularly due to the sensitivity of ALMA, were now able to probe gas physics at redshifts up to z = 7. Sergio Martin (Joint ALMA Observatory) focused on the prototypical ULIRG, Arp 220, from which ALMA has detected thousands of lines in surveys from 86-363 GHz. Line identification and analysis is difficult due to severe line blending and self-absorption. The double nucleus, one of which may contain an AGN, has been resolved but there is no imprint of the AGN on molecular abundances, since both nuclei appear to have similar LTE abundances to within a factor of three. This is exciting for our field as it clearly opens a new astrochemical window into the early Universe.

Javier Goioechea (Madrid) spoke on the use of high spatial resolution observations of hydrides to probe the physics of photon-dominated regions. He showed the detection in the Orion Bar of cis-HCOOH which lies some 10,000K in energy higher than trans-HCOOH. He argued that this was the first astronomical evidence of a cis-trans conversion driven by fluorescence.

There were several talks and posters on low-mass star formation and Yoko Oya (Tokyo) presented an ALMA study of the rotating, infalling envelope of IRAS 16293-2422 Source A and demonstrated the power of chemistry to trace different regions of the infall, in particular the position of the centrifugal barrier at which the gas composition appears to be dominated by the evaporation products of ice mantles. This work highlights the import of ALMA for our field as the chemistry associated with protostellar collapse may be a useful tool to isolate important phases, such as the young disk. This work is still in its infancy and we can look forward to significant advances in the coming years.

The subject of ice mantles is a very active area of theoretical and experimental research worldwide and Herma Cuppen (Radboud) summarised theoretical models of surface

chemistry, in particular in relation to the formation of complex organic molecules (COMs). She argued that the formation, diffusion and reaction of the HCO radical was critical in the determination of molecular complexity in the ice and encouraged laboratory studies of this radical. Laboratory astrophysics is playing an important role in understanding surface and bulk processes in ices and the Symposium featured many talks and posters on this subject. The interaction of ices with soft X-rays was reviewed by Sergio Pilling (Vale de Paraibe) in a keynote presentation. He showed that soft X-ray irradiation of cosmic ice mixtures induced a complex chemistry that resulted in the formation of the nucleobase adenine and peptide bonds, amongst others. Susanna Widicus Weaver (Emory) described an impressive new experiment in which the photolysis products of methanol ice were detected using gas-phase millimetre and sub-millimetre spectroscopy. This opens up an exciting new way in which photodesorption yields can be measured directly and which can identify products that cannot be differentiated using conventional mass spectroscopic techniques. This is certain evidence that laboratory work is moving in directions that will continue to be central to our field.

Molecules are also important in the formation of dust grains in supernovae, circumstellar envelopes and the interstellar medium (ISM). Leen Decin (Leuven) made the long trip to Puerto Varas despite the hindrance of a full-length leg cast following knee surgery to speak about ALMA observations of the dust-forming regions of O-rich AGB stars. Here detections of species such as TiO, TiO_2, SiO, AlO and AlOH are aimed at understanding how dust precursors help nucleation and growth. Thomas Henning (Heidelberg) presented evidence from liquid He drop experiments that SiO molecules could grow to nanoscale amorphous clusters at 0.37K, giving experimental support to the hypothesis that most silicate dust must form in the ISM given its fast destruction time scale in supernovae explosions.

A significant part of the program was devoted to low-mass star formation and PPDS and Satoshi Yamamoto (Tokyo) presented a Keynote talk which showed the importance of molecules in tracing the dynamics in such regions. There were also several talks on PPDs including ways in which to determine the water snowline (Merel van't Hoff, Leiden), observations of COMs (Karin Oberg, Harvard and Catherine Walsh, Leeds), gaps and rings (Ilse Cleeves, Harvard), grain growth and dynamics (Stefano Facchini, Munich), disk masses and carbon depletion (Melissa McClure, Munich), dust in transition disks (Simon Casassus, Univ. Chile) and isotopic chemistry (Viviana Guzman, Joint Astronomy Centre and Ruud Visser, Munich). One of the highlights of this session were the amazing images from ALMA where it is clear that the chemistry associated with planet formation is slowly being revealed.

Kathrin Altwegg (Bern) presented an informative and entertaining Keynote address on the molecular 'zoo' detected by the Rosetta Mission at comet 67P/CG. Her talk covered a huge range of topics from the observation that the comet does not have a solar Xe isotopic distribution, to the conclusion that comets did not supply the Earth's water, and that its O_2 is likely inherited from interstellar ice. Our audience sat stunned at the vast array of molecules detected by Rosetta and we suspect that many are excited to take advantage of this exciting field. Vianney Taquet (Leiden) discussed the formation of O_2 in some detail and argued that the only model consistent with laboratory experiments and observations of the ISM and 67P/CG was one in which it formed at high density in ices at 15-25 K to ensure

that O atoms are mobile in the ice matrix. Maria Drozdovskeya (Bern) discussed the 67P/CG results in the context of the PILS survey of the protostar, IRAS 16293-2422 noting that methyl chloride, CH_3Cl, had been detected in both.

Nikku Madhusudhan (Cambridge) presented an in-depth review of the chemistry in exoplanet atmospheres noting that in addition to species such as H_2O and CO_2, there was evidence emerging for the presence of a more exotic chemistry. He argued that advances in observational techniques and new approaches to theoretical modelling were able to provide significant constraints on the properties of these atmospheres. He showed, as an example, that the H_2O abundance is very sensitive to the initial C/O ratio at the position in the disk at which the planet forms and that sub-solar abundances implied that planets had be scattered out and back into the disk. He concluded by noting that a major task for the exoplanetary chemistry was to develop a community similar to that current in astrochemistry. Looking forward, the chemical composition of exoplanetary atmospheres is an area where our field will continue to make contributions and we look forward to the amazing advances that will be revealed in upcoming meetings.

The programme explicitly included a number of invited talks on future facilities including the JWST (Stefanie Milam, NASA Goddard) and ALMA Band 1 (Oscar Morata, Taipei). Pierre Cox (JAO) presented some recent highlights of ALMA science, including the detection of KCl and NaCl from cryogenic volcanic ejection on Io, to observations of multiple outflows in Orion and to maps of the spiral structure in the pre-planetary nebula, LL Pegasi.

The conference finished with extensive and passionate debate following Ewen Campbell's (Basel) talk in which he argued that the C_{60}^+ ion was responsible for five of the diffuse interstellar bands with a column density in diffuse clouds similar to that of CH^+, an identification that was rejected by Jacek Krelowski (Torun) who argued that atmospheric contamination had not been effectively removed from the astronomical spectra and that non-LTE stellar lines were also blended with C_{60}^+ features.

The assembled participants were dismissed with an exhortation to 'make Astrochemistry great'.

(iii) List of participants

IAU S332 Registered Participants

Maria	Cunningham	Australia	F
Paul	Jones	Australia	M
John	Lopez	Australia	M
Chenoa	Tremblay	Australia	F
Leen	Decin	Belgium	F
Marie	Van de Sande	Belgium	F
Heloisa	Boechat	Brazil	F
Victor	de Souza Bonfim	Brazil	M
Natalia	Drake	Brazil	F
Felipe	Fantuzzi	Brazil	M
Marina	Gomes Rachid	Brazil	F
Sergio	Pilling	Brazil	M
Rafael	Pinotti	Brazil	M
Mohamad	Ali-Dib	Canada	M
Jan	Cami	Canada	M
Els	Peeters	Canada	F
Claudia	Agliozzo	Chile	F
Manuel	Aravena	Chile	M
David	Arias-Olivares	Chile	M
Leonardo	Bronfman	Chile	M
John	Carpenter	Chile	M
Simon	Casassus	Chile	M
Pierre	Cox	Chile	M
Otoniel	Denis Alpizar	Chile	M
Viviana	Guzman	Chile	F
Andrés	Guzmán	Chile	M
Jinhua	He	Chile	M
Violette	Impellizzeri	Chile	M
Natalia	Inostroza	Chile	F
Diego	Mardones	Chile	M
Sergio	Martin	Chile	M
Gautier	Mathys	Chile	M
Hugo	Messias	Chile	M
Sudeep	Neupane	Chile	M
Lars-Ake	Nyman	Chile	M
Neil	Phillips	Chile	M
Monica	Rubio	Chile	F
Lei	Zhu	Chile	M
Qiang	Chang	China	M
Jiaerken	Yeshengbieke	China	M
Jianjun	Zhou	China	M
Elizabeth	Artur de la Villarmois	Denmark	F
Hannah	Calcutt	Denmark	F
Steffen	Jacobsen	Denmark	M

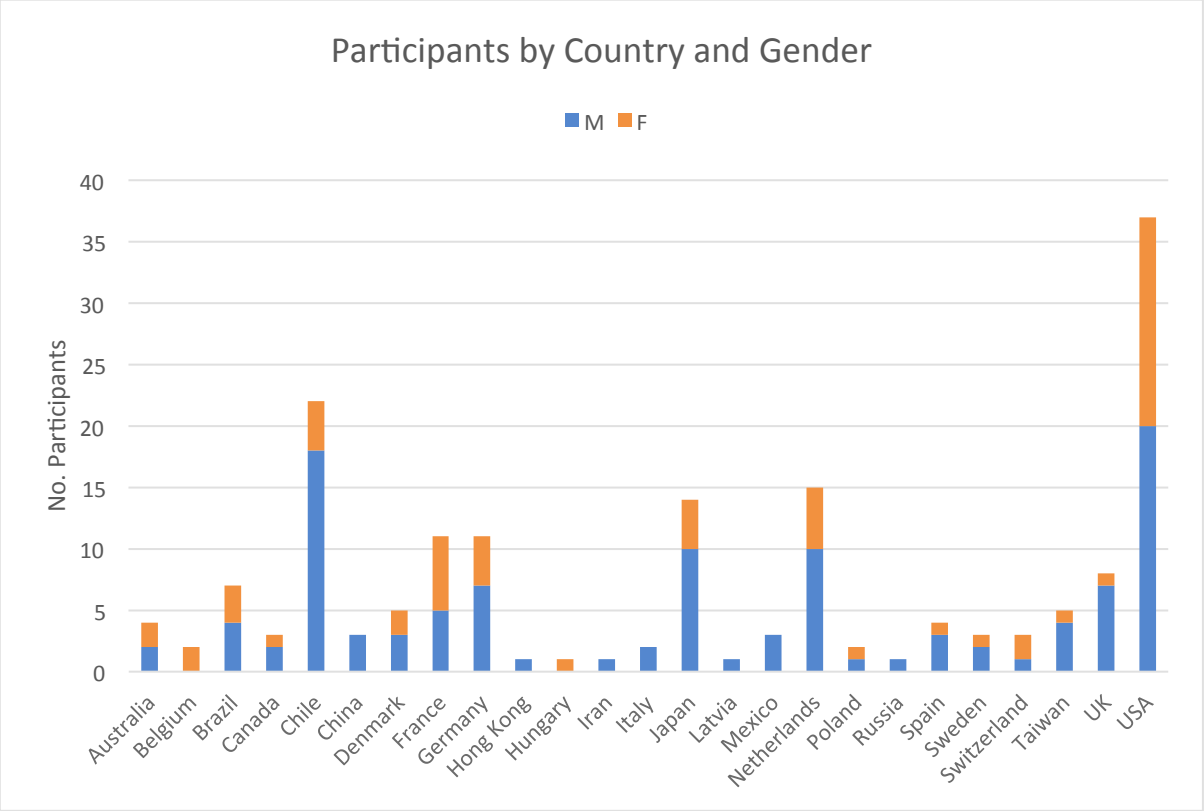
Jes	Jorgensen	Denmark	M
Lars E.	Kristensen	Denmark	M
Dominique	Bockelée	France	F
Emmanuel	Caux	France	M
Anne	DUTREY	France	F
Lisseth	Gavilan	France	F
Maryvonne	Gerin	France	F
Suzanne	Madden	France	F
Jan	Orkisz	France	M
Laurent	Pagani	France	M
Ian	Sims	France	M
Valeska	Valdivia	France	F
Thomas	Vidal	France	M
Arnaud	Belloche	Germany	M
Paola	Caselli	Germany	F
Paolo	Cazzoletti	Germany	M
Stefano	Facchini	Germany	M
Thomas	Henning	Germany	M
Melissa	McClure	Germany	F
Anna	Punanova	Germany	F
Richard	Teague	Germany	M
Ruud	Visser	Germany	M
Nadine	Wehres	Germany	F
Hans	Zinnecker	Germany	M
Allan	Cheung	Hong Kong	M
Sarolta	Zahorecz	Hungary	F
Habib	Khosroshahi	Iran	M
Roberto	Capuzzo Dolcetta	Italy	M
Victor M.	Rivilla	Italy	M
Yuji	Ebisawa	Japan	M
Kenji	Furuya	Japan	M
Satoshi	Hamano	Japan	M
Aya	Higuchi	Japan	F
Muneaki	Imai	Japan	M
Yuri	Nishimura	Japan	F
Hideko	Nomura	Japan	F
Shota	Notsu	Japan	M
Yoko	Oya	Japan	F
Takashi	Shimonishi	Japan	M
Taiki	Suzuki	Japan	M
Yoshimasa	Watanabe	Japan	M
Satoshi	Yamamoto	Japan	M
Kento	Yoshida	Japan	M
Juris	Kalvans	Latvia	M
David Enrique	Green Tripp	Mexico	M
Antonio	Hernández-Gómez	Mexico	M
Luis Fernando	Tapia Schiavon	Mexico	M
Arthur	Bosman	Netherlands	M

Tao	Chen	Netherlands	M
Ko-Ju	Chuang	Netherlands	M
Herma	Cuppen	Netherlands	F
Christian	Eistrup	Netherlands	M
Alvaro	Hacar	Netherlands	M
Niels	Ligterink	Netherlands	M
Anna	Miotello	Netherlands	F
Nadia	Murillo	Netherlands	F
Vachail	Salinas	Netherlands	M
Vianney	Taquet	Netherlands	M
Lukasz	Tychoniec	Netherlands	M
Merel	van 't Hoff	Netherlands	F
Matthijs	van der Wiel	Netherlands	M
Ewine	van Dishoeck	Netherlands	F
Agata	Karska	Poland	F
Jacek	Krelowski	Poland	M
Igor	Zinchenko	Russia	M
Pedro	García-Lario	Spain	M
Javier	Goicoechea	Spain	M
Jesus	Martin Pintado	Spain	M
Sarah	Massalkhi	Spain	F
John	Black	Sweden	M
Hans	Olofsson	Sweden	M
Eva	Wirström	Sweden	F
Kathrin	Altwegg	Switzerland	F
Ewen	Campbell	Switzerland	M
Maria	Drozdovskaya	Switzerland	F
Nanase	Harada	Taiwan	F
Tien-Hao	Hsieh	Taiwan	M
Yi-Jehng	Kuan	Taiwan	M
Xiaohu	Li	Taiwan	M
Oscar	Morata	Taiwan	M
Sean	Ayling	UK	M
Gary	Fuller	UK	M
Mark	Hollands	UK	M
Nikku	Madhusudhan	UK	M
Catherine	Walsh	UK	F
Paul	Woods	UK	M
Tom	Millar	UK	M
David	Quénard	UK	M
Dana	Anderson	USA	F
Chris	Arumainayagam	USA	M
Edwin	Bergin	USA	M
Jennifer	Bergner	USA	F
Brandon	Carroll	USA	M
Steven	Charnley	USA	M
Ilse	Cleeves	USA	F
Ilsa	Cooke	USA	F

Martin	Cordiner	USA	M
Gwenaelle	Dufour	USA	F
Edith	Fayolle	USA	F
Rob	Garrod	USA	M
Jane	Huang	USA	F
Jean	Huang	USA	F
Nick	Indriolo	USA	M
Edward	Jenkins	USA	M
Harvey	Liszt	USA	M
Ryan	Loomis	USA	M
Brett	McGuire	USA	M
Christopher	Merchantz	USA	M
Stefanie	Milam	USA	F
Karin	Öberg	USA	F
Tyler	Pauly	USA	M
Jamila	Pegues	USA	F
Ellen	Price	USA	F
Anthony	Remijan	USA	M
Thomas	Rice	USA	M
Farid	Salama	USA	M
Deborah	Schmidt	USA	F
Kamber	Schwarz	USA	F
Peter	Strittmatter	USA	M
Jonathan	Tan	USA	M
Nienke	van der Marel	USA	F
Susanna	Widicus Weaver	USA	F
Eric	Willis	USA	M
Alwyn	Wootten	USA	M
Ke	Zhang	USA	F

169 individuals attended the Symposium, 111 males and 58 females, from 25 countries, with the largest attendances from the USA (37), Chile (22), the Netherlands (15) and Japan (14). Attendance, especially from major European countries such as Spain and Italy, was disappointing. The SOC were expecting a much higher number based on previous Astrochemistry Symposia. It was clear from anecdotal evidence that the cost of travel (and travel distances involved) was prohibitive for many.

The following figure gives the attendance broken down by country and gender.



(iv) **List of Recipients of IAU Travel Grants**

The following table gives details of the 34 recipients of IAU travel grants, 14 females and 20 males, some 19 nationalities based in 16 countries. We received 52 applications (23 female) for support which were circulated to the entire SOC for comments and ranking as High, Medium, Low or None. Seven members of the SOC responded and, as there was quite a scatter amongst the responses on High and Medium we agreed, for the purposes of this exercise, to treat High and Medium equally. The resultant allocations agreed by the three senior officers of Commission H2, Tom Millar as President, Ted Bergin as Vice-President and Maria Cunningham as Secretary.

We agreed ground rules for the allocation of individual sums, as outlined in an e-mail to the AGS on 2 January 2017. In total, we offered support to 45 applicants (21 female) totalling €19,840. As is usual, a number of individuals turned down awards, most commonly because they could not find additional support; in some of these cases, such additional support was dependent on the individual making an oral presentation which we were not able to guarantee. Re-allocation of monies was agreed at each stage with the AGS.

In the end, the SOC allocated €14,400 euros to 34 individuals, with sums ranging from €300 to €680. We noted two points: (i) that offers of up to €1000 were not enough to allow several individuals from India to accept. We felt that it would be unfair to other applicants if we were to go beyond an allocation of 5% of the total funds to any one individual; (ii) we would have liked to ask some early career researchers to present invited talks. Much

excellent work is being done by such individuals and an invited talk at an IAU Symposium is a wonderful indicator of esteem on their CVs. The IAU rule that travel grants cannot be awarded to invited speakers meant that very few were able to accept since their travel funding is usually very limited.

The SOC suggest that this rule should be waived for PhD students or postdoctoral fellows invited to give review papers at IAU meetings.

IAU S332 TRAVEL GRANTS

Family Name	First name	Gender	Country	Nationality	IAU AWARD	RECEIPT
Anderson	Dana	F	USA	US	565	Y
Artur de la V	Elizabeth	F	Denmark	Argentine	575	Y
Ayling	Sean	M	UK	UK	300	Y
Bonfim	Victor	M	Brazil	Brazil	400	Y
Carroll	Paul	M	USA	US	430	Y
Chen	Tao	M	NL	China	300	Y
Chuang	Ko-Ju	M	NL	Taiwan	300	Y
Cooke	Ilsa	F	USA	New Zealans	500	Y
Drake	Natalia	F	Brazil	Russia	300	Y
Drozdovskay	Maris	F	Switzerland	Russia	300	Y
Gavilan	Lisseth	F	France	Peru	500	Y
Green	David	M	Mexico	Mexico	600	Y
Hernandez	Antonio	M	Mexico	Mexico	300	Y
Hollands	Mark	M	UK	UK	500	Y
Jacobsen	Steffen	M	Denmark	Denmark	575	Y
Kalvans	Juris	M	Latvia	Latvia	680	Y
Lopez	John	M	Australia	Australia	300	Y
Massalkhi	Sarah	F	Spain	Denmark	300	Y
McGuire	Brett	M	USA	US	420	Y
Murillo	Nadia	F	NL	Costa Rica	300	Y
Neupane	Sudeep	M	Chile	Nepali	455	Y
Orkisz	Jan	M	France	France	625	Y
Pauly	Tyler	M	USA	US	300	Y
Pinotti	Rafael	M	Brazil	Brazil	300	Y
Punanova	Anna	F	Germany	Russian	500	Y
Quenard	David	M	UK	France	300	Y
Rachid	Marina	F	Brazil	Brazil	450	Y
Rivilla	Victor	M	Italy	Spain	300	Y
Schmidt	Deborah	F	USA	US	500	Y
Teague	Richard	M	Germany	UK	300	Y
Van de Sand	Marie	F	Belgium	Belgium	500	Y
Walsh	Catherine	F	UK	UK	325	Y
Willis	Eric	M	USA	US	500	Y
Zahorecz	Sarolta	F	Hungary	Hungary	600	Y
IAU Travel Grants			**TOTAL**		**14400**	

(v) **Executive Summary (1-2 pages for IAU web site)**

Astrochemistry VII – Through the Cosmos from Galaxies to Planets was the latest in a series of IAU Symposia, held every 6 or so years, on the topic of astrochemistry, a subject that has become much more central to modern astronomy since the first IAU Symposium of its kind held in Goa in 1985. Since the last IAU Symposium on the topic, held in 2011, the release of exciting new results from facilities such as Herschel, ALMA, NOEMA, SOFIA and Rosetta have challenged our understanding of the physical and chemical processes at work in objects such as comets, diffuse clouds, high- and low-mass star forming regions and circumstellar envelopes. The promise of new observatories such as the JWST, the SKA and the E-ELT made this an opportune time to review the field and to plan for the future. The Symposium was sponsored by Divisions H, B and F and Commissions H2, B5 and F3.

In this context, and given the huge amount of data available from ALMA, it seemed appropriate to hold *Astrochemistry VII* in Chile, in the beautiful lakeside resort of Puerto Varas. The conference venue was the Hotel Cumbres which provided a high level of service for both the scientific discussions and the social aspects of the meeting.

The scientific discussions were divided between nine major thematic areas:

1) astrochemistry at high redshifts,
2) astrochemistry in extreme regions,
3) interstellar dust,
4) molecular clouds,
5) protoplanetary disks,
6) exoplanets and solar system objects
7) observing facilities,
8) laboratory astrophysics, and
9) hot topics.

To aid discussion, the SOC identified 6 Keynote and 15 Invited speakers, (13 males and 8 females).

The Scientific Organising Committee (SOC) reviewed and scored all submitted abstracts and selected a further 36 oral contributions, taking into account scientific impact, gender, geographical distribution and stage of career. Keynotes were allocated 40 mins, invited reviews 30 mins and oral contributions 20 mins, including discussion time. 116 poster presentations were also accepted. In total, 169 individuals, 111 males and 58 females, from 25 countries attended with the USA (37) and Chile (22) registering the highest numbers of participants. Individual sessions were chaired by members of the SOC and other senior attendees whilst a variety of PDRAs and PhD students supported the logistics throughout the sessions.

The 116 posters were divided into two sessions on Tuesday and Thursday, lasting 90 and 100 mins respectively, and a small group awarded prizes to 6 individuals, three from each session. The winners were Ko-Ju Chuang (Leiden), Anna Miotello (Leiden), Victor Rivilla (Arcetri), Richard Teague (Munich), Marie van de Sande (Leuven) and Merel van't Hoff (Leiden).

John Carpenter (JAO, Santiago) held a very popular session on ALMA in which he outlined its new capabilities and gave advice on proposal writing and ALMA tools. Ewine van Dishoeck (Leiden) also made a special presentation on 'Women in Astronomy', summarising the results of the recent IAU survey on this topic. She encouraged participants to contact her with any ideas on how the IAU could grow the number of its female members.

The Symposium proceedings, edited by Maria Cunningham, Yuri Aikawa and Tom Millar, are to be published by Cambridge University Press.

In addition to the scientific sessions, the attendees enjoyed a welcome reception on Monday 20 March and a bus tour on Wednesday 22 March to the Vicente Pérez Rosales National Park with a stop at the Saltos del Petrohué waterfalls and a boat trip on the Lago de Todos los Santos. The conference dinner was held at the Hotel Dreams de los Volcanes on Thursday 23 March, after which the SOC Chair, Tom Millar, gave – in his own words – 'a short, witty and erudite after-dinner speech on astrochemistry' and presented prizes to the poster competition winners and a token of the SOC's appreciation to Melissa McClure (ESO) for her wonderful design of the conference poster.

The organisers would like to thank a number of institutions for providing organisational and financial support: in particular, the IAU for the award of travel grants to 34 participants, 20 males and 14 females, some 19 nationalities based in 16 countries; NRAO; ALMA; ESO; Queen's University Belfast; the University of New South Wales; the Universidad de Chile, and the journal, Molecular Astrophysics.

The Local Organising Committee, which was ably chaired by Gautier Mathys, who brought his organisational skills and experience to this key role, comprised of Natalia Inostroza, Diego Mardones, Sergio Martin, Lars Nyman, Ann Edmunds, Maria Gomez, Paulina Jirón and Ursala Throm. They performed their duties both before and during the Symposium in a highly effective manner and the fact that the Symposium ran so smoothly is a testament to their professional approach and to the fact that many of the LOC remained on site throughout the duration of the meeting to ensure attendees had a stress-free experience.

Ted Bergin, Maria Cunningham and Tom Millar, as Co-Chairs, were greatly aided in their duties by the other members of the SOC: Susanna Aalto, Yuri Aikawa, Jacob Bean, Dominique Bockelée-Morvan, Paola Caselli, Pierre Cox, Jes Jørgensen, Sun Kwok, Farid Salama, Stephan Schlemmer and Satoshi Yamamoto.

Ted Bergin, Maria Cunningham, Tom Millar
(Co-Chairs, IAU S332)