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Power Supply Accuracy in RHIC

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DISCLAIMER

RHIC-AP-24

POWER SUPPLY ACCURACY IN RHIC

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December 18, 1985

Power Supply Accuracy in RHIC

G. Parzen, 12/18/85

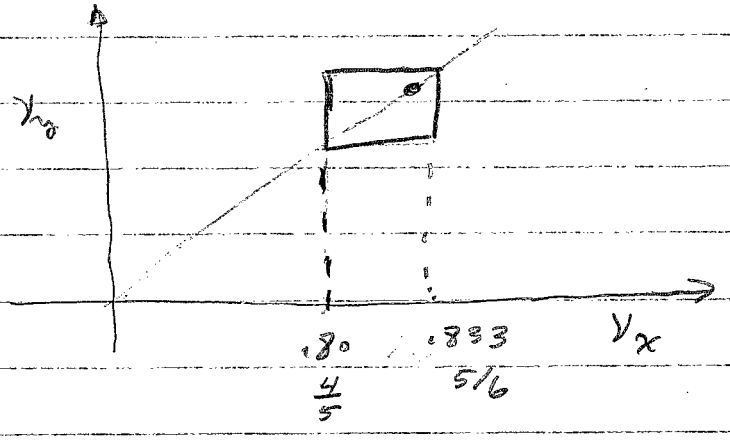
Criterion

ISR, CBA – no $\Delta\nu(t)$

$\Delta\nu \leq 1\times10^{-3}$

RHIC – $\Delta\nu(t)$ present due to Synchrotron oscillations

No crossing of 10^{th} order allowed (SPS).



Box is 33×10^{-3} wide

$A_{SL} = 19$ mm $\rightarrow$ $\nu = 28.827,\ 28.822$

6×10^{-3} from 6^{th} order resonance

Beam-Beam interaction gives $\Delta\nu \simeq 20\times10^{-3}$

$\nu(A) \leq 19\times10^{-3}$

$\nu(A)$ depends on $\delta p/p$ $\rightarrow$ additional $\Delta\nu = 6\times10^{-3}$

Box is fairly full

Criterion $\Delta\nu \leq 1\times10^{-3}$ seems reasonable.

Major Sources of $\Delta\nu$ errors

QF, QD	tuning
Q1 Q2 Q3	bypass
Q2 Q3	tuning
B2H, B2V	chromaticity Control
Q7, Q6	tuning

Accuracy Definition

B - swing of 15 $\quad \gamma = 7 \longrightarrow \gamma = 100$

$$\text{Current accuracy} = \frac{\Delta I}{I}$$

$$\text{Power Supply Accuracy} = \frac{\Delta I}{I_{max}}$$

Current Accuracy = 15 x Power Supply Accuracy

Quads in Series with Dipoles, QF Bypass, QD Bypass

Coil	Location	$b_{k,max}$ %	amps	cm^{-1}	ΔV_x	ΔV_y	Power Supply Accuracy	Current Accuracy
					10^{-3}		10^{-5}	10^{-5}
B1H	QF	10	450	.013	.59	.10	1, 2	18
B1V	QD	10	450	.013	.10	.59	1, 2	18
Q123	Q1Q2Q3	60	1750	.100	.57	.57	1.0	15
Q7I		10	400	.020	.05	.26	10	150
Q6I		10	400	.020	.17	.11	10	150
Q3I		7	200	.012	.20	.07	5	75
Q2I		7	200	.012	.15	.35	5	75
Q1F		7	200	.012	.22	.23	5	75
Q1O		7	200	.012	.23	.22	5	75
Q2O		7	200	.012	.35	.15	5	75
Q3O		7	200	.012	.07	.20	5	75
Q6O		10	400	.020	.11	.17	10	150
Q7O		10	400	.020	.26	.05	10	150
Q8I		5	200		.02	.003	10	
Q5I		5	200		.007	.06	10	
Q4I		5	200		.06	.007	10	
QXI		5	200		.02	.05	10	
QXO								
Q4O								
Q5O								
Q8O				ΔV_{Total}	1.06	1.06		

QF, QD – Seperate power supply, QF QD Bypass

B1Q	QF, QD	100	4500		.50	.50	.12	1.8
BYQFQD		10	450		.2	.2	.4	6

B1Q, $PSAC \simeq \frac{1}{10}$ (PSAC (B1H))

BYQFQD $PSAC \simeq PSAC(B1H) \times \frac{1}{3}$

Ripple Question

Quad Ripple $\rightarrow \Delta\nu_Q$

Dipole Ripple $\rightarrow \Delta\nu_D$

$\Delta\nu_Q + \Delta\nu_D = 0$ if Chromaticity $= 0$ and ripples are equal.

If ripples uncorrelated, and natural chromaticity ~ 60

$$\Delta\nu = 2 * 60 * \text{Ripple} \leq .2 \times 10^{-3}$$

$$\text{Ripple} \leq 2 \times 10^{-6}$$