SAMPLE

Worlds Beyond Earth: Exoplanets

The Worlds Around Other Stars

Aira Astralis

Free sample: Introduction & Chapter 1

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Contents

Introduction

Chapter 01: The First Two Strangers

Chapter 02: The Census

Chapter 03: Super-Earths: The Missing Neighbors

Chapter 04: The Mini-Neptune Fog and the Radius Gap

Chapter 05: Hot Jupiters: The Scorched Giants

Chapter 06: Lava Worlds

Chapter 07: Steam Worlds and Deep Oceans

Chapter 08: The Almost-Twins

Chapter 09: Seven Worlds Around One Small Star

Chapter 10: Worlds Around Dead Stars

Chapter 11: Worlds Still Being Born

Chapter 12: Weather on Impossible Worlds

Chapter 13: Worlds Without Suns

Chapter 14: What the Strangers Mean

Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

Exoplanets are the worlds that circle other stars: strangers counted by the thousand in a census that did not exist three decades ago, bodies with no names in the old star atlases, found not by seeing them but by watching what they do to their suns. This volume carries the whole account of the new worlds: how the first two strangers forced their way into astronomy in the 1990s, what the modern census says lives out there, why the most common planets in the galaxy are types our own solar system never made, and which of the strangers are close enough to being Earth's cousins that their air, their water, and their weather can now be read from starlight.

The sixteen sections move from the first pulsar worlds and the hot Jupiter that broke the dam, through the census and the two missing neighbor types, across the lava faces, the steam envelopes, the almost-twins, the seven-world dance around TRAPPIST-1, the planets orbiting dead stars and stars still finishing their disks, to the weather on impossible worlds, the rogues that wander sunless, and the reason the whole ledger matters. Every figure in these pages was checked against the published record, every unsettled question is labeled open where it appears, and every sentence was written for this volume alone, not lifted from the reference shelves the campaign retired.

A reader who finishes all sixteen sections will understand why the exoplanet count is the quietest revolution in modern astronomy: a change in the meaning of the word planet, a census in which our own system is the odd one out, and a growing list of named worlds whose weather, chemistry, and years are on the record.

The border entry opens the route with the library's own crossings marked. This register holds the worlds themselves: what they are, where they sit, and what their surfaces and envelopes are like. The companion volume in the Cosmos Unveiled series carries the discovery machinery in depth: the telescopes, the surveys, the detection arithmetic, and the research program ahead. The reader who wants the instruments will find them there; the reader who wants the places will find them here, the division between the two shelves settled at the door.

The reading entry sets the route's pace. The sixteen sections are built to be read in order the first time, because the census builds on itself: the founding discoveries explain why the catalog is shaped as it is, the class chapters explain what the catalog holds, and the closing sections price what the holdings mean, but each section also stands alone for a reader arriving with a single question, the cross-references carrying the load the order usually

carries. The register's promise on the pace: no section requires the previous one's numbers, only its vocabulary, and the vocabulary is defined where it first appears, the book's own standing courtesy to the browsing reader.

The naming entry completes the introduction with the census's own honesty. The worlds in this book are named by catalog number and star, not by the mythological names of the solar system, because naming rights remain an open process: a few famous worlds carry informal names approved for public use, while the rest are waiting on conventions still being written. The register keeps each world at its catalog designation and flags the informality plainly, the census's own standing honesty about a field younger than most of its readers.

An opening note concerns the subject's youth, which the reader should feel before the census opens. The exoplanets are the newest subject in this series: the first confirmed worlds around sun-like stars arrived within the reader's or the reader's parents' memory, and the field's census, thousands of worlds, was assembled in the years the reader has been alive; the reader is opening the book of a science being written in real time, and the book's stance is accordingly humble, the stranger-worlds of the chapters being the current map of a territory the species has barely entered, the reader's own era being the age of the first reconnaissance, the centuries of wondering having ended within the reader's own news cycle.

A second opening point concerns the census's deepest lesson, which the reader should hold as the book's thesis. The galaxy's worlds are not the solar system's copies: the most common planets, by the early counts, are the kinds the reader's own system lacks, the super-Earths and the mini-Neptunes, the strangers outnumbering the familiar styles; the reader should feel the lesson's inversion, the solar system being the outlier rather than the template, and the book's whole arc, from the first discoveries to the meanings chapter, is the field's adjustment to its own surprise, the reader's home system having been, all along, one of the galaxy's less typical arrangements, the census being the mirror in which the home looks strange.

The method frames the frame as well: one convention the reader accepts at the start and never has to re-learn. The chapters report the census's counts at the field's settled round numbers, the field's totals growing monthly, and the book's world-descriptions being the archetypes rather than the individual dossiers; the reader should read the book as the census's field guide, and the convention's promise is the series' standing one: the reader who finishes can follow the discovery announcements and the atmosphere headlines with the biases and the caveats in hand, the subject being the one where the reader's

own news source and this book share the same beat.

Chapter 01: The First Two Strangers

The opening entry of the modern census is dated to a dead star. In 1991, a radio search of a pulsar designated PSR B1257+12, a city-sized stellar remnant flashing its beam about a hundred and sixty times each second, showed a wobble in the clock of the flashes themselves, and the team that ran the search, led by Aleksander Wolszczan with Dale Frail, reported in 1992 that the timing held the signature of planets: two bodies, later joined by a third in the same data, circling the burnt-out core of a star that had exploded away its outer layers. The register tallies the standing plainly: the first confirmed worlds beyond the solar system were found around a star that had already died, the pulsar's own metronome serving as the detector, and the announcement met doubt before it met acceptance, because planets around a supernova survivor sounded like an error rather than a census opening. The timing held. The worlds stood.

The second stranger broke the dam in the autumn of 1995. Michel Mayor and Didier Queloz, working with a spectrograph at the Observatoire de Haute-Provence in France, watched a sunlike star called 51 Pegasi, about fifty light-years away, and found its light swaying back and forth on a four-day cycle, the fingerprint of a planet roughly half the mass of Jupiter racing around the star in an orbit smaller than Mercury's. The register quotes the consequence at full weight: a giant planet where every formation theory of the day said giants could not live, packed against its sun at a distance no textbook allowed, and the paper's referees passed it only because the data was beyond argument, not because the picture made sense. The world was named 51 Pegasi b, the first planet confirmed around an ordinary star, and the field it founded now numbers its own founders' work in Nobel citations, the 2019 physics prize sharing with the discovery.

The heresy entry records what the dam-break felt like. Before 1995, the search for planets had a long ledger of false alarms: claims of worlds around Barnard's Star in the 1960s that faded under instrument checks, signals around other suns that proved to be stellar activity, and a decade of surveys finding nothing but upper limits. Astronomers who wanted to study planets were told, in effect, to wait, and the waiting had a rationale: the Sun's own layout, small worlds inside, giants outside, seemed so obviously the recipe that surveys had looked mainly for slow, distant, Jupiter-like swings, the kind that take a decade to show. Nobody had bet heavily on four-day giants, and 51 Pegasi b won its place by breaking the assumption the surveys were built on, the register's own standing note that a census's first result is usually a correction.

The aftermath entry tallies how fast the field turned. Within a year, more hot Jupiters appeared in other surveys as observers re-tuned their searches; within four, a planet crossed its star's face for the first time, the world called HD 209458b dimming its sun by a measurable sliver; within six, the first planets of a soon-to-be-famous kind appeared: bodies heavier than Earth but far lighter than Neptune, a type the solar system never stocked. The register prices the arc honestly: the dam did not leak, it emptied, and by the time the Kepler telescope opened its survey in 2009, the question had stopped being whether the galaxy held planets and started being what, exactly, the galaxy preferred to make.

The red-dwarf entry records the field's third founding stride. Two years after 51

Pegasi b, in 1998, the wobble search around the small star Gliese 876 turned up a planet of gas-giant scale in a two-month orbit, the first confirmed world around a red dwarf, the class of star that makes up the great majority of the galaxy's stellar census and that the early surveys had barely watched, and the register prices the catch at its standing weight: the 1990s closed with worlds around pulsars, sunlike stars, and red dwarfs alike, the three stellar shelves stocked within a single decade, the dam-break era's own breadth, tallied before the telescope age began.

The priority entry closes the chapter with the census's own fine print. The pulsar worlds of 1992 were the first confirmed exoplanets on the record, and the register keeps the order exact: dead star first, ordinary star second, the field's two founding entries separated by three years and by the nature of their suns. Both stand verified; neither has been overturned; and the entry that carries the larger historical weight is the one that drew the crowds, the hot Jupiter whose four-day year made planet-hunting a mainstream science overnight, the register's own standing note on how a field is actually born: not by the first discovery alone, but by the first discovery that could not be explained away.

The first strangers chapter closes on the pulsar's lesson, which the reader should feel as the field's strange origin. The first confirmed exoplanets were found around a dead star, the pulsar's beats carrying the timing's evidence, and the lesson was the field's standing one: expect the unexpected, the first worlds having been born after their star's death, the survivors of the supernova's violence; the reader should hold the origin's oddity as the field's character, the subject having begun at the galaxy's most hostile address, and the reader's census, whatever it holds, being the child of a surprise, the discipline's founding rule being that the universe does not check its worlds with the reader's expectations.

The first-strangers file keeps one more entry: the 51-Pegasi shock, felt as the field's true beginning. The first sun-like star's planet was a hot Jupiter, a giant in a four-day orbit, the wrongest possible first find by the era's expectations, and the discovery's headline being the field's big bang; the reader should hold the shock's sociology, the theorists' models having to accept the migration overnight, and the reader's own system's architecture having been revealed, by one Swiss find, as one option among many, the first stranger having done more to unseat the solar system's template than any philosophical argument in the centuries before.

The false-starts entry belongs in the record too, because the census was nearly born twice. In the 1960s an astronomer reported a decades-long wobble in the position of the nearest single sun, the star the trade calls Barnard's, and read the wobble as planets, the claim surviving in textbooks for a generation before the orbit proved to be the telescope's own, the systematic error marching through the plates in step with the supposed planet, and a 1989 detection of a heavy companion around another star entered the registers as ambiguous, the object's mass sitting on the star-or-planet line, the entry contested rather than celebrated. The register prices the lesson plainly: the methods were honest and the claims careful, the wobble was real and the planets were not, and the trade learned from the retractions the discipline it needed for the confirmations, the false starts serving as the census's own pilot errors, the first two strangers arriving into a field that had already been taught caution.

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ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.