ExoPlanet News
An Electronic Newsletter

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Contents

1 Editorial

Welcome to the fortieth edition of ExoPlanet News.

After last month's larger than usual edition, this month we have only a relatively small selection of abstracts for you. However, we're sure that their quality makes up for lack of quantity.

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. The next edition is planned for the beginning of July 2011. Please send anything relevant to exoplanet@open.ac.uk, and it will appear then.

Best wishes
Andrew Norton & Glenn White
The Open University

2 Abstracts of refereed papers

Low-velocity collisions of centimeter-sized dust aggregates

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The Astrophysical Journal, accepted (arXiv: 1102.4441)

Collisions between centimeter- to decimeter-sized dusty bodies are important to understand the mechanisms leading to the formation of planetesimals. We thus performed laboratory experiments to study the collisional behavior of dust aggregates in this size range at velocities below and around the fragmentation threshold. We developed two independent experimental setups with the same goal to study the effects of bouncing, fragmentation, and mass transfer in free particle-particle collisions. The first setup is an evacuated drop tower with a free-fall height of 1.5 m, providing us with 0.56 s of microgravity time so that we observed collisions with velocities between 8 mm/s and 2 m/s. The second setup is designed to study the effect of partial fragmentation (when only one of the two aggregates is destroyed) and mass transfer in more detail. It allows for the measurement of the accretion efficiency as the samples are safely recovered after the encounter. Our results are that for very low velocities we found bouncing as could be expected while the fragmentation velocity of 20 cm/s was significantly lower than expected. We present the critical energy for disruptive collisions $Q^{\star}$, which showed up to be at least two orders of magnitude lower than previous experiments in the literature. In the wide range between bouncing and disruptive collisions, only one of the samples fragmented in the encounter while the other gained mass. The accretion efficiency in the order of a few percent of the particle's mass is depending on the impact velocity and the sample porosity. Our results will have consequences for dust evolution models in protoplanetary disks as well as for the strength of large, porous planetesimal bodies.

Download/Website: `arxiv.org/abs/1102.4441`

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The high albedo of the hot Jupiter Kepler-7 b

Brice-Olivier Demory[1], *Sara Seager*[1], *Nikku Madhusudhan*[2], *Hans Kjeldsen*[3], *Jørgen Christensen-Dalsgaard*[3], *Michaël Gillon*[4], *Jason F. Rowe*[5], *William F. Welsh*[6], *Elisabeth R. Adams*[7], *Andrea Dupree*[7], *Don McCarthy*[8], *Craig Kulesa*[8], *William J. Borucki*[5], *David G. Koch*[5] *and the Kepler Science Team*

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Astrophysical Journal Letters, in press (1105.5143)

Hot Jupiters are expected to be dark from both observations (albedo upper limits) and theory (alkali metals and/or TiO and VO absorption). However, only a handful of hot Jupiters have been observed with high enough photometric precision at visible wavelengths to investigate these expectations. The NASA *Kepler* mission provides a means to widen the sample and to assess the extent to which hot Jupiter albedos are low. We present a global analysis of Kepler-7 b based on Q0-Q4 data, published radial velocities, and asteroseismology constraints. We measure an occultation depth in the *Kepler* bandpass of 44±5 ppm. If directly related to the albedo, this translates to a *Kepler* geometric albedo of 0.32±0.03, the most precise value measured so far for an exoplanet. We also characterize the planetary orbital phase lightcurve with an amplitude of 42±4 ppm. Using atmospheric models, we find it unlikely that the high albedo is due to a dominant thermal component and propose two solutions to explain the observed planetary flux. Firstly, we interpret the Kepler-7 b albedo as resulting from an excess reflection over what can be explained solely by Rayleigh scattering, along with a nominal thermal component. This excess reflection might indicate the presence of a cloud or haze layer in the atmosphere, motivating new modeling and observational efforts. Alternatively, the albedo can be explained by Rayleigh scattering alone if Na and K are depleted in the atmosphere by a factor of 10-100 below solar abundances.

Download/Website: `http://arxiv.org/abs/1105.5143`

Contact: `demory@mit.edu`

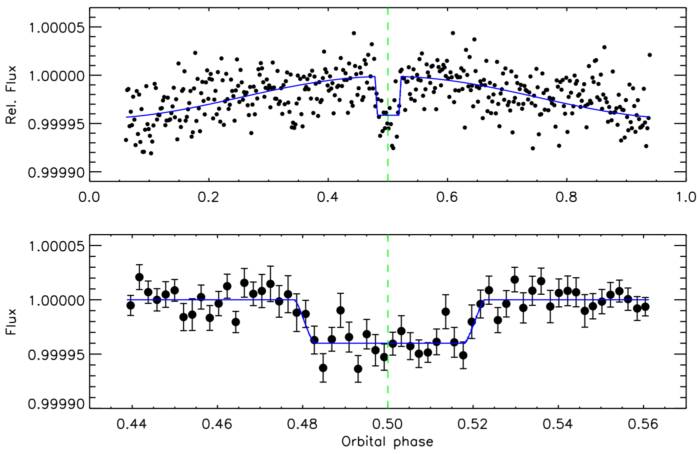

Figure 1: (Demory et al.) Top : Kepler-7 b orbital phase curve with best-fit model (see text) superimposed. Transits are omitted. Bottom : Kepler-7 b phase-folded occultation lightcurve with best-fit model. Binned per 15min.

Micrometer-sized ice particles for planetary-science experiments - I. Preparation, critical rolling friction force, and specific surface energy

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Icarus, accepted (arXiv: 1102.0430)

Coagulation models assume a higher sticking threshold for micrometer-sized ice particles than for micrometer-sized silicate particles. However, in contrast to silicates, laboratory investigations of the collision properties of micrometer-sized ice particles (in particular, of the most abundant water ice) have not been conducted yet. Thus, we used two different experimental methods to produce micrometer-sized water ice particles, i. e. by spraying water droplets into liquid nitrogen and by spraying water droplets into a cold nitrogen atmosphere. The mean particle radii of the ice particles produced with these experimental methods are $(1.49 \pm 0.79)\,\mu\mathrm{m}$ and $(1.45 \pm 0.65)\,\mu\mathrm{m}$. Ice aggregates composed of the micrometer-sized ice particles are highly porous (volume filling factor: $\phi = 0.11 \pm 0.01$) or rather compact (volume filling factor: $\phi = 0.72 \pm 0.04$), depending on the method of production. Furthermore, the critical rolling friction force of $F_{Roll,ice} = (114.8 \pm 23.8) \times 10^{-10}\,\mathrm{N}$ was measured for micrometer-sized ice particles, which exceeds the critical rolling friction force of micrometer-sized $\mathrm{SiO_2}$ particles ($F_{Roll,SiO_2} = (12.1 \pm 3.6) \times 10^{-10}\,\mathrm{N}$). This result implies that the adhesive bonding between micrometer-sized ice particles is stronger than the bonding strength between $\mathrm{SiO_2}$ particles. An estimation of the specific surface energy of micrometer-sized ice particles, derived from the measured critical rolling friction forces and the surface energy of micrometer-sized $\mathrm{SiO_2}$ particles, results in $\gamma_{ice} = 0.190\,\mathrm{J\,m^{-2}}$.

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High-contrast Imaging Search for Planets and Brown Dwarfs around the Most Massive Stars in the Solar Neighborhood

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Astrophysical Journal, in press (arXiv:1105.2577)

There has been a long-standing discussion in the literature as to whether core accretion or disk instability is the dominant mode of planet formation. Over the last decade, several lines of evidence have been presented showing that core accretion is most likely the dominant mechanism for the close-in population of planets probed by radial velocity and transits. However, this does not by itself prove that core accretion is the dominant mode for the total planet population, since disk instability might conceivably produce and retain large numbers of planets in the far-out regions of the disk. If this is a relevant scenario, then the outer massive disks of B-stars should be among the best places for massive planets and brown dwarfs to form and reside. In this study, we present high-contrast imaging of 18 nearby massive stars, of which 15 are in the B2–A0 spectral type range and provide excellent sensitivity to wide companions. By comparing our sensitivities to model predictions of disk instability based on physical criteria for fragmentation and cooling, and using Monte-Carlo simulations for orbital distributions, we find that ∼85% of such companions should have been detected in our images on average. Given this high degree of completeness, stringent statistical limits can be set from the null-detection result, even with the limited sample size. We find that $<$30% of massive stars form and retain disk instability planets, brown dwarfs and very low-mass stars of $<100\ M_{\mathrm{jup}}$ within 300 AU, at 99% confidence. These results, combined with previous findings in the literature, lead to the conclusion that core accretion is likely the dominant mode of planet formation.

Download/Website: `http://arxiv.org/abs/1105.2577`

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Clouds in the atmospheres of extrasolar planets. II. Thermal emission spectra of Earth-like planets influenced by low and high-level clouds

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Astronomy & Astrophysics, accepted for publication

We study the impact of multi-layered clouds (low-level water and high-level ice clouds) on the thermal emission spectra of Earth-like planets orbiting different types of stars. Clouds have an important influence on such planetary emission spectra due to their wavelength dependent absorption and scattering properties. We also investigate the influence of clouds on the ability to derive information about planetary surface temperatures from low-resolution spectra. A previously developed parametric cloud model based on observations in the Earth's atmosphere, coupled to a one-dimensional radiative-convective steady state climate model is used. This model is applied to study the effect of clouds on the thermal emission spectra of Earth-like extrasolar planets in dependence of the type of central star. The presence of clouds lead in general to a decrease of the planetary IR spectrum associated with the dampening of spectral absorption features such as the $9.6\ \mu m$ absorption band of O_3 for example. This dampening is not limited to absorption features originating below the cloud layers but was also found for features forming above the clouds. When only single cloud layers are considered, both cloud types exhibit basically the same effects on the spectrum but the underlying physical processes are clearly different. For model scenarios where multi-layered clouds have been considered with coverages which yield mean Earth surface temperatures, the low-level clouds have only a small influence on the thermal emission spectra. In these cases the major differences are caused by high-level ice clouds. The largest effect was found for a planet orbiting the F-type star, where no absorption features can be distinguished in the low-resolution emission spectrum for high cloud coverages. However, for most central stars, planetary atmospheric absorption bands are present even at high cloud coverages. Clouds also affect the derivation of surface temperatures from low-resolution spectra when fitting black-body radiation curves to the spectral shape of the IR emission spectra. With increasing amount of high-level clouds the derived temperatures increasingly underestimate the real planetary surface temperatures. Consequently, clouds can alter significantly the measured apparent temperature of a planet as well as the detectability of the characteristic spectral signatures in the infrared. Therefore, planets with observationally derived somewhat lower surface temperatures should not be discarded too quickly from the list of potential habitable planets before further investigations on the presence of clouds have been made.

Download/Website: `http://arxiv.org/abs/1002.2927`

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Interior Structure Models of Solid Exoplanets Using Material Laws in the Infinite Pressure Limit

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Icarus, in press (doi:10.1016/j.icarus.2011.05.027)

The detection of low-mass extrasolar planets has initiated growing interest in massive rocky bodies (super-Earths) for which no solar system analogue does exist. Here, we present a new model approach to investigate their interior structure and thermal state. We improve and extend previous interior models mainly in two areas: The first improvement is due to the consequent application of equations of state (EoS) that are compliant with the thermodynamics of the high-pressure limit and facilitate reinvestigating mass-radius relations for terrestrial-type exoplanets. To quantify the uncertainty due to extrapolation, we compare a generalized Rydberg and a Keane EoS, which are both consistent

with the infinite pressure limit. Furthermore, we consider a reciprocal $K^{'}$ EoS that fits the seismologically obtained Preliminary Reference Earth Model (PREM), thereby accounting for the mineralogical composition of the Earth. As a result, the predicted planetary radii of terrestrial-type exoplanets of up to ten Earth masses would differ by less than 2 % between all three EoS, well within current observational limits. The second extension arises from the adoption of a mixing length formulation instead of the commonly used, more simplified parameterized approach to model convective heat transport in planetary mantles. In comparison to parameterized convection models, our results indicate generally hotter interiors with increasing planetary mass and a cumulative tendency to extended regimes of sluggish convection in the lowermost mantle. The latter is attributed to less efficient convective heat transport with increasing mantle pressures. An improved knowledge of the present thermal state is prerequisite to gain a better understanding of the pathways of internal evolution of terrestrial-type exoplanets.

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3 Conference announcements

2011 Sagan Summer Workshop: Exploring Exoplanets with Microlensing

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NASA Exoplanet Science Institute, California Institute of Technology, Pasadena, CA, USA

Pasadena, CA, July 25-29, 2011

The 2011 Sagan Exoplanet Summer Workshop: “Exploring Exoplanets with Microlensing”, will take place on the Caltech campus July 25 - 29, 2011. The workshop is intended for graduate students and postdocs interested in learning more about the microlensing technique, however all interested parties are welcome to attend. A preliminary list of topics to be covered includes:

- History of Microlensing Theory, Detection, and Follow-up Teams
- Introduction to Microlensing Photometric Techniques
- HST/AO Data Reduction
- Modeling of Microlensing Data
- Extracting the Physical Parameters of Planetary Events
- Null Results and Detection Efficiency
- Future Prospects and Challenges of Microlensing

The workshop will include hands-on sessions to give participants direct experience with the microlensing technique. Attendees will also have the opportunity to present brief summaries of their research.

Important Dates

- **June 7: Early on-line registration ends**
- June 22: Hotel Registration deadline to be eligible for group rate
- July 1: POP/Poster Submission deadline
- July 8: On-line registration closed

- July 24: Sagan Exoplanet Summer Workshop Opening Reception
- July 25-29: 2011 Sagan Exoplanet Summer Workshop

Download/Website: http://nexsci.caltech.edu/workshop/2011
Contact: sagan_workshop@ipac.caltech.edu

4 As seen on astro-ph

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

Exoplanets

astro-ph/1105.0021: **Hydrogen Greenhouse Planets Beyond the Habitable Zone** by *Raymond Pierrehumbert, Eric Gaidos*
astro-ph/1105.0024: **The Heavy Element Masses of Extrasolar Giant Planets, Revealed** by *Neil Miller, Jonathan J. Fortney*
astro-ph/1105.0287: **Time evolution of high-energy emissions of low-mass stars:I. Age determination using stellar chronology with white dwarfs in wide binaries** by *A. Garces, S. Catalan, I. Ribas*
astro-ph/1105.0550: **Estimation of the XUV radiation onto close planets and their evaporation** by *J. Sanz-Forcada, G. Micela, I. Ribas et al*
astro-ph/1105.1031: **Gliese 581d is the first discovered terrestrial-mass exoplanet in the habitable zone** by *Robin Wordsworth, Francois Forget, Franck Selsis et al*
astro-ph/1105.1150: **Bayesian evidence for two companions orbiting HIP 5158** by *F. Feroz, S. T. Balan, M. P. Hobson*
astro-ph/1105.1271: **Physical State of the Deep Interior of the CoRoT-7b Exoplanet** by *F.W. Wagner, F. Sohl, T. Ruckriemen et al*
astro-ph/1105.1716: **Planetary Phase Variations of the 55 Cancri System** by *Stephen R. Kane, David R. Ciardi, Diana Dragomir et al*
astro-ph/1105.1782: **The Exoplanet Census: A General Method, Applied to Kepler** by *Andrew N. Youdin*
astro-ph/1105.1887: **The CoRoT Exoplanet program : status & results** by *M. Deleuil, C. Moutou, P. Borde et al*
astro-ph/1105.2018: **Simultaneous formation of Solar System giant planets** by *O. M. Guilera, A. Fortier, A. Brunini et al*
astro-ph/1105.2321: **The Role of Drag in the Energetics of Strongly Forced Exoplanet Atmospheres** by *Emily Rauscher, Kristen Menou*
astro-ph/1105.2713: **The 1:1 resonance in Extrasolar Systems: Migration from planetary to satellite orbits** by *John D. Hadjidemetriou, George Voyatzis*
astro-ph/1105.2577: **High-contrast Imaging Search for Planets and Brown Dwarfs around the Most Massive Stars in the Solar Neighborhood** by *Markus Janson, Mariangela Bonavita, Hubert Klahr et al*
astro-ph/1105.2998: **Three-body-interaction effects on the relativistic perihelion precession for the Sun-Jupiter-Saturn system** by *Kei Yamada, Hideki Asada*
astro-ph/1105.3062: **The influence of non-isotropic scattering of thermal radiation on spectra of brown dwarfs and hot exoplanets** by *R.J. de Kok, Ch. Helling, D.M. Stam et al*
astro-ph/1105.3083: **Abundances of Refractory Elements for G-type Stars with Extrasolar Planets** by *Wonseok Kang, Sang-Gak Lee, Kang-Min Kim*
astro-ph/1105.3179: **WASP-44b, WASP-45b and WASP-46b: three short-period, transiting extrasolar planets** by *D. R. Anderson, A. Collier Cameron, M. Gillon et al*

astro-ph/1105.3372: **On the Mass of CoRoT-7b** by *Artie P. Hatzes, Malcolm Fridlund, Gil Nachmani*
astro-ph/1105.3544: **Unbound or Distant Planetary Mass Population Detected by Gravitational Microlensing** by *T. Sumi, K. Kamiya, A. Udalski et al*
astro-ph/1105.3551: **Accurate p-mode measurements of the G0V metal-rich CoRoT target HD 52265** by *J. Ballot, L. Gizon, R. Samadi et al*
astro-ph/1105.3568: **Clouds in the atmospheres of extrasolar planets. II. Thermal emission spectra of Earth-like planets influenced by low and high-level clouds** by *D. Kitzmann, A.B.C. Patzer, P. von Paris et al*
astro-ph/1105.3849: **Spin-orbit inclinations of the exoplanetary systems HAT-P-8, HAT-P-9, HAT-P-16 and HAT-P-23** by *Claire Moutou, Rodrigo F. Diaz, Stephane Udry et al*
astro-ph/1105.3936: **Tidal dissipation compared to seismic dissipation: in small bodies, in earths, and in superearths** by *Michael Efroimsky*
astro-ph/1105.4043: **Search and characterization of T-type planetary mass candidates in the sigma Orionis cluster** by *K. Pena Ramirez (IAC), M. R. Zapatero Osorio, V. J. S. Bejar et al*
astro-ph/1105.4065: **Atmospheric circulation of tidally locked exoplanets II: dual-band radiative transfer and convective adjustment** by *Kevin Heng, Dargan M.W. Frierson, Peter J. Phillipps*
astro-ph/1105.4409: **Ionisation in atmospheres of Brown Dwarfs and extrasolar planets II Dust-induced collisional ionization** by *Ch. Helling, M. Jardine, F. Mokler*
astro-ph/1105.4603: **TASTE. II. A new observational study of transit time variations in HAT-P-13b** by *V. Nascimbeni, G. Piotto, L. R. Bedin et al*
astro-ph/1105.4607: **A 5 Micron Image of beta Pictoris b at a Sub-Jupiter Projected Separation: Evidence for a Misalignment Between the Planet and the Inner, Warped Disk** by *Thayne Currie, Christian Thalmann, Soko Matsumura et al*
astro-ph/1105.4616: **How common are Earth-Moon planetary systems?** by *Sebastian Elser, Ben Moore, Joachim Stadel et al*
astro-ph/1105.4647: **Kepler-10c, a 2.2-Earth radius transiting planet in a multiple system** by *Francois Fressin, Guillermo Torres, Jean-Michel Desert et al*
astro-ph/1105.4696: **Orbital structure of the GJ876 extrasolar planetary system, based on the latest Keck and HARPS radial velocity data** by *Roman V. Baluev*
astro-ph/1105.5143: **The high albedo of the hot Jupiter Kepler-7b** by *Brice-Olivier Demory, Sara Seager, Nikku Madhusudhan et al*
astro-ph/1105.5393: **Directed follow-up strategy of low-cadence photometric surveys in Search of transiting exoplanets - I. Bayesian approach for adaptive scheduling** by *Yifat Dzigan, Shay Zucker*
astro-ph/1105.5599: **Long-Term Transit Timing Monitoring and Refined Light Curve Parameters of HAT-P-13b** by *Benjamin J. Fulton, Avi Shporer, Joshua N. Winn et al*

Disks

astro-ph/1105.0045: **The Photoevaporative Wind from the Disk of TW Hya** by *I. Pascucci, M. Sterzik, R. D. Alexander et al*
astro-ph/1105.0759: **Massive young disks around Herbig Ae stars** by *Jeremie Boissier, Tomas Alonso-Albi, Asuncion Fuente et al*
astro-ph/1105.0861: **Exploring the Habitable Zone for Kepler planetary candidates** by *L. Kaltenegger, D. Sasselov*
astro-ph/1105.0888: **Hubble and Spitzer Space Telescope Observations of the Debris Disk around the Nearby K Dwarf HD 92945** by *D. A. Golimowski, J. E. Krist, K. R. Stapelfeldt et al*
astro-ph/1105.0915: **The four-populations model: a new classification scheme for pre-planetesimal collisions** by *Ralf J. Geretshauser, Farzana Meru, Roland Speith et al*
astro-ph/1105.2046: **Protoplanetary Disk Masses in IC348: A Rapid Decline in the Population of Small Dust Grains After 1 Myr** by *Nicholas Lee, Jonathan P. Williams, Lucas A. Cieza*

astro-ph/1105.2050: **Migration then assembly: Formation of Neptune mass planets inside 1 AU** by *Brad M. S. Hansen, Norm Murray*

astro-ph/1105.2235: **3D MHD Simulations of Planet Migration in Turbulent Stratified Disks** by *Ana Uribe, Hubert Klahr, Mario Flock et al*

astro-ph/1105.2287: **Detecting Planets around Very Cool Dwarfs at Near Infrared Wavelengths with the Radial Velocity Technique** by *Florian Rodler, Carlos del Burgo, Soeren Witte et al*

astro-ph/1105.2406: **On the lifetime of discs around late type stars** by *Barbara Ercolano, Nate Bastian, Loredana Spezzi*

astro-ph/1105.2524: **Asymmetric transit curves as indication of orbital obliquity: clues from the brown dwarf companion in KOI-13** by *Gy. M. Szabo, R. Szabo, J. M. Benko et al*

astro-ph/1105.2586: **High-sensitivity search for clumps in the Vega Kuiper-belt. New PdBI 1.3mm observations** by *Vincent Pietu, Emmanuel Di Folco, Stephane Guilloteau et al*

astro-ph/1105.3125: **Modelling the rotational evolution of solar-like stars: the rotational coupling timescale** by *F. Spada, A.C. Lanzafame, A.F. Lanza et al*

astro-ph/1105.4015: **The Origin of Planetary System Architectures. I. Multiple Planet Traps in Gaseous Discs** by *Yasuhiro Hasegawa, Ralph E. Pudritz*

astro-ph/1105.5172: **A perspective from extinct radionuclides on a Young Stellar Object: The Sun and its accretion disk** by *Nicolas Dauphas, Marc Chaussidon*

astro-ph/1105.5328: **Stirring up the dust: A dynamical model for halo-like dust clouds in transitional disks** by *Sebastiaan Krijt, Carsten Dominik*

Instrumentation and Techniques

astro-ph/1105.0959: **Science Yield of an Improved Wide Field Infrared Survey Telescope (WFIRST)** by *Michael E. Levi, Alex G. Kim, Michael L. Lampton et al*

astro-ph/1105.0989: **Searching For Planets Around Low Mass Stars in the Infrared Using the Dispersed Fixed Delay Interferometer Method** by *Ji Wang, Jian Ge, Peng Jiang et al*

astro-ph/1105.2027: **Eclipsing Binary Science Via the Merging of Transit and Doppler Exoplanet Survey Data - A Case Study With the MARVELS Pilot Project and SuperWASP** by *Scott W. Fleming, Pierre F. L. Maxted, Leslie Hebb et al*

astro-ph/1105.2154: **Multi-Color Coronagraph Experiment in a Vacuum Testbed with a Binary Shaped Pupil Mask** by *Kanae Haze, Keigo Enya, Lyu Abe et al*

astro-ph/1105.2502: **Astrometry with the MCAO instrument MAD - An analysis of single-epoch data obtained in the layer-oriented mode** by *Eva Meyer, Martin Kuerster, Carmelo Arcidiacono et al*

astro-ph/1105.2961: **Data Reduction Techniques for High Contrast Imaging Polarimetry. Applications to ExPo** by *H. Canovas, M. Rodenhuis, S. V. Jeffers et al*

astro-ph/1105.3189: **The Transits of Extrasolar Planets with Moons** by *David M. Kipping*

astro-ph/1105.3499: **LUNA: An algorithm for generating dynamic planet-moon transits** by *David M. Kipping*

astro-ph/1105.5393: **Directed follow-up strategy of low-cadence photometric surveys in Search of transiting exoplanets - I. Bayesian approach for adaptive scheduling** by *Yifat Dzigan, Shay Zucker*