14-MeV neutrons in bulk beryllium was correctly predicted by the existing beryllium microscopic data sets. The investigation was inspired by a series of measurements, beginning with that of Cloth et al.,[1] which indicated that the neutron multiplication in bulk beryllium was grossly overpredicted by calculations. Our studies were intended as a benchmark test in a well-defined beryllium geometry, and they apply only to neutron multiplication in bulk beryllium. We found excellent agreement between experiment and calculation using both the Young-Stewart and ENDF/B-VI data sets. The higher $(n,2n)$ cross section of the Young-Stewart evaluation is partially compensated by the higher absorption cross section. We found also that some of the early experiments failed because the investigators did not calculate the exact quantity measured. Moreover, since beryllium is a very efficient moderator, any calculations should include a suitable scattering kernel in the beryllium data set.

We feel that our results and conclusions are valid for bulk beryllium, not restricted to spherical geometry. However, they constitute only one stage in the investigation of beryllium properties. Questions of tritium breeding and multiplication in multimaterial assemblies were beyond the scope of our investigation. Further studies will be required to establish the optimization of blanket structure and composition for the purpose of breeding tritium in a fusion reactor.

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REFERENCE

1. P. CLOTH et al., "Neutron Multiplication Effect of CTR Blankets Containing Beryllium," *Proc. 9th Symp. Fusion Technology*, Garmisch-Partenkirchen, Germany, June 14–18, 1978, Pergamon Press (1977).

COMMENTS ON "STABILITY PROPERTIES OF THE URAGAN-2M TORSATRON"

Carreras et al.[1] used the VMEC three-dimensional magnetohydrodynamics code[2] and the three-dimensional Mercier criterion[3,4] to chart the stability boundary of URAGAN-2M against a changing plasma pressure. The destabilizing term in the Mercier criterion involves surface averages of the component of the plasma current parallel to the magnetic field lines, which in fully three-dimensional geometries is the sum of a set of resonant terms associated with rational values of the rotational transform. To calculate properly this parallel current $\boldsymbol{J}\cdot\boldsymbol{B}$, the fields output from VMEC should be transformed into a set of straight field line coordinates. We have shown[5] that a simple finite differencing of the VMEC fields will mask the resonant structure of $\boldsymbol{J}\cdot\boldsymbol{B}$ and may result in artificially high stability limits. In the case of URAGAN-2M, the rotational transform profile is comparatively flat (for a torsatron) with the rational surfaces corresponding to $\frac{1}{7}$, $\frac{1}{6}$, and $\frac{1}{5}$ per period inside the vacuum configuration. The profiles of the total Mercier criterion D_m obtained in Ref. 1 show no sign of the resonance contributions that would be associated with these surfaces.

While it is unclear how much significance one should attach to the resonant terms in the Mercier criterion as an indication of the limits of plasma stability, it should be explicitly stated whether the energy minimization algorithm of VMEC is being used as an ad hoc smoothing algorithm for $\boldsymbol{J}\cdot\boldsymbol{B}$. The issue is an important one when comparing the relative merits of different stellarator designs. For example, the Helias optimization study[6] leading to the Wendelstein 7-X stellarator proposal was done using a full calculation of the three-dimensional Mercier criterion in straight field line coordinates.

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REFERENCES

1. B. A. CARRERAS, N. DOMINGUEZ, V. E. LYNCH, N. T. BESEDIN, I. M. PANKRATOV, and A. A. SHISHKIN, "Stability Properties of the URAGAN-2M Torsatron," *Fusion Technol.*, **23**, 71 (1993).

2. S. P. HIRSCHMAN, W. I. VAN RIJ, and P. MERKEL, "Three-Dimensional Free Boundary Calculations Using a Spectral Green's Function Method," *Comput. Phys. Commun.*, **43**, 143 (1986).

3. C. MERCIER, "Un critere necessaire de stabilite hydromagnetique por un plasma en symetrie de revolution," *Nucl. Fusion*, **1**, 47 (1960).

4. F. BAUER, O. BETANCOURT, and P. GARABEDIAN, *Magnetohydrodynamic Equilibrium and Stability of Stellarators*, Springer-Verlag, New York (1984).

5. H. J. GARDNER and B. D. BLACKWELL, "Calculation of Mercier Stability Limits of Toroidal Heliacs," *Nucl. Fusion*, **32**, 2009 (1992).

6. J. NÜHRENBERG and R. ZILLE, "Quasi-Helically Symmetric Toroidal Stellarators," *Phys. Lett. A*, **129**, 113 (1988).