Cornell *et al.* Reply: Gabrielse has pointed out[1] that if the magnetic-field fluctuations in our laboratory were the same as in his, and if our superconducting solenoid provided, *in situ,* only the shielding which he estimates for it in free space, then we should have observed larger fluctuations in our results.[2] We agree. However, our measurements on our solenoid show that it shields 3 times better than his estimate, and recently measured magnetic-field fluctuations observed in our laboratory are consistent with our observed (and reported) errors for measurements made during the magnetically noisy part of the day.

The shielding of external fields by a superconducting magnet may be quantified by the field penetration factor, $\Delta B_{\mathrm{int}}/\Delta B_{\mathrm{ext}}$. We have measured this ratio by finding the correlation coefficient between internal magnetic variations (seen as shifts of the ion cyclotron resonance frequency) and external magnetic-field variations measured with a flux-gate magnetometer. We measured a field penetration factor of 0.03(2) when the subway was off and ΔB_{ext} dominated by an elevator ~12 m away, and of 0.11(1) when the subway dominated the magnetic noise (though apparatus in our building was on as well) (Fig. 1). (The value 0.15 used in Ref. 2 resulted from a conservative combination of data with the field penetration factor determined from placement of a permanent magnet near our solenoid.) The large dependence of the observed field penetration factor on the *source* of the external field suggests that magnetic materials in the building contribute to the *in situ* field penetration factor (and does not necessarily contradict Gabrielse's estimate of 0.3 for our solenoid in free space).

In light of our small observed field penetration factor, Gabrielse's nighttime field variations would cause no problem in our nighttime run No. 3. The 250-μG step recorded[1] late Tuesday evening would cause a shift of only 3×10^{-10} (in one ion interchange), and would be averaged away in one night's measurements to $\frac{1}{2}$ of our reported error of 4×10^{-10}. In fact, our laboratory is $\sim\sqrt{2}$ farther from the subway than is the Gabrielse laboratory, so our field variation may well be somewhat smaller. Daytime fluctuations are much larger. Recent daytime field measurements in our laboratory indicate that field fluctuations will cause an error of 1 ppb in a mass comparison made during the day, such as our run No. 1 or our run No. 2.

In conclusion, we would like to reemphasize (see Ref. 2) that external field fluctuations are only one of several sources contributing to our internal field variation, and at night do not appear to be even the dominant source of such variations. The dependence of the field penetration factor on the source of external magnetic-field fluctuations makes it difficult to argue conclusively about the overall error in the measurements from the magnetic-field variations as Gabrielse has done. Our procedure of arguing from the observed temporal variations in the individual cyclotron frequencies[2] (each of which is measured to $\frac{1}{2}$ the fractional error of the final result) seems far preferable.

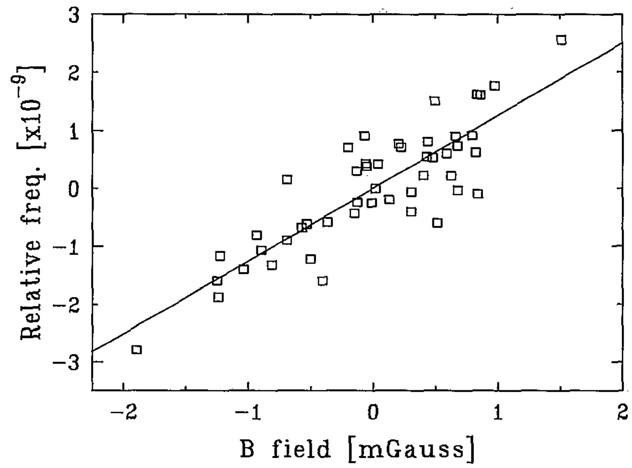

FIG. 1. Scatter plot of simultaneous cyclotron frequency and external magnetic-field measurements. Before plotting, a quadratic time dependence was removed from the frequency data and from the field data as well. The remaining field dependence, 1.2(1) ppb/mG, indicates the field at trap center is 0.11(1) the field at the magnetometer probe. Data were taken during the day, with both subway and elevator running.

In comparing our result to previous measurements, we combined errors from the standard nuclear mass table.[3] These errors are correlated, and a sharper comparison can be made with the value $M({}^{14}N_2{}^+)-M({}^{12}C\,{}^{16}O^+)=11\,233\,374(24)$ ν which is a fit of parameter in the global fit the mass measurements used to construct the mass table.[4] Our result, 11 233 393(11) ν is inside these error bars and has slightly less than $\frac{1}{2}$ the error.

We would like to thank Deborah Kuchnir for technical assistance. This work was supported by the NSF (through Grant No. PHY86-05893 and a Graduate Fellowship to E.A.C.), and by the Joint Services Electronics Program Grant No. DAAL03-89-C-0001. G.P.L. thanks the donors of the Petroleum Research Fund. We are grateful to G. Gabrielse for helpful discussions.

Eric A. Cornell, Robert M. Weisskoff, Kevin R. Boyce, Robert W. Flanagan, Jr., Gregory P. Lafyatis, and David E. Pritchard

Research Laboratory of Electronics, Department of Physics
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Received 29 January 1990
PACS numbers: 35.10.Bg, 07.75.+h

[1]G. Gabrielse, preceding Comment, Phys. Rev. Lett. **64**, 2098 (1990).

[2]E. A. Cornell, R. M. Weisskoff, K. R. Boyce, R. W. Flanagan, Jr., G. P. Lafyatis, and D. E. Pritchard, Phys. Rev. Lett. **63**, 1674 (1989).

[3]A. H. Wapstra and G. Audi, Nucl. Phys. **A432**, 1 (1985).

[4]A. H. Wapstra, G. Audi, and R. Hoekstron, Nucl. Phys. **A432**, 185 (1985).