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Model wavefunctions for fractional quantum Hall collective modes[1] BO YANG, F.D.M. HALDANE, ZIXIANG HU, ZLATKO PAPIC, Princeton University — We examine the collective modes of primary fractional quantum Hall states which can be represented by Jack polynomial wavefunctions, in particular the $\nu = 1/3$ Laughlin and the $\nu = 1/2$ (or $5/2$) Moore-Read states. Using the extension of Jack Polynomial states (B. A. Bernevig and F. D. M. Haldane, Phys. Rev. Lett. 102, 066802 (2009)) to describe states with excited quasiparticles as well as quasiholes, we model the collective mode as a dipole formed by the combination of a single elementary quasiparticle with a single quasihole. In the Laughlin case, this neutral collective excitation is bosonic, while in the Moore-Read case, it has two forms, one bosonic and one fermionic. For small electric dipole moment (also small momentum and wavenumber) the (variational) energy of this mode lies above the threshold of the continuum of roton-pair (Laughlin) or neutral-fermion-pair (Moore-Read) excitations. In the long-wavelength limit the bosonic mode is a "spin-2" excitation that has an analogy to the "graviton" suggested by a recent geometric approach (F. D. M. Haldane, Phys. Rev. Lett. 108, 116801 (2011)) to FQH systems, while the neutral fermionic mode (present if the "odd-denominator rule" is violated) has "spin-3/2", and has a possible analogy to the "gravitino".

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