Annual Report for 2014

Centre for Astrophysics and Planetary Science

School of Physical Sciences
University of Kent

http://astro.kent.ac.uk
## Contents of Annual Report 2014

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1 General Objectives

**CAPS** has two main sub-groups, each with 3 faculty members: Solar System and Star Formation. The Solar System group studies phenomena from planets, to asteroids and comets, and down to sub-micron interplanetary dust. The Star Formation group studies molecular clouds, protostars and star clusters. CAPS has grown from 4 faculty members in 2008 to 6 now with over 22 active researchers including one post-doc, one experimental officer, 15 postgraduate research students, and other visiting and associated staff.

Mission Statement. CAPS exists to:
(a) act as a Forum to bring together all those with research interests in Astrophysics and Planetary Science,
(b) advance the Frontiers of knowledge in astronomy and space science with top quality research,
(c) Foster interest in the study of our Universe,
(d) Further astronomy to the surrounding community and provide an expert and accessible resource.

The general Strategy of the Centre is:

1. To provide a focus for astronomical and planetary science research that crosses disciplinary borders, and to construct a larger coherent grouping.
2. To provide an opportunity to exchange ideas and information between departments and other interested parties.
3. To raise the profile of Kent in the international community, acting as a host for short and long term visitors, supporting collaborations and the use of external facilities.
4. To act as a body for hosting seminars, workshops and conference.
5. To raise the profile and awareness of astronomy and planetary science in Kent by involving schools, amateur astronomers and the general public.
6. To provide a common infrastructure, sharing archival data, knowledge and computing resources.
7. To provide a forum for cross fertilisation of doctoral and postdoctoral training and support, and to support their interests nationally.
8. To provide a local host for Astronomy in the South-East of England through the SEPnet and SEPNNet-Astro Community.
In REF2014, CAPS represented the entire Kent physics Unit of Assessment, in the national Research Excellence Framework, the 5-year research evaluation exercise other research groups all contain physicists but were submitted to other UoAs. We obtained a creditable rating with 27\% 4* research activity. placing Kent 13th in the country overall \textit{and top in the country for small-to-medium physics groups (under 20 academics)}. \textit{We also came top in the University for REF funing per FTE.}

CAPS continued to prosper in 2014, with a high number of quality publications and extensive public engagement. A full seminar programme and other research, training and teaching resources were provided (see the webpages http://astro.kent.ac.uk).

Open Access. We endeavor to publish all our journal papers on the open access site astro-ph.

Growth. CAPS is part of the rapidly expanding School of Physical Sciences which now has 35 faculty members organised within four research groups. In addition to Physics with Astronomy, a unique Astronomy and Space Science degree (BSc and MPhys) is offered at Kent. The annual intake exceeds 60 astronomy degree and 80 straight physics students. We train and supply researchers for the aerospace industry (e.g. Airbus) as well as for commerce and science sectors. The strain due to inflated teaching duties has impacted on research time and research quality. This has been felt for several years and the balance now needs redressing to maintain both research and teaching vitality.

Awards. The Centre has received support through the award of time on facilities to the estimated value of £6 Million over the last five years. This is the allocated in-kind value to CAPS as Principle Investigators. The University benefits from this invisible income without any visible expenditure in terms of space, facilities or other human resources. Hence, this research income is not just turnover but is actually profit. As Co-Investigators, the value cannot be plausibly estimated but is many times higher. In addition, an STFC consolidated grant has been awarded and directed towards solar system work by Burchell and pricey (£406k, 2013-2016). Price also holds a STFC/Aurora grant (£100K).

Teaching. Since 2005/6 the undergraduate population taking Astro-related degrees has risen from 46 to 172 in 2012, remaining constant in 2013. In addition, the CAPS staff are heavily involved in the straight physics programmes which have suffered even higher success.

A wide range of world-leading facilities were utilized. CAPS contributes directly to this international facility. Facilities which were employed in the reported results include the Herschel and Spitzer Space Observatories (ESA/NASA), the Very Large Telescope (ESO, Chile), VISTA (ESO, Chile), the SMART spacecraft (NASA), the Rosetta spacecraft (ESA), and UKIRT.
Internally, the High-Velocity Impact Lab and the Forge Supercomputer were in full use. Both facilities will need some investment to sustain their discovery capabilities. The Impact Lab is running out of space and a solution must be found. The Forge supercomputer is heading towards full capacity and we anticipate the need for replacement in 2016.

3 January – April 2014 Triannual Update

Highlights

ESO SCIENCE RELEASE: The Anatomy of an Asteroid

PR Image eso1405b: Asteroid (25143) Itokawa seen in close-up (Credit ESO)
ESO’s New Technology Telescope (NTT) has been used to find the first evidence that asteroids can have a highly varied internal structure. Using very precise ground-based observations, Stephen Lowry (University of Kent, UK) and colleagues have measured the speed at which the near-Earth asteroid (25143) Itokawa spins and how that spin rate is changing over time.
**Funding**

Burchell is PI on a $25,000 (approx. £16k) sub-contract to provide services to NASA for impact testing of new sensor designs (May 2014).

£2000 awarded to HOYS team:
Dirk Frpebrich, Mark Price, Vicky Mason, Chrysa Avdellidou
from Public Engagement with Research Fund at UoK for ‘HOYS-CAPS: Hunting Outbursts from Young Stars with the Centre for Astrophysics and Planetary Science’; 08.04.2014

Chrysa Avdellidou sent another HOYS application for a grant to the Institute of Physics, but we are going to have the results mid-June.

STFC Studentship awarded to Dirk Froebrich. He also submitted an ESO proposal for 202 hours of VLT time with KMOS instrument.

Mark Price submitted a 2M euro ERC starting grant with Penny Wozniakiewicz.

**Visitors & CAPS seminars**

John C. Bridges, University of Leicester
What we Have Learnt About Mars From The Curiosity Rover

Manda Banerji, UCL
The Co-evolution of Galaxies and their Supermassive Black-Holes: Insights from New Wide-Field Galaxy Surveys

Neil Bowles, University of Oxford, gave a talk in February:
Exploring the Moon in the thermal infrared: A tale of temperature extremes

**Events & Activity**

Burchell was an external PhD examiner at Cranfield in Jan 2014
Burchell is a member of the STFC Astronomy Grants Panel for 2014
Burchell was a member of the Astronomy Grants panel of the Finland Academy for 2014
Burchell is a member of the Strategic Advisory Panel for the Institute of Shock Physics at Imperial, and took part in their 2014 review in Feb. 2014

Froebrich is a member of the Review Panel for a Collaborative Research Centre to be funded by the German Science Foundation (EUR 8.1M)
Michael Smith acted as reader for the UNESCO L’oreal award programme.

**Talks, Visits, Observing Trips**

Nisha Ramkisoon in January presented a poster at UKPF held at the open University, an in March enjoyed a trip to the Isle of Skye to collect basalt for impact experiments (with Kathryn McDermott). Also in March, she presented a poster at LPSC 2014. And in April gave a talk at the PETER conference.

Burchell, Price, Lowry, McDermott (with Wozniakiewicz from NHM) organised a 1 day meeting at the Royal Astronomical Society in April 2014. The topic was “Comets after Stardust and before Rosetta”.

**Talks:**
1) *Cometary Delivery of Volatiles to the Moon.* Royal Astronomical Society Open Meeting, April, 2014. *Invited talk*

**Posters**
Lawrence Yolland and Karl Landers both had posters at the April PETER meeting in London.

Froebrich talk: 19.03.2014, University of Kent, From Dust to Stars and Clusters, Talk at Kent Physics Society

Froebrich talk: 05.03.2014, Liverpool John Moores University, FU-Ori objects in the infrared, Froebrich attended the GAIA Variables Follow-up Workshop 04.02.2014

Mark Price submitted abstracts to attend Asteroid, Comet and Meteors in Finland in July, and submitted abstracts to attend the European and Planetary Science Congress in Lisbon in Sept.

Chrysa Avdellidou gave a talk in UKPF in January at the Open University.

Chris Lynch will attend this summer:
SEPPNet Inaugural Summer School - NPL, June 2014
NAM2014 - University of Portsmouth,

**Student news**

GI has passed his minor corrections
Sally Makin (SM) has accepted the STFC Studentship to start Sep2014

4 May – September 2014 Triannual Update

Highlights

CAPS submitted a University Beacon application, which was successful. This raises £100k for a new telescope and dome.

The UK Planetary Forum 12th Early Career Scientists’ Meeting will be held in Kent. Chrysa Avdellidou is organizing the two day event having gained funding from the faculty and school.

‘Evidence for interstellar origin of seven dust particles collected by the Stardust spacecraft’ was published in Science, 2014:

The dust speck called Orion also contained crystalline minerals olivine and
spinel as well as an amorphous material containing magnesium, and iron. (Credit: Westphal et al. 2014, Science/AAAS).

**New Members**

CAPS members are listed here: http://astro.kent.ac.uk/staff.html

We welcome Dr. Jon Hillier, arriving from Heidelberg.

New members include Sally Makin, James New, Jack Nicholas, Igor Novikov and Jamie Wickham-Eade who starts his PhD with an Alumni scholarship.

**Funding & Proposals**

Agata Rożek submitted an Arecibo observing proposal of radar observations of a YORP target, asteroid 1999 JV6 (on the September 2nd deadline). Planned observing+training visit will take place 7/01-12/02/2015 and is partially supported by RAS.


Jon Tandy (Uni. of Leicester) applied for a Royal Society Fellowship and for an STFC Ernest Rutherford Fellowship to come and work in the Impact group (outcomes expected Dec. 2014/Jan. 2015).

*Telescope proposals submitted by Dirk Froebrich: (Smith Co-I on some)*

- ESO proposal for 202hr of VLT time with KMOS resubmitted (PI)
- 15n, LT, Col, Early science with GAIA transients, ITP proposal
- 15n, Mercator, Col, Early science with GAIA transients, ITP proposal
- 7n WHT, Col, Early science with GAIA transients, ITP proposal
- 7n INT, Col, Early science with GAIA transients, ITP proposal
- 92hr, LT, Col, Follow up of Gaia Transients

**Appointments**

Mark Burchell is a member of the STFC Astronomy Grants Panel for 2014 and attended two panel meetings in Sept. 2014.

Dirk Froebrich has been appointed Chair of Beacon Observatory.
**Visitors**

Jingqi Miao hosted the visit by Prof. Koji Sugitani and his Ph.D student Takeyoshi Kusune at the end week of May 2014, to finalize the co-work for an ApJ paper which was submitted in July, and resubmitted in Sept after modification suggested by referee.

Mark Price hosted Dr Eugene Hertel of the Hypervelocity Impact Symposium committee to discuss with the committee to hold its international meeting at Kent in 2016/2017.

Chrysa Avdellidou successfully negotiated with the UK Planetary Forum for Kent to host the 2015 Young Scientists meeting in SPS in Feb. 2015. Financial Contributions made from the Dean, Head of School and SEPnet.

Mark Gieles, heading a new group in Surrey, make a colloquium entitles: The origin of the Milky Way globular clusters

**Events & Activity**

UWISH2 5th Anniversary Press Release  
http://www.ljmu.ac.uk/newsupdate/viewarticle/1665/

Chrysa Avdellidou completed the Sepnet outreach course for which she received training last February. The result is a workshop which will be held in the School on the 25th of October. Froebirch and Avdellidou contacted local groups with amateur astronomers to get them involved Froebirch’s observational survey on clusters. During the workshop he will present the scientific part and the theory on observations and Avdellidou will present a hands-on session on how to analyse their data by themselves.

Outreach:  
Agata Rożek talk:  
"Asteroid discoveries and studies, and what we do about them at Kent", an outreach talk for the Monkton Stargazers amateur astronomy group, 23/05/2014

Agata Rożek talk:  
"Asteroid discoveries and studies, and what we do about them at Kent", an outreach talk for the Space School at Kent, 9/08/2014

Agata Rożek was volunteer demonstrator at the "Catch a comet" exhibit at the Royal
Society Summer Science Exhibition in London (5/07/2014)

Agata Rożek
Schools: SEPnet GRADnet Summer School at the National Physical Laboratory, Teddington, 9-12/06/2014

**Burchell made a TV:** Appeared on BBC SE News in August, about paper in Phil Trans Roy Soc. This paper was also discussed in New Scientist (with an interview), on-line in several national and overseas newspapers (including the Daily Mail and a Canadian newspaper), involved interviews with several on-line news groups and articles appeared on over 50 websites world-wide
Filmed by the Discovery channel for a documentary to appear in US in Dec, and then world wide next year.
Also filmed by BBC Horizon on Sept. 29th for an episode later this year on space debris.

**Talks, Visits, Observing Trips**

Chrysa Avdellidou attended:
1) ACM conference in Helsinki and presented a poster.
2) EPSC conference Estoril, Lisbon, gave a talk.
3) present a poster at the Research Symposium 2014 (SPS).

Anne Buckner attended the conference and presented a poster at 'MODEST'14: Dance of the stars' in Bad Honnef, Germany (June)
Poster title: Scale Height Evolution of Star Clusters

Burchell held two talks:
3) *Shock effects on fossil materials* at the Hopkinson Centenary Conference, Cambridge, Sept. 2014. **Invited talk**
4) *Shock Metamorphism* at the European Mineralogical Union PhD summer school, Univ. of Glasgow, Aug 2014. **Invited talk**

Froebrich visited Liverpool John Moores University, 3-5.8.2014
And gave a talk: 04.08.2014, Liverpool John Moores University, Scale Height Evolution of Star Clusters, Luchtime Research Seminar

Froebrich talked on 16.09.2014, at the University of Kent, Astrophysics Research, SPS Away Day

Agata Rożek: Conferences/talks:
"Obserwacje planetoid zbliżających się do Ziemi, poszukiwanie YORPa i nie tylko" ("Observing near-Earth asteroids in search of YORP and beyond"), a seminar talk at the Astronomical Observatory Institute of Adam Mickiewicz University in Poznań, Poland, 15/05/2014
Agata Rożek attended Asteroids, Comets, Meteors in Helsinki, Finland, 30/06-4/07/2014, presented a talk: Agata Rozek et al. "Spin-state and thermophysical analysis of the near-Earth asteroid (8567) 1996 HW1" (abstract book is at http://www.helsinki.fi/acm2014/). The conference participation has been supported by the Federation of Finnish Learned Societies (accommodation + conference fee).

Jenna-Louise Pasini

Jenna Louise Pasini Presented poster at LPSC in Texas, USA in March
Presented 2 talks at EPSC in Estoril, Portugal in September
Won RAS Grant for £628.00 for attending EPSC.
Was featured in Discover Magazine, and Science Uncovered Magazine.

Price, Ramkissoon, Avdellidou and Hibbert presented at the European Planetary Space Congress in Lisbon.

Wozniakiewicz presented at the Meteoritical Society meeting in Casablanca

Smith and Lynch attended the National Astronomy Meeting in Portsmouth in June. Smith chaired a plenary session.

Smith held a series of six public lectures on the Braemar cruise ship and held star-gazing and Perseid meteor sessions in August.

**Student news**


**CAPS research:** **UWISH2 Survey Celebrates 5th Anniversary!**
The area shown here was part of the very first image taken for the UWISH2 survey. It shows on the top a region of massive star formation (called G35.2N) with two spectacular jets. On the bottom an intermediate mass young stellar cluster (Mercer14) can be seen. Several jets are visible in its vicinity, as well as a region of photo-ionized material surrounding a young massive star. See Dirk Froebrich for details.

5 October – December 2014

Highlights

Beacon funding finally approved and order sent to Baader for new Observatory.

Burchell was appointed Chair of the Planetary Studies sub-group of the STFC
Astronomy Grants Panel for the period 1 January 2015 to 31 December 2018

Smith gave the physics colloquium at the University of Miami in October.

**Activity**

The Kent Impact lab and Mark Price featured in an edition of BBC Sky at Night devoted to Rosetta. The link is at BBC i-Player at [http://www.bbc.co.uk/programmes/b04pkvpq](http://www.bbc.co.uk/programmes/b04pkvpq) and Kent appears about 35 minutes in (when the presenter starts walking through trees philosophing about how life started on Earth, those are Univ of Kent trees and he is about to enter the Ingram Building). Don’t forget to watch Horizon on BBC in Feb 2015 which should also feature the Impact Lab

Price appeared on the "Sky at Night".

- MCP and MJB lobbying to host the 2017 Hypervelocity Impact Symposium at Kent

- MCP successfully negotiated some Enterprise work with AWE to use the light gas gun.

  - New collaboration forged with Portsmouth's Earth Sciences group (through PhD student Ricky Hibbert).

Smith travelled to Miami giving five Public Lectures and holding a Colloquium at the University of Miami on Astrophysical Jets in October.

**Funding & Awards**

Froebrich: £4,500, PI, for a SEPNET workshop funding, for RAS workshop on Galactic Plane Science with widefield surveys

Smith, Froebrich £1,000, Faculty of Sciences Research Funding, for RAS workshop on Galactic Plane Science with widefield surveys

Froebrich: 60 nights (30/30 in 15A/B), Liverpool Telescope, T, Col, JL15A03, Solving the Young Star Luminosity Problem

Froebrich, Smith Col: "Early science with GAIA" transients" (ITP-2014, 15 nights LT, 15 Mercator, 7 WHT, 7 Isaac Newton Telescope

Froebrich, SmithCols The APEX Large CO Heterodyne Outflow Legacy
Supercam survey of Orion (ALCOHOLS) ALCOHOLS project is awarded 32 hours time through the ESO and the Swedish allocation.

Froebrich, Smith Col: proposals (P29 and P14) have been awarded 9 nights on WHT (PI: Fraser), and 18 nights on INT (PI: Hodgkin), for spectroscopy of Gaia Alerts

Froebrich, Smith Col: PI Fraser - 92 hr total - 46 hr from each of Liverpool JMU and PATT

Avdellidou: During this WHOLE year got grants for:  
1.475 pounds grant from RAS to participate to ACM conference in Helsinki  
2. Grant from ACM conference itself to participate  
3. 1000 pounds grant from RAS to organise the UKPF meeting here at Kent  
4. 1000 pounds grant from the HoS to organise the UKPF meeting here at Kent  
5. 1000 pounds grant from the Dean of Science to organise the UKPF meeting here at Kent  
6. 310 pounds grant from SEPNet to organise the UKPF meeting here at Kent  
7. 2000 pounds grant from Uni to organise the outreach workshop with amateur astronomers here at Kent. HOYS-CAPS project. Froebrich was the PI. but Avdellidou was the motivator for the workshop.

Lowry Awarded STFC Public Outreach grant to host Rosetta Teacher Training Conference event at the University of Kent in July 2015. Co-organiser is Dr. Vicky Mason.

Lowry conducted several national radio and television interviews related to Rosetta involvement: BBC Radio Kent, BBC Radio 5 Live, BBC news, ITV, Radio 5, BBC Radio 4

**Talks, Visits, Observing Trips**

Duncan MacKay attended British Society for Literature & Science symposium at the University of Westminster on November 8th as invited speaker on panel discussing issues of cross-cultural influences between Arts and Sciences, including DM's experience delivering Arts-based seminars to CAPS postgraduate students.

Miao is invited by Prof Sugitani to visit him at Nagoya City Univ. for two weeks in March 2015.

Deller gave a talk on "Simulations of impacts on rubble pile asteroids" at the Asteroids, Comets, and Meteors Conference in Helsinki, 30.06 - 4.7. 2014
Deller gave a talk on "Impact Simulations on the Rubble Pile Asteroid Steins" at the DPS annual meeting in Tucson, Arizona, 10th-14th 11

Deller was presented the "Pierazzo International Student Travel Award" by Mark Sykes, consisting of a certificate and a cheque of $2000 (http://www.psi.edu/pista/awardees.html)

Froebrich: Organisation for RAS workshop on Galactic Plane Science with widefield surveys has started properly, registration is now open (http://astro.kent.ac.uk/~df/gp/index.html)

Avdellidou hosted 2 two invited speakers. Dr. Marco Delbo' from Observatoire de le Cote d'Azur, Nice, and Dr. Apostolis Christou from Armagh, N.Ireland

Avdellidou and Froebrich held the HOYS-CAPS workshop for amateur astronomers on October 25 2014.

Invited Speakers

In October:
Giovanna Tinetti (UCL) Galactic Planetary Science
Marco Delbo: Observatoire de la côte d'Azur, Nice: Burning Asteroids with the light of the Sun

In November:
Tim Haworth (Cambridge) Synthetic observations of star forming regions
Aurora Sicilia-Aguilar :Herschel views of star formation and protoplanetary disks

In December:
Tolis Cristou (Armagh Observatory):Martian Trojan asteroids: A new feature of the inner solar system
Anthony Whitworth (Cardiff) : Star Formation and the Role of Feedback
Ben Rozitis (Tennessee): Cohesive forces in a rubble-pile asteroid

Publications Oct-Dec 2014

Miao has a paper in press:
Kusune, Takayoshi et al.

Burchell M.J. Human Spaceflight and an Asteroid Redirect Mission. Space Policy 30, 163 – 169, 2014. (A personal landmark as this was Burchell's 200th refereed journal paper)


Price and PhD students submitted 5 abstracts to the Lunar and Planetary Science conference to be held in Houston, Texas, March 2015.

- P. J. Wozniakiewicz et al. (including MCP) published in Meteoritics and Planetary Science

Price co-author on paper written by Donna Arnold and submitted to "Dalton Transactions"

### 6 Journal Publications 2014

Extreme Infrared Variables from UKIDSS - I. A concentration in Star Forming Regions
[2014MNRAS.439.1829C](2014MNRAS.439.1829C)


Kepler-210: An active star with at least two planets
Ioannidis, P.; Schmitt, J. H. M.; Avdellidou, Ch.; von Essen, C.; Agol, E.
2014A&A...564A..33I

http://adsabs.harvard.edu/abs/2014A%26A...567L...2G

Mottola, S.; Lowry, S.; Snodgrass, C.; Lamy, P. L.; Toth, I.; Rożek, A.; et al., The rotation state of 67P/Churyumov-Gerasimenko from approach
observations with the OSIRIS cameras on Rosetta, 09/2014, A&A, 569L, 2M
http://adsabs.harvard.edu/abs/2014A%26A...569L...2M

Spectroscopy of HD 86222 - a quintuple system with an eclipsing component
Rożek, A.; Bartczak, P.; Borczyk, W.; Schwarzenberg-Czerny, A.
2014A&A...564A..26D

Continued activity in P/2013 P5 PANSTARRS. Unexpected comet, rotational break-up,
or rubbing binary asteroid?
Hainaut, O. R.; Boehnhardt, H.; Snodgrass, C.; Meech, K. J.; Deller, J.; Gillon, M.;
2014A&A...563A..75H

The internal structure of asteroid (25143) Itokawa as revealed by detection of YORP
spin-up
Lowry, S. C.; Weissman, P. R.; Duddy, S. R.; et al.
2014A&A...562A..48L

Spectral similarity of unbound asteroid pairs
Wolters, Stephen D.; Weissman, Paul R.; Christou, Apostolis; Duddy, Samuel R.;
Lowry, Stephen C.
2014MNRAS.439.3085W

Price M.C., Ramkissoon N.K., McMahon S., K. Mijković, J. Parnell, P. J. Wozniakiewicz,
Kearlsey A.T., Blamey N.J.F., Cole M.J., and Burchell M.J. Limits on methane release
and generation via hypervelocity impact of Martian analog materials. International
2014IJAsB..13..132P

Gangappa R., Burchell M.J. and Hogg S.I. Morphological and molecular analysis calls
for a reappraisal of the Red Rain cells of Kerala. Current Microbiology 68, 192 - 198,
2014.

Evolutionary tracks of massive stars during formation
Smith, Michael D.
Collective outflow from a small multiple stellar system
Peters, Thomas; Klaassen, Pamela D.; Mac Low, Mordecai-Mark; Schrön, Martin; Federrath, Christoph; Smith, Michael D.; Klesse, Martin; Federrath, Christoph; Smith, Michael D.; Klesse, Martin.

Molecular jets in the DR21/W75N high-mass star-forming region
Smith, Michael D.; Davis, Chris J.; Rowles, Jonathan H.; Knight, Michael


Burchell List, Sept 2014


3 Other Submissions & Publications 2014

VISTA Variables in the Vía Láctea (VVV): Halfway Status and Results
Hempel, M.; Minniti, D. et al inc. Smith, M.D.
2014Msngr.155...29H

4 Other Conference Abstracts/Publications

Mark Price is co-author and first author on 10 conference abstract presented at the Lunar and Planetary Science conference in Houston, Texas.