Recent work on Low Emittance Transport, Main Linac

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Agenda, after Dec. 11

- Webex meetings of the LET groups:
  - **Feb 05 2008**
    - Dynamic simulation @ Desy, Freddy Poirier
  - **Feb 28, Sendai Meeting.**
    - Dynamic Simulation, Summary, by F. Poirier
  - **March 18 2008**
    - Main Linac Dispersion Free Steering with Placet., J.R. Lopez, (Oxford, based on earlier work by D.Schulte et al, CERN)
    - Issues with DFS, K. Kubo.
  - **March 27-28**
    - Workshop on Beam Polarisation, Cockroft Inst.
  - **April 15:**
    - Sorting out DFS issues with Merlin, F. Poirier.

Methodology, Comments

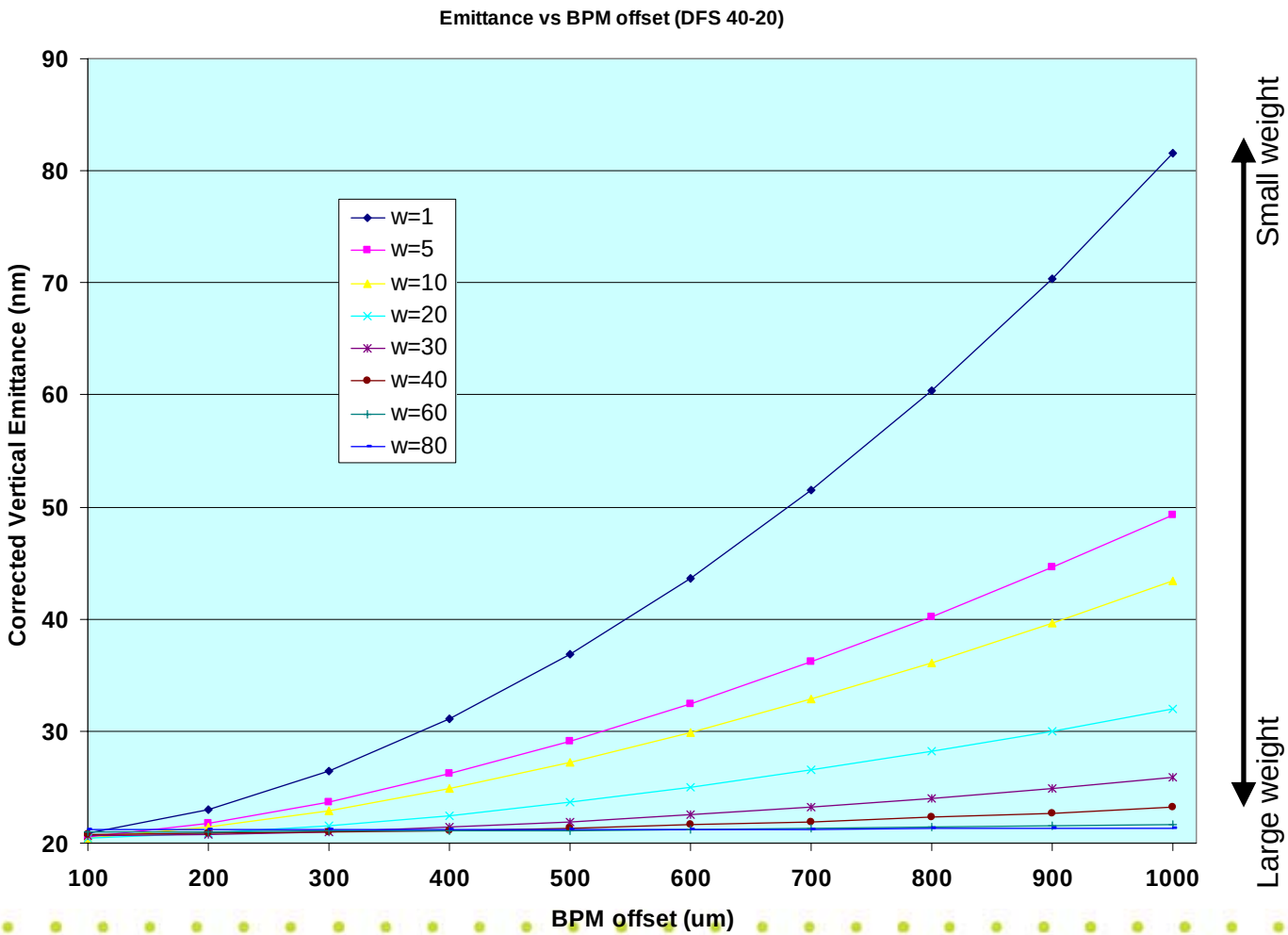
- Simulation must be Cross-Checked.
  - **And disagreement(s) resolved..**
    - Using different codes…
  - **Resolution**
    - Not always plain and simple programming bugs!
    - Slightly different assumption, or definition of imput parameters.
    - Steering algorithm details matters.
    - Complex problems => firm conclusions can rarely be reached…
- Static Tolerance errors

Simple Example: BPM offset

- K. Kubo noticed different sensitivity to BPM offset, result presented by K. Ranjan ~ 2 years ago.
- Studied by F. Poirier, (Desy), and Fermilab. (last year)
  - **Proper definition of reference frames..**
    - Improved misalignment model, SLAC meeting, Dec 2007
    - Implemented at KEK, Fermilab, CERN..
    - Was different than in LIAR, ~2005
  - **DFS Algorithm tuning**
    - Relative weight of the “1-to-1” to pure Dispersion Free Steering.
  - **Resolution: Difference tentatively understood,**
    - Good news: in the limit of “pure DFS”, the BPM static offset tolerance does not need to be that strict..

Emittance vs BPM Offset Error

- Vertical emittance versus the BPM offset is here checked.
- Energy Strategy:
  - **Grad= -20%**
  - **Init. Beam= -20%**



The slope of the emittance versus the BPM Offset is highly dependent on the weight chosen

I.e. difficult to make a direct comparison between codes without the knowledge of the weight used in the various code (and understanding of the DFS algorithm)

Corrected Emittance= Energy Correlation numerically removed.

A bit more difficult: Cavity Tilts

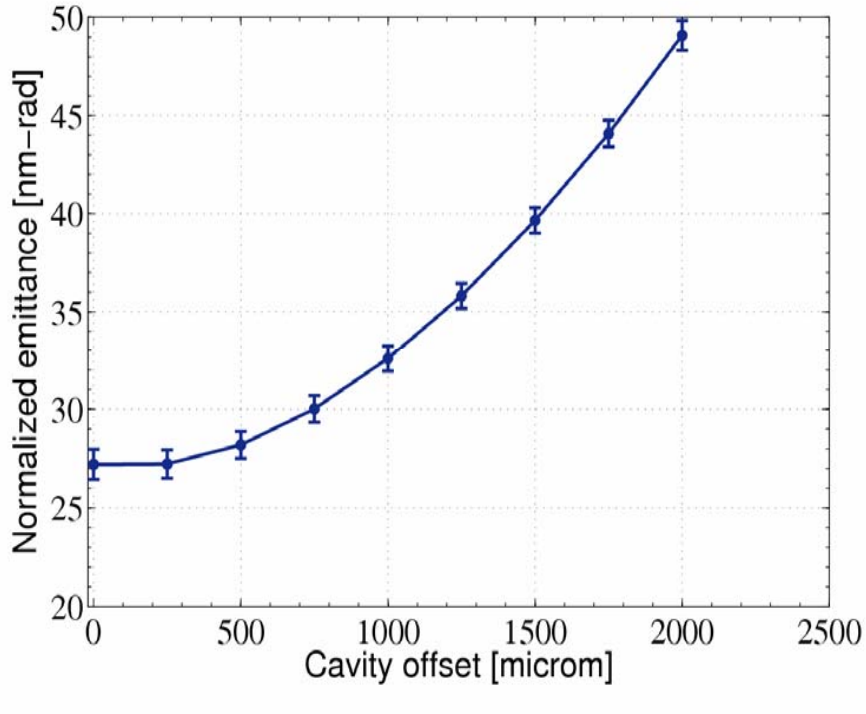
- Again, disagreement among various code on the required tolerance for cavity tilts
- Recently studied by F. Poirier, (Desy), and J. Lopez, Oxford

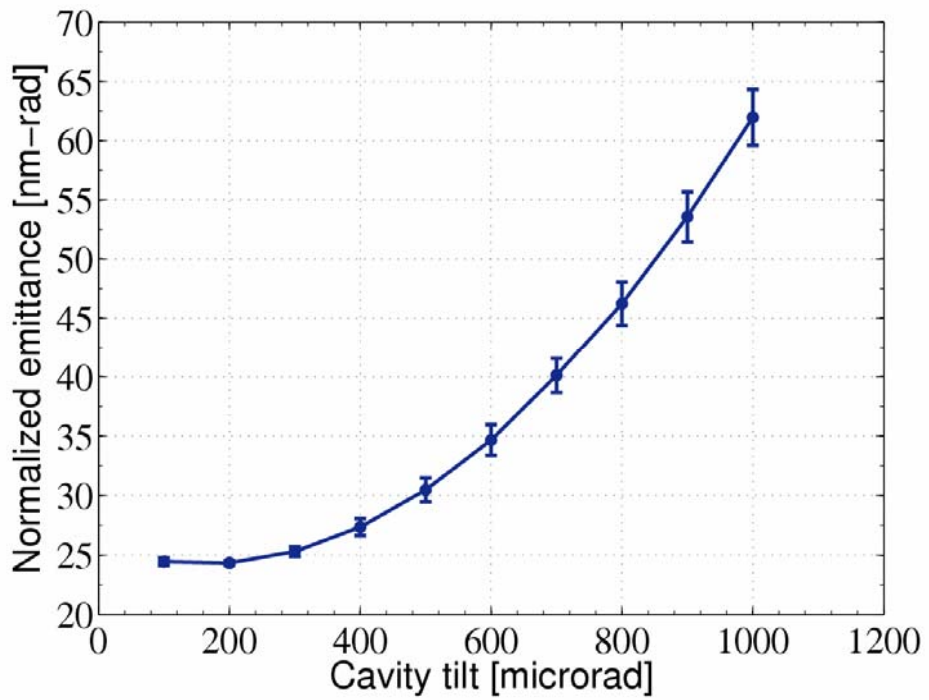
Some preliminary results

Emittance growth versus cavity errors

From J. Lopez, Oxford.

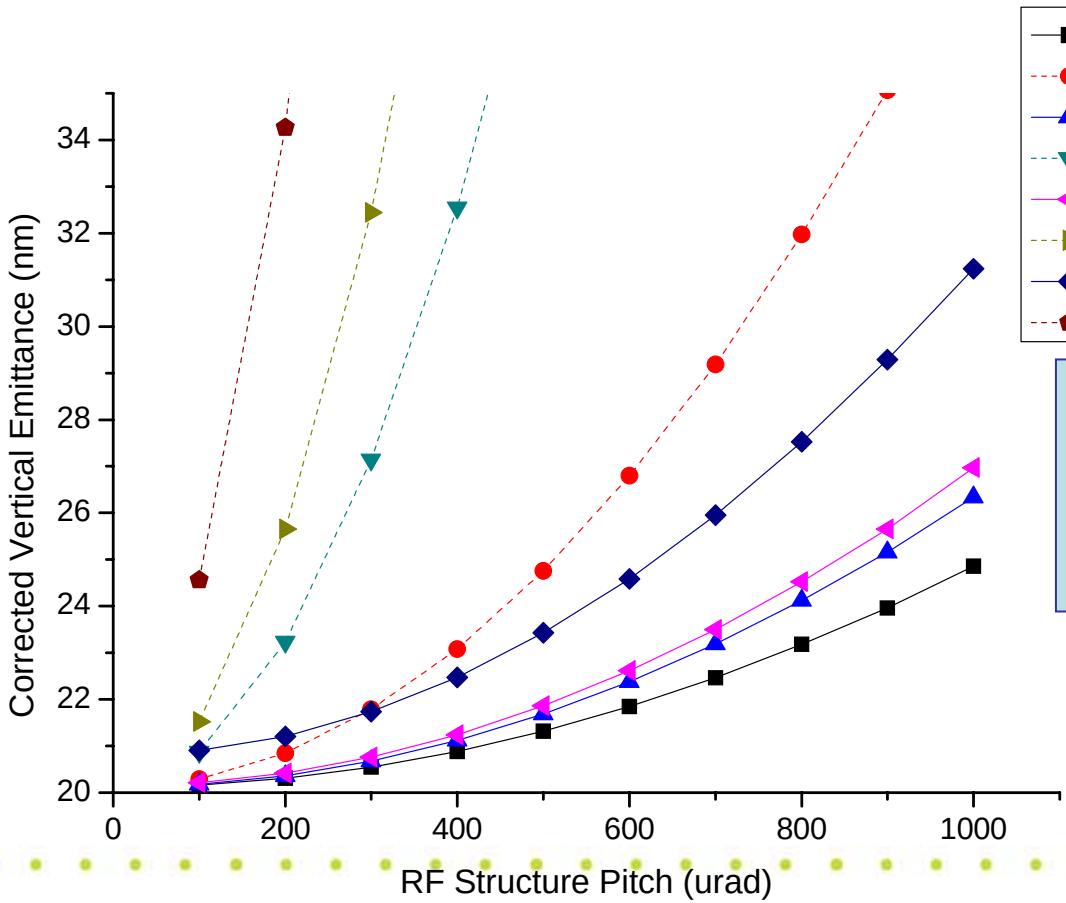
Average over 100 random seeds.
In this case the error bars indicate the standard deviation





Pitch Error

- Close-up from previous slide:



IB (Initial Beam Energy):

Dash → IB=0%

Plain → IB=-20%

The use of a 2nd test beam with an initial decreased energy allows here to be less sensitive to RF structure pitch errors

→ This can explain the difference between KK results and K. Rajan results (*)

(*) Though a clear understanding of the various algorithm used for DFS would further help to know where might be other differences

Cavity Tilts

- Other codes: CHEF, Fermilab…
  - **Never been able to reproduce such good performance with near pure DFS, with SVD null space suppression, with large (~ 500 micro-radian) pitch angle !!.**
  - **To be checked:**
    - Tracking accuracy through rotated r.f. Cavity fields, with Wakes field.
- Remains a critical items, for the upstream section of the linac (~ 1st kilometer), and the RTML.

Dynamic Simulation

- Progress at Desy:
  - **Talk at the last GDE meeting, Sendai. !!**
- Does not mean we are “done” !..
  - **Note: Past experience:**
    - RunII Tevatron designers did not requested a slow feedback system for accurate control (~10 microns resolution BPM) of the Helical orbits Proton/Pbar in the Tev, during a ~ 20 hour store..
    - And our emittance are ~ 50 smaller…
- No easy and quick gains: This is work requires dedicated man-power.

Conclusion

From F. Poirier, Sendai

- Quite a few studies which include dynamic effects
  - **Ground Motion & Vibration**
  - **Slow correction (1-to-1, Mikado)**
- More to be done:
  - **Strategy of the slow correction has to be reviewed (continuous steering or periodic, on entire lattice or sections)**
  - **Effectiveness of steering with Ground motion**
    - With machine initially tuned
    - More realistic GM (?)
  - **Effectiveness of fast feedback for ML**
  - **Coupling action of fast Feedback**
    - Application strategy of several FFB (e.g. gain)
- Will have to integrate the above effect into the start-to-end simulations
  - **Steering in the undulator (?)**
- **Missing here:**
  - Complete review of what has been done
  - Concrete step by step plan for the work

LET “Work” @ Fermilab

- Related Non-ILC work:
  - **Code Stabilization after PAC07**
    - Upgraded my LET code to latest release of HEF (our local code)
    - Adapted and documented the CHEF-LET code such that we have a maintained LET example, from which we can start again..
  - **Kept in touch!**