

AMPL Day 2009

Common Room, University House
Friday 3 July



09.15 Welcome**09.20** Quantum mechanics and planetary atmospheres*Brenton Lewis*

Molecular excitation and dissociation, whether due to photon or electron impact, are important processes in planetary atmospheres, playing significant roles, for example in photochemistry, isotopic fractionation, and aurorae. The relevant molecular electronic states are generally accessible only in the vacuum- or extreme-ultraviolet spectral regions, where there is a complex interplay between Rydberg and valence states which requires treatment by coupled-channel techniques. An outline will be given of the coupled-channel description of diatomic molecular dissociation, with examples of application to planetary-atmospheric problems.

09.40 Transition rate measurements of metastable helium*Sean Hodgman*

The transition rates of electron decay in atoms are an important test of Quantum Electro-Dynamical theory. Of particular interest are the transition rates of helium, which theorists favour as it has the simplest multi electron structure of any atom. The first accurate experimental determination of transition rates for four key levels of helium are presented here, including that of the longest lived atomic excited state.

10.00 The influence of molecular orientation on the breakup of molecules*Julian Lower*

The nature of the physical world is determined by the interaction of atoms and molecules with each other and with their environment. The extent to which such reactions can be controlled is the limiting factor in the advancement of many areas of technological and environmental interest. I will present results for the breakup of molecules by charged particle impact. The work reveals the role played by molecular orientation in determining reaction outcomes and opens up the exciting possibility of exploiting molecular orientation to optimize chemical reactions.

10.20 Morning Tea / Coffee**10.40** A new beamline for positron annihilation lifetime spectroscopy*Ryan Weed*

Positron Annihilation Lifetime Spectroscopy (PALS) is a powerful tool to investigate porous properties of a wide array of materials. We use a radioactive source and buffer gas trap to produce a pulsed positron beam. Sub-nanosecond pulses are then injected into the chosen material at energies up to 20keV. The annihilation lifetime of the positrons inside the material can be related to the open volume structure. The operation of the experiment and initial results will be presented.

11.00 Observations and modelling of terrestrial planetary atmospheres*Frank Mills*

I will provide a summary of my research at the ANU, which is focused on observations and modelling of the atmospheres of Venus and the Earth, and how this research connects with other ongoing ANU activities. The primary objectives for my Venus research are to understand the chemistry in Venus' current atmosphere and how it may have evolved. My Earth atmosphere research is transitioning from assessing the impact of Australian aerosols on surface ultraviolet radiation to studying the interactions between atmospheric chemistry and climate.

11.20 Dual species Rb-He* cold atom system*Lesa Byron*

From a certain temperature on, the molecules 'condense' without attractive forces; that is, they accumulate at zero velocity. The theory is pretty, but is there some truth in it? - Albert Einstein. The first Bose-Einstein Condensate (BEC) was created in 1995 and since then the field of atom-optics has exploded. In recent year's one area of experimental research has focussed on creating multi-species BECs, however these experiments have been limited to various alkali atom combinations. We intend to create the first realisation of a multispecies cold atom system utilising a metastable species. I will present current progress on this experiment and also show you that not only is the theory pretty but the experiment is too.

11.40 Electron scattering at high momentum transfer

Maarten Vos

Large-angle scattering of keV electrons is an unexplored area of physics. In our laboratory we can investigate such scattering events in both the gas-phase and condensed matter. Recent experiments show a range of interesting phenomena, and I will show some examples, illustrating the relevance of these experiments for fields as diverse as electron microscopy, neutron scattering, high-energy photoemission and surface science/interface physics.

12.00 Group photo and lunch (menu attached)

14.00 Technical Report

Stephen Battison

The technical support group within AMPL has seen some changes in the last year or two, as has the legislative environment of our workplace. I will be updating you on our staff and their expertise, providing you with legal and practical guidelines for proper use of the AMPL workshop, giving a quick recapitulation in regards to Occupational Health and Safety compliance, and giving a brief introduction to 3D CAD modelling and how it benefits our research.

14.20 Positron science activities within CAMS

Stephen Buckman

The Centre for Antimatter-Matter Studies is a collaboration of seven universities and one government research laboratory performing research on positron and electron interactions with matter, from single atoms to biological molecules, surfaces and materials. I will present a brief overview of the positron science activities undertaken by CAMS researchers here in our laboratory as well as introducing some of the broader activities from the other CAMS nodes and their potential applications in biology and materials science.

14.40 Velocity-map imaging: the ultimate speed camera for photoelectrons

Stephen Gibson

Electrons hide anonymously within negative ions, protected from investigation by the laws of quantum mechanics. They make their escape once the anion is illuminated with laser light and speed off in every direction. Our camera captures every electron, determining with precision their speed and direction, even those that tailgate, or travel very slowly. Some electrons are of special interest; they hold information about their role in the anion, and that of the neutral species left behind. These electrons are interrogated through their spectroscopic signatures. They reveal a detailed picture of their environment and the sharing needed to attempt escape.

15.00 Afternoon Tea / Coffee

15.20 Atomic ionization in strong electromagnetic fields

Anatoli Kheifets

Present day experimental techniques are now capable of producing short and intensive bursts of electromagnetic radiation which can eject electrons from atoms with great efficiency in a well controlled manner. This opens up a possibility of tracing the electron motion in atoms in real time and to manipulate variety of physical and chemical properties of matter. To match these spectacular developments, we formulated a time-dependent theory of atomic ionization which incorporated a realistic description of electronic structure with particular emphasis on many-electron correlation. Examples of recent calculations of strong field ionization and high harmonic generation will be presented.

15.40 An overview of experiments on the atomic and molecular positron beamline

Adric Jones

Over the past several years our research area has produced a variety of experimental results on both fundamental targets and some more complex, biologically relevant, molecules. The different types of measurements will be discussed along with some example results.

16.00 A high resolution laser source for precision measurement

Ken Baldwin

We have developed through an Australian Research Council collaboration with Macquarie University a new pulsed laser source which operates close to the highest theoretically possible resolution. The light produced is in the infrared but yields high energy pulses sufficient for frequency conversion into the vacuum ultraviolet. We aim to apply the high resolution laser source for the precision measurement of atomic and molecular structure, in particular a new determination of the Lamb shift in helium.

16.20 Close

**Atomic and Molecular Physics Laboratories
Staff, Students, Visiting Fellows**

Alena Almassy
Ken Baldwin
Stephen Battison
Deborah Bordeau
Stephen Buckman
Lesa Byron
Peter Caradonna
Stephen Cavanagh
Lewis Chadderton
Robert Crompton
Ron Cruikshank
Alex Cubis
Robert Dall
Colin Dedman
Robert Evans
Rajesh Ganesan
Stephen Gibson
Kirsty Hannam
Alan Heays
Sean Hodgman
Adric Jones
Anatoli Kheifets
Mitsu Kono
Brenton Lewis
Julian Lower
Casten Makochekanwa
Andrew Manning
Frank Mills
Dennis Mueller
Bill Noble
Prasanga Palihawadana
Jason Roberts
Daniel Slaughter
James Sullivan
Wade Tattersall
Colin Taylor
Ross Tranter
Andrew Truscott
Maarten Vos
Ryan Weed
Erich Weigold
Michael Went
Ju Kuei Wu

Apologies

Igor Ivanov (Russia)
Robert McEachran (Canada)
Eskender Mume (Sweden)
Robert Robson (overseas)

HOT BUFFET LUNCH

Chicken stir-fry, oyster sauce, fresh vegetables, and hokkien noodles

or

Market fresh fish with lime and coriander salsa on mixed Asian greens

or

Beef Stroganoff, with cream, smoked paprika, and button mushrooms

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Australian cheese platter, with macerated fruit, nuts

Sliced Seasonal Fruit

** * **

*Yealands Way Sauvignon Blanc
Marlborough, New Zealand*

*Geoff Merrill Cabernet Sauvignon
McLaren Vale, South Australia*

*Cascade Premium Light 375ml
Carlton Draught 375ml*