Comment on "Asymmetric Fission of ^{56}Ni"

The Letter by Sanders *et al.*[1] suggests that the asymmetric binary yields observed in ^{28}Si+^{12}C can be explained by compound-nucleus fission and that their assignment to the orbiting process is unwarranted. In their Letter the authors dispute the claim made in the original papers[2,3] that the cross sections observed for projectile-like and targetlike fully damped fragments are too large to be accounted for by a fusion-fission mechanism. We wish to point out that subsequent publications are available which present further evidence, of a different nature, regarding the extent of equilibration attained in these processes.[4-6]

In our response to this Letter we address only the point raised in Ref. 1: "The ratio of fission to evaporation-residue cross sections (σ_f/σ_{er}) can be understood in terms of recent-fission barrier calculations." The paper reports the cross-section ratios given in Table I for fission and evaporation.

At the heart of this table is a comparison of cases 1 and 2. In the authors' eyes theory and experiment are in "reasonable agreement" for both item 1 and 2, and hence fusion-fission can account for the observed cross sections in ^{28}Si+^{12}C. However, in my view there is an overall discrepancy of a factor of 5. As noted by the authors, the predicted fission-to-evaporation ratio depends strongly on the choice of the diffuseness parameter for the angular momentum distribution. With their particular choice of diffuseness $\Delta=1.4$ they overpredict their fission data by a factor of 2 and underpredict the Si+C case by a factor of 2.5. A more appropriate choice of the diffuseness parameter such as $\Delta=1.0$ (in line with Ref. 7) would scale down the predicted fission cross section in both systems. This would result in a better description of their data but will underpredict the ^{28}Si+^{12}C by a factor of 5. Item 3 in this table deals with the low-energy data. The ^{12}C yield at backward angles from ^{28}Si+^{12}C is mostly concentrated near the ground and low-lying excited states. Sanders *et al.*[8] have themselves suggested that these may be yields from resonances of the nucleus-nucleus potential and not from compound-nucleus decay. The fourth system in that table is similar in mass to the system that they have studied and it may well be that for these heavier systems, fusion-fission becomes more dominant.

To summarize, in an earlier article[2,3] we claimed a factor-of-10 discrepancy between our data and fusion-fission calculations. Admittedly, our work preceded recent information on fission barriers, but we were quite close, and this article does not disprove it. We, therefore, disagree with the interpretation of the work of Sanders *et al.* as a case for fusion-fission, and against orbiting as documented for ^{28}Si+^{12}C and in other lighter systems.

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TABLE I. Comparison of calculated and measured complex-fragment (carbon) yield in several systems.

	System	Calculations	Data	Discrepancy factor
1	^{32}S+^{24}Mg	106/992	59/1050	1.90
2	^{28}Si+^{12}C ($E_{c.m.}=54$ MeV)	40/765	95/728[a]	0.40
3	^{28}Si+^{12}C ($E_{c.m.}=30$ MeV)	9/970	7/967	1.28
4	^{16}O+^{48}Ti	76/1214	66/1300	1.23

[a]In comparing our data to theory the authors picked only the cross sections in the ^{12}C channel. If we add the other binary channels (O and N) we get 120 mb and a discrepancy factor of 0.32 rather than 0.4.