

1. Highlight confusion.
2. Show evidence of your thinking on the page
3. Write a one-page reflection

### **Cast Adrift in the Milky Way, Billions of Planets, All Alone**

Source: Dennis Overbye/*New York Times*

Is the galaxy full of orphans?

Astronomers said Wednesday that space was littered with hundreds of billions of planets that had been ejected from the planetary systems that gave them birth and either were going their own lonely ways or were only distantly bound to stars at least 10 times as far away as the Sun is from the Earth.

There are two Jupiter-mass planets floating around for each of the 200 billion stars in the Milky Way galaxy, according to measurements and calculations by an international group of astronomers led by Takahiro Sumi, of Osaka University in Japan, and reported in the journal *Nature*.

“It’s a bit of a surprise,” said David Bennett, a Notre Dame astronomer who was part of the team. Before this research, it was thought that only about 10 or 20 percent of stars harbored Jupiter-mass planets. Now it seems as if the planets outnumber the stars.

“The implications of this discovery are profound,” wrote Joachim Wambsganss, of Heidelberg University in Germany, in an accompanying commentary in *Nature*.

Alan Boss of the Carnegie Institution in Washington said, “It means there are a lot more gas giants out there than previous estimates.” This, he added, has important consequences for theories of how such planets form.

Planetary astronomers say the results will allow them to tap into a whole new unsuspected realm of exoplanets — as planets outside our own solar system are called — causing scientists to re-evaluate how many there are, where they are and how they are created, even as astronomers immediately begin to ponder whether the new planets in question are in fact floating free or are just far from their stars, at distances comparable to those of Uranus and Neptune in our own solar system.

“Either there is a large population of Jupiter-mass planets far from their star, or, yes, there are a lot of lonely planets out there,” said Sara Seager, a planetary theorist at the Massachusetts Institute of Technology.

In the past two decades, astronomers have identified some 500 planets that are circling other stars, and this year scientists using NASA’s Kepler satellite announced 1,235 more candidates. But these were found using methods that favored the detection of planets close to their stars.

The new work was done using a method known as gravitational microlensing, which is more sensitive to planets farther out. It relies on the ability of the gravitational field of a massive object — in this case a planet and its star — to bend light and act as a magnifying lens, as predicted by Einstein’s general theory of relativity.

Astronomers from two groups — Microlensing Observations in Astrophysics, based in New Zealand and Japan, and the Optical Gravitational Lensing Experiment, based in Poland and Chile — monitor the light from a vast field of background stars,

looking for brief blips of increased brightness caused by a planet and its host star passing in the foreground.

The group recorded 10 such events consistent with being caused by planet-size objects but did not detect the corresponding blips from these planets' host stars, suggesting either that they did not belong to any star, having been ejected by gravitational pinball games earlier in their lives, or that they were very distant.

Dr. Bennett said the results were consistent with these new planets' being about the same mass as Jupiter. In that case, he said, the prospects for life on them would be dim.

In principle, microlensing could detect planets as small as Earth. Indeed, a microlensing experiment to look for planets was to be part of a new NASA spacecraft known as WFIRST, which was given the highest priority by a prestigious National Academy of Sciences panel last summer. Now, however, it will not fly until the 2020s, if it flies at all, because NASA will not have any money for it until the troubled James Webb Space Telescope, Hubble's successor, is finally launched, perhaps in 2018.

Why call these things planets rather than small failed stars, like the slightly more massive brown dwarfs? Dr. Bennett said there are simply too many of them, even when nature's propensity to make more and more smaller objects is taken into account. "We suspect they formed like planets," he said, explaining that they were once part of primordial protoplanetary disks.

More and better observations should eventually establish whether they are true orphans or just on a long leash.

Dr. Boss pointed out that most planetary systems would not have the gravitational oomph to eject so many massive objects. When push comes to shove, moreover, it is always the smaller object that gets sent out into space. There is no way, for example, that our own solar system could have kicked out any of those putative free-floaters, he said.

"More likely," Dr. Boss wrote in an e-mail, "these are distant gas giants, much like our own Jupiter and Saturn. That makes our solar system's outer reaches look a little more commonplace."

Possible WN topics:

- Do you believe these new planets are orphans? Or are they on long leashes? Explain.
- In a time of economic trouble, should the United States continue spending money to explore space? Yes? No? Explain your answer.