

**Sanders *et al.* Reply:** In our Letter<sup>1</sup> we developed a case, based on experimental data, for the mass-asymmetric fission of <sup>56</sup>Ni as populated in the <sup>32</sup>S+<sup>24</sup>Mg reaction. It was shown that, within the uncertainties of the standard fission model, the observed fully damped yields can be understood as arising from a fusion-fission process, without the need to invoke an orbiting mechanism. In view of these observations it was suggested that similar yields observed in even light systems should be reexamined to see whether some, if not all, of the observed fully damped yields can be attributed to the fusion-fission process.

The basis of our argument in favor of a fission mechanism as opposed to a deep-inelastic process was the observation of full equilibration of the mass-asymmetry coordinate of the reaction products, with the fragment mass distribution showing little memory of the entrance channel. As discussed in our Letter, the mass distribution predicted by the orbiting model is dominated by the <sup>28</sup>Si exit channel, contrary to our observations. We also presented the results of a CASCADE<sup>2</sup> calculation which indicated that the magnitude of observed cross section summed over final channels was consistent with the fission decay of the <sup>56</sup>Ni compound nucleus. This calculation was done with use of newer estimates<sup>3</sup> of the macroscopic energy at the saddle point—a comparable calculation with rotating-liquid-drop-model energies would result in the prediction of a very small fission cross section. We recognize the schematic nature of these calculations and, as indicated in our Letter<sup>1</sup> and as we have discussed more fully in an earlier paper,<sup>4</sup> we do not believe it reasonable to expect detailed agreement with experimental results from the calculations performed. In particular, the fission barriers used in the CASCADE calculation are for the symmetric decay of the compound nucleus and we would expect even greater fission competition if the mass-asymmetric barriers (which are not available) were to be incorporated into the calculations. As mentioned in the Letter small adjustments of parameters in the calculations (e.g., diffuseness of the partial-wave distribution and level-density parameters) can

bring the predicted fission cross section into exact agreement with the measurements, but because of the uncertainties discussed above we did not deem such adjustments warranted.

Our comparison of calculated fission cross sections with the observed fully damped yields in lighter systems using the *same* calculation parameters was intended to show that fission competition should not be ignored in these systems as has generally been the case. Fully damped yields arising from an additional orbiting mechanism in systems lighter than <sup>56</sup>Ni may be present. However, the presence of fusion-fission yields (with estimated cross sections considerably larger than when the experimental results for these systems were originally published) should be taken into account. The absence of fission competition in these lighter systems would imply a problem with the calculated fission barriers for these systems or a failure of the fission-model calculations, and we are not aware of any currently published results which give compelling evidence that such problems exist, such as those problems addressed in the preceding Comment.<sup>5</sup>

This work was supported by the U.S. Department of Energy, Nuclear Physics Division, under Contract No. W-31-109-ENG-38.

S. J. Sanders, D. G. Kovar, B. B. Back, C. Beck, B. K. Dichter, D. Henderson, R. V. F. Janssens, J. G. Keller, S. Kaufman, T.-F. Wang, B. Wilkins, and F. Videbaek  
Argonne National Laboratory  
Argone, Illinois 60439

Received 18 April 1988  
PACS numbers: 25.70.Jj

<sup>1</sup>S. J. Sanders *et al.*, Phys. Rev. Lett. **59**, 2856 (1987).

<sup>2</sup>F. Pühlhofer, Nucl. Phys. **A280**, 267 (1977).

<sup>3</sup>A. J. Sierk, Phys. Rev. C **33**, 2039 (1986).

<sup>4</sup>S. J. Sanders *et al.*, Phys. Rev. C **34**, 1746 (1986).

<sup>5</sup>D. Shapira, preceding Comment [Phys. Rev. Lett. **61**, 2153 (1988)].