Is Eta Carinae a fast rotator, and how much does the companion influence the inner wind structure?

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We analyze interferometric measurements of the Luminous Blue Variable Eta Carinae with the goal of constraining the rotational velocity of the primary star and probing the influence of the companion. Using 2-D radiative transfer models of latitude-dependent stellar winds, we find that prolate wind models with a ratio of the rotational velocity (vrot) to the critical velocity (vcrit) of W=0.77-0.92, inclination angle of i=60-90 degrees, and position angle PA=108-142 degrees reproduce simultaneously K-band continuum visibilities from VLTI/VINCI and closure phase measurements from VLTI/AMBER. Interestingly, oblate models with W=0.73-0.90 and i=80-90 degrees produce similar fits to the interferometric data, but require PA=210-230 degrees. Therefore, both prolate and oblate models suggest that the rotation axis of the primary star is not aligned with the Homunculus polar axis. We also compute radiative transfer models of the primary star allowing for the presence of a cavity and dense wind-wind interaction region created by the companion star. We find that the wind-wind interaction has a significant effect on the K-band image mainly via free-free emission from the compressed walls and, for reasonable model parameters, can reproduce the VLTI/VINCI visibilities taken at phase 0.92-0.93. We conclude that the density structure of the primary wind can be sufficiently disturbed by the companion, thus mimicking the effects of fast rotation in the interferometric observables. Therefore, fast rotation may not be the only explanation for the interferometric observations. Intense temporal monitoring and 3-D modeling are needed to resolve these issues.

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