ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Welcome back after our winter break to the sixty sixth edition of ExoPlanet News. As usual, we have an excellent selection of abstracts this month.

As I write this, it has just been revealed that, following the candidate mission presentations in Paris last week, the recommendation to ESA's Science Programme Committee is that PLATO 2.0 be selected for the M3 launch slot. The final decision will be made at the SPC meeting on February 19/20. Congratulations to Heike Rauer, Don Pollacco and the rest of the PLATO team for getting this far. The current status of the M3 selection has been summarized nicely on the BBC website: http://www.bbc.co.uk/news/science-environment-25911893

The next edition of the newsletter is planned for end of February / early March 2014. Please send anything relevant before then to exoplanet@open.ac.uk, and it will appear in the next edition. Remember that past editions of this newsletter, submission templates and other information can be found at the ExoPlanet News website: http://exoplanet.open.ac.uk.

Best wishes
Andrew Norton
The Open University

2 Abstracts of refereed papers

Superhabitable Worlds

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Astrobiology, in press (arXiv:1401.2392)

To be habitable, a world (planet or moon) does not need to be located in the stellar habitable zone (HZ), and worlds in the HZ are not necessarily habitable. Here, we illustrate how tidal heating can render terrestrial or icy worlds habitable beyond the stellar HZ. Scientists have developed a language that neglects the possible existence of worlds that offer more benign environments to life than Earth does. We call these objects "superhabitable" and discuss in which contexts this term could be used, that is to say, which worlds tend to be more habitable than Earth. In an appendix, we show why the principle of mediocracy cannot be used to logically explain why Earth should be a particularly habitable planet or why other inhabited worlds should be Earth-like. Superhabitable worlds must be considered for future follow-up observations of signs of extraterrestrial life. Considering a range of physical effects, we conclude that they will tend to be slightly older and more massive than Earth and that their host stars will likely be K dwarfs. This makes Alpha Centauri B, member of the closest stellar system to the Sun that is supposed to host an Earth-mass planet, an ideal target for searches of a superhabitable world.

Download/Website: `http://arxiv.org/abs/1401.2392`

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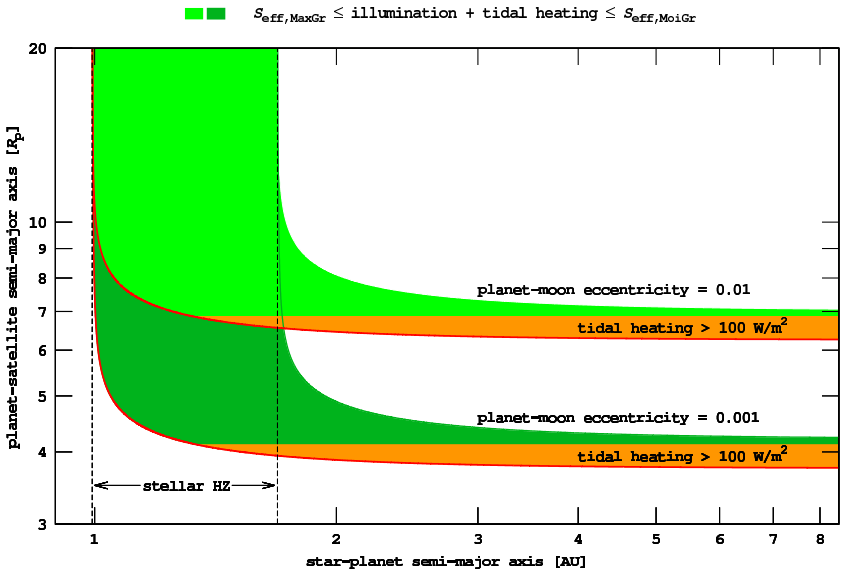

Figure 1: (Heller & Armstrong) Circumplanetary habitable orbits of an extrasolar moon (ordinate) as a function of circumstellar distance (abscissa). Within the shaded areas, the moon prevents transition into either a runaway greenhouse effect or a snowball state. The two stripes correspond to different orbital eccentricities (0.01 and 0.001) of this hypothetical, Earth-like satellite orbiting a Jupiter-like planet around a solar luminosity star. Clearly, worlds can be habitable beyond the stellar habitable zone if tidal heating provides an alternative heat source. Orange zones indicate extremely strong tidal surface heating rates above $100\,\mathrm{W/m^2}$.

Revisiting the proposed circumbinary multiplanet system NSVS 14256825

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Monthly Notices of the Royal Astronomical Society, published (2014MNRAS.438..307H)

In this work, we carry out an analysis of the observed times of primary and secondary eclipses of the post-common envelope binary NSVS 14256825. Recently, Almeida, Jablonski and Rodrigues proposed that two circumbinary companions orbit this short-period eclipsing binary, in order to explain observed variations in the timing of mutual eclipses between the two binary components. Using a standard weighted least-squares minimization technique, we have extensively explored the topology of χ^2 parameter space of a single planet model. We find the data set to be insufficient to reliably constrain a one-companion model. Various models, each with similar statistical significance, result in substantially different orbital architectures for the additional companion. No evidence is seen for a second companion of planetary nature. We suspect insufficient coverage (baseline) of timing data causing the best-fitting parameters to be unconstrained.

Download/Website: `http://adsabs.harvard.edu/abs/2014MNRAS.438..307H`

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A Dynamical Investigation of the Proposed BD +20 2457 System

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Monthly Notices of the Astronomical Society, in press (2014arXiv1401.2793H)

We present a detailed dynamical analysis of the orbital stability of the BD +20 2457 system, which features planets or brown dwarfs moving on relatively eccentric orbits. We find that the system exhibits strong dynamical instability on astronomically short timescales across a wide range of plausible orbital eccentricities, semi-major axes, and inclinations. If the system truly hosts massive planets or brown dwarfs, our results suggest that they must move on orbits significantly different to those proposed in the discovery work. If that is indeed the case, then it is likely that the best-fit orbital solutions for the proposed companions will change markedly as future observations are made. Such observations may result in the solution shifting to a more dynamically-stable regime, potentially one where stability is ensured by mutually resonant motion.

Download/Website: `http://adsabs.harvard.edu/abs/2014arXiv1401.2793H`

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The role of Jupiter in driving Earth's orbital evolution

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Proceedings of the 13th Australian Space Science Conference, in press (arXiv:1401.6741H)

In coming years, the first truly Earth-like planets will be discovered orbiting other stars, and the search for signs of life on these worlds will begin. However, such observations will be hugely time-consuming and costly, and so it will be important to determine which of those planets represent the best prospects for life elsewhere. One of the key factors in such a decision will be the climate variability of the planet in question - too chaotic a climate might render a planet less promising as a target for our initial search for life elsewhere.
On the Earth, the climate of the last few million years has been dominated by a series of glacial and interglacial periods, driven by periodic variations in the Earth's orbital elements and axial tilt. These Milankovitch cycles are driven by the gravitational influence of the other planets, and as such are strongly dependent on the architecture of the Solar system.
Here, we present the first results of a study investigating the influence of the orbit of Jupiter on the Milankovitch cycles at Earth - a first step in developing a means to characterise the nature of periodic climate change on planets beyond our Solar system.

Download/Website: `http://adsabs.harvard.edu/abs/2014arXiv1401.6741H`

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Wobbling Ancient Binaries – Here Be Planets?

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Proceedings of the 13th Australian Space Science Conference, in press (arXiv:1401.6742H)

In the last few years, a number of planets have been proposed to orbit several post main-sequence binary star systems on the basis of observed variations in the timing of eclipses between the binary components. A common feature of these planet candidates is that the best-fit orbits are often highly eccentric, such that the multiple planet systems proposed regularly feature mutually crossing orbits - a scenario that almost always leads to unstable planetary systems. In this work, we present the results of dynamical studies of all multiple-planet systems proposed to orbit these highly evolved binary stars, finding that most do not stand up to dynamical scrutiny. In one of the potentially stable cases (the NN Serpentis 2-planet system), we consider the evolution of the binary star system, and show that it is highly unlikely that planets could survive from the main sequence to obtain their current orbits - again casting doubt on the proposed planets. We conclude by considering alternative explanations for the observed variation in eclipse timings for these systems.

Download/Website: `http://adsabs.harvard.edu/abs/2014arXiv1401.6742H`

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Physical properties and transmission spectrum of the WASP-80 planetary system from multi-colour photometry

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Astronomy & Astrophysics, in press (arXiv:1312.4982)

WASP-80 is one of only two systems known to contain a hot Jupiter which transits its M-dwarf host star. We present eight light curves of one transit event, obtained simultaneously using two defocussed telescopes. These data were taken through the Bessell I, Sloan $g'r'i'z'$ and near-infrared JHK passbands. We use our data to search for opacity-induced changes in the planetary radius, but find that all values agree with each other. Our data are therefore consistent with a flat transmission spectrum to within the observational uncertainties. We also measure an activity index of the host star of $\log R'_{\rm HK} = -4.495$, meaning that WASP-80 A shows strong chromospheric activity. The non-detection of starspots implies that, if they exist, they must be small and symmetrically distributed on the stellar surface. We model all available optical transit light curves to obtain improved physical properties and orbital ephemerides for the system.

Download/Website: `http://arxiv.org/abs/1312.4982/`

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Constraining the initial entropy of directly-detected exoplanets

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Monthly Notices of the Royal Astronomical Society, published (2014MNRAS.437.1378M)

The post-formation, initial entropy S_i of a gas giant planet is a key witness to its mass-assembly history and a crucial quantity for its early evolution. However, formation models are not yet able to predict reliably S_i, making unjustified the use solely of traditional, 'hot-start' cooling tracks to interpret direct imaging results and calling for an observational determination of initial entropies to guide formation scenarios. Using a grid of models in mass and entropy, we show how to place joint constraints on the mass and initial entropy of an object from its observed luminosity and age. This generalises the usual estimate of only a lower bound on the real mass through hot-start tracks. Moreover, we demonstrate that with mass information, e.g. from dynamical stability analyses or radial velocity, tighter bounds can be set on the initial entropy. We apply this procedure to 2M1207 b and find that its initial entropy is at least 9.2 $k_\mathrm{B}/\mathrm{baryon}$, assuming that it does not burn deuterium. For the planets of the HR 8799 system, we infer that they must have formed with $S_\mathrm{i} > 9.2\ k_\mathrm{B}/\mathrm{baryon}$, independent of uncertainties about the age of the star. Finally, a similar analysis for β Pic b reveals that it must have formed with $S_\mathrm{i} > 10.5\ k_\mathrm{B}/\mathrm{baryon}$, using the radial-velocity mass upper limit. These initial entropy values are respectively ca. 0.7, 0.5, and 1.5 $k_\mathrm{B}/\mathrm{baryon}$ higher than the ones obtained from core accretion models by Marley et al., thereby *quantitatively* ruling out the coldest starts for these objects and constraining warm starts, especially for β Pic b.

Download/Website: `http://arxiv.org/abs/1302.1517`

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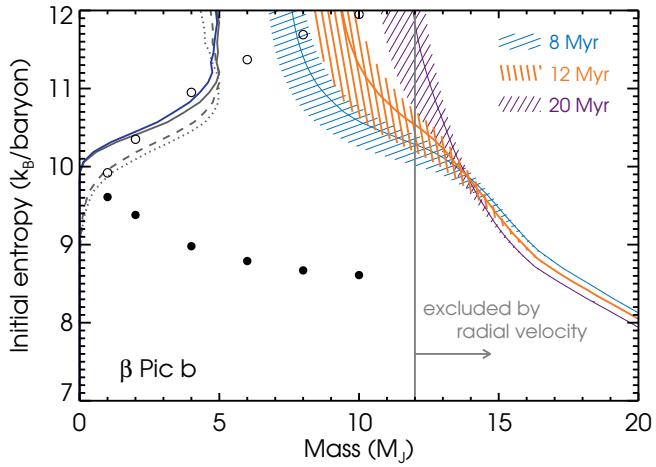

Figure 2: (Marleau & Cumming) Allowed values of planet mass M and initial entropy S_i for β Pic b using our estimated $\log L_\mathrm{bol}/L_\odot = -3.90^{+0.05}_{-0.12}$ and an age of 12^{+8}_{-4} Myr. The curves along the vertical axis show the marginalised posterior distributions on S_i from MCMC simulations using the luminosity and age values and their uncertainties and different mass priors. We recover a hot-start mass $\simeq 9.5 \pm 2.5\ M_\mathrm{J}$ (in agreement with, e.g., Bonnefoy et al. 2013), but additionally find that higher masses are consistent with the luminosity measurement. Moreover, using the radial-velocity mass upper limit, the constraints on the initial entropy can be made tighter: with an age of 12 Myr, it must be that $S_\mathrm{i} > 10.5\ k_\mathrm{B}/\mathrm{baryon}$. The circles show the results from Marley et al. (2007) for cold starts (filled circles) and hot starts (open circles).

Meridional circulation of gas into gaps opened by giant planets in three-dimensional low-viscosity disks

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Icarus, in press

We examine the gas circulation near a gap opened by a giant planet in a protoplanetary disk. We show with high resolution3D simulations that the gas flows into the gap at high altitude over the mid-plane, at a rate dependent on viscosity. We explain this observation with a simple conceptual model. From this model we derive an estimate of the amount of gas flowing into a gap opened by a planet with Hill radius comparable to the scale-height of a layered disk (i. e. a disk with viscous upper layer and inviscid midplane). Our estimate agrees with modern MRI simulations(Gressel et al., 2013). We conclude that gap opening in a layered disk can not slow down significantly the runaway gas accretion of Saturn to Jupiter-mass planets.

Download/Website: `http://arxiv.org/pdf/1401.2925v1`

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Calculating the Habitable Zone of Multiple Star Systems (http://astro.twam.info/hz)

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The Astrophysical Journal, published (2014ApJ...782...26M)

We have developed a comprehensive methodology and an interactive website for calculating the habitable zone (HZ) of multiple star systems. Using the concept of spectral weight factor, as introduced in our previous studies of the calculations of HZ in and around binary star systems, we calculate the contribution of each star (based on its spectral energy distribution) to the total flux received at the top of the atmosphere of an Earth-like planet, and use the models of the HZ of the Sun to determine the boundaries of the HZ in multiple star systems. Our interactive website for carrying out these calculations is publicly available at http://astro.twam.info/hz . We discuss the details of our methodology and present its application to some of the multiple star systems detected by the *Kepler* space telescope. We also present the instructions for using our interactive website, and demonstrate its capabilities by calculating the HZ for two interesting analytical solutions of the three-body problem.

Download/Website: `http://astro.twam.info/hz`

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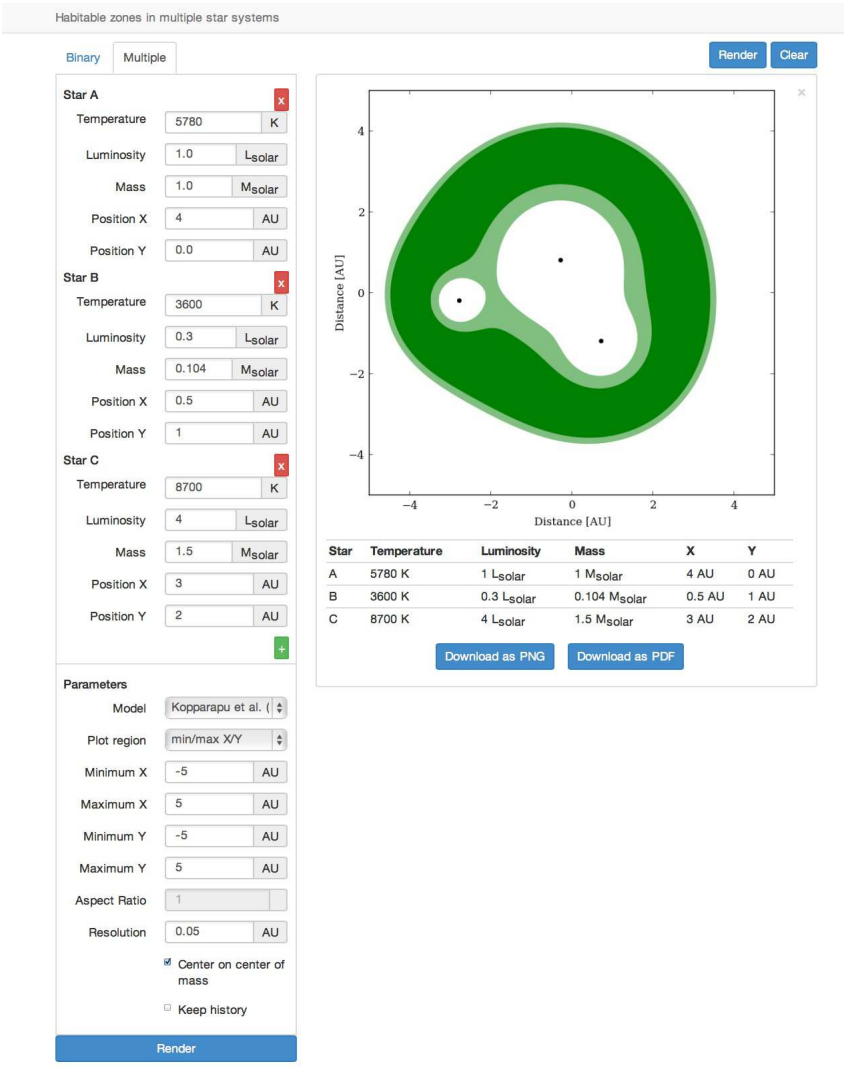

Figure 3: (Müller & Haghighipour) A screenshot of the interactive website http://astro.twam.info/hz for calculating the HZ of binary and multiple star systems.

Scattering outcomes of close-in planets: constraints on planet migration

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The Astrophysical Journal, submitted (arXiv:1401.4457)

Many exoplanets in close-in orbits are observed to have relatively high eccentricities and large stellar obliquities. We explore the possibility that these result from planet-planet scattering by studying the dynamical outcomes from a large number of orbit integrations in systems with two and three gas-giant planets in close-in orbits (0.05 AU$<$ a $<$0.15 AU). We find that at these orbital separations, unstable systems generally lead to planet-planet collisions in which the collision product is a planet on a low-eccentricity, low-inclination orbit. This result is inconsistent with the observations. We conclude that eccentricity and inclination excitation from planet-planet scattering must precede migration of planets into short-period orbits. This result constrains theories of planet migration: the semi-major axis must shrink by 1-2 orders of magnitude without damping the eccentricity and inclination.

Download/Website: `http://arXiv.org/abs/1401.4457`

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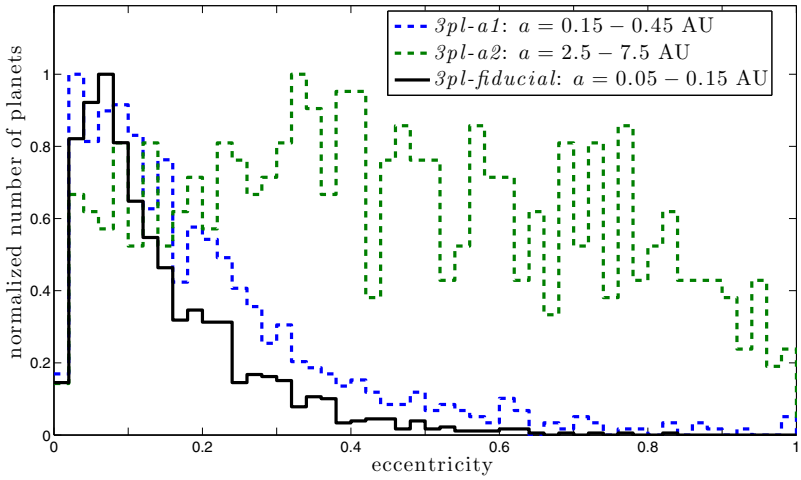

Figure 4: (Petrovich et al.) Final eccentricity distribution of all planets in the active systems (final number of planets is less than the number at the start) for the simulations with three Jupiter-like planets. The different lines indicate the result for a different semi-major axis range, as labeled. As the planets are placed at smaller semi-major axis, planet-planet collisions become more important than planet ejections and the eccentricity distribution shifts to lower values.

The Influence of Galactic Cosmic Rays on Ion-Neutral Hydrocarbon Chemistry in the Upper Atmospheres of Free-Floating Exoplanets

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International Journal of Astrobiology, in press (arXiv:1312.1138)

Cosmic rays may be linked to the formation of volatiles necessary for prebiotic chemistry. We explore the effect of cosmic rays in a hydrogen-dominated atmosphere, as a proof-of-concept that ion-neutral chemistry may be important for modelling hydrogen-dominated atmospheres. In order to accomplish this, we utilize Monte Carlo cosmic ray transport models with particle energies of 10^6 eV $< E <$ 10^{12} eV in order to investigate the cosmic ray enhancement of free electrons in substellar atmospheres. Ion-neutral chemistry is then applied to a DRIFT-PHOENIX model of a free-floating giant gas planet. Our results suggest that the activation of ion-neutral chemistry in the upper atmosphere significantly enhances formation rates for various species, and we find that C_2H_2, C_2H_4, NH_3, C_6H_6 and possibly $C_{10}H$ are enhanced in the upper atmospheres because of cosmic rays. Our results suggest a potential connection between cosmic ray chemistry and the hazes observed in the upper atmospheres of various extrasolar planets. Chemi-ionization reactions are briefly discussed, as they may enhance the degree of ionization in the cloud layer.

Download/Website: `http://arxiv.org/abs/1312.1138/`

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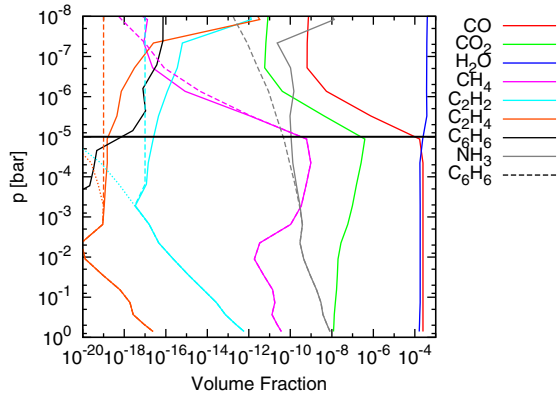

Figure 5: (Rimmer, Helling & Bilger) Volume fraction of various species as a function of the gas pressure, p [bar] for the model atmosphere of a free-floating giant gas planet ($T_{\rm eff}$ = 1000 K, $\log g$ = 3), obtained by combining our results to those of Bilger et al. (2013). The results of Bilger et al. (2013), the results assuming chemical quenching of C_2H_2 and C_2H_4 at height at $\sim 10^{-3}$ (dashed), and the results with cosmic ray ionization (solid) are all presented in this plot. A thick black horizontal line indicates the pressure above which intermolecular reactions may dominate.

Colour-magnitude diagrams of transiting Exoplanets. I - Systems with parallaxes

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Monthly Notices of the Royal Astronomical SocietyLetters, accepted (2014MNRAS.tmpL...5T/arXiv:1312.4926)

Broadband flux measurements centred around [3.6 μm] and [4.5 μm] obtained with *Spitzer* during the occultation of seven extrasolar planets by their host stars have been combined with parallax measurements to compute the absolute magnitudes of these planets. Those measurements are arranged in two colour-magnitude diagrams. Because most of the targets have sizes and temperatures similar to brown dwarfs, they can be compared to one another. In principle, this should permit inferences about exo-atmospheres based on knowledge acquired by decades of observations of field brown dwarfs and ultra-cool stars' atmospheres. Such diagrams can assemble all measurements gathered so far and will provide help in the preparation of new observational programs. In most cases, planets and brown dwarfs follow similar sequences. HD 2094589b and GJ 436b are found to be outliers, so is the nightside of HD 189733b. The photometric variability associated with the orbital phase of HD 189733b is particularly revealing. The planet exhibits what appears like a spectral type and chemical transition between its day and night sides: HD 189733b straddles the L-T spectral class transition, which would imply different cloud coverage on each hemisphere. Methane absorption could be absent at its hot spot but present over the rest of the planet.

Download/Website: `http://adsabs.harvard.edu/doi/10.1093/mnrasl/slt180`

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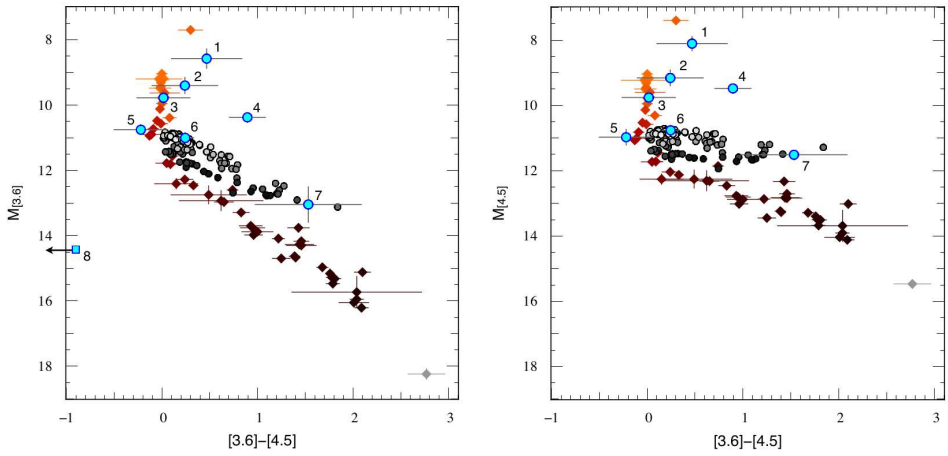

Figure 6: (Triaud) Two colour-magnitude diagrams of absolute magnitudes at [3.6 μm] and [4.6 μm] versus [3.6]-[4.5] colour. The diamonds show late M dwarfs, L, T, and one Y dwarf as compiled in Dupuy & Liu (2012). The grey diamond is WD 0806-661B has no spectral type yet (Luhman, 2012). The kink at $M_{[3.6]}$ $\sim$11.5 corresponds approximately to a L9 spectral type and the location where methane absorption starts appearing in the [3.6 μm] band. Large, blue circles represent the transiting planets whose emission has been measured and whose host star has a *Hipparcos* parallax. Smaller grey circles represent the phase curve of HD 189733b (Knutson et al. 2012), (lighter gray is for dayside, while darker tones are for nightside). The blue square shows the upper limit of GJ 436b, which is located to the left of the diagram. 1) WASP-33b; 2) WASP-18b; 3) HAT-P-2b; 4) HD 209458b; 5) HD 149026b; 6) HD 189733b dayside; 7) HD 189733b nightside; 8) GJ 436b.

M-dwarf stellar winds: the effects of realistic magnetic geometry on rotational evolution and planets

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[4] Dublin Institute for Advanced Studies, School of Cosmic Physics, 31 Fitzwilliam Place, Dublin 2, Ireland
[5] LATT - CNRS/Université de Toulouse, 14 Av. E. Belin, Toulouse, F-31400, France
[6] Boston University, 725 Commonwealth Ave, Boston, MA, 02215, USA
[7] University of Michigan, 1517 Space Research Building, Ann Arbor, MI, 48109-2143, USA

Monthly Notices of the Royal Astronomical Society, in press (doi: 10.1093/mnras/stt2265)

We perform three-dimensional numerical simulations of stellar winds of early-M dwarf stars. Our simulations incorporate observationally reconstructed large-scale surface magnetic maps, suggesting that the complexity of the magnetic field can play an important role in the angular momentum evolution of the star, possibly explaining the large distribution of periods in field dM stars, as reported in recent works. In spite of the diversity of the magnetic field topologies among the stars in our sample, we find that stellar wind flowing near the (rotational) equatorial plane carries most of the stellar angular momentum, but there is no preferred colatitude contributing to mass loss, as the mass flux is maximum at different colatitudes for different stars. We find that more non-axisymmetric magnetic fields result in more asymmetric mass fluxes and wind total pressures $p_{\rm tot}$ (defined as the sum of thermal, magnetic and ram pressures). Because planetary magnetospheric sizes are set by pressure equilibrium between the planet's magnetic field and $p_{\rm tot}$, variations of up to a factor of 3 in $p_{\rm tot}$ (as found in the case of a planet orbiting at several stellar radii away from the star) lead to variations in magnetospheric radii of about 20 percent along the planetary orbital path. In analogy to the flux of cosmic rays that impact the Earth, which is inversely modulated with the non-axisymmetric component of the total open solar magnetic flux, we conclude that planets orbiting M dwarf stars like DT Vir, DS Leo and GJ 182, which have significant non-axisymmetric field components, should be the more efficiently shielded from galactic cosmic rays, even if the planets lack a protective thick atmosphere/large magnetosphere of their own.

Download/Website: `http://arxiv.org/abs/1311.5063`

Contact: `Aline.Vidotto@st-andrews.ac.uk`

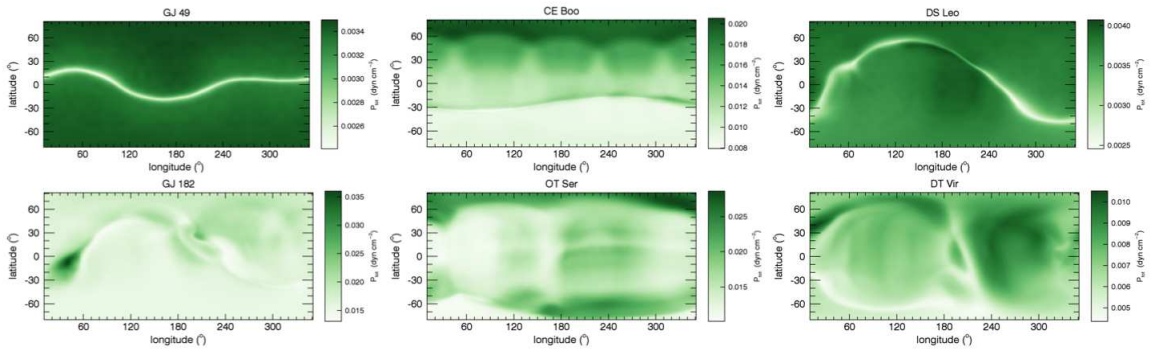

Figure 7: (Vidotto et al.) Distribution of the stellar wind total pressure $p_{\rm tot}$ at a spherical surface of radius $\sim 19\ R_\star$ (close to the edge of our simulation domain). The more asymmetric topology of the stellar magnetic field results in more asymmetric $p_{\rm tot}$. Because planetary magnetospheric sizes r_M are set by pressure equilibrium between the planet's magnetic field and $p_{\rm tot}$, as the planet interacts with the wind of its host star along its orbital path, r_M becomes smaller (larger) when the external $p_{\rm tot}$ is larger (smaller)

The Anglo-Australian Planet Search. XXIII. Two New Jupiter Analogs

R. A. Wittenmyer[1,2], J. Horner[1,2], C. G. Tinney[1,2], R. P. Butler[3], H. R. A. Jones[4], M. Tuomi[4,5], G. S. Salter[1,2], B. D. Carter[6], F. E. Koch[7], S. J. O'Toole[8], J. Bailey[1,2], D. Wright[1,2]

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[7] San Diego State University, Physics Department, 5500 Campanile Drive San Diego, CA 92182-1233, USA
[8] Australian Astronomical Observatory, PO Box 915, North Ryde, NSW 1670, Australia

The Astrophysical Journal, in press (2014arXiv1401.5525W)

We report the discovery of two long-period giant planets from the Anglo-Australian Planet Search. HD 154857c is in a multiple-planet system, while HD 114613b appears to be solitary. HD 114613b has an orbital period P=10.5 years, and a minimum mass m sin i of 0.48 Jupiter masses; HD 154857c has P=9.5 years and m sin i=2.6 Jupiter masses. These new data confirm the planetary nature of the previously unconstrained long-period object in the HD 154857 system. We have performed detailed dynamical stability simulations which show that the HD 154857 two-planet system is stable on timescales of at least 100 million years. These results highlight the continued importance of "legacy" surveys with long observational baselines; these ongoing campaigns are critical for determining the population of Jupiter analogs, and hence of those planetary systems with architectures most like our own Solar system.

Download/Website: `http://adsabs.harvard.edu/abs/2014arXiv1401.5525W`

Contact: `rob@phys.unsw.edu.au`

A Detailed Analysis of the HD 73526 2:1 Resonant Planetary System

R. A. Wittenmyer[1,2], X. Tianyu[3,4], M. H. Lee[3,5], J. Horner[1,2], C. G. Tinney[1,2], R. P. Butler[6], G. S. Salter[1,2], B. D. Carter[7], H. R. A. Jones[8], S. J. O'Toole[9], J. Bailey[1,2], D. Wright[1,2], J. D. Crane[10], S. A. Schectman[10], P. Arriagada[6], I. Thompson[10], D. Minniti[11,12] & M. Diaz[11]

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[6] Department of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Road, NW, Washington, DC 20015-1305, USA
[7] Faculty of Sciences, University of Southern Queensland, Toowoomba, Queensland 4350, Australia
[8] Univ. of Hertfordshire, Centre for Astrophysics Research, Science and Technology Research Inst., College Lane, AL10 9AB, Hatfield, UK
[9] Australian Astronomical Observatory, PO Box 915, North Ryde, NSW 1670, Australia
[10] The Observatories of the Carnegie Institution of Washington, 813 Santa Barbara Street, Pasadena, CA 91101, USA
[11] Institute of Astrophysics, Ponticia Universidad Catolica de Chile, Casilla 306, Santiago 22, Chile
[12] Vatican Observatory, V00120 Vatican City State, Italy

The Astrophysical Journal, published (2014ApJ...780..140W)

We present six years of new radial velocity data from the Anglo-Australian and Magellan Telescopes on the HD 73526 2:1 resonant planetary system. We investigate both Keplerian and dynamical (interacting) fits to these data, yielding four possible configurations for the system. The new data now show that both resonance angles are librating, with amplitudes of 40 and 60, respectively. We then perform long-term dynamical stability tests to differentiate these solutions, which only differ significantly in the masses of the planets. We show that while there is no clearly preferred system inclination, the dynamical fit with i = 90 provides the best combination of goodness-of-fit and long-term dynamical stability.

Download/Website: `http://adsabs.harvard.edu/abs/2014ApJ...780..140W`

Contact: `rob@phys.unsw.edu.au`

Stochastic accretion of planetesimals onto white dwarfs: constraints on the mass distribution of accreted material from atmospheric pollution

M. C. Wyatt[1]*, J. Farihi*[1]*, J. E. Pringle*[1]*, A. Bonsor*[2,3]

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[2] Institut de Planétologie et d'Astrophysique de Grenoble, Université Joseph Fourier, CNRS, BP 53, 38041 Grenoble, France
[3] H.H. Wills Physics Laboratory, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK

Monthly Notices of the Royal Astronomical Society, in press (arXiv:1401.6173)

This paper explores how the stochastic accretion of planetesimals onto white dwarfs would be manifested in observations of their atmospheric pollution. Archival observations of pollution levels for unbiased samples of DA and non-DA white dwarfs are used to derive the distribution of inferred accretion rates, confirming that rates become systematically lower as sinking time (assumed here to be dominated by gravitational settling) is decreased, with no discernable dependence on cooling age. The accretion rates expected from planetesimals that are all the same mass (i.e., a mono-mass distribution) are explored both analytically and using a Monte Carlo model, quantifying how measured accretion rates inevitably depend on sinking time, since different sinking times probe different times since the last accretion event. However, that dependence is so dramatic that a mono-mass distribution can be excluded within the context of this model. Consideration of accretion from a broad distribution of planetesimal masses uncovers an important conceptual difference: accretion is continuous (rather than stochastic) for planetesimals below a certain mass, and the accretion of such planetesimals determines the rate typically inferred from observations; smaller planetesimals dominate the rates for shorter sinking times. A reasonable fit to the observationally inferred accretion rate distributions is found with model parameters consistent with a collisionally evolved mass distribution up to Pluto-mass, and an underlying accretion rate distribution consistent with that expected from descendants of debris discs of main sequence A stars. With these parameters, while both DA and non-DA white dwarfs accrete from the same broad planetesimal distribution, this model predicts that the pollution seen in DAs is dominated by the continuous accretion of < 35 km objects, and that in non-DAs by > 35 km objects (though the dominant size varies between stars by around an order of magnitude from this reference value). Further observations that characterise the dependence of inferred accretion rates on sinking time and cooling age (including a consideration of the effect of thermohaline convection on models used to derive those rates), and the decadal variability of DA accretion signatures, will improve constraints on the mass distribution of accreted material and the lifetime of the disc through which it is accreted.

Download/Website: `http://arxiv.org/abs/1401.6173`

Contact: `wyatt@ast.cam.ac.uk`

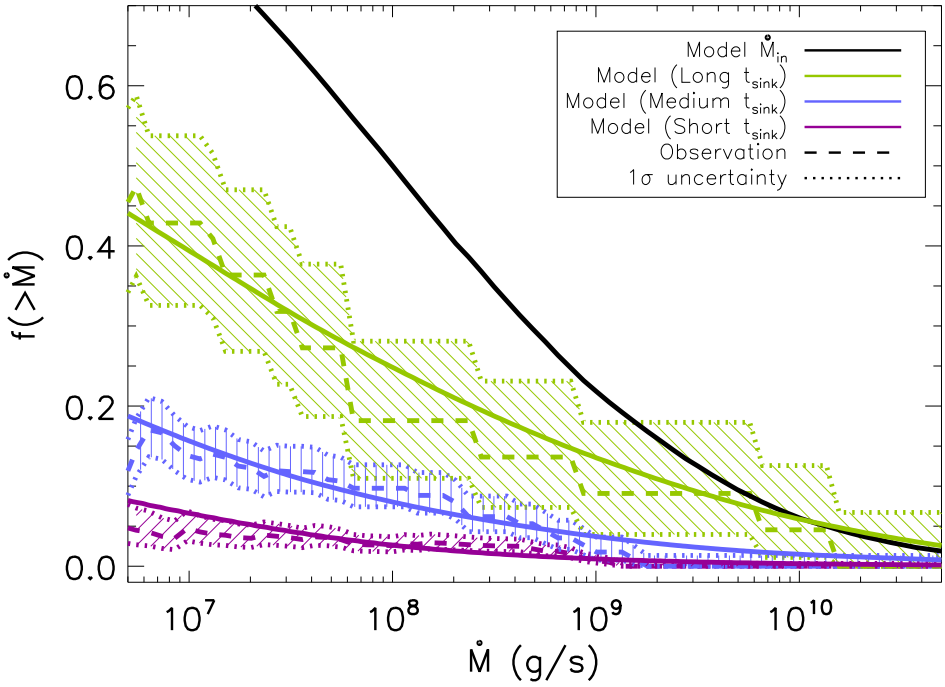

Figure 8: (Wyatt et al.) Fraction of white dwarfs for which their atmospheric composition implies accretion rates above a given level. The observed distributions are shown with dashed lines for an unbiased white dwarf sample split according to the gravitational settling time for metals to sink in their atmospheres (long means $t_{\rm sink} = 0.1 - 1$ Myr, medium is 100 yr-0.1 Myr and short 0.01-100 yr); the hatched region shows the 1-σ uncertainty. The solid lines show a model fit to the distributions in the different sinking time bins, where the (uppermost) black line is the distribution of rates at which planetesimals with a range of masses are scattered toward all of these stars (and eventually accreted), and the lower lines account for the discrete nature of the planetesimal mass distribution, and how this inevitably results in the distribution of pollution signatures having a strong dependence on sinking time.

3 Announcements

2014B NASA Keck Call for General Observing Proposals

Dr. Dawn M. Gelino
NASA Exoplanet Science Institute

Proposals Due: March 20, 2014, 4 pm PDT

NASA is soliciting proposals for the use of the two 10m W. M. Keck Telescopes for the 2014B observing semester (August 2014 - January 2015). Complete call information will be made available on the website below by mid-February and all proposals are due by **20 March 2014 at 4 pm PDT**.

The opportunity to propose as Principal Investigators for NASA time on the Keck Telescopes is open to all U.S.-based astronomers (a U.S.-based astronomer has his/her principal affiliation at a U.S. institution). *Investigators from institutions outside of the U.S. may participate as Co-Investigators*.

NASA intends the use of the Keck telescopes to be highly strategic in support of on-going space missions and/or high priority, long term science goals. NASA Keck time is open to a wide range of disciplines and proposals are sought in the following areas: (1) investigations in support of EXOPLANET EXPLORATION science goals and missions; (2) investigations of our own SOLAR SYSTEM; (3) investigations in support of COSMIC ORIGINS science goals and missions; (4) investigations in support of PHYSICS OF THE COSMOS science goals and missions; and (5) direct MISSION SUPPORT in any of the previous four areas.

The proposal process is being handled by the NASA Exoplanet Science Institute (NExScI) at Caltech.

Download/Website: `http://nexsci.caltech.edu/missions/KeckSolicitation/index.shtml`

Contact: `KeckCFP@ipac.caltech.edu`

Fizeau exchange visitors program in optical interferometry - call for applications

European Interferometry Initiative

www.european-interferometry.eu, application deadline: Mar. 15

The Fizeau exchange visitors program in optical interferometry funds (travel and accommodation) visits of researchers to an institute of his/her choice (within the European Community) to perform collaborative work and training on one of the active topics of the European Interferometry Initiative. The visits will typically last for one month, and strengthen the network of astronomers engaged in technical, scientific and training work on optical/infrared interferometry. The program is open for all levels of astronomers (Ph.D. students to tenured staff). Applicants are strongly encouraged to seek also partial support from their home or host institutions.
The deadline for applications is March 15. Fellowships can be awarded for missions starting in May 2014.
Further informations and application forms can be found at: www.european-interferometry.eu
The program is funded by OPTICON/FP7.
Looking forward to your applications,
Josef Hron & Laszlo Mosoni (for the European Interferometry Initiative)

Download/Website: `http://www.european-interferometry.eu`

Contact: `fizeau@european-interferometry.eu`

50 Years of Brown Dwarfs - From Prediction to Discovery to Forefront of Research

V. Joergens[1,2]

[1] Max-Planck-Institute for Astronomy, Heidelberg, Germany
[2] Center for Astronomy Heidelberg, Institute of Theoretical Astrophysics, University of Heidelberg, Germany

Springer International Publishing, 2014, published (DOI 10.1007/978-3-319-01162-2)

The years 2012 / 2013 mark the 50th anniversary of the theoretical prediction that Brown Dwarfs, i.e. degenerate objects which are just not massive enough to sustain stable hydrogen fusion, exist. In this volume, pioneers of Brown Dwarf research review the history of the theoretical prediction and the observational discovery of Brown Dwarfs and combine them with a description of the development of the field to the current state of the art.

Content of the book:

With a foreword from Alex Wolszczan.

Download/Website: `http://link.springer.com/book/10.1007/978-3-319-01162-2`
Contact: `viki@mpia.de`

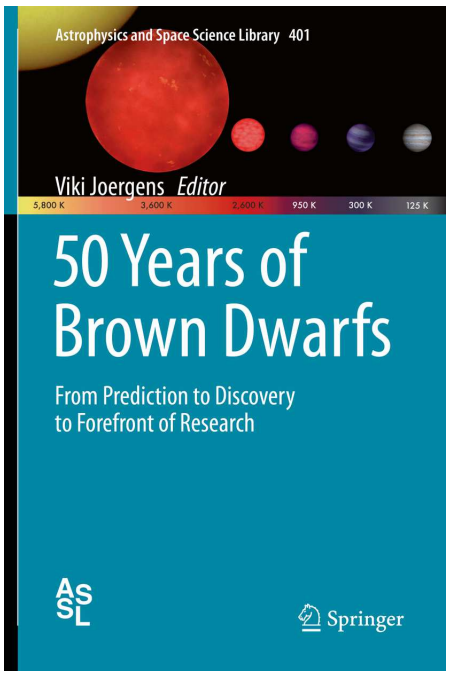

Figure 9: (Joergens) 50 Years of Brown Dwarfs - From Prediction to Discovery to Forefront of Research

4 PhD Theses

Ground-based Investigations of the Atmospheres of Extrasolar Planets

J. R. Burton
Astrophysics Research Centre, Queen's University Belfast, University Road, Belfast, Co. Antrim, BT71NN

PhD Thesis, Accepted

In the aforementioned thesis, I present three main studies which demonstrate significant development in the field of exoplanet atmosphere detection and modelling.
In the first study, a model is established for estimating the distortion of hot-Jupiter exoplanets due to the gravitational attraction by the host star that is based solely on observable parameters of transiting systems. The distortion can cause an over-estimation of the density of hot-Jupiters; an important factor for models of exoplanetary atmospheres and dynamics. The most significant case of distortion found is for WASP-19b, which shows a bulk density over-estimation of 12%.
The secondary eclipse of the transiting hot- Jupiter WASP-19b was observed, and found to have an eclipse depth of $0.088 \pm 0.019\%$ based on a single observation. Whilst this does represent a significant result, the systematics present in the data support further observations to better constrain the depth, duration and timing of the secondary eclipse. This result has subsequently been used to estimate the C/O ratio in the atmosphere of WASP-19b.
The final result presented in the thesis is a pilot study of a new technique called 'defocussed transmission spectroscopy', a method designed to improve the detection of elements in the atmospheres of transiting extra-solar planets from ground-based platforms. I present limits on the strength of sodium in the atmospheres of three hot-Jupiters (HD189733b, HD209458b and WASP-12b), and provide a detailed investigation into the systematics associated with this novel observing technique. I also make recommendations as to how future observations can be improved, and present a possible detection of sodium in the atmosphere of WASP-12b, with an absorption depth of $0.12 \pm 0.03\%$.

Download/Website: `Available upon request`

Contact: `jburton04@qub.ac.uk`

5 Jobs and Positions

Post Doctoral Research Associate in Exoplanet Observations

Carole Haswell
Department of Physical Sciences, The Open University, Walton Hall, Milton Keynes MK7 6AA, UK

Closing date, February 28, 2014

The Open University
Department of Physical Sciences
Post Doctoral Research Associate in Exoplanet Observations, Ref: 9721
Salary: £30,424 – £36,298 p.a.
Applications are invited for a Postdoctoral Research Associate in Exoplanet Observations at the Open University. You will work collaboratively and independently on observations of exoplanets using new and archival data from facilities such as HST and ESO as well as proprietary facilities. We will examine the properties of extended exospheres of exoplanets, assess evidence for star-planet interactions, examine exoplanet compositions, evolution and exoplanetary mass loss.
You will have a PhD or equivalent qualification in physics, astronomy or a related subject, a strong background in independent research with a good publication record, strong analytic and programming skills, good oral and written communication skills in English and a demonstrable grasp of the relevant research literature. You will have demonstrated you can work harmoniously in a team, and are willing to collaborate with others in the department. Research experience in (one or more of) exoplanetary, planetary, stellar or interstellar astrophysics is highly desirable.
For further information and details of how to apply please see http://www3.open.ac.uk/employment.
Please quote reference 9721 in all communication.

Download/Website: `http://www3.open.ac.uk/employment/`

Contact: `c.a.haswell@open.ac.uk`

Research Fellow in Astrophysics

Andrew Collier Cameron
SUPA, School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews KY16 9SS, UK

Closing date, 3 March 2014

University of St Andrews
School of Physics & Astronomy
Research Fellow in Astrophysics MR1422
Salary: 30,728 - 36,661 per annum

The School of Physics & Astronomy is seeking an ambitious Research Fellow to work on searches for low-mass extrasolar planets.

Applications are invited for an active researcher in the area of radial-velocity searches for low-mass exoplanets. The successful candidate should have experience in the field of high-resolution spectroscopic characterisation of exoplanet host stars, and analysis of radial-velocity data. Additional experience with parameter estimation for transiting exoplanets, or interpretation of radial-velocity data in the presence of stellar magnetic activity, would be an advantage.

You will be expected to play a leading role in defining samples of planet-host stars from the NASA Kepler mission for intensive radial-velocity follow-up with the HARPS-N instrument, participating in HARPS-N observations, and in determining stellar effective temperatures, surface gravities, metallicities, densities, rotation periods and ages.

The School of Physics & Astronomy offers a vibrant and modern work environment. Astrophysics research in St Andrews combines observational, theoretical, and numerical research in extra-solar planets, star formation, active galactic nuclei, galaxy evolution and cosmology.

You should have a PhD in astronomy, astrophysics, or a closely related field, with experience in high-resolution stellar spectroscopy in an exoplanetary-science context.

Starting 1 May 2014, or as soon as possible thereafter. The appointment will be for a period of two years initially to work in collaboration with Professor Andrew Cameron, with potential for a one-year renewal. The project is part of the ETAEARTH consortium, funded by an EU FP7-SPACE grant, and is associated with the HARPS-N consortium.

Informal enquiries to Andrew Cameron, e-mail: acc4@st-andrews.ac.uk

Candidates should send a CV, publication list, and a brief statement of research interest and experience. Three referees will be contacted automatically by the University after an application has been received.

Closing Date: 3 March 2014

We encourage applicants to apply online at http://www.vacancies.st-andrews.ac.uk/welcome.aspx, however if you are unable to do this, please call +44 (0)1334 462571 for an application pack.

Please quote ref: MR1422

The University is committed to equality of opportunity. The University of St Andrews is a charity registered in Scotland (No SC013532).

Download/Website: `http://www.vacancies.st-andrews.ac.uk/welcome.aspx`

Contact: `acc4@st-andrews.ac.uk`

6 Conference announcements

Exoplanetary Science

Michel Mayor
Observatoire de Geneve, Geneva, Switzerland

Quy Nhon, Vietnam, April 20-26, 2014

This is a first announcement and a call for contributions, to an international conferrence entitled "Exoplanetary Science". This conference is in in the "Rencontres du Vietnam" series, and will take place during the week 20-26 April, 2014.
The conference will be organized in the coastal university town of Quy Nhon, Vietnam, in the newly inaugurated ICISE (International Centre for Interdisiciplinary Science and Education). The conference will be centred on the emerging discipline of exoplanetary science, and will concentrate in particular on the impact of new observational and theoretical results, and the promise of new projects. It will be a mix of plenary sessions for invited talks, as well as parallel sessions for contributed papers. The scientific programme is under construction; if you need information which is not as yet available on our site, you can contact Ludwik Celnikier, at the email address: ludwik.celnikier@obspm.fr
The site will be updated systematically; you should check regularly for new information. The site includes a registration form, as well as a form for submitting abstracts. The main topics will include (non-exhaustive list):

- space projects after COROT/KEPLER/Spitzer: GAIA, TESS, CHEOPS, PLATO or ECHO
- ground based projects: EPICS, ESPRESSO, SPHERE, HARPS-N, Spectroscopy IR
- New instruments for transit observations: MEARTH

Download/Website: `http://vietnam.in2p3.fr/2014/exo/`
Contact: `Ludwik.celnikier@obspm.fr, Michel.Mayor@unige.ch, jtrantv@gmail.com`

Towards Other Earths II: The Star-Planet Connection

Pedro Figueira, Sérgio Sousa, Nuno Santos
Centro de Astrofísica da Universidade do Porto

15–19 September 2014, Porto, Portugal

The study of extrasolar planets is one of the most active areas of research of modern astronomy. Central to this research is the characterization of the planet's host star properties. Several reasons exist for that:

- Planets form around stars. The planetary properties and the way they evolve with time are thus deeply related to the characteristics of their host (e.g. metallicity, mass, age, binnarity) and to the way the two interact (e.g. tidal effects).
- Most planetary detection methods are indirect and must be carefully scrutinized for stellar contamination ("noise") and false positives arising from other astrophysical sources (e.g. activity, blends). Understanding astrophysical sources of noise may be critical for the detection of other Earths.
- Interestingly, stellar variability also presents an opportunity to enhance our understanding of the planetary systems. The measurement of stellar oscillations will allow us to better characterize the host stars. Star-planet interactions can give us information about the planetary magnetic field and internal structure. In some cases, it is even possible to use stellar activity to improve the knowledge about the planets themselves (e.g. the orbital orientation).

- Finally, as one pushes both planetary detection and characterization to its limits, one is frequently limited by the uncertainties on the determination of stellar parameters (e.g. stellar radii or mass).

This conference aims at reviewing the state of the art of star-planet connection, with some focus on the detection and characterization of Earth like planets orbiting other stars. We propose to debate how the field of extrasolar planets will evolve in respect to this and how it will face the challenges of the upcoming years.

Download/Website: `http://www.astro.up.pt/toe2014`

Contact: `toe2014@astro.up.pt`

The 2014 STScI Spring Symposium: Habitable Worlds Across Time and Space

John H. Debes, Chair

Space Telescope Science Institute, Baltimore, Maryland, April 28 - May 1st, 2014

2^{nd} **Annoucement**

Abstract submission deadline: February 28, 2014
On-line registration deadline: March 28, 2014
(Registration now open!) Registration Fee: $75

Within a matter of years, humanity will know for the first time the frequency of terrestrial planets in orbit around other stars. This knowledge will pave the way for joining research from astronomy, Earth science, and biology to understand the past, present, and future of the Earth within its larger context as one of many habitable worlds throughout the Galaxy. Such work seeks to understand the formation and fate of the Earth as well as predict where and when different bodies will be suitable for both simple and complex forms of life.

In this four-day symposium, scientists from diverse fields will discuss the formation and long-term evolution of terrestrial bodies throughout the various phases of stellar and Galactic evolution. A particular focus will be in how the specific conditions and challenges for habitability on Earth extend to other bodies in the Solar System and beyond. This symposium will include discussions about sites for Galactic habitability that have not yet been given much attention, such as around post-main sequence stars. The existence of these overlooked environments may provide motivation for novel astronomical observations with existing and next generation ground and space-based observatories.

Invited speakers will cover the following topics:
-Terrestrial planet formation, volatile delivery, and the formation of moons
-Early Earth geochemistry, atmosphere, and the origins of life
-The frequency of terrestrial planets across stellar mass
-The limits to Earth-like life
-Habitability of planets and moons during all phases of stellar evolution
-Habitability in low-luminosity environments

Registration for this Symposium is now open and attendance is limited. We also invite contributions in the form of talks and posters, which can be submitted during the registration process or after one has registered. Only a small number of contributed talks will be selected, others will be presented as posters.

Download/Website: `http://www.stsci.edu/institute/conference/habitable-worlds`

Contact: `hwats2014@stsci.edu.`

2014 Sagan Summer Workshop: Imaging Planets and Disks

C. Brinkworth
NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Pasadena, CA, July 20-25, 2014

Registration and the application for financial aid for the 2014 Sagan Exoplanet Summer Workshop on "Imaging Planets and Disks" hosted by the NASA Exoplanet Science Institute (NExScI) will be available in early February. The workshop will take place on the Caltech campus July 20 - 25, 2014. The workshop is intended for graduate students and postdocs, however all interested parties are welcome to attend.

The 2014 workshop will explore current techniques and technology used to image exoplanets and debris disks, as well as the underlying science driving the modeling of exoplanetary atmospheres and disk structure. Leaders in the field will summarize the current state of the art in science, hardware, and software for both ground and space-based missions and data. Prospects for future space instruments will also be discussed. Attendees will participate in hands-on exercises to gain experience working with imaging data, astrophysical models, and instrument design. Attendees will also have the opportunity to present their own work through short presentations (research POPs) and posters.

Important Dates

- February 3: On-line Registration available and Financial Support Application period open
- March 7: Financial Support applications and supporting letter of recommendation due
- March 24: Financial Support decisions announced via email
- April 2: POP/Poster submission page on-line
- June 20: Early on-line registration ends
- July 4: POP/Poster Submission deadline and hotel registration deadline to be eligible for group rate
- July 11: On-line registration closed and final agenda posted
- July 20: Sagan Exoplanet Summer Workshop Opening Reception
- July 21-25: 2014 Sagan Exoplanet Summer Workshop

Download/Website: `http://nexsci.caltech.edu/workshop/2014`
Contact: `sagan_workshop@ipac.caltech.edu`

7 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during December 2013 and January 2014. If you see any that we missed, please let us know and we'll include them in the next issue.

December 2013

astro-ph/1312.0151: **A Parametric Modeling Approach to Measuring the Gas Masses of Circumstellar Disks** by *Jonathan P. Williams, William M. J. Best*

astro-ph/1312.0613 : **The Habitable Epoch of the Early Universe** by *Abraham Loeb*

astro-ph/1312.0662: **Revised Stellar Properties of Kepler Targets for the Quarter 1-16 Transit Detection Run** by *Daniel Huber, et al.*

astro-ph/1312.0924: **Herschel HIFI observations of ionised carbon in the β Pictoris debris disk** by *G. Cataldi, et al.*

astro-ph/1312.0936: **The Mass-Radius Relation for 65 Exoplanets Smaller than 4 Earth Radii** by *Lauren M. Weiss, Geoffrey W. Marcy*

astro-ph/1312.1265: **HD 106906 b: A planetary-mass companion outside a massive debris disk** by *Vanessa Bailey, et al.*

astro-ph/1312.1328: **Remote Life Detection Criteria, Habitable Zone Boundaries, and the Frequency of Earth-like Planets around M and Late-K Stars** by *James F. Kasting, et al.*

astro-ph/1312.1360: **A Search for Methane in the Atmosphere of GJ 1214b via GTC Narrow-Band Transmission Spectrophotometry** by *P. A. Wilson, et al.*

astro-ph/1312.1459: **Opacity of fluffy dust aggregates** by *Akimasa Kataoka, et al.*

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