220th AAS Meeting – Anchorage, AK June, 2012

AAS Summer Meeting Abstracts – LAD Posters Only

- 208 – Laboratory & Astrophysics: Atoms
- 209 – Laboratory & Astrophysics: Molecules
- 210 – Laboratory & Astrophysics: Dust & Ice
- 211 – Laboratory & Astrophysics: Plasma
- 212 – Laboratory & Astrophysics: Planetary

208 – Laboratory & Astrophysics: Atoms

Poster Session – Exhibit Hall, Dena'ina Center – 6/11/2012 9:00:00 AM to 6/14/2012 2:00:00 PM

208.01 – **Electron Impact Excitation Of Ti XIX**

Kanti M. Aggarwal[1], F. P. Keenan[1]

[1]Queen's University Belfast, United Kingdom.

9:00 AM - 6:30 PM

Emission lines of Ti XIX are important for the modeling and diagnostics of lasing, fusion and astrophysical plasmas, for which atomic data are required for a variety of parameters, such as energy levels, radiative rates (A- values), and excitation rates or equivalently the effective collision strengths (Y), which are obtained from the electron impact collision strengths (Ω). Experimentally, energy levels are available for Ti XIX on the NIST website, but there is paucity for accurate collisional atomic data. Therefore, here we report a complete set of results (namely energy levels, radiative rates, and effective collision strengths) for all transitions among the lowest 98 levels of Ti XIX. These levels belong to the (1s2) 2s2, 2s2p, 2p2, 2s3l, 2p3l, 2s4l, and 2p4l configurations. Finally, we also report the A- values for four types of transitions, namely electric dipole (E1), electric quadrupole (E2), magnetic dipole (M1), and magnetic quadrupole (M2), because these are also required for plasma modeling. For our calculations of wavefunctions, we have adopted the fully relativistic GRASP code, and for the calculations of Ω, the Dirac atomic R-matrix code (DARC) of PH Norrington and IP Grant. Additionally, parallel calculations have also been performed with the Flexible Atomic Code (FAC) of Gu, so that all atomic parameters can be rigorously assessed for accuracy.

208.02 – **Recent Developments with the CHIANTI Atomic Database for Astrophysical Spectroscopy**

Kenneth P. Dere[1]

[1]George Mason Univ..

9:00 AM - 6:30 PM

The CHIANTI atomic database for astrophysical spectroscopy maintains an assessed set of atomic data that are necessary to calculate emission from ionized plasmas that exist throughout the universe. As new atomic data becomes available, it is added to the CHIANTI database in order to improve the accuracy of data already in the database, to extend the range of spectral lines that can be reproduced or to develop new ions that are not already in the database.

Version 7 of the database was recently released (Landi et al., 2012). This included several new ions and a wide range of updated ions. A Python interface to CHIANTI, ChiantiPy, was developed to complement the existing IDL interface. A web application, based on ChiantiPy, was also developed that allows the user to make spectral calculations using the Chianti database directly from a web browser.

Version 7.1 is expected to be released in 2012 and is expected to include updated atomic data for existing ions and the develop of new ions. Ionization equilibria will be updated based on new calculations of dielectronic recombination for some isoelectronic sequences.

208.03 – **Recent Advances In The Spectral Simulation Code Cloudy**

Gary J. Ferland[1]

[1]Univ. of Kentucky.

9:00 AM - 6:30 PM

The spectral simulation code Cloudy is under constant development. I will outline recent improvements in the atomic, molecular, and grain physics, and discuss applications to cool core cluster filaments and star forming regions.

208.04 – **Radiative Rates for Forbidden Transitions in Doubly-Ionized Fe-Peak Elements**

Vanessa Fivet[1], P. Quinet[2], M. Bautista[1]

[1]Western Michigan University, [2]Université de Mons - UMONS, Belgium.

9:00 AM - 6:30 PM

Accurate and reliable atomic data for lowly-ionized Fe-peak species (Sc, Ti, V, Cr, Mn, Fe, Co, Ni and Cu) are of paramount importance for the analysis of the high resolution astrophysical spectra currently available. The third spectra of several iron group elements have been observed in different galactic sources like Herbig-Haro objects in the Orion Nebula [1] and stars like Eta Carinae [2]. However, forbidden transitions between low-lying metastable levels of doubly-ionized iron-peak ions have been very little investigated so far and radiative rates for those lines remain sparse or inexistent.

We are carrying out a systematic study of the electronic structure of doubly-ionized iron-peak elements. The magnetic dipole (M1) and electric quadrupole (E2) transition probabilities are computed using the pseudo-relativistic Hartree-Fock (HFR) code of Cowan [3] and the central Thomas-Fermi-Dirac potential approximation implemented in AUTOSTRUCTURE [4]. This multi-platform approach allows for consistency checks and intercomparison and has proven very successful in the study of the complex Fe-peak species where many different effects contribute [5].

References

[1] A. Mesa-Delgado et al., MNRAS 395 (2009) 855

[2] S. Johansson et al., A&A 361 (2000) 977

[3] R.D. Cowan, The Theory of Atomic Structure and Spectra, Berkeley: Univ. California Press (1981)

[4] N.R. Badnell, J. Phys. B: At. Mol. Opt. Phys. 30 (1997) 1

[5] M. Bautista et al., ApJ 718 (2010) L189

208.05 – **Eta Carinae and the Homunculus: an Astrophysical Laboratory**

Theodore R. Gull[1], H. Hartman[2], M. A. Bautista[3]

[1]NASA/GSFC, [2]Lund University & Malmo University, Sweden, [3]Western Michigan University.

9:00 AM - 6:30 PM

Today Eta Carinae, from the 1840s Great Eruption, is surrounded by a 20", neutral, dusty bipolar shell with intervening skirt, containing 12-40 solar masses of N-rich, C- and O-poor ejecta. The ionized Little Homunculus, ejected in the 1890s, expands within. At the core are a massive extended interacting wind structure and the bright Weigelt blobs, that change between a low-ionization (<7.8 eV) to a high-ionization state (>40 eV) driven by the 5.5-year massive binary.

Thousands of narrow emission and absorption lines originate from a variety of regions: 1) the Weigelt blobs and the extended wind structures; 2) the Strontium Filament, a unique photoioionized metal nebula dominated by TiII, VII, SrII, ScII, CaII, MnII, CrII and FeI, but no HI; 3) the ionized Little Homunculus; and 4) the Homunculus seen in nearly a thousand atomic absorption lines in high and low states, but a thousand H2 absorptions only seen in the high state. Ionized iron-peak elements co-exist with CH, OH, NH and H2. This system is an excellent laboratory for the study of many iron-peak species from neutral to doubly-ionized states. The variations of incident radiation allow us to study atomic processes and derive atomic data not available from terrestrial laboratories, making Eta Carinae an astrophysical laboratory in its true sense.

Moreover, the Homunculus, as inventoried by Herschel spectral scans, is dominated by N-bearing molecules. While C and O are depleted nearly 100-fold, due to CNO-nuclear reactions coupled with high conduction in the massive stellar cores, dust and molecules have still formed. How? Is the Homunculus dust metallic in character? Silicates and alumina? Could the formed dust also contribute to the C,O-depletions? Through multiple studies we are gaining clues on the robustness of molecular and dust formations.

208.06 – **Storage Ring Measurements of Electron Impact Ionization for Calculations of Plasma Charge State Distributions**

Michael Hahn[1], A. Becker[2], D. Bernhardt[3], M. Grieser[2], C. Krantz[2], M. Lestinsky[4], A. Müller[3], O. Novotný[1], R. Repnow[2], S. Schippers[3], K. Spruck[3], A. Wolf[2], D. W. Savin[1]

[1]*Columbia University,* [2]*Max-Planck-Institut für Kernphysik, Germany,* [3]*Justus-Liebig-Universität Giessen, Germany,* [4]*GSI Helmholtzzentrum für Schwerionenforschung, Germany.*

9:00 AM - 6:30 PM

Knowledge of the charge state distribution (CSD) of astrophysical plasmas is important for the interpretation of spectroscopic data. Reliable electron impact ionization (EII) cross sections are needed to calculate accurate CSDs for electron ionized objects such as stars, supernovae, galaxies, and clusters of galaxies. We are studying EII for astrophysically important ions using the TSR storage ring located at the Max Planck Institute for Nuclear Physics in Heidelberg, Germany. Storage ring measurements are largely free of the metastable contamination found in other experimental geometries, resulting in unambiguous EII cross section data. We have found discrepancies of 10% - 30% between the measured cross sections and those commonly used in CSD models. Because it is impractical to perform experimental measurements for every astrophysically relevant ion, theory must provide the bulk of the needed EII data. These experimental results provide an essential benchmark for such EII calculations.

208.07 – **Near-UV Atomic Line Identifications in Metal-Poor Solar-Type Stars**

Ruth Peterson[1]

[1]*Astrophysical Advances.*

9:00 AM - 6:30 PM

This poster illustrates the extent to which laboratory identifications are still needed for lines that appear in near-UV spectra, from 1900A to 3000A, of moderately metal-poor stars at and below the solar temperature. The plots compare observed high-resolution spectra of such stars to calculations from first principles. Input line parameters are based on the updated Kurucz (2011, Can. J. Phys., 89, 417) line lists, after modifying gf-values and damping constants of the identified lines to match stellar spectra over a wide variety of line strengths. Identifications and line parameters were guessed for features without identifications, designated with colons, that nonetheless appear in the spectra. Peterson (2011, ApJ, 742, 21) provides further details and recent examples for the 2000A region.

208.08 – **Radiative and Collision Atomic Parameters for N-like ions**

Swaraj S. Tayal[1]

[1]*Clark Atlanta Univ..*

9:00 AM - 6:30 PM

The improved radiative and collision atomic parameters calculations for nitrogen like Mg VI and Si VIII ions have been performed using the B-spline Breit-Pauli R-matrix method. The flexible non-orthogonal sets of spectroscopic and correlation radial functions are employed for an accurate representation of the target states and scattering functions. The close-coupling expansion includes 74 bound levels of Mg VI and Si VIII covering all possible terms of the ground $2s^22p^3$ and excited $2s2p^4$, $2p^5$, $2s^22p^23s$, $2s^22p^23p$, and $2s^22p^23d$ configurations. The calculated excitation energies of the target levels are in excellent agreement with experiment and represent an improvement over the previous calculations. The present results of cross sections are compared with a variety of other close-coupling and distorted-wave calculations. The oscillator strengths and transition probabilities for several transitions are in good agreement with other theories and available experimental data. The present cross sections are in good agreement with other theories for many transitions, but some differences in magnitude and shape for some other transitions are also noted. These data should be useful to interpret the recent ground and space-based observations and to model the solar and other astrophysical plasmas.

---

209 – Laboratory & Astrophysics: Molecules

Poster Session – Exhibit Hall, Dena'ina Center – 6/11/2012 9:00:00 AM to 6/14/2012 2:00:00 PM

209.01 – **The ORGANIC Experiment on EXPOSE-R on the ISS: A Space Exposure Experiment**

Kathryn Bryson[1], Z. Peeters[2], F. Salama[3], B. Foing[4], P. Ehrenfreund[5], A. J. Ricco[3], E. Jessberger[6], A. Bischoff[6], M. Breitfellner[7], W. Schmidt[8], F. Robert[9]

[1]*Bay Area Environmental Research Insitute,* [2]*Carnegie Institute of Washington,* [3]*NASA Ames Research Center,* [4]*European Space Agency, ESTEC, Netherlands,* [5]*Leiden Institute of Chemistry, Netherlands,* [6]*Westfälische Wilhelms-Universität, Germany,* [7]*European Space Astronomy Centre, Spain,* [8]*PAH Research Institute, Germany,* [9]*Laboratoire de Minéralogie et Cosmochimie du Muséum, France.*

9:00 AM - 6:30 PM

Aromatic networks are among the most abundant organic material in space. PAHs and fullerenes have been identified in meteorites and are thought to be among the carriers for numerous astronomical absorption and emission features. Thin films of selected PAHs and fullerenes have been subjected to the low Earth orbit environment as part of the ORGANIC experiment on the multi-user facility EXPOSE-R onboard the International Space Station. The ORGANIC experiment monitored the chemical evolution, survival, destruction, and chemical modification of the samples in space environment. EXPOSE-R with its experiment inserts was mounted on the outside of the ISS from March 10, 2009 to January 21, 2011. The samples were returned to Earth and inspected in spring 2011. The 682-day period outside the ISS provided continuous exposure to the cosmic-, solar-, and trapped-particle radiation background and >2500 h of unshadowed solar illumination. All trays carry both solar-irradiation-exposed and dark samples shielded from the UV photons, enabling discrimination between the effects of exposure to solar photons and cosmic rays.

The samples were analyzed before exposure to the space environment with UV-VIS spectroscopy. Ground truth monitoring of additional sample carriers was performed through UV-VIS spectroscopy at regular intervals at NASA Ames Research Center. During the exposure on the ISS, two control sample carriers were exposed with a slight time shift in a planetary simulation chamber at the Microgravity User Support Center (MUSC) at DLR. Vacuum, UV radiation, and temperature fluctuations are simulated according to the telemetry data measured during flight. The spectroscopic measurements of these two carriers have been performed together with the returned flight samples.

We report on the scientific experiment, the details of the ground control analysis, and preliminary flight sample results. We discuss how extended space exposure experiments allow to enhance our knowledge on the evolution of organic compounds in space.

209.02 – **High Resolution Laboratory Studies for**

Astronomical Spectroscopy

Harshal Gupta[1], L. R. Brown[1], B. J. Drouin[1], C. E. Miller[1], J. C. Pearson[1], K. Sung[1], S. Yu[1]
[1]*Jet Propulsion Laboratory, California Institute of Technology.*

9:00 AM - 6:30 PM

Understanding astronomical observations of molecules requires detailed spectroscopic data that can only be derived from laboratory studies. These data, including accurate transition frequencies, intensities, broadening coefficients, and collisional rates are essential for the proper characterization of the physics, chemistry, and dynamics of astronomical sources. Equally important is the comprehensive spectroscopic characterization of astronomical molecules in multiple wavelength regions. A strong effort is in place in the JPL Molecular Spectroscopy Group to provide fundamental knowledge to support ground-, aircraft-, and space-based astronomical spectroscopy. A synopsis of the high-resolution laboratory spectroscopy of astronomical molecules at JPL is presented, highlighting benchmark studies that span wavelengths from the radio to the optical. The systems under study include molecules that are ubiquitous in the interstellar medium and/or exoplanetary atmospheres (CH_4, CO_2, H_2O, and NH_3), as well as ones that have recently been shown to be important constituents of the interstellar gas (O_2, CH_3OH, H_3O^+, and HCl^+).

209.03 – **Oscillator Strengths and Predissociation Rates for $^{12}C^{16}O$ Bands between 92.9 and 93.4 nm**

Steven Robert Federman[1], M. Eidelsberg[2], J. L. Lemaire[2], G. Stark[3], A. N. Heays[3], L. Gavilan[2], J. Fillion[4], F. Rostas[2], J. R. Lyons[5], P. L. Smith[3], N. de Oliveira[6], D. Joyeux[6], M. Roudjane[6], L. Nahon[6]
[1]*Univ. of Toledo,* [2]*Observatoire de Paris, France,* [3]*Wellesley,* [4]*Univ. PVI UMPC, France,* [5]*UCLA,* [6]*Synchrotron SOLEIL, France.*

9:00 AM - 6:30 PM

We are conducting experiments on the DESIRS beam-line at the SOLEIL Synchrotron (Saint Aubin, France) to acquire the necessary data on oscillator strengths and predissociation rates for modeling CO photochemistry in astronomical environments. In particular, models of diffuse clouds, photon dominated regions associated with molecular clouds, circumstellar disks around newly-formed stars, and circumstellar envelopes surrounding evolved stars require this input. A VUV Fourier Transform Spectrometer provides a resolving power of about 350,000, allowing us to discern individual lines in electronic transitions. Here we focus on results for six overlapping bands between 92.9 and 93.4 nm seen in spectra of $^{12}C^{16}O$ and compare them with earlier determinations. Absorption from the ground electronic level, $X\ ^1\Sigma^+\ v'' = 0$, to the upper levels 4pπ(2), II $^1\Pi$, 4pσ(2), 5pπ(0), 5pσ(0), and I $^1\Pi$ was analyzed. Our results are the first to provide data on each band. The spectra also reveal a continuum feature that was synthesized, but its identification is not known at the present time.

209.04 – **A Novel Apparatus To Study Interstellar Organic Chemistry**

Aodh O Connor[1], K. A. Miller[1], J. Stützel[1], X. Urbain[2], E. F. McCormack[3], D. W. Savin[1]
[1]*Columbia University,* [2]*Université catholique de Louvain, Belgium,* [3]*Bryn Mawr College.*

9:00 AM - 6:30 PM

We have developed a new apparatus to study interstellar organic chemistry. Our focus is on ion-neutral reactions, a class of reactions which drives most of the gas-phase chemistry in the interstellar medium. The proof-of-principle measurement is $C + H_3^+ \rightarrow CH^+ + H_2$ which is believed to be a bottleneck in the gas phase chemistry leading to the formation of complex organic molecules in interstellar clouds. Previous experiments have been hampered by the difficulty in producing a sufficiently intense and well characterized beam of neutral atomic carbon. Theory provides little insight as fully quantum mechanical calculations, for four or more atom systems, are beyond current computational capabilities. Experimental reaction studies are thus required as a basis for astrochemical models and to provide benchmarks for future theoretical development. Our apparatus consists of a negative ion sputter source combined with a mass filter to generate a 30 keV C^- beam. Using an 808-nm laser (1.53 eV), we neutralize ~10% of the beam via photodetachment. The remaining C^- is electrostatically removed, yielding a well defined ground term atomic C beam. This beam is then merged with a velocity matched H_3^+ ion beam generated by a duoplasmatron ion source. As the beams are co-propagating this enables study of reactions for center-of-mass energies from tens of meV (~ 100 K) to tens of eV. Reaction channels are studied using an energy analyzer to separate the charged end products which are detected on a channel electron multiplier. Here we will report progress in the apparatus development and preliminary results. This work was supported in part by the NSF Division of Astronomical Sciences.

209.05 – **From the Laboratory to Space: Neutral and Ionized PAHs in Translucent Interstellar Clouds**

Farid Salama[1], G. Galazutdinov[2], L. Biennier[3], J. Krelowski[4]
[1]*NASA Ames Research Center,* [2]*Instituto de Astronomia, Universidad Catolica del Norte, Chile,* [3]*Institut de Physique de Rennes, UMR 6251 du CNRS, France,* [4]*Center for Astronomy, Nicolaus Copernicus University, Poland.*

9:00 AM - 6:30 PM

We describe and discuss the laboratory experiments that were designed to test the proposal of relating the origin of some of the diffuse interstellar bands (DIBs) to neutral and ionized polycyclic aromatic hydrocarbons (PAHs) present in diffuse interstellar clouds. The spectra of several cold, isolated gas-phase PAH ions and neutral molecules have been measured using the COSmIC laboratory facility at NASA-Ames and are compared with an extensive set of astronomical spectra of reddened, early type stars. The COSmIC facility combines a supersonic free jet expansion with discharge plasma and high-sensitivity cavity ringdown spectroscopy to provide experimental conditions that closely mimic the interstellar conditions. This comparison provides - for the first time - accurate upper limits for the abundances of specific PAH molecules and ions along specific lines-of-sight. Something that is not attainable from infrared observations alone. The comparison of these unique laboratory data with high resolution, high S/N ratio astronomical observations leads to major findings regarding the column densities of the individual PAH molecules and ions that are probed in this survey and leads to clear and unambiguous conclusions regarding the expected abundances for PAHs of various sizes and charge states in these environments. This quantitative survey of neutral and ionized PAHs in the optical range opens the way for unambiguous quantitative searches of PAHs and complex organics in a variety of interstellar and circumstellar environments.

Acknowledgements: F.S. acknowledges the support of the NASA's Space Mission Directorate APRA Program. The authors are deeply grateful to the ESO archive as well as to the ESO staff members for their active support.

209.06 – **Measurements of the Associative Detachment Reaction $H^- + H \rightarrow H_2 + e^-$ for Modeling Protogalaxy and First Star Formation in the Early Universe**

Daniel Wolf Savin[1], K. A. Miller[1], H. Bruhns[1], H. Kreckel[1], X.

Urbain[2], J. Eliášek[3], M. Čížek[3]
[1]Columbia Astrophysics Lab., [2]Universié catholiuqe de Louvain, Belgium, [3]Charles University, Czech Republic.

9:00 AM - 6:30 PM

Molecular hydrogen plays a central role in the cooling and formation of protogalaxies and first stars in the early universe. The dominant H_2 formation mechanism during this epoch is the associative detachment (AD) reaction $H^- + H \rightarrow H_2 + e^-$. Previously published values for this process differ by almost an order of magnitude. These uncertainties hinder our ability to reliably model this epoch of the universe, limiting our ability to understand the formation of protogalaxies, the characteristic masses of the first stars, and the cooling times for formation of the first stars. We have developed a novel merged-beams apparatus to measure, for the first time, the energy resolved cross section for this reaction. Beginning with an H^- beam, we use an infrared laser to convert ~ 10% of the beam into ground state H via photodetachment. This generates a self-merged, anion-neutral beams arrangement. Laboratory energies are in the keV range; but because the beams co-propagate, center-of-mass energies from the meV to keV range are achievable. We have measured the cross section for energies from 3.7 meV to 4.8 eV. Our results confirm recent non-local calculations but are not in agreement with other previously published theoretical results or with published flowing afterglow measurements. This work was supported in part by the NSF Divisions of Chemistry and Astronomical Sciences.

209.07 – Dissociative Recombination of Astrophysically Relevant Polyatomic Ions

Julia Stuetzel[1], O. Novotný[1], H. Buhr[2], W. Geppert[3], M. Hamberg[3], C. Krantz[4], M. Mendes[4], A. Petrignani[4], D. Schwalm[2], A. Wolf[4], D. W. Savin[1]
[1]Columbia University, [2]Weizmann Institute of Science, Israel, [3]Stockholm University, Sweden, [4]Max Planck Institute for Nuclear Physics, Germany.

9:00 AM - 6:30 PM

Dissociative recombination (DR) of molecular ions is a key mechanism driving changes in the charge density and composition of the cold interstellar medium (ISM). In order to understand the ISM chemical network, astrochemists need total DR cross sections as well as the chemical composition and excitation states of the neutral products. Theoretical methods have not yet advanced to the point where they can reliably generate the reams of DR data required. For many polyatomic ions, experimentally investigating the DR process is the only way to gain reliable data. We have carried out DR measurements of polyatomic molecular ions utilizing the TSR storage ring at the Max-Planck-Institute for Nuclear Physics in Heidelberg, Germany. The application of a merged ion-electron beams technique, in combination with an energy- and position-sensitive imaging detector, allows for absolute rate coefficient measurements from the DR fragment count rates. Moreover, measuring the kinetic energies of the fragments of an individual breakup yields the mass identification of the neutrals and therefore the fragmentation channel for each DR event. The fragment distances on the imaging detector provide information on the reaction kinematics as well as on the initial and final excitations. Such combined information is essential for DR studies of polyatomic ions that imply multi-channel, multi-fragment breakups. We report recent DR results on D_3O^+, $DCND^+$ and D_2Cl^+. This work is supported in part by the NSF Astronomy and Astrophysics Grand Program, the NASA Astrophysics Research Analysis Program, the Max-Planck Society, and the German-Israeli Foundation for Scientific Research and Development.

---

210 – Laboratory & Astrophysics: Dust & Ice

Poster Session – Exhibit Hall, Dena'ina Center – 6/11/2012 9:00:00 AM to 6/14/2012 2:00:00 PM

210.01 – The Effects Of Methanol On The Trapping Of Volatile Ice Components

Wendy Brown[1], D. Burke[1]
[1]University College London, United Kingdom.

9:00 AM - 6:30 PM

Icy mantle evaporation gives the rich chemistry observed around hot cores. Water ice is the dominant component of many astrophysical ices and this has motivated studies to identify the sublimation of volatile ice components when water-rich ices are heated. Most investigations focus on binary ices, with water as the main component. To understand thermal processing of real astrophysical ices, the current laboratory definition of these ices needs to be extended. Methanol is important in this regard, due to its close association with water. It is typically the second most abundant species and the most abundant organic molecule detected in cometary comae, interstellar ices and on a variety of bodies at the edge of our solar system. Methanol abundance varies depending on the environment, ranging from as low as 5% with respect to water in dark clouds, to approximately 30% near low and high mass proto-stars. With this in mind, we present an investigation of the adsorption and desorption of interstellar ices, showing the effect of methanol on the trapping and release of volatiles from water-rich ices. OCS and CO2 are used as probe molecules since they reside in water and methanol-rich environments.

Experiments show that OCS thermal desorption depends on ice morphology and composition. Data suggest that OCS is incorporated into amorphous water ice during heating, as a result of morphological changes in the ice, and it then explosively desorbs as the water crystallises. Similar effects are observed for OCS deposited on/within methanol ice. In contrast, OCS desorption from mixed water/methanol ices is complex. Desorption occurs at the onset of methanol desorption, in addition to co-desorption with crystalline water. Hence co-depositing impurities, e.g. methanol, with water ice significantly alters the desorption dynamics of volatiles. These results are of interest as they can be used to model star formation.

210.02 – LASSIE - Laboratory Astrochemical Surface Science in Europe

Wendy Brown[1]
[1]University College London, United Kingdom.

9:00 AM - 6:30 PM

Understanding solid state and surface chemical processes is becoming increasingly important in astrochemistry. The role of solids and surfaces in synthesising small molecules is without doubt as is their role in creating the chemical complexity from which the potential for life can spring. LASSIE (Laboratory Astrochemical Surface Science in Europe ; http://www.lassie-itn.eu) is a large training network funded by the European Commission tasked with investigating as widely as possible the role of solids and surfaces in a range of astrophysical environments. This poster will describe the membership of LASSIE, it’s scientific goals and it’s training role in Europe.

210.03 – Sublimation and Irradiation of Glycolaldehyde/Water Ices

Daren Burke[1], W. A. Brown[1], S. Viti[1], P. M. Woods[1], B. Slater[1]
[1]University College London, United Kingdom.

9:00 AM - 6:30 PM

There is currently great interest among astronomers and astrobiologists in the inventory of organic molecules in space, in particular in star and planet-forming regions. Observations towards the Galactic Centre have revealed a rich and complex chemistry, from simple organic molecules such as methane (CH_4) and methanol (CH_3OH) to the recent detection of ethyl formate (C_2H_5OCHO) and n-propyl cyanide (C_3H_7CN). Amongst the most important organic species detected in space is glycolaldehyde (CH_2OHCHO), an isomer of methyl formate ($HCOOCH_3$) and acetic acid (CH_3COOH). Glycolaldehyde is the simplest of the monosaccharide sugars and it reacts with propenal to form ribose, a central constituent of RNA. As a consequence, it is thought that glycolaldehyde may have a role in the origins of life in our universe.

We present a detailed investigation of the adsorption and desorption of glycolaldehyde and methyl formate using temperature programmed desorption (TPD) and reflection absorption infrared spectroscopy (RAIRS) under ultra-high vacuum. The sublimation of glycolaldehyde/water and methyl formate/water containing ices from a model carbonaceous grain surface (graphite) will be presented, along with kinetic parameters for desorption (such as the binding energy, order of desorption and desorption pre-exponential factor) derived from analysis of TPD. These experimental parameters will be incorporated into astronomical models of star-forming regions.

Additional experiments investigating the stability of glycolaldehyde/water containing ices to electron/UV irradiation will also be discussed. Electron irradiation (simulating the effect of cosmic ray ionisation, which produces electrons) and UV irradiation (over a range of wavelengths) is used to examine competing routes for non-thermal desorption, decomposition and formation. RAIRS and TPD will be used to identify any reaction products and to monitor the desorption/decomposition of glycolaldehyde as a function of irradiation time.

This work forms part of a larger project, incorporating experiment, theory and astrochemical modelling, to investigate the formation of glycolaldehyde in space.

210.04 – **Laboratory Studies of the Formation of Carbonaceous Cosmic Dust from PAH Precursors**

Farid Salama[1], C. S. Contreras[1]

[1] *NASA Ames Research Center.*

9:00 AM - 6:30 PM

The study of the formation and destruction processes of cosmic dust is essential to understand and to quantify the budget of extraterrestrial organic molecules. Although dust with all its components plays an important role in the evolution of interstellar chemistry and in the formation of organic molecules, little is known on the formation and destruction processes of carbonaceous dust. PAHs are important chemical building blocks of interstellar dust. They are detected in interplanetary dust particles and in meteoritic samples and are an important, ubiquitous component of the interstellar medium. The formation of PAHs from smaller molecules has not been extensively studied. Therefore, it is imperative that laboratory experiments be conducted to study the dynamic processes of carbon grain formation from PAH precursors. Studies of interstellar dust analogs formed from a variety of PAH and hydrocarbon precursors as well as species that include O, N, and S, have recently been performed using the COSmIC facility in our laboratory under conditions that simulate interstellar and circumstellar environments. The species formed in the pulsed discharge nozzle (PDN) plasma source are detected and characterized with high-sensitivity cavity ringdown spectroscopy coupled to a Reflectron time-of-flight mass spectrometer (ReTOF-MS), thus providing both spectroscopic and ion mass information in-situ. We report the measurements obtained in these experiments. Studies with hydrocarbon precursors show the feasibility of specific molecules to form PAHs, while studies with carbon ring systems (benzene and derivatives, PAHs) precursors provide information on pathways toward larger carbonaceous molecules. From these unique measurements, we derive information on the size and the structure of interstellar dust grain particles, the growth and the destruction processes of interstellar dust and the resulting budget of extraterrestrial organic molecules.

Acknowledgements: This research is supported by the NASA SMD Cosmochemistry and APRA programs. C.S.C. acknowledges the support of the NASA Postdoctoral Program.

210.05 – **Formation of Water on Dust Grains**

Gianfranco Vidali[1], D. Jing[1], J. He[1]

[1] *Syracuse Univ..*

9:00 AM - 6:30 PM

We studied the formation of D_2O on an amorphous silicate surface using atomic deuterium and oxygen beams. Besides D_2O we detect the formation of D_2O_2; however D_2O_2 formation is greatly reduced for D/O ratios that are closer to ISM values. We also studied the diffusion of oxygen atoms and the formation of molecular oxygen and ozone (2).

(1) D.Jing, J.He, J.Brucato, A. De Sio, L. Tozzetti, & G.Vidali, Ap.J.L. 749, L9 (2011)

(2) D.Jing, J.He, J.Brucato, A. De Sio, L. Tozzetti, & G.Vidali, to be submitted

Financial Support from NSF Astronomy & Astrophysics Division and from MIUR PRIN-08 (Italy) is gratefully acknowledged.

210.06 – **Laboratory Spectral Studies of NH3 Ice Mixtures Relevant to Astrophysical Environments**

Douglas White[1], R. M. E. Mastrapa[2], P. A. Gerakines[3], S. A. Sandford[1]

[1] *NASA Ames Research Center,* [2] *The SETI Institute,* [3] *NASA Goddard Space Flight Center.*

9:00 AM - 6:30 PM

Small quantities of NH_3 have been detected in interstellar environments such as icy grain mantles and cometary environments via infrared (IR) absorption spectroscopy in the range λ = 0.9-25 μm (e.g., Hagen et al., 1980; Crovisier, 1997; Lacy et al., 1998). In our presentation, we will describe spectral studies of some H_2O-dominated ice mixtures containing small amounts (≤10%) of NH_3. We also present spectral data collected at the University of Alabama at Birmingham Astrophysics Laboratory of H_2O-dominated ice mixtures containing NH_3 (White 2010). Positions and profiles of absorption features of NH_3 are noted according to temperature and mixture, along with the profiles of H_2O. Mixtures with other species such as CO_2 are also investigated. These results may then be used to identify IR spectral signatures from NH_3 and other species from observational data from ground- and space-based observatories.

Crovisier, J. 1997, Earth Moon and Planets, 79, 125

Hagen, W., Allamandola, L. J., & Greenberg, J. M. 1980, A&A, 86, L3

Lacy, J. H., Faraji, H., Sandford, S. A., & Allamandola, L. J. 1998, The Astrophysical Journal Letters, 501, L105

White, D. W. 2010, PhD thesis, University of Alabama at Birmingham

---

211 – Laboratory & Astrophysics: Plasma

Poster Session – Exhibit Hall, Dena'ina Center – 6/11/2012 9:00:00 AM to 6/14/2012 2:00:00 PM

211.01 – **Thermodynamics And Convergence In Simulations Of The ICM With Anisotropic Conduction**

Mark Avara[1], C. S. Reynolds[1], T. Bogdanovic[1]
[1]*Department of Astronomy, UMD.*
9:00 AM - 6:30 PM

In the intracluster medium (ICM) of cool-core galaxy clusters, where the plasma is weakly collisional and heat conduction occurs nearly entirely along magnetic-field lines, the thermodynamics of the ICM may be significantly affected by convective instabilities driven by anisotropic heat conduction. We perform local simulations with the magnetohydrodynamic code Athena to investigate the non-linear development of the heat-flux driven buoyancy instability (HBI) and investigate the numerical convergence of such simulations as a function of magnetic field strength and numerical resolution. We identify several criteria for convergence with resolution and show that depending on the strength of magnetic field, the ICM may find itself in three different states: (1) a strong field regime in which the HBI is quenched, (2) a weak field regime in which the growth of the HBI is uninhibited, and (3) an intermediate regime when magnetic field strength is comparable to the values measured from observations of cool-core clusters. In the intermediate regime we find sustained net heat flux conducted along stable magnetic-field line filaments which may have important implications for the transport of heat into cooling cores.

211.02 – **The Madison Plasma Dynamo Experiment: a Laboratory for Astrophysics**

Benjamin Brown[1], M. D. Nornberg[1], C. B. Forest[1], E. G. Zweibel[1], J. B. Wallace[1], M. Clark[1], E. J. Spence[2], K. Rahbarnia[1], E. J. Kaplan[1], N. Z. Taylor[1]
[1]*Univ. of Wisconsin - Madison,* [2]*Princeton Plasma Physics Laboratory.*
9:00 AM - 6:30 PM

Plasma experiments in laboratory settings offer the opportunity to address fundamental aspects of the solar dynamo, magnetism in solar and stellar atmospheres, and instabilities that may play important roles in astrophysical systems. The newly constructed Madison Plasma Dynamo Experiment (MPDX) Is a platform for investigating the self-generation of magnetic fields and related processes in large, weakly magnetized, fast flowing, and hot (conducting) plasmas. Planned experiments will probe questions that are of crucial importance to heliophysics in the solar interior, atmosphere and wind. These include studying large and small scale dynamos, varying between laminar and turbulent regimes, studying stratified convection and magnetic buoyancy instabilities, and studying dissipation processes in collisionless plasmas. In addition, MPDX will allow us to study the basic physical processes underlying magnetic reconnection and flares in the solar atmosphere, the nature of CMEs, and the interactions between planetary magnetospheres and the solar wind. Results from these experiments will create the benchmarks necessary for validating heliospheric codes used to mode our Sun and forecast solar activity. Laboratory plasma experiments are likely to contribute new understanding complementary to the traditional observational and modeling approach normally used by space physicists.

211.03 – **Collaborative Comparison of High-Energy-Density Physics Codes**

Bruce Alan Fryxell[1], M. Fatenejad[2], D. Lamb[2], C. Grazianni[2], E. Myra[1], C. Fryer[3], J. Wohlbier[3]
[1]*University of Michigan,* [2]*University of Chicago,* [3]*Los Alamos National Laboratory.*
9:00 AM - 6:30 PM

Performing radiation-hydrodynamic simulations is vital to the understanding of laboratory astrophysics experiments. A number of codes have been developed for this purpose. A collaboration has begun to compare several of these codes, including CRASH (Unversity of Michigan), FLASH (University of Chicago), RAGE and CASSIO (LANL) and HYDRA (LLNL). We are in the process of testing these codes on a wide variety of problems, ranging from very simple tests to full laboratory astrophysics experiments. The algorithms and physics models differ significantly between these codes, so complete agreement is not expected, especially on the full-experiment simulations. The goal is to understand the differences between the codes and how these differences influence the results. We intend to determine which codes contain the most accurate algorithms and physics models and, where possible, to improve the other codes to produce more faithful representations of the experiments. The first set of tests are simple temperature relaxation problems in an infinite, uniform medium. The second suite of tests was designed to test the diffusion solvers (both conduction and radiation) in the codes. Following this, tests will be performed that include hydrodynamic effects. Results of these comparisons will be presented. The eventual goal is to compare the results from all of the codes on simulations of radiative shock experiments being performed by The Center for Radiative Shock Hydrodynamics at the University of Michigan and to understand any discrepancies between the results of the simulations and the experiments.

This research was supported by the DOE NNSA/ASC under the Predictive Science Academic Alliance Program by grant number DEFC52-08NA28616.

211.04 – **Radiation-Hydrodynamic Simulation of Experiments With Intense Lasers Generating Collisionless Interpenetrating Plasmas**

Michael Grosskopf[1], R. Drake[1], C. Kuranz[1], H. Park[2], N. Kugland[2], S. Pollaine[2], J. Ross[2], B. Remington[2], A. Spitkovsky[3], L. Gargate[3], G. Gregori[4], A. Bell[4], C. Murphy[4], J. Meinecke[4], B. Reville[4], Y. Sakawa[5], Y. Kuramitsu[5], H. Takabe[5], D. Froula[6], G. Fiksel[6], F. Miniati[7], M. Koenig[8], A. Ravasio[8], E. Liang[9], N. Woolsey[10]
[1]*University of Michgan,* [2]*Lawrence Livermore National Laboratory,* [3]*Princeton University,* [4]*Oxford University, United Kingdom,* [5]*Osaka University, Japan,* [6]*Laboratory for Laser Energetics,* [7]*ETH Science and Technology University, Switzerland,* [8]*Ecole Polytechnique, France,* [9]*Rice University,* [10]*University of York, United Kingdom.*
9:00 AM - 6:30 PM

Collisionless shocks, shocks generated by plasma wave interactions in regions where the collisional mean-free-path for ions is long compared to the length scale for instabilities that generate magnetic fields, are found in many astrophysical systems such as supernova remnants and planetary bow shocks. Generating conditions to investigate collisionless shock physics is difficult to achieve in a laboratory setting; however, high-energy-density physics facilities have made this a possibility. Experiments whose goal is to investigate the production and growth of magnetic fields in collisionless shocks in laboratory-scale systems are being carried out on intense lasers, several of which are measuring the plasma properties and magnetic field strength in counter-streaming, collisionless flows generated by laser ablation. This poster reports radiation-hydrodynamic simulations using the CRASH code to model the ablative flow of plasma generated in order to assess potential designs, as well as infer properties of collected data from previous experiments.

This work is funded by the Predictive Sciences Academic Alliances Program in NNSA-ASC via grant DEFC52- 08NA28616, by the NNSA-DS and SC-OFES Joint Program in High-Energy-Density Laboratory Plasmas, grant number DE-FG52-09NA29548, and by the National Laser User Facility Program, grant number DE-NA0000850.

211.05 – **Theory and High-Energy-Density Laser Experiments Relevant to Accretion Processes in**

Cataclysmic Variables

Christine Krauland[1], R. Drake[1], B. Loupias[2], E. Falize[2], C. Busschaert[2], A. Ravasio[3], R. Yurchak[4], A. Pelka[4], M. Koenig[4], C. C. Kuranz[1], T. Plewa[5], C. M. Huntington[1], D. N. Kaczala[1], S. Klein[1], R. Sweeney[1], B. Villete[2], R. Young[1], P. A. Keiter[1]

[1]University of Michigan, [2]CEA, France, [3]UnEcole Polytechnique, France, [4]Ecole Polytechnique, France, [5]Florida State University.

9:00 AM - 6:30 PM

We present results from high-energy-density (HED) laboratory experiments that explore the contribution of radiative shock waves to the evolving dynamics of the cataclysmic variable (CV) systems in which they reside. CVs can be classified under two main categories, non-magnetic and magnetic. In the process of accretion, both types involve strongly radiating shocks that provide the main source of radiation in the binary systems. This radiation can cause varying structure to develop depending on the optical properties of the material on either side of the shock. The ability of high-intensity lasers to create large energy densities in targets of millimeter-scale volume makes it feasible to create similar radiative shocks in the laboratory. We provide an overview of both CV systems and their connection to the designed and executed laboratory experiments preformed on two laser facilities. Available data and accompanying simulations will likewise be shown.

Funded by the NNSA-DS and SC-OFES Joint Prog. in High-Energy-Density Lab. Plasmas, by the Nat. Laser User Facility Prog. in NNSA-DS and by the Predictive Sci. Acad. Alliances Prog. in NNSA-ASC, under grant numbers are DE-FG52-09NA29548, DE-FG52-09NA29034, and DE-FC52-08NA28616.

211.06 – **NIF Laboratory Astrophysics Experiments Investigating The Effects Of A Radiative Shock On Hydrodynamic Instabilities**

Carolyn C. Kuranz[1], R. P. Drake[1], C. M. Huntington[1], S. R. Klein[1], M. R. Trantham[1], H. S. Park[2], B. A. Remington[2], A. R. Miles[2], K. Raman[2], J. L. Kline[3], T. Plewa[4]

[1]University of Michigan, [2]Lawrence Livermore National Laboratory, [3]Los Alamos National Laboratory, [4]Florida State University.

9:00 AM - 6:30 PM

This paper will describe ongoing laboratory astrophysics experiments at the National Ignition Facility (NIF) relevant to the complex radiation hydrodynamics that occurs in red supergiant, and core-collapse supernovae. Experiments on NIF can deliver 300 eV radiative heating that can be utilized uniquely access the regime in which radiation affects the development of hydrodynamic instabilities within an evolving object. This is relevant to the dynamics that occur during the core-collapse explosions of red supergiant stars. These stars have dense circumstellar plasma, producing a strongly radiative shock whose radiation interacts with the hydrodynamic structures produced by instabilities during the explosion. While published astrophysical simulations have not included complex, multidimensional radiation hydrodynamics, such effects are very physical and expected to affect the evolution of early stages of astrophysical objects described above. This presentation will include a summary of the two test shots that we have performed on NIF, including a 0.7 scale, gas-filled hohlraum test shot, and a description of the integrated physics shots scheduled at the facility.

This work is funded by the NNSA-DS and SC-OFES Joint Program in High-Energy-Density Laboratory Plasmas under grant number DE-FG52-09NA29548 , the Lawrence Livermore National Security, LLC, under Contract No. DE-AC52-07NA27344 and Predictive Sciences Academic Alliances Program in NNSA-ASC via grant DEFC52- 08NA28616.

211.07 – **Discrete-Ordinates and Flux-Limited-Diffusion Methods for Radiation Transport: A Comparison Study**

Eric S. Myra[1], W. D. Hawkins[2]

[1]University of Michigan, [2]Texas A&M University.

9:00 AM - 6:30 PM

The Center for Radiative Shock Hydrodynamics (CRASH) seeks to improve the predictive capability for models of Omega laser experiments of radiative shock waves. The laser is used to shock, ionize, and accelerate a beryllium plate into a xenon-filled shock tube. These shocks, when driven above a threshold velocity of about 60 km/s, become strongly radiative and convert most of the incoming energy flux into radiation. Radiative shocks have properties that are significantly different from purely hydrodynamic shocks and, in modeling this phenomenon numerically, it is important to compute radiative effects accurately. In this presentation, we examine approaches to modeling radiation transport by comparing two methods: (i) a computationally efficient approximation (multigroup flux-limited diffusion), currently in use in the CRASH code, with (ii) a more accurate discrete-ordinates treatment that is offered by the code PDT. We present a selection of updated results from a suite of comparison tests, showing both idealized problems and those that are representative of conditions found in the CRASH experiment. This research was supported by the DOE NNSA/ASC under the Predictive Science Academic Alliance Program by grant number DEFC52-08NA28616.

211.08 – **Particle-in-cell Simulations Of Particle Energization From Low Mach Number Fast Mode Shocks**

Chuang Ren[1], E. Blackman[1], J. Park[1], R. Siller[1], J. Workman[1]

[1]University of Rochester.

9:00 AM - 6:30 PM

Collisionless perpendicular mangetosonic shocks relevant for termination shocks during solar flares are studied using two-dimensional particle-in-cell simulations with a reduced ion/electron mass ratio and a moving wall boundary condition. Compared to the reflection boundary condition, the moving wall method can control the shock speed and allows for smaller box sizes and longer simulation times in the study of shocks. In a purely perpendicular shock with the Alfven Mach number of 6.8 and plasma beta of 8. Electron and ion acceleration via shock drift acceleration (SDA) is observed. The modified two-stream instability due to the incoming and reflecting ions in the shock transition region is identified to be a possible turbulent dissipation mechanism. We determine the respective minimum energies required for electrons and ions to incur SDA. We derive a theoretical electron distribution via SDA that compares favorably to the simulation results. This work was supported by DOE under Grant DE-FG02-06ER54879 and Cooperate Agreement No. DE-FC52-08NA28302, by NSF under Grant PHY-0903797, and by NSFC under Grant No. 11129503. The research used resources of NERSC. We also thank the OSIRIS consortium for the use of OSIRIS.

211.09 – **Developments in the Generation of Large, Laser-Driven Magnetized Collisionless Shocks**

Derek Schaeffer[1], E. T. Everson[1], D. Winske[2], C. G. Constantin[1], A. S. Bondarenko[1], K. A. Flippo[2], D. S. Montgomery[2], C. Niemann[1]

[1]UCLA, [2]Los Alamos National Laboratory.

9:00 AM - 6:30 PM

We present experiments on the Trident laser facility at Los Alamos National Laboratory and on the Phoenix laser system at the University of California-Los Angeles that demonstrate key elements in the production of laser-driven, magnetized, laboratory-scaled astrophysical collisionless shocks. These include the creation of a novel magnetic piston to couple laser energy to a background plasma and the generation of a collisionless shock precursor. We also observe evidence of decoupling between a laser-driven fast ion population and a background plasma, in contrast to the coupling of laser-ablated slow ions with background ions through the magnetic piston. 2D hybrid simulations further support these developments and show the coupling of the slow to ambient ions, the formation of a magnetic and density compression pulse consistent with a collisionless shock, and the decoupling of the fast ions.

211.1 – **A New Way to Generate Collimated Plasma Jets?**

Rachel Young[1], C. C. Kuranz[1], R. M. Sweeney[1], R. P. Drake[1]

[1]*University of Michigan.*

9:00 AM - 6:30 PM

We may have a new way to generate collimated, high-Mach-number plasma jets for laboratory astrophysics experiments. Analytic calculations show that irradiating the rear side of a cone-shaped foil can produce a collimated plasma jet with a Mach number of more than 2. Preliminary numeric simulations confirm this. We intend to test this method with a day of experiments at OMEGA (Laboratory for Laser Energetics, Rochester, New York) in April 2012; results may be available in time for this meeting.

If successful, this will be the first step in an experimental campaign to investigate the affects of magnetic fields on mixing plasma jets. We hope to create a swirling disk of magnetized plasma_and possibly witness the turbulent dynamo_by firing roughly half a dozen such jets towards each other. However, for such an experiment to succeed, the disk must rotate more quickly than it expands, requiring the contributing jets to have M > 2.

This work is funded by the NNSA-DS and SC-OFES Joint Program in High-Energy-Density Laboratory Plasmas, grant number DE-FG52-09NA29548, and by the National Laser User Facility Program, grant number DE-NA0000850.

---

212 – Laboratory & Astrophysics: Planetary

Poster Session – Exhibit Hall, Dena'ina Center – 6/11/2012 9:00:00 AM to 6/14/2012 2:00:00 PM

212.01 – **Probing the effect of Gases on Activated Lunar Simulant**

F. Salama[1], C. L. Ricketts[1], **Ella Sciamma-O'Brien**[1], C. S. Contreras[1], A. L. Mattioda[1], E. L. Yates[1], L. T. Iraci[1], A. Ricca[1]

[1]*NASA Ames Research Center.*

9:00 AM - 6:30 PM

The lunar surface is constantly ‘activated’ through bombardment of solar radiation and micrometeorites. This ‘activation’ is significant enough to affect the surface dust by creating free radicals, dangling bonds and lattice defeats. Hence, the reactive effect of the dust particles on spacecraft instrumentation and human toxicology is a concern. There is currently little information on the surface chemical activation of lunar regolith after exposure to gases brought to the Moon by human activities. Information is needed in order to understand the regolith toxicity, effect on spacecraft, determine lunar dust exposure limits and meet the needs of the technological development of appropriate physical/chemical tools for regolith passivation.

In this experimental study, we grind JSC-1af lunar simulant to simulate micrometeorite impacts and expose the simulant to vacuum ultraviolet (VUV) light to simulate solar radiation. We then flow a variety of gases (N2, CO2, CH4) over the simulant to simulate the exposure of the activated dust to gases humans would bring to the Moon. Mass spectra are taken using the Reflectron Time-Of-Flight Mass Spectrometer at NASA Ames’ Cosmic Simulation facility (COSmIC), before, during and after exposure to VUV and the various gases. Infrared spectra and Scanning Electron Microscope images of the simulant are taken, before and after activation and gas exposure. Future plans include theory and replicating these experiments using real lunar dust. Here we describe our new custom built lunar dust holder, experimental procedure and latest results.

Acknowledgments: NASA LASER supports this research. E.S.O. and C.S.C. acknowledge the support of the NASA Postdoctoral Program.

212.02 – **Laboratory Simulations Of Titan’s Atmospheric Chemistry With The NASA Ames Titan Haze Simulation Experiment**

Ella Sciamma-O'Brien[1], C. S. Contreras[1], C. L. Ricketts[1], F. Salama[1]

[1]*NASA Ames Research Center.*

9:00 AM - 6:30 PM

Solar UV radiation and electron bombardment from Saturn’s magnetosphere dissociate nitrogen and methane in Titan’s atmosphere, leading to the production of heavier molecules and solid organic aerosols that contribute to the haze layers giving Titan its characteristic orange color. The detection of benzene and toluene, critical precursors of polycyclic aromatic hydrocarbon (PAH), in Titan’s ionosphere, by the Cassini INMS suggests that PAHs might play a role in the production of Titan’s aerosols. The Titan Haze Simulation (THS) experiment has been developed at NASA Ames’ Cosmic Simulation facility (COSmIC) to study the chemical pathways that link the simple molecules resulting from the first steps of the N2-CH4 chemistry (C2H2, C2H4, HCN..) to benzene, and to PAHs and nitrogen-containing PAHs (PANHs) as precursors to the production of solid aerosols. In the THS experiment, Titan’s atmospheric chemistry is simulated by plasma in the stream of a supersonic jet expansion. With this unique design, the gas mixture is cooled to Titan-like temperature (~150K) before inducing the chemistry by plasma discharge. Different gas mixtures containing the first products of Titan’s N2-CH4 chemistry, but also much heavier molecules like PAHs or PANHs can be injected to study specific chemical reactions. The products of the chemistry are detected and studied using Cavity Ring Down Spectroscopy and Time-Of-Flight Mass Spectrometry. Thin tholin (Titan aerosol analogs) deposits are also produced in the THS experiment and can be analyzed by Gas Chromatography-Mass Spectrometry (GC-MS) and Scanning Electron Microscopy (SEM). We present the results of mass spectrometry studies using different gas mixtures, and discuss their relevance for the study of specific pathways in Titan’s atmospheric chemistry.

Acknowledgements: This research is supported by NASA PATM. E.S.O., C.S.C. and C.L.R acknowledge the support of the NASA Postdoctoral Program. The authors acknowledge the collaboration of H. Imanaka, C. McKay and S. Lebonnois.