

ATF EXT optics analysis and matching

Rob Appleby

ATF emittance measurement
and growth meeting

30/04/08

The need for properly understood optics

- The optics in the diagnostic straight need to be understood for precise measurements
 - Evolution of beam size
 - Emittance measurement: want π/N phase advance from station to station (N stations)
- The inputs from ‘opticians’
 - Operational procedure for optics
 - Ability to re-match optics for our needs
 - Provide tools for the collaboration
 - Understand limitations of optical hardware
 - e.g. quads, measurement techniques.

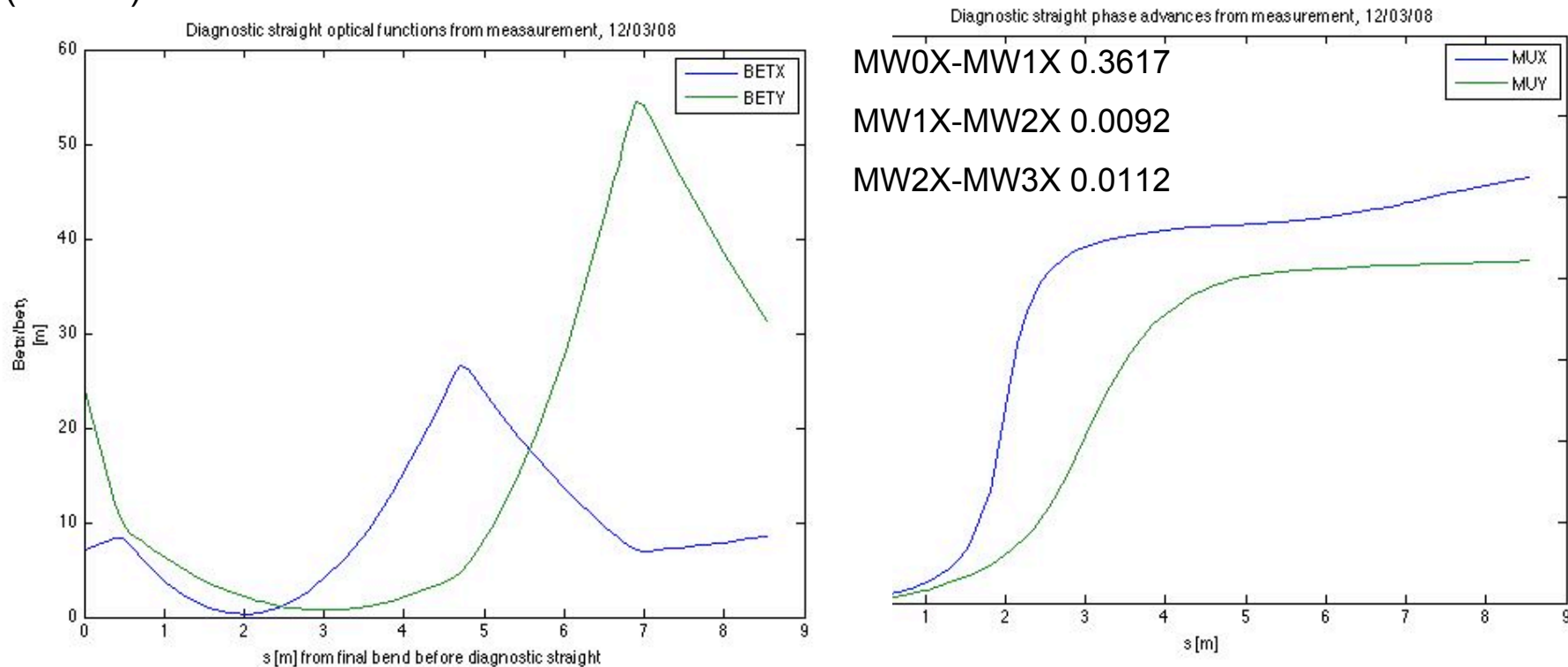
Diagnostic straight optics

12/03/08

$S(\text{MW1X}) = 3.65\text{m}$

$S(\text{MW2X}) = 5.5\text{m}$

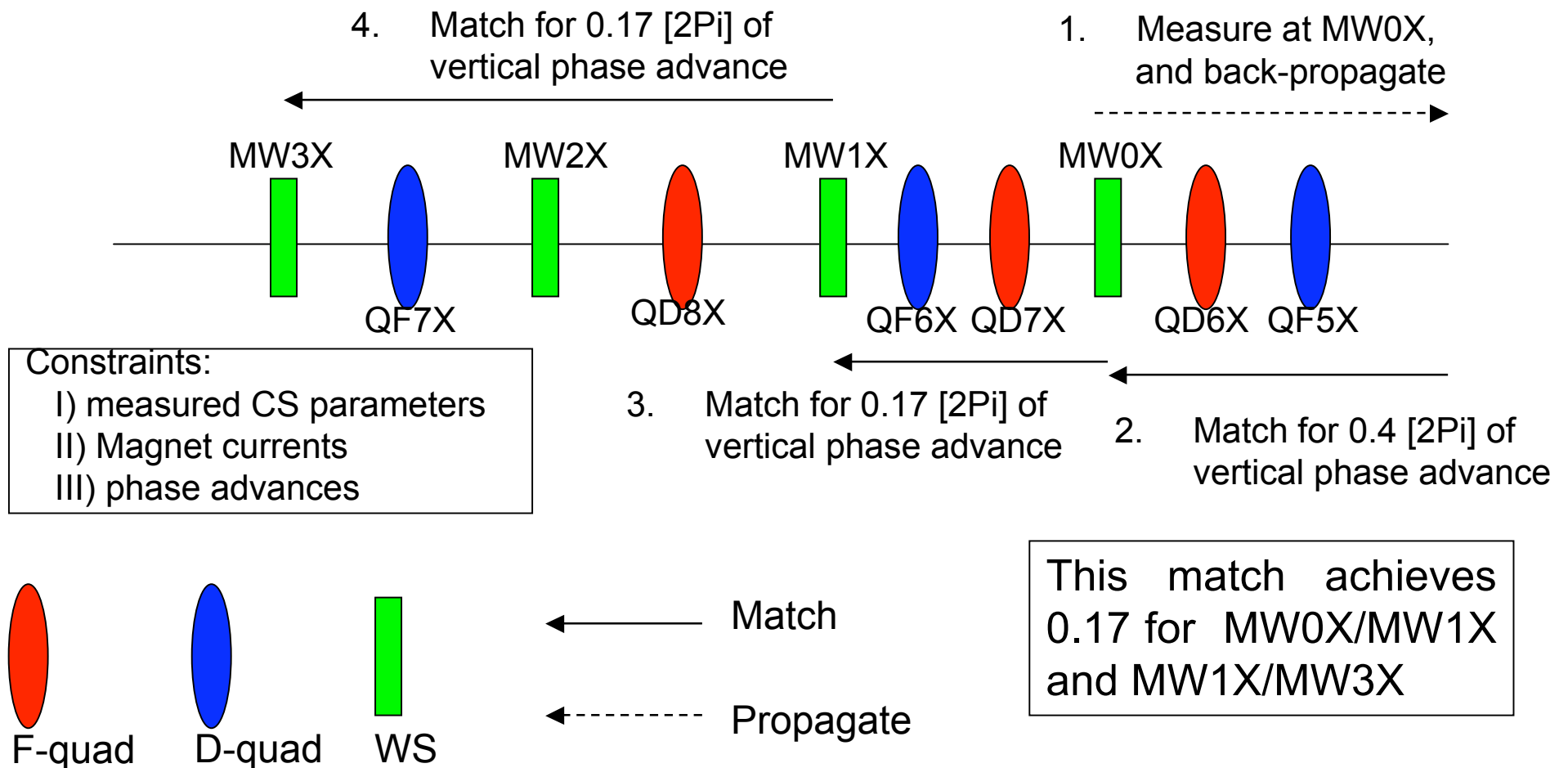
$S(\text{MW3X}) = 7.72\text{m}$



CS parameters at MW0X reconstructed (Scarfe) from WS measurements and linear optics.

The phase advances between WSs are not good (Pi/N)

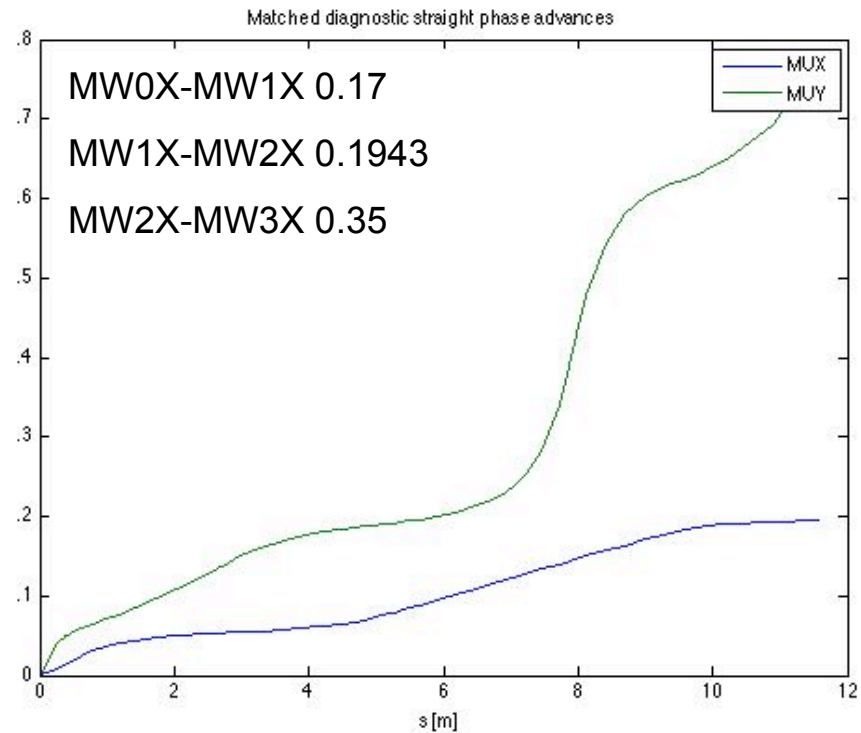
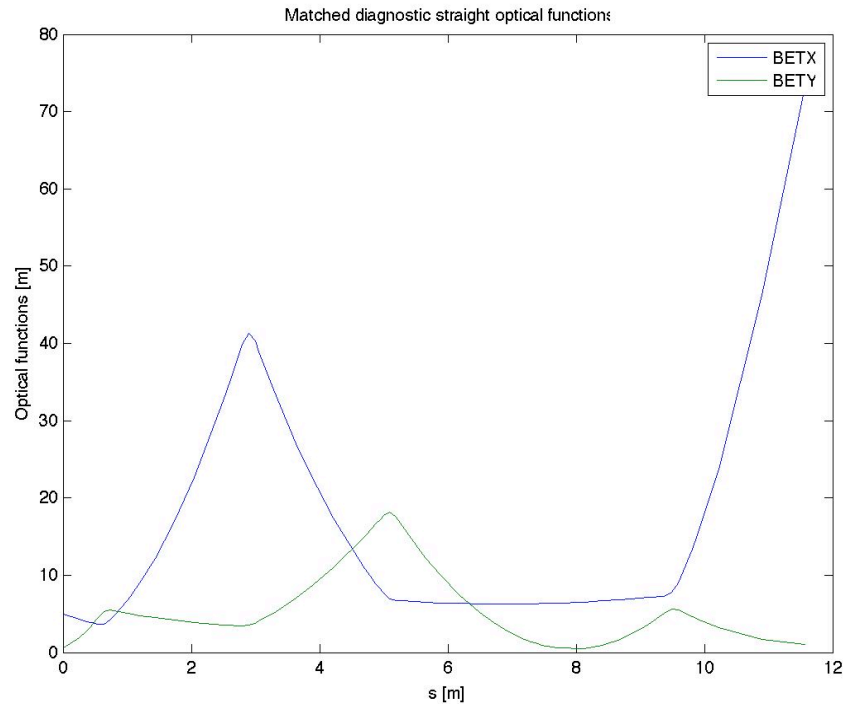
Matching strategy



Magnet maximum strengths

- QF5X (Hitachi Type 5)
 - $KL_{max} = 2.1050$ @ 100 amps [polarity: $KL > 0$]
- QD6X (Tokin 3393)
 - $KL_{max} = 0.3021$ @ 100 amps [polarity: $KL > 0$]
- QD7X (Hitachi Type 5)
 - $KL_{max} = 2.1050$ @ 100 amps [polarity: $KL < 0$]
- QF6X (Hitachi Type 5)
 - $KL_{max} = 2.1050$ @ 100 amps [polarity: $KL > 0$]
- QD8X (Hitachi Type 4)
 - $KL_{max} = 2.0650$ @ 200 amps [polarity: $KL < 0$]
- QF7X (Hitachi Type 4)
 - $KL_{max} = 2.0650$ @ 200 amps [polarity: $KL > 0$]
- QD9X (IHEP QEA)
 - in series with QD8X

Matching results



Matched strengths

QF5X: (KL)=0.3000 /m I=14.3 Amps

QD6X: (KL)=0.1454 /m I=48.1 Amps ←

QD7X: (KL)=-1.3240 /m I=62.9 Amps

QD8X: (KL)=-0.6241 /m I=60.5 Amps

S(MW1X) = 3.65m

S(MW2X) = 5.5m

S(MW3X) = 7.72m

Operational procedure

- Load some optics, and make a measurement of the CS parameters in the diagnostic straight e.g. MW0X. Quad scanning could be best
- Propagate to the start of the diagnostic region with magnet set file
- Using these optics,
 - rematch the phase advance to MW0X (QF5X and QD6X)
 - rematch phases MW0X/MW1X and MW1X/MW3X
- Generate set file, apply optics and re-measure the CS parameters in diagnostic straight
- If consistent, procedure with emittance study

Optics tools

- A set of Matlab/MAD based tools are under development to assist this work
 - *EXTmodel* (MDW) to convert current set file to MAD set file
 - *get_twiss* (RBA) to calculate EXT CS using measured or fixed conditions, using set file, and plotting
 - *match_phase_diagbend* (RBA) to match QF5X and QD6X in the EXT, to MW0X
 - *match_phase* (RBA) to match optimum phases between wire scanners
 - *EXTQuadSetValues* (MDW) to write a control-system format set file
- These are available, but not polished

All routines are Windows/Mac except *EXTQuadSetValues*, which is currently Windows only.

Conclusions

- There is a need within our collaboration for a dedicated set of optics in the diagnostic straight
- The measured optics from the 12/03/08 shift show a non-optimum phase advance between wire scanners
 - This is fixable, and matched optics with good phase advances are possible
 - BUT, these optics will need to be re-matched based on future measurements made at the time
 - This matching may require a polarity switch of QD6X (>0)
- This should be done within a (long) shift so dedicated tools and procedures are needed
- One such procedure, together with Matlab tools, has been prepared