Experience on optics matching, and flight simulators

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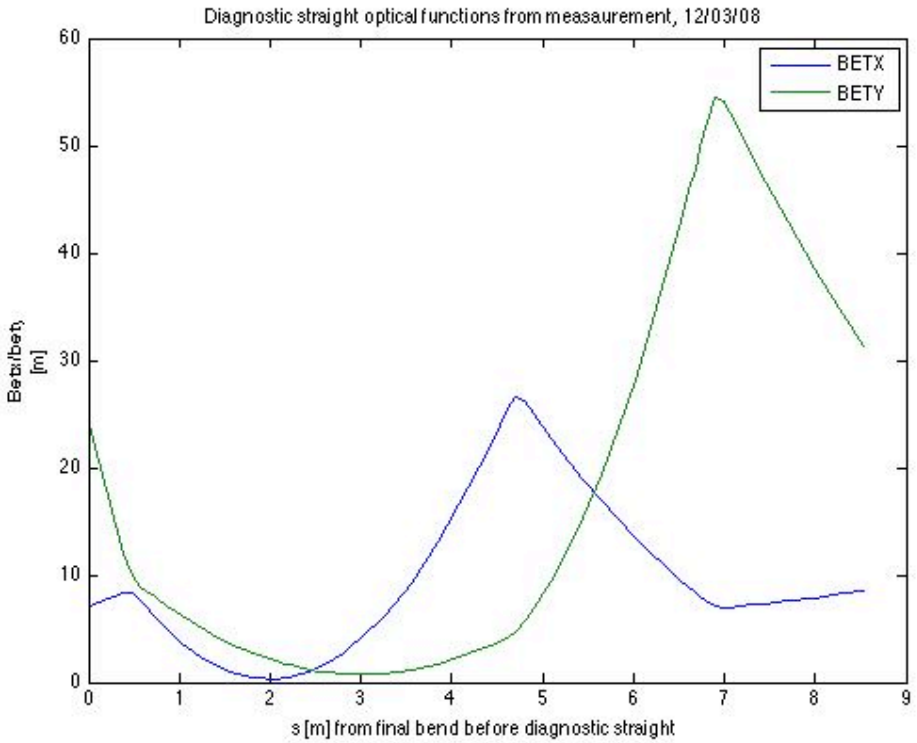
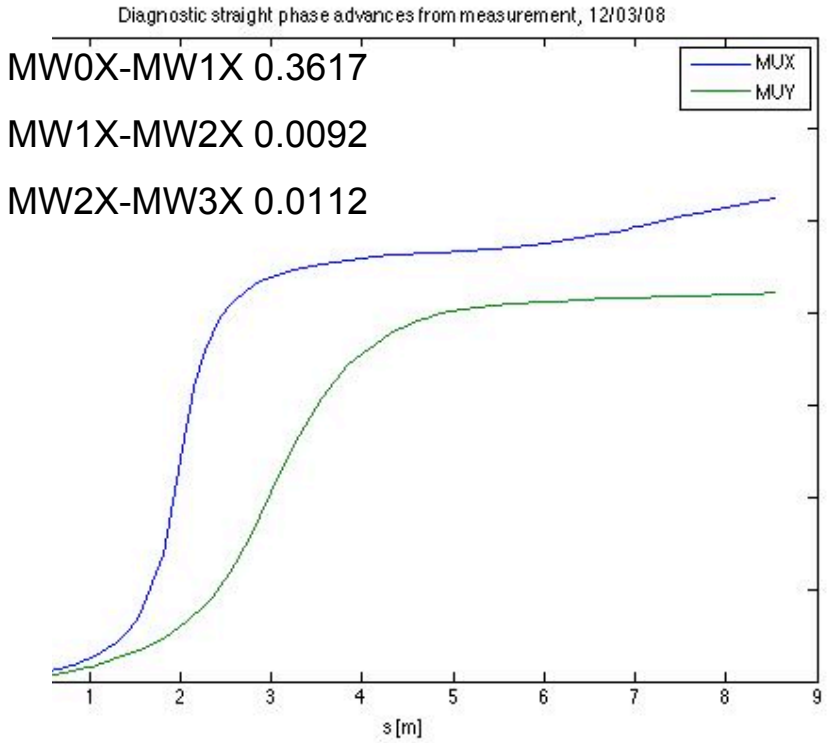
Optics in the FS

- The optics in the diagnostic straight need to be understood for precise measurements
  - Evolution of beam size
  - Emittance measurement: want Pi/N phase advance from station to station (N stations)
- In the recent shifts, optics measurement and matching in real time was very useful to understand the machine state and make effective measurements
- The flight simulation can be extended to include automated measurement and subsequent matching, with a iterative loop if needed

Measured diagnostic straight optics 12/03/08

S(MW1X) = 3.65m
S(MW2X) = 5.5m
S(MW3X) = 7.72m





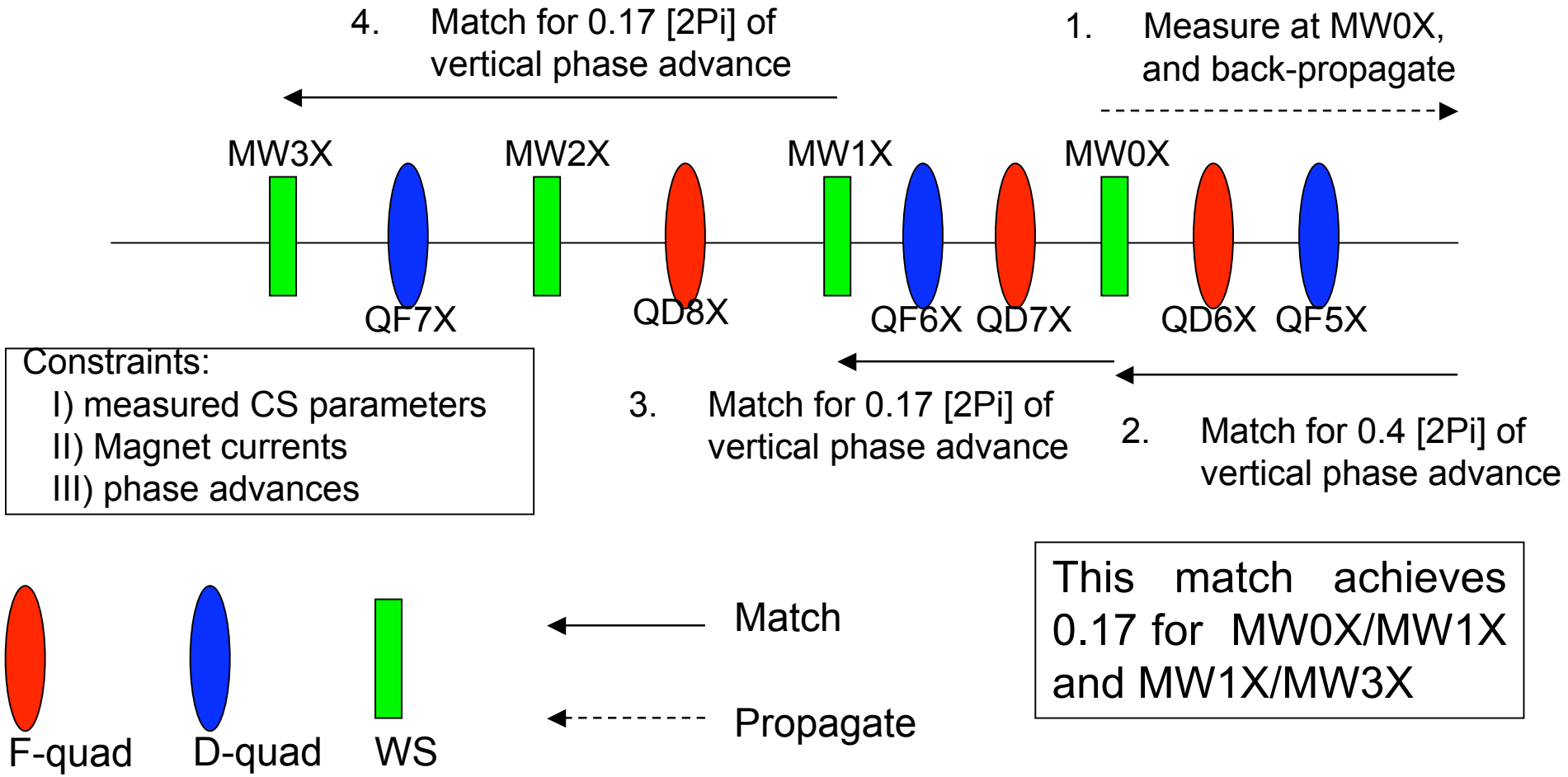
MW0X-MW1X 0.3617

MW1X-MW2X 0.0092

MW2X-MW3X 0.0112

CS parameters at MW0X reconstructed from WS measurements and linear optics.
The phase advances between WSs are not good (Pi/N)

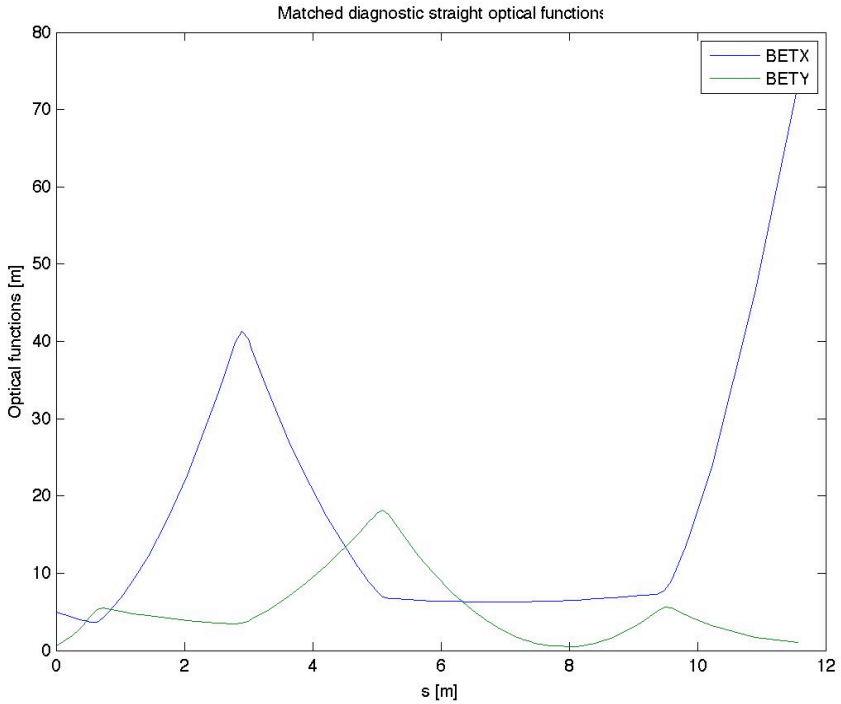
Matching strategy

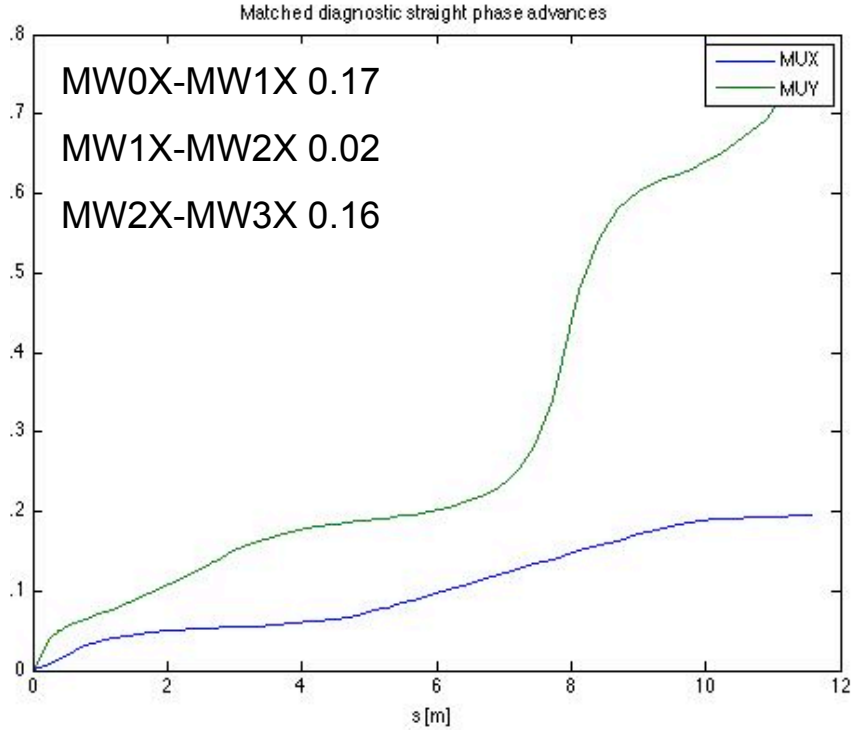


Magnet maximum strengths

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

Matching results





<u>Matched strengths</u>

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

Manual operational procedure

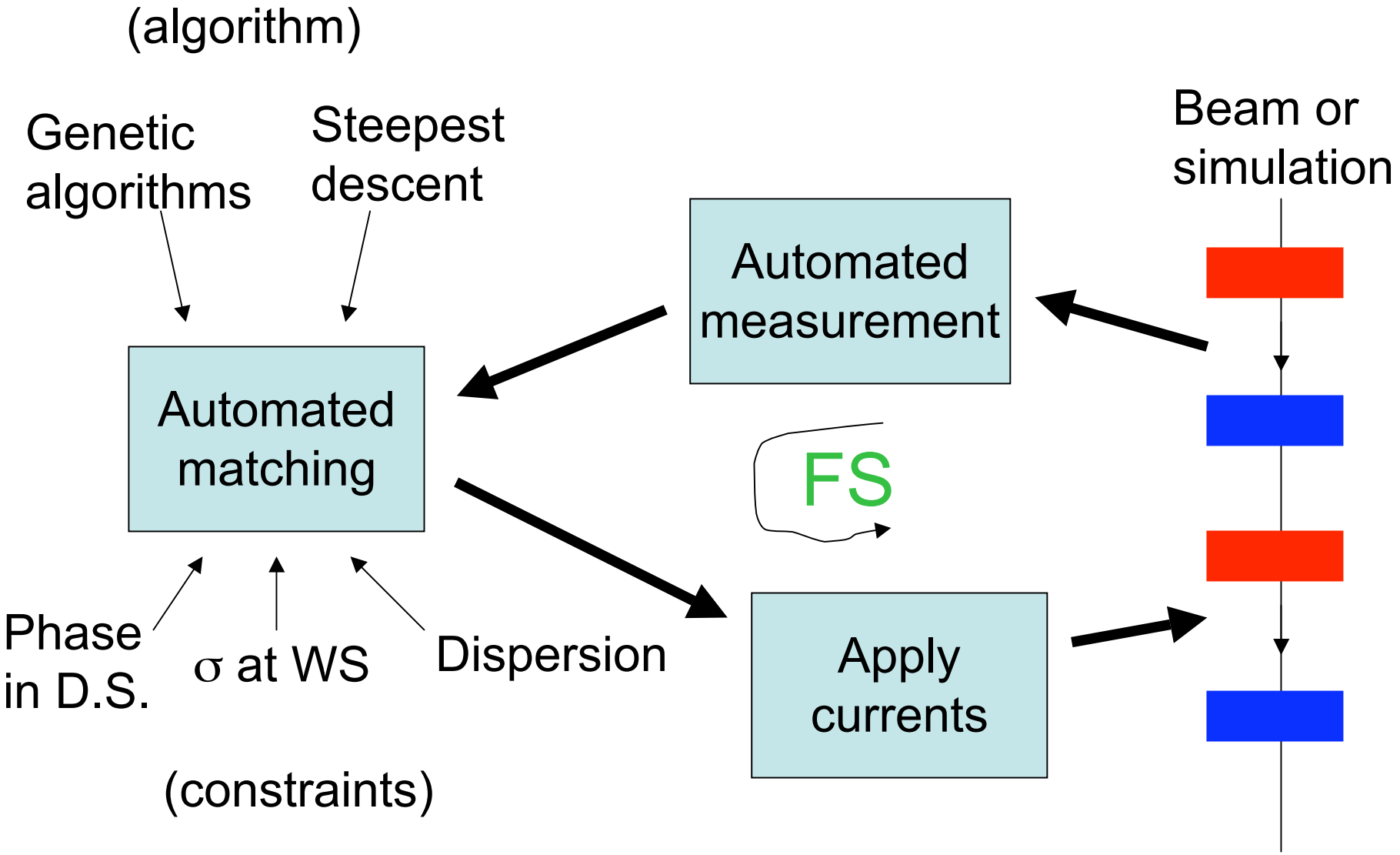
- Load some optics, and make a measurement of the CS parameters in the diagnostic straight
- Propagate to the start of the diagnostic region with magnet set file
- Using these optics,
  - rematch the phase advance to MW0X (QF5X and QD6X)
  - rematch phases MW0X/MW1X and MW1X/MW3X
- Generate set file, apply optics and re-measure the CS parameters in diagnostic straight

Automated operational procedure

- A set of Matlab tools has been written for this procedure e.g.

  get_twiss , match_phase, EXTQuadSetValues and so on
- If the FS was developed to automatically perform a measurement of the CS parameters at some point in the beam line
  - This information could be fed to a set of optics matching (phase, CS functions, dispersion etc) to achieve automatic optics for shifts
    - Wire scanning measurement optics in diagnostic straight
    - Quad scan optics
    - Dispersion free, or small beam size, optics at some point
  - In principle, provide fast optics feedback, and can apply sophisticated algorithms for selecting the point in magnet configuration space

Logical flow



Conclusions

- The measured optics from the 12/03/08 shift show a non-optimum phase advance between wire scanners, when wire scanning(!)
  - The optics were re-matchable
  - BUT, understanding and re-matching of the optics is a critical task for all experiments on the ATF (e.g. bumps, quad scans, laser wire and so on)
- Optics tools can, and should, be built into the FS framework, both for automated measurement, re-matching for a specific goal and feedback to and from the machine.
  - The starting point is the Matlab tools already written
- Some progress has been made in Matlab with optics tool, but there's plenty of scope for more, and plenty to do if people are interested