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Detecting Quasars by Their Variability

Kasper B. Schmidt[1], Hans-Walter Rix[1], Sebastian Jester[1], Phil Marshall[2], Gregory Dobler[3], and Joseph F. Hennawi[1]

[1]Max Planck Institute for Astronomy, Königstuhl 17, D-69117 Heidelberg, Germany
Email: kschmidt@mpia.de
[2]Physics Department, University of California, Santa Barbara, CA 93106, USA
[3]Center for Astrophysics, Harvard University, Cambridge, MA 02138, USA

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We demonstrate that quantifying the intrinsic variability of quasars by fitting individual structure function data pairs with a 2-parameter power law model separates quasars from contaminating variable and non-variable point sources with a completeness of 93% and a purity of 99%. This approach can be used to select quasar samples in surveys like that being performed by Pan-STARRS1, where the usual color selection of quasars is not possible due to a filter system that is too red.

Reference

Richards, G. T., *et al.* 2002, *AJ*, 123, 2945

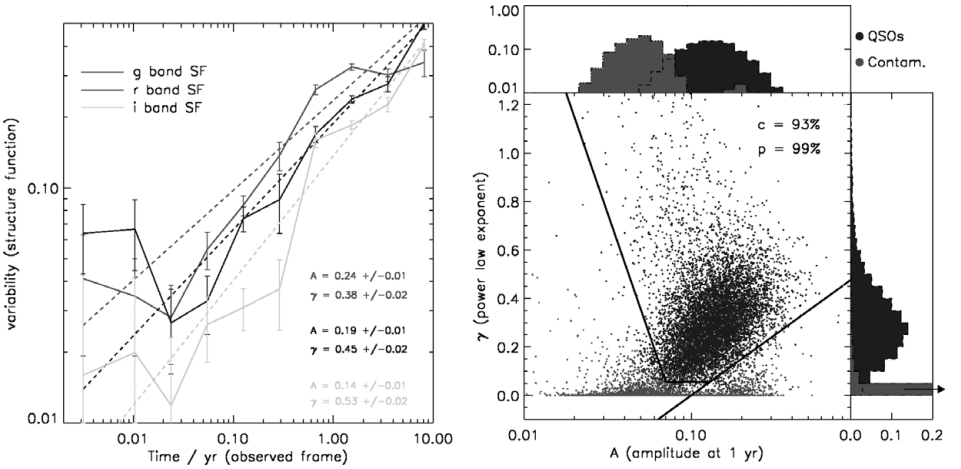

Figure 1. *Left:* The g, r and i band structure functions (SF) for a single spectroscopically confirmed quasar. The dashed lines are the SF power law fits calculated via a MCMC temperature annealing fitting technique. The fitted power law is on the form $V_{\rm model}(\Delta t) = A\,(\Delta t/1{\rm yr})^{\gamma}$. The optimized A and γ values are shown in the lower right corner. *Right:* The A-γ space from fitting the SDSS stripe 82 multi-epoch r-band SF data pairs of 9157 spectroscopically confirmed quasars and 9571 contaminants (5000 F/G-stars and 4571 RR Lyrae candidates). The probability distributions of the power law parameters are attached to the axes of the scatter plot. The quasars are separated from the variable and non-variable contaminants with a completeness (c) of 93% and a purity (p) of 99% calculated via the simple cut indicated by the solid lines. Such a variability discrimination will be crucial in the search for quasars in surveys like Pan-STARRS1 where the filters are too red to give a reasonable quasar completeness and efficiency with the 'usual' quasar color selection (Richards *et al.* 2002. A complete color and variability selected quasar catalog from the Pan-STARRS1 3π survey (30,000 deg^2) will contain $\gtrsim 10^6$ quasars, and allow us to uncover hundreds of new gravitationally lensed quasars. The details of the variability selection algorithm and its prospects are summarized in a forthcoming paper.