HB2014
East Lansing, MI
10-14 November 2014
54th ICFA
Advanced Beam Dynamics
Workshop on High-Intensity,
High Brightness and
High Power Hadron Beams

Summary of Working Group D: Accelerator System Design, RF, Injection and Extraction

S. Gilardoni – CERN

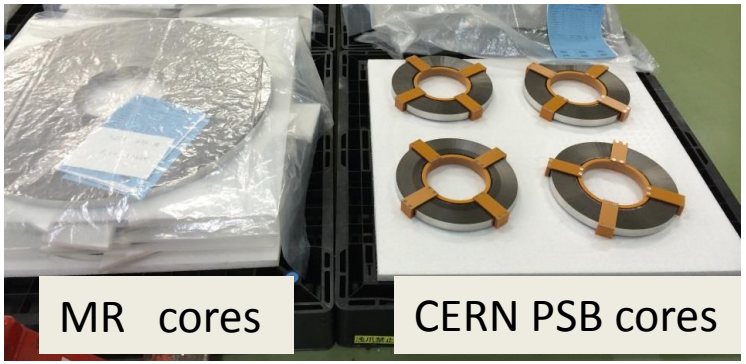
M. Plum – SNS

S. Wang – IHEP (Absent due to VISA problem)

Working Group D

- 12 Talks
  - 2 talks on remote connection
  - 1 recorded audio in powerpoint
- +3 shared with WG-A
- 2 discussion sessions

High Gradient RF System for Upgrade of J-PARC (C. Ohmori)



Impressive RF cavities:

- broadband
- for upgrade 70 kV or >30 kV/m.
  280 kV -> 560 kV with 9 cav.
- needed to increase MR rep rate from 0.40 to 1 Hz.
- Developed Finmet FT3L. Already used in operation

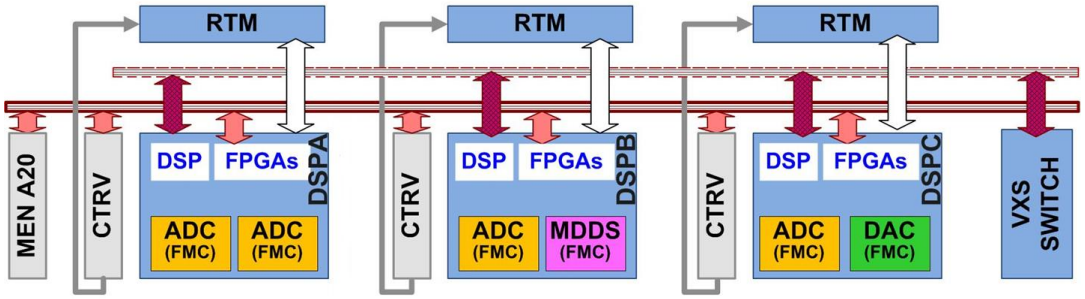
Interesting that Cu ions degrade performance so need water cooling that is separate from the magnet cooling.

In 2017 add 2nd harmonic but air cooled.

FT3L will also be used in PSB h=1 and h=2 and PS longitudinal damping cavities.

Upgrades of the RF Systems in the LHC Injector Complex (H. Damerau)

- PSB RF upgrade will use the J-PARC developed FT3L Finemet, for both h=1 and h=2. Solid state amps down at beam line, seems to be OK with radiation.
- New PS longitudinal dumper Finemet based for coupled bunch instability
- Upgrade to 200 MHz in SPS 750 kW to 1.6 MW, arrange in different manner plus new power plants, needed for HL-LHC, now good for 1.3e11 ppb, need >2e11 ppb.
- Upgrade of 800 MHz, used for bunch shortening and longitudinal emittance controls.



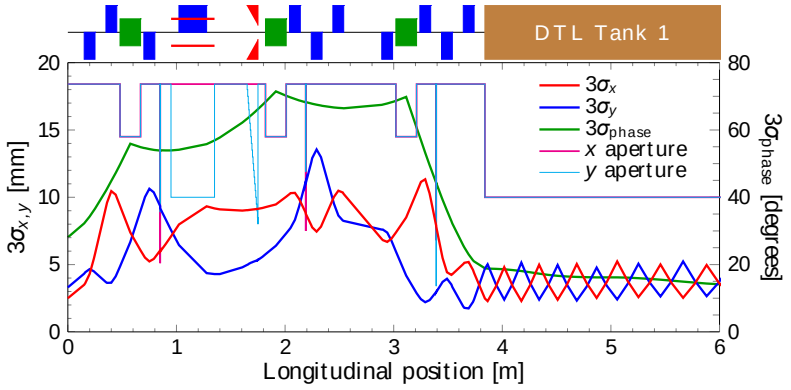
Enhancements of the Fermilab Booster to Reduce Losses and Extend Lifetime: The Proton Improvement Plan (R. Zwaska)

PIP overview: bring the FNAL complex to deliver 700 kW pot

- Many upgrades for Linac and Booster
- Linac Laser notching is unique (chooper like), to be installed next year. Needed for clean extraction from Booster.
- Plan to replace 7835 Linac 201.25 MHz tube (MTBF is 10 h) with klystron. Note that LANSCE chose diacrode.
- 2 ion sources
- Booster built for 15 Hz but some components limited to 7.5 Hz. Refurbishment of 40-y old cavities

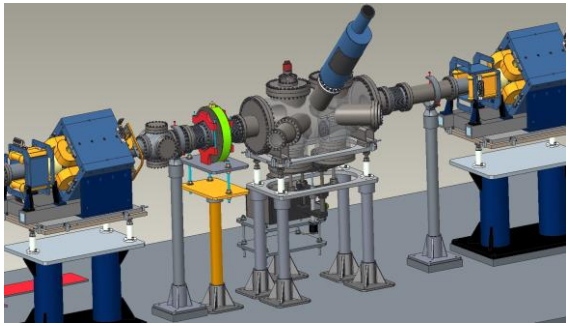
CURRENT STATUS ON ESS MEDIUM ENERGY BEAM TRANSPORT (R. Miyamoto)

- MEBT functions: Chopping, Scraping, Diagnostics ,Matching
- 3 scraper locations, each with 4 TBLR scrapers.
  - Positioned to intercept partially chopped beam.
- Chopping efficiency better than 99%
- Full of beam diagnostics



Status of Preparations for a 10 µs Laser-Assisted H- Beam Stripping Experiment (S. Cousineau)

- Goal: Demonstrate H- laser-assisted stripping with 90% efficiency for a 5 – 10 µs, 1 GeV H- beam.
- Build on success of 6 ns experiment >90%. Now 10 us, 10 Hz, 1 GeV, in 2016.
- Laser $1M , on hand and meets req. incl. 3 MW peak power.



- Req. beam optics has just now been demonstrated

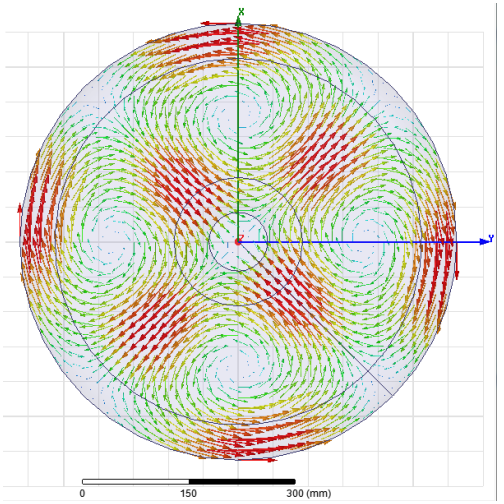
The Design and Construction Status of Injection and Extraction system for CSNS/RCS (S. Wang)

- First beam in Aug. 2017.
  - 10 kW in Sept. 2017.
  - 100 kW 2021.
- Demonstrated injection painting pulsed power converters.

- Demonstrated extraction kicker pulsed power system.

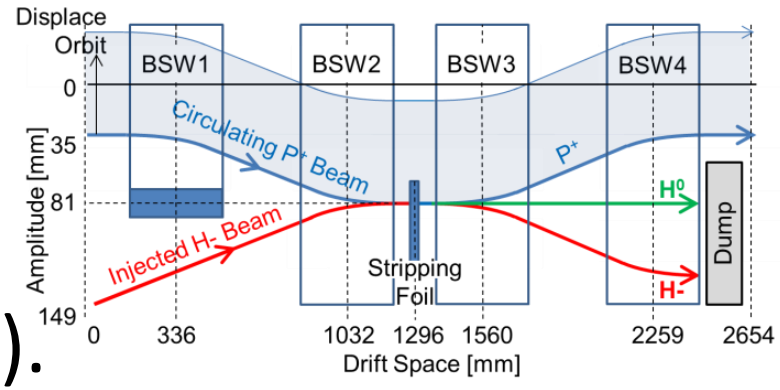
RF quadrupole for Landau damping in accelerators. Analytical and numerical studies (A. Grudiev)

- 47 m of octupoles could be replaced by 6 800 MHz superconducting cavities 1 m total length to Landau damp the most unstable modes
- Advantage is less real estate and does not limit dynamic aperture.
- Test in SPS is being proposed.



Brighter Beams for LHC - New PSB H- injection and PS 2GeV transfer (W. Bartmann)

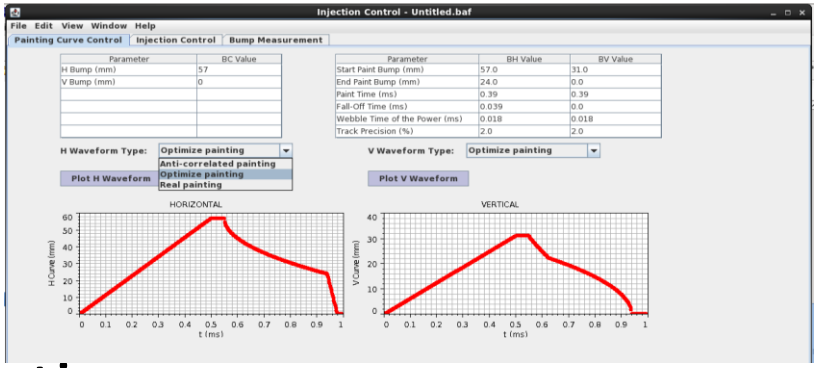
- PSB H^- injection at 160 MeV with L4
- 15 turn inj. : must minimize emittance, so match Twiss param., no painting.
  Diff. from SNS, PSR, ISIS.
- Note that see emit growth in FNAL Booster (disc. Session).

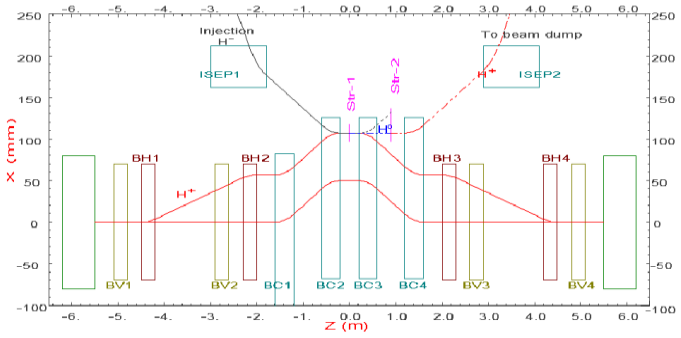


- Eddy current septum for PS with injection bump integrated.

Study on the particle distribution and beam parameters during the injection process for CSNS/RCS (M.-Y. Huang)

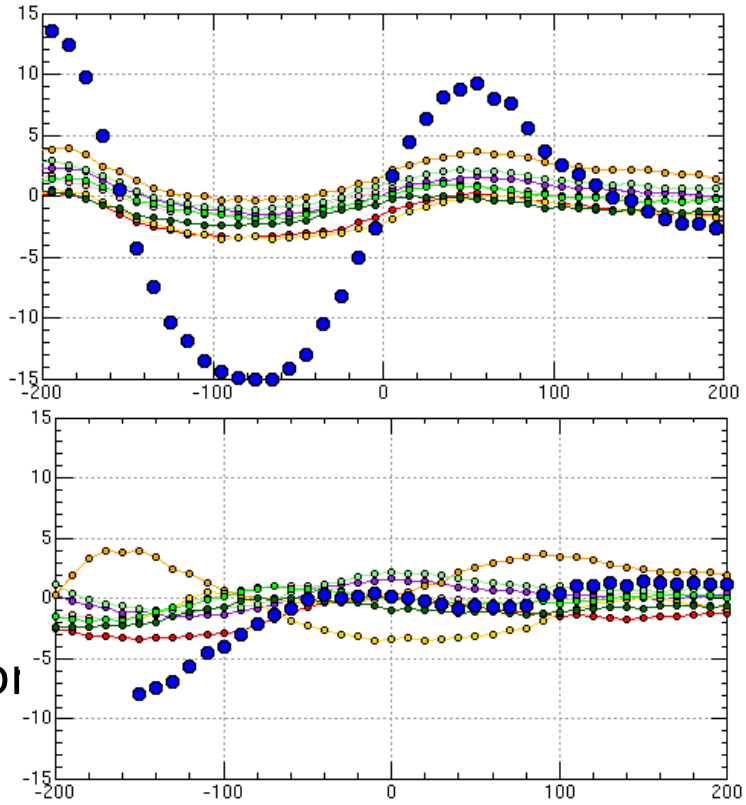
- Simulated correlated and anti-correlated injection painting.
  - Either one seems OK.
  - Control software is ready.
  - Also for orbit correction at injection.





Dynamic correction of extraction beam displacement by field ringing of extraction pulsed kicker magnets in the J-PARC 3-GeV RCS (H. Harada)

- 8 extraction kicker flat tops are not flat due to dual thyratron drive.
- If uncorrected, leads to non uniform distribution on target and losses in MR.
- Fixed by adjusting timing by up to 200 ns to cancel components and optimize flat top summation.
- Position variation +10/-14 to +0.6/-1.1 mm at a BPM in the extraction line.
- Also implemented automatic timing correctio to adjust for drift in thyratron firing time.

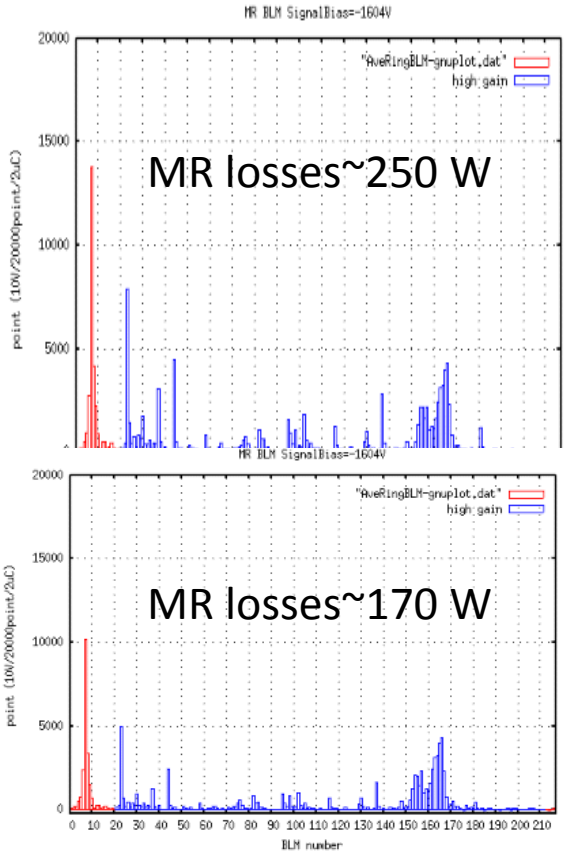


Modeling and Feedback Design Techniques for Controlling Intra- Bunch Instabilities at CERN SPS Ring

- Talk given be Rivetta over Bridget rather than Turgut in person.
- Planning model-based feedback controller.
- For SPS e-p instability and TMCI.
- Being designed for Q20 optics which is optimized for the low gamma transition.

Pulse-to-pulse transverse beam emittance controlling for the MLF and MR in the 3-GeV RCS of J-PARC (P. K. Saha)

- Pulse-to-pulse emittance control.
  - MLF needs big emittances, MR small emittances
- Two methods for horizontal.
  - Use Pulse Steering magnets (PSTR1,2) + Horizontal painting magnets.
  - using only Horizontal painting magnets
- Prefer magnets in RCS because it is better for injection dump.
- Achieved 30% reduction in MR losses.



Discussion sessions

- H^- injection: Discussed possibility of testing emittance growth of 15 turn H^- injection for CERN application. FNAL is similar, and sees growth, but may be due to impedances.
- Future plans for further develop the FT3L Finemet material. J-PARC has conservative application now, may push in future to higher gradients and higher frequencies.
- Discussed hybrid cavities with Finemet core surrounded by ferrite. Could be interesting area for future work

A legacy for future discussions…

- Accelerator system design

a) High-intensity high-power hadron linacs are moving to designs based on superconducting cavities.

b)The change-over from warm to cold RF cavities is moving to lower and lower energies. What are the practical limitations to the change-over energy, and what energy makes the most sense with today's technologies?

c) Protection devices for injection/extraction elements: are techniques using passive devices considered sufficient? Any new idea (like electron lenses or plasma lenses) of any use?

d) Kickers are one of the most relevant source of impedance for high intensity fast cycling machine. Are the simulation codes for impedance and the impedance measurement techniques sufficiently precise and predictive? Any news on that? Any alternative technique to reduce impedance?

II. RF systems

a) What are the limitations in the accelerating gradients achievable today?

b) What are the limitations of active (kicker like) longitudinal damping systems?

III. Ring injection

a) Charge exchange injection today is done almost exclusively with stripper foils. But some applications today are almost at the limits due to foil heating. What are the alternative technologies, and where do they stand?

b) How well we can predict and in operation control the transverse emittances and intensities resulting from charge exchange injection?

- Thanks for
  - The very interesting talks
  - The very interesting discussions
  - The remote speakers
  - Respecting the time allocated despite the Italian conveners…
  - The nice venue…