Astrobiology Society of Britain

Astrobiology Society of Britain, 4th Biannual Meeting

Royal Holloway University of London

April 7th-9th 2010

Science & Technology Facilities Council

Thursday 8th April

LIFE'S ORIGIN AND EVOLUTION: Chair, Lewis Dartnell

09:00 KEYNOTE ADDRESS. Euan Nisbett, The Evolution of Earth's Atmosphere.

09:40 Michael McCabe, On the Origin and Evolution of Life in the Galaxy.

10:05 Terence Kee, The H-Phosphinate-Pyruvate System; En Route to Proto-RNA?

10:30 Tea/Coffee

11:00 Katie Marriott, Chemical Complexity in the H_3PO_2:Pyruvate System.

11:25 Aidan J. Ross, Carbon in the solar system.

11:50 Sohan Jheeta, An Alcoholic Universe! Irradiation of 1:1 Mixture of NH3:CH3OH Ice at 30 K with 1 keV Electrons

12:15 Lunch

IMPACTS: Chair, Zita Martins

13:15 Jonti Horner, The Neptune Trojans - A New Source for the Centaurs?

13:40 Jonathan Watson, Use of Organic Molecular Parameters to Estimate Post Impact Cooling in the Boltysh Impact Crater.

14:05 Paula Lindgren, Calcite microstructures as a palaeopiezometer in carbonaceous chondrites.

14:30 Adam Nixon, Glycine Survival in Hypervelocity Impacts.

14:55 Mark Burchell, Survival In Hypervelocity Impacts of Complex Organic Compounds.

15:20 Tea/Coffee.

HABITABILITY: Chair, Jonti Horner

16:10 KEYNOTE: Helmut Lammer, The Classification of Habitats and the Evolution of Habitable Planets.

16:50 Martin Leitzinger, Spectral signatures of stellar activity: AD Leo - an example.

17:15 William Bains, How weird can biochemistry be? A biotechnological perspective.

17:40 Lucy Norman, Life in Titan's Liquid Hydrocarbons: Are There Any Plausible Cell Membranes?

18:05 Close.

19:00 – 22:00 Conference Dinner, Royal Holloway Picture Gallery.

Friday 9th April

DETECTING LIFE: Chair, Terence Kee

09:00 KEYNOTE: Giovanna Tinetti, Characterising extrasolar worlds today and tomorrow.

09:40 Susana E. Jorge-Villar, A Tool for Planetary Exploration: Raman Spectroscopy for Bio- and Geo-Marker Detection.

10:05 Jean-Philippe Beaulieu, From frozen Super Earth to Habitable Earth via microlensing.

10:30 Tea/Coffee

11:00 John Parnell, Application of sulphur isotopes to investigate deep biosphere on Earth and Mars

11:25 Samuel Spinks, Sulphur isotopes as a signature for evolving microbial life: an example from the Mesoproterozoic

11:50 Jonti Horner, The search for life: Which "Earth" to target?

12:15 Ingo Waldmann, Characterisations of exoplanetary atmospheres from the ground.

12:40 Lunch

EXTREMOPHILES: Chair, Mark Burchell

13:40 Susana E. Jorge-Villar, A Look At Extremophile Organisms Across Raman Spectroscopy.

14:05 Mariliza Derveni, The effect of space radiation on immunoassay reagents: Implications for the Life Marker Chip Experiment for ESA's ExoMars mission.

14:30 Karen Olsson-Francis, Isolation of an Extremophilic Cyanobacterium Using Low Earth Orbit as a Selection Factor.

14:55 Lottie Davis, Preliminary data on the culturable microbiology of an alkaline soda lake.

15:20 Tea/Coffee.

16:10 Katinka Apagyi, Evolution of Methanogens living in the Polar permafrost.

16:35 Paul Wilkinson, Thermophilic bacteria in cold volcanic basalt.

17:10 Claire Cousins, Differing Bacterial Diversity From Two Basaltic Lava Lithologies In A Cold Volcanic Desert.

17:35 Conference Closes.

The Search for Life: Which "Earth" to Target?

Jonathan A Horner

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In the coming decade, it is likely that the first truly habitable planets will be discovered around nearby stars. As with all other fields of astronomical discovery, the number known will likely grow at an ever increasing rate, presenting observers with a large sample to search for evidence of life. But where should we look? The search for life on a distant planet will require an unprecedented amount of dedicated telescope time, and prove hugely costly. These factors taken together mean that it will clearly be impossible to simultaneously search all exo-Earths for life, and so observers will have to focus their attentions on just one or two targets. The task of selecting these targets will require detailed study of the various factors which can influence the habitability of a planet, such that the best candidates can be chosen. In this talk, intended to provoke discussion, I will briefly cover the wide range of effects that could render an otherwise ideal candidate planet sterile, or at least less likely to host life as we know it.

Jupiter: Friend or Foe

Jonathan A Horner[1] and Barrie W Jones[2]

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It has long been believed that the planet Jupiter has played an important role in the development of life on Earth. Without the particular size and placement of Jupiter, it is argued, the Earth would have experienced a greatly enhanced flux of impacts from asteroids and comets, hindering or entirely preventing the development of life.

Despite the vigour with which this belief is held, very little work has been performed to examine the effect of Jupiter on the terrestrial impact flux. We have now completed the first detailed study on the effect of Jupiter's mass on the impact rate of the three types of potentially hazardous objects - the Near Earth Asteroids, the Short Period Comets, and the Long Period Comets. Although a massive Jupiter does act to whittle down the population of Long Period comets threatening the Earth, its role in managing the threat from Near Earth Asteroids and Short Period Comets is much less clear. Indeed, it seems that the impact risk from these families of object is significantly higher in Solar Systems with a Jupiter-mass planet than in those without, although the greatest level of "threat" is posed by a planet in a Jupiter-like orbit with a mass similar to that of Saturn. Above this mass the hazard falls away significantly.

The Neptune Trojans - a New Source for the Centaurs?

Jonathan A Horner[1] and Patryk Sofia Lykawka[2]

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The fact that the Centaurs are the primary source of the short-period comets is well established. However, the origin of the Centaurs is still under some debate, with a variety of source reservoirs being proposed in the last decade. Here, we suggest that planetary Trojans represent an additional significant source of Centaurs. Using dynamical simulations of the first Neptune Trojan discovered (2001 QR322) and integrations following the evolution of theoretical Neptune Trojans captured during simulations of planetary migration, we show that the Neptune Trojan population contains many objects which are unstable on both Myr and Gyr time-scales. Using individual examples, we show how objects that leave the Neptunian Trojan cloud evolve on to orbits indistinguishable from those of the known Centaurs, before estimating the flux from this region to the Centaur population. With only moderate assumptions, we show that the Trojans can contribute a significant proportion of the Centaur population, and may even be the dominant source reservoir. This result is supported by past work on the colours of the Trojans and the Centaurs, but it will take future observations to determine the full scale of the contribution of the escaped Trojans to the Centaur population.

Dynamical Simulations of HR8799

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In late 2008, it was announced that the debris disc star HR8799 was host to at least three exoplanets, which had been discovered through direct imaging. The discovery prompted a wealth of dynamical studies intended to determine the stability (or otherwise) of the planetary system. The first studies suggested that the current three planet configuration is likely to be unstable over periods as short as 1 Myr. Subsequent studies favoured a configuration of the three planets in 1:2:4 resonance for maximum stability, with a system lifetime of the same order as the star (~ 100Myr). These results lead to speculation that the system could be in the process of a catastrophic orbital restructuring similar to that proposed to explain the hypothesised Late Heavy Bombardment in our own Solar system. In this work, we study the influence of planetary eccentricity on the stability of the HR8799 system, examining a wide range of potential orbital architectures matching the current observational constraints. Through systematic variation of the orbital eccentricities and radii of the three planets, we provide dynamical stability maps of the planetary system, revealing that the situation is far more complicated than originally thought.

Although many hypothetical architectures of the HR8799 are decidedly unstable, a broad range of initial conditions can give systems of dramatically greater stability, as a result of mutual resonant behaviour between the planets in question. We show that it is not infeasible that the planetary system could by dynamically stable on timescales at least as long as the lifetime of the parent star, even if we observe the system orientated face-on.