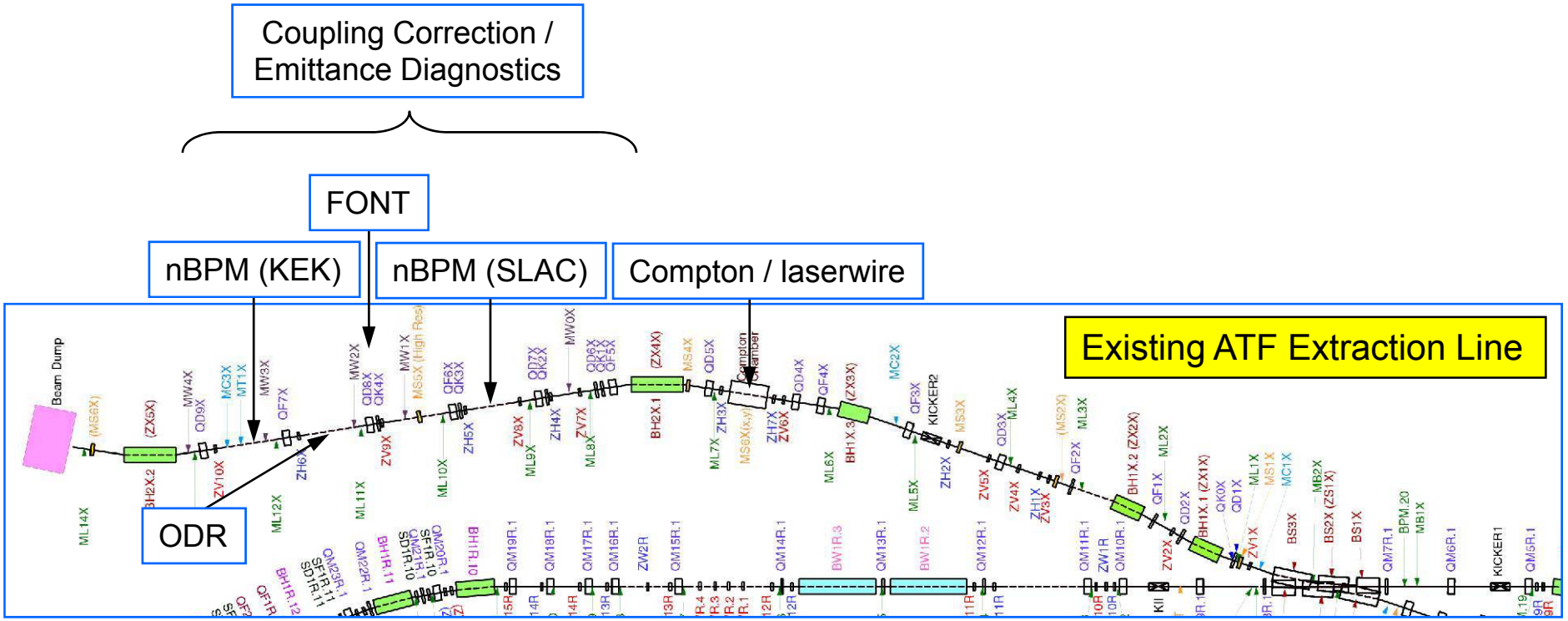
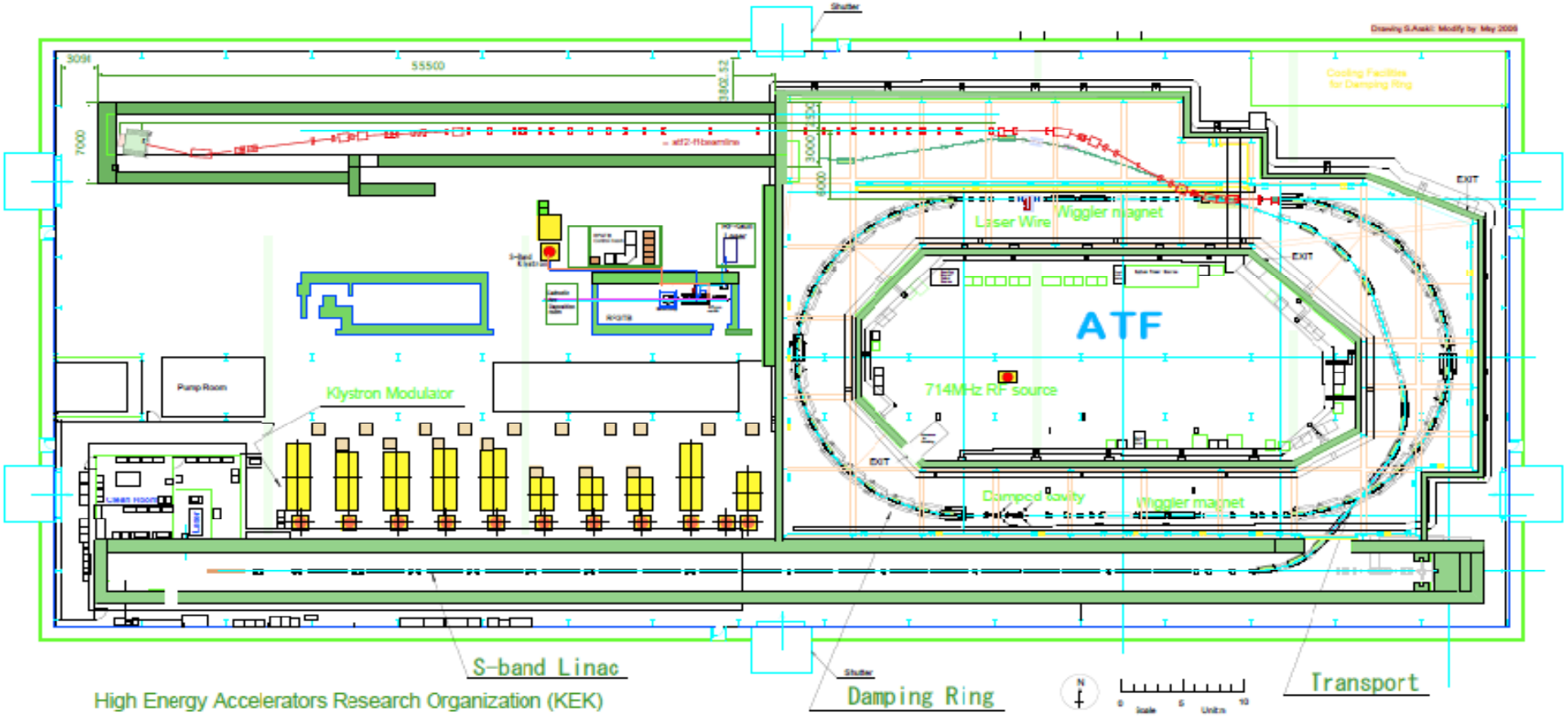
ATF2 Layout/Optics (v3.8)



ATF2 LAYOUT (v3.8)



Version 3.8 Changes

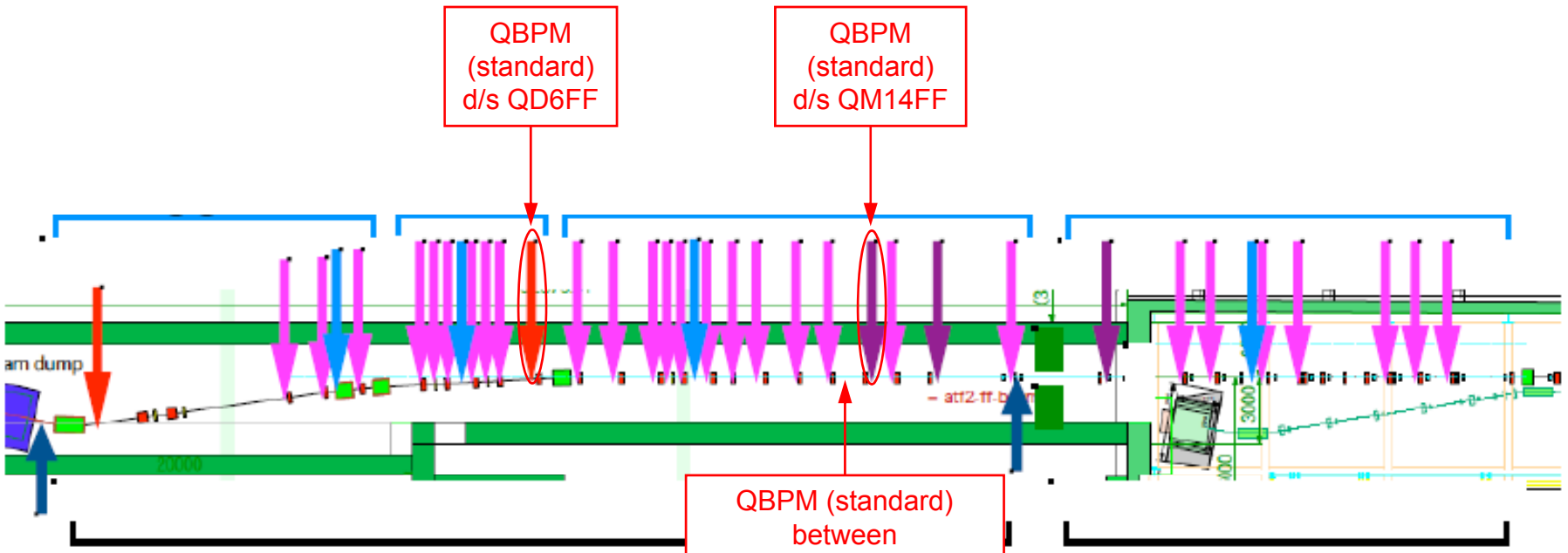
- rematched geometry (DR septa realignment)
  - see report of 55th ATF2 Weekly Meeting (August 22, 2007)
- IPBPM and nBPM reference cavities added; QBPM reference cavities (4) at Honda-san's suggested locations
- separate QBPM + mover at vertical "IP phase" for feedback (between QM14FF and QM13FF) … now 34 QBPMs total
- updated diagnostic station locations (IPBPM, nBPM; no ODR to start)
- Okugi-san's stripline BPM assignments
- some EXT devices returned to v3.5 locations (Sugahara-san's list)
- drift between BDMP and dump increased from 1.0 m to 2.0 m
- three movers removed from FF matching quad section (QM16FF, QM15FF, and QM14FF; now 25 movers total)
- new initial Twiss and QM6R.1/QM7R.1 strengths from "07dec03" optics
  - QM6R.1: -0.71212 (DRLBW44) → -0.71174
  - QM7R.1: 0.39808 (DRLBW44) → 0.40822

from Honda-san's report of 53rd ATF2 Weekly Meeting (July 25, 2007)

Q-BPM/Ref.cav. layout

- prefer to spread reference cavities with equally distance (temp. variation on cable, etc.)
- specified which QBPM belongs which ref.cav.
- removed the one at d/s of BDMP, may be strip-line is good eough.

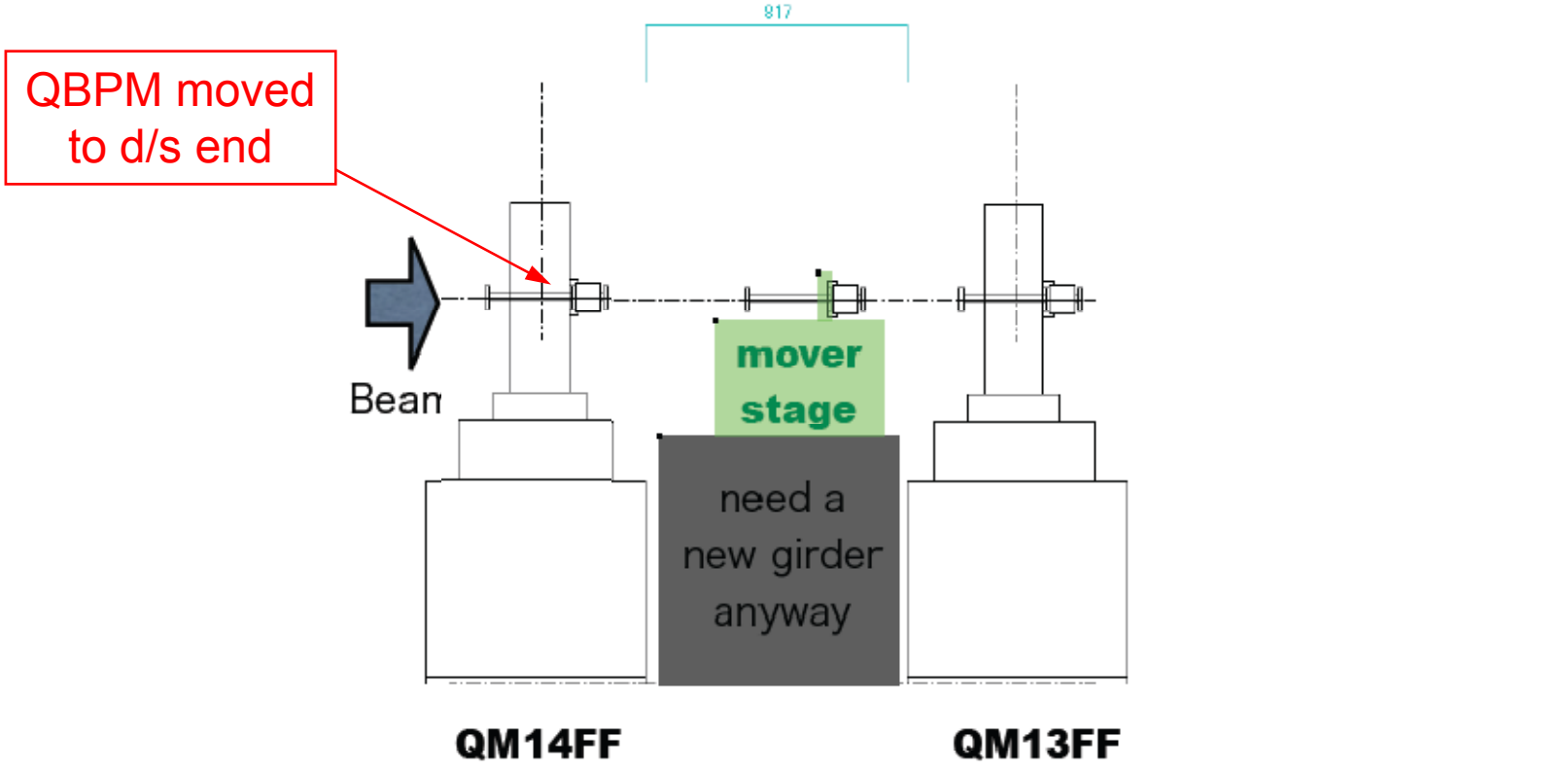
QBPM (standard)
QBPM (non-standard)
QBPM (short pipe ver.)
reference cavity
ICT



from Honda-san's report of 55thd ATF2 Weekly Meeting (August 22, 2007)

Situation at QM14FF-QM13FF area

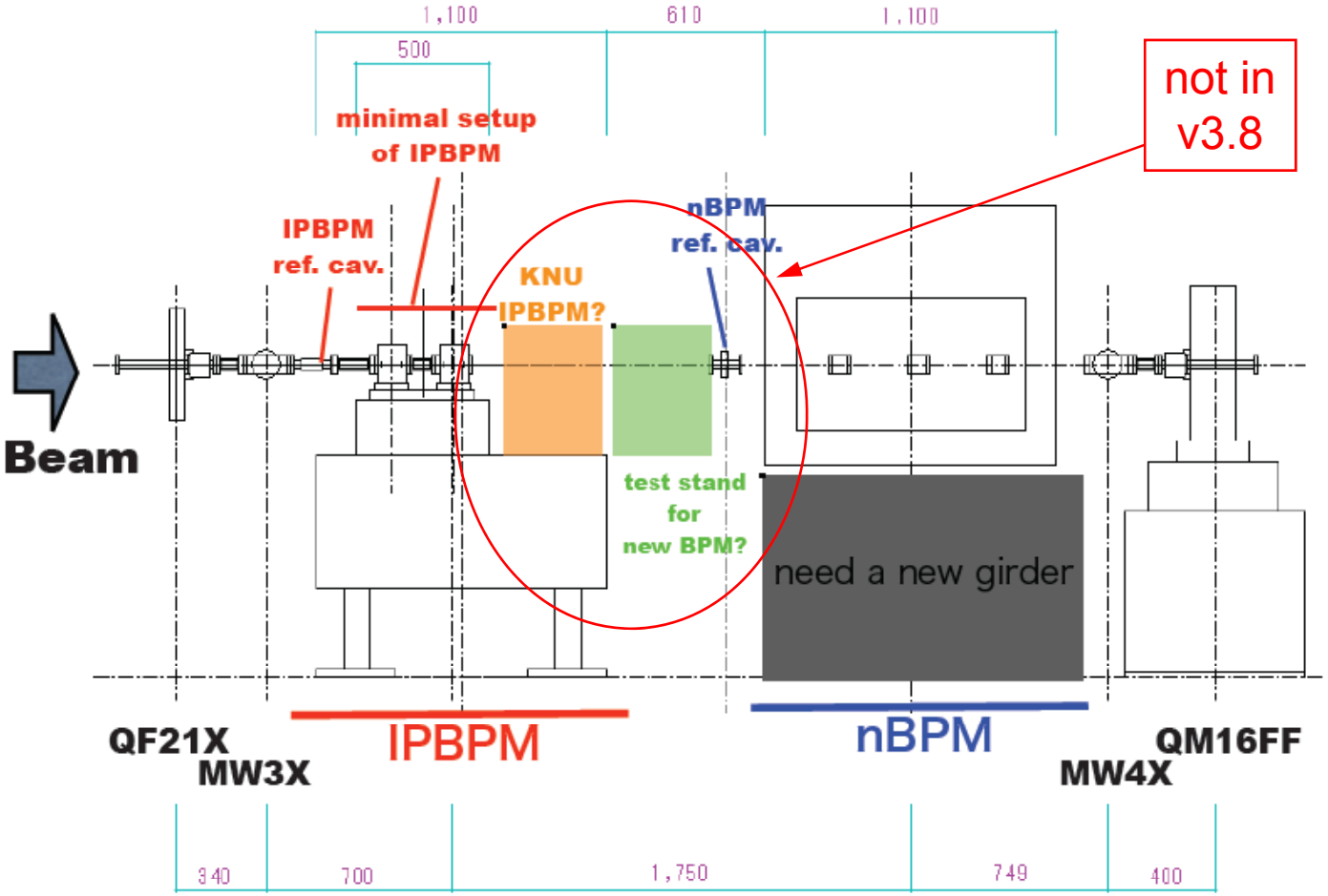
- Its true that there is a 1120mm length space (flange to flange) between QM13FF and QM14FF.
- But subtracting the foot prints of concrete pillers, 817mm is left for installing a device.
- The cylinder-flame of nBPM is ~850mm, plastic covering is 1100mm length. Not impossible but ...
- There will be 5 Q-BPM spares left, it can be used for pulse-to-pulse BPM if a high sensitivity electronics is available. Rigid girder and a mover stage will be needed also.



from Honda-san's report of 55thd ATF2 Weekly Meeting (August 22, 2007)

Idea for QF21X-QM16FF area

- This largest free space can contain both "IPBPM test setup" and "nBPM triplet".
- It will be possible to install other R&D BPMs such as KNU group's BPM.



from Okugi-san's okugi_080807mod.ppt file

Stripline BPM Device List

Old BPM Name	Electrode Length	Pipe Diameter	Original				Modified				Bellows	
			Magnet Thickness	Pipe Length		Total Length	Magnet Thickness	Pipe Length		Total Length	Original	Modified
				Electrode Side	No Electrode			Electrode Side	No Electrode			
ML1X	40	Narrow	60	155	120	335	60	155	60	275	○	○
ML2X	40	Wide	60	180	120	360	180	155	330	665	×	○
ML3X	40	Wide	60	180	120	360	180	155	60	395	×	○
ML4X	40	Wide	180	120	60	360	180	155	60	395	×	○
ML5X	40	Wide	180	155	60	395	180	155	60	395	○	○
ML6X	40	Wide	180	120	60	360	180	155	60	395	×	○
ML7X	40	Narrow	180	120	60	360	180	155	220	555	×	○
ML8X	120	Narrow	60	270	80	410	180	220	60	460	○	○
ML9X	120	Narrow	180	220	300	700	180	220	60	460	○	○
ML10X	120	Narrow	180	220	300	700	180	220	60	460	○	○
ML11X	120	Narrow	180	220	300	700	180	220	60	460	○	○
ML12X	120	Narrow	180	220	300	700	N/A	220	30	250	○	○
ML13X	40	Narrow	N/A	N/A		170	N/A	N/A		170	×	×
ML14X	40	Narrow	N/A	N/A		375	180	155	60	395	×	○

Blue ; wide beam pipe
Red ; Long Electrode (High Resolution)

from Okugi-san's okugi_080807mod.ppt file

name	old name	function	type	location	comments
ML1X	ML2X	BPM	stripline (L.R.)	d/s end of QF1X (Hitachi 180)	MS1X move by +35mm
ML2X	ML3X	BPM	stripline (L.R.)	d/s end of QD2X (Hitachi 180)	
ML3X	ML4X	BPM	stripline (L.R.)	d/s end of QF3X (Hitachi 180)	
ML4X	ML5X	BPM	stripline (L.R.)	d/s end of QF4X (Hitachi 180)	
ML5X	ML6X	BPM	stripline (L.R.)	u/s end of QD5X (Hitachi 180)	
ML6X	ML7X	BPM	stripline (L.R.)	u/s end of QF6X (Hitachi 180)	
ML7X	ML1X	BPM	stripline (L.R.)	d/s end of QF7X (Hitach 60)	
ML8X	ML14X	BPM	stripline (H.R.)	d/s end of QD8X (Hitachi 180)	
ML9X	ML8X	BPM	stripline (H.R.)	u/s end of QF9X (Hitachi 180)	
ML10X	ML9X	BPM	stripline (H.R.)	d/s end of QF13X (Hitachi 180)	
ML11X	ML10X	BPM	stripline (H.R.)	d/s end of QD14X (Hitachi 180)	
ML12X	ML11X	BPM	stripline (L.R.)	d/s end of QF15X (Hitachi 180)	
QBPM1X		BPM	C-band cavity	d/s end of QD10X (QEA 180)	No mover
QBPM2X		BPM	C-band cavity	d/s end of QF11X (QEA 180)	No mover
QBPM3X		BPM	C-band cavity	d/s end of QD12X (QEA 180)	No mover
QBPM4X		BPM	C-band cavity	d/s end of QD16X (QEA 180)	No mover
QBPM5X		BPM	C-band cavity	d/s end of QF17X (QEA 180)	No mover
QBPM6X		BPM	C-band cavity	d/s end of QD18X (QEA 180)	No mover
QBPM7X		BPM	C-band cavity	d/s end of QF19X (QEA 180)	No mover
QBPM8X		BPM	C-band cavity	u/s end of QD20X (Hitach 60)	C-band BPM with Hitachi
QBPM9X		BPM	C-band cavity	d/s end of QF21X (Hitach 60)	C-band BPM with Hitachi

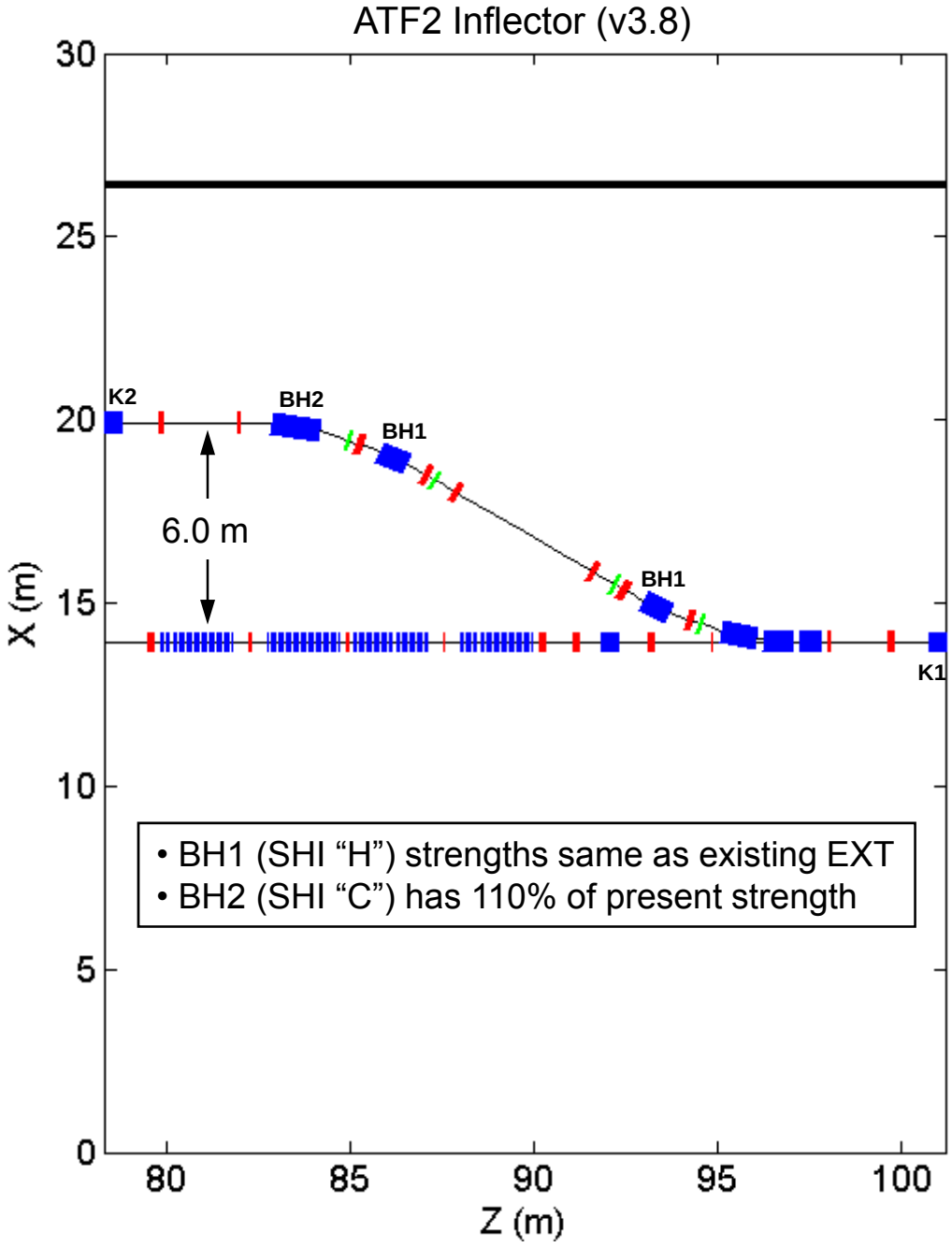
name	old name	function	type	location	comments
ML1FF	ML12X	BPM	stripline (H.R.)	between QM12FF and QM11FF	pulse-to-pulse feedback
ML2FF	ML13X	BPM	stripline (L.R.)	d/s dump bend	

Sughara-san's List

- all devices from Sugahara-san's list returned to v3.5 locations
- tuning/tracking simulations have not yet been made to check the performance

ATF2_v3.7_dispG 2007.7.30 by S.Kuroda

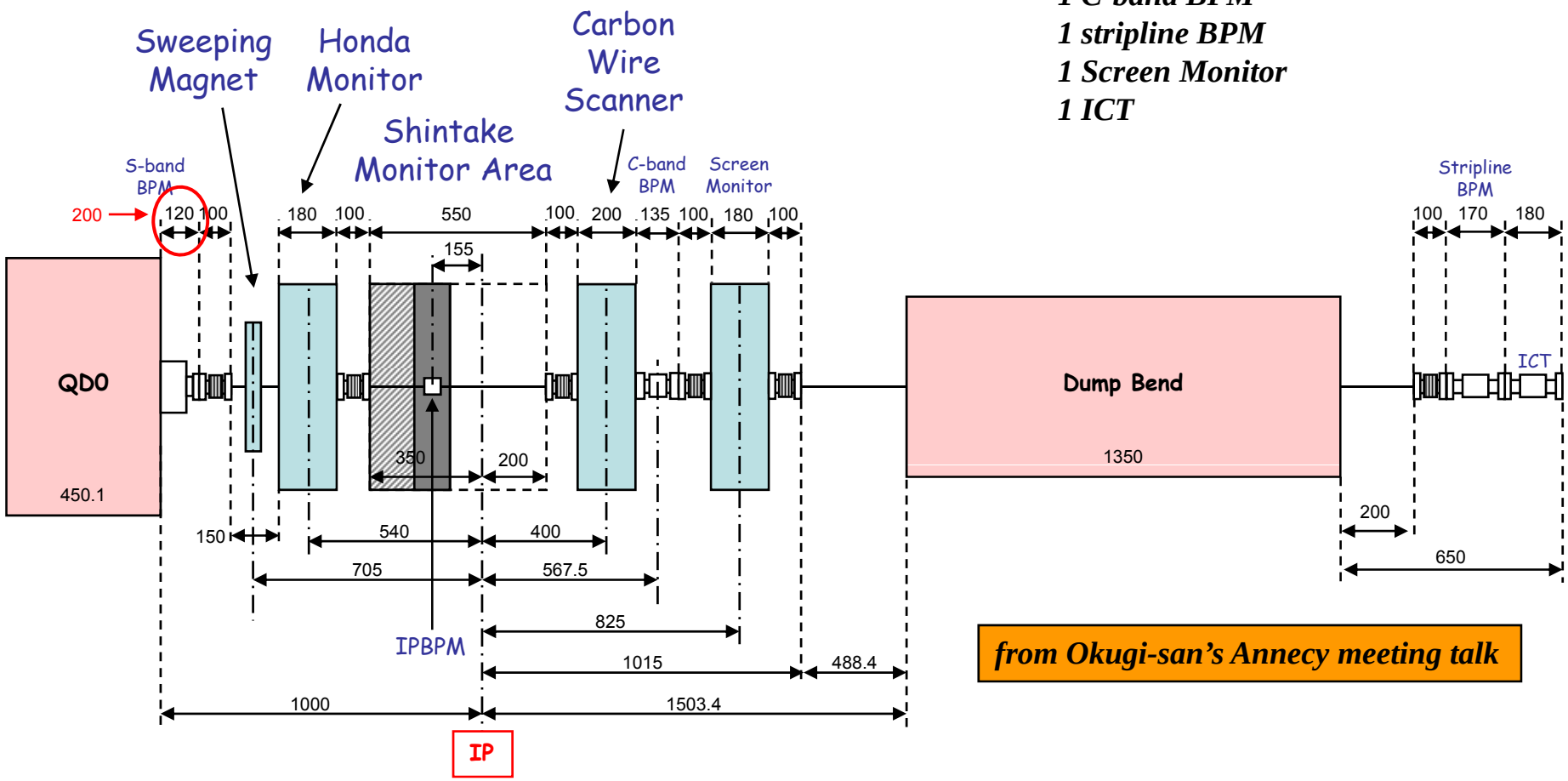
Element	Xew	Ynew	S (m)	L (m)	C-C dist. In v3.7	C-C dist. In v3.5	C-C dist. In v3.8	
ZV7X	19.803240	13.121402	27.192378	0.124800				
L102D	19.803240	13.246202	27.317178	0.008265				
QK1X.1	19.803240	13.254467	27.325443	0.039335				
QK1X.2	19.803240	13.293802	27.364778	0.039335	0.110000	0.261700	0.261700	
L102E	19.803240	13.333137	27.404113	0.121420				
QD10X.1	19.803240	13.454557	27.525533	0.099245				
MSKEW	19.803240	13.553802	27.624778	0.000000				
QD10X.2	19.803240	13.553802	27.624778	0.099245	0.260000	0.239300	0.239300	Q+Qk+ZV
L103A	19.803240	13.653047	27.724023	0.017755				
ZH5X	19.803240	14.627841	28.698818	0.111921				
L103C	19.803240	14.739762	28.810739	0.164795				
QF11X.1	19.803240	14.904557	28.975533	0.099245				
QF11X.2	19.803240	15.003802	29.074778	0.099245	0.319999	0.316000	0.316000	Q+ZH
L104A	19.803240	15.103047	29.174023	0.017755				
ZV8X	19.803240	16.021402	30.092378	0.124800				
L104C	19.803240	16.146202	30.217178	0.008265				
QK2X.1	19.803240	16.154467	30.225443	0.039335				
QK2X.2	19.803240	16.193802	30.264778	0.039335	0.110000	0.261700	0.261700	
L104D	19.803240	16.233137	30.304113	0.121420				
QD12X.1	19.803240	16.354557	30.425533	0.099245				
QD12X.2	19.803240	16.453802	30.524778	0.099245	0.260000	0.239300	0.239300	Q+Qk+ZV
L105A	19.803240	16.553047	30.624023	0.017755				
ZV9X	19.803240	20.159277	34.230254	0.124800				
L108C	19.803240	20.284077	34.355054	0.008265				
QK3X.1	19.803240	20.292342	34.363319	0.039335				
QK3X.2	19.803240	20.331677	34.402654	0.039335	0.110000	0.261700	0.261700	
L108D	19.803240	20.371012	34.441989	0.121420				
QD16X.1	19.803240	20.492432	34.563409	0.099245				
QD16X.2	19.803240	20.591677	34.662654	0.099245	0.260000	0.239300	0.239300	Q+Qk+ZV
L109A	19.803240	20.690922	34.761899	0.017755				
ZH3X	19.803240	21.665717	35.736693	0.111921				
L109C	19.803240	21.777638	35.848614	0.164795				
QF17X.1	19.803240	21.942432	36.013409	0.099245				
QF17X.2	19.803240	22.041677	36.112654	0.099245	0.320000	0.316000	0.316000	Q+ZH
L110A	19.803240	22.140922	36.211899	0.017755				
ZV10X	19.803240	24.041777	38.112753	0.124800				
L110D	19.803240	24.166577	38.237553	0.158355				
QD18X.1	19.803240	24.324932	38.395906	0.099245				
QD18X.2	19.803240	24.424177	38.495153	0.099245	0.320000	0.322400	0.322400	Q+ZV
L111A	19.803240	24.523422	38.594398	0.017755				
ZH9X	19.803240	25.492967	39.563843	0.111921				
L111D	19.803240	25.604788	39.675764	0.164795				
QF19X.1	19.803240	25.769582	39.840558	0.099245				
QF19X.2	19.803240	25.868827	39.939803	0.099245	0.319999	0.316000	0.316000	Q+ZH
L112A	19.803240	25.968072	40.039048	0.017755				


ATF2 Inflector (v3.8)
30
25
20
15
10
5
0
X (m)
80
85
90
95
100
Z (m)
K2
BH2
BH1
BH1
K1
6.0 m
• BH1 (SHI “H”) strengths same as existing EXT
• BH2 (SHI “C”) has 110% of present strength

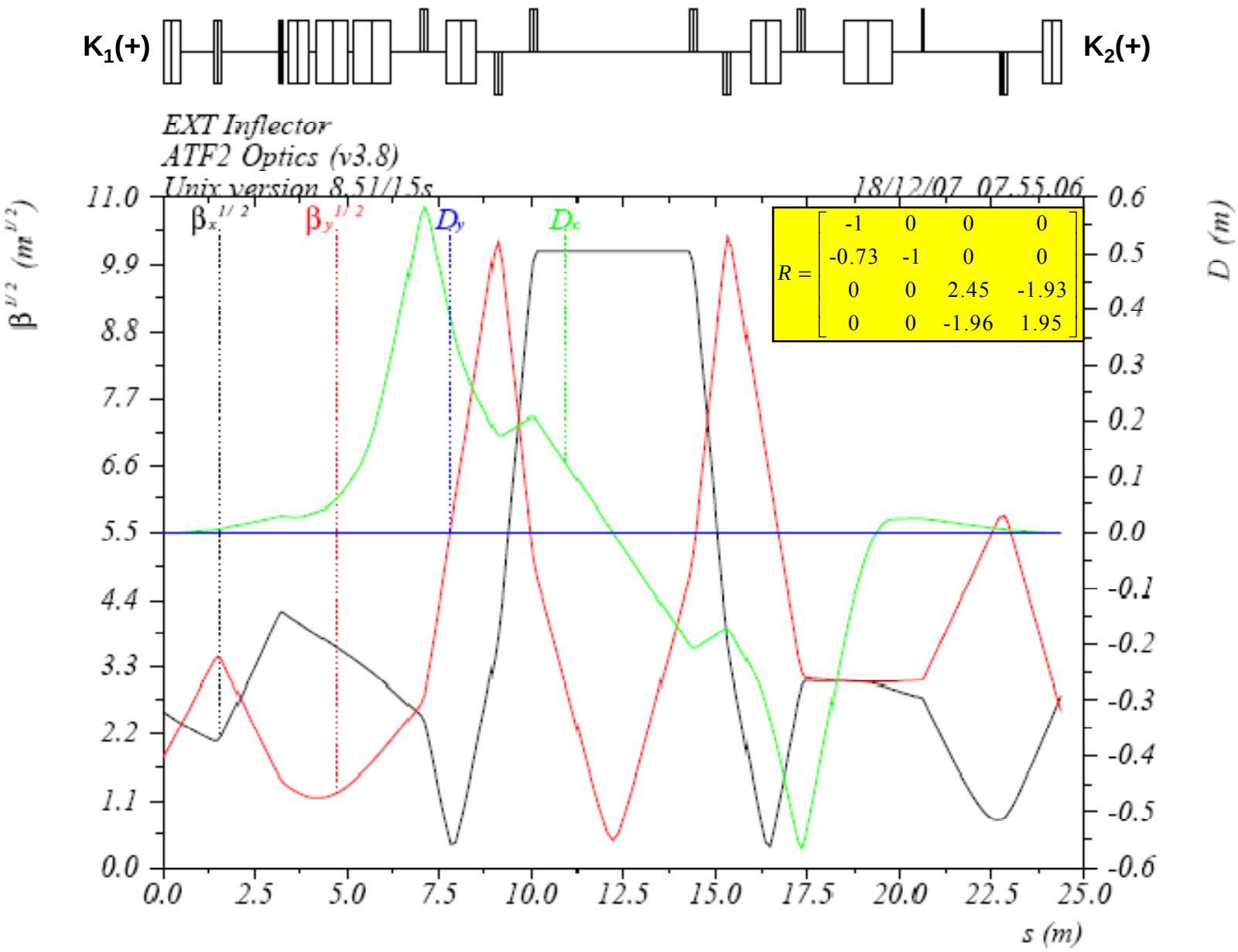
FF: IP Area

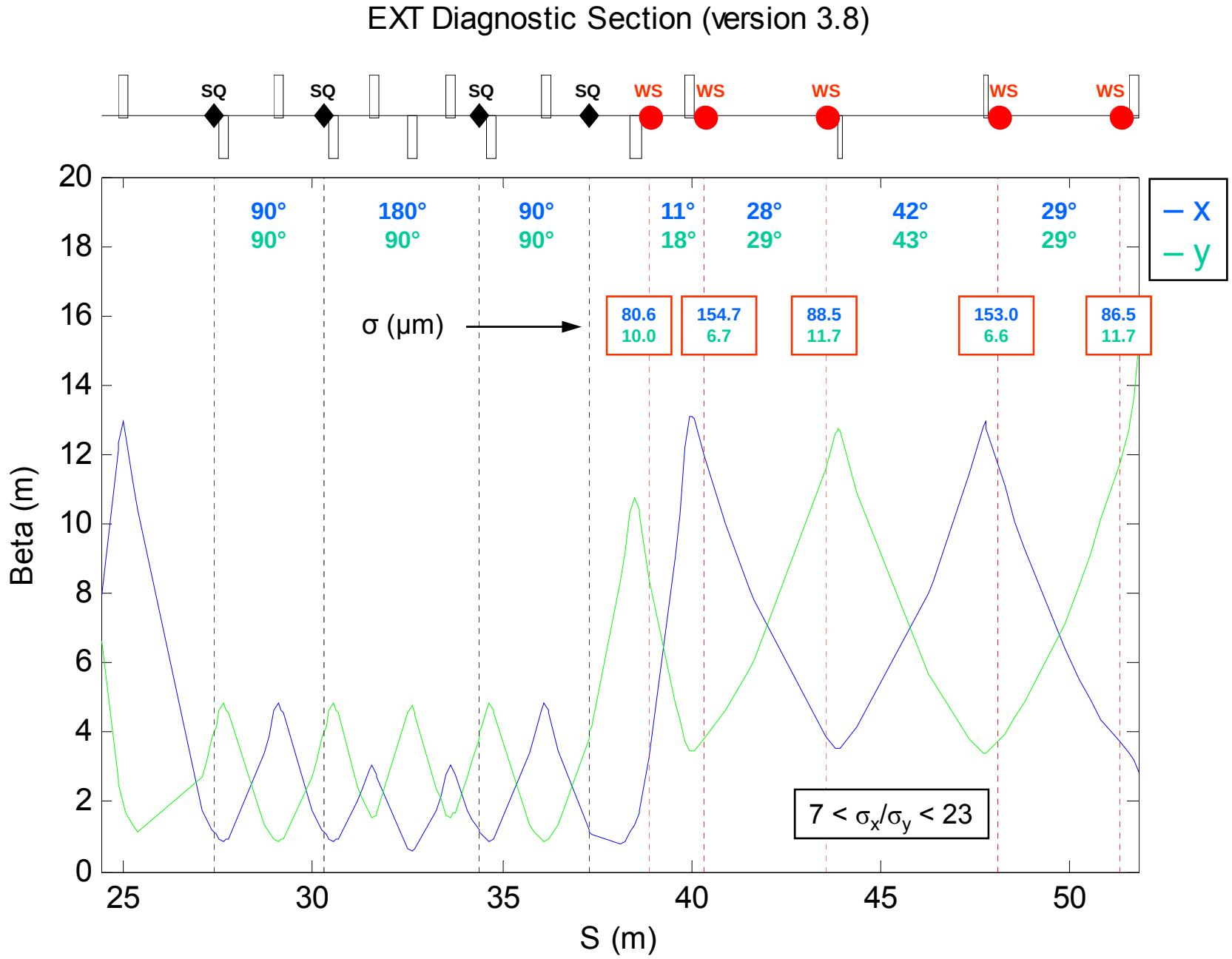
IP configuration

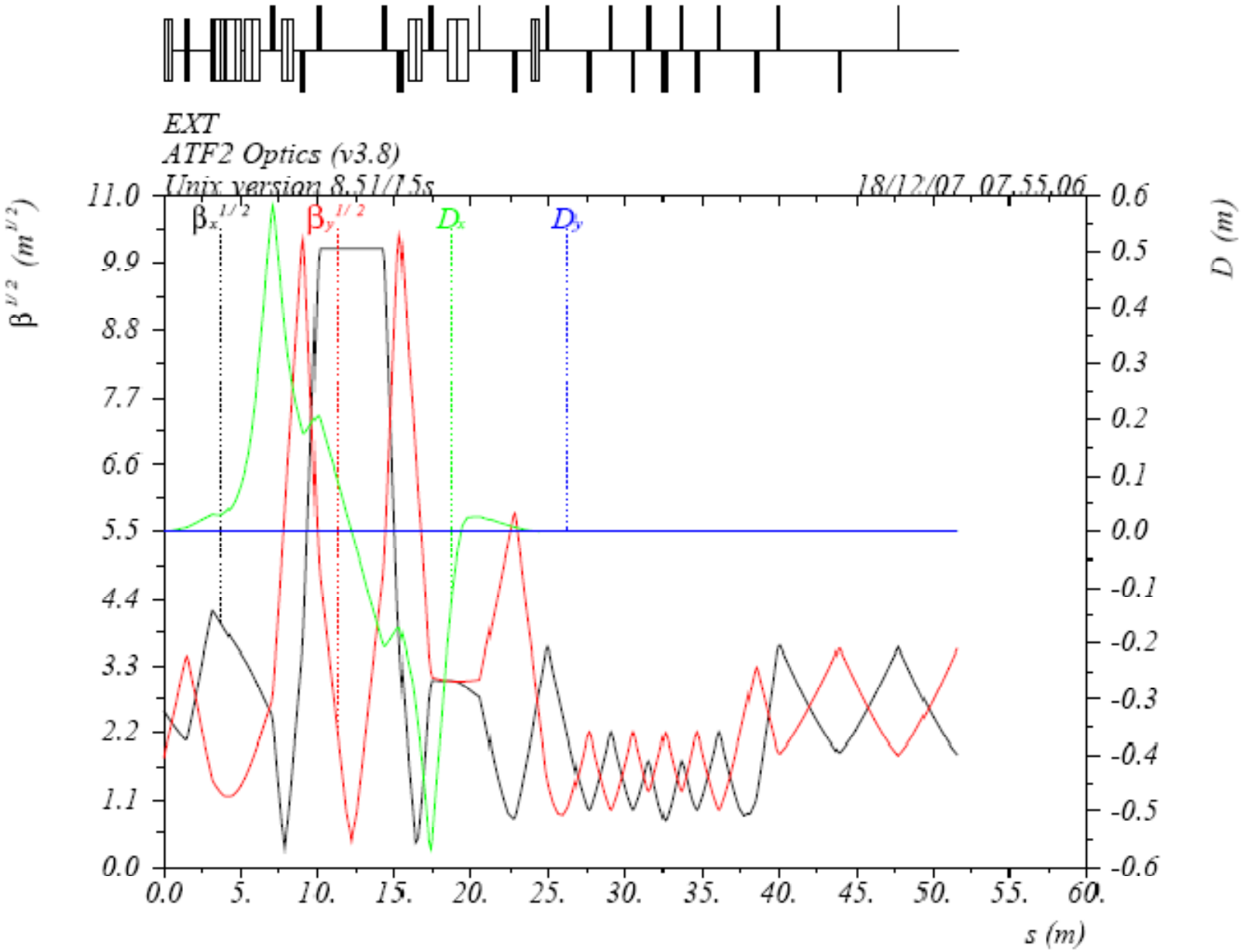
Monitors : ***3 beam size monitors***
1 IP-BPM
1 C-band BPM
1 stripline BPM
1 Screen Monitor
1 ICT

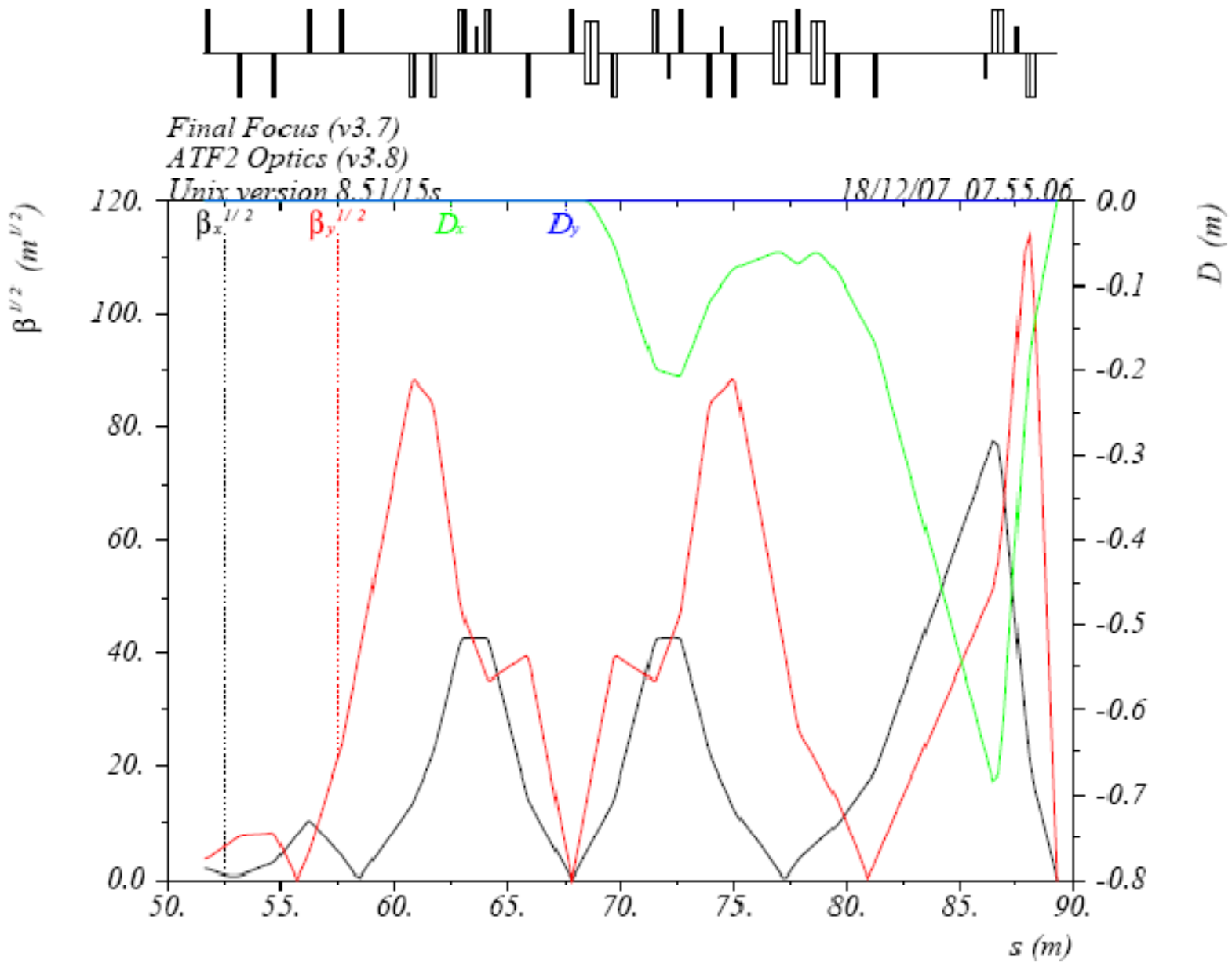


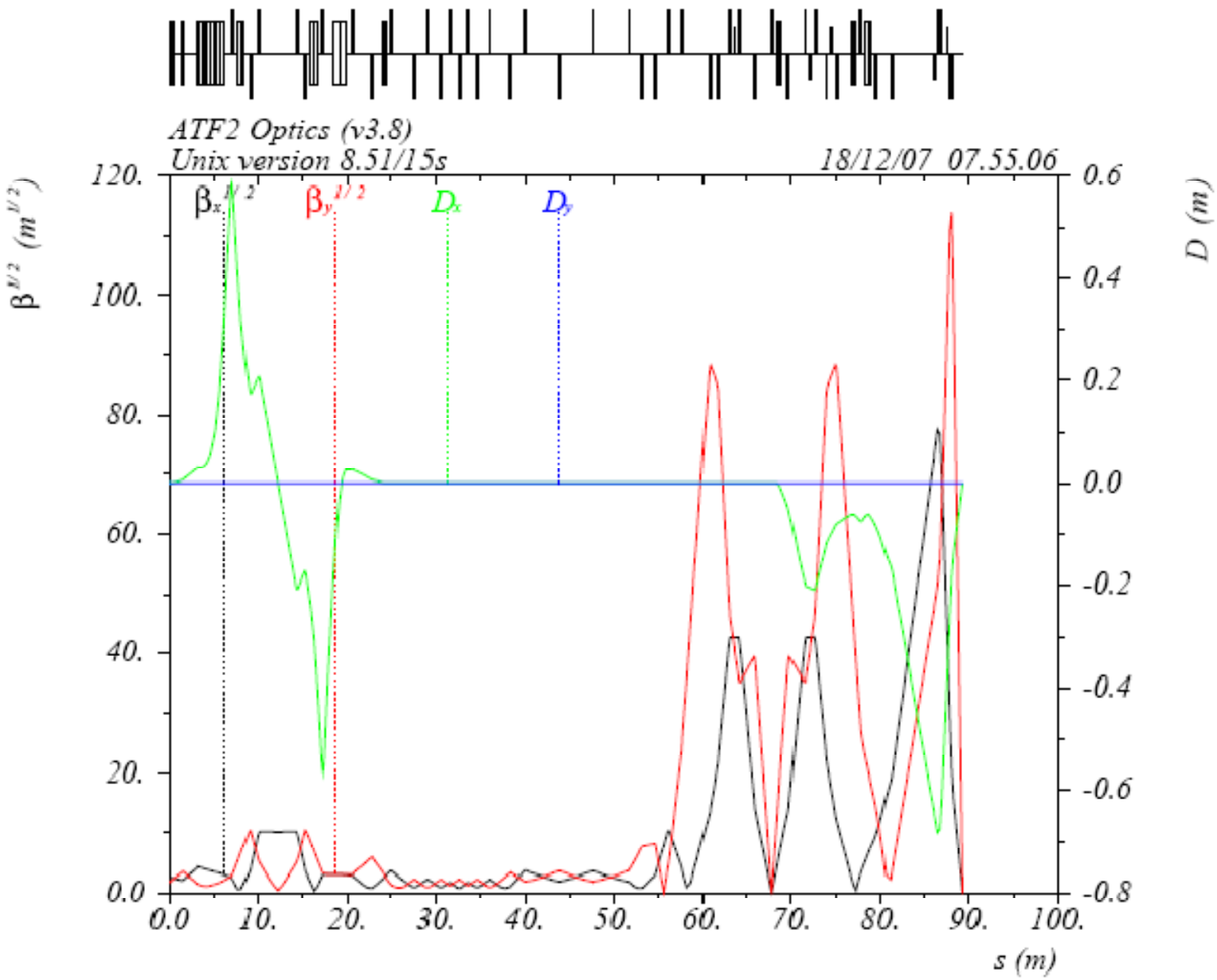
from Okugi-san's Annecy meeting talk

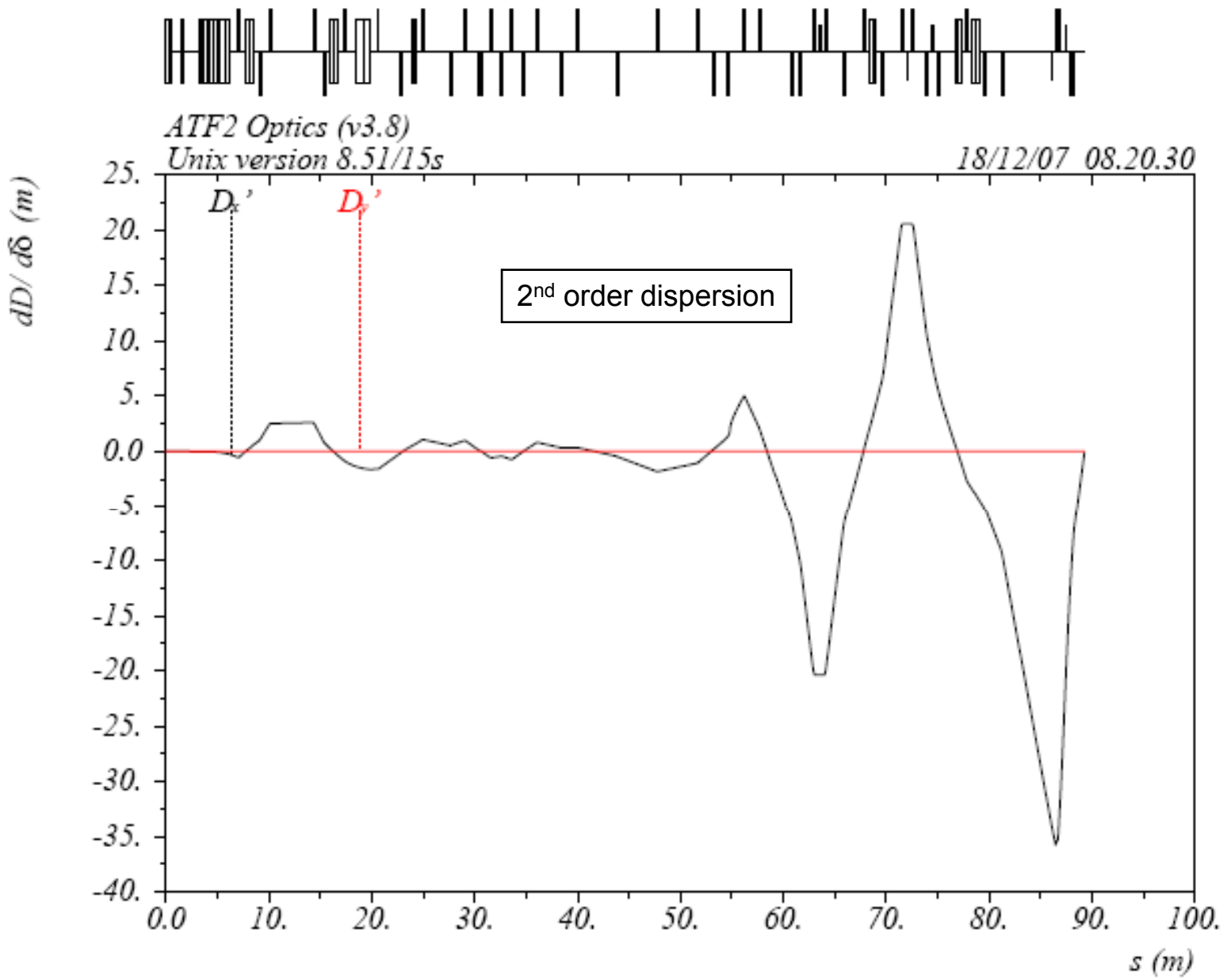

K1(+)
K2(+)
EXT Inflector
ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 07.55.06
βx 1/2
βy 1/2
Dy
Dx
R =
-1 0 0 0
-0.73 -1 0 0
0 0 2.45 -1.93
0 0 -1.96 1.95
β 1/2 (m 1/2)
D (m)
s (m)
11.0
9.9
8.8
7.7
6.6
5.5
4.4
3.3
2.2
1.1
0.0
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
20.0
22.5
25.0

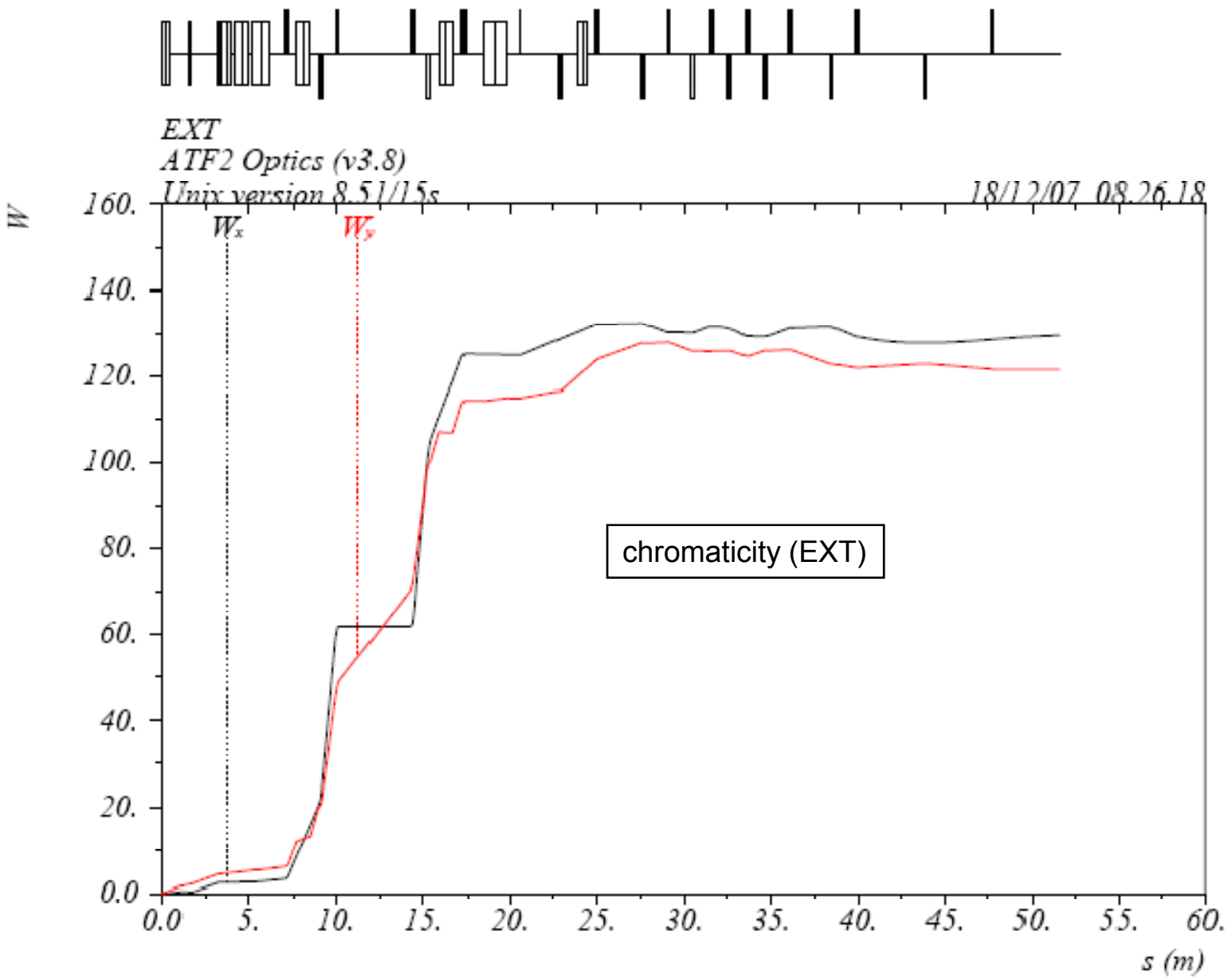

EXT Diagnostic Section (version 3.8)
SQ
SQ
SQ
SQ
WS
WS
WS
WS
WS
90°
90°
180°
90°
90°
90°
11°
18°
28°
29°
42°
43°
29°
29°
σ (μm)
80.6
10.0
154.7
6.7
88.5
11.7
153.0
6.6
86.5
11.7
– x
– y
7 < σx/σy < 23
Beta (m)
S (m)
0
2
4
6
8
10
12
14
16
18
20
25
30
35
40
45
50


EXT
ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 07.55.06
$\beta_x^{1/2}$
$\beta_y^{1/2}$
D_x
D_y
$\beta^{1/2}$ ($m^{1/2}$)
D (m)
s (m)
11.0
9.9
8.8
7.7
6.6
5.5
4.4
3.3
2.2
1.1
0.0
0.6
0.5
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
0.0
5.
10.
15.
20.
25.
30.
35.
40.
45.
50.
55.
60.


Final Focus (v3.7)
ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 07.55.06
$\beta_x^{1/2}$
$\beta_y^{1/2}$
D_x
D_y
$\beta^{1/2}$ ($m^{1/2}$)
D (m)
s (m)
120.
100.
80.
60.
40.
20.
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
50.
55.
60.
65.
70.
75.
80.
85.
90.

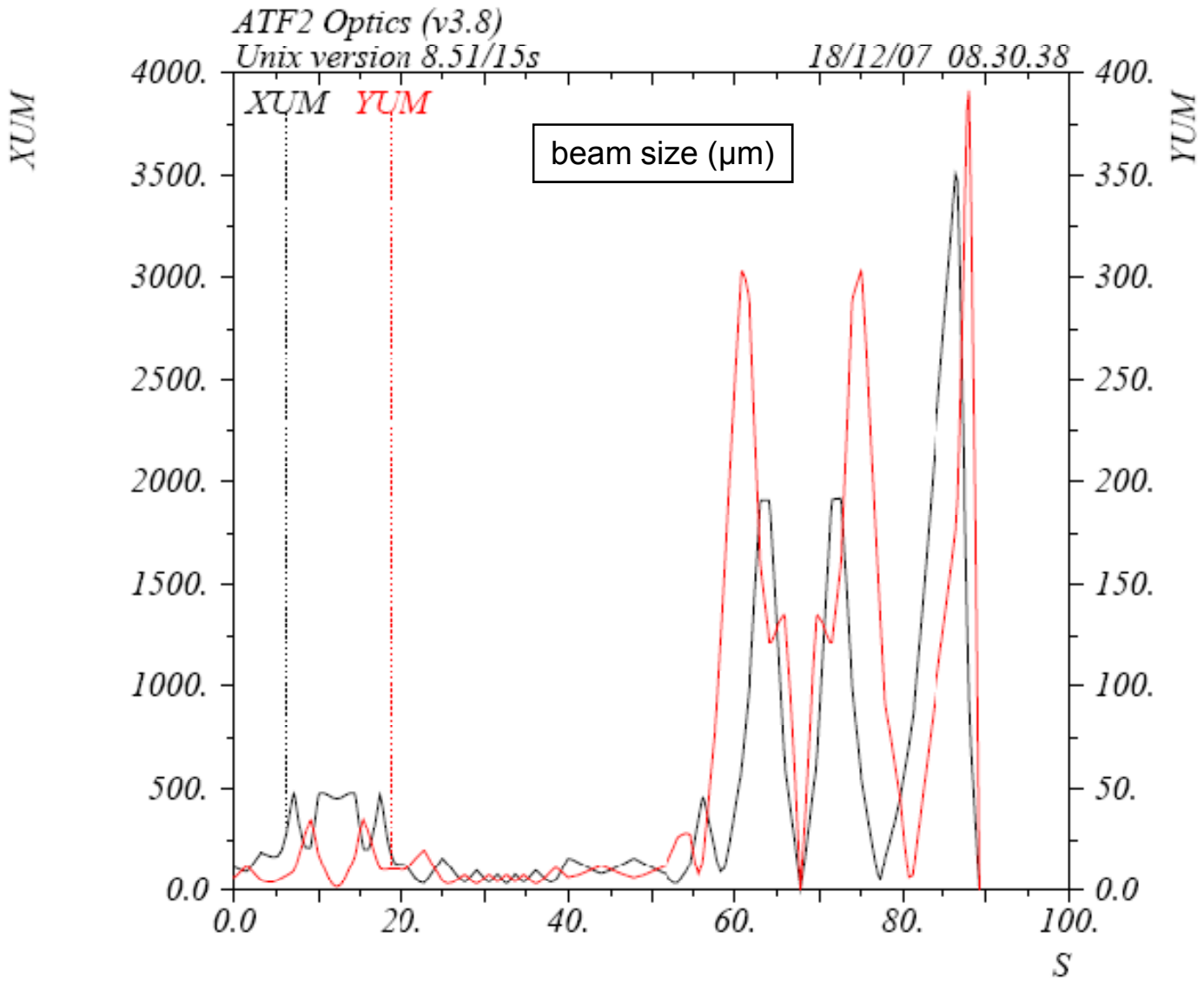

ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 07.55.06
$\beta_x^{1/2}$
$\beta_y^{1/2}$
D_x
D_y
$\beta^{1/2}$ ($m^{1/2}$)
D (m)
s (m)
120.
100.
80.
60.
40.
20.
0.0
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
0.0
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.


ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 08.20.30
dD/ dδ (m)
Dx'
Dy'
2nd order dispersion
25.
20.
15.
10.
5.
0.0
-5.
-10.
-15.
-20.
-25.
-30.
-35.
-40.
0.0
10.
20.
30.
40.
50.
60.
70.
80.
90.
100.
s (m)


EXT
ATF2 Optics (v3.8)
Unix version 8.51/15s
18/12/07 08.26.18
W
W_x
W_y
160.
140.
120.
100.
80.
60.
40.
20.
0.0
0.0
5.
10.
15.
20.
25.
30.
35.
40.
45.
50.
55.
60.
s (m)
chromaticity (EXT)

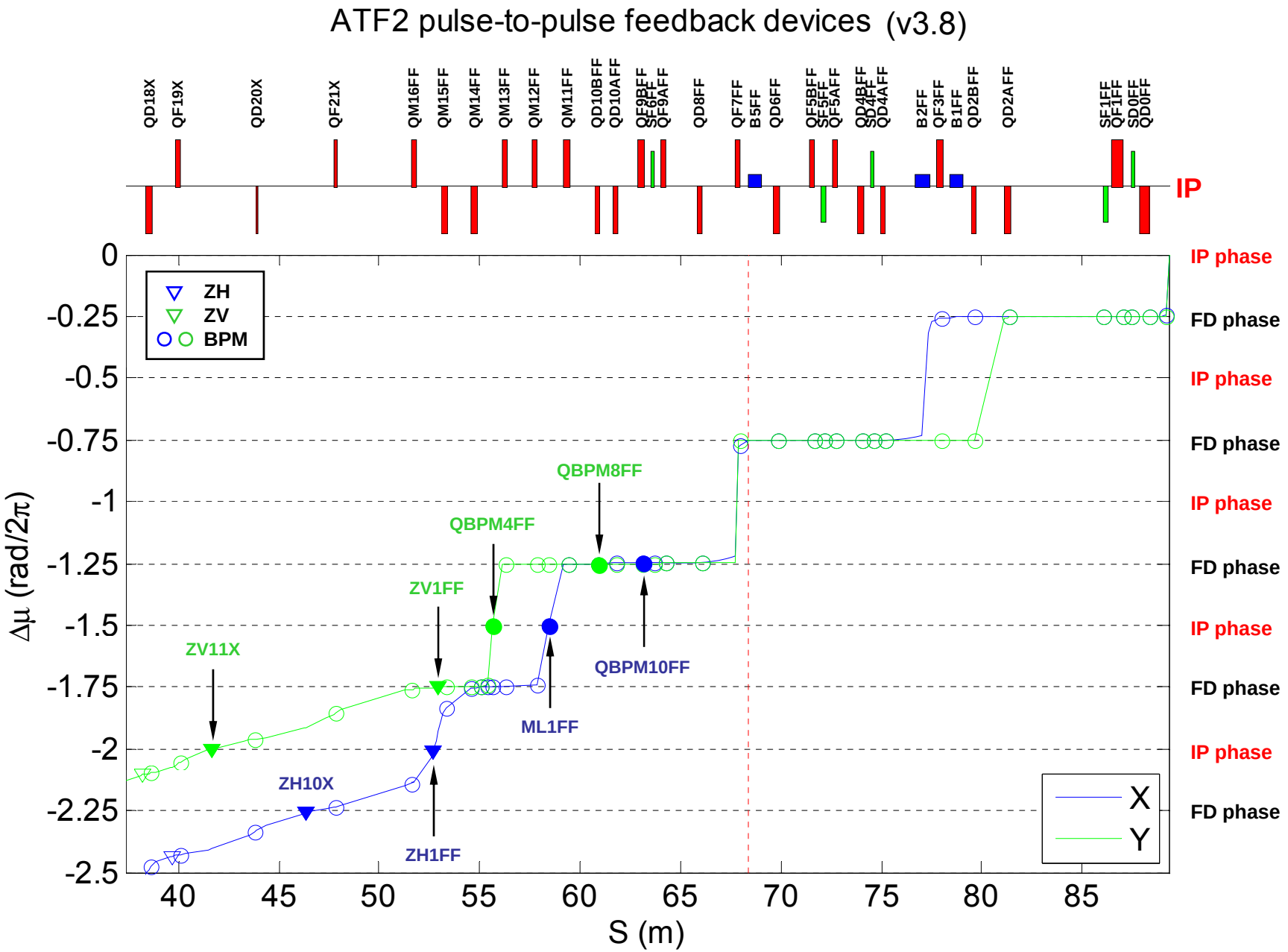
Parameters

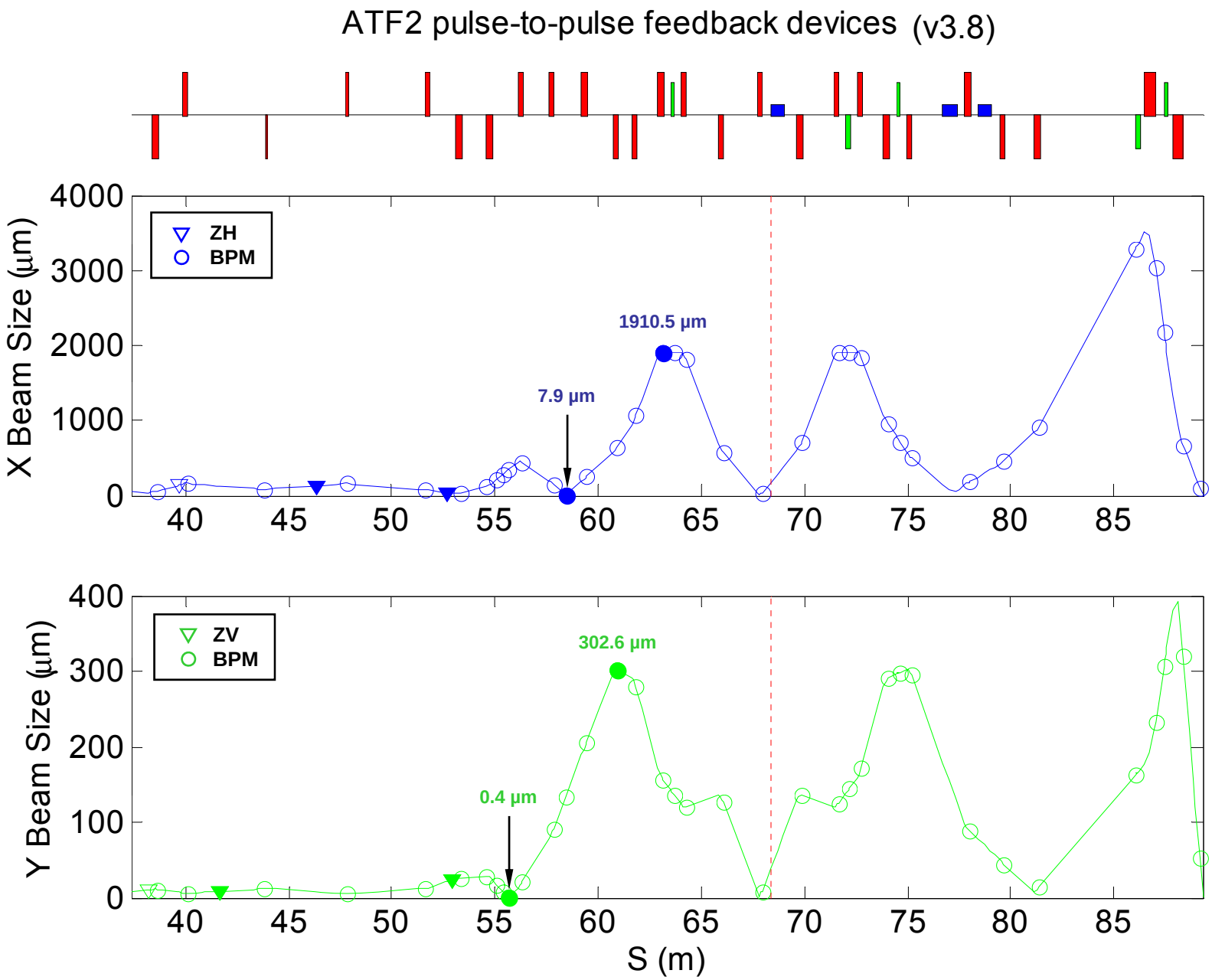
energy = 1.3 GeV
$\gamma\varepsilon_x = 5\times10^{-6}$ m
$\varepsilon_x = 2\times10^{-9}$ m
$\gamma\varepsilon_y = 3\times10^{-8}$ m
$\varepsilon_y = 1.2\times10^{-11}$ m
$\sigma_z = 8$ mm
$\sigma_\delta = 0.08$ %
$\beta_x^* = 4$ mm
$\beta_y^* = 0.1$ mm
$\sigma_x^* = 2.828$ μm
$\sigma_y^* = 34$ nm



Pulse-to-Pulse Feedback

- stabilize beam into Final Focus (especially at sextupoles)
- 2 dipole correctors per plane (Final Doublet phase and IP phase)
- 2 BPMs per plane (Final Doublet phase and IP phase)
- correctors and BPMs should be as far downstream as possible
- feedback BPMs should have no dispersion
- cavity BPMs used for feedback must have movers
- BPMs must have resolution ≤ spot size for sub-σ stabilization
- requires sub-micron resolution for vertical BPM at IP phase
  - use a dedicated QBPM with mover at the selected location (between QM14FF and QM13FF)
- use a stripline BPM for horizontal BPM at IP phase


ATF2 pulse-to-pulse feedback devices (v3.8)
QD18X
QF19X
QD20X
QF21X
QM16FF
QM15FF
QM14FF
QM13FF
QM12FF
QM11FF
QD10BFF
QD10AFF
QD8FF
QF7FF
B5FF
QD6FF
B2FF
QF3FF
B1FF
QD2BFF
QD2AFF
SF1FF
QF1FF
SD0FF
QD0FF
IP
ZH
ZV
BPM
QBPM8FF
QBPM4FF
ZV1FF
ZV11X
QBPM10FF
ML1FF
ZH10X
ZH1FF
X
Y
IP phase
FD phase
Δμ (rad/2π)
S (m)


ATF2 pulse-to-pulse feedback devices (v3.8)
X Beam Size (μm)
ZH
BPM
1910.5 μm
7.9 μm
Y Beam Size (μm)
ZV
BPM
302.6 μm
0.4 μm
S (m)

Version 3.8 Parts List Issues

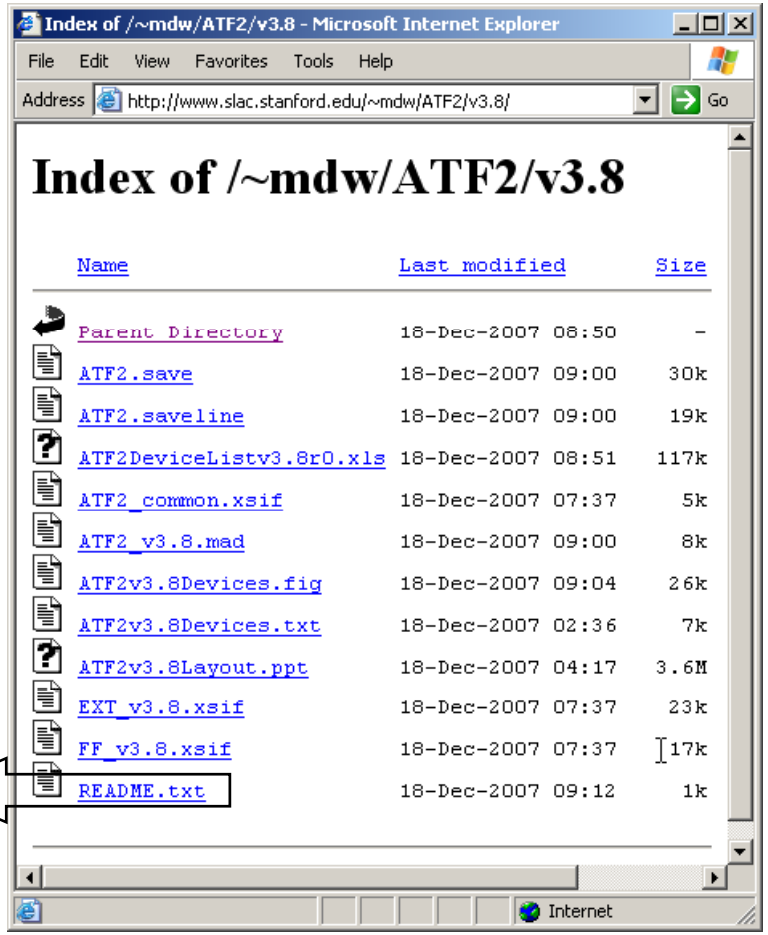
- 2 new IDX skew quadrupoles (QS1X and QS2X)
- 2 new 20 amp bipolar power supplies (QK1X and QK4X)
- QD14X running at 97% of max power supply current (see parts list …)
- power supply for BDMP
- Feedforward/Feedback devices for EXT have not yet been incorporated into the MAD decks
- off-beamline components (detectors, gamma collimators, MONALISA, etc.) not included
- also see comments and notes on each worksheet of the parts list …

Version 3.8 Optics and Simulation Issues

- still studying effects of far-off-axis extraction through QM7R.1 … may need to rematch EXT or change DR optics to compensate
- ambiguity remains in choice of locations for vertical dispersion correction skew quadrupoles (Okugi-san's locations and mine) … determine from simulations which locations are most efficient
- Feedforward / Feedback / FONT kickers are not in the deck yet … need a design (30 cm striplines? FEATHER kickers?)
- other Feedforward / Feedback device locations? (maybe some specifics at this meeting …)
- simulations with estimated multipole content of SLAC epoxy kickers, QM7R.1, BS1X, shimmed QC3s, …
- need to redo and expand full tuning simulations (especially with realistic errors in diagnostics)
- revisit fine-tuning of higher-order aberrations (à la Andre)
- need "small spot" optics for LW1X (1 μm) operation
- MPS issues for commissioning?

Version 3.8 Release Files

```
Release v3.8 Files (December 19, 2007)
-------------------------------------------------------------------------------
ATF2_common.xsif          : MAD input file (common definitions)
EXT_v3.8.xsif             : MAD input file (EXT line)
FF_v3.8.xsif              : MAD input file (Final Focus)
ATF2_v3.8.mad             : top level MAD command file
ATF2_v3.8.save            : MAD SAVE file (for conversion to other optics
                            program inputs)
ATF2_v3.8.saveline        : MAD SAVELINE file (for conversion to other optics
                            program inputs)
-------------------------------------------------------------------------------
ATF2v3.8.ppt              : v3.8 overview presentation (PowerPoint)
ATF2v3.8.pdf              : v3.8 overview presentation (pdf)
ATF2DeviceListv3.8r0.xls  : detailed parts list (Excel)
ATF2v3.8Layout.ppt        : scaled cartoons of specific locations (PowerPoint)
ATF2v3.8Devices.txt       : simple text file with device names, lengths, center
                            positions, and nearby spaces
ATF2v3.8Devices.fig       : scrollable beamline schematic (Matlab figure file)
-------------------------------------------------------------------------------
```



Homework

Tracking Results

Program	σ_y*(rms) nm	σ_y*(sig) nm	$\gamma\varepsilon_y$ nm	$\Delta\gamma\varepsilon_y$ %
MAD	38.261	35.524	32.8839	9.6
ELEGANT	38.401	35.551	32.9674	9.9
TURTLE	36.292	34.791	31.6332	5.4
DIMAD	38.165	36.575	32.7121	9.0
LUCRETIA				
SAD				

- perfect machine
- 10,000 particles (Gaussian distributions; 5σ)
- sextupole component in SHI H-bends included
- multipoles in SLAC epoxy kickers, QM7R.1, BS1X, QF1, and QD0 not included
- no chromatic correction in EXT