The Houghton College Cyclotron
A Study of Weak Magnetic Focusing

Sylvia Morrow, Mark Yuly
Houghton College
Force on Ion:
\[ \frac{mv^2}{r} = qvB \]

Resonance:
\[ f = \frac{qB}{2\pi m} \]

Kinetic Energy:
\[ T = \frac{q^2B^2r^2}{2m} \]
Set to the He+/3 resonance.

\[ T \alpha r^2 \]

Maximum radius: 78mm

\[ T \alpha \left( \frac{3r}{4} \right)^2 \approx 0.56r^2 \]
Linearly decrease $B_z$ by 2% from the middle to the outer edge.

Field index: $n = -\frac{r}{B_z} \frac{dB_z}{dr}$

Resonant frequency: $f = \frac{qB_z}{2\pi m}$
Poisson Superfish
Simion
$B_z$ vs. r

- B changes by 2% at:
  - Old: 5.8 cm
  - New: 7.3 cm

- $n=0.2$ occurs at:
  - Old: 6.3 cm
  - New: 8.3 cm

- T at max ion radius:
  - Old: $T=0.47$ MeV
  - New: $T=0.92$ MeV
Ion angle: \( \alpha = 0^\circ \)
Easiest solution: increased Dee voltage.

Future steps:
• Optimize parameters
• Strong focusing/sector pole tips
Questions?