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A high-quality axion from the non-minimal SU(6) GUT

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We propose an SU(6) GUT, which enjoys a global symmetry of $SU(2) \times U(1)_{PQ}$. The GUT breaking to the SM gauge symmetry undergoes two stages. The second stage of symmetry breaking scale corresponds to the axion physics scale. By studying the Peccei-Quinn quality constraint, we show an upper bound to the axion decay constant to be consistent with the classical axion window. The QCD axion, which has a KSVZ-type coupling to the vector-like quarks, has a DFSZ-type effective di-photon couplings, and can be probed by the upcoming IAXO experiment. Some other issues of the SU(6) GUT will be discussed as well.

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