

QDOFF IPBPM calibration

T. Bromwich

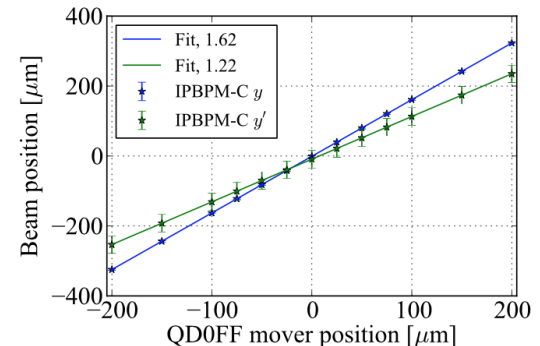
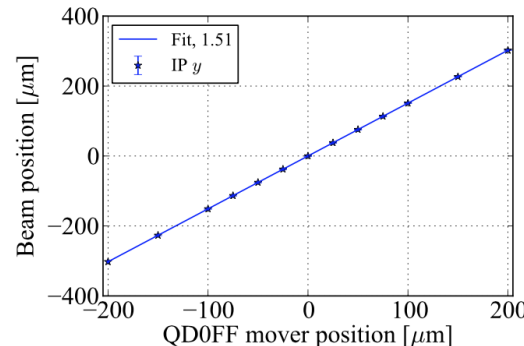
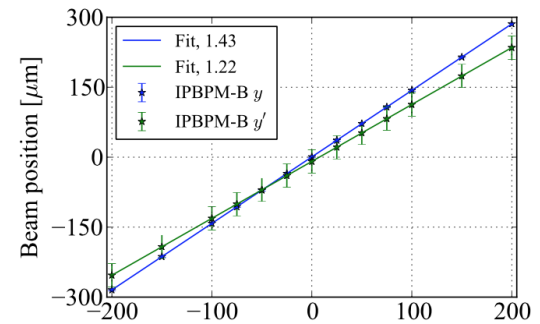
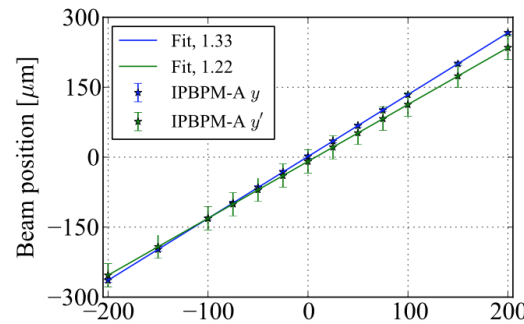
Previous QD0FF simulations

Attempt to reproduce
Young-Im Kim's QD0FF
simulations from 2013:

https://agenda.linearcollider.org/event/6267/attachments/24225/37512/20131129_YoungImKim.pdf

These were performed for
a nominal waist (i.e. waist
at IP, shown right), and
then with the waist at IPA,
IPB and IPC, which all
correspond to different
QD0FF currents.

Nominal waist



Method:

- Use the **ATF2 MAD8 model** to load optics with the waist on the IP.
- Run the simulation to calculate the **6x6 transfer matrices** between:
QD0FF to IPA QD0FF to IPB QD0FF to IP
- Transfer matrix elements M_{33} and M_{34} can be used to propagate transverse position between the two locations. I.e. $y_2 = M_{33} * y_1 + M_{34} * y'_1$
- Simulate an AQD0FF offset by inputting y QD0FF offset values for the beam trajectory with zero angle i.e. $y' = 0$, and then subtract that offset value from the propagated position.

(1)	Without displaced QD0FF:	$y_{IP} = M_{33} * y_{QD0FF}$
(2)	With displaced QD0FF:	$y_{IP} = M_{33} * y_{QD0FF} - y_{QD0FF}$

- Use the M_{33} matrix elements to calculate positions at the IP, based on a range of QD0FF offsets, plot and then fit to obtain conversion factors required for calibrating.

Transfer matrices

```

1912 L229 1 226.396 begin RMATRIX range
1927 IPBPMA 1 227.708 end RMATRIX range
  2.607651 1.649718 0.000000 0.000000 0.000000 0.000000
  1.514123 1.341390 0.000000 0.000000 0.000000 0.000000
  0.000000 0.000000 -0.326859 1.005389 0.000000 0.000000
  0.000000 0.000000 -1.220106 0.693516 0.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 1.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 0.000000 1.000000

```

```

1912 L229 1 226.396 begin RMATRIX range
1929 IPBPMB 1 227.789 end RMATRIX range
  2.730295 1.758371 0.000000 0.000000 0.000000 0.000000
  1.514123 1.341390 0.000000 0.000000 0.000000 0.000000
  0.000000 0.000000 -0.425687 1.061564 0.000000 0.000000
  0.000000 0.000000 -1.220106 0.693516 0.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 1.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 0.000000 1.000000

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```

1912 L229 1 226.396 begin RMATRIX range
1933 IP 1 227.859 end RMATRIX range
  2.836587 1.852536 0.000000 0.000000 0.000000 0.000000
  1.514123 1.341390 0.000000 0.000000 0.000000 0.000000
  0.000000 0.000000 -0.511339 1.110249 0.000000 0.000000
  0.000000 0.000000 -1.220106 0.693516 0.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 1.000000 0.000000
  0.000000 0.000000 0.000000 0.000000 0.000000 1.000000

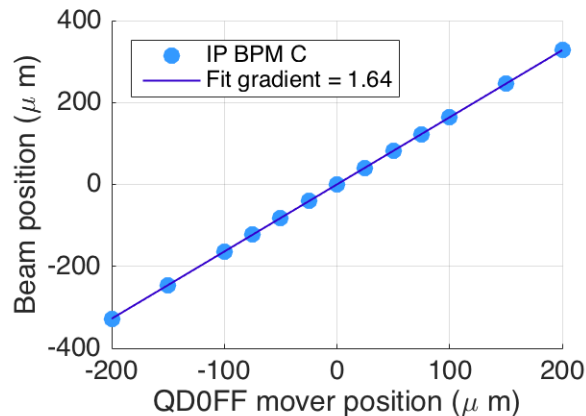
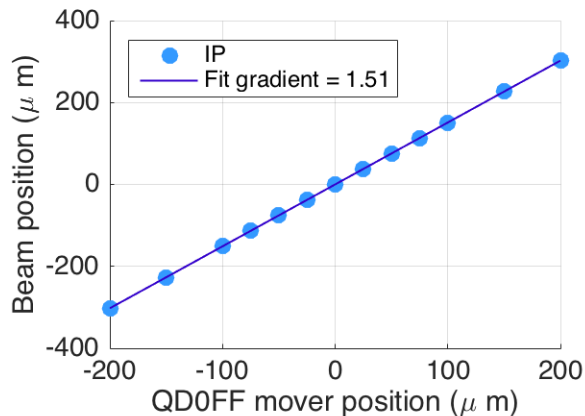
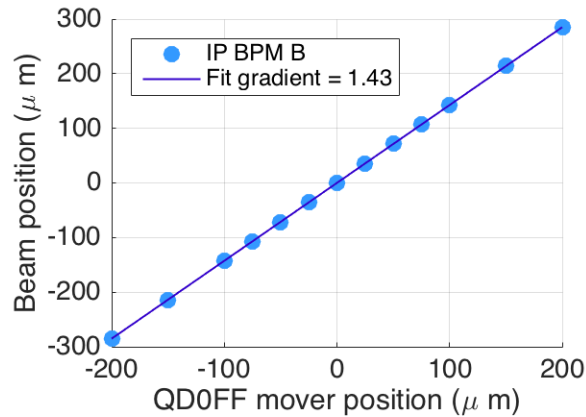
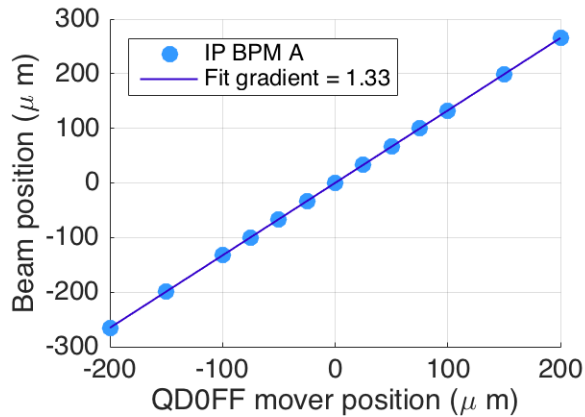
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Note: Colin pointed out that the matrix elements need to be from the input side of QDOFF, so I am using the drift space element L229, which is immediately before QDOFF in the MAD8 simulation.

The model does not include IPC, so extrapolate from the positions calculated at IPA and IPB given known separation of BPMs.

Longitudinal distance (mm)	
IPA to IPB	80.8 ± 0.1
IPB to IPC	174.2 ± 0.5

New simulations nominal optics



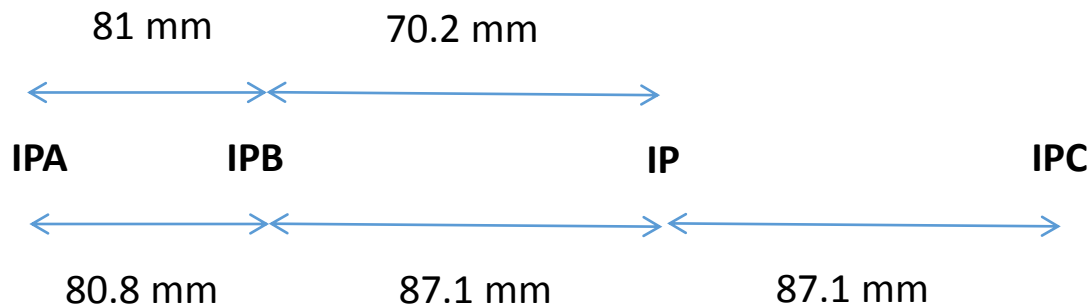
	Young-Im	New
IPA	1.33	1.33
IPB	1.43	1.43
IP	1.51	1.51
IPC	1.62	1.64

Discrepancies for IPC.

BPM separations

IPC differences due to different BPM separations defined in the MAD8 model?

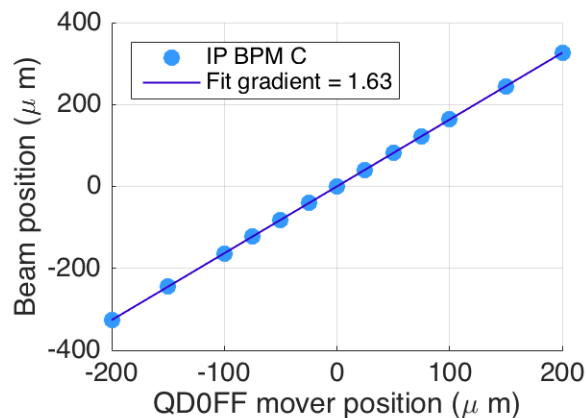
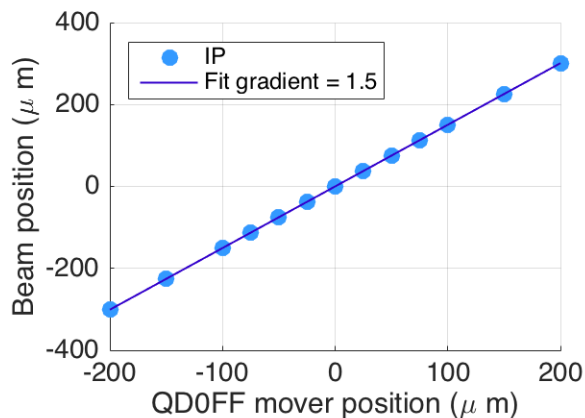
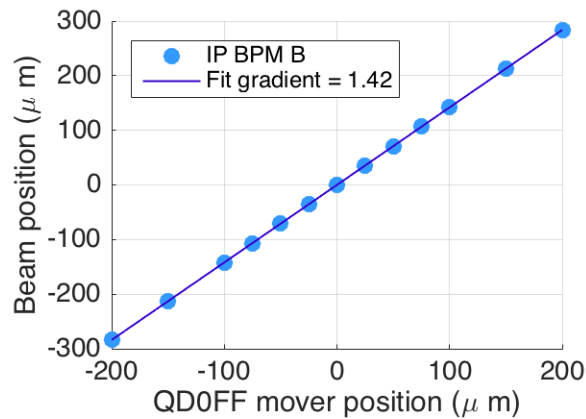
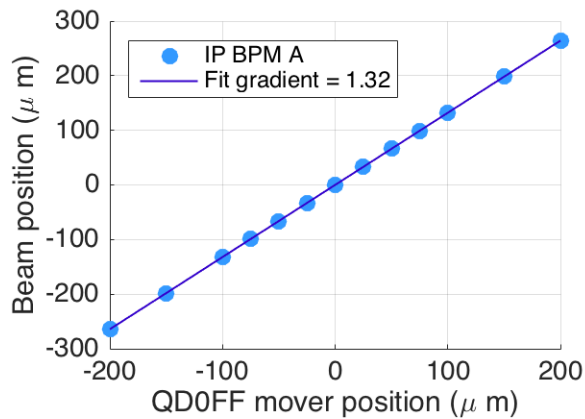
MAD8 ATF2 model BPM and nominal IP separations



Current ATF2 BPM and nominal IP distances (from Neven's thesis)

	Longitudinal distance (mm)
IPA to IPB	80.8 ± 0.1
IPB to IPC	174.2 ± 0.5

Repeat for high-beta optics



Optics set-file:
set17jun22_1749.dat

	Nominal	High beta
IPA	1.33	1.32
IPB	1.43	1.42
IP	1.51	1.50
IPC	1.64	1.63