

Authenticating the Presence of a Relativistic Massive Black Hole Binary in OJ 287 Using Its General Relativity Centenary Flare: Improved Orbital Parameters

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Abstract

© 2018. The American Astronomical Society. All rights reserved. Results from regular monitoring of relativistic compact binaries like PSR 1913+16 are consistent with the dominant (quadrupole) order emission of gravitational waves (GWs). We show that observations associated with the binary black hole (BBH) central engine of blazar OJ 287 demand the inclusion of gravitational radiation reaction effects beyond the quadrupolar order. It turns out that even the effects of certain hereditary contributions to GW emission are required to predict impact flare timings of OJ 287. We develop an approach that incorporates this effect into the BBH model for OJ 287. This allows us to demonstrate an excellent agreement between the observed impact flare timings and those predicted from ten orbital cycles of the BBH central engine model. The deduced rate of orbital period decay is nine orders of magnitude higher than the observed rate in PSR 1913+16, demonstrating again the relativistic nature of OJ 287's central engine. Finally, we argue that precise timing of the predicted 2019 impact flare should allow a test of the celebrated black hole "no-hair theorem" at the 10% level.

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Keywords

black hole physics, gravitation, quasars: general, quasars: individual (OJ 287)

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