Report Session 3
Comparison modeling/experiments

- ESRF
  - Non linear behaviour: a few puzzling points (Annick Ropert)
- DIAMOND
  - Calibration of non-linear ring model
    (Riccardo Bartolini)
  - Comparing measured/design performance
    (Ian Martin)
- SOLEIL
  - Comparison modeling/reality: transverse dynamic aperture
    (Laurent Nadolski)
- + LHC (SPS) on-line modeling (Frank Schmidt)

1. Experimental equipment

Pingers: very powerful for…
1. creating turn by turn beam signals for FFT
2. direct probing of transverse apertures
- require calibration by scraper

→ Scrapers

Turn by turn BPM system
- ~ 10 micron resolution
- take into account nonlinearity of BPM calibration!

Lifetime measurement
- Current transformer
- Sum signal of BPMs (faster)

2. Methods for experiment and model-based machine improvement

LOCO is standard technique
- Beta beat correction 1% (Diamond), 0.3% (Soleil)
- Coupling suppression 0.1% (Diamond)
- Vertical dispersion 0.3 mm (Diamond)

Frequency maps
- Tunes as function of momentum and transverse amplitudes
- Same method (FFT/NAFF) for tracking code and experiment

Resonance identification in beam spectra
- record *all* BPMs for comparison with tracking, because amplitude and phase of resonance varies along ring

- rather short samples (Diamond: 128 turns):
  resonance order m+1 decoheres m x faster than fundamental
- NAFF standard method for evaluation of spectra
- **Suppression of resonances by LOCO-analogue method for sextupole corrections → real gain in lifetime/acceptance!**

3. Results: achieved level of understanding the machines

Linear optics: good agreement model/reality
- Tunes, beta, dispersion: agreement
- Chromaticity: deviation for Diamond. General: model imperfections?
- Equilibrium parameters: ok

Nonlinear optics:

> Tune shifts / frequency maps
Agreement model/reality requires some iterations and model refinements…
- Diamond: sextupole scaling – calibration error?
- ESRF ok, new possibilities by increased number of sextupole families
- Soleil: ok
- [BESSY: including octupole moments in quadrupoles to get agreement]

> Resonance driveterms
- SPS/Tevatron: agreement with model prediction achieved.
- Diamond: successfully used for lifetime increase (proves agreement)
- ESRF: practical approach: dedicated sextupole correctors for suppression of single resonances: it works!

> Acceptances
- Vertical: well understood:
  - Given approx. by physical limit due to ID gaps,
  - dynamic slightly less due to nonlinear distortions.
- Horizontal & injection efficiency:
  - **Horizontal DA usually less than model, not fully understood.**
  - But large enough to provide good injection efficiency.
- Longitudinal and Touschek lifetime:
  - Diamond, Soleil, ESRF: ~ok for bare lattice
  - ESRF: breakdown at -1% dp/p, but no impact on lifetime
  - Soleil: strong impact from IDs

Conclusion:
- Exploit turn by turn BPM signals also for nonlinear machine optimization
- Work on understanding of horizontal acceptance limitations
- Modeling of insertion devices and understanding/compensation of their effects