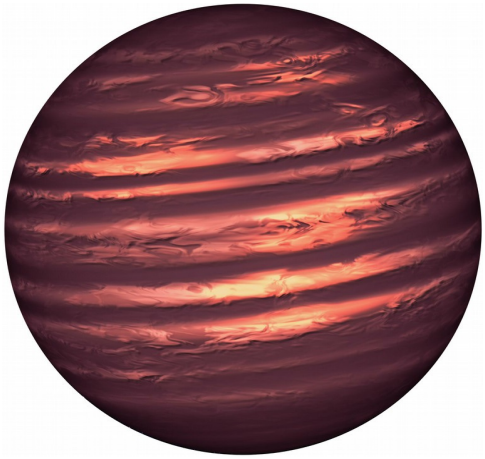
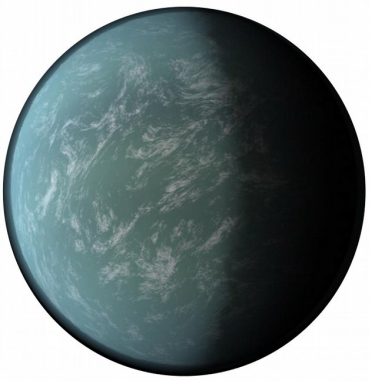
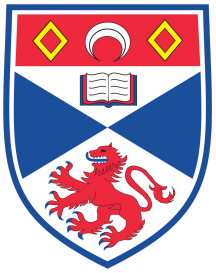
2nd Scottish Exoplanet & Brown Dwarf Community Meeting

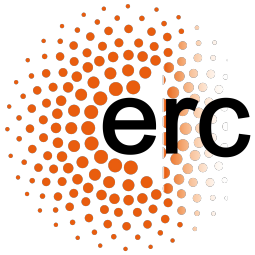
2nd September 2015

Institute for Astronomy
University of Edinburgh









PROGRAMME SUMMARY

10:00 Arrival and Welcome Coffee in the IfA Rooftop Gallery
10:30 Welcome from Beth & Christiane

Morning Session. Chair: Beth Biller

10:35 Pop-up Session 1:
Andrew Cameron, Christiane Helling, Keith Horne, & Ken Rice
10:50 Guillaume Laibe
On planet formation in HL Tau
11:10 Mariangela Bonavita
SPOTS: The Search for Planets Orbiting Two Stars -Constraints on the frequency of circumbinary planets in wide orbits
11:30 Johanna Vos
The First Search for Exoplanet Weather
11:50 Cassandra Hall
Directly observing self-gravitating spiral wave in protostellar discs

12:10 Discussion (may be used after each talk as well at the discretion of the Chair)

12:30 Lunch

Afternoon Session. Chair: Ken Rice

14:00 Pop-up round 2:
Katelyn Allers, Beth Biller, Soko Matsumura, Paul Palmer, Ken Rice, & Aleks Scholz
14:20 Eric Lopez
Re-inflating Wam Jupiters around Red Giants
14:40 Annelies Mortier
The HARPS search for Neptunes around metal-poor stars
15:00 Irena Vorgul
Modelling lightning imprint into cyclotron emission from brown dwarfs and exoplanets
15:20 Victor See
Exoplanetary radio emission variability

15:40 Discussion

16:00 Farewell Coffee
16:30 End of Meeting

DETAILED PROGRAMME

10:00, Arrival & Welcome Coffee (IfA Rooftop Gallery)
Talks and Lunch also in here

10:30, Welcome
Dr. Beth Biller & Dr. Christiane Helling

Morning Session. *Chair: Beth Biller*

10:35, Pop-up Presentations Round 1 [3-4 min each]:
Andrew Cameron, Christiane Helling, Keith Horne, & Ken Rice

10:50 *Guillaume Laibe* On planet formation in HL Tau

Abstract: *I will show that the axisymmetric gaps seen in recent long-baseline observations of the HL Tau protoplanetary disc with ALMA can be interpreted as the different response of gas and dust to three (super)-saturn planets embedded in the disc. Our 3D dusty smoothed particle hydrodynamics calculations successfully reproduce most of the structures seen in the ALMA image.*

11:10 *Mariangela Bonavita* SPOTS: The Search for Planets Orbiting Two Stars Constraints on the frequency of circumbinary planets in wide orbits

Abstract: *In the past decade, an increasing amount of effort has been spent on studying the formation and evolution of planets in the environment of binary host star systems (see e.g. the book "Planets in Binaries", Haghighipour 2010). The Exoplanets.org database (Wright et al. 2011) lists several confirmed planets that have been found in binary systems to date. All of these discoveries have been made with indirect detection methods such as Doppler spectroscopy or transit photometry methods, which are heavily biased towards planets with short orbital periods and, therefore, favor circumstellar (`s-type') configurations around individual components of wide binary systems. Despite this bias, the Kepler spacecraft has discovered seven planets in circumbinary (`p-type') orbits encompassing tight binary systems, hinting at the existence of an extensive unseen population of circumbinary planets. Direct imaging, on the other hand, is a powerful planet detection technique particularly well suited to planets on wide orbits, which complements the limited parameter space of the indirect detection methods. However, such surveys have typically rejected binary systems from their target sample, leaving the population of wide-orbit planets in such systems largely unexplored. To address this, the SPOTS project (Search for Planets Orbiting Two Stars; Thalmann et al. 2014) is conducting the first dedicated direct imaging survey for circumbinary planets. In this talk I will present the results of a statistical analysis of the combined body of existing high contrast imaging constraints*

on circumbinary planets carried on to complement the results of our ongoing survey.

11:30 *Johanna Vos* The First Search for Exoplanet Weather

Abstract: *Periodic variability due to rotation and patchy cloud cover has been detected in L and T brown dwarfs, with considerably higher variability amplitudes observed at the L/T transition. Directly imaged planets occupy the same temperature regime as L and T type brown dwarfs and are likely to exhibit similar variability. We are currently conducting the first survey of weather patterns on free-floating young planetary mass objects with NTT SOFI. We aim to discover and characterise variability in these objects and to constrain the fraction that show periodic variability due to rotationally modulated patchy cloud cover. A comparison of our survey with surveys of field brown dwarfs will provide insight into the effects of surface gravity on cloud structure. Here I will present some preliminary results from this survey.*

11:50 Cassandra Hall Directly observing self-gravitating spiral wave in protostellar discs

Abstract: *We use self-consistent analytical models to examine the parameter space of self-gravitating protostellar discs. We generate synthetic images at a range of wavelengths and caution that the parameter space in which spiral arms are detectable with an acceptable signal to noise ratio is narrow. As a case study, we apply our investigation to HD142527, which has revealed emission which extends out to 600 AU. Matching the observed accretion rate requires a disc mass five times higher than is observed, and such a disc is almost certain to fragment. Such large disc radii are possible at lower accretion rates, but at such large distances the temperature is incredibly low and even a small amount of external irradiation can wipe out spiral features. For all discs,i f a system is self-gravitating, the spiral strucutres are likely to be faint for typical accretion rates, especially for discs with R>100 AU.*

12:10 Discussion (may be used after each talk as well at the discretion of the Chair)

12:30 Lunch

Afternoon Session. *Chair: Ken Rice*

14:00 Pop-up Presentations Round 2 [3-4 Minutes Each]
Katelyn Allers, Beth Billers, Soko Matsumura, Paul Palmer, & Aleks Scholz

14:20 *Eric Lopez* Re-inflating Warm Jupiters around Red Giants.

Abstract: *Ever since the discovery of the first transiting hot Jupiter, models have sought to explain the anomalously large radii of highly irradiated gas giants. We now know that the size of the hot Jupiter radius anomaly scales strongly with a planet's level of irradiation and numerous models have since been developed to help explain these inflated radii. In general however, these models can be grouped into two broad*

categories: 1) models that directly inflate planetary radii by depositing a fraction of the incident irradiation in the convective interior and 2) models that simply slow a planet's radiative cooling allowing it to retain more heat from formation and thereby delay contraction. Here we will present a new test to distinguish between these two classes of models, by examining the post-main sequence evolution of moderately irradiated warm Jupiters.

14:40 *Annelies Mortier* The HARPS search for Neptunes around metal-poor stars

Abstract: *Soon after the first exoplanets were detected it became clear that the frequency of orbiting giant planets is higher for metal-rich stars. The same clear trend has not been found for lower mass planets. An extensive observational program has been set up to use HARPS in order to detect lower mass planets around metal-poor stars. In this talk I will discuss the results as of yet for this program.*

150:00 *Irena Vorgul* Modeling lightning imprint into cyclotron emission from brown dwarfs and exoplanets

Abstract: *Brown dwarfs are known to form mineral clouds in their atmospheres, and mechanisms of ionisation in the clouds were suggested, which can lead to large-scale discharges in form of lightning that results in a substantial sudden increase of local ionisation. Most of the lightning will occur inside the clouds, like on Earth, Saturn and Jupiter. Brown dwarfs are also confirmed sources of a coherent cyclotron radio emission. We show that the signature of a strong atmospheric ionisation event (ash ionisation) can be imprinted on a pre existing radiation. Such ionisation events can also result from explosion's shock waves, from bursts or eruptions. Detection of such ash ionisation events will open investigations into the ionisation state and atmospheric dynamics. While no cyclotron emission is so far detected from exoplanets, a search for the radio emission is ongoing, with models predictions showing possibility of detection. This makes our lightning in-direct detection by imprints on the cyclotron emission applicable to exoplanets, if the radio emission is detected. We present an analytical model that describes the modulation of a pre-existing electromagnetic radiation by a time-dependent conductivity that is characteristic for ash ionisation events like lightning or other trasnient luminiscent events. Our conductivity model reproduces the conductivity function derived from observations of Terrestrial Gamma Ray Flashes. Our model is applicable to astrophysical objects with strong temporal variations in the local ionization, as in planetary atmospheres and protoplanetary disks. We demonstrate how cyclotron radiation travelling through a rapidly ionised medium (e.g. by lighting) experiences an energy transfer that causes a modulated radiation signal. We show that the eld responds with a characteristic ash-shaped pulse to a conductivity of intermediate intensity. More powerful ionisation events result in smaller variations of the initial radiation, or in its damping. We show that the characteristic damping of the response field for high-power initial radiation carries information about the ionisation ash magnitude and duration. The duration of the pulse amplification or the damping is consistently shorter for larger conductivity variations and can be used to evaluate the*

intensity of the ash ionisation. Our work suggests that cyclotron emission could be probe signals for electrification processes inside BD atmosphere.

15:20 *Victor See* Exoplanetary radio emission variability

Abstract: *To date, there have been no exoplanetary radio emission detections. Efforts at studying radio emission are necessarily conned to the solar system planets and numerical simulations. Radio emission models typically assume a stellar surface magnetic eld strength and extrapolate this out to the planet in an isotropic manner. However, this ignores variations in the magnetic eld strength and geometry. In this talk, we explore how a realistic eld geometry affects the radio emission one might expect from an exoplanet and the time dependent variations this can induce.*

15:40 Discussion (may be used after each talk as well at the discretion of the Chair)

16:00 Farewell Coffee

16:30 End of Meeting