

Influence of the SMBBH to the broad line asymmetry in the case of lowmass ratio systems

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We investigate broad line shapes emitted from the supermassive binary black holes (SMBBHs) for a special case of components having quite different masses, (mass ratio $q \sim 0.1$) with the accretion present only in the less massive component. We used the model presented in Popovic et al. (2021) that assumes a complex broad line region (BLR), composed of a moving BLR of the less massive component and one circum-binary BLR. We analyze the H β line shapes and light curves taking the different total masses of the SMBBH, in the range 10^6 to 10^9 Solar masses. The asymmetry of the line shape is discussed in terms of expected differences between SMBBH with one active component and a recoiling black hole.

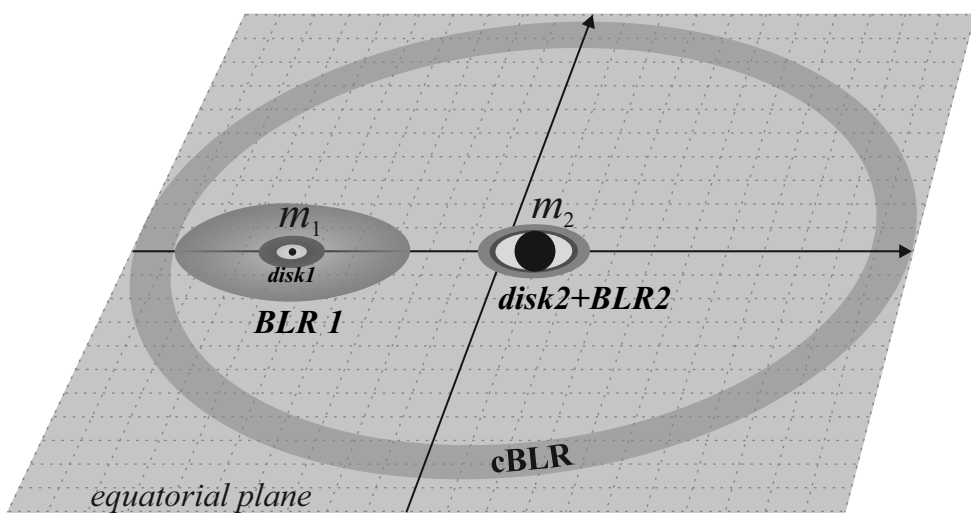


Figure 1. Sketch of the binary system configuration with low q ratio.

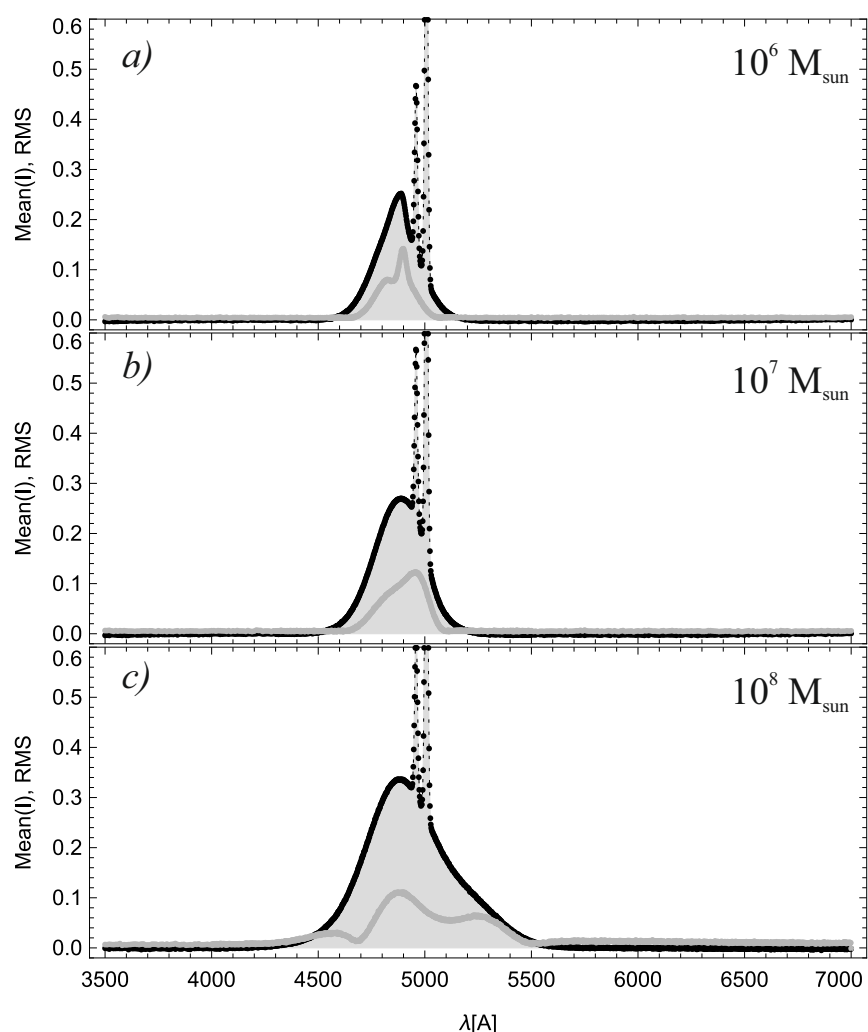


Figure 2. Mean line profile (black line) and appropriate rms values (gray line) of H β line for three full orbits and for three different mass orders: a) $10^6 M_{\text{sun}}$, b) $10^7 M_{\text{sun}}$ and c) $10^8 M_{\text{sun}}$ and fixed mass ratio of $q = 0.1$.

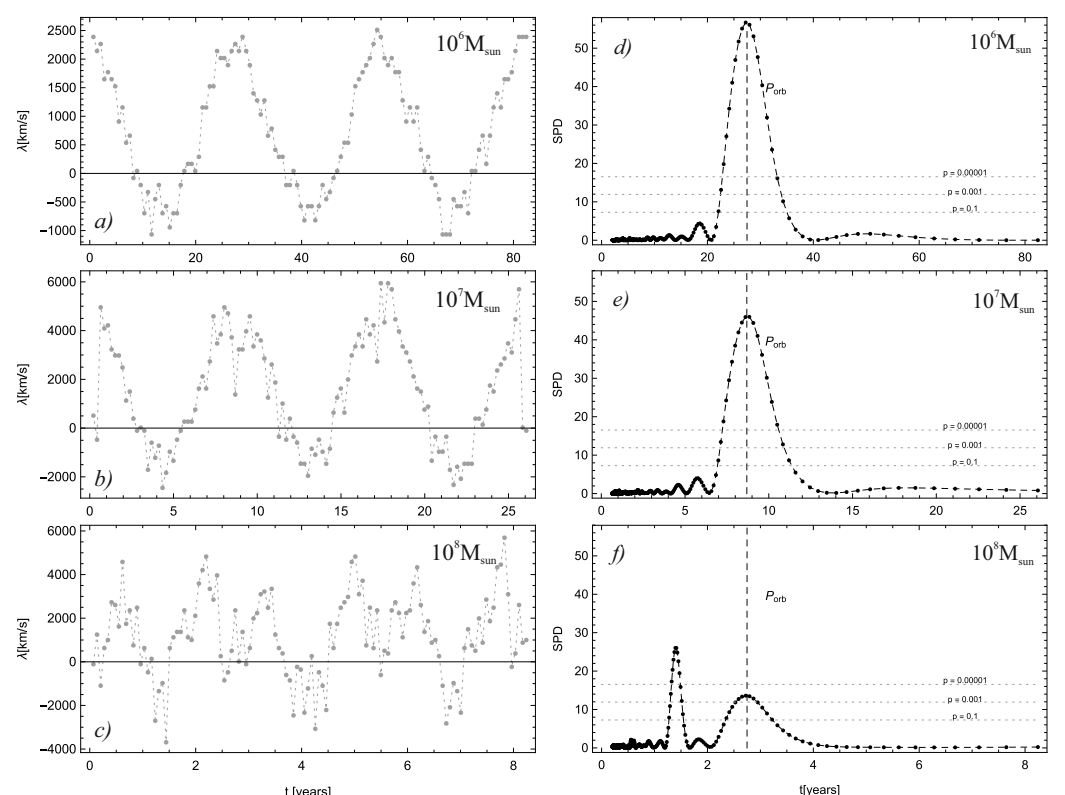


Figure 3. H β line shift (left panes) and appropriate LS periodograms (right panes) during three full rotations of the binary system, for BH masses given in Fig 2.

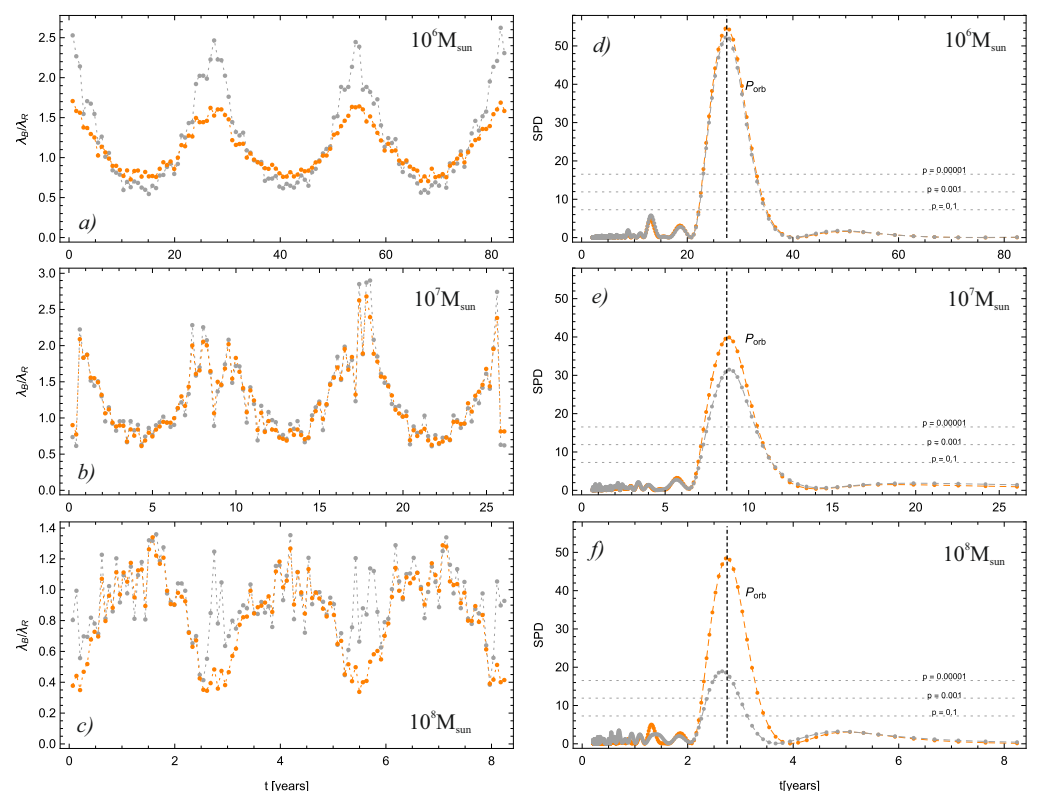


Figure 4. Same as in Fig. 3, but for H β line asymmetry. We presented asymmetry on left panes for 50% (gray dots) and 25% (orange dots) of line maximum, as well as appropriate periodograms given in right panes.