The Na D profiles of nearby low-power radio sources: Jets powering outflows

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(abridged) We have analyzed the properties of the Na D doublet lines in a large sample of 691 radio galaxies using the Sloan Digital Sky Survey (SDSS). These radio galaxies are resolved in the FIRST survey, have redshifts less that 0.2 and radio flux densities at 1.4 GHz higher than 40 mJy. Approximately 1/3 of the sources show a significant excess (above that contributed by their stellar populations) of Na D absorption that can be robustly fitted with two Voigt profiles representing the Na D doublet. A further 1/6 of the sources show residual absorption, for which the fits were not well constrained though while ~50% of the sample show no significant residual absorption. The residual absorption is modestly blueshifted, typically by ~50 km/s, but the velocity dispersions are high, generally ~500 km/s. Assuming that the size of the absorbing region is consistent with ~1 kpc for dust lanes in a sample of generally more powerful radio sources and a continuous constant velocity flow (continuity equation), we estimate mass and energy outflow rates of about 10 Msun/yr and few x e42 erg/s. These rates are consistent with those in the literature based on HI absorption line observations of radio galaxies. The energy required to power these outflows is on the order of 1-10% of the jet mechanical power and we conclude that the radio jet alone is sufficient. The mass and energy outflow rates are consistent with what is needed to heat/expel the mass returned by the stellar populations as well as the likely amount of gas from a cooling halo. This suggests that radio-loud AGN play a key role in energizing the outflow/heating phase of the feedback cycle. The deposition of the jet mechanical energy could be important for explaining the ensemble characteristics of massive early type galaxies in the local universe.

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