1 Interactions between the radio jet and the ambient gas

I have investigated the possibility of shocks as the explanation for the strong NV in some of the objects in the sample.

I am quite confident that the strong NV is not due to shocks. There are two objects with clear evidence of jet/cloud interactions (and therefore shocks). These objects, however, show *faint NV*: 4C41.17 and USS0828+193. Moreover, objects with a morphology apparently dominated by the AGN illumination, show strong NV: 4C23.56 and 4C00.54 (?).

1.1 4C41.17

The evidence for jet-cloud interactions comes from:

1) the correlation between the radio continuum emission and the UV emitting line regions (Dey et al. 1997, Chamber et al. 1990)

2) The kinematics: the galaxy presents similar features in the UV lines as PKS2250-41 (a clear jet-cloud interaction target) in the optical lines. Some of the lines present a broad component $\sim$1100-1400 km s^{-1} and a relatively narrow component $\sim$500-600 km $^{-1}$.

The NV line in this galaxy does not present the broad component observed in, for instance, CIII]. If NV was enhanced due to shocks, it should be broad.

1.2 USS0828+193

The clumpy and narrow morphology in the Lyα and continuum images in Joel's homepage suggest to me that the the radio and optical structures are interacting. Moreover, the overlaid of the radio+Lyα image shows a close connection between the clumpy Lyα and continuum structures and the radio map.

1.3 4C23.56

The impressive Lyα image of Knopp and Chambers (1997) shows a beautiful biconical nebula with apex at the probably obscured nucleus. [1]

1.4 4C00.54

The image in Joel's page seems to show a more diffuse and broader morphology than in other radio galaxies which show highly collimated and aligned structures.

Therefore, shocks cannot explain the NV ratios

2 Some more thoughts on AGN photoionization. Can we explain the strong NV line with higher metallicities?

Mark Allen run a few models for me with different metallicities and fixing the ionization level, density, power law, etc. He used MAPPINGS II. The predicted UV line ratios are shown in Table 1. Table 2 shows the observed values. Increasing metallicities produce fainter NV with respect to the the C lines. The ratios are always lower than observed for the HzRG. Lower metallicities increase the NV/C ratios. However, to produce NV ratios as high as observed in the targets, too low metallicities are required which will produce discrepant C/He and N/HeII ratios.

Higher ionization parameters do not help, since NV/CIV is not very sensitive to U (Hamman & Ferland 1992).

Therefore, high (or low) metallicities cannot explain the NV ratios

[1] I wonder if there is an alternative possibility to explain this morphology. Interestingly, the cones are edge brightened in this object. This suggests that the material has been swept and the cones are empty, therefore we see the emission from the edges. It reminds me a lot of the morphology observed in some protostellar nebulae with outflowing material (see Nature April 16th, page 685)

Table 1:

$Z/Z_\odot$	NV/CIII	NV/CIV	NV/HeII	CIV/CIII	CIV/HeII	CIII/HeII
0.1	0.143	0.082	0.015	1.739	0.179	0.102
0.4	0.116	0.071	0.048	1.633	0.672	0.412
0.8	0.100	0.062	0.075	1.556	1.162	0.747
1.6	0.082	0.054	0.074	1.515	1.369	0.904
3.2	0.053	0.040	0.025	1.323	0.616	0.465

Table 2:

Name	NV/CIII	NV/CIV	NV/HeII	CIV/CIII	CIV/HeII	CIIII/HeII
4c23.56a	1.07	0.654	0.89	1.63	1.37	0.840
4c23.56b	1.00	0.471	0.57	2.12	1.21	0.571
4c00.54	1.5	0.5	0.67	3	1.33	0.44
TXS0211-122	1.41	0.563	1.10	2.51	1.96	0.781
B30731+438	0.26	0.132	0.16	1.98	1.21	0.611
TXS0828+193	0.56	0.213	0.32	2.62	1.50	0.573
MRC0943-242	0.44	0.271	0.27	1.61	1.01	0.627
4C41.17	0.43	0.294	0.70	1.45	2.38	1.641

3 C depletion

Table 2 shows that those objects with larger NV/CIV values have also the largest NV/HeII values (4C41.17 is an exception). This suggests to me that the overabundance of N is also relative to elements like He (non sensitive to depletion) and not only to C. On the other hand, N is also sensitive to depletion (although less than C). If C was depleted, N should also be depleted and N/He lines should be lower than in other objects. Moreover, CIV/HeII is not smaller in objects where NV is stronger, as we would expect if C was depleted.

Therefore, C depletion is not the explanation for the strong NV emission. This emission is unusually strong, also compared to He.

4 Conclusions

The results of my previous draft and this one suggest that we cannot explain the strong NV emission unless this element is overabundant with respect to the other elements. The overabundance is not due to a depletion of C, but rather to a mechanism which enhances the NV emission.

There are numerous references (see my previous draft) in the literature to the possibility of NV being enhanced *in high z radio galaxies and quasars* as due to starburst.

5 The scenario

I have thought about the scenario you propose to explain the correlations between P and Lya/CIV and NV/CIV. We see that objects with stronger NV show fainter Lyα (relative to other lines) and higher polarization. You suggest that those objects contain more stars, therefore more dust which could explain the higher polarization and fainter Lyα. It seems that my study confirms the overabundance of NV, which can be the evidence for starburst.

I see a few open question with this scenario:

1) If there are more stars, there is more stellar light to dilute the polarization. Why should we expect larger polarization (even if there is more dust)?

2) Why 2356b shows strong NV and no polarization?

3) Why 4C41.17, with the best evidence for the existence of stars, does not show strong NV? Maybe the starburst is not old enough? If I have time before going to Florence, I'll look into the literature to see how long it will take for the N to be overabundant after the starburst begins.