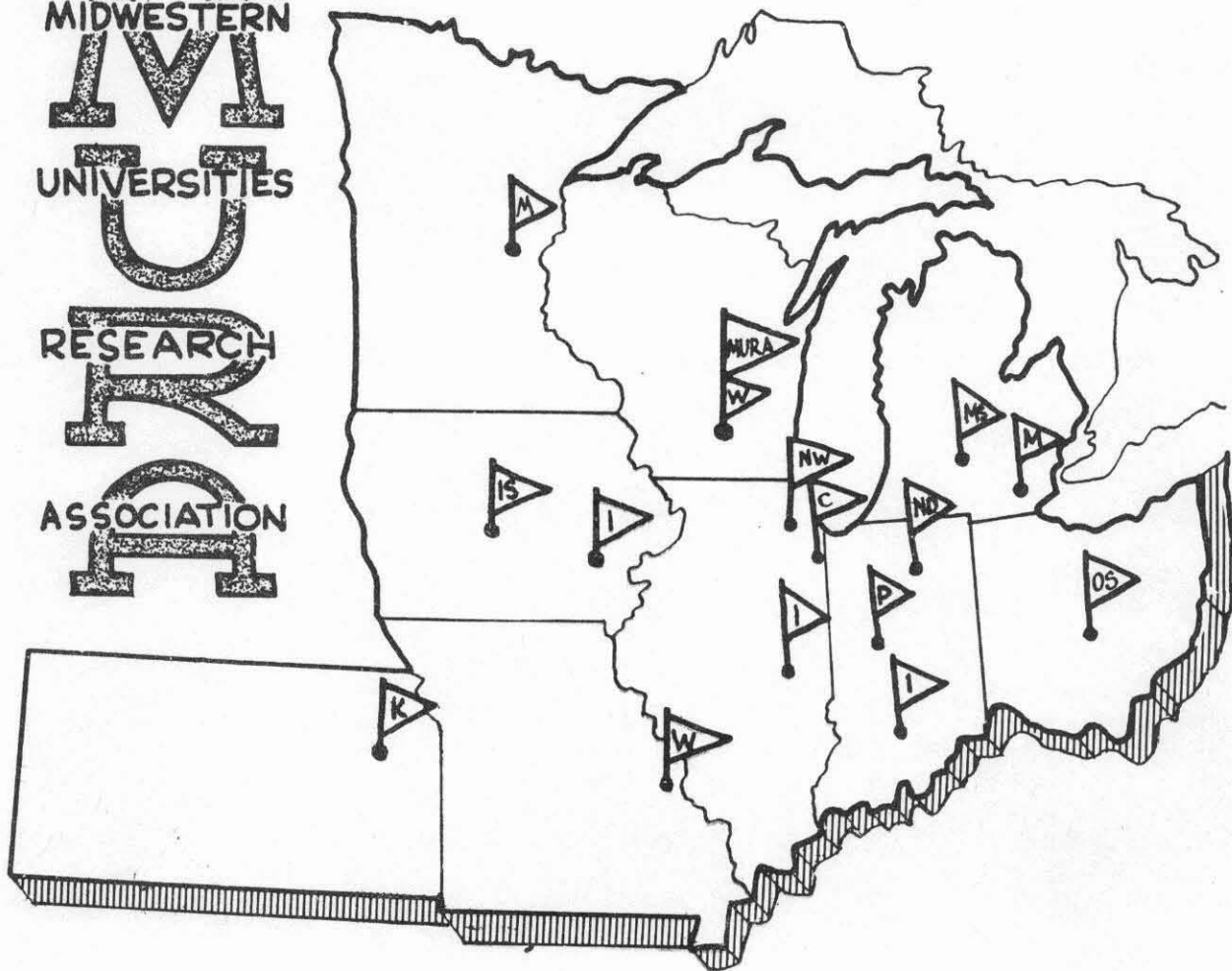




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RETABULATION OF SPACE-CHARGE EFFECTS IN THE AGS

REPORT

NUMBER 33

## RETABULATION OF SPACE-CHARGE EFFECTS IN THE AGS

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(MURA Notes)

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An estimate is made of the charge which can be injected into an A.G. synchrotron before space-charge forces become sufficient to move the operating point from the center of a small diamond, bounded by integral and half-integral resonances, half way towards the edge. Numerical examples, for proton A. G. synchrotron, are given.

A simple discussion of space-charge effects in the alternate-gradient synchrotron was given in LJL(MAC)-2 (January, 1954), MURA #14. It now appears that attention may be focused on single-turn injection, but that the value  $\Delta = 4.0$  cm assumed for that case in the example of LJL(MAC)-2 may be excessive.

It appears desirable, therefore, to present a revised table based on single-turn injection and with  $\Delta$  taken as 1.5 cm (radius). We take, in this example,  $n = 345$  (cf. EDC-12, p. 6, in which the value 348 for  $n$  is discussed). The table is constructed by use of eq. (5) of LJL(MAC)-2 and, because of the more conservative assumptions, contains results approximately 1/10 as large as those cited previously.

$$R_0 = 8600 \text{ cm}$$

$$\Delta = 1.5 \text{ cm radius}$$

$$\begin{aligned} \delta n &= \pm 0.07 n^{1/2} \\ &= \pm 0.07 (345)^{1/2} \\ &= \pm 1.3 \end{aligned}$$

| Kinetic Energy at Injection (Mev) | Total Charge (Coulombs) | Inj. Current, 1 rev. (ma) | Particles for 50percent capture |
|-----------------------------------|-------------------------|---------------------------|---------------------------------|
| 4                                 | $9.6 \times 10^{-9}$    | 0.49                      | $3.0 \times 10^{10}$            |
| 5                                 | 12.0                    | 0.68                      | 3.7                             |
| 6                                 | 14.4                    | 0.90                      | 4.5                             |
| 10                                | 24.2                    | 1.95                      | 7.5                             |
| 15                                | 36.5                    | 3.6                       | 11.4                            |
| 20                                | 49.1                    | 5.5                       | 15.3                            |
| 30                                | 74.7                    | 10.2                      | 23.4                            |
| 40                                | 101                     | 15.8                      | 31.6                            |
| 50                                | 128                     | 22.2                      | 40                              |