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Fractional Solitons in Excitonic Josephson Junctions JUNG-JUNG SU, Dept. of Electrophysics, National Chiao Tung University, YA-FEN HSU, National Center of Theoretical Science — The Josephson effect is especially appealing because it reveals macroscopically the quantum order and phase. Here we study this effect in an excitonic Josephson junction: a conjunct of two exciton condensates with a relative phase ϕ_0 applied. Such a junction is proposed to take place in the quantum Hall bilayer (QHB) that makes it subtler than in superconductor because of the counterflow of excitonic supercurrent and the interlayer tunneling in QHB. We treat the system theoretically by first mapping it into a pseudospin ferromagnet then describing it by the Landau-Lifshitz-Gilbert equation. In the presence of interlayer tunneling, the excitonic Josephson junction can possess a family of fractional sine-Gordon solitons that resemble the static fractional Josephson vortices in the extended superconducting Josephson junctions. Interestingly, each fractional soliton carries a topological charge Q which is not necessarily a half/full integer but can vary continuously. The resultant current-phase relation (CPR) shows that solitons with $Q = \phi_0/2\pi$ are the lowest energy states for small ϕ_0. When $\phi_0 > \pi$, solitons with $Q = \phi_0/2\pi - 1$ take place – the polarity of CPR is then switched.

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