A REDSHIFT SURVEY OF VERY FAINT ($B \leq 22.5$) FIELD GALAXIES, RADIO SOURCES, AND QUASARS

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As part of a three year program to study the evolution of galaxies, quasars, and radio sources (in collaborations with R. Kron and R. Windhorst), we will use over 30 nights on the KPNO 4-m CCD Cryogenic Camera System, in the multi-aperture mode, to measure the redshifts of several hundred very faint objects. These will be selected from four fields (SA68 00h+15; Lynx 08h+45; SA57 13h+30; Herc 17h+50); for each we possess 4-m plates in four bandpasses (limits: $U \simeq 23$, $B \simeq 24$, $V \simeq 23$, $I \simeq 21$) as well as Westerbork interferometer maps to 1 mJy at 21cm (a 50cm survey is in progress). Galaxies are selected randomly by their apparent red magnitudes as measured with a PDS; quasar candidates to $B \approx 22.5$ by stellar objects which lie apart from Galactic stars in the multi-color diagram ; and radio sources by their positional coincidence with optical images ($\sim$50% of the 300 radio sources are identified). To date , 10 nights have produced spectra of $\sim$250 field galaxies, $\sim$20 radio sources, and $\sim$40 quasar candidates. Reductions are still underway, but we do have a few preliminary results:

1) We find that the magnitude-redshift distribution of a subsample of 54 field galaxies (Fig. 1) favors mild evolution, with the caveat that our current sample is obviously biased, e.g., by including only those galaxies with two or more strong spectral features, often emission lines. We have sacrificed completeness to assure reliability of our redshifts. This subsample still contains very faint galaxies ($B \approx m(6100)+1.5$). Yet not one galaxy has an unusually high redshift $z > 0.6$; evolution, if present, has been mild. Evidence for evolution can be seen, however, by noting that 24 galaxies in Fig. 1 lie above the no-evolution 75% line. About 14 are predicted, so this deviation is significant at the $(24-14)/\sqrt{14}$ or 2.7 sigma level. In contrast, the dashed 75% line of the evolutionary model does indeed separate a sample of $\sim$14. Both models are detailed by Koo (1981) and use Bruzual's (1981) evolutionary synthesis of galaxy spectra.

2) In the radio sample, a few apparently blue, very faint galaxies ($V \geq 21$) yielded low redshifts $z \sim 0.3$; the implied intrinsic blueness ($B-V \sim 0.5$) and normal luminosities ($M_V \sim -20.5$) both serve as warnings that distant radio galaxies do not all belong to one class of luminous

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early-type galaxies.

3) We have counted 65 quasar candidates in a 1050 arc min^2 field in SA68 to $B \approx 22.5$ (Koo and Kron 1982); we also counted 58 in SA57 (unpublished). These results support a universe that is homogeneous and isotropic to within 10% at quasar redshifts and favor a luminosity evolution (LE) over a density evolution (DE) model of quasars. We now have spectra of 26 candidates with $B \sim 22 \pm 0.5$ for an area ~ 600 $arcmin^2$: 9 show broad emission lines typical of quasars (5 have $z \sim 2.3$); 6 have strong narrow emission in $H\beta$ and [OIII] 5007,4959 (all with $z < 0.6$ and UV excess; see Fig. 2 for one example); 3 possess a single narrow emission line (probably [OII] 3727; if so, $z < 0.65$); and 8 display no strong features so their identification is uncertain. The nature of the narrow-lined objects is unknown. Perhaps they are a compact subset of Markarian or Haro galaxies (at $z \approx 0.4$, 7kpc equals 1" for $H_o = 50$). The log10 of their number density per Gpc^3 per magnitude interval at $M_B \sim -20$ ($H_o = 50$, $q_o = 0$, and no K corrections assumed) is 4.4 ± 0.2. As for the high-redshift broad-lined quasars, the 5 with $z \sim 2.3$ imply a density, in the above units but at $M_B \sim -25$, of 3.0,a factor of 30 below the prediction of DE models. In contrast, even if the 8 unknown candidates were all at $z \sim 2.3$, the higher density would be better fit by models with LE (e.g., see Table 9 of Braccesi et al. 1980); with LE the brightness increase with z (for $z < 2.5$) is close to $(1+z)^n$, where $n \approx 4.2 \pm 0.2$. This survey thus lends spectroscopic support to a scenario in which the number density of quasar objects or events has been constant since $z \sim 2$, but in which they are today fainter by a factor of 100.

References

Braccesi, A., Zitelli, V., Bónoli, F., Formagginni, L.: 1980, Astron. Astrophys. 85,pp. 80-92.

Bruzual, G.A.: 1981, Ph.D. Dissertation, Univ. of Calif., Berkeley

Koo, D.C.: 1981, Ph.D. Dissertation, Univ. of Calif., Berkeley

Koo, D.C., Kron, R.G.: 1982, Astron. Astrophys. 105,pp. 107-119.

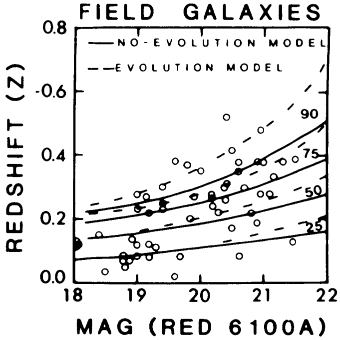

Fig. 1. Magnitude-redshift plot of 54 galaxies. Lines show model predictions of fraction (in percent) of total sample that should lie below.

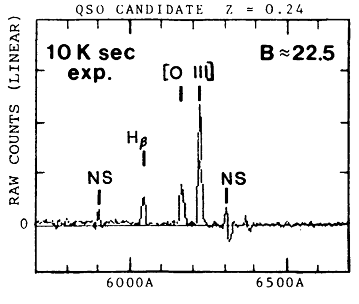

Fig. 2. Typical spectrum of a narrow-line quasar candidate. Night sky lines are labeled NS.