ExoPlanet News
An Electronic Newsletter

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1 Editorial

Welcome to the 82nd edition of Exoplanet News. As well as the usual selection of great abstracts, along with a few enticing conference announcements and job adverts, I'm pleased to see a couple of reports on a summer school and a workshop – please keep similar reports, and conference summaries, coming!

I'll also draw your attention to my announcement of the re-launch of the Journal *Astronomical Review*, now under the ownership of the publishers Taylor & Francis. It would be great to receive some review articles for the journal submitted on topics in exoplanet science.

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. Although note that my updates to the website only become live over-night. So if you want to get the newsletter as soon as it is ready, please subscribe and get it by email on the day it's released.

Best wishes
Andrew Norton
The Open University

2 Abstracts of refereed papers

The Center of Light: Spectroastrometric Detection of Exomoons

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The Astrophysical Journal, in press (arXiv:1509.01615)

Direct imaging of extrasolar planets with future space-based coronagraphic telescopes may provide a means of detecting companion moons at wavelengths where the moon outshines the planet. We propose a detection strategy based on the positional variation of the center of light with wavelength, "spectroastrometry." This new application of this technique could be used to detect an exomoon, to determine the exomoon's orbit and the mass of the host exoplanet, and to disentangle of the spectra of the planet and moon. We consider two model systems, for which we discuss the requirements for detection of exomoons around nearby stars. We simulate the characterization of an Earth-Moon analog system with spectroastrometry, showing that the orbit, the planet mass, and the spectra of both bodies can be recovered. To enable the detection and characterization of exomoons we recommend that coronagraphic telescopes should extend in wavelength coverage to 3 micron, and should be designed with spectroastrometric requirements in mind.

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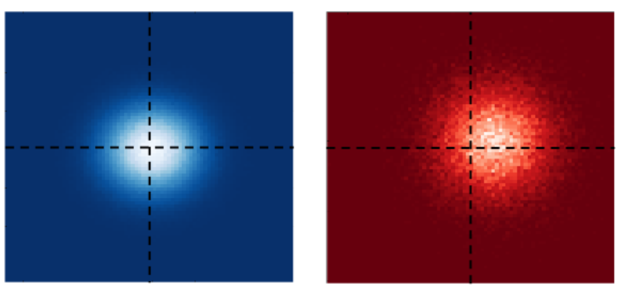

Figure 1: (Agol et al.) Spectroastrometric signal. Left: at a bluer wavelength dominated by the planet, the centroid aligns with the planet's posi- tion at the origin. Right: at a redder wavelength dominated by the moon (within an absorption band in which the planet's spectrum is dark), the centroid shifts to the position of the moon.

The GAPS Programme with HARPS-N at TNG. X. Differential abundances in the XO-2 planet hosting binary

K. Biazzo[1], *R. Gratton*[2], *S. Desidera*[2], *S. Lucatello*[2], *A. Sozzetti*[3], *A. S. Bonomo*[3], *M. Damasso*[3], *D. Gandolfi*[4,5], *L. Affer*[6], *C. Boccato*[2], *F. Borsa*[7], *R. Claudi*[2], *R. Cosentino*[1,8], *E. Covino*[9], *C. Knapic*[10], *A. F. Lanza*[1], *J. Maldonado*[6], *F. Marzari*[11], *G. Micela*[6], *P. Molaro*[10], *I. Pagano*[1], *M. Pedani*[8], *I. Pillitteri*[6], *G. Piotto*[2,11], *E. Poretti*[7], *M. Rainer*[7], *N. C. Santos*[12,13,14], *G. Scandariato*[1], *R. Zanmar Sanchez*[1]

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Astronomy & Astrophysics, in press (arXiv:1506.01614)

Binary stars hosting exoplanets are a unique laboratory where chemical tagging can be performed to measure with high accuracy the elemental abundances of both stellar components, with the aim to investigate the formation of planets and their subsequent evolution. Here, we present a high-precision differential abundance analysis of the XO-2 wide stellar binary based on high resolution HARPS-N@TNG spectra. Both components are very similar K-dwarfs and host planets. Since they formed presumably within the same molecular cloud, we expect they should possess the same initial elemental abundances. We investigate if the presence of planets can cause some chemical imprints in the stellar atmospheric abundances. We measure abundances of 25 elements for both stars with a range of condensation temperature $T_{\rm C} = 40 - 1741$ K, achieving typical precisions of ~ 0.07 dex. The North component shows abundances in all elements higher by $+0.067 \pm 0.032$ dex on average, with a mean difference of +0.078 dex for elements with $T_{\rm C} > 800$ K. The significance of the XO-2N abundance difference relative to XO-2S is at the 2σ level for almost all elements. We discuss the possibility that this result could be interpreted as the signature of the ingestion of material by XO-2N or depletion in XO-2S due to locking of heavy elements by the planetary companions. We estimate a mass of several tens of $M_\oplus$ in heavy elements. The difference in abundances between XO-2N and XO-2S shows a positive correlation with the condensation temperatures of the elements, with a slope of $(4.7 \pm 0.9) \times 10^{-5}$ dex K^{-1}, which could mean that both components have not formed terrestrial planets, but that first experienced the accretion of rocky core interior to the subsequent giant planets.

Download/Website: `http://www.aanda.org/articles/aa/pdf/forth/aa26375-15.pdf`

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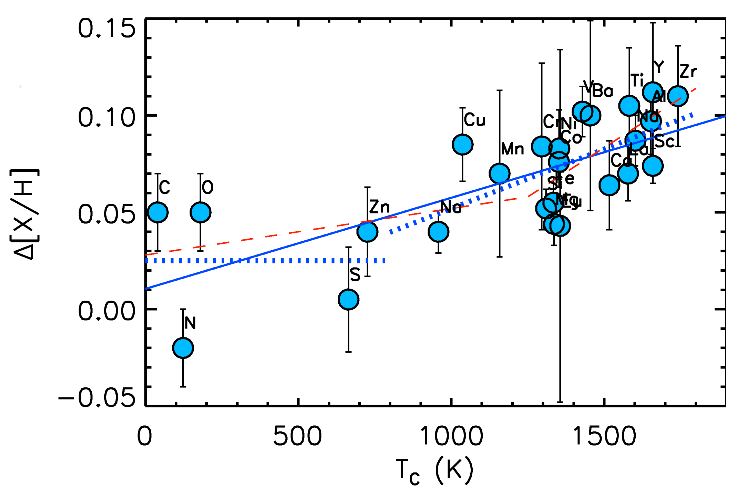

Figure 2: (Biazzo et al.) Differential elemental abundances of XO-2N – XO-2S versus condensation temperatures. Solid blue line is the unweighted linear least-square fit to our data. The horizontal dotted blue line represents the average of the volatiles, while the other dotted blue line is the trend of the refractory elements. The dashed red line is the mean trend obtained by Meléndez et al. (2009) for eleven solar twins with respect to the Sun, after a vertical shift was applied to match the refractory elements.

History of Water Loss and Atmospheric O2 Buildup on Rocky Exoplanets near M Dwarfs

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Earth and Planetary Science Letters, in press

It is recently proposed that early stellar luminosity evolution of M dwarfs leads to severe water loss and the buildup of massive O2 atmospheres on rocky exoplanets in the habitable zone of these stars if interactions of such O2 atmospheres with planetary surfaces are inefficient. Here we show that even without considering atmosphere-surface interactions, the existence of a massive O2 atmosphere on such exoplanets is not an unavoidable consequence around M0-M3 stars and depends on stellar XUV properties, the mass of the exoplanets, and most importantly the initial planetary water inventories. In the case of inefficient atmosphere-surface interactions, the distribution of atmospheric O2 contents on these exoplanets should be bi-modal and such a distribution could be verified by future surveys of rocky exoplanets.

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Post-coronagraphic tip-tilt sensing for vortex phase masks: the QACITS technique

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Astronomy & Astrophysics, in press (arXiv:1509.06158)

Small inner working angle coronagraphs, like the vortex phase mask, are essential to exploit the full potential of ground-based telescopes in the context of exoplanet detection and characterization. However, the drawback of this attractive feature is a high sensitivity to pointing errors, which degrades the performance of the coronagraph. In this paper, we propose a tip-tilt retrieval technique based on the analysis of the final coronagraphic image, hereafter called Quadrant Analysis of Coronagraphic Images for Tip-tilt Sensing (QACITS). Under the assumption of small phase aberrations, we show that the behaviour of the vortex phase mask can be simply described from the entrance pupil to the Lyot stop plane by Zernike polynomials. This convenient formalism is used to establish the theoretical basis of the QACITS technique which principle is validated by experimental results in the case of an unobstructed circular aperture, and by simulations in presence of a central obstruction. In particular, the typical configuration of the Keck telescope (24% central obstruction) has been simulated with additional high order aberrations. In these conditions, our simulations show that the QACITS technique is still adapted to centrally obstructed pupils and performs tip-tilt retrieval with a precision of $5\times10^{-2}\lambda/D$ when wavefront errors amount to $\lambda/14$ rms and $10^{-2}\lambda/D$ for $\lambda/70$ rms errors (with λ the wavelength and D the pupil diameter). Since the implementation of the QACITS technique is based on the analysis of the scientific image, it does not require any modification of the original setup. Current facilities equipped with a vortex phase mask can thus directly benefit from this technique to improve the contrast performance close to the axis.

Download/Website: `http://adsabs.harvard.edu/abs/2015arXiv150906158H`

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Toroidal vortices and the conglomeration of dust into rings in protoplanetary discs

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Monthly Notices of the Royal Astronomical Society, Letters, 453, L78-L82
(http://adsabs.harvard.edu/abs/2015MNRAS.453L..78L)

We identify a new hydrodynamical instability in protoplanetary discs that may arise due to variations in the dust-to-gas ratio and may lead to concentration of dust grains within a disc. The instability can arise due to dust settling, which produces a vertical compositional entropy gradient. The entropy gradient drives a baroclinic instability that is capable of creating toroidal gas vortices that gather dust into rings. Such dust rings are potentially observable via continuum emission of the dust or scattered light. Indeed, this instability may offer an explanation for the rings recently observed in the discs around the young stars HL Tau and TW Hya that does not rely on clearing by protoplanets. The instability may also have wider ramifications, potentially aiding dust agglomeration, altering the radial migration of larger planetesimals, and modifying angular momentum transport within a disc.

Download/Website: `http://www.astro.ex.ac.uk/people/mbate/Animations/dust1.html`

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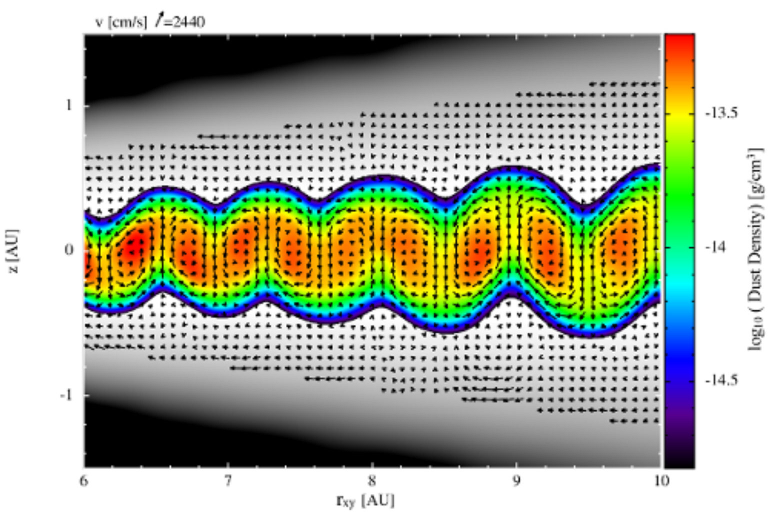

Figure 3: (Lorén-Aguilar & Bate) Plot of the velocity field (vectors) and the azimuthally-averaged dust density (colour rendering) and gas density (greyscale, ranging from $\log_{10}(\rho_{\rm gas}) = [-17, -12]$ in g cm^{-3}). The toroidal vortices within the dust layer are clearly evident, and the dust density is highest at the centres of the vortices (i.e. producing concentric rings).

Broad-band spectrophotometry of the hot Jupiter HAT-P-12b from the near-UV to the near-IR

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Astronomy & Astrophysics, in press (arXiv:1509.05272)

The detection of trends or gradients in the transmission spectrum of extrasolar planets is possible with observations at very low spectral resolution. Transit measurements of sufficient accuracy using selected broad-band filters allow for an initial characterization of the atmosphere of the planet. We want to investigate the atmosphere of the hot Jupiter HAT-P-12b for an increased absorption at the very blue wavelength regions caused by scattering. Furthermore, we aim for a refinement of the transit parameters and the orbital ephemeris. We obtained time series photometry of 20 transit events and analyzed them homogeneously, along with eight light curves obtained from the literature. In total, the light curves span a range from 0.35 to 1.25 microns. During two observing seasons over four months each, we monitored the host star to constrain the potential influence of starspots on the derived transit parameters. We rule out the presence of a Rayleigh slope extending over the entire optical wavelength range, a flat spectrum is favored for HAT-P-12b with respect to a cloud-free atmosphere model spectrum. A potential cause of such gray absorption is the presence of a cloud layer at the probed latitudes. Furthermore, in this work we refine the transit parameters, the ephemeris and perform a TTV analysis in which we found no indication for an unseen companion. The host star showed a mild non-periodic variability of up to 1%. However, no stellar rotation period could be detected to high confidence.

Download/Website: `http://arxiv.org/abs/1509.05272`

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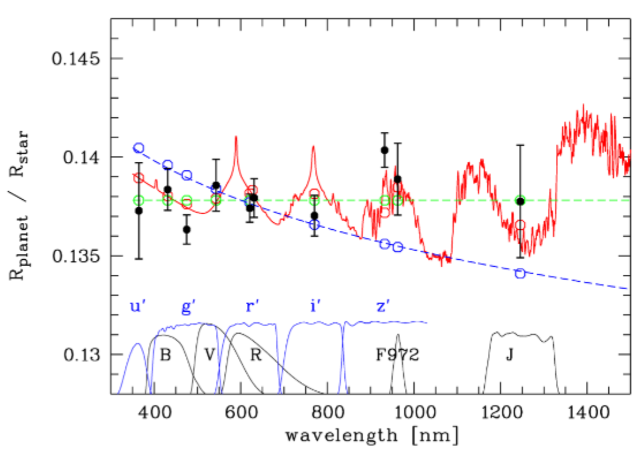

Figure 4: (Mallonn et al.) Broad-band transmission spectrum of HAT-P-12b. The measured values are given in black. Overplotted are a cloud-free solar metallicity spectrum of HAT-P-12b from Jonthan Fortney (red solid line), a Rayleigh-scattering slope (blue solid line), and a flat line presenting wavelength-independent atmospheric absorption (green solid line). At the bottom the transmission curves of the used filters are shown.

Triggered fragmentation in self-gravitating discs: forming fragments at small radii

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Monthly Notices of the Royal Astronomical Society, in press (arxiv:1509.03635)

We carry out three dimensional radiation hydrodynamical simulations of gravitationally unstable discs to explore the movement of mass in a disc following its initial fragmentation. We find that the radial velocity of the gas in some parts of the disc increases by up to a factor of ≈ 10 after the disc fragments, compared to before. While the movement of mass occurs in both the inward and outward directions, the inwards movement can cause the inner spirals of a self-gravitating disc to become sufficiently dense such that they can potentially fragment. This suggests that the dynamical behaviour of fragmented discs may cause subsequent fragmentation to occur at smaller radii than initially expected, but only *after* an initial fragment has formed in the outer disc.

Movies of the simulation shown in the Figure are available at:
www.ast.cam.ac.uk/∼fmeru/Movies/massmovementsigma.mov and
www.ast.cam.ac.uk/∼fmeru/Movies/massmovementvR.mov)

Download/Website: `arxiv.org/abs/1509.03635`

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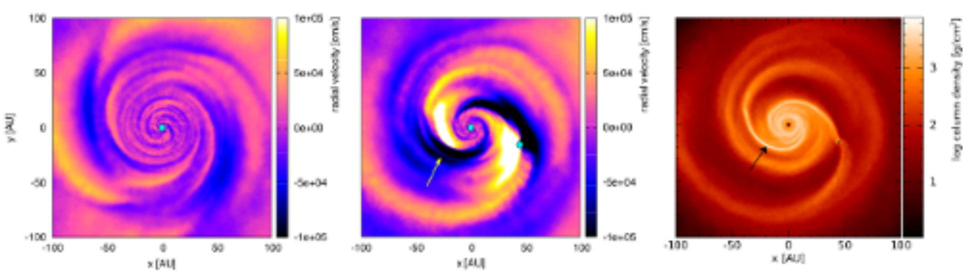

Figure 5: (Meru) Radial velocity (left and middle panels) and surface mass density (right panel) rendered images of Simulation 1. Before the formation of the first fragment (left panel), the gravitational instability has developed and the radial velocity is neither at one extreme nor the other. Negative and positive values of the velocity indicate inwards and outwards movement, respectively. After the first fragment forms the disc material becomes more dynamic (middle panel). Material moves radially inwards (marked by an arrow in the middle panel), causing the inner spiral (indicated by an arrow in the right panel) to become dense and unstable such that it fragments. Prior to the formation of the first fragment this inner disc region was stable and unable to fragment. The central star and fragment are given by dots.

Hot Jupiters with relatives: discovery of additional planets in orbit around WASP-41 and WASP-47

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Astronomy & Astrophysics, submitted (arXiv:1509.07750)

We report the discovery of two additional planetary companions to WASP-41 and WASP-47. WASP-41 c is a planet of minimum mass 3.18 ± 0.20 $M_{\rm Jup}$, eccentricity 0.29 ± 0.02 and orbiting in 421 ± 2 days. WASP-47 c is a planet of minimum mass 1.24 ± 0.22 $M_{\rm Jup}$, eccentricity 0.13 ± 0.10 and orbiting in 572 ± 7 days. Unlike most of the planetary systems including a hot Jupiter, these two systems with a hot Jupiter have a long period planet located at only $\sim$1 AU from their host star. WASP-41 is a rather young star known to be chromospherically active. To differentiate its magnetic cycle from the radial velocity effect due the second planet, we use the emission in the Hα line and find this indicator well suited to detect the stellar activity pattern and the magnetic cycle. The analysis of the Rossiter–McLaughlin effect induced by WASP-41 b suggests that the planet could be misaligned, though an aligned orbit cannot be excluded. WASP-47 has recently been found to host two additional transiting super Earths (Becker et al. 2015). With such an unprecedented architecture, the WASP-47 system will be very important for the understanding of planetary migration.

Download/Website: `http://arxiv.org/abs/1509.07750`

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The dust grain size – stellar luminosity trend in debris discs

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Monthly Notices of the Royal Astronomical Society, in press (arXiv:1509.04032)

The cross section of material in debris discs is thought to be dominated by the smallest grains that can still stay in bound orbits despite the repelling action of stellar radiation pressure. Thus the minimum (and typical) grain size $s_{\rm min}$ is expected to be close to the radiation pressure blowout size $s_{\rm blow}$. Yet a recent analysis of a sample of Herschel-resolved debris discs showed the ratio $s_{\rm min}/s_{\rm blow}$ to systematically decrease with the stellar luminosity from about ten for solar-type stars to nearly unity in the discs around the most luminous A-type stars. Here we explore this trend in more detail, checking how significant it is and seeking to find possible explanations. We show that the trend is robust to variation of the composition and porosity of dust particles. For any assumed grain properties and stellar parameters, we suggest a recipe of how to estimate the "true" radius of a spatially unresolved debris disc, based solely on its spectral energy distribution. The results of our collisional simulations are qualitatively consistent with the trend, although additional effects may also be at work. In particular, the lack of grains with small $s_{\rm min}/s_{\rm blow}$ for lower luminosity stars might be caused by the grain surface energy constraint that should limit the size of the smallest collisional fragments. Also, a better agreement between the data and the collisional simulations is achieved when assuming debris discs of more luminous stars to have higher dynamical excitation than those of less luminous primaries. This would imply that protoplanetary discs of more massive young stars are more efficient in forming big planetesimals or planets that act as stirrers in the debris discs at the subsequent evolutionary stage.

Download/Website: `http://arxiv.org/abs/1509.04032`

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Lyot-plane phase masks for improved high-contrast imaging with a vortex coronagraph

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Astronomy & Astrophysics, in press (arXiv:1509.05750)

The vortex coronagraph is an optical instrument that precisely removes on-axis starlight allowing for high contrast imaging at small angular separation from the star, thereby providing a crucial capability for direct detection and characterization of exoplanets and circumstellar disks. Telescopes with aperture obstructions, such as secondary mirrors and spider support structures, require advanced coronagraph designs to provide adequate starlight suppression. We introduce a phase-only Lyot-plane optic to the vortex coronagraph that offers improved contrast performance on telescopes with complicated apertures. Potential solutions for the European Extremely Large Telescope (E-ELT) are described and compared. Adding a Lyot-plane phase mask relocates residual starlight away from a region of the image plane thereby reducing stellar noise and improving sensitivity to off-axis companions. The phase mask is calculated using an iterative phase retrieval algorithm. Numerically, we achieve a contrast on the order of 10^{-6} for a companion with angular displacement as small as $4\ \lambda/D$ with an E-ELT type aperture. Even in the presence of aberrations, improved performance is expected compared to either a conventional vortex coronagraph or optimized pupil plane phase element alone.

Download/Website: `http://arxiv.org/abs/1509.05750`

Contact: `gjr8334@rit.edu`

Testing particle trapping in transition disks with ALMA

P. Pinilla[1], *N. van der Marel*[1], *L. M. Pérez*[2,3], *E. .F. van Dishoeck*[1,4], *S. Andrews*[5], *T. Birnstiel*[5], *G. Herczeg*[6], *K. M. Pontoppidan*[7], *T. van Kempen*[1]

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[2] National Radio Astronomy Observatory, P.O. Box O, Socorro NM 87801, USA
[3] Jansky Fellow
[4] Max-Planck-Institut für Extraterrestrische Physik, Giessenbachstrasse 1, 85748, Garching, Germany
[5] Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA
[6] Kavli Institute for Astronomy and Astrophysics, Peking University, Yi He Yuan Lu 5, Haidian District, Beijing 100871, China
[7] Space Telescope Science Institute, 3700 San Martin Drive, Baltimore, MD 21218, USA

Astronomy & Astrophysics, in press (arXiv:1509.03040)

Some protoplanetary disks show evidence of inner dust cavities. Recent observations of gas and dust of these so-called transition disks have given major support to the hypothesis that the origin of such cavities is trapping in pressure bumps. We present new Atacama Large Millimeter/submillimeter Array (ALMA) continuum observations at 336 GHz of two transition disks, SR21 and HD 135344B. In combination with previous ALMA observations from Cycle 0 at 689 GHz, we compare the visibility profiles at the two frequencies and calculate the spectral index ($\alpha_{\rm mm}$). The observations of SR 21 show a clear shift in the visibility nulls, indicating radial variations of the inner edge of the cavity at the two wavelengths. Notable radial variations of the spectral index are also detected for SR 21 with values of $\alpha_{\rm mm} \sim 3.8 - 4.2$ in the inner region ($r < 35$ AU) and $\alpha_{\rm mm} \sim 2.6 - 3.0$ outside. An axisymmetric ring (*"ring model"*) or a ring with the addition of an azimuthal Gaussian profile, for mimicking a vortex structure (*"vortex model"*), is assumed for fitting the disk morphology. For SR 21, the ring model better fits the emission at 336 GHz, conversely the vortex model better fits the 689 GHz emission. For HD 135344B, neither a significant shift in the null of the visibilities nor radial variations of $\alpha_{\rm mm}$ are detected. Furthermore, for HD 135344B, the vortex model fits both frequencies better than the ring model. However, the azimuthal extent of the vortex increases with wavelength, contrary to model predictions for particle trapping by anticyclonic vortices. For both disks, the azimuthal variations of $\alpha_{\rm mm}$ remain uncertain to confirm azimuthal trapping. The comparison of the current data with a generic model of dust evolution that includes planet-disk interaction suggests that particles in the outer disk of SR 21 have grown to millimetre sizes and have accumulated in a radial pressure bump, whereas with the current resolution there is not clear evidence of radial trapping in HD 135344B, although it cannot be excluded either.

Download/Website: `http://arxiv.org/pdf/1509.03040v1.pdf`

Contact: `pinilla@strw.leidenuniv.nl`

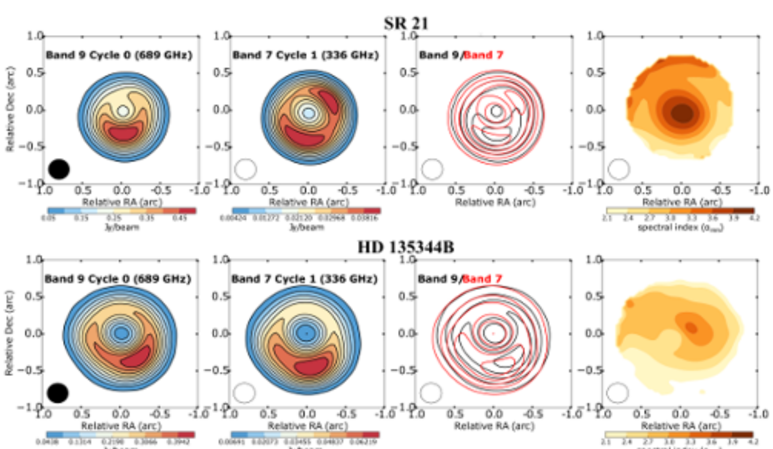

Figure 6: (Pinilla et al.) ALMA observations of dust continuum emission for SR 21 (top panels) and HD 135344B (bottom panels) in Cycle 0 and 1 and the overlay. The right column shows the resolved spectral index in colour contours.

The Resonance Overlap and Hill Stability Criteria Revisited

X.S. Ramos[1], *J.A. Correa-Otto*[2], *C. Beaugé*[1]

[1] Instituto de Astronomía Teórica y Experimental (IATE), Observatorio Astronómico, Universidad Nacional de Córdoba, Argentina
[2] Complejo Astronómico El Leoncito (CASLEO-CONICET), San Juan, Argentina

Celestial Mechanics and Dynamical Astronomy, published(2015CeMDA.tmp...50R/arXiv:1509.03607)

We review the orbital stability of the planar circular restricted three-body problem, in the case of massless particles initially located between both massive bodies. We present new estimates of the resonance overlap criterion and the Hill stability limit, and compare their predictions with detailed dynamical maps constructed with N-body simulations. We show that the boundary between (Hill) stable and unstable orbits is not smooth but characterized by a rich structure generated by the superposition of different mean-motion resonances which does not allow for a simple global expression for stability.

We propose that, for a given perturbing mass m_1 and initial eccentricity e, there are actually two critical values of the semimajor axis. All values $a < a_{\rm Hill}$ are Hill-stable, while all values $a > a_{\rm unstable}$ are unstable in the Hill sense. The first limit is given by the Hill-stability criterion and is a function of the eccentricity. The second limit is virtually insensitive to the initial eccentricity, and closely resembles a new resonance overlap condition (for circular orbits) developed in terms of the intersection between first and second-order mean-motion resonances.

Download/Website: `http://link.springer.com/article/10.1007%2Fs10569-015-9646-z`

Contact: `xramos@oac.unc.edu.ar`

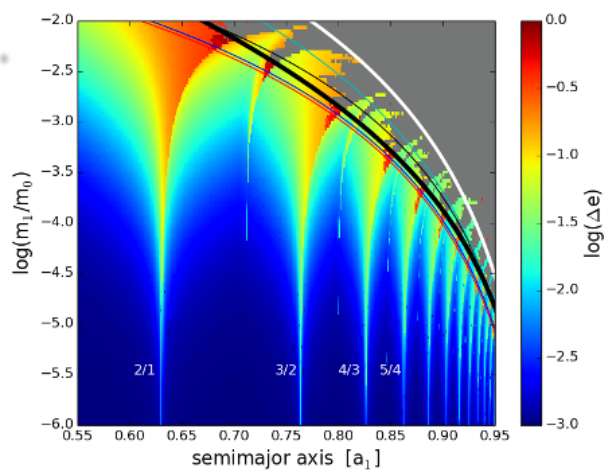

Figure 7: (Ramos, Correa-Otto & Beaugé) Dynamical map for initially circular orbits (i.e. $e = 0$) and all angular variables equal to zero, for a grid of initial conditions in the $(a/a_1, m_1/m_0)$ plane. All unstable initial conditions are highlighted in gray. The thin curves mark the predictions of the different resonance overlap criteria; Black: Wisdom (1980), Blue: Deck et al. (2013) and Red: Duncan et al. (1989), Cyan: new overlap limit defined in this work. The broad black curve shows the predictions of the Hill Stability Criterion, while the broad white curve is the empirical global instability limit $a_{\rm unstable}(m_1/m_0)$ given by $a_{\rm unstable} \simeq a_1 \left[1 - 0.75\left(\frac{m_1}{m_0}\right)^{0.26}\right]$.

Know the Star, Know the Planet. V. Characterization of the Stellar Companion to the Exoplanet Host Star HD 177830

L.C. Roberts, Jr.[1], *Rebecca Oppenheimer*[2], *Justin R. Crepp*[3], *Christoph Baranec*[4], *Charles Beichman*[1,5,6], *Douglas Brenner*[2], *Rick Burruss*[1], *Eric Cady*[1], *Statia Luszcz-Cook*[2], *Richard Dekany*[5], *Lynne Hillenbrand*[5], *Sasha Hinkley*[7], *David King*[8], *Thomas G. Lockhart*[1], *Ricky Nilsson*[2,9], *Ian R. Parry*[8], *Laurent Pueyo*[10,11], *Anand Sivaramakrishnan*[9], *Rmi Soummer*[9], *Emily L. Rice*[12], *Aaron Veicht*[2], *Gautam Vasisht*[1], *Chengxing Zhai*[1], *and Neil T. Zimmerman*[13]

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[11] Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218, USA
[12] Department of Engineering Science and Physics, College of Staten Island, City University of New York, Staten Island, NY 10314, USA
[13] Princeton University, MAE, D207 Engineering Quad, Princeton, NJ 08544, USA

The Astronomical Journal, Published, 2015AJ....150..103R

HD 177830 is an evolved K0IV star with two known exoplanets. In addition to the planetary companions it has a late-type stellar companion discovered with adaptive optics imagery. We observed the binary star system with the PHARO near-IR camera and the Project 1640 coronagraph. Using the Project 1640 coronagraph and integral field spectrograph we extracted a spectrum of the stellar companion. This allowed us to determine that the spectral type of the stellar companion is a M4±1V. We used both instruments to measure the astrometry of the binary system. Combining these data with published data, we determined that the binary star has a likely period of approximately 800 years with a semi-major axis of 100-200 AU. This implies that the stellar companion has had little or no impact on the dynamics of the exoplanets. The astrometry of the system should continue to be monitored, but due to the slow nature of the system, observations can be made once every 5-10 years.

Download/Website: `http://arxiv.org/abs/1507.07913`

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

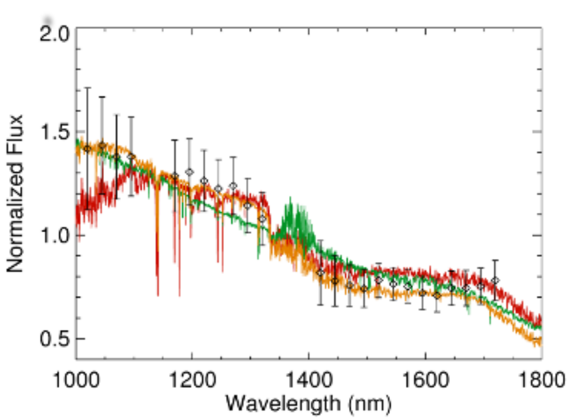

Figure 8: (Roberts et al.) The spectrum extracted from the P1640 data of HD 177830 B. The three over plotted template spectra are Green=M2V, Orange=M4V, and Red=M6V. The determination of the spectral type is M4±1V.

High-contrast imaging of Sirius A with VLT/SPHERE: Looking for giant planets down to one astronomical unit

A. Vigan[1,2], *C. Gry*[1], *G. Salter*[1], *D. Mesa*[3], *D. Homeier*[4,5], *C. Moutou*[1,6] *and F. Allard*[5]

[1] Aix Marseille Université, CNRS, LAM (Laboratoire d'Astrophysique de Marseille) UMR 7326, 13388, Marseille, France
[2] European Southern Observatory, Alonso de Córdova 3107, Vitacura, Cassilla 19001, Santiago, Chile
[3] INAF - Osservatorio Astronomico di Padova, Vicolo dell'Osservatorio 5, 35122 Padova, Italy
[4] Zentrum für Astronomie der Universität Heidelberg, Landessternwarte Königstuhl 12, 69117 Heidelberg, Germany
[5] École Normale Supérieure, Lyon, CRAL (UMR CNRS 5574), Université de Lyon, 69364 Lyon Cedex 07, France
[6] CNRS, Canada-France-Hawaii Telescope Corporation, 65-1238 Mamalahoa Hwy., Kamuela, HI 96743, USA

Monthly Notices of the Royal Astronomical Society, published (2015MNRAS.454..129V)

Sirius has always attracted a lot of scientific interest, especially after the discovery of a companion white dwarf at the end of the $19^{\rm th}$ century. Very early on, the existence of a potential third body was put forward to explain some of the observed properties of the system. We present new coronagraphic observations obtained with VLT/SPHERE that explore, for the very first time, the innermost regions of the system down to 0.2" (0.5 AU) from Sirius A. Our observations cover the near-infrared from 0.95 to 2.3 micron and they offer the best on-sky contrast ever reached at these angular separations. After detailing the steps of our SPHERE/IRDIFS data analysis, we present a robust method to derive detection limits for multi-spectral data from high-contrast imagers and spectrographs. In terms of raw performance, we report contrasts of 14.3 mag at 0.2", ∼16.3 mag in the 0.4–1.0" range and down to 19 mag at 3.7". In physical units, our observations are sensitive to giant planets down to 11 $M_{\rm Jup}$ at 0.5 AU, 6–7 $M_{\rm Jup}$ in the 1–2 AU range and ∼4 $M_{\rm Jup}$ at 10 AU. Despite the exceptional sensitivity of our observations, we do not report the detection of additional companions around Sirius A. Using a Monte Carlo orbital analysis, we show that we can reject, with about 50% probability, the existence of an 8 $M_{\rm Jup}$ planet orbiting at 1 AU. In addition to the results presented in the paper, we provide our SPHERE/IFS data reduction pipeline under the MIT license.

Download/Website: `http://people.lam.fr/vigan.arthur/`

Contact: `arthur.vigan@lam.fr`

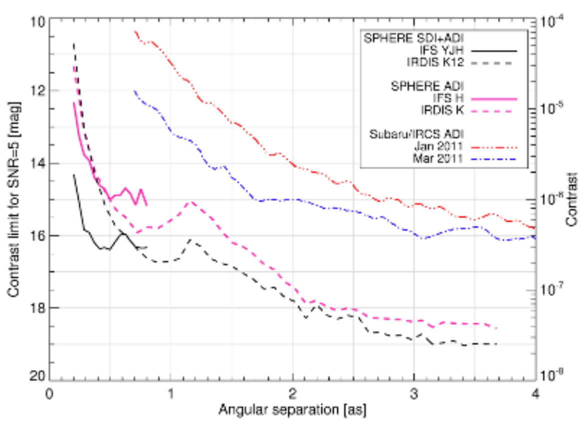

Figure 9: (Vigan et al.) SPHERE sensitivity in contrast to obtain a detection at SNR=5 with the IFS (plain curve) and IRDIS (dashed curve) assuming a companion with a constant contrast ratio with respect to the star in all spectral channels. We show the sensitivity obtained both for an SDI+ADI analysis and for an ADI-only analysis, and we compare it to the limits published by Thalmann et al. (2011) with Subaru/IRCS in the Br α filter at 4.05 micron.

3 Jobs and Positions

Postdoctoral Researcher in Exoplanet and Binary Star Studies

Simon Albrecht
University Aarhus, Denmark

3 year postdoc position in the field of exoplanet and binary star research at the Stellar Astrophysics Centre (SAC), Aarhus University, Denmark.

The aim of the Stellar Astrophysics Centre (SAC) is to perform a coherent study of stars and planetary systems. From an observational point of view the study of the physics of stars and planetary systems is undergoing a revolution, thanks to recent and coming observational facilities, including the Kepler mission, the Transiting Exoplanet Survey Satellite (TESS), and the Danish-led SONG network. The goal of the Centre is to ensure that full use is made of these possibilities to perform a coherent study of stars, and their associated planetary systems, through the integration of several normally separate fields. The Department of Physics and Astronomy plays a leading role in the asteroseismic use of data from the NASA Kepler and K2 missions and in the ground-based SONG network. We have access to telescopes through the Danish membership in the European Southern Observatory (ESO) and the Nordic Optical Telescope (NOT).

SAC has established direct research collaborations with research groups from MIT, University of Sydney, University of Birmingham, NASA Ames Space Center, University of Göttingen, and University of Freiburg, which form an integral part of the Centre. There is an extensive exchange of scientists with our collaborators, with many shorter and longer visits to, and by, them. The many visitors and the postdoc and PhD programme at SAC provide a vibrant working environment and we invite the successful applicant to be a part of this environment. The SAC is actively committed to equal opportunity in employment and guarantees a gender-neutral working environment.

The postdoc will work in connection to the DFF Sapere Aude Starting Grant ”Spin-Orbit Alignment in Binary Star Systems”. This project focuses on measuring stellar obliquities in double star systems with and without planets and interpreting these measurements in the framework of star and planet formation and evolution. However, the successful candidate is also encouraged to develop her/his own profile within the context of the funded DFF project and in connection with the exopanet research carried out by the members of the SAC.

Candidates must have a Ph.D. in astronomy, astrophysics, physics, or equivalent, by the date of their appointment. The starting date is expected to be in 2016, but the exact date is negotiable. The duration of the position is three years. Aarhus University is an equal opportunity employer. We celebrate diversity and encourage applications from all qualified candidates.

Formalities: Applicants should submit a cover letter, a CV, a list of publications, a statement explaining their past and current research (maximum 3 pages), and a statement of research interests (maximum 3 pages).

Furthermore, applicants should arrange for three letters of recommendation to be uploaded together with the application or sent directly to albrecht@phys.au.dk. Please be aware that all reference letters should be uploaded or e-mailed before the application deadline. Questions regarding this job offer should be directed to Associate Professor Simon Albrecht (albrecht@phys.au.dk).

Deadline: All applications must be made online and received by: 01/12/2015

Download/Website: `http://www.au.dk/en/about/vacant-positions/scientific-positions/`

Contact: `albrecht@phys.au.dk`

PhD positions: International Max Planck Research School for Solar System Science at the University of Göttingen

S. Schuh, IMPRS Scientific Coordinator

Max-Planck-Institut für Sonnensystemforschung, Justus-von-Liebig-Weg 3, 37077 Göttingen, Germany
in collaboration with Georg-August-University of Göttingen, Germany

Location: Göttingen, Date: Review of applications begins on 15 November 2015 for starting dates in 2016

The Solar System School invites applications for PhD positions in Solar System Science.
The International Max Planck Research School for Solar System Science at the University of Göttingen ("Solar System School") offers a research-oriented doctoral program covering the physical aspects of Solar system science. It is jointly run by the Max Planck Institute for Solar System Research (MPS) and the University of Göttingen. Research at the MPS covers three main research areas: "Sun and Heliosphere", "Solar and Stellar Interiors" and "Planets and Comets". Solar System School students collaborate with leading scientists in these fields and graduates are awarded a doctoral degree from the renowned University of Göttingen or, if they choose, another university.
The Solar System School is open to students from all countries and offers an international three-year PhD program in an exceptional research environment with state-of-the-art facilities on the Göttingen Campus. Successful applicants will be offered a three-year doctoral support contract as well as postdoc wrap-up funding.
The language of the structured graduate program is English, with complimentary German language courses offered (optional). The program includes an inspiring curriculum of scientific lectures and seminars as well as advanced training workshops and provides travel funds to attend international conferences.
Applicants to the Solar System School should have a keen interest in Solar system science and a record of academic excellence. They must have, or must be about to obtain, an M.Sc. degree or equivalent in physics or a related field, including a written Masters thesis (or a scientific publication), and must document a good command of the English language.
Review of applications for a starting date of September 2016 will begin on 15 November 2015, but other starting times are also negotiable. The positions are awarded on a competitive basis.
The Solar System School is committed to diversity. The MPS is an equal opportunity employer and places particular emphasis on providing career opportunities for women. Applications of handicapped persons are encouraged and will be favored in case of comparable qualifications.

Applications should be submitted online through the application portal, following the instructions at `http://www.mps.mpg.de/phd/applynow`

Download/Website: `http://www.solar-system-school.de`

Contact: `info@solar-system-school.de`

4 Conference announcements

Protoplanetary Discussions 2016

P. Woitke[1], J. D. Ilee[1], W. K. M. Rice[2], D. Forgan[1], C. Hall [2]
[1] School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, KY16 9SS, UK
[2] Institute for Astronomy, University of Edinburgh, Blackford Hill, Edinburgh, EH9 3HJ

John McIntyre Conference Centre, Edinburgh, UK, 7th - 11th March 2016

This is the second announcement for the international conference entitled ‘Protoplanetary Discussions’ to be held at the John McIntyre Conference Centre, Edinburgh, UK, 7th - 11th March 2016.

Abstract submission and full registration is now open, and can be completed by visiting our website. The deadline for abstract submission is **Friday, November 20th, 2015.**

The SOC will select contributions by the end of 2015, and registration will close in January 2016.

The number of participants will be limited to 150 people, and early bird registrations are available. In addition, a number of pre-reserved hotel rooms are bookable on a first come, first served basis.

Scientific sessions include:

1. Disc hosting stars
2. The inner disc
3. The structure of protoplanetary discs
4. Disc chemistry
5. Disc dynamics
6. The disc-planet connection

Confirmed invited speakers include Myriam Benisty (Grenoble, FR), Ilse Cleeves (Michigan, US), Kevin France (Colorado, US), Colin Johnstone (Vienna, AT), Inga Kamp (Kapteyn, NL), Quinn Konopacky (UCSD, US), Guillaume Laibe (St Andrews, UK), Geoffroy Lesur (Grenoble, FR), Richard Nelson (QMUL, UK), Sijme-Jan Paardekooper (QMUL, UK), Christophe Pinte (Santiago, CL), Klaus Pontoppidan (Baltimore, US), Catherine Walsh (Leiden, NL), Zhaohuan Zhu (Princeton, US).

In addition to invited/contributed talks and poster sessions, we will also be offering attendees the chance to propose and host their own discussion sessions. These sessions can take any form (open discussions, collaborative ‘hack’ sessions, or splinter-like session with self-organized talks). The selected sessions will be chaired and organised entirely by the proposer, who will then be given the chance to report back to the full conference.

Social activities will include welcome drinks on Sunday evening, a conference dinner in the historic Playfair Library Hall, a whisky tasting experience, a visit to a preserved 17th Century area of Edinburgh, and a walking trip to the famous viewpoint of Arthur’s Seat.

A limited amount of financial support will be available for students and young researchers in the form of reimbursement. If you wish to apply for this, please indicate as such during the abstract submission process.

Download/Website: `http://www-star.st-and.ac.uk/ppdiscs`

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

K2SciCon

R.A. Street
LCOGT, 6740 Cortona Drive, Suite 102, Goleta, CA, 93117, USA

Santa Barbara, CA, Nov 2–5, 2015

K2SciCon will highlight the wide range of science coming from the Kepler Primary, K2 and TESS missions, from our own Solar System and exoplanets to young stars and distant galaxies. We will hear updates on the mission and discuss the latest in data processing techniques.

We are pleased to announce the **K2SciCon Student Researcher Awards**. The Science Organizing Committee will select a small number of students, based on their submitted abstracts, to benefit from this award which will cover their travel costs to Santa Barbara and meeting registration fee. To be eligible, you must be a current graduate or under-graduate student at a recognized educational institution. Students at both US and overseas institutions may apply. To be considered for this award, please email the K2SciCon LOC <k2scicon-loclcogt.net>, indicating the institution at which you are studying and the course / subject area of your research, before the 10th Oct, 2015.

Registrations for poster contributions is still open, but hotel places are limited, so book soon.

Download/Website: `http://lcogt.net/k2scicon`
Contact: `k2scicon-loc@lcogt.net`

5 Conference reports

Lecture notes from the Summer School: Protoplanetary Disks: Theory and Modelling Meet Observations

I. Kamp[1], P. Woitke[2], J.D. Ilee[2]
[1] Kapteyn Astronomical Institute, University of Groningen, The Netherlands
[2] SUPA, School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, Scotland, KY16 9SS, UK

EPJ Web of Conferences, published

The summer school was held from 16th to the 20th of June 2014 at the Hotel Amelander Kaap on the Island of Ameland, The Netherlands. The School was attended by 45 PhD students and post-docs from 19 countries around the world. Ten lecturers from the DIANA team explained basic theories ranging from the formation and evolution of protoplanetary disks, chemistry and radiative transfer in disks to the diversity of observational data such as SEDs, images, line emission and interferometry. Several lectures focused on disk modelling and its application to observations including limitations, pitfalls and outlook to new instrumentation. We hope that this collection of lectures contributes to the development of new university lecture courses about star and planet formation, and that it will inspire the next generation of scientists to continue unraveling the mysteries involved.

Acknowledgments: The Summer School has received funding from the European Union Seventh Framework Programme FP7-2011 under grant agreement no 284405 DiscAnalysis.

Download/Website:
`http://www.epj-conferences.org/articles/epjconf/abs/2015/21/contents/contents.html`

Contact: `kamp@astro.rug.nl`

Results of IRAC 2nd Workshop on High Precision Time Series Photometry

J. Krick, J. Ingalls
Spitzer Science Center, IPAC, Caltech, Pasadena, CA

The 2nd IRAC Data Workshop at the IAU meeting in August was a great success! The repeatability and reliability of warm IRAC light curve data were discussed in some detail and a comparison of state of the art analysis techniques was presented. The Workshop was capped by a presentation of the results of the Data Challenge, in which 5 teams attempted to extract the eclipse depths from real and simulated exoplanet data. The results point to a strong degree of instrumental repeatability, as well as consistency between various methodologies and accuracy in the ability to estimate depths. Thanks to all who participated!
All talks from the Workshop and the results of the Data Challenge are available at http://irachpp.spitzer.caltech.edu/page/IRAC_IAU_I2015.

Download/Website: `http://irachpp.spitzer.caltech.edu/page/IRAC_IIAU_I2015`
Contact: `help@spitzer.caltech.edu`

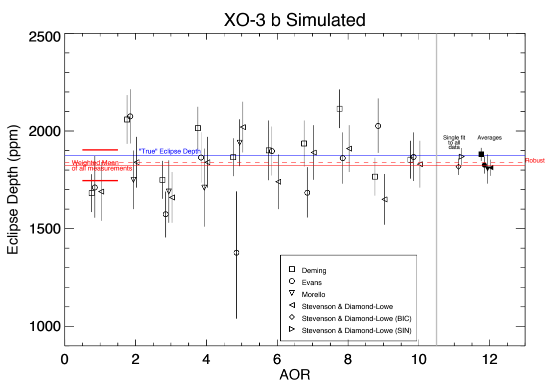

Figure 10: (Krick & Ingalls) Results of simulated data portion of challenge. The extracted eclipse depths as a function of synthetic observation number (10 in all) are shown as different symbols for each of the reduction methods applied by the participants. The blue line is the input eclipse depth and the red lines are estimates of the mean derived depth over all observations and participants. The individual method averages are on the right hand side of the figure.

6 Announcements

Astronomical Review

Andrew Norton
The Open University

Taylor & Francis, Journal re-launched from 1st Jan 2016

The journal *Astronomical Review* is shortly to be re-launched, following its takeover by the publishers Taylor & Francis, with me (Andrew Norton) as Editor-in-Chief.
The focus is to be on authoritative and topical review articles, across the entire field of astronomy (Solar physics, Solar system, exoplanets, stars, high energy phenomena, galaxies & local Universe, cosmology & distant Universe, instrumentation, computational modelling and astronomical software). The journal will be entirely online and delivered through "gold" open access. To facilitate this, each accepted article carries an Article Publishing Charge of $ 750 / £469 / 625 Euro.
I know that many of us are (rightly) sceptical whenever a new journal is launched. However, I believe that there is a real need for a journal publishing high quality reviews in astronomy, which none of the current major journals do on a regular basis. These will be the sort of review articles that one would expect to see cited in the introductory paragraphs of original research papers, PhD theses, etc. With the backing of an international publisher like Taylor & Francis, I am confident this journal will therefore be of great use to the professional astronomical community.
If anyone would like to write and submit a review article for the journal, by all means speak to me first if you wish, alternatively the Editorial Manager website for submissions is already live at http://www.editorialmanager.com/tare

Download/Website: `http://www.tandfonline.com/loi/tare20`

Contact: `andrew.norton@open.ac.uk`

Second Announcement of Opportunity (AO) for Membership of the CHEOPS Science Team

European Space Agency
Head of the Coordination Office for the Scientific Programme, ESA

Deadlines, Mandatory Letters of Intent - 20th October (Noon CEST) 2015;
Proposals - 18th November (Noon CEST) 2015

The Characterising ExOPlanet Satellite (CHEOPS) is a small mission in the ESA Science Programme. Proposals are solicited for membership in the CHEOPS Science Team. Scientists from institutions located in ESA Member States are invited to apply. The deadline for receipt of mandatory Letters of Intent is 20 October (12:00 noon CEST); proposals are due by 18 November (12:00 noon CET).

Details on the Announcement of Opportunity can be found on the ESA webpage given below.

Download/Website: `http://sci.esa.int/cheops-cst-2015/`

Contact: `Luigi.Colangeli@esa.int`

7 As seen on astro-ph

The following list contains all the entries relating to exoplanets that we spotted on astro-ph during September 2015. If you see any that we missed, please let us know and we'll include them in the next issue.

astro-ph/1509.00007 : **Direct Exoplanet Detection with Binary Differential Imaging** by *Timothy J. Rodigas, et al.*

astro-ph/1509.00015 : **High-contrast imaging of Sirius A with VLT/SPHERE: Looking for giant planets down to one astronomical unit** by *A. Vigan, et al.*

astro-ph/1509.00041 : **A Machine Learning Technique to Identify Transit Shaped Signals** by *Susan E. Thompson, et al.*

astro-ph/1509.00201 : **Transit-Depth Metallicity Correlation: A Bayesian Approach** by *P. Sarkis, C. Nehme*

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