

Preface

Alien worlds, extra-solar planets, deep space planets, exoplanets – whatsoever we choose to call them, what sort of objects do we mean when we talk of planets belonging to stars other than the Sun?

A few years ago the TV, radio and newspapers were full of the temerity of astronomers who had demoted Pluto from being one of the nine major planets in the solar system to something called a ‘Dwarf Planet’. In 2006 the International Astronomical Union (IAU) made this decision because of the discovery of solar system objects further from the Sun than Pluto that were similar in size to Pluto. One of these, Eris, is actually larger than Pluto and was briefly called the tenth planet of the solar system. It was the prospect of many more such objects being found and the number of planets becoming unmanageable that led the IAU to change Pluto’s status. However the IAU has no legal standing and many professional and most amateur astronomers do not belong to it. Thus anyone who still wishes to regard Pluto as the ninth planet of the solar system is perfectly entitled to do so.

When it comes to planets beyond the solar system the IAU has no official definition – indeed the details of the existing classification actually mean that the word ‘planet’ *only* applies to eight objects within the solar system. Unofficially a number of varied criteria are in use to define an ‘exoplanet’. Most definitions agree that if the object’s mass is more than thirteen times the mass of Jupiter then it is too big to be called an exoplanet but should be classed as a type of ‘failed star’ known as a brown dwarf.

For those objects below the 13 Jupiter-mass limit though:

Are satellites to be included?

Are objects as small as our Moon to be included?

What of objects orbiting brown dwarfs?

and

What of objects that float free of any star by themselves in space?

In these areas opinions vary regarding which objects should be called exoplanets and which should be classed as something else.

Names are useful shorthand labels, but should not dominate the subject as the recent debate over whether Pluto is a planet or a dwarf planet has done. Lewis Carroll has his own take on the importance of names and other words:

“ ‘When *I* use a word,’ Humpty Dumpty said in rather a scornful tone, ‘it means just what I choose it to mean – neither more nor less.’

‘The question is,’ said Alice, ‘whether you CAN make words mean so many different things.’

‘The question is,’ said Humpty Dumpty, ‘which is to be master – that’s all.’”

Through the Looking Glass

Acting on Dumpty’s principle a broad definition will be adopted in this book. The term ‘Exoplanets’ will cover objects ranging from small asteroids (say 1,000 m across or a mass 0.00000000001 % that of the Earth) to just short of the failed stars known as Brown Dwarfs (4,000 Earth masses, 13 Jupiter masses). Of course sometimes sub-divisions, such as Planetesimals, Super Earths, Hot Jupiters, etc. will prove to be useful and objects outside the defined range of exoplanets, such as dust particles and small stars will come into the discussions at times. This book though is mostly about the menagerie of sub-stellar entities, whatever they may be called and whenever, howsoever and wherever they are to be found in the universe.

Our Sun is a pretty commonplace star and, as we well know, it is accompanied by a host of planets, dwarf planets, asteroids, satellites, comets and the like, each gravitating around the Sun and themselves in a complex and un-repeating 4,500 million year long ballet.

If the Sun is a typical star, then surely other stars must also have their retinues of planets and satellites? By the late twentieth century many astronomers were beginning to think that the Sun’s planetary family must be a rare and unusual occurrence because decades of searching for planets beyond the solar system had failed to turn up any examples.

The situation changed abruptly in the 1990s. Firstly in 1992 Aleksander Wolszczan and Dale Frail discovered two rocky planets orbiting the pulsar PSR B1257+12 (see Appendix I for an explanation of stars’ and exoplanets’ names and labels). Then in 1995 came the real break-through when Michel Mayor and Didier Queloz found the

first planet belonging to a normal star. From a good observing site, that star, named 51 Pegasi, may just be seen with the naked eye about halfway between the bright western stars of the square of Pegasus. 51 Peg is very similar to our Sun though a bit older and its planet has a mass about half that of Jupiter. What came as a major surprise in 1995 however was that the planet is only 7,500,000 km away from its host star – an eighth of Mercury’s distance from the Sun. The exoplanet’s surface temperature reaches 1,200°C – hot enough to melt most rocks. 51 Peg’s planet though is a gas giant like Jupiter.

Writing in early 2011, we know of around 530 exoplanets, many of which are giant planets close in to their stars like 51 Peg’s planet. Sufficient is now understood about exoplanets that we are no longer restricted just to examining individual planets but we may begin to develop ideas and come to conclusions about the properties, natures and characteristics of planets that have a broader application and validity throughout the universe.

For the first time in the history of human science we may begin to see the importance of the Earth and the solar system within a wider context and not just as the local neighbourhood wherein we happen to live. The aims of this book are thus

- To conduct the reader through the heady experience of exploring one of the most exciting and rapid establishments of a new area of science that has ever happened,
 - To explore the avalanche of dramatic discoveries of new planets that have been made over the last decade-and-a-half,
 - To seek out how and why those discoveries have been made possible and to highlight where amateur astronomers can contribute to the research,
 - To probe what we now know about exoplanets – both for individual planets and the more universally applicable trends,
- and last, but not least,
- To investigate whether or not we might ever travel to and perhaps colonize an exoplanet.

I have assumed that the reader will have some prior knowledge of astronomy but not beyond the level of a well-read person who has an interest in the sciences generally. If you do find something that is unfamiliar and need to look it up, then a recently published introductory astronomy book, an astronomy dictionary

or the internet should be sufficient and a list of suggested sources of other reading is provided at the end of this book. For those of you who wish to know more, deeper briefings about some of the technicalities behind finding, exploring and understanding alien worlds are also included at the end of the book. BUT – you do not need to read those sections or deal with equations in order to enjoy the main part of the book and to see how scientists really get to work in a brand new theatre of science.

I hope that you are pleased with the book and find it interesting and useful.

Happy Reading!

Hertford

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Exoplanets

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