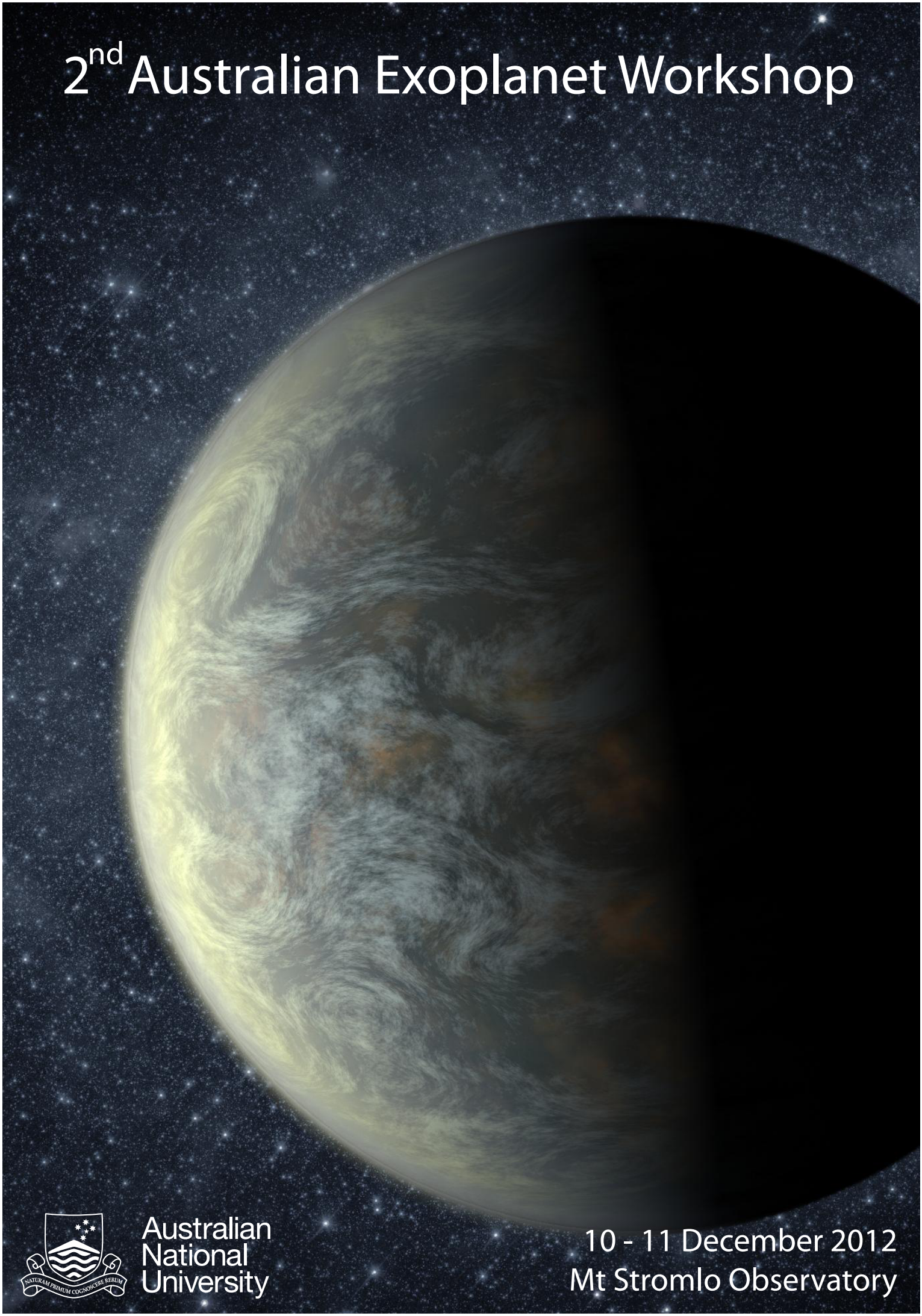
2nd Australian Exoplanet Workshop



Australian National University

10 - 11 December 2012
Mt Stromlo Observatory

10.30 am	Welcome	
	Session 1	Chair: Daniel Bayliss
10.45 am	Ben Ayliffe	The properties of circumplanetary discs
11:00 am	Sarah Keith	Constraints on circumplanetary disks
11:15 am	Grant Kennedy	Debris disks and their relation to planets
11:30 am	Catarina Ubach	Signatures of grain growth in protoplanetary discs
11:45 am	Duncan Wright	Searching for Habitable Zone planets around M Dwarfs
12.00 pm	Lunch	
	Session 2	Chair: Lucyna Chudczer
01:20 pm	Daniel Bayliss	Exoplanet Observing from Australia
01:35 pm	Michael Albrow	Microlensing Searches for Extrasolar Planets
01:50 pm	Rob Wittenmyer	Minerva-South: A dedicated Australian exoplanet search facility
02:05 pm	Patrick Tisserand	The future of exoplanets detection via Microlensing
02:20 pm	Peter Tuthill	New approaches to direct imaging detection
02:35 pm	Coffee break	
	Session 3	Chair: Michael Ireland
03:00 pm	Jeremy Bailey	A CubeSat Mission for Exoplanet Transit Detection and Asteroseismology

03:20 pm	John Greenhill	The contribution of microlensing to the study of exoplanets
03:35 pm	Peter McGregor	Exosolar Planet Science With GMTIFS
03:50 pm	Carlos Bacigalupo	A Compact Spectrograph to search for Extrasolar Planets
04:05 pm	End	
06.30 pm	Dinner & drinks	Thai Lemongrass, Civic

	Session 4	Chair: Charley Lineweaver
09:30 am	Chris Wright	Star and planet formation research at UNSW Canberra
09:45 am	Guillaume Laibe	Collapsing turbulent dust layers in protoplanetary discs
10:00 am	Mark Walker	Planets from snowballs
10:15 am	Sarah Maddison	Who polluted the solar system?? The super-AGB star hypothesis
10:30 am	Lucyna Chudczer	D/H ratio as a diagnostic of planetary formation and evolution
10:45 am	Coffee break	
	Session 5	Chair: Sarah Maddison
11:15 am	Chris Tinney	The Y dwarf W1639-6847 and future Y dwarf/exoplanet science
11:30 am	Jackie Faherty	The Brown Dwark Kinematics Project: Characterizing Giant Exoplanet Analogs
11:45 am	George Zhou	Probing Exoplanet Atmospheres
12:00 pm	Joao Bento	Optical Transmission Photometry of large scale-height Hot-Jupiters
12:15 pm	Lunch	
	Session 6	Chair: Chris Tinney
02:00 pm	Ross Taylor	One World or Many?
02:15 pm	Michael Ireland	The Effect of Multiplicity on Planet Formation

02.30 pm	Tim Bovaird	Applying the Titius-Bode Relation to multi-planet exoplanetary systems.
02:45 pm	Martin George	Exoplanets and the Public
03:00 pm	Charley Lineweaver	What is the most common type of planetary system?...and is our Solar System one?

03.15 pm Afternoon Tea

03.30 pm Discussions

04.30 pm End

Day 3 - 12/12/12

09:30 am Jessie Christiansen **Kepler Data Tutorial**

The Kepler spacecraft monitors 160,000+ stars with continuous, 30-min or 1-min sampling. Kepler data provide a unique combination of photometric precision, duration, contiguity and source volume. The community are encouraged to participate in Kepler's primary exoplanet science and exploit the mission's unique archive and observing resources to pursue unrelated stellar and extragalactic astrophysics.

From Oct 28, 2012 access to the Kepler data archives will be unrestricted. Images, pixels and light curves can all be downloaded.

For the participants to get the most out of the hands-on session, they should download and install PyKE and PyRAF to their laptops. Instructions can be found at: http://keplergo.arc.nasa.gov/PyKE.shtml.

12.00 pm End

Ben Ayliffe — The properties of circumplanetary discs

Monash Centre for Astrophysics

I will discuss the properties of circumplanetary discs formed in 3D, self-gravitating radiation hydrodynamical models of giant planet growth. These properties include sizes and scaleheights, as well as density and temperature profiles. Such discs are interesting as sites of galilean-like satellite formation. Some authors have also suggested that they may contribute flux to direct images of exoplanets. I will also discuss recent results by other authors that indica! te such discs may play an important role in determining planet growth rates. Such results mean that circumplanetary discs are attracting more attention as important players in the development of planetary systems.

Carlos Bacigalupo — A Compact Spectrograph to search for Extrasolar Planets

Macquarie University

The most successful method used so far to search for extrasolar planets is the radial velocity technique, where periodical shifts on the measured emission from a star provide evidence for an orbiting planet. This method has been used on large telescopes with large and expensive instrumentation, only enabling a small amount of observing time per star. We have developed a compact spectrograph fed by one or several single-mode fibres that avoids the need for complex fibre scrambling or gas absorption cells for calibration. In principle, this will enable planet searches around bright stars over the next few years. We aim to pave the way for large networks of small telescopes searching for Earth-like planets. At a resolving power of R~50000, we have characterized this spectrograph, determined its stability and the fidelity required for a simultaneous calibration source.

Catarina Ubach — Signatures of grain growth in protoplanetary discs

Swinburne University

Multi-wavelength studies of protoplanetary discs are conducted to observe the first stages of the multi-step process of planet formation. Continuum emission from protoplanetary discs at 1-3 mm is assumed to arise from optically thin thermal dust emission, and a dust opacity index \beta < 1 is an indication of mm-sized grains. A constant spectral slope up to 7 mm and beyond indicates that thermal dust emission dominates the emission and that pebbles may be present! . A change in the spectral slope, combined with temporal flux variability, can be used to determine the dominant emission mechanism at cm wavelengths. I present results of a multi-wavelength ATCA continuum survey, which investigates grain growth in 20 protoplanetary discs. Results show that 11 sources are dominated by thermal dust emission at 7 mm, with 6/11 having \beta < 1, indicating grain growth up to mm sizes. Temporal monitoring of a subsample of these sources on monthly and yearly timescales supports the notion that we are witnessing the first stages of planet formation in these discs.

Charley Lineweaver — What is the most common type of planetary system?...and is our Solar System one?

ANU

I will briefly summarize the ability of Kepler results (and other results) to determine how typical our Solar System is. I will introduce and motivate the work Tim Bovaird and I have been doing applying the Titius Bode relation to exoplanetary systems.

Chris Tinney — The Y dwarf W1639-6847 and future Y dwarf/exoplanet science

UNSW

Methane imaging techniques have identified the near-infrared counterpart of the bright WISE source WISEJ163940.83−684738.6. The large proper motion of this source (≈3.0"/yr) has moved it, since its original WISE identification, very close to a much brighter background star. But observations in good seeing conditions using methane sensitive filters have revealed a near-infrared counterpart. Spectroscopy confirms a Y dwarf spectral type, and astrometry indicates a distance of 5.0 ± 0.5 pc and a substantial tangential velocity of 73 ± 8 km/s. WISE Y dwarfs, like this one, can provide critical insights into the spectral properties of very cold planets at T=200 400K. Gemini GeMS multi-conjugate adaptive optics imaging will be a powerful tool for obtaining more parallaxes at the J>21 magnitudes of these targets, and probing the binary of these objects.

Chris Wright — Star and planet formation research at UNSW Canberra

UNSW (Canberra)

We will present ATCA 1 cm images of the disks around two Herbig stars thought to be harboring planets, namely HD100546 and HD142527. At resolutions down to 15 AU various structures are detected, including inner disk clearings. Also, we will present thermal IR polarization images of young stars, carried out with the Canari-Cam instrument on the Gran Telescopio Canarias, which trace the magnetic field in the circumstellar disk and/or bipolar outflow.

Daniel Bayliss — Exoplanet Observing from Australia

ANU

I will outline a number of new facilities that will soon be operating in Australia that focus on exoplanets. The aim is to discuss how the Australian exoplanet research community may benefit from these facilities.

Duncan Wright — Searching for Habitable Zone planets around M Dwarfs

UNSW

Detecting the small velocity amplitudes (<10 m/s) produced by habitable zone rocky planets around M Dwarfs requires radial velocity precisions of a few m/s. Iodine absorption cell methods commonly used for high precision velocities are not efficient for red and faint objects like M Dwarfs. Instead, arc lamps have to be used. Achieving ~m/s calibration with arc lamps has not been possible because spectrographs experience drifts of several hundred m/s due to local atmospheric changes. I will outline a new M Dwarf planet search program that is using a differential radial velocity method and a simultaneous Thorium-Xenon calibration lamp enabling ~m/s precision from the AAT. This technique will allow the detection of habitable zone rocky planets around M Dwarfs with radial velocity amplitudes of a few m/s.

George Zhou — Probing Exoplanet Atmospheres

ANU

Although ~800 planets have now been discovered around other stars, we know very little about the properties of each system. Planets that transit their host stars are unique in allowing in-depth characterisations of their atmospheres. Observations of the primary transit will probe for the presence of absorbers in the upper planetary atmospheres, whilst the IR secondary eclipse depth is directly related to the day-side temperature of the planets. In this talk, I will present our detection of neutral sodium absorption in the atmosphere of the highly inflated hot-Jupiter, WASP-17b. I will then detail our plans to measure the temperature distributions of hot-Jupiters and transiting hot-brown dwarfs.

Grant Kennedy — Debris disks and their relation to planets

Institute of Astronomy, Cambridge, UK

I will describe dome results from several Herschel surveys of nearby stars that aim to discover and characterise their cool debris disks. These results show the first signs of a correlation between the presence of dust and planets, particularly for low mass planets. I will also briefly show some work on the luminosity function of rare warm terrestrial-zone dust, and the implications for TPF-like missions that will aim to image extrasolar Earths.

Guillaume Laibe — Collapsing turbulent dust layers in protoplanetary discs

Monash University

Thin dust layers are required to form planet embryos by gravitational instability (Goldreich- Ward mechanism). Grains of constant size cannot form such a thin layer when they settle since they are spread by turbulence in the gas out of the disc mid-plane. However, grains are known to grow via a hit-and-stick process, at least until they reach a critical bouncing/fragmentation size. Taking grain growth into account and a proper model of correlated turbulence, I will explain how dust can collapse into a very thin layer.

Jackie Faherty — The Brown Dwark Kinematics Project: Characterizing Giant Exoplanet Analogs

Universidad de Chile

Young brown dwarfs and directly-imaged exoplanets have enticingly similar photometric and spectroscopic characteristics, indicating that their cool, low gravity atmospheres should be studied in concert. We have identified, confirmed, and characterized several new young M and L type brown dwarfs and compared them to directly-imaged planetary-mass companions and exoplanets like 2MASS 1207b and HR8799b. Similarities between the peculiar shaped H band and location on near-IR color magnitude diagrams provide important clues about how to extract physical properties of planets from current brown dwarf observations.

Jeremy Bailey — A CubeSat Mission for Exoplanet Transit Detection and Asteroseismology

UNSW

We describe a satellite concept that incorporates a small wide field telescope for precision photometry in a 6U CubeSat format. The science goals of the mission are exoplanet detection through transits and the study of stellar pulsations (asteroseismology). The NASA Kepler mission has demonstrated the value of a wide field space telescope for detecting transitting planets too small to be detectable from the ground. However, most of the planet candidates found by Kepler are orbiting stars too faint for follow-up with radial-velocity studies or atmospheric characterization by spectroscopy. By using a much smaller telescope with a wider field we can find similar candidates around much brighter stars that are much more suitable for follow-up.

Joao Bento — Optical Transmission Photometry of large scale-height Hot-Jupiters

Macquarie University

We present transit observations of planets with large atmospheric scale heights (WASP-15b and WASP-17b) using the high-speed multi-band photometer ULTRACAM on ESO's NTT telescope. We aim to accurately measure transit depths in the optical regime, using this information to perform transmission photometry of inflated planets and probe the opacity sources in their atmospheres. Our choice of filters is designed to detect features arising from TiO, Na or Rayleigh scattering.

John Greenhill — The contribution of microlensing to the study of exoplanets

University of Tasmania

The microlensing technique has maximum sensitivity for detection of planetary systems similar to the solar system and many of the cloud of low mass exoplanets predicted by core accretion theory. It also has the potential for detection of free floating planets, planetary moons, very low mass brown dwarf systems and isolated black holes. I will discuss the potential contributions of microlensing as the world wide array of telescopes with wide field cameras come online and describe some recent discoveries using the technique.

Lucyna Chudczer — D/H ratio as a diagnostic of planetary formation and evolution

UNSW

Study of deuterium enrichment in the Solar System can be used to understand processes of planetary formation and the range and pace of subsequent migration of planets. I will review observations of D/H ratio for giant planets in our Solar System and discuss models proposed to explain the results. I will describe preliminary modelling of GNIRS/Gemini high resolution spectra of Titan, which suggests the D/H ratio in methane to be consistent with Saturn's and Titan's formation in its current location.

Mark Walker — Planets from snowballs

Manly Astrophysics

I will briefly summarise evidence that points to solid H2 being a significant component of interstellar dust. I'll also sketch some new pathways for planet formation, inspired by the dusty ISM.

Martin George — Exoplanets and the Public

International Planetarium Society

Since 1995, when we first established that planets existed in orbit around other stars, the public has been exposed to frequent news reports about this field of research.
There is a natural fascination in the topic of extrasolar planets, especially now that we are detecting planets with a mass closer to that of Earth.
It is important that non-astronomers have an understanding of this research. We need to promote not only an understanding of extrasolar planets but also maintain the level of excitement about what we have done and where we are heading.
The speaker will discuss public understanding of this topic and some misconceptions that are held.

Michael Albrow — Microlensing Searches for Extrasolar Planets

University of Canterbury

I will discuss some recent methodology and results from microlensing and preview some future projects.

Michael Ireland — The Effect of Multiplicity on Planet Formation

Macquarie University & AAO

The majority of solar-type stars form in multiple star systems. This has a profound influence on the evolution of protoplanetary disks and the likelihood for planetary formation in systems such as alpha Cen. For 5-50 AU binaries, we have recently shown that there is a strong anti-correlation between binarity and disk presence. I will summarise this work, and show continuing aperture-mask interferometry observations where we are surveying all Kepler objects of interest within a volume-limited sample. The disk-binary anti-correlation appears to continue to older systems with a clear planet-binary anti-correlation. Finally, I will discuss how the longer-lived disks around close binary stars may beam that "Tatooine"-type planets are common, and will outline a spectroscopic survey in early 2013 we will be carrying out to determine the link between long-lived disks and close stellar companions.

Peter McGregor — Exosolar Planet Science With GMTIFS

ANU

I want this audience to tell me if there is interest in using GMTIFS on GMT for exosolar planet science. I can summarize its capabilities, but I really want to know what science R~5,000-10,000 near-infrared spectra of exosolar planets will address.

Peter Tuthill — New approaches to direct imaging detection

University of Sydney

This talk will highlight recent progress at the University of Sydney using interferometric and polarimetric techniques to recover faint structures embedded within in circumstellar environments.

Rob Wittenmyer — Minerva-South: A dedicated Australian exoplanet search facility

UNSW

I describe a plan for Minerva-South: an installation of four 0.7m telescopes feeding a high-resolution spectrograph, to be sited at Siding Spring Observatory. Such a facility would give Australian exoplanetary scientists the ability to pursue dedicated radial-velocity searches for planets orbiting the nearest bright stars. In addition, Minerva-South could be used in collaboration with Chinese astronomers to follow up on objects of interest from Antarctic telescopes such as AST-3. I will describe the diverse science cases for this highly cost-effective facility. If it goes forward, Minerva-South would be of tremendous benefit to Australian exoplanetary science.

Ross Taylor — One World or Many?

ANU

Here I discuss the problems of forming earth-like planets, with insights from our solar system. The concept of a multitude of habitable worlds has appeared historically under several headings such as 'the plurality of worlds', 'the principle of plenitude (abundance)' and more recently as 'the principle of mediocrity', which states that our neighbourhood is typical of the rest of the universe. These seem to be a reaction to pre-Copernican views of the central importance of the Earth. The question turns on whether this planet formed as an inevitable and natural consequence of planetary-building processes, or whether its formation and history were dominated by chance events. If the first scenario is true, then duplicate copies of our agreeable planet, although missing in our system might be expected to be common elsewhere. If the formation and evolution of our planet as well as the development of life and intelligence has been dominated by random processes, then the presence of Earth-like planets as opposed to Earth-mass planets elsewhere becomes more of a lottery.

Sarah Keith — Constraints on Circumplanetary Disks

Macquarie University

During formation, a giant planet is surrounded and fed by an accretion disk called the circumplanetary disk. This disk also serves as the birth site of the planet's moons. Detailed models of these disks are essential for understanding the growth of these planet-satellite systems. Although circumplanetary disk models are in their infancy, constraints based on the present state of regular moons (e.g, the Galilean moons), the formation time scales, and current simulations provide clues about the disk environment. I will review the key constraints and current techniques for modelling circumplanetary disks, and discuss prospects for future developments.

Sarah Maddison — Who polluted the solar system?? The super-AGB star hypothesis

Swinburne University

The meteorite record shows that now extinct short-lived radionuclides (SLR) were present in the early Solar System and require a local origin. The first refractory solids to have formed in the Solar System show a bimodal distribution in their 26Al/27Al ratio, with half having the canonical value of ~5e-5 and the other half having little or no detectable 26Al. These two populations have th! e same distribution of O isotopic ratios, and hence the process that delivered the 26Al to the early Solar System ~10^4 years after the first solids formed did not unduly affect its O composition. These observations place strong constraints on the potential source of the SLR. We present a new candidate stellar source – a nearby "super"-asymptotic giant branch (SAGB) stars. Using the Monash/Mt Stromlo stellar evolution code and the Monash stellar nucleosynthesis post-processing code, we present predictions for the abundances of SLR and O isotopes in the winds of SAGB stars (i.e. stars with initial mass ~7-11 Msun). We then use a simple pollution model to mix this material with the solar nebula. The dilution factor (M_SAGB-wind/M_SN) is set to match the observed 26Al/27Al ratio and the time delay (time interval between SLR being ejected in SAGB wind and incorporated into solar nebula solids) is set to match the observed 41Ca/40Ca (since 41Ca is the shortest SLR). Our SAGB models can account for the canonical 26Al/27Al ratio while also matching the observed abundances of 41Ca and 60Fe. We discuss the distance the stellar polluter must have been to the young solar system and the likelihood of such an environment.

Tim Bovaird — Applying the Titius-Bode Relation to multi-planet exoplanetary systems.

ANU

We have applied the Titius-Bode relation to multi-planet exoplanetary systems in order to predict the existence of undetected exoplanets. I will describe our method, some of the problems we encountered and some of the results we have obtained.

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Tim Bovaird
Ben Prout