

Potential Collaboration Subjects for Beam Physics

R. Miyamoto

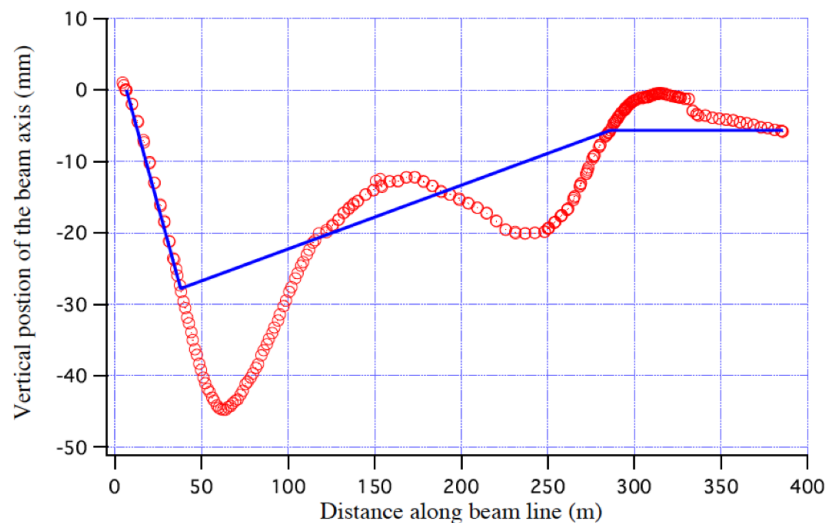
M. Eshraqi, Y. Levinsen, C. Plostinar

ESS - J-PARC Workshop
18-19th of January, 2018

- We made last min changes on the subjects, to suite to the expertise of the participants.
 - Beam Dynamics Error Studies of the ESS Linac (Y. Levinsen)
 - ESS neutrino beam studies (M. Eshraqi)
 - ESS Linac Integrated Planning for the Installation, Testing, and Commissioning (C. Plostinar)
- At the moment, beam physics has no active collaboration.
 - Except for occasional email exchanges and discussions during conferences and workshops.
 - I will list potential collaboration subjects in 1 page.

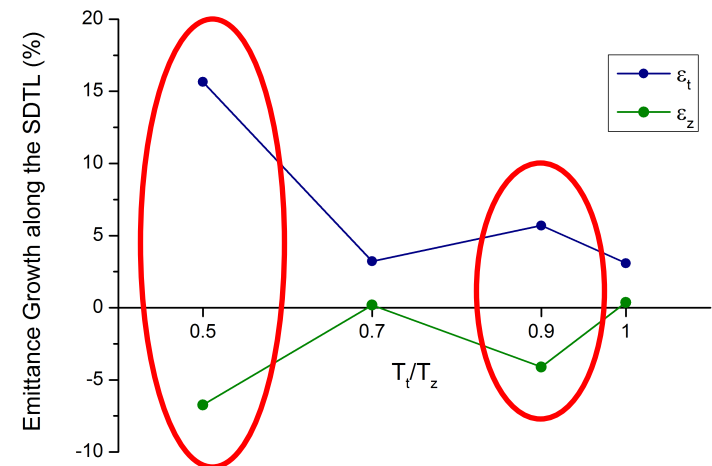
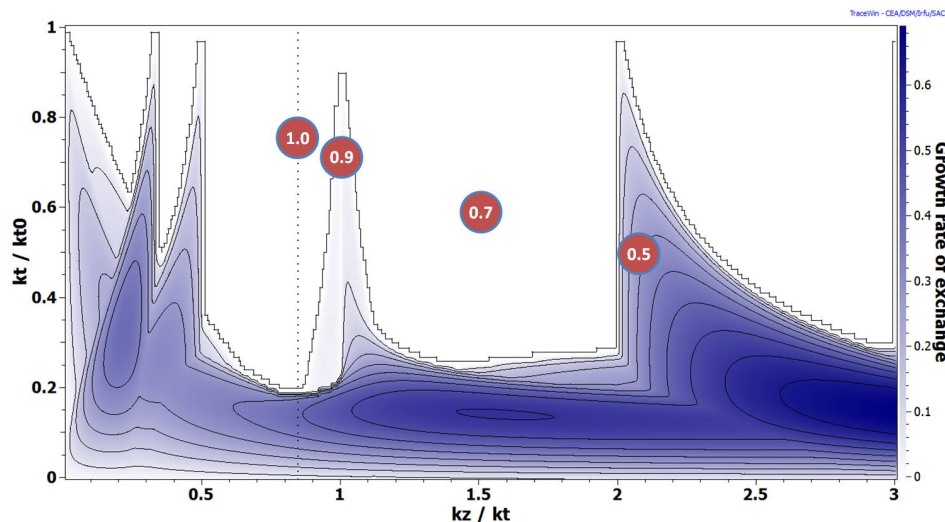
Past relation (1): Miyamoto's visit to the start-up in 2011

- R. Miyamoto made a ~2 weeks visit in Dec 2011, to observe the start-up after the earthquake.
- The experience has provided useful inputs to the ESS beam commissioning planning.
- **Sharing experiences in the linac commissioning/tuning and operation are useful for ESS. It is even better if we could send more physicists/operators to observe the J-PARC start-up.**



Past relation (2): Plostinar's collaboration in beam dynamics study

- Before arriving to ESS, C. Plostinar made several visits to J-PARC to do an experimental beam dynamics study.
- The space-charge resonance and equipartitioning conditioning were studied in great detail. (IPAC13 THPWO087)
 - The study in 2012 changed the “temperature” ratio ($T_t/T_z \sim k_t \epsilon_t / k_z \epsilon_z$) in SDTL to 4 different values: 1.0, 0.9, 0.7, and 0.5.
 - Some cases were consistent with the simulations and the other cases were not...
- This type of study is useful for further machines, but do we have time and resources to conduct this type of detailed study together?

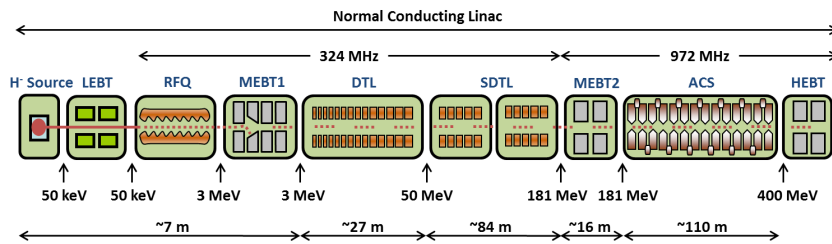


Potential future collaboration subjects

- Expertise transfer during commissioning and operations
 - Sending people each other?
- Beam commissioning and tuning
 - Algorithms and applications for the machine tunings.
 - OpenXAL and online model.
- Beam dynamics study
 - As the main tracking code, J-PARC use IMPACT and ESS dose TraceWin. We can do a cross-check of the machine and code.
 - Beam dynamics studies along the line of the C. Plostinar's study, for pushing the limit of the beam current.
 - ESSvSB collaboration is studying a neutrino program upgrade and could use expertise in H- linac. (More info in <https://indico.esss.lu.se/event/965/>).

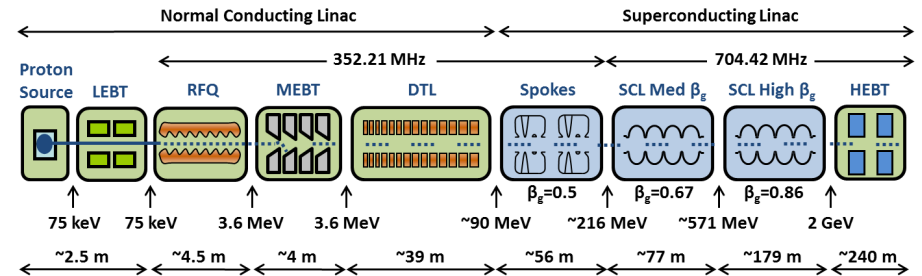
ESS linac vs J-PARC linac (backup)

J-PARC (Equipartitioned)



Ion Species	H ⁺	
Output Energy	400	MeV
Frequency	324/972	MHz
Pulse Length	0.5	ms
Peak Current	30/50	mA
ions per Pulse	9.4 x 10 ¹³ / 1.5 x 10 ¹⁴	
Repetition Rate	25	Hz
Duty Cycle	1.25	%
Average Beam Power	80/133	kW
Accelerating Structures	RFQ, DTL, SDTL, ACS	
Accelerator Length	~244	m

ESS (Equitunedepression)



Ion Species	Protons	
Output Energy	2	GeV
Frequency	352.21/704.42	MHz
Pulse Length	2.86	ms
Peak Current	62.5	mA
Protons per Pulse	1.1 x 10 ¹⁵	
Repetition Rate	14	Hz
Duty Cycle	4	%
Average Beam Power	5	MW
Accelerating Structures	RFQ, DTL, SC Spokes/Elliptical	
Accelerator Length	~365	m