ExoPlanet News
An Electronic Newsletter

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# Contents

# 1 Editorial

Welcome to the forty-third edition of ExoPlanet News.

We're pleased to present another large selection of excellent abstracts this month covering a wide range of exoplanet science. It's also encouraging to see a good selection of jobs and positions on offer at various levels of seniority. This month has been a busy one for exoplanet science with discovery highlights including the announcement of 41 new HARPS planets, 23 new SuperWASP planets and the Kepler team's announcement of the first circumbinary exoplanet. As we write this, we're awaiting the decision by ESA on the down-select for their M-class missions, with the next generation planet-finder PLATO in competition for a launch slot. Fingers crossed for some good news to report on that next month.

The next edition of the newsletter is planned for the beginning of November 2011, so please send anything relevant to exoplanet@open.ac.uk, and it will appear then. 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 & Glenn White
The Open University

# 2 Abstracts of refereed papers

## Fundamental Parameters of the Exoplanet Host K Giant Star $\iota$ Draconis from the CHARA Array

*E. K. Baines*[1], *H. A. McAlister*[2], *T. A. ten Brummelaar*[2], *N. H. Turner*[2], *J. Sturmann*[2], *L. Sturmann*[2], *P. J. Goldfinger*[2], *C. D. Farrington*[2], *S. T. Ridgway*[3]

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*Astrophysical Journal, in press (arXiv:1109.4950)*

We measured the angular diameter of the exoplanet host star $\iota$ Draconis with Georgia State University's Center for High Angular Resolution Astronomy (CHARA) Array interferometer, and, using the star's parallax and photometry from the literature, calculated its physical radius and effective temperature. We then combined our results with stellar oscillation frequencies from Zechmeister et al. (2008) and orbital elements from Kane et al. (2010) to determine the masses for the star and exoplanet. Our value for the central star's mass is $1.82\pm0.23\ M_\odot$, which means the exoplanet's minimum mass is $12.6\pm1.1\ M_{\rm Jupiter}$. Using our new effective temperature, we recalculated the habitable zone for the system, though it is well outside the star-planet separation.

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## Giant Planet Formation by Disk Instability: Flux-Limited Radiative Diffusion and Protostellar Wobbles

*Alan P. Boss*

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*Monthly Notices of the Royal Astronomical Society, in press*

Giant planet formation by gravitational disk instabilities has become theoretically and observationally acceptable at large distances, but remains theoretically contentious at distances inside about 20 AU. Several new three dimensional hydrodynamics models are presented, where radiative transfer is handled in the flux-limited diffusion approximation from the very start of the model, rather than being employed only after clumps have begun to form. The three models show that the use of the flux-limiter has little appreciable effect on the early evolution of a disk instability, in agreement with the conclusions of the previous models, which studied later phases. In addition, two new models are presented where the central protostar is either held fixed or is allowed to wobble in such a manner as to preserve the center of mass of the star-disk system. While spiral arms and clumps form in both models, the wobbling protostar model appears to be better able to form self-gravitating clumps that could contract to form gas giant protoplanets. Combined with previous results, the new models imply that disk instability should be able to form self-gravitating clumps inside, as well as outside, 20 AU in suitably massive and cool protoplanetary disks.

*Download/Website:* http://www.dtm.ciw.edu/users/boss/ftp/fluxwobble.pdf

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## A Disk Around the Planetary-Mass Companion GSC 06214-00210 b: Clues About the Formation of Gas Giants on Wide Orbits

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*ApJ, in press (arXiv:1109.5693)*

We present Keck/OSIRIS 1.1–1.8 $\mu$m adaptive optics integral field spectroscopy of the planetary-mass companion to GSC 06214-00210, a member of the $\sim$5 Myr Upper Scorpius OB association. We infer a spectral type of L0$\pm$1, and our spectrum exhibits multiple signs of youth. The most notable feature is exceptionally strong Pa$\beta$ emission ($EW$=–11.4$\pm$0.3 Å) which signals the presence of a circumplanetary accretion disk. The luminosity of GSC 06214-00210 b combined with its age yields a model-dependent mass of 14$\pm$2 $M_{\rm Jup}$, making it the lowest-mass companion to show evidence of a disk. With a projected separation of 320 AU, the formation of GSC 06214-00210 b and other very low-mass companions on similarly wide orbits is unclear. One proposed mechanism is formation at close separations followed by planet-planet scattering to much larger orbits. Since that scenario involves a close encounter with another massive body, which is probably destructive to circumplanetary disks, it is unlikely that GSC 06214-00210 b underwent a scattering event in the past. This implies that planet-planet scattering is not solely responsible for the population of gas giants on wide orbits. More generally, the identification of disks around young planetary companions on wide orbits offers a novel method to constrain the formation pathway of these objects, which is otherwise notoriously difficult to do for individual systems. We also refine the spectral type of the primary from M1 to K7 and detect a mild (2-$\sigma$) excess at 22 $\mu$m using $WISE$ photometry.

*Download/Website:* `http://arxiv.org/abs/1109.5693`

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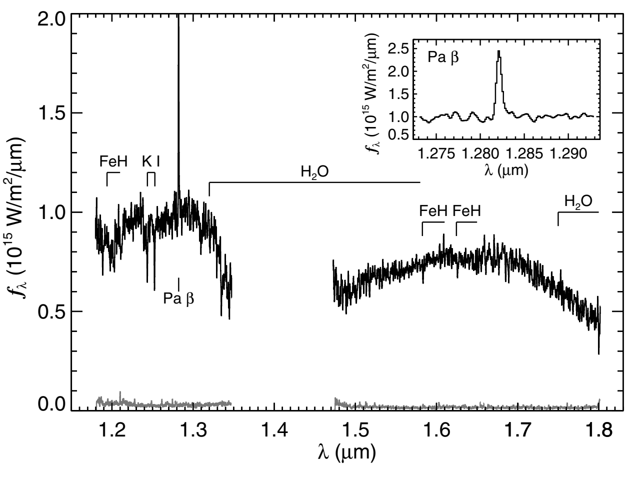


Figure 1: (Bowler et al.) Flux-calibrated $J$ and $H$ band spectra of GSC 06214-00210 b. The strong emission line at 1.282 $\mu$m (inset) is Pa$\beta$ ($EW$=–11.4$\pm$0.3 Å). The spectrum exhibits absorption features typical of late-M/early-L spectral types including FeH, K1, and $H_2O$. Spectral measurement uncertainties are shown at the bottom in gray.

## Hot exozodiacal dust resolved around Vega with IOTA/IONIC

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*Astronomy & Astrophysics, published A&A 534, A5*

Although debris discs have been detected around a significant number of main-sequence stars, only a few of them are known to harbour hot dust in their inner part where terrestrial planets may have formed. Thanks to infrared interferometric observations, it is possible to obtain a direct measurement of these regions, which are of prime importance for preparing future exo-Earth characterisation missions. In this context, we have resolved the exozodiacal dust disc around Vega with the help of infrared stellar interferometry and estimated the integrated H-band flux originating from the first few AUs of the debris disc. Using precise H-band interferometric measurements obtained with the 3-telescope IOTA/IONIC interferometer (Mount Hopkins, Arizona), thorough modelling of both interferometric data (squared visibility and closure phase) and spectral energy distribution was performed to constrain the nature of the near-infrared excess emission. The most straightforward scenario consists in a compact dust disc producing a thermal emission that is largely dominated by small grains located between 0.1 and 0.3 AU from Vega and accounting for $1.23 \pm 0.45\%$ of the near-infrared stellar flux for our best-fit model. This flux ratio is shown to vary slightly with the geometry of the model used to fit our interferometric data (variations within $\pm 0.19\%$). Initially revealed by K-band CHARA/FLUOR observations, the presence of hot exozodiacal dust in the vicinity of Vega is confirmed by our H-band IOTA/IONIC measurements at the 3-sigma level. Whereas the origin of the dust is still uncertain, its presence and the possible connection with the outer disc suggest that the Vega system is currently undergoing major dynamical perturbations.

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## A Survey of Alkali Line Absorption in Exoplanetary Atmospheres

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*Astrophysical Journal, in press (arXiv: 1109.1802)*

We obtained over 90 hours of spectroscopic observations of four exoplanetary systems with the Hobby-Eberly Telescope (HET). Observations were taken in transit and out of transit, and we analyzed the differenced spectra—i.e., the transmission spectra—to inspect it for absorption at the wavelengths of the neutral sodium (Na I) doublet at $\lambda\lambda 5889, 5895$ and neutral potassium (K I) at $\lambda 7698$. We used the transmission spectrum at Ca I $\lambda 6122$—which shows strong stellar absorption but is not an alkali metal resonance line that we expect to show significant absorption in these atmospheres—as a control line to examine our measurements for systematic errors. We use an empirical Monte Carlo method to quantity these systematic errors. In a reanalysis of the same dataset using a reduction and analysis pipeline that was derived independently, we confirm the previously seen Na I absorption in HD 189733b at a level of $(-5.26 \pm 1.69) \times 10^{-4}$ (the average value over a 12 Å integration band to be consistent with previous authors). Additionally, we tentatively confirm the Na I absorption seen in HD 209458b (independently by multiple authors) at a level of $(-2.63 \pm 0.81) \times 10^{-4}$, though the interpretation is less clear. Furthermore, we find Na I absorption of $(-3.16 \pm 2.06) \times 10^{-4}$ at $< 3\sigma$ in HD 149026b; features apparent in the transmission spectrum are consistent with real absorption and indicate this may be a good target for future observations to confirm. No other results (Na I in HD 147506b and Ca I and K I in all four targets) are significant to $\geq 3\sigma$, although we observe some features that we argue are primarily artifacts.

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## Analysis of new high-precision transit light curves of WASP-10 b: starspot occultations, small planetary radius, and high metallicity

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*Astronomy & Astrophysics, in press/arXiv:1109.4749)*

The WASP-10 planetary system is intriguing because different values of radius have been reported for its transiting exoplanet. The host star exhibits activity in terms of photometric variability, which is caused by the rotational modulation of the spots. Moreover, a periodic modulation has been discovered in transit timing of WASP-10 b, which could be a sign of an additional body perturbing the orbital motion of the transiting planet. We attempt to refine the physical parameters of the system, in particular the planetary radius, which is crucial for studying the internal structure of the transiting planet. We also determine new mid-transit times to confirm or refute observed anomalies in transit timing. We acquired high-precision light curves for four transits of WASP-10 b in 2010. Assuming various limb-darkening laws, we generated best-fit models and redetermined parameters of the system. The prayer-bead method and Monte Carlo simulations were used to derive error estimates. Three transit light curves exhibit signatures of the occultations of dark spots by the planet during its passage across the stellar disk. The influence of stellar activity on transit depth is taken into account while determining system parameters. The radius of WASP-10 b is found to be no greater than $1.03^{+0.07}_{-0.03}$ Jupiter radii, a value significantly smaller than most previous studies indicate. We calculate interior structure models of the planet, assuming a two-layer structure with one homogeneous envelope atop a rock core. The high value of the WASP-10 b's mean density allows one to consider the planet's internal structure including 270 to 450 Earth masses of heavy elements. Our new mid-transit times confirm that transit timing cannot be explained by a constant period if all literature data points are considered. They are consistent with the ephemeris assuming a periodic variation of transit timing. We show that possible starspot features affecting the transit's ingress or egress cannot reproduce variations in transit timing at the observed amplitude.

*Download/Website:* http://web.astri.umk.pl/ttv

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## Accretion of Rocky Planets by Hot Jupiters

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*Astrophysical Journal Letters, in press*

The observed population of Hot Jupiters displays a stunning variety of physical properties, including a wide range of densities and core sizes for a given planetary mass. Motivated by the observational sample, this paper studies the accretion of rocky planets by Hot Jupiters, after the Jovian planets have finished their principal migration epoch and become parked in $\sim 4$-day orbits. In this scenario, rocky planets form later and then migrate inward due to torques from the remaining circumstellar disk, which also damps the orbital eccentricity. This mechanism thus represents one possible channel for increasing the core masses and metallicities of Hot Jupiters. This paper determines probabilities for the possible end states for the rocky planet: collisions with the Jovian planets, accretion onto the star, ejection from the system, and long-term survival of both planets. These probabilities depend on the mass of the Jovian planet and its starting orbital eccentricity, as well as the eccentricity damping rate for the rocky planet. Since these systems are highly chaotic, a large ensemble ($N \sim 10^3$) of simulations with effectively equivalent starting conditions is required. Planetary collisions are common when the eccentricity damping rate is sufficiently low, but are rare otherwise. For systems that experience planetary collisions, this work determines the distributions of impact velocities – both speeds and impact parameters – for the collisions. These velocity distributions help determine the consequences of the impacts, e.g., where energy and heavy elements are deposited within the giant planets.

*Download/Website:* `arXiv: 1109.5104`

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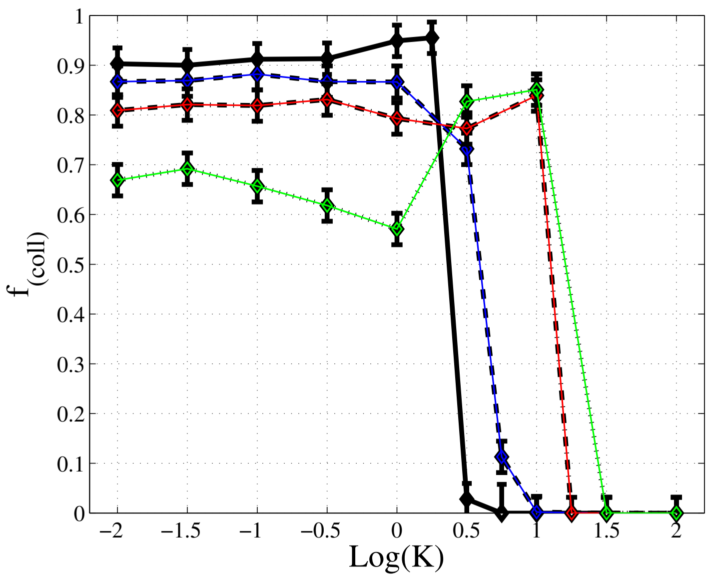


Figure 2: (Ketchum, Adams & Bloch) Collision fraction for rocky planets impacting Hot Jupiters versus eccentricity damping parameter $K$. The curves correspond to varying initial eccentricity of the Jovian orbit: $e = 0$ (black-solid), $e = 0.1$ (blue-dashes), $e = 0.2$ (red-dot-dashes), and $e = 0.3$ (green-dots).

## Modeling Magnetorotational Turbulence in Protoplanetary Disks with Dead Zones

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*Astrophysical Journal, in press (arXiv:1108.4892)*

Turbulence driven by magnetorotational instability (MRI) crucially affects the evolution of solid bodies in protoplanetary disks. On the other hand, small dust particles stabilize MRI by capturing ionized gas particles needed for the coupling of the gas and magnetic fields. To provide an empirical basis for modeling the coevolution of dust and MRI, we perform three-dimensional, ohmic-resistive MHD simulations of a vertically stratified shearing box with an MRI-inactive "dead zone" of various sizes and with a net vertical magnetic flux of various strengths. We find that the vertical structure of turbulence is well characterized by the vertical magnetic flux and three critical heights derived from the linear analysis of MRI in a stratified disk. In particular, the turbulent structure depends on the resistivity profile only through the critical heights and is insensitive to the details of the resistivity profile. We discover scaling relations between the amplitudes of various turbulent quantities (velocity dispersion, density fluctuation, vertical diffusion coefficient, and outflow mass flux) and vertically integrated accretion stresses. We also obtain empirical formulae for the integrated accretion stresses as a function of the vertical magnetic flux and the critical heights. These empirical relations allow to predict the vertical turbulent structure of a protoplanetary disk for a given strength of the magnetic flux and a given resistivity profile.

*Download/Website:* `http://arxiv.org/abs/1108.4892v1`

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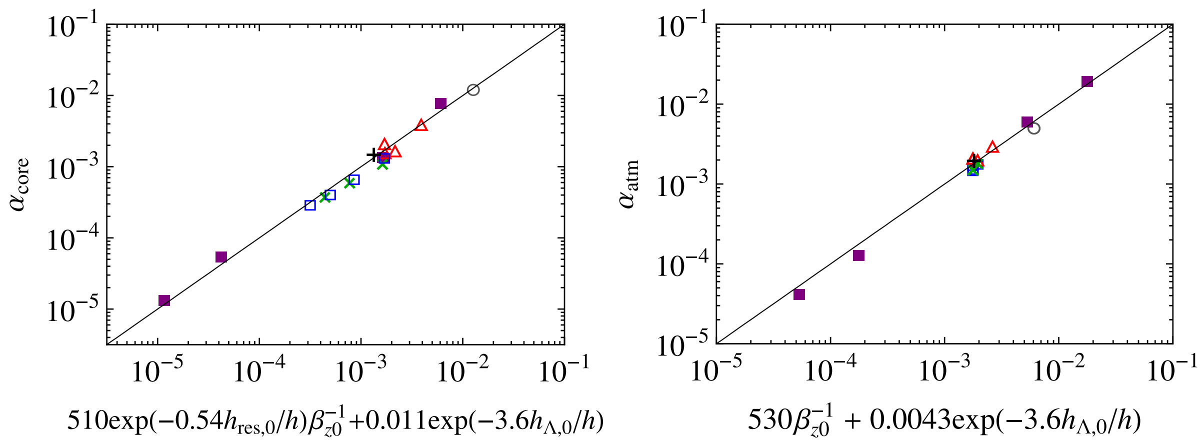


Figure 3: (Okuzumi & Hirose.) Accretion stresses integrated over the disk core ($\alpha_{\rm core}$; left panel) and atmosphere ($\alpha_{\rm atm}$; right panel) from our MHD simulations, compared with the predictor functions (solid lines). Here, $\beta_{z0}$ is the initial plasma beta at the midplane, $h$ is the gas scale height, and $h_{\rm res,0}$ and $h_{\Lambda,0}$ are the "critical heights" that characterize the vertical extent of the dead zones.

## The effects of dynamical interactions on planets in young substructured star clusters

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*Monthly Notices of the Royal Astronomical Society, in press (arXiv: 1109.6007)*

We present $N$-body simulations of young substructured star clusters undergoing various dynamical evolutionary scenarios and examine the direct effects of interactions in the cluster on planetary systems. We model clusters initially in cool collapse, in virial equilibrium and expanding, and place a 1 Jupiter-mass planet at either 5 au or 30 au from their host stars, with zero eccentricity. We find that after 10 Myr $\sim$10 per cent of planets initially orbiting at 30 au have been liberated from their parent star and form a population of free-floating planets. A small number of these planets are captured by other stars. A further $\sim$10 per cent have their orbital eccentricity (and less often their semi-major axis) significantly altered. For planets originally at 5 au the fractions are a factor of 2 lower. The change in eccentricity is often accompanied by a change in orbital inclination which may lead to additional dynamical perturbations in planetary systems with multiple planets. The fraction of liberated and disrupted planetary systems is highest for subvirial clusters, but virial and supervirial clusters also dynamically process planetary systems, due to interactions in the substructure.

Of the planets that become free-floating, those that remain observationally associated with the cluster (i.e. within two half-mass radii of the cluster centre) have a similar velocity distribution to the entire star cluster, irrespective of whether they were on a 5 au or a 30 au orbit, with median velocities typically $\sim$1 km s$^{-1}$. Conversely, those planets that are no longer associated with the cluster have similar velocities to the non-associated stars if they were originally at 5 au ($\sim$9 km s$^{-1}$), whereas the planets originally at 30 au have much lower velocities (3.8 km s$^{-1}$) than the non-associated stars (10.8 km s$^{-1}$). These findings highlight potential pitfalls of concluding that (a) planets with similar velocities to the cluster stars represent the very low-mass end of the IMF, and (b) planets on the periphery of a cluster with very different observed velocities form through different mechanisms.

*Download/Website:* `http://arxiv.org/abs/1109.6007`

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## A Search for the Transit of HD 168443b: Improved Orbital Parameters and Photometry

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*Astrophysical Journal, in press (arXiv:1109.5166v1)*

The discovery of transiting planets around bright stars holds the potential to greatly enhance our understanding of planetary atmospheres. In this work we present the search for transits of HD168443b, a massive planet orbiting

the bright star HD 168443 ($V = 6.92$) with a period of 58.11 days. The high eccentricity of the planetary orbit ($e = 0.53$) significantly enhances the a-priori transit probability beyond that expected for a circular orbit, making HD 168443 a candidate for our ongoing Transit Ephemeris Refinement and Monitoring Survey (TERMS). Using additional radial velocities from Keck-HIRES, we refined the orbital parameters of this multi-planet system and derived a new transit ephemeris for HD168443b. The reduced uncertainties in the transit window make a photometric transit search practicable. Photometric observations acquired during predicted transit windows were obtained on three nights. CTIO 1.0 m photometry acquired on 2010 September 7 had the required precision to detect a transit but fell just outside of our final transit window. Nightly photometry from the T8 0.8 m Automated Photometric Telescope (APT) at Fairborn Observatory, acquired over a span of 109 nights, demonstrates that HD 168443 is constant on a time scale of weeks. Higher-cadence photometry on 2011 April 28 and June 25 shows no evidence of a transit. We are able to rule out a non-grazing transit of HD168443b.

*Download/Website:* `http://arxiv.org/abs/1109.5166`

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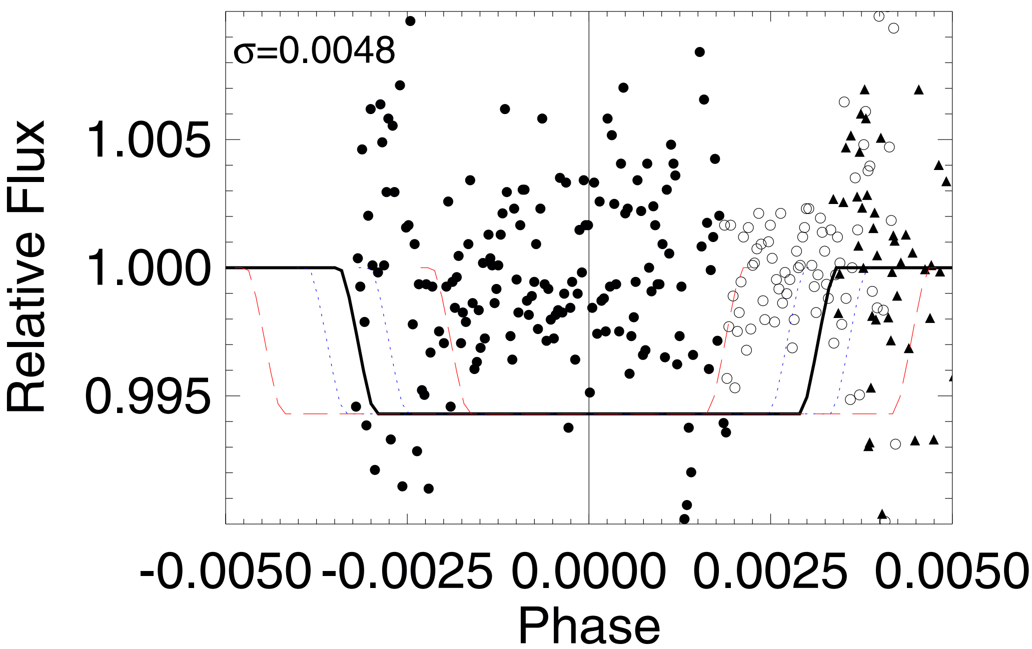


Figure 4: (Pilyavsky et al.) Phase diagram of the observations from all three nights of transit monitoring. The filled and unfilled circles are the T8 APT measurements from 2011 June 25 and April 28, respectively. The filled triangles are the CTIO observations from 2010 September 7. The solid line represents the predicted flux changes during a transit. The dotted blue and the dashed red lines represent $\pm 1 - \sigma$ and $\pm 3 - \sigma$ deviations in the time of transit, respectively.

## Three Body Resonance Overlap in Closely Spaced Multiple Planet Systems

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*Monthly Notices of the Royal Astronomical Society, in press/(arXiv-1106.0156)*

We compute the strengths of zero-th order (in eccentricity) three-body resonances for a co-planar and low eccentricity multiple planet system. In a numerical integration we illustrate that slowly moving Laplace angles are matched by variations in semi-major axes among three bodies with the outer two bodies moving in the same direction and the inner one moving in the opposite direction, as would be expected from the two quantities that are conserved in the three-body resonance. A resonance overlap criterion is derived for the closely and uniformly spaced, equal mass system with three-body resonances overlapping when interplanetary separation is less than an order unity factor times the planet mass to the one quarter power. We find that three-body resonances are sufficiently dense to account for wander in semi-major axis seen in numerical integrations of closely spaced systems and they are likely the cause of instability of these systems. For interplanetary separations outside the overlap region, stability timescales significantly increase. Crudely estimated diffusion coefficients in eccentricity and semi-major axis depend on a high power of planet mass and interplanetary spacing. An exponential dependence previously fit to stability or crossing timescales is likely due to the limited range of parameters and times possible in integration and the strong power law dependence of the diffusion rates on these quantities.

*Download/Website:* `http://arxiv.org/abs/1106.0156`

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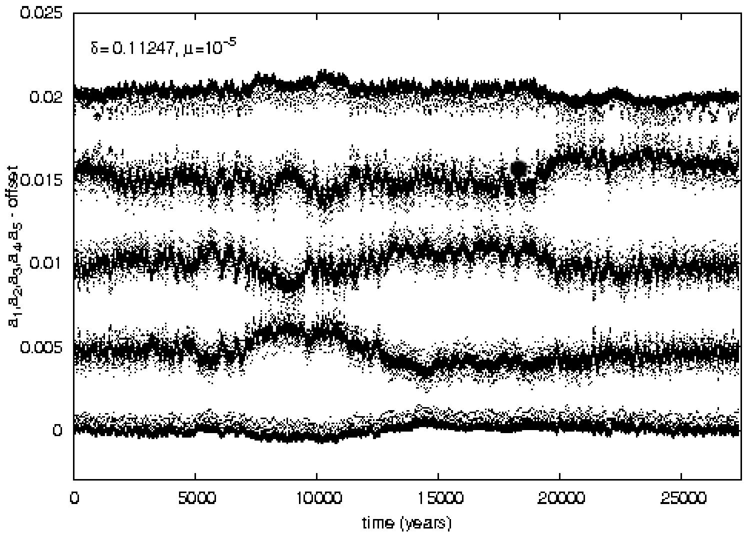


Figure 5: (Quillen) An example of a numerical integration of 5 equal low mass tightly packed bodies experiencing three body resonance crossings. The semi-major axes as a function of time in rotation periods of the innermost body are shown for all 5 bodies. Each set of points has been shifted by an arbitrary amount but has not been rescaled. Three body resonances between consecutive planets with Laplace angles $\phi = p\lambda_i - (p+q)\lambda_j + q\lambda_k$ for $p = 5, p+q = 11, q = 6$ and $p = 6, p+q = 13, q = 7$ are strong in this simulation. A signature of the three-body resonance is that the middle body's semi-major axis moves in one direction and the outer two move in the opposite direction.

## Possible planet-forming regions on submillimetre images

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*Monthly Notices of the Royal Astronomical Society, in press (2011arXiv1109.6177R)*

Submillimetre images of transition discs are expected to reflect the distribution of the optically thin dust. Former observation of three transition discs LkH$\alpha$ 330, SR 21N, and HD 1353444B at submillimetre wavelengths revealed images which cannot be modelled by a simple axisymmetric disc. We show that a large-scale anticyclonic vortex that develops where the viscosity has a large gradient (e.g., at the edge of the disc dead zone), might be accountable for these large-scale asymmetries. We modelled the long-term evolution of vortices being triggered by the Rossby wave instability. We found that a horseshoe-shaped (azimuthal wavenumber $m = 1$) large-scale vortex forms by coalescing of smaller vortices within $5 \times 10^4$ yr, and can survive on the disc life-time ($\sim 5 \times 10^6$ yr), depending on the magnitude of global viscosity and the thickness of the viscosity gradient. The two-dimensional grid-based global disc simulations with local isothermal approximation and compressible-gas model have been done by the GPU version of hydrodynamic code FARGO (GFARGO). To calculate the dust continuum image at submillimetre wavelengths, we combined our hydrodynamical results with a 3D radiative transfer code. By the striking similarities of the calculated and observed submillimetre images, we suggest that the three transition discs can be modelled by a disc possessing a large-scale vortex formed near the disc dead zone edge. Since the larger dust grains (larger than mm in size) are collected in these vortices, the non-axisymmetric submillimetre images of the above transition discs might be interpreted as active planet and planetesimal forming regions situated far ($> 50$ AU) from the central stars.

*Download/Website:* `http://arxiv.org/abs/1109.6177`

*Contact:* `regaly@konkoly.hu`

## Know the Star, Know the Planet. I. Adaptive Optics of Exoplanet Host Stars

*Lewis C. Roberts, Jr.*[1], *Nils H. Turner*[2], *Theo A. ten Brummelaar*[2], *Brian D. Mason*[3], *William I. Hartkopf*[3]

[1] Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena CA 91109, USA
[2] Center for High Angular Resolution Astronomy, Georgia State University, Mt. Wilson, CA 91023, USA
[3] U.S. Naval Observatory, 3450 Massachusetts Avenue, NW, Washington, DC 20392-5420, USA

*Astronomical Journal, in press (arXiv: 1109.4320)*

The results of an adaptive optics survey of exoplanet host stars for stellar companions are presented. We used the AEOS Telescope and its adaptive optics system to collect deep images of the stars in $I$-band. Sixty-two exoplanet host stars were observed and fifteen multiple star systems were resolved. Of these, eight are known multiples, while seven are new candidate binaries. For all binaries, we measured the relative astrometry of the pair and the differential magnitude in $I$-band. We computed improved orbits for HD 19994 and $\tau$ Boo, which cast light on how the binary may have impacted the evolution of the planetary system. These observations will provide improved statistics on the duplicity of exoplanet hosts stars and an increased understanding of the dynamics of known binary star exoplanet hosts.

*Download/Website:* `http://arxiv.org/abs/1109.4320`

*Contact:* `lewis.c.roberts@jpl.nasa.gov`

## Know the Star, Know the Planet. II. Speckle Interferometry of Exoplanet Host Stars

*Brian D. Mason*[1], *William I. Hartkopf*[1], *Deepak Raghavan*[2], *John P. Subasavage*[3], *Lewis C. Roberts, Jr.*[4], *Nils H. Turner*[5], *& Theo A. ten Brummelaar*[5]

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[3] Cerro Tololo Inter-American Observatory, La Serena, Chile
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[5] Center for High Angular Resolution Astronomy, Georgia State University, Mt. Wilson, CA 91023

*Astronomical Journal, in press (arXiv:1109.4569)*

A study of the host stars to exoplanets is important to understanding their environment. To that end, we report new speckle observations of a sample of exoplanet host primaries. The bright exoplanet host HD 8673 (= HIP 6702) is revealed to have a companion, although at this time we cannot definitively establish the companion as physical or optical. The observing lists for planet searches and for these observations have for the most part been pre-screened for known duplicity, so the detected binary fraction is lower than what would otherwise be expected. Therefore, a large number of double stars were observed contemporaneously for verification and quality control purposes, to ensure the lack of detection of companions for exoplanet hosts was valid. In these additional observations, ten pairs are resolved for the first time and sixty pairs are confirmed. These observations were obtained with the USNO speckle camera on the NOAO 4m telescopes at both KPNO and CTIO from 2001 to 2010.

*Download/Website:* `http://exoplanet.open.ac.uk/`

*Contact:* `bdm@usno.navy.mil`

## The orbital phases and secondary transit of Kepler-10b. A physical interpretation based on the lava-ocean planet model

*D. Rouan*[1] , *H. J. Deeg*[2,3] , *O. Demangeon*[4,5] , *B. Samuel*[4,5] , *C. Cavaroc*[4,5] , *B. Fegley*[6] , *& A. Léger*[4,5]

[1] LESIA, UMR 8109 CNRS , Observatoire de Paris, UVSQ, Université Paris-Diderot, 5 place J. Janssen, 92195 Meudon, France
[2] Instituto de Astrofsica de Canarias, E-38205 La Laguna, Tenerife, Spain
[3] Universidad de La Laguna, Dept. de Astrofísica, E-38200 La Laguna, Tenerife, Spain
[4] Institut d'Astrophysique Spatiale, Université Paris XI, F-91405 Orsay, France
[5] Institut d'Astrophysique Spatiale, CNRS, F-91405 Orsay, France
[6] Planetary Chemistry Laboratory, McDonnell Center for the Space Sciences, Department of Earth and Planetary Sciences

*Astrophysical Journal Letters, in press (arXive-1109.2768)*

The Kepler mission has made an important observation, the ?rst detection of photons from a terrestrial planet by observing its phase curve (Kepler-10b). This opens a new ?eld in exoplanet science: the possibility to get information about the atmosphere and surface of rocky planets, objects of prime interest. In this Letter, we apply the Lava-ocean model to interpret the observed phase curve. The model, a planet with no atmosphere and a surface partially made of molten rocks, has been proposed for planets of the class of CoRoT-7b, i.e., rocky planets very close to their star (at few stellar radii). Kepler-10b is a typical member of this family. It predicts that the light from the planet has an important emission component in addition to the re?ected one, even in the Kepler spectral band. Assuming an isotropical re?ection of light by the planetary surface (Lambertian-like approximation), we ?nd that a Bond albedo of $\approx$50% can account for the observed amplitude of the phase curve, as opposed to a ?rst attempt where an unusually high value was found. We propose a physical process to explain this still large value of the albedo. The overall interpretation can be tested in the future with instruments such as James Webb Space Telescope or Exoplanet Characterization Observatory. Our model predicts a spectral dependence that is clearly distinguishable from that of purely re?ected light and from that of a planet at a uniform temperature.

*Contact:* `daniel.rouan@obspm.fr`

## The Time Dependence of hot Jupiters' Orbital Inclinations

*Amaury H. M. J. Triaud*
Observatoire Astronomique de l'Université de Genève, Chemin des Maillettes 51, CH-1290 Sauverny, Switzerland

*A&A, accepted*

Via the Rossiter-McLaughlin effect, it is possible to measure the sky-projected angle between the stellar spin and a planet's orbital spin. Observed orbital inclinations have been found to range over all possible angles. A tentative detection of a correlation between the dispersion in spin/orbit angle and the youth of the system is revealed, using spin/orbit measurements for hot Jupiters around stars with masses $\geq 1.2\,M_{\odot}$ for which age estimates are more accurately determined. The chance of this pattern arising by chance has been computed to 7%. This appears in accordance with tidal dissipation where non-coplanar hot Jupiters' orbits tidally realign. The results show they would do so within about 2.5 Gyr. For the considered sample, the results give support to hot Jupiters being placed on non coplanar orbits early in their history rather than this happening late. Such events could involve strong planet-planet scattering.

*Download/Website:* `http://arxiv.org/abs/1109.5813`

*Contact:* `amaury.triaud@unige.ch`

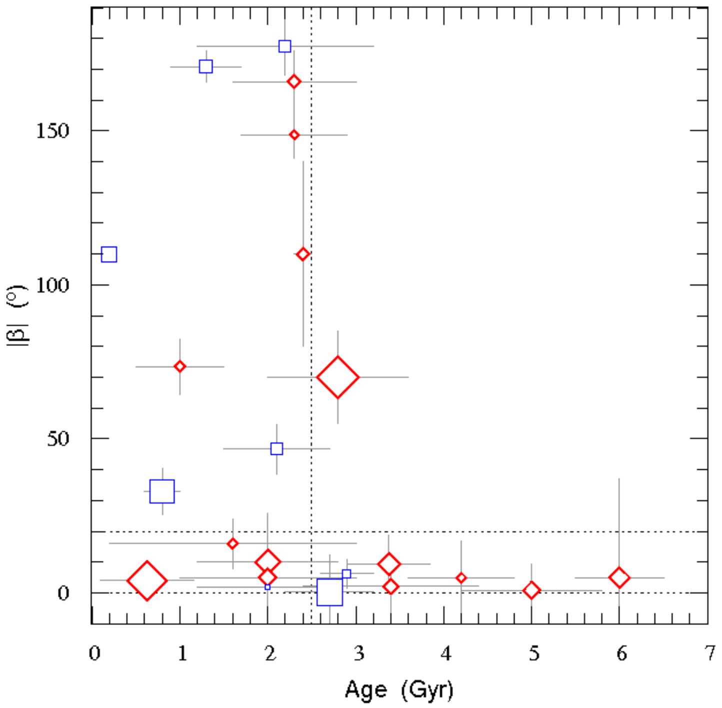


Figure 6: (Triaud) Secure, absolute values of $\beta$ against stellar age (in Gyr), for stars with $M_{\star} \geq 1.2\,M_{\odot}$. Size of the symbols scales with planet mass. In blue squares, stars with $M_{\star} \geq 1.3\,M_{\odot}$; in red diamonds $1.3 > M_{\star} \geq 1.2\,M_{\odot}$. Horizontal dotted line show where aligned systems are. Vertical dotted line shows the age at which where misaligned planets start to disappear.

## Terrestrial, Habitable-Zone Exoplanet Frequency from Kepler

*W. Traub*
Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109

*Astrophysical Journal, in press, arXiv:1109.4682*

Data from Kepler's first 136 days of operation are analyzed to determine the distribution of exoplanets with respect to radius, period, and host-star spectral type. The analysis is extrapolated to estimate the percentage of terrestrial, habitable-zone exoplanets. The Kepler census is assumed to be complete for bright stars (magnitude $< 14.0$) having transiting planets $> 0.5$ Earth radius and periods $< 42$ days. It is also assumed that the size distribution of planets is independent of orbital period, and that there are no hidden biases in the data. Six significant statistical results are found: there is a paucity of small planet detections around faint target stars, probably an instrumental effect; the frequency of mid-size planet detections is independent of whether the host star is bright or faint; there are significantly fewer planets detected with periods $< 3$ days, compared to longer periods, almost certainly an astrophysical effect; the frequency of all planets in the population with periods $< 42$ days is 29%, broken down as terrestrials 9%, ice giants 18%, and gas giants 3%; the population has a planet frequency with respect to period which follows a power-law relation $dN/dP \sim P^{\beta-1}$, with $\beta \simeq 0.71 \pm 0.08$; and an extrapolation to longer periods gives the frequency of terrestrial planets in the habitable zones of FGK stars as $\eta_{\oplus} \simeq (34 \pm 14)\%$. Thus about one-third of FGK stars are predicted to have at least one terrestrial, habitable-zone planet.

*Contact:* `wtraub@jpl.nasa.gov`

## The outcome of protoplanetary dust growth: pebbles, boulders, or planetesimals? III. Sedimentation driven coagulation inside the snowline

*A. Zsom*[1], *C.W. Ormel*[1], *C. P. Dullemond*[1,2], *Th. Henning*[1]
[1] Max-Planck-Institute für Astronomie, Königstuhl 17, D-69117 Heidelberg, Germany
[2] Institut für Theoretische Astrophysik, Universität Heidelberg, Heidelberg, Germany

*Astronomy & Astrophysics, in press*

The evolution of dust particles in protoplanetary disks determines many observable and structural properties of the disk, such as the spectral energy distribution (SED), appearance of disks, temperature profile, and chemistry. Dust coagulation is also the first step towards planet formation.
We investigate dust growth due to settling in a 1D vertical column of a disk. It is known from the ten micron feature in disk SEDs, that small micron-sized grains are present at the disk atmosphere throughout the lifetime of the disk. We hope to explain such questions as what process can keep the disk atmospheres dusty for the lifetime of the disk and how the particle properties change as a function of height above the midplane.
We used a Monte Carlo code to follow the mass and porosity evolution of the particles in time. We gradually build up the complexity of the models by considering the effects of porosity, different collision models, turbulence, and different gas models, respectively. This way we can distinguish the effects of these physical processes on particle growth and motion. The collision model used is based on laboratory experiments performed on dust aggregates. As the experiments cannot cover all possible collision scenarios, the largest uncertainty of our model comes from the necessary extrapolations we had to perform. We simultaneously solved for the particle growth and motion. Particles can move vertically due to settling and turbulent mixing. We assumed that the vertical profile of the gas density is fixed in time and that only the solid component evolves.
We find that the used collision model strongly influences the masses and sizes of the particles. The laboratory-experiment based collision model greatly reduces the particle sizes compared to models that assume sticking at all collision velocities. We find that a turbulence parameter of $\alpha = 10^{-2}$ is needed to keep the dust atmospheres dusty, but such strong turbulence can produce only small particles at the midplane, which does not favor for planetesimal formation models. We also see that the particles are larger at the midplane and smaller at the upper layers of the disk.

At 3-4 pressure-scale heights, micron-sized particles are produced. These particle sizes are needed to explain the ten micron feature of disk SEDs. Turbulence may therefore help keep small dust particles in the disk atmosphere.

*Download/Website:* `http://arxiv.org/abs/1107.5198`

*Contact:* `zsom@mpia.de`

# 3 Jobs and Positions

## Lectureship in Exoplanetary Astrophysics

*Mike Barlow*
University College London, Gower Street, London WC1E 6BT

*UCL, London, Due: 31 October 2011; Starting: 01 April 2012*

UCL invites applications for a lectureship in Exoplanetary Astrophysics from candidates with an excellent record of academic research and promise for future achievements. The successful candidate will be expected to enhance our research programme in Exoplanetary Astrophysics, to develop new research initiatives and to generate the external income to support them. Proven ability to raise funds for one's own research (e.g. through a personal fellowship) would be an advantage. The position will also involve participation in the Departmental teaching programme at undergraduate and graduate level.
We are seeking a candidate with a PhD in Physics (or a closely related discipline) and a high profile in the field of exoplanetary astrophysics or planetary atmospheres. Further details, including a job description and person specification, can be found at: http://www.ucl.ac.uk/phys/vacancies
The Lecturer will be appointed on the salary scale Lecturer Grade 8, £39668 to £46822 per annum inclusive of London Allowance.
The closing date for applications is 5pm on Monday, 31st October 2011
Applications for the position should be made online at http://www.ucl.ac.uk/hr/jobs. If you have any queries regarding the application process, please contact Mrs Kay Nakum, k.nakum@ucl.ac.uk, +44 (0)20 7679 33458. Applicants should ask their three referees to email letters of reference by the same deadline to Mrs Kay Nakum.
The post is available from 01 April 2012. The interviews for this post will be held probably during the second half of November 2011.
If you wish to discuss the post informally, please contact Professor Mike Barlow, mjb@star.ucl.ac.uk.
We particularly welcome female applicants and those from an ethnic minority, as they are currently under-represented within UCL at this level.

*Download/Website:* `http://www.ucl.ac.uk/phys/vacancies/`

*Contact:* `k.nakum@ucl.ac.uk`

## Tenure track assistant professor for astronomy / planetary sciences

*W. Benz*
Center for Space and Habitabilty, Sidlerstrasse 5, 3012 Berne, Switzerland

*Berne, Due: November 15, 2011; Start: Fall 2012*

The successful candidate should have an outstanding research record in planetary evolution. A focus on habitability and its potentially detectable signatures would be of particular interest. She/he is expected to contribute to the multidisciplinary research activities of the newly created Centre for Space and Habitability, to participate actively in the teaching of physics at both the undergraduate and graduate level, and to attract external funding. Expected starting date: Fall 2012.

The current scientific research of the division is in the field of the origin and characterization of the solar and extrasolar planets and planetary systems. This includes the in-situ and remote exploration of planets, satellites, small bodies of the solar system, laboratory investigations of meteorites and the theory of planet formation. Within the Centre, there is the potential for collaboration with activities in atmospheric physics, climate physics, geophysical processes, cosmochemistry and life sciences.

The University of Bern particularly encourages women to apply for this position.

Applications (in English) including a curriculum vitae, a list of publications, copies of the five most relevant publications, and an outline of current and planned future research should be sent as a single PDF file or as a hard copy by November 15, 2011 to: Prof. S. Decurtins, Dean, Faculty of Science, University of Berne, Sidlerstrasse 5, CH-3012 Berne (Switzerland), e-mail:dekan@natdek.unibe.ch.

*Download/Website:* `http://www.space.unibe.ch`

*Contact:* `wbenz@space.unibe.ch`

## McLean Postdoctoral Fellowship - Exo-Planets, Brown Dwarfs and Young Stars

*Prof. Ray Jayawardhana*

*Toronto, Canada, 2012*

Applications are invited for a postdoctoral fellowship at the University of Toronto to start in 2012. The successful candidate, designated as McLean Postdoctoral Fellow, will work with Prof. Ray Jayawardhana and his collaborators on observational and analytical studies of extra-solar planets, brown dwarfs and young stars, and will be encouraged to pursue independent research on related topics. On-going projects include high-contrast imaging searches for sub-stellar companions around young stars, photometric and spectroscopic studies of extra-solar planets (including a successful CFHT Large Program), investigations of brown dwarf variability and multiplicity, and the SONYC (Substellar Objects in Nearby Young Clusters) ultra-deep survey, using data from VLT, Subaru, Gemini, Keck, Spitzer, CFHT, and other major observatories. The position is for two years, with extension to a third year possible, and comes with a competitive salary and funds for research expenses. Applicants should send a curriculum vitae, a description of research interests and plans and a list of publications, and should arrange for three letters of recommendation to be sent directly to rayjay@astro.utoronto.ca. All materials should be submitted electronically. Applications received before 2011 December 15 will receive full consideration. Early expressions of interest and inquiries are welcome.

*Download/Website:* `http://www.astro.utoronto.ca`

*Contact:* `rayjay@astro.utoronto.ca`

## 2012 NASA Sagan Fellowship Program

*Dawn M. Gelino, NASA Exoplanet Science Institute*

*Applications Due: Nov. 3, 2011, Start Date: Fall 2011*

The NASA Exoplanet Science Institute announces the 2012 Sagan Postdoctoral Fellowship Program and solicits applications for fellowships to begin in the Fall of 2012.

The Sagan Fellowships support outstanding recent postdoctoral scientists to conduct independent research that is broadly related to the science goals of the NASA Exoplanet Exploration area. The primary goal of missions within this program is to discover and characterize planetary systems and Earth-like planets around nearby stars.

The proposed research may be theoretical, observational, or instrumental. This program is open to applicants of any nationality who have earned (or will have earned) their doctoral degrees on or after January 1, 2009, in astronomy, physics, or related disciplines. The fellowships are tenable at U.S. host institutions of the fellows' choice, subject to a maximum of one new fellow per host institution per year. The duration of the fellowship is up to three years: an initial one-year appointment and two annual renewals contingent on satisfactory performance and availability of NASA funds.

*Note:* Starting with the call for 2012 Sagan Fellows, we are accepting the submission of up to two host institutions. The purpose of designating first and second-choice institutions in the application is to provide the program with flexibility should there be several highly ranked applications at any single institution.

The Announcement of Opportunity, which includes detailed program policies and application instructions is available at the web site: http://nexsci.caltech.edu/sagan/fellowship.shtml

Applicants must follow the instructions given in this Announcement. Applications must be submitted electronically through the above website. Inquiries about the Sagan Fellowships may be directed to saganfellowship@ipac.caltech.edu

**The deadline for both applications and letters of reference is Thursday, November 3, 2011**. Offers will be made before February 1, 2012 and new appointments are expected to begin on or about September 1, 2012.

*Download/Website:* `http://nexsci.caltech.edu/sagan/fellowship.shtml`

*Contact:* `saganfellowship@ipac.caltech.edu`

## Postdoctoral Research Position: : Spectroscopic Follow-up of CoRoT transiting planetary candidates Place

*Francois Bouchy & Guillaume Hébrard*
University College London, Gower Street, London WC1E 6BT

*Institut d'Astrophysique de Paris and Haute Provence Observatory, France, Due: 31 October 2011*

The Institut d'Astrophysique of Paris (IAP) and the Haute Provence Observatory (OHP) have an immediate opening for a two-years postdoctoral research associate to participate to the CoRoT exoplanet search program and more specifically to the spectroscopic follow-up of CoRoT transiting planetary candidates using the SOPHIE high-precision spectrograph based on the 1.93-m OHP telescope. The candidate will contribute to the upgrade and the

optimization of the SOPHIE spectrograph and SOPHIE data reduction pipeline. S/He will participate in the scientific exploitation (observations and data analysis) of the large program of spectroscopic and radial velocity follow-up conducted with SOPHIE on the CoRoT transiting planetary candidates. S/He will also participate to the development and commissioning of a 50-cm robotic telescope for the photometric and low-resolution spectroscopic follow-up of CoRoT candidates.

The postdoctoral duration is two years starting as early as January 2012. The gross yearly salary will be in the range 28-30 keuros.

The candidate should have a PhD thesis on astrophysics. Preference will be given to applicants who have a background in instrumentation, data reduction and observational astronomy as well as experience in exoplanets and spectral classification.

Applications are requested before 31 October 2011 and should include a Curriculum Vitae, a statement of research interests, a list of publications and letters of references.

Contacts :
Francois Bouchy & Guillaume Hébrard; Observatoire de Haute Provence; 04870 St Michel l'Observatoire; France.
fax : 33 (0)4 92 76 62 95
tel : 33 (0)4 92 70 64 94 / 65 21
*Contact:* `bouchy@iap.fr or hebrard@iap.fr`

## PhD position in Protoplanetary Disc Research

*P. Woitke & J. Greaves*
University College London, Gower Street, London WC1E 6BT

*University of St Andrews, Due: 11 November 2011; Starting: 01 January 2012*

We seek applications for a 3.5-year PhD position in the Astronomy Group, to work with Dr Jane Greaves and Dr Peter Woitke in the field of circumstellar discs and planet formation. The research includes the collection of existing and planning of future observations, from X-ray to millimetre wavelengths, using telescopes like XMM, HST, VLT, Spitzer, Herschel, JCMT, eMerlin, and ALMA. The student will collate such data from telescope archives and compile a database to form the basis for multi-wavelength analysis by novel disc models. Much of this data has never been analysed and so there are exciting opportunities for new discoveries, as well as for follow-up observations. The work requires to communicate to observers as well as to modellers, and to figure out how to best compare models with observations. The skills required include logic, persistence, and willingness to learn to process astronomical data at many different wavelengths. Some previous experience or interest in database coding would be an advantage.

The research is funded by FP7-SPACE-2011, exploitation of space exploration data, collaborative project #284405 ("DiscAnalysis"), and will be carried out simultaneously in five different European institutions, among them Amsterdam (NL), Groningen (NL), Grenoble (F), coordinated from St Andrews (UK). For more information about the Astronomy group in St Andrews, see http://star-www.stand. ac.uk/astronomy. The ability to work in a team is an important factor for the choice of candidates. Applicants will take part in outreach activities and in an exchange programme to visit the participating institutes for the duration of several weeks each. Formal education in advanced astronomy is required as part of the PhD and is offered via the post-graduate courses of the Scottish Universities Physics Alliance (SUPA).

Applications include a CV and a summary of any research projects undertaken for previous degree. We encourage applicants to apply online via https://www.vacancies.st-andrews.ac.uk, or alternatively, by email to peter.woitke@st-andrews.ac.uk. If you are unable to do this, please call +44 (0)1334 462571 for an application pack. Applicants should arrange for two letters of reference sent by the referees directly to the same address. Applications will be considered until a suitably qualified student is appointed. Duration of PhD funding will be from 1 January 2012 to 30 June 2015. Informal enquiries to Dr. P. Woitke (peter.woitke@st-andrews.ac.uk) or Dr. J. Greaves (jsg5@st-andrews.ac.uk).

Closing Date: Friday, 11.11.11

Interview Date: late November

Please quote Ref No: "FP7_Greaves_Woitke"

*Download/Website:* `https://www.vacancies.st-andrews.ac.uk`

*Contact:* `peter.woitke@st-andrews.ac.uk or jsg5@st-andrews.ac.uk`

# 4 Conference announcements

## Astrophysics at Extremely High Angular Resolution: Optical and Infrared Interferometry

*René Oudmaijer, Ettore Pedretti, Chris Haniff*
Leeds, St Andrews & ESO, Cambridge

*The Geological Society, Burlington House, LONDON,W1J 0BG, UK, Friday 11 November, 10:30 - 15:30*

We'd like to announce a one day RAS Specialist Discussion meeting on Astrophysics at Extremely High Angular Resolution: Optical and Infrared Interferometry

The new century has seen a quantum leap in the field of optical and infrared long-baseline interferometry, with facilities such as the CHARA and VLTI arrays now routinely producing images with milliarcsecond resolution. As a result, over the past ten years, ground-based optical/IR interfometry has transitioned to become a mainstream, common-user, technique offering unprecedented insights into a wide range of astrophysical phenomena. These include asteroseismology, YSO accretion, photosphere dynamics, exoplanet characterization, and the structure of AGN cores.

This meeting will bring together experts and novices in the field to present their latest scientific results, and to highlight the existing and upcoming capabilities at facility class arrays such as the VLTI. We hope to attract not only attendees who are excited by the possibilities that interferometric methods can bring to their research, but also those who wish to find out more and assess the investment of their time needed to best exploit the UK's access to European and American interferometric arrays.

You can find more information, including a preliminary program on the website.

*Download/Website:* `http://www.ast.leeds.ac.uk/ roud/rasmeet2012.htm`

*Contact:* `r.d.oudmaijer@leeds.ac.uk`

## Science with a Wide-field Infrared Telescope in Space *and* The 16th International Conference on Gravitational Microlensing

*Caltech*

*Pasadena, CA, February 13-17, 2012*

Please join us for this two-part, week long conference that capitalizes on the synergy between the top ranked space-based recommendation of the Astronomy and Astrophysics Decadal Survey report and the burgeoning field of microlensing. The conference will begin with two and a half days (Feb. 13-15) focusing on the scientific potential of observations with a wide-field infrared survey telescope in space to probe the nature of dark energy, conduct searches for exoplanets using gravitational microlensing, and as a general facility for wide-area surveys. The second half of the week (Feb. 15-17) will be the 16th in a series of conferences to discuss the latest results from microlensing searches and the perspectives opened by new methodologies and observational and computational facilities.

This meeting is being hosted by NASA, the Infrared Processing and Analysis Center (IPAC) at the California Institute of Technology, the Jet Propulsion Laboratory (JPL), and the Goddard Space Flight Center (GSFC). It will take place at the Pasadena Hilton.

*Download/Website:* `http://ipac.caltech.edu/wfir2012/`

*Contact:* `wfir2012@ipac.caltech.edu`

# 5 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during September 2011. If you see any that we missed, please let us know and we'll include them in the next issue.

**Exoplanets**

astro-ph/1109.0321: **Long-term magnetic activity of a sample of M-dwarf stars from the HARPS program I. Comparison of activity indices** by *J. Gomes da Silva, N.C. Santos, X. Bonfils et al*

astro-ph/1109.0360: **Treating dynamical stability as an observable: a 5:2 MMR configuration for the extrasolar system HD 181433** by *Giammarco Campanella*

astro-ph/1109.0582: **The Optical andNear-Infrared Transmission Spectrum of the Super-Earth Planet GJ1214b: Further Evidence for a Metal-Rich Atmosphere** by *Jacob L. Bean, Jean-Michel Desert, Petr Kabath et al*

astro-ph/1109.0659: **Atmospheres of Hot Super-Earths** by *Thibaut Castan, Kristen Menou*

astro-ph/1109.0717: **LTE model atmopsheres MARCS, ATLAS and CO5BOLD** by *Piercarlo Bonifacio, Elisabetta Caffau, Hans-Guenter Ludwig et al*

astro-ph/1109.0936: **Prospecting transit duration variations in extrasolar planetary systems** by *C. Damiani, A. F. Lanza*

astro-ph/1109.1094: **The Final State of the Thermal Evolution of Free-Floating Giant Planet** by *R. Szczesniak, M.W. Jarosik, M. Szczesniak et al*

astro-ph/1109.1262: **The Biological Big Bang: The First Oceans of Primordial Planets at 2-8 Million Years Explain Hoyle/Wickramasinghe Cometary Panspermia** by *Carl H. Gibson*

astro-ph/1109.1561: **The Kepler-19 System: A Transiting** $2.2R\_oplus$ **Planet and a Second Planet Detected via Transit Timing Variations** by *Sarah Ballard, Daniel Fabrycky, Francois Fressin et al*

astro-ph/1109.1574: **Atmospheric Circulation and Composition of GJ1214b** by *Kristen Menou*

astro-ph/1109.1611: **Discovery and Atmospheric Characterization of Giant Planet Kepler-12b: An Inflated RadiusOutlier** by *Jonathan J. Fortney, Brice-Olivier Demory, Jean-Michel Desert et al*

astro-ph/1109.1750: **The long history of the Rossiter-McLaughlin effect and its recent applications** by *Simon Albrecht*

astro-ph/1109.1802: **A Survey of Alkali Line Absorption in Exoplanetary Atmospheres** by *Adam G. Jensen, Seth Redfield, Michael Endl et al*

astro-ph/1109.1819: **Near-Infrared Spectroscopy of Low-Mass Kepler Planet-Candidate Host Stars: Effective Temperatures, Metallicities, Masses and Radii** by *Philip S. Muirhead, Katherine Hamren, Everett Schlawin et al*

astro-ph/1109.2270: **Constraining High Speed Winds in Exoplanet Atmospheres Through Observations of Anomalous Doppler Shifts During Transit** by *Eliza Miller-Ricci Kempton, Emily Rauscher*

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