IOTA antidamper

Fundamental constants

$m_p := 938.256 \cdot 10^6 \text{eV}$ $\quad M_p := 1.67252 \cdot 10^{-24}$ $\quad m_e := 0.511006 \cdot 10^6 \text{ eV}$ $\quad M_e := 9.109 \cdot 10^{-28}$

$c := 2.997925 \cdot 10^{10} \text{cm/c}$ $\quad Z_0 := 377 \ \Omega$ $\quad e_{SI} := 1.6021 \cdot 10^{-19}$ $\quad e_{SGS} := 4.80298 \cdot 10^{-10}$ $\quad e_{conv} := 299.7925$

$\kappa_B := 1.38054 \cdot 10^{-16}$

$$r_p := \frac{e_{SGS} \cdot e_{conv}}{m_p} \qquad r_e := \frac{e_{SGS} \cdot e_{conv}}{m_e} \qquad r_p \cdot 10^{16} = 1.535$$

$f_{RF} := 30.03465 \cdot 10^6$ Hz

Delay in electronics: $\Delta T := (2 \cdot 15 + 30) \cdot 10^{-9}$

Length of kicker cable: $L_{kick} := 230 \cdot 2.54 \cdot 12$ cm $\quad L_{kick} \cdot 0.01 = 70.104$ m

$\beta_{kick} := 0.66$ $\quad \beta_{pickup} := 0.84$ $\quad T_{kick} := \frac{L_{kick}}{\beta_{kick} \cdot c}$ $\quad T_{kick} = 3.543 \times 10^{-7}$

M := ...\BPM_twiss.dat

$j := 4 .. \text{rows}(M) - 2$

$$L_{PU} := \begin{pmatrix} 2 & \text{"IBA1"} & \text{"A-"} & \text{"Right"} & 178 \\ 3 & \text{"IBA2R"} & \text{"A-"} & \text{"Right"} & 170.92 \\ 4 & \text{"IBA3R"} & \text{"A-"} & \text{"Right"} & 163.71 \\ 5 & \text{"IBB1R"} & \text{"B-"} & \text{"Right"} & 157.23 \\ 6 & \text{"IBB2R"} & \text{"B-"} & \text{"Right"} & 149.47 \\ 7 & \text{"IBC1R"} & \text{"C-"} & \text{"Right"} & 150.48 \\ 8 & \text{"IBC2R"} & \text{"C-"} & \text{"Right"} & 157.2 \\ 9 & \text{"IBD1R"} & \text{"D-"} & \text{"Right"} & 162.04 \\ 10 & \text{"IBD2R"} & \text{"D-"} & \text{"Right"} & 176.7 \\ 11 & \text{"IBE1R"} & \text{"E-"} & \text{"Right"} & 181.94 \\ 12 & \text{"IBE2R"} & \text{"E-"} & \text{"Right"} & 186.33 \\ 13 & \text{"IBE2L"} & \text{"E-"} & \text{"Left"} & 195.89 \\ 14 & \text{"IBE1L"} & \text{"E-"} & \text{"Left"} & 196.35 \\ 15 & \text{"IBD2L"} & \text{"D-"} & \text{"Left"} & 204.69 \\ 16 & \text{"IBD1L"} & \text{"D-"} & \text{"Left"} & 211.3 \\ 17 & \text{"IBC2L"} & \text{"C-"} & \text{"Left"} & 224.04 \\ 18 & \text{"IBC1L"} & \text{"C-"} & \text{"Left"} & 225.38 \\ 19 & \text{"IBB2L"} & \text{"B-"} & \text{"Left"} & 201.25 \\ 20 & \text{"IBB1L"} & \text{"B-"} & \text{"Left"} & 200.97 \\ 21 & \text{"IBA3L"} & \text{"A-"} & \text{"Left"} & 180.02 \\ 22 & \text{"IBA2L"} & \text{"A-"} & \text{"Left"} & 180.35 \end{pmatrix}$$

$i := 0 .. \text{rows}(L_{PU}) - 1$ $\quad T_{pickup_i} := \frac{2.54 \cdot 12 \cdot L_{PU_{i,4}}}{\beta_{pickup} \cdot c}$

Phase advance from kicker to BPM (first BPM, IBA1, is ignored): $\Delta\nu x_i := M_{i+3,11} - M_{3,11}$

$$n_{d_i} := \frac{f_{RF}}{4} \cdot \left(T_{kick} + T_{pickup_i} + \Delta T\right)$$

$\text{rows}(L_{PU}) = 21$

$\text{rows}(M) - 4 = 21$

$n_d =$

	0
0	4.729
1	4.664
2	4.599
3	4.54
4	4.469
5	4.478
6	4.54
7	4.584
8	4.717
9	4.764
10	4.804
11	4.891
12	4.895
13	4.971
14	5.031
15	5.147
16	5.159
17	4.94
18	4.937
19	4.747
20	4.75

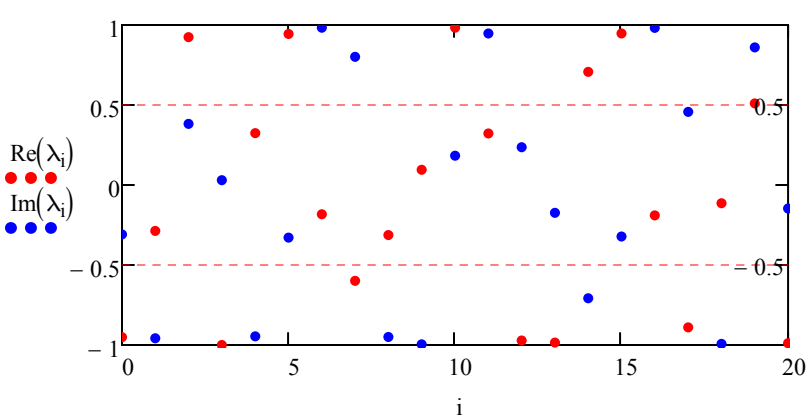
$\Delta\nu x_i =$

	0
0	0
1	0.154
2	0.512
3	0.945
4	1.253
5	1.397
6	1.729
7	1.802
8	2.149
9	2.215
10	2.479
11	2.648
12	2.912
13	2.978
14	3.325
15	3.398
16	3.73
17	3.875
18	4.182
19	4.615
20	4.973

Effective damping rate

$\nu_x := M_{24,11}$ $\quad \nu_x = 5.3$

$$\lambda_i := -i \cdot \frac{\exp\left[-2i \cdot \pi \left(\nu_x - \Delta\nu x_i\right)\right] \cdot \left(1 - \exp\left(-2i \cdot \pi \nu_x\right)\right) \cdot \exp\left(-2i \cdot \pi \cdot \text{floor}\left(n_{d_i} + 1\right)\right)}{\left|1 - \exp\left(-2i \cdot \pi \nu_x\right)\right|}$$



$R_{i,0} := L_{PU_{i,1}}$

$R_{i,1} := \left|Re\left(\lambda_i\right)\right|$

$R_{i,2} := n_{d_i} - floor\left(n_{d_i}\right)$ $\quad R_{i,4} := floor\left(n_{d_i} + 1\right)$

$R_{2,3} := \text{"OK"}$ $\quad R_{12,3} := \text{"OK"}$ $\quad R_{20,3} := \text{"OK"}$

$R_{5,3} := \text{"OK"}$ $\quad R_{13,3} := \text{"OK"}$

$R_{10,3} := \text{"OK"}$ $\quad R_{15,3} := \text{"OK-"}$

R =

	0	1	2	3	4
0	"IBA1"	0.951	0.729	0	5
1	"IBA2R"	0.287	0.664	0	5
2	"IBA3R"	0.924	0.599	"OK"	5
3	"IBB1R"	1	0.54	0	5
4	"IBB2R"	0.324	0.469	0	5
5	"IBC1R"	0.944	0.478	"OK"	5
6	"IBC2R"	0.183	0.54	0	5
7	"IBD1R"	0.599	0.584	0	5
8	"IBD2R"	0.313	0.717	0	5
9	"IBE1R"	0.095	0.764	0	5
10	"IBE2R"	0.983	0.804	"OK"	5
11	"IBE2L"	0.322	0.891	0	5
12	"IBE1L"	0.972	0.895	"OK"	5
13	"IBD2L"	0.985	0.971	"OK"	5
14	"IBD1L"	0.707	0.031	0	6
15	"IBC2L"	0.947	0.147	"OK-"	6
16	"IBC1L"	0.19	0.159	0	6
17	"IBB2L"	0.89	0.94	0	5
18	"IBB1L"	0.114	0.937	0	5
19	"IBA3L"	0.51	0.747	0	5
20	"IBA2L"	0.989	0.75	"OK"	5
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