*Emission Lines in Active Galaxies: New Methods and Techniques*
*ASP Conference Series, Vol. 113, 1997*
*B.M. Peterson, F.-Z. Cheng, and A.S. Wilson (eds.)*

# Spectral Properties of Parkes Flat-Spectrum Radio Sources

Michael J. Drinkwater

*Anglo-Australian Observatory, Coonabarabran, NSW 2357, Australia*

Paul J. Francis and Rachel L. Webster

*School of Physics, University of Melbourne, Parkville, Vic 3052, Australia*

**Abstract.** We have constructed composite spectra of a large sample of flat-spectrum radio sources. The spectra are all very similar over a wide range of radio and optical properties, and are also similar to a composite of optically selected QSOs. We find, however, that the forbidden lines of the very reddest objects are anomalously strong.

## 1. Definition of the Sample

The Parkes half-Jansky flat-spectrum radio sources have been studied by several groups over the years, but it has proved difficult to obtain complete optical identifications with redshifts. In this paper, we use a new compilation of the sample (Drinkwater et al. 1996) with much more complete identifications. The new sample was selected according to the following criteria:

1. Both 2.7 GHz ($S_{2.7}$) and 5.0 GHz ($S_{5.0}$) fluxes defined.
2. Flux limit: $S_{2.7} > 0.5$ Jy.
3. Flat-spectrum criterion: $\alpha_{2.7/5.0} > -0.5$, where $S_\nu \propto \nu^\alpha$.
4. Galactic latitude: $|b| > 20°$.
5. Declination: $-45° < \delta_{1950} < +10°$.
6. Any planetary nebulae were removed.

This gave a final sample of 323 sources of which 321 have confirmed optical identification and 277 have measured redshifts. In this paper, we describe the analysis of the optical emission-line properties of the sample. We have obtained spectra of 206 or 60% of the sample: the subsample for which we have spectra is not biased with respect to any of the optical or radio properties.

## 2. Spectral Analysis

We used the approach of Francis & Koratkar (1995) to analyze the spectra, constructing composite spectra from the sources as a function of spectral index

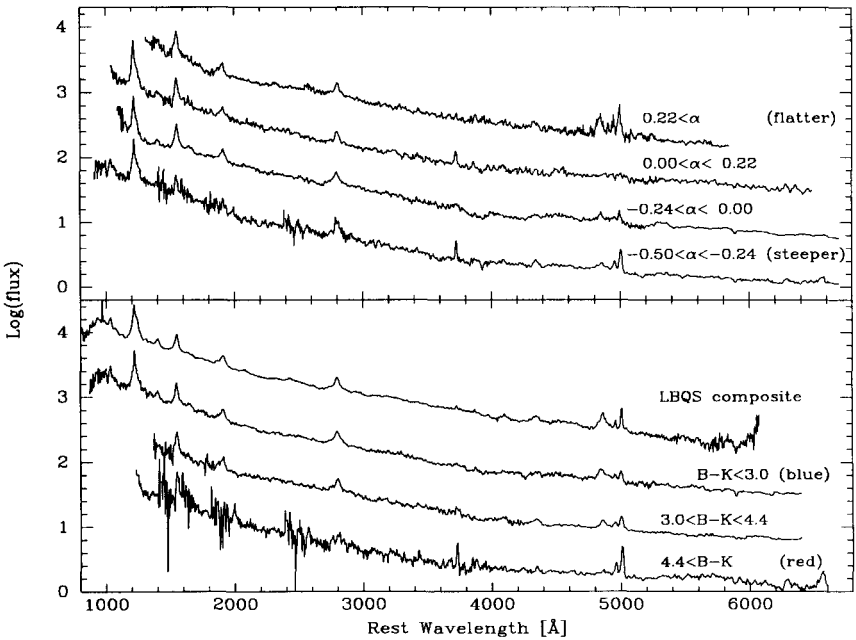


Figure 1. Composite optical spectra generated from the Parkes sample as a function of radio spectral index $\alpha$ (upper panel) and optical $(B-K)$ color (lower panel). In the lower panel, a composite spectrum of optically selected QSOs (LBQS) is also shown for comparison.

and color, shown in Fig. 1. Note that the spectra were first normalized to the same continuum slope.

The major observation we make from Fig. 1 is the similarity between the different spectra over a large range of colors, magnitudes, and radio properties. The Parkes spectra are also remarkably similar to the composite of optically selected QSOs (LBQS, see Francis et al. 1991), also shown in Fig. 1. This suggests that there is some rationale to attempts to explain quasar activity in terms of unified schemes.

No strong trend is seen in the spectra with spectral index, but a trend can be seen as a function of color: the equivalent widths of the forbidden lines increase as the spectra become redder in $B-K$. This evidence of increased narrow-line region activity in the reddest quasars may be consistent with the dust model we propose to explain the reddening (Francis et al., this volume).

## References

Drinkwater, M. J., et al. 1996, MNRAS, in press.
Francis, P. J., & Koratkar, A. 1995, MNRAS, 274, 504.
Francis, P. J., et al. 1991, ApJ, 373, 465.