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den Herder *et al.* Reply: The Comment by Perez on the results of our $(e, e'p)$ experiment¹ on ^{51}V basically criticizes the unexpected smallness of the summed spectroscopic strength $\sum S_{1f} = 1.11 \pm 0.14$ found for the transitions to the $(1f_{7/2})^2$ quadruplet in ^{50}Ti . This value is considered incompatible with both the independent-particle shell-model value $\sum S_{1f} = 3$ and with the result $\sum S_{1f} = 3 \pm 0.15$ of a spin-dependent sum-rule (SDSR) analysis² of pickup and stripping data. We first discuss the $(e, e'p)$ result.

The value $\sum S_{1f} = 1.1$ was obtained from distorted-wave impulse-approximation analysis with an approximate correction for Coulomb distortion of the electron wave functions³ and with a proton current operator that is not gauge invariant. From a reanalysis of the momentum distributions with a recent code⁴ that takes both effects into account, we obtain $\sum S_{1f} = 1.33 \pm 0.12$. However, this is not all $1f$ proton knockout strength in ^{51}V . For example, in discrete transitions between 5 and 8 MeV we find $\sum S_{1f} = 0.13$, i.e., 10% of the quadruplet strength, the same fraction as observed in a recent high-resolution $(d, ^3\text{He})$ experiment.⁵ The total $1f$ strength determined from an l decomposition³ of our data in the excitation-energy region from 4 to 10 MeV is $\sum S_{1f} = 0.37 \pm 0.15$. Since we observe no additional strength (upper limit 0.05) between 10 and 20 MeV, we arrive at a summed spectroscopic strength ^{51}V of 1.7 ± 0.2 , i.e., $(57 \pm 7)\%$ of the independent-particle shell-model sum-rule value.

The issue is how to interpret this number. The possible depletion of shell-model orbitals is an important one that has been the subject of a long-standing controversy.^{6,7} Recent calculations in a correlated basis⁸⁻¹⁰ yield a depletion of the occupation for states near the Fermi edge in the doubly magic nucleus ^{208}Pb of about (20–35)%. It would seem reasonable to assume that in the open-shell nucleus ^{51}V the depletion is not smaller than in ^{208}Pb . Hence, a fair estimate of the number of $1f$ protons in ^{51}V would be 2.0–2.4, which is not too far from the experimental value, especially if one realizes that these calculations also predict that because of short-range correlations some strength is scattered to (very) high excitation energies.

Now is this observation incompatible with a SDSA analysis? We think not. The sum-rule analysis, as mentioned by Perez himself, may be blind to orbit depletions or unobserved strength provided that a particular spin dependence is assumed. In fact Perez gets good agreement with both $\langle J_r \rangle$ and $\langle Q \rangle$ by taking into account the strength in the quadruplet only, leaving out the experimentally found^{1,5} strength in higher-lying states. Moreover, as pointed out by Clement,¹¹ the calculated quadrupole moment $\langle Q \rangle$ is very sensitive to small $2p$ ad-

mixtures. As a result the calculated $\langle Q \rangle$ varies between -0.024 and -0.041 . At present, experiment has not determined the amount of $2p$ pickup strength with sufficient accuracy.

In conclusion, we believe that the strength of 1.7 found in our experiment is not unreasonable compared with theoretical estimates, and, given the uncertainties^{7,12} in the SDSA analysis due to unobserved stripping strength, not incompatible with Perez's analysis. Nevertheless one should be open to the possibility that the distorted-wave impulse-approximation description of the $(e, e'p)$ reaction process can be improved. Preliminary studies of the final-state interaction^{3,13} show no larger effects than 10% on the deduced spectroscopic factors. Results obtained for the virtual-photon-proton coupling¹⁴ indicate that the observed deviation from the impulse approximation is not larger than (10–20)%. An extensive investigation of the $(e, e'p)$ reaction mechanism is presently undertaken at Sektie Kernfysica, Nationaal Instituut voor Kernfysica en Hoge-Energiefysica, in order to study these effects in greater detail.

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