BNL-104880-2014-TECH

AGS/AD/Tech Note No. 464;BNL-104880-2014-IR

# CALCULATED FORMULAS FOR CONTROLLING THE AGS TUNE

E. J. Bleser

July 1997

Collider Accelerator Department

**Brookhaven National Laboratory**

**U.S. Department of Energy**

USDOE Office of Science (SC)

# DISCLAIMER

P. Hughes-Orig. For
Tech. Note File

*For Internal Distribution Only*

Accelerator Division
Alternating Gradient Synchrotron Department
BROOKHAVEN NATIONAL LABORATORY
Upton, New York 11973

Accelerator Division
Technical Note

**AGS/AD/Tech. Note No. 464**

# CALCULATED FORMULAS FOR CONTROLLING THE AGS TUNE

E. Blesser
and
M. Mussorrafiti

July 22, 1997

# CALCULATED FORMULAS FOR CONTROLLING THE AGS TUNE

AGS Accelerator Division Technical Note 455 documented the field measurements for a typical AGS high field tune quadrupole. This note documents calculations of the formulas to be used with these magnets. Figures 1 thru 6 show plots of the MAD calculated tunes versus the quadrupole currents at injection, transition, and extraction. To the accuracy used in the AGS these lines are all straight. The momentum dependence of the measured slopes is very linear. The results can be summarized in the equations:

$$P * \Delta Q_x = m_{11} * I_h + m_{12} * I_v$$
$$P * \Delta Q_y = m_{21} * I_h + m_{22} * I_v$$

where:

P = the momentum in GeV/c
$\Delta Q_x$ = the change in the horizontal tune
$\Delta Q_y$ = the change in the vertical tune
$I_h$ = the current in the horizontal quadrupoles in Amperes
$I_v$ = the current in the vertical quadrupoles in Amperes

The table gives the results:

| | VALUE | STD |
|---|---|---|
| $m_{11}$ | **.01071** | **$3.81*10^{-5}$** |
| $m_{12}$ | **-.00521** | **$2.84*10^{-5}$** |
| $m_{21}$ | **-.00517** | **$3.1*10^{-5}$** |
| $m_{22}$ | **.01072** | **$2.46*10^{-5}$** |

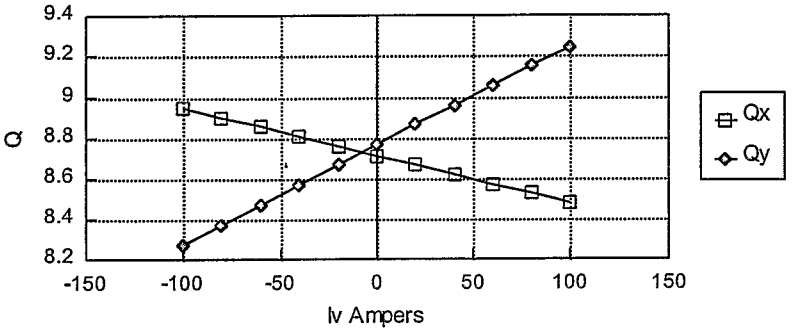
These results are in good agreement with the empirical numbers used in the AGS tune control program.

It is convenient to record the inverse of these equations:

$$I_h = 121.9908 * P * \Delta Q_x + 58.83324 * P * \Delta Q_y$$
$$I_v = 59.28843 * P * \Delta Q_x + 121.877 * P * \Delta Q_y$$

## Q vs. Iv

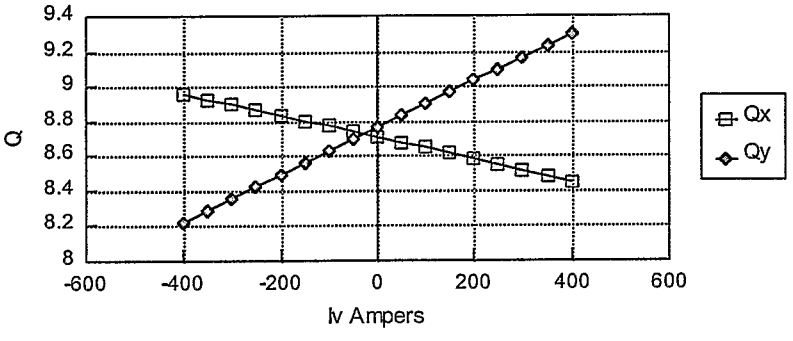
Figure 4




with ih remaining constant
P = 2.224

## Q vs. Iv

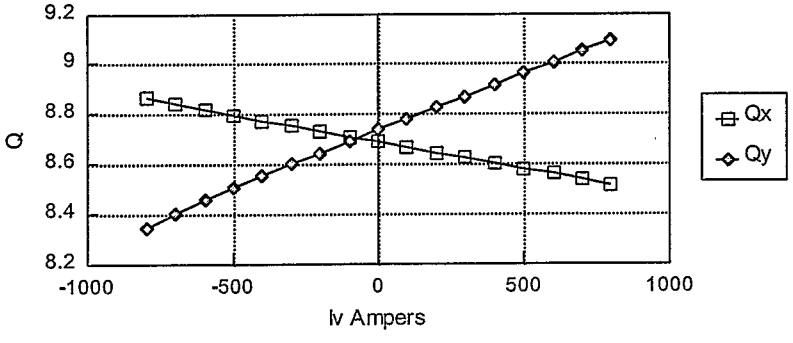
Figure 5




with Ih remaining constant
P = 8.0

## Q vs. Iv

Figure 6




with Ih remaining constant
P = 24.0