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Simulating a planet inside highly relativistic pulsar wind

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We investigated a novel pulsar planet detection method based on radio emissions produced by the interaction of a terrestrial planet with the pulsar wind.
Using the PLUTO code, we simulate relativistic magnetohydrodynamics of an Earth-sized planet ensconced in a highly relativistic pulsar wind. We achieved a Lorentz factor of approximately 6 or a pulsar wind speed of approximately 98.5\% of the speed of light in our simulation.
We examine the effects of changes in pulsar wind densities and external magnetic field strengths on the radio emission characteristics and compare the results with previous studies at lower velocity. The resulting emissions show characteristics similar to those of Alfven wing structures, in which wing-like disturbances in the flow are produced by the interaction of a conducting barrier with a magnetized plasma. Our findings suggest that radio emissions from a planet the size of Earth can have intensities that are within the current radio telescopes' sensitivity limits; thus this offers a new opportunity to search for planets around pulsars using existing data and a base for new observation proposals. Furthermore, the anticipated spectrum properties provide a diagnostic for differentiating terrestrial pulsar planets from other astrophysical radio emitters.

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