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Signatures of star-planet interactions across the electromagnetic spectrum

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Close-in exoplanets can interact with their host stars magnetically, producing a variety of observable signatures at different wavelengths. For these interactions to occur, the planet must orbit inside the Alfvén surface of the stellar wind plasma, the region where magnetic forces dominate. As it is not generally possible to measure the plasma properties of the stellar winds of low-mass stars, the location of the Alfvén surface cannot be determined from observations. However, by coupling both observationally-derived magnetic field maps of the stellar surface and constraints on the stellar wind mass-loss rate with sophisticated magnetohydrodynamic models, we can obtain a 3D picture of the stellar wind plasma. This allows us to determine both the size and shape of the Alfvén surface, which in turn can be used to assess the feasibility of magnetic star-planet interactions occurring. In this talk, I will discuss how this approach allows us to predict and interpret hints of star-planet interactions from radio to X-ray wavelengths. I will illustrate how obtaining near-simultaneous observations at these wavelengths is our best bet for benchmarking these magnetohydrodynamic models.