

Two Intriguing New Planets

1 Recent discoveries of two planets in outer space have raised new questions and possibilities in the study of astronomy. In August 2009, researchers in the United Kingdom, led by Andrew Collier Cameron of the University of St. Andrews, Scotland, discovered a new planet, named WASP-17b, that, contrary to all other known planets within or outside of our solar system, rotates in the opposite direction from its star. The group United Kingdom's Wide Area Search for Planets (WASP) worked with Switzerland's Geneva Observatory. WASP-17b is the largest and the dense extra-solar planet (that is, a planet outside the solar system) discovered thus far. It is almost twice the size of Jupiter, but has less than fifteen percent of Jupiter's mass. Located approximately one thousand light years away, WASP-17b, is also the closest known planet to its star.

2 In our solar system, all planets orbit the sun in the same direction as the sun itself is turning. Most scientists believe this is because the sun and planets all evolved out of one original mix of gases and dust particles. There had been an expectation that extra-solar planets would follow the same pattern. The planets in our solar system also follow an orbit that has the shape of a disc. Over 370 exoplanets (another name for extra-solar planets) have been discovered since 1995, and only three of these do not follow the familiar pattern of a disc-shaped orbit. In each of these three cases, the planet rotates around its star in the same direction as the star's rotation, but with an axis that is tilted somewhat.

3 WASP-17b was discovered using the transit method: that is, measuring the dimming of the light from its star as the planet passes between the star and the observers. ■ (A) Further calibrations determined the unusual backward rotation. ■ (B) Coel Hellier, of Keele University, believes a larger planet also rotating around the star may have altered WASP-17b's rotational direction by passing close by. ■ (C) He believes that a near-collision with the right trajectory acted like a gravitational slingshot that flung one of the planets into a retrograde orbit. ■ (D)

4 Another team member, Andrew Collier Cameron of the University of St. Andrews, believes it is more likely that WASP-17b has an as-yet-undetected neighboring body whose gravity causes the planet to gradually change its orbit over time. He theorizes that WASP-17b once orbited its star in the same direction as the star's rotation, but that its rotation gradually tilted away from the axis of the star's rotation until it was perpendicular and continued tilting until it reached its current reverse rotation. If Cameron's theory is correct, eventually WASP-17b will once again be rotating in the same direction as the star.

5 In addition to the transit method used to discover WASP-17b, astronomers use many other ways to discover new planets. Most of the discoveries to date have used the radial velocity method, which measures the wobble of a star caused by the gravitational pull of a planet. The Hubble Space Telescope has played an important role in this method.

6 In May of 2009, Stuart Shaklan and Steven Prado, astronomers at the United States National Aeronautics and Space Administration's (NASA) Jet Propulsion Laboratory, announced that they had discovered a new planet using astrometry, a method of searching for planets that was first tried fifty years ago, but which had not previously been successful. Shaklan and Prado measured the motions of thirty stars over a period of twelve years, looking for variations in each star's location caused by the gravitational pull of a planet. The planet they found, VB 10b, is a gas giant approximately twenty light-years away, with six times the mass of Jupiter, and it orbits a star that is the smallest star known to be orbited by a planet. Prado feels that astrometry is optimal for discovering other solar system configurations like our own, that might hold other Earths. As new techniques and instruments have been developed, the rate of discovery of new planets has increased every year, along with exponential growth of data, leading to new understandings and new theories about planet formation and the birth of the universe.

1. The word **particles** in paragraph 2 is closest in meaning to
 - (A) clouds
 - (B) pieces
 - (C) areas
 - (D) storms
2. According to paragraph 2, what did scientists expect to be true about extra-solar planets?
 - (A) They would have a tilted axis.
 - (B) They would not follow a disc-shaped orbit.
 - (C) They would have evolved out of gas and dust.
 - (D) They would rotate in the same direction as their stars.
3. According to paragraph 3, how is the transit method used to detect the presence of a planet?
 - (A) It measures how the star's light changes when it is blocked by the planet.
 - (B) It measures how long it takes for light from the star to reach observers.
 - (C) It measures the strength of the star's light when it reaches the planet.
 - (D) It measures how much light from the star is reflected by the planet.
4. The word **calibrations** in paragraph 3 is closest in meaning to
 - (A) observations
 - (B) measurements
 - (C) instruments
 - (D) researchers

5. Look at the four squares [■] in paragraph 3 that indicate where the following sentence could be added.

Team members are not in agreement about a probable cause.

Where would the sentence best fit?

6. The word **whose** in paragraph 4 refers to
- (A) the orbit
 - (B) WASP-17b
 - (C) a neighboring body
 - (D) Andrew Collier Cameron
7. According to paragraph 4, what does Andrew Collier Cameron believe is the likely cause of WASP-17b's unusual rotational direction?
- (A) The speed at which the planet travels
 - (B) The shape of the planet's orbit
 - (C) A nearby object in space
 - (D) Gravity from its star
8. Why does the author discuss different methods used to discover planets in paragraph 5?
- (A) To highlight the importance of the discovery of VB 10b by astrometry
 - (B) To increase the reader's confidence in the work of astronomers
 - (C) To introduce information about the Hubble Space Telescope
 - (D) To explain how WASP-17b was discovered
9. According to paragraph 5, which of the following is true about the Hubble Space Telescope?
- (A) It played an important role in the discovery of WASP-17b.
 - (B) It has not been particularly useful in the discovery of new planets.
 - (C) Its measurements are more accurate than those of other instruments.
 - (D) It has been used to search for new planets by the radial velocity method.
10. The word **wobble** in paragraph 5 is closest in meaning to
- (A) speed
 - (B) route
 - (C) shaking
 - (D) heaviness
11. The word **optimal** in paragraph 6 is closest in meaning to
- (A) unreliable
 - (B) useful
 - (C) accurate
 - (D) best

12. Which of the following sentences best expresses the information in the highlighted sentence in paragraph 6?
- (A) Technological developments have increased the discovery of new planets, and these discoveries have increased our understanding of how the universe was formed.
 - (B) As new technologies are developed, we will discover more planets and collect more data about the universe.
 - (C) Every year, new instruments and new technologies are developed, based on theories that have been proposed about the formation of planets and of the universe.
 - (D) The discovery of new planets will contribute to the development of new techniques and instruments for exploring the universe and collecting data.

13. An introductory sentence for a brief summary of the passage is given below. Complete the summary by choosing THREE answers that best represent the main ideas in the passage. This question is worth 2 points.

The recent finding of two extra-solar planets contributes to the development of our research and understanding of outer space.

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Answer Choices

- (A) The planet WASP-17b is the only known planet to rotate in a direction opposite of its star's rotation.
- (B) Although WASP-17b is a great deal larger than Jupiter, it is also less dense, and it is the largest known extra-solar planet.
- (C) Most extra-solar planets, like the planets in our solar system, have an orbit that is in the shape of a disc.
- (D) There are several theories, but no agreement, about the reason for the unusual rotational direction of WASP-17b.
- (E) Most extra-solar planets have been discovered with the use of a method known as "radial velocity".
- (F) Different methods have been used to discover planets, and the discovery of the planet VB 10b was the first successful use of the astrometry method.