Contents

Cover image: Threaded molecular wire

This image was produced by Dr Sergio Brovelli and refers to recent results obtained by the group of Professor Franco Cacialli. The molecular wire consists of a semiconducting conjugated polymer supramolecularly encapsulated (i.e. with no covalent bonds) into cyclodextrin macrocycles (in green). This class of organic functional materials gives highly controllable optical properties and higher luminescence efficiency when employed as the active layer in light-emitting diodes. The supramolecular shield prevents potentially detrimental intermolecular interactions and preserves single-molecule photophysics even at high concentration.

Introduction

The old Chinese curse says "May you live in interesting times" and 2008 was certainly an interesting year.

The years end was awaited with interest by all UK academics for the announcement of the results of the final Research Assessment Exercise (RAE). The results arrived using a new scoring system which makes them harder to interpret, or more precisely open to a number of differing interpretations. However what is clear in the outcome for Physics at UCL, which includes the Department of Space and Climate

Physics and Astronomy Students

Student Entry and Pass Figures for 2008

Undergraduates

Entrants: 100

BSc Degrees			
1st 9	**2:1** 5	**2:2** 1	**3rd** 4

MSc Degrees			
1st 20	**2:1** 21	**2:2** 10	**3rd** 1

Postgraduates

MSc entrants: 11

PhD entrants: 28

MSc Degrees	
Distinction 5	**Pass** 4

PhD Degrees
Pass 22

NB: Numbers specified are head counts

2008 PRIZE WINNERS

UNDERGRADUATE PRIZES

HOLLY ALEXANDER
Huggins Prize
(Best performance 2nd year Astronomy)
C.A.R. TAYLER PRIZE
(Best 2nd Year Essay)

SETRAK BALIAN
Wood Prize
(Best performance 2nd year Physics)

YUVAL BEN HAIM
Best Performance 3rd Year Physics
& **William Bragg Prize**
(Best overall undergraduate)

ALEXANDER DUNNING
Corrigan Prize
(Best performance in experimental work, 2nd year)

DAVID JOHNSON
David Ponter Prize
(Most improved performance in Department, 2nd year)

KALLE KARHUNEN
Best Performance 3rd Year Astronomy

KATARINA MARKOVIC
Brian Duff Memorial Prize
(Best 4th Year project in the department)

KIRITHIKA MOHAN
Halley Prize
(Best performance 1st year Astronomy)

CALLUM NOBLE
Burhop Prize
(Best performance 4th year Physics)

FRANCISCUS PRINS
Additional Sessional Prize for Merit

SUNIL RATTU
Tessella Prize for Software
(Best use of software in final year Physics/Astronomy projects)

DANIEL SHORT
Herschel Prize
(Best performance 4th year Astronomy)

SIDNEY TANOTO
Additional Sessional Prize for Merit

WEI ZHOU
Oliver Lodge Prize
(Best performance 1st year Physics)

POSTGRADUATE PRIZES

CHRISTOPHER HADLEY
Carey Foster Prize
(Postgraduate Research, Physics AMOPP)

TOMMI KOSKINEN
Jon Darius Prize
(Outstanding Postgraduate Research, Astronomy)

ARTHUR LOVELL
Marshall Stoneham Prize
(Postgraduate Research, Physics CMMP)

DANIEL NICHOLASS
Hepp Group
(Postgraduate Research, Physics HEP)

ZIRI YOUNSI
Harrie Massey Prize
(Most Outstanding MSc student)

PhDs AWARDED

Jennifer C Brookes
A microscopic model of signal transduction mechanisms: Olfaction
(Supervisor Prof. Marshall Stoneham)

Mark Dorman
Cross section measurements for quasi-elastic neutrino-nucleus scattering with the MINOS near detector (Supervisor Prof. J Thomas)

Natasha Doss
Calculated final state probability distributions for T_2 β-decay measurements (Supervisor Prof. Jonathan Tennyson)

Christina Dunn
Pseudo-random toolpaths for deterministic surface processing
(Supervisor Dr D Walker)

Flemming Ehlers
Modelling of the interaction of Cu and rare earth metal with Si(001)
(Supervisor Dr D Bowler)

Hannah Fox
New statistical mechanical simulation methods for the calculation of surface properties (Supervisor Prof. M J Gillan)

Gabriela Halmova
R-matrix calculations of electron-molecule collisions with C_2 and C_2^-
(Supervisor Prof. Jonathan Tennyson)

Clare E Jenner
A new semi-analytical treatment of the effect of supernovae on ULIRG spectral energy distributions
(Supervisors Prof. M J Barlow, Dr J Yates)

Christopher King
A new approach to stitching optical metrology data (Supervisor Dr D Walker)

Tommi Koskinen
Stability of short-period exoplanets
(Supervisor Prof. Alan Aylward)

Ho-Chih Lin
Local approach to quantum entanglement (Prof. Andrew Fisher)

Daniel Nicholass
The study of D+- and D0 meson production in deep inelastic scattering at HERA II with the ZEUS detector
(Supervisor Dr M Wing)

Nick Nicolaou
Single and two-photon fluorescence studies of linear and nonlinear optical chromophores (Supervisor Dr A J Bain)

Matthew North
Rapid rotation in Be Stars
(Supervisor Prof. Ian Howarth)

Chiara Piccarreta
Calculation of resonance effects in low-energy electron-water collisions
(Supervisor Prof. Jonathan Tennyson)

Julia Roberts
The chemical evolution of low mass prestellar cores and young stellar objects (Supervisor Prof. J Rawlings)

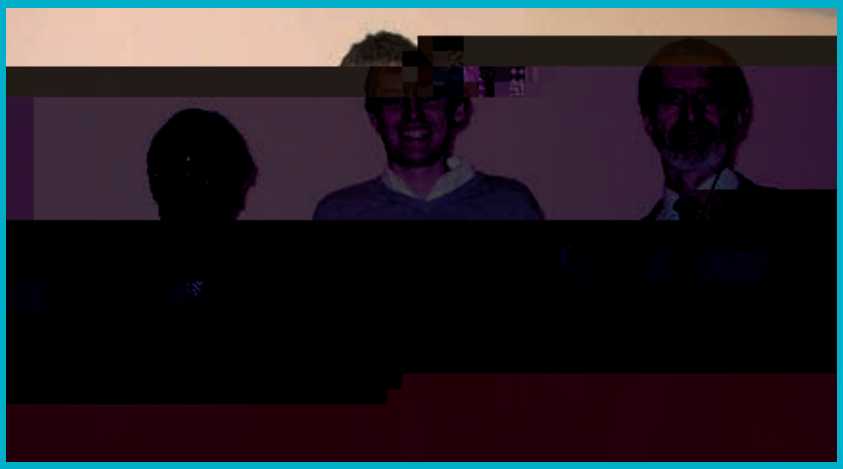
Mischa Stocklin
Quantum chaos with cold atoms and spin waves
(Supervisor Prof. T S Monteiro)

Jiayu Tang
Investigating future probes of cosmic acceleration
(Supervisor Prof. J Weller)

Paolo Emilio Trevisanutto
Theoretical models of photo-induced processes at surfaces of oxide nanoparticles
(Supervisor Prof. Alexander Shluger)

Troy Vine
A Direct measurement of the W decay width
(Supervisor Prof. M Lancaster)

Nicholas J Wright
The structure and chemistry of evolved stars and nebulae
(Supervisor Prof. M J Barlow)



(L ft to right) Jayantha Dhanapala, ***Emme Fa aghe*** *and* ***J hn Finne***

Emmet Farragher, a first year student in Physics and Astronomy was awarded the inaugural Joseph Rotblat essay prize. The award was launched this year to honor the centenary birth of one of the founders of the Pugwash Conferences on Science and International Affairs, Sir Joseph Rotblat. Rotblat, who shared the 1995 Nobel Peace Prize with the Pugwash Conferences, was an ardent advocate of young people and believed that drawing on their creativity and energy could be crucial in creating a better world.

The prize essay analysed the scenarios in which an independent British nuclear weapon could arguably be used, together with an examination of non-nuclear alternatives in each case.

Emmet received his award from Ambassador Jayantha Dhanapala, the President of Pugwash and a past UN Under-Secretary-General for Disarmament Affairs, following a keynote address on the Urgency of Disarmament at an event jointly hosted by British Pugwash and the SOAS Centre for International Studies and Diplomacy.

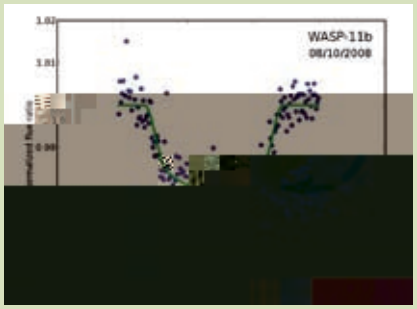
NEWS HIGHLIGHTS

Follow-up Monitoring of Transiting Extrasolar Planets from ULO

UCL undergraduates are participating in a collaborative observational project to study the transits of extrasolar planets. Transitting extra solar planets are a particular class of planets who, when viewed from earth, pass directly in front of their star. These planets are particularly interesting because they can be studied by observing the light from their star.

The scientific aim of the project is to use UCL's observatory (ULO) to monitor the transits of known and candidate extrasolar planets, with a view to characterizing the planetary companions in confirmed systems, and checking the status of transit candidates which have been discovered by wide-field surveys elsewhere.

The observing programme is engaging undergraduates across all years directly with astronomical research in a field which is growing fast, providing opportunities for the further development of their own practical and research skills, and supporting on-going final-year MSci project work.



The Figure shows a transit event (October 2008) of the recently-discovered system WASP-11b, obtained at ULO by 4th-yr MSci student Ingo Waldmann (Natural Sciences). The observed starlight measurements are in blue, and the green line is a model fit.

Transit observations such as these show that WASP-11b, a planet with half Jupiter's mass and orbiting its parent star in just 3.7 days, has a radius about the same as Jupiter, indicating a low-density gas-giant with a low-mass core.

These findings have recently been accepted for publication in Monthly Notices of the Royal Astronomical Society (MNRAS).

Physics Outreach Project

This is a voluntary based project aimed at improving the public image of physics amongst primary and secondary school pupils. The project is led by a group of five UCL physics students, Nick Elias, Robin Gajria, Salim Damani, Jennifer Lardge and Luisa Pruessner, and is supported by the Voluntary Services Unit, part of the UCL Union. The idea is to entice and enthuse students to the captivating world of physics through talks and presentations delivered by our volunteers.

Each volunteer, with the help and support of the project leaders, will create their own talk based on an aspect of physics that interests them personally. The nature of these talks therefore varying widely in content, however they all have the common purpose of explaining the basic principles of physics in both an entertaining and educational manner. Previous presentations have included 'Physics of ice cream' and 'What to do with a degree in Physics.'

The students are always enthusiastic and attentive. Things can get a little chaotic during demonstrations with a class of 30 but that's all part of the fun. The students are encouraged to ask questions and join in the talks. Their response, as well as that from teachers has been very inspiring. Peter Turner, the Extended Schools Manager of Central Foundation School for Boys said 'Can I thank the UCL students who came to the school for their excellent presentations. They were a credit to your University.'

The scheme has been running for over three years now and it will be continuing this year with one returning Project Leader and four new Project Leaders from various year levels, which makes this a great opportunity for the volunteers to meet students on other years and disciplines within the department. It's also an excellent way to practice presentation skills and in particular, it's great for explaining scientific ideas in simple terms.

The Physics Outreach Project can be contacted by email at **physics.outreach@hotmail.co.uk**

Annual Weekend at Cumberland Lodge

'H ros and Villans': Som tim s th alt r- gos of a f w of our stud nts g t to 'play' a part in th D partm nt's lif

The picture above features some of our undergraduate cast who stared in a play at Cumberland Lodge based on the Batman story. The department organises an annual weekend at Cumberland Lodge in Windsor Great Park for undergratuate students as part of the first year induction. Although the planned activities vary from year to year the production of a play has been a very popular addition for many years and involves both students and staff.

Careers with Physics and Astronomy Degrees

Andrew Wilson

IT Developer (BSc Astronomy & Physics 1994)

Since graduating from UCL in 1994 I have spent the majority of my working life in the City. For the last three years I have been working as an IT developer in the risk department of a Japanese investment bank. With all that has happened in the global economy over the past year this has proven to be a very challenging environment, though it must be said with never a dull moment! I have found that my time studying science at UCL has equipped me with the logical approach and problem solving skills that are so crucial to doing well in my chosen career.

I had an interest in astronomy from a young age, and my study of Astronomy and Physics at UCL was the culmination of this interest. I had originally envisaged that I would spend my life in research, though my career ended up taking a different path. I decided that if I wasn't to have a career in science, then I would find a way to pursue my own interests in the subject. So I became actively involved in the UK and Global amateur astronomy scene through the British Astronomical Association. I was largely interested in finding ways to contribute to scientific research and so I became a member of the Variable Star Section. My main area of interest over the past few years has been monitoring active galaxies. I have been part of a collaboration of amateur and professional astronomers who study the binary black hole OJ+287. The amateurs have provided long time series brightness measurements of the black holes (both visual and CCD) giving the professionals a wealth of data to analyse. This has resulted in 2 scientific papers, the most recent of which was in Nature; 'A massive binary black hole system in OJ 287 and a test of general relativity', Valtonen [illegible], Nature, 452, 851-853, (2008). This analysed the orbit of the black holes showing evidence of energy loss through gravitational radiation, one of the last remaining tests of Einstein's General Theory of Relativity.

At present I am working on a database project with the British Astronomical Association Variable Star Section. This will put their 2 million plus observations dating back to the 1890's online for amateurs and professionals to access for their research.

I've continued my academic studies through maths courses at the Open University. I have found this very rewarding, though I cannot study every year due to work and life commitments.

2008 has been an especially busy year for me. It has seen the completion of an observatory in my back garden equipped with a 14" telescope. Another highlight has been my visit to China in July and August to see a total eclipse of the Sun from the Gobi desert.

Orsola De Marco and Nic Fulton

Orsola and Nic met while at UCL, Orsola was a Physics Undergraduate and Nic was studying for his PhD. Orsola and Nic are now married with two children. While Orsola continues to work in academia, Nic works for Thomson Reuters.

Nic Fulton

Chief Scientist, Reuters Media (BSc Physics with Electronics 1991, PhD Physics 1995)

My time as an undergraduate at UCL in the Physics Dept. was probably about as normal as anyone else's. Too much beer in the Union, l.n

Staff Highlights and News

Promotions

Promotion to Professor

Professor Mark Lancaster

Professor Ferruccio Renzoni

Professor Linda Smith

Promotion to Reader

Dr Sarah Bridle

Dr Robert Thorne

Dr David Waters

New Appointments

The following academic members of staff started on 1 January 2009.

Dr Nguyen Thanh

Reader in CMMP, associated with the Royal Institution and holder of a Royal Society University Research fellowship. From Liverpoool University.

Dr Giorgio Savini

Lecturer in Astrophysical

Professor Chris Pickard

EP RC L

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Professor Quentin Pankhurst heads new Davy-Faraday Research Laboratory

Following its two and a half year closure for an extensive £22 million renovation, Quentin Pankhurst has been appointed the new Director of the Davy-Faraday Research Laboratory (DFRL). Quentin was previously Deputy Director of the London Centre for Nanotechnology at UCL and has been appointed to undertake research in Healthcare Biomagnetics – the application of magnetic materials to healthcare. Quentin also retains a 10% appointment in the Department.

Quentin took up this post on 1 May 2008 and will lead an ambitious collaborative research programme to build a new DFRL team of 15 resident scientists, engineers, medics and technologists to tackle major challenges in the field of Healthcare Biomagnetics. In addition, the RI-UCL programme will see at least another 35 scientists making direct use

Deep-Inelastic Scattering and Related Subjects (DIS 2008) Workshop in UCL

Spring 2008 saw the 'XVI International Workshop on Deep-Inelastic Scattering and Related Subjects' (DIS 2008) held at UCL, jointly organised by the High Energy Particle Physics Groups of the University of Oxford and UCL. The workshop ran from Monday 7 April to Friday 11 April and consisted of a multitude of subjects with around 270 talks and 300 participants. Not only was there a vibrant scientific programme, but also an extensive list of social events enjoyed by all.

The first day, opened in the Cruciform building by the Provost and President Professor Malcolm Grant, contained mainly plenary talks with speakers detailing recent experimental and theoretical highlights and prospects in the areas of the strong force and high energy colliders such as the electron-proton collider, HERA, in Hamburg; the proton-antiproton collider, Tevatron, in Chicago, and the proton-proton collider, Large Hadron Collider (LHC), which was turned on this year in Geneva (see page 19).

The main subject of the DIS workshop series, the structure of the proton, has seen tremendous advances recently with the combination of data from two experiments, H1 and ZEUS at HERA. Leading to a much increased precision, significantly better than the simple effect of doubling the statistics. Taking advantage of the very different detectors and their systematic uncertainties, the measurements from H1 and ZEUS effectively 'cross-calibrate' and lead to uncertainties of 1–2% for a large fraction of the 500 data points. All of the results are crucial inputs to our understanding of quantum chromodynamics (QCD) and in particular the structure of the proton which is needed as the starting point for most physics at the LHC.

Several social events were included in the workshop programme. A welcome reception of beer and cheese, held in the North Cloisters in UCL and a brilliant concert by Jack Liebeck (violin) and Katya Apekisheva (piano) at Queen Elizabeth Hall.

The social highlight of the Workshop was the dinner held at Lord's Cricket Ground – the home of cricket. After a tour of the ground and champagne in the museum, an excellent dinner was served, followed by a speech from Norman McCubbin (STFC/RAL) entitled, "The scattering of balls: an English obsession". Norman explained the delights of this English game, such as the length of the game, the many and complicated options on when tea can be taken and the history of Lord's. All supported by props and how the game relates to physics and specifically deep inelastic scattering.

The contributions from our many
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Opening of the ν-Building at Mullard Space Science Laboratory (MSSL)

The morning of Wednesday 30 April was wet, cold and miserable. Not an auspicious start for the beginning of one of the most important developments for the capability of the High Energy Physics (HEP) group at UCL. Fortunately the weather brightened as guests arrived for the official opening of the ν-building at MSSL, a collaborative project between HEP and MSSL.

The project was conceived four years ago when Professor Jenny Thomas (HEP) and Professor Keith Mason (then Director of MSSL) persuaded UCL's Provost and the PPARC CEO to fund the development of a new building to enhance UCL's capabilities to lead large construction projects in Particle Physics and Space Science. That was the easy part – the project then had to be approved by the Deputy Prime Minister's Office and the Local Councils. Jenny Thomas and Professor Alan Smith who succeeded Keith Mason as head of MSSL successfully steered the plans through the authorities and construction began in 2006.

The underlying science of MSSL and the HEP group are surprisingly connected. Particle Physics studies the evolution of the universe in the first micro-second which created the conditions for stars to form. Space scientists study the life cycle and properties of these stars and galaxies. The most interesting synergy lies in the study of the neutrino, given the Greek symbol, ν, pronounced 'new'. Large numbers of neutrinos are emitted by stars such as our sun and in super-nova explosions such as the explosion of SN1987A observed in 1987. The neutrino also potentially holds the key as to why our universe is dominated by matter and why all the anti-matter disappeared within a few minutes of its creation in the Big Bang. The neutrino however only interacts very weakly with matter and its observation requires large sophisticated detectors which will be built in the ν Building.

Guests began to arrive at 2pm and included local dignitaries, the chairpersons of the two local parish councils, Abinger and Ewhurst, and the local MP Sir Paul Beresford as well as prominent members of the research community. First they were taken on a tour of the ν Building and then Jenny Thomas and Alan Smith each gave a presentation explaining their vision for the future and the desire of the two groups to work closely together and how closely aligned this was to the 'Institute of Origins' which is a recent Faculty initiative (see page 15).

The opening ceremony was then carried out by the Provost.

The ν Building is a fantastic facility – nearly half of it is taken up with a new clean room which is approximately 12m square and 7m high (above). Its inaugural project will be the construction of detectors for the SuperNEMO experiment. SuperNEMO will search for a very rare process, neutrinoless double beta decay. If it is observed it will confirm a long held view that neutrinos are their own anticuC20 (T)ng and then T micro-second wT.

Staff Profile

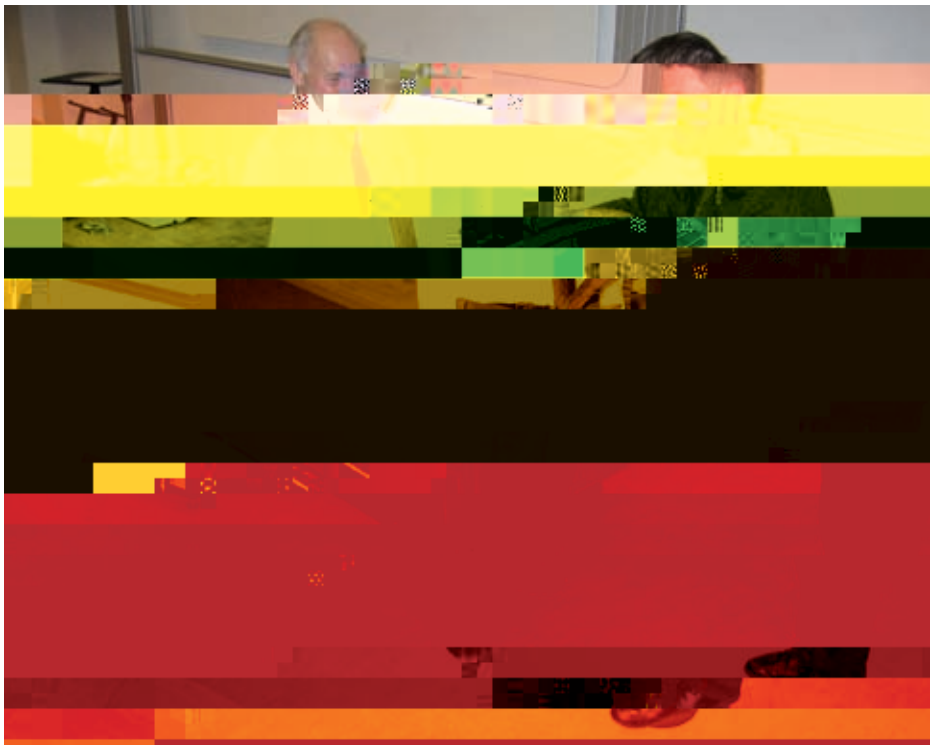
Professor John Humberston

John has been a long-standing and immensely popular member of the department for nearly 50 years. Indicative of his popularity was the award of the Departmental Teaching Prize in 2008. Additionally, although John officially retired five years ago, the department was loath to lose such a popular teacher and so managed to persuade him to continue teaching classical mechanics for a further five years. All bribery methods exhausted, sadly John decided to relinquish the course in 2008. He is now looking forward to a peaceful and exam-free retirement.

John joined UCL in October 1959 as a PhD student working under the supervision of Sir Harrie Massey. After he obtained his PhD, John was appointed to a lectureship at UCL in 1966 and, with the exception of spending a couple of years working at different institutions in North America, he has been at UCL ever since.

John is both a keen researcher and teacher and has successfully managed to balance both the teaching and research aspects of his academic career. On the research side he is part of the AMOPP group and is involved in the theoretical aspects of positron-atom collisions. One particularly significant piece of research in which John was involved was the theory of positron-helium scattering. Scientists were then able to use his theoretical results to justify and explain the experimental results, thus serving to prove the viability of positron scattering. In addition to this, John, in collaboration with Michael Charlton (ex- UCL, currently EPSRC Senior Fellow at Swansea University) has written one of the only comprehensive texts on Positron Physics, published in 2001, aptly titled 'Positron Physics'.

On the teaching side, John has taught classical mechanics in the department for at least ten years and is famous both with the students and staff for his ingenious use of demonstrations (see image below).



John uses simple apparatus in practical examples to illustrate important basic principles in classical mechanics.

So what are John's plans for the future? When talking to John one can't help but notice a real love for teaching and academia and luckily for us he plans to retain ties with the department by giving a weekly tutorial to a group of second year undergraduates. His research will also continue but the majority of his time will be taken up concentrating on family life with his two grandchildren.

Institute of Origins

The Institute of Origins has been recently established to promote world leading research in topics related to the Origins and Evolution of the Universe. The institute embraces the work carried out in at least four UCL departments covering Astrophysics, High Energy Physics, Solar System Physics and Mathematics. The Institute had its formal launch event on 27 February 2009 with keynote speeches from Sir Paul Nurse, Nobel Prize winner in Physiology or Medicine 2001 (President of Rockerfeller University, New York) and Professor John Ellis (CERN).

Initially funded as a special initiative in fundamental physical science by the Provost's special fund, the institute will in due course look for external funding to ensure the continuation of its multidisciplinary activity.

Participants at th Astronomy Colloquium 7–10 July 2008.

Quantum Delocalization Behaviour of Molecular Hydrogen in Potassium-Graphite

Arthur Lovell, **Felix Fernandez-Alonso**, **Neal T Skipper**, Keith Refson, **Stephen M Bennington**, and Stewart F Parker

Phys. Rev. Lett. 101, 126101 (2008)

Understanding how molecular hydrogen (H_2) binds to materials is crucial to designing a new generation of hydrogen storage media for 'clean' fuel cell vehicles. By combining neutron scattering studies with first-principles (DFT) calculations, new insight into H_2 binding sites in the layered potassium-graphite intercalate KC_{24} has been gained.

The inelastic neutron spectra show features consistent with a single adsorption site, unlike in the similar compound CsC_{24}. Further, H_2 is strongly pinned along a single quantization axis and the H_2-substrate interaction is characterized by rotational barriers ~100 times greater than in pure graphite.

First-principles calculations suggestgreater than zum2eC

Many members of the department have continued with their public and school outreach during 2008, in anticipation to the International Year of Astronomy (IYA2009).

The dark universe has been a major public topic, one very brief example of this is Professor Ofer Lahav talking on the Radio 4 Today programme discussing dark matter.

School outreach work has included Dr Steve Fossey continuing to work with the Alexandra Park School. This collaboration between the School and UCL was recognised by the London Education Partnership Awards with an award in the category 'Excellent Professional Practice in Curriculum and Student Support in science, technology,

***Fig 2**. **Pe e D el**, l ad r of th Optical Sci nc Laboratory (l ft) and **Ofe Laha** (right), H ad of th Astrophysics Group, insp cting on of th DES l ns s at H athrow. Th fiv l ns s will b ass mbl d at UCL, b for b ing shipp d to th t l scop in Chil .*

The vast DES galaxy map will enable the astronomers to measure dark energy far more precisely than current observations.

The glass for the five lenses was manufactured in the US before being shipped to France where the lenses will be polished to a smoothness level of one millionth of a centimetre. The polishing and assembly of the five DES lenses will be a major technological achievement. This level of polishing across such large lenses is far more demanding than for normal eye glasses. The lenses will then be sent to the Optical Science Laboratory at UCL for assembly into the camera and from there to the telescope in Chile, where observations will start in 2011 and will continue until 2016.

The DES collaboration involves over 100 scientists from the US, UK, Spain and Brazil.

Sweet Molecule Could Lead Us To Alien Life

In November 2008 scientists detected an organic sugar molecule, glycolaldehyde in a massive star forming region of our galaxy where habitable planets could exist. This is an important discovery as glycolaldehyde is directly linked to the origin of life.

An international team of researchers, including Dr Serena Viti, used the IRAM radio telescope in France to detect the molecule in a massive star forming region of space, some 26000 light years from Earth.

The sugar molecule has previously only been detected towards the centre of our galaxy where conditions are extreme compared to the rest of the galaxy. This new discovery, in an area far from the galactic centre, also suggests that the production of this key ingredient for life could be common throughout the galaxy. This is good news in our search for alien life, as a wide spread of the molecule improves the chances of it existing along side other molecules vital to life and in regions where Earth-like planets may exist.

Imag court sy: IRAM ©

***Fig 4.** Mod l of th glycolald hyd mol cul .*

Glycolaldehyde, the simplest of the monosaccharide sugars, can react with the substance propenal to form ribose, a central constituent of Ribonucleic acid (RNA), thought to be the central molecule in the origin of life.

The team were able to detect glycolaldehyde by using the IRAM telescope (Fig. 3) to observe the region with high-angular resolution and at different wavelengths. The observations confirmed the presence of three lines of glycolaldegyde towards the most central part of the core of the region.

Imag court sy: IRAM/R bus©

***Fig 3**. Th IRAM Plat au d Bur Int rf rom t r.*

High Energy Physics

High energy particle physics is about looking at extremely small sizes, or equivalently at extremely high energies. It teaches us about the underlying nature of the physical universe, and the forces and laws that govern its development, from the first moments of the Big Bang, through to the present day, and far into the future. As well as challenging our theories, experiments capable of reaching these extremes of energy and size pose significant technical problems. The challenges include devising precision detectors which can operate in hostile environments, particle accelerators which can achieve high energy collisions, super-sensitive detectors capable of identifying very rare decays with very small 'background noise', high-speed electronics which can read out millions of pieces of information per

Atomic, Molecular, Optical and Position Physics

The atomic, molecular, optical and positron physics group is engaged in experimental and theoretical research that covers a wide breadth in this very active field.

Their research spans from the fundamental to the applied and encompasses the following broad topics: positron, positronium and electron collisions, ultracold gases, quantum chaos and statistical physics, ultrafast laser spectroscopy and strong laser interactions, biological physics and optical tweezers, atomic and molecular spectroscopy, and quantum information.

The group comprises 15 members of academic staff almost equally divided between theory and experiment.

Recent decades have seen a pronounced shift in research by traditional 'atomic physics' groups to work much more on problems involving molecules. At UCL the work on molecular physics is underpinned by a very active theoretical molecular physics group whose leader, Professor Jonathan Tennyson, summarises some of the group's recent activities.

Quantum Theory

Seventy years ago British Noble prize laureate Paul Dirac famously said that "the underlying physical laws necessary for the mathematical theory for a large part of physics and the whole of chemistry are…completely known" before adding the important rider that "the difficulty is only that the exact application of these laws leads to equations much too complicated to be soluble". The laws of non-relativistic quantum mechanics have remained essentially unchanged since Dirac's day, what has however changed is the advent of ever faster computers which have led to a revolution in our ability to perform useful calculations on problems of interest. The theoretical molecular physics group aims to find quantum mechanical solutions to problems of current scientific or technological interest. To do this end we study not only the quantum mechanical fundamentals

extended wavefunctions and we coined the phrase Asymptotic Vibrational States to describe them. These extended states are a direct result of quantum mechanics: energetically the molecule can all but break up but it cannot actually completely dissociate because there is insufficient energy in the system for

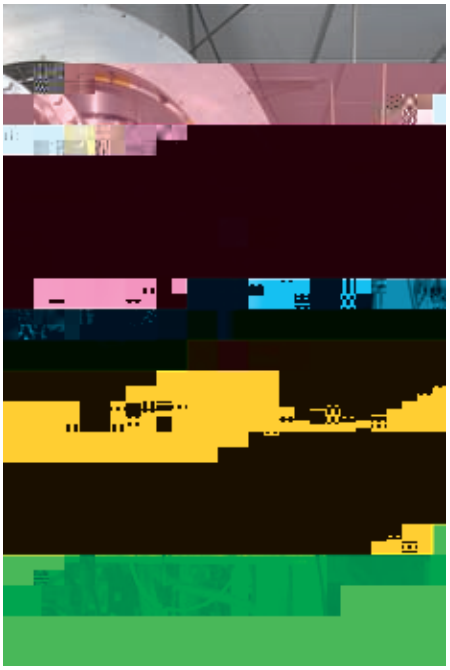


***Fig e 3**. Positronium is th 'atom' form d by a positron and l ctron. Pictur d is th world's only positronium b am which is in* **Professor Gaetana Laricchia's** *Laboratory at UCL.*

these methods only work for a few specific species but Professor Peter Barker has pioneered a method of cooling rather general and therefore chemically interesting molecules. However a second step is required to make these molecules ultracold. He proposes to do this using a 'chill wind' of ultracold rare gas atoms such as helium or argon. Before spending considerable time, money and effort setting up such an experiment it is good to be confident that it should work. Dr Paolo Barletta has performed a series of such calculations, so far focusing on molecular hydrogen and benzene.

These studies show that this so-called sympathetic cooling should be very efficient and potential loses of trapped cold gases by collisions which excite the molecule in question should be too infrequent to worry about. The experiments are now being built.

The Katrin Collaboration

Finally what is the mass of a neutrino? Well know it has a mass and we know that it is small but so far its value has defied measurement. Attempts to do this in the laboratory have proved extraordinarily difficult but a new collaboration called KATRIN (Karlsruhe Tritium Neutrino experiment) have determined to do this. KATRIN aims to achieve this by measuring the decays from a huge tank of molecular tritium, the radioactive form of hydrogen, (Figure 4). To remove systematic errors which plagued previous attempts at such lab studies, Dr Natasha Doss performed a series of detailed studies on the molecular processes that arises after the spontaneous radioactive decay of a T_2 molecule. Measurements are due to start early in the next decade and we hope these calculations will help weigh these light, elusive but very common fundamental particles.

***Fig e 4**. Th main sp ctrom t r for th KATRIN xp rim nt on th final part of its journ y to th Forschungsz ntrum Karlsruh , G rmany wh r th xp rim nt will b p rform d.*

Condensed Matter and Materials Physics

The work of the group covers an enormous range of activities, both experimental and theoretical, in the physics of condensed matter. In the examples below Dr Christian Ruegg describes fundamental studies of quantum phase transitions, and Dr Maria Sushko demonstrates the impact of physical theory on biological problems.

Quantum Phase Transitions in One Dimension

Phase transitions are familiar from our everyday experience, such as water molecules forming a gas, liquid, or solid depending on temperature and pressure. Physicists are interested in finding model systems to understand similar transitions that do not involve changes in the form of the material being studied, but in its internal properties. In a solid material, containing magnetic copper atoms for example, phase transitions and exotic quantum behaviour can be studied at the most fundamental level. In particular, the states of pairs of magnetic moments (dimers) in so-called quantum magnets can be tuned and closely monitored by different experimental techniques. As part of an international collaboration, UCL physicists Dr Christian Rüegg and Professor Des McMorrow study exciting fundamental properties of matter in novel model materials at temperatures close to absolute zero.

Classical magnets have typically a characteristic temperature, where the magnetic moments (or spins) of the individual atoms align. But there are systems where formation of an ordered state can be impossible, even at the lowest possible temperature, due to quantum fluctuations. The spins remain then in a quantum-disordered, liquid-like state. Such behaviour is frequently observed when the individual magnetic moments are small, and when the spins are coupled to form low-dimensional structures.

An ordered state is then eventually recovered at a new type of phase transition when not the temperature, but a different parameter like a magnetic field, exceeds a critical value. The transition is then called a quantum phase transition and occurs at absolute zero temperature. But even beyond this field-driven transition, dimerised spins do not behave like those in classical magnets below the ordering temperature. Their quantum mechanical nature is still important. The new phase is characterised more accurately by a mixture between classical and quantum behaviour, and can be described as a Bose-Einstein condensate (or BEC). Such condensates are now extensively studied in many areas of physics.

The BEC is one example of a phase which dimers can enter at absolute zero temperature and in a magnetic field of sufficient strength. By contrast, quantum (phase) fluctuations are even stronger and preclude the formation of long-ranged order or BEC, if the pairs of spins are arranged in a one-dimensional structure, for example as rungs on a ladder. At UCL we have focussed especially on such one-dimensional quantum spin ladders. Nature provides us with a prototypical realisation of this geometry in the material piperidinium copper bromide $(C_5H_{12}N)_2CuBr_4$, which has the large ring-like organic molecules $C_5H_{12}N$ isolating the magnetic ladders from each other (inset Figure 1).

In this case the spins completely refuse to behave like their classical analogues, even after a first quantum phase transition in a magnetic field.

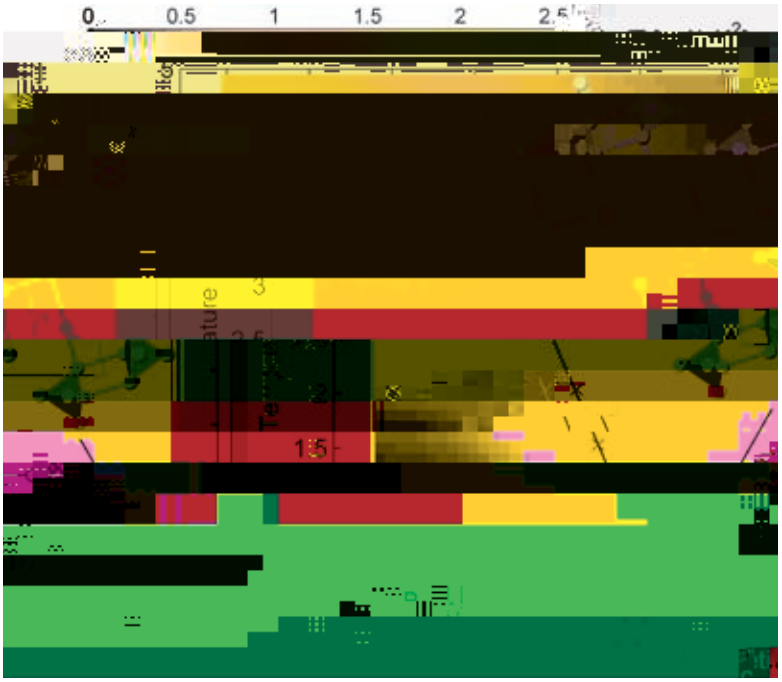


Fig e 1. *Magn tic fi ld-t mp ratur phas diagram of th spin-ladd r compound $(C_5H_{12}N)_2CuBr_4$, showing quantum disord r d (QD), quantum critical (QC), and spin Lutting r liquid (LL) phas s. Quantum phas transitions occur at B_c (closing of spin tripl t gap) and B_s (spin syst m fully polariz d). Ins t: lattic structur of $(C_5H_{12}N)_2CuBr_4$ in proj ction along th b-axis, with Cu atoms blu and Br whit .*

They remain in a fascinating state called a spin Luttinger liquid, until a very strong magnetic field forces them to align completely parallel like in a ferromagnet (Figure 1). The spin Luttinger liquid is another fundamental phase, which has its origin in the quantum properties of the individual magnetic moments.

These quantum phases, which have fascinated physicists for decades, can be studied in detail in quantum

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Condensed Matter and Materials Physics

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Studentship for Andrew Walters (STFC)
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£200,000 PI: N Skipper

Development of simultaneous diffraction-conductance measurements at ISIS (CCLRC/STFC)
£29,000 PI: N Skipper

Studentship: T Headon (Schlumberger Cambridge Research)
£6,000 PI: N Skipper

Publications 2008

Astrophysics

1. D. Zhang, D. Rodiguez Sanmartin, T. Button, C. Atkins, P. Doel, C. Dunare, C. Feldman, A. James, A. Michette, W. Parks, S. Pfauntsch, S. Sahraei, T. Stevenson, H. Wang and R. Willingale, Development of Piezoelectric Actuators for Active X-ray Optics, Proc. of Electroceramics, XI (2008).

2. C. Atkins, H. Wang, P. Doel, D. Brooks, S. Thompson, C. Feldman, R. Willingale, T. Button, D. Rodriguez Sanmartin, D. Zhang, A. James, C. Theobald, Future high resolution X-ray telescope technologies: prototype fabrication and finite element analysis, Proc. of SPIE, 7011, 70110X (2008).

3. C. Feldman, R. Willingale, C. Atkins, H. Wang, P. Doel, D. Brooks, S. Thompson, T. Button, D. Zhang, D. Rodriguez Sanmartin, A. James, C. Theobald, Development of thin shell adaptive optics for high angular resolution X-ray telescopes, Proc. of SPIE, 7011, 70110Y (2008).

4. B. Jergovic, S. Miller, Framing space: UK newspaper coverage of the Beagle 2 and Cassini-Huygens space missions, Communicating Astronomy to the Public Journal, 1, 5-11 (2008).

5. M. Lystrup, S. Miller, N. DelloRusso, R.J Vervack, T. Stallard, First vertical ion density profile in Jupiter's auroral atmosphere: direct observation using the Keck II telescope, The Astrophysical Journal (APJ), 677, 790-797 (2008).

6. S. Miller, So where's the theory: On the relationship between science communication practice and research, Chapter 16 in Cheng,D., Claessens,M., Gascoigne,T., Metcalfe,J., Schiele,B., Shunke,S. (ed.) Communicating science in social contexts: new models, new practices, Springer, 275-288 (2008).

7. H. P. Peters, D. Brossard, S. deChevegnie, S. Dunwoody, M. Kalfass, S. Miller, S. Tsuchida, Science-Media interface: it's time to reconsider, Science Communication, 30, 266-276 (2008).

8. H. P. Peters, D. Brossard, S. deCheveigny, S. Dunwoody, M. Kalfass, S. Miller, S. Tsuchida, Interactions with the mass media, Science, 321, 204-205 (2008).

9. T. S. Stallard, S. Miller, M. Lystrup, N. Achilleos, C .S. Arrdige, M. Dougherty, Dusk-brightening event in Saturn's H_3^+ aurora, ApJ, 673, L203-L206 (2008).

10. T. Stallard, M. Lystrup, S. Miller, Emission line imaging of Saturn's aurora, ApJ, 675, L117-L120 (2008).

11. T. Stallard, S. Miller, H. Melin, M. Lystrup, S. W. H. Cowley, E. J. Bunce, N. Achilleos, M. Dougherty, Jovian-like aurorae on Saturn, Nature, 453, 1083-1085 (2008).

12. D. M. Kipping, Transiting planets – Lightcurve analysis for eccentric orbits, Monthly Notices of the Royal Astronomical Society (MNRAS), 389, 1383-1390 (2008).

13. R. Wesson, M. J. Barlow, R. L. M. Corradi, E.J. Drew, P. J. Groot, C. Knigge, D. Steeghs. B.T. Gaensicke, R. Napiwotzk, P. Rodriguez-Gil, A.A. Zijlstra, M.F. Bode, J.J. Drake, D.J. Frew, E.A. Gonzalez-Solares, R. Greimel, M.J. Irwin, L. Morales-Rueda, G. Nelemans, Q.A. Parker, J.L. Sokoloski, A. Somero, H. Uthas, B. Warner, C.A. Watson, N.J. Wright, A planetary nebula around Nova V458 Vulpeculae undergoing flash ionization, ApJ, 688, L21-L24 (2008).

14. R. Wesson, M.J. Barlow, X.W. Liu, P. Storey, B. Ercolano, O. de Marco, The hydrogen-deficient knot of the 'born-again' planetary nebula Abell 58 (V605 Aql), MNRAS, 383, 1639-1648 (2008).

15. P. Caputo, Daniel, A.K. Speck, M.J. Barlow, R. Wesson, K. Volk, G.C. Clayton, The formation of PAHs: A case study on carbon-rich AGB stars, Bulletin of the American Astronomical Society, 40, 196 (2008).

16. A. Speck, M.J. Barlow, R. Wesson, G. Clayton, K. Volk, Unidentified infrared bands and the formation of PAHs around carbon stars, IAU Symposium, 251, 195-196 (2008).

17. C. Escolano, J.C. Bouret, J.F. Donati, F. Martins, T. Lanz, W. Marcolino, and I. Howarth, The magnetic field of the supergiant star Zeta Ori A, SF2A-2008: Proceedings of the Annual meeting of the French Society of Astronomy and Astrophysics, 465 (2008).

18. J.C. Bouret, J.F. Donati, F. Martins, C. Escolano, W. Marcolino, T. Lanz, I.D. Howarth, The weak magnetic field of the O9.7 supergiant Zeta Orionis A, MNRAS, 389, 75-85 (2008).

19. I.D. Howarth, N.R. Walborn, D.J. Lennon, J. Puls, and Y. Naze, Towards an understanding of the Of?P star HD 191612: optical spectroscopy, Revista Mexicana de Astronomia y Astrofisica, 33,120-120 (2008).

20. N.R. Walborn, O. Stahl, R.C. Gamen, T. Szeifert, N.I. Morrell, N. Smith, I.D. Howarth, R.M. Humphreys, H.E. Bond, and D.J. Lennon, A three-decade outburst of the LMC luminous blue variable R127 draws to a close, ApJ, 683, L33-L36 (2008).

21. F.C. Fekel, K.H. Hinkle, R.R. Joyce, P.R. Wood, I.D. Howarth, Infrared spectroscopy of symbiotic stars. VI. Combined orbits for two S-Type systems: V455 Scorpii and SS 73-90, ApJ, 136, 146-158 (2008).

22. C.J. Evans, I.D. Howarth, Kinematics of massive stars in the Small Magellanic Cloud, MNRAS, 386, 826-834 (2008).

23. R.A. Gruendl, Y.H. Chu, J.P. Seale, M. Matsuura, A.K. Speck, G.C. Sloan, L.W. Looney, Discovery of extreme carbon stars in the large magellanic cloud, ApJ, 688, L9-L14 (2008).

24. M.M. Dworetsky, J. Persaud, Xenon in mercury-manganese stars, MNRAS, 385, 1523-1529 (2008).

25. M.M. Dworetsky, A. Dyer, J.L. Persaud, Strontium and yttrium in HgMn stars, Contrib. Astron. Obs. Skalnaté Pleso, 38, 141-146 (2008).

26. A.J. Willis, P. Crowther, P. Morris, K.A. van der Hucht, J.D. Smith, A.P. Marston, J. Hillier, P. Williams, The neon abundance in WC stars: Testing massive star evolution, ASP Conference Series Volumes, 388, 233 (2008).

27. T. Stallard, S. Miller, M. Lystrup, N. Achilleos, E.J. Bunce, C.S. Arridge, M.K. Dougherty, S.W.H. Cowley, S.V. Badman, D.L. Talboys, R.H. Brown, K.H. Baines, B.J. Buratti, R.N. Clark, C. Sotin, P.D. Nicholson, P. Drossart, Complex structure within Saturn's infrared aurora, Nature, 456, 214-217 (2008).

28. C.M. Jackman, C.S. Arridge, N. Krupp, E.J. Bunce, D.G. Mitchell, H.J. McAndrews, M.K. Dougherty, C.T. Russell, N. Achilleos, G.H. Jones, A.J. Coates, A multi-instrument view of tail reconnection at Saturn, J Geophys Res, 113, A11213 (2008).

29. N. Achilleos, C.S. Arridge, C. Bertucci, C.M. Jackman, M.K. Dougherty, K.K. Khurana, C.T. Russell, Large-scale dynamics of Saturn's magnetopause: Observations by Cassini, J Geophys Res, 113, A11209 (2008).

30. A. Masters, N. Achilleos, M.K. Dougherty, J.A. Slavin, G.B. Hospodarsky, C.S. Arridge, A.J. Coates, An empirical model of Saturn's bow shock: Cassini observations of shock location and shape, J Geophys Res, 113, A10210 (2008).

31. C. Bertucci, N. Achilleos, M.K. Dougherty, R. Modolo, A.J. Coates, K. Szego, A. Masters, Y. Ma, F.M. Neubauer, P. Garnier, J.-E. Wahlund, D.T. Young, The Magnetic Memory of Titan's Ionized Atmosphere, Science, 321, 1475 (2008).

32. C.S. Arridge, K.K. Khurana, C.T. Russell, D.J. Southwood, N. Achilleos, M.K. Dougherty, A.J. Coates, H.K. Leinweber, Warping of Saturn's magnetospheric and magnetotail current sheets, J Geophys Res, 113, 8217 (2008).

33. C.S. Arridge, N. Andre, N. Achilleos, K.K. Khurana, C.L. Bertucci, L.K. Gilbert, G.R. Lewis, A.J. Coates, M.K. Dougherty, Thermal electron periodicities at 20RS in Saturn's magnetosphere, Geophys Res Lett, 35, L15107 (2008).

34. B. Marty, N. Achillieos, 46 co-authors,

62. S. Paulin-Henriksson, A. Amara, L. Voigt, A. Refregier, S. L. Bridle, Point spread function calibration requirements for dark energy from cosmic shear, A&A, 484, 67-77 (2008).

63. Y.G. Tsamis, J.R. Walsh, D. Pequignot, M.J. Barlow, I.J. Danziger, X.-W. Liu, Integral field spectroscopy of planetary nebulae: mapping the line diagnostics and hydrogen-poor zones with VLT FLAMES, MNRAS, 386, 22-46 (2008).

64. M. Lerate, J. Yates, S. Viti, M.J. Barlow, B.M. Swinyard,LiuH,iaaWnnic28inSaro s.R. WGoicoec28inSea

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MINOS

M. Dorman, J. Evans, A. Holin, M. Kordosky, D. Koskinen, R. Nichol, C. Smith, J. Thomas, P. Vahle

46. Search for active neutrino disappearance using neutral-current interactions in the MINOS long-baseline experiment, Phys. Rev. Lett.101,221804 (2008).

47. Testing Lorentz invariance and CPT conservation with NuMI neutrinos in the MINOS Phys. Rev. Lett.101,151601 (2008).

48. Measurement of neutrino oscillations with the MINOS detectors in the NuMI beam. Phys. Rev. Lett.101,131802 (2008).

OPAL

D. Miller, P. Sherwood

49. Measurement of alpha(s) with radiative hadronic events, Eur. Phys .J. C53, 21-39 (2008).

PHENOMENOLOGY

J. Butterworth, A. Davison

50. Higgs search channel at the LHC, Phys. Rev. Lett.100, 242001 (2008).

THEORY – LOW ENERGY

C. Wilkin

51. Coupled-channel effectsin the pp → ppK+ K- reaction, Phys. Lett. B 668, 315-318 (2008).

52. Polarisation of the omega meson in the pd → He-3 omega reaction at 1360 and 1450-MeV, Phys. Lett. B 668, 258-262 (2008).

53. Observation of inverse diproton photodisintegration at intermediate energies, Phys. Rev. Lett.101, 102501 (2008).

54. Nucleon charge exchange on the deuteron: A Critical review, Eur. Phys. J. A, 37, 143-149 (2008).

55. Interpretation of K+ anti-K0 pair production in p p collisions, Eur. Phys. J. A, 38, 1-8 (2008).

56. Coupling Constant for N*(1535)N(rho), Phys. Rev. C77, 058202 (2008).

57. Differential cross section and analyzing power of the vec- p p → pp pi0 reaction at a beam energy of 390-MeV, Phys. Rev. C77, 044004 (2008).

58. Determination of target thickness and luminosity from beam energy losses, Phys. Rev. ST Accel.Beams 11, 052801 (2008).

ZEUS

S. Boutle, J. Butterworth, C. Gwenlan, T. Jones, J. Loizides, M. Wing

59. Multijet cross sections in charged current ep scattering at HERA, Phys. Rev. D78, 03d004 (2008).

58. Determinati6nel at the LHC,S)K0(S) TdTfanceam energy losses-0.005 Tc[cueur)148(. Ph)37(. R)1 B 6

21. G. Peach, D.F.T. Mullamphy, I.B. Whittingham, Unification of the impact and one-perturber theories of line shapes, 19th International Conference on Spectral Line Shapes (ICSLS), Valladolid, Spain, (AIP Conf Proc vol 1058) ed. M.A. Gigosos and M.A. Gonzalez (New York: AIP) 234-236 (2008).

22. X. Huang, B.J. Braams, J.M. Bowman, R.E.A. Kelly, J. Tennyson, G.C. Groenenboom, A. van der Avoird, New ab initio potential

54. M. Brown, F. Renzoni, Ratchet effect in an optical lattice with biharmonic driving: A numerical analysis, Phys. Rev. A, 77, 033405 (2008).

55. R. Gommers, V. Lebedev, M. Brown, F. Renzoni, Gating ratchet for cold atoms, Phys. Rev. Lett. 100, 040603 (2008).

31. A.P. Horsfield, M. Finnis, M. Foulkes, J. LePage, D. Mason, C. Race, A.P. Sutton, D.R. Bowler, A.J. Fisher , R. Miranda, L. Stella, A.M. Stoneham, D. Dundas, E. McEniry, T.N. Todorov, C.G. Sánchez, Correlated electron-ion dynamics in metallic systems, Computational Materials Science 44 16-20 (2008)

32. S. Hussain, I.J. Ford, The dielectric properties of charged nanoparticle colloids at radio and microwave frequencies: high frequency relaxation, J. Phys. D: Appl. Phys. 41 015302 (2008)

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