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**The structure of low Mach number, low beta, quasi-perpendicular collisionless shocks** LYNN WILSON III, NASA/GSFC, ANDRIY KOVAL, NASA/GSFC and Goddard Planetary Heliophysics Inst. Univ. of Maryland Baltimore , ADAM SZABO, NASA/GSFC, MICHAEL STEVENS, Harvard-Smithsonian Center for Astrophysics, Harvard University, JUSTIN KASPER, University of Michigan, Ann Arbor, CYNTHIA CATTELL, School of Physics and Astronomy, University of Minnesota, VLADIMIR KRASNOSELSKIKH, LPC2E/CNRS, University of Orleans — A study of the structure of 145 low Mach number ($M \leq 3$), low beta ($\beta \leq 1$), quasi-perpendicular interplanetary collisionless shock waves observed by the *Wind* spacecraft has provided strong evidence that these shocks have large amplitude whistler precursors. The common occurrence and large amplitudes of the precursors raise doubts about the standard assumption that such shocks can be classified as laminar structures. This directly contradicts standard models. In 113 of the 145 shocks (∼78%), we observe clear evidence of magnetosonic-whistler precursor fluctuations with frequencies ∼0.17 Hz. The presence or absence of precursors showed no dependence on any shock parameter. The majority (∼66%) of the precursors propagate at ≤45° with respect to the upstream average magnetic field, most ( 87%) propagate ≥30° from the shock normal vector, and most (∼79%) propagate at least 20° from the coplanarity plane. The peak-to-peak wave amplitudes are large with a range of maximum values of ∼0.213 nT with an average of ∼3 nT. When we normalize the wave amplitudes to the upstream averaged magnetic field and the shock ramp amplitude, we find average values of ∼50% and ∼80%, respectively.

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