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The Nature of the X-ray Emission and Innermost Accretion Regions of Typical Radio-Loud Quasars

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Radio-loud quasars (RLQs) are typically more X-ray luminous, by a factor of 2-20, than matched radio-quiet quasars (RQQs). This excess X-ray emission has generally been attributed to small-scale jets. To determine the nature of this excess X-ray emission, we have constructed a large, uniform sample of 729 optically selected RLQs with high fractions of X-ray detections and radio-slope measurements. We investigate correlations between their X-ray, optical/UV, and radio luminosities, as well as their X-ray spectral and variability properties. Strikingly, we find that steep-spectrum RLQs (SSRQs) follow a quantitatively similar relation between X-ray vs. optical luminosities as RQQs, suggesting a common accretion-disk corona origin for the X-ray emission of both classes. Formal statistical model selection supports these conclusions, as does consideration of analogies with black-hole X-ray binaries. However, the relation's intercept for SSRQs is larger than that for RQQs and increases with radio loudness, suggesting a connection between the radio jets and the accretion-flow configuration. Flat-spectrum RLQs also generally appear to have corona-dominated X-ray emission, though in some cases jets make large contributions. Our spectral measurements of X-ray continuum shapes and (average) reflection signatures confirm these conclusions, as do our inter-observation measurements of X-ray variability on timescales of weeks-years. Our results indicate the corona-jet, disk-corona, and disk-jet connections of RLQs are likely driven by independent physical processes. Moreover, the observed corona-jet connection implies that small-scale processes in the vicinity of black holes, probably associated with the magnetic flux/topology instead of black-hole spin, are controlling quasar radio loudness.

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