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**Location of low-energy zeroes in bound-free quadrupole matrix elements and their systematics in comparison to quantum defects and phase shifts** L.A. LAJOHN, R.H. PRATT, U. Pittsburgh, G. PRADHAN, T. BANERJEE, IIT-Madras, H. VARMA, IIT-Mandi, P.C. DESHMUKH, IIT-Madras and IIT-Mandi, S.T. MANSON, Ga. St. U. — Using the example of photoionization of 3s and 4s atomic subshells, we study the energies of quadrupole Cooper minima (QCM) over the entire range of Z for which they appear in the continuum. The results show that s→d continuum QCM show up over a much larger range of Z than their s→p dipole (DCM) counterparts. For 3s photoionization QCM exist for Z=11-30, a much larger range than dipole case of Z=11-14; for 4s photoionization, QCM exist for Z=19-50, compared to the dipole case of Z=19-36. Also, for any Z for which both dipole and quadrupole minima exist for a given subshell, the energy location of the QCM is always larger than the energy of the DCM. This phenomenology is related to the phase shifts of the continuum wave and the fact that the d-wave phase shift is always smaller than the corresponding p-wave in the atomic potential, which means that the p-wave is always pulled in towards the nucleus more than the corresponding d-wave. The calculations were performed using fully relativistic Dirac-Slater wave functions over the broad range. In selected cases relativistic-random-phase approximation (RRPA) calculations were also performed.

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