Direct instantons, topological charge screening and QCD glueball sum rules Hilmar Forkel IFT - Universidade Estadual Paulista, Rua Pamplona, 145, 01405-900 Sao Paulo, SP, Brazil  Institut für Theoretische Physik, Universität Heidelberg, D-69120 Heidelberg, Germany

abstract Nonperturbative Wilson coefficients of the operator product expansion (OPE) for the spin-0 glueball correlators are derived and analyzed. A systematic treatment of the direct instanton contributions is given, based on realistic instanton size distributions and renormalization at the operator scale. In the pseudoscalar channel, topological charge screening is identified as an additional source of (semi-) hard non-perturbative physics. The screening contributions are shown to be vital for consistency with the anomalous axial Ward identity, and previously encountered pathologies (positivity violations and the disappearance of the $0^{-+}$ glueball signal) are traced to their neglect. On the basis of the extended OPE, a comprehensive quantitative analysis of eight Borel-moment sum rules in both spin-0 glueball channels is then performed. The nonperturbative OPE coefficients turn out to be indispensable for consistent sum rules and for their reconciliation with the underlying low-energy theorems. The topological short-distance physics strongly affects the sum rule results and reveals a rather diverse pattern of glueball properties. New predictions for the spin-0 glueball masses and decay constants and an estimate of the scalar glueball width are given, and several implications for glueball structure and experimental glueball searches are discussed.