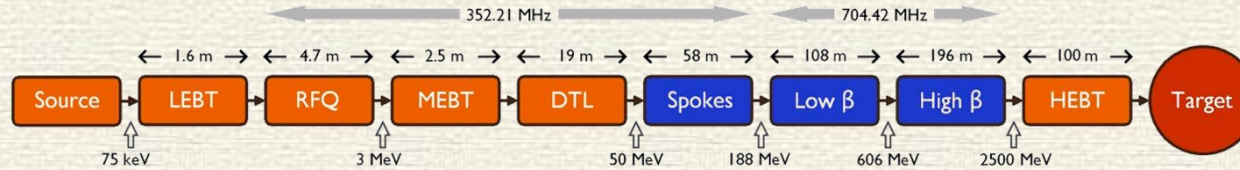


Time Structure of the ESS Proton Beam

Håkan Danared
European Spallation Source

ESS, 22 September 2011

Main Parameters of ESS Proton Linac

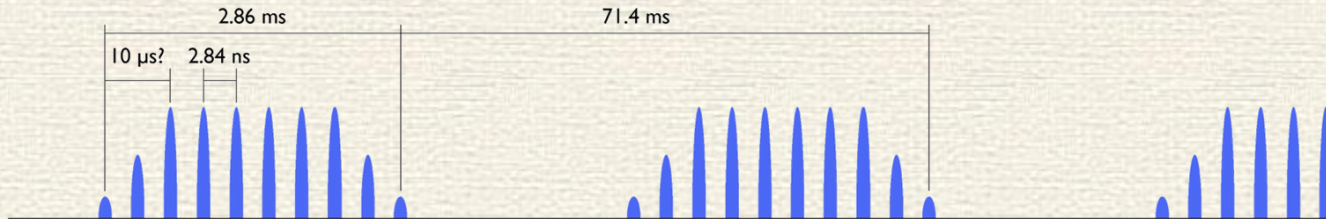


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Top-Level Parameters	Unit	Value
Average beam power	MW	5
Proton kinetic energy	GeV	2.5
Average macro-pulse current	mA	50
Macro-pulse length	ms	2.86
Pulse-repetition rate	Hz	14
Maximum cavity surface field	MV/m	40
Maximum linac length	m	392

Section	Lab	Energy _{out}	Beta _{out}	Length	Temp	Freq
Ion source	Catania	75 keV	0.01	2.5 m	300 K	-
RFQ	Saclay	3 MeV	0.08	4.7 m	300 K	352 MHz
MEBT	Bilbao	3 MeV	0.08	2.5 m	300 K	352 MHz
DTL	Legnaro	50 MeV	0.31	19 m	300 K	352 MHz
Spokes, $\beta_{opt} = 0.50$	Orsay	188 MeV	0.55	58 m	2 K	352 MHz
Ellipticals, $\beta_g = 0.70$	Saclay	606 MeV	0.79	108 m	2 K	704 MHz
Ellipticals, $\beta_g = 0.90$	Saclay	2500 MeV	0.96	196 m	2 K	704 MHz
HEBT	Århus	2500 MeV	0.96	100 m hor	300 K	-

Proton Pulse Structure – Basic

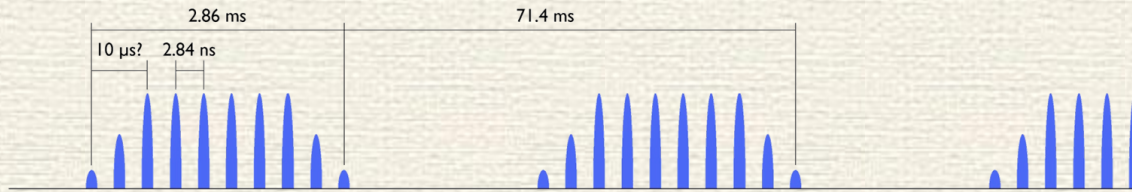


Basic time structure is given by

- Pulse repetition frequency 14 Hz
- Pulse length 2.86 ms ($=20/14 \times 2$ ms)
- Bunch frequency 352 MHz (RF frequency 352 and 704 MHz)
- Rise and fall times of power supplies etc.



Proton Pulse Structure – Variations



Original (not to scale!)



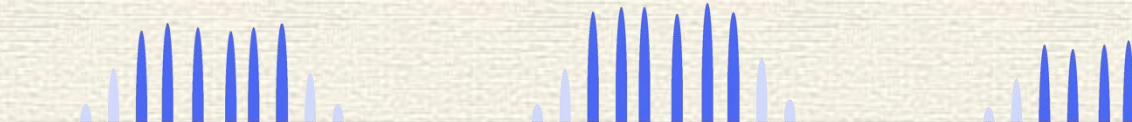
Chopped flanks, 0.1–1 μs?



Beam to parasitic experiment at end of pulse

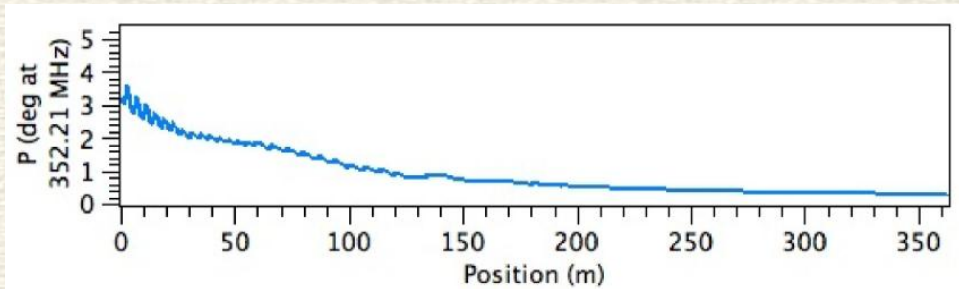


Beam to parasitic experiment in middle of pulse



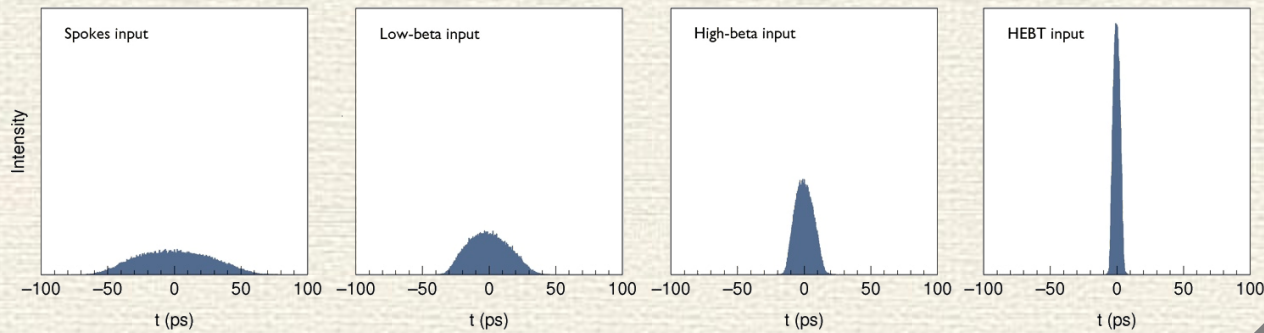
Intensity and timing fluctuations from ion source, RF and other devices

Bunch Profiles



Bunch length through superconducting linac, 1 degree at 352 MHz corresponds to 8 ps.

M. Eshraqi, HS_2011_06_22



Bunch profiles at spokes, low-beta, high-beta input and SC linac output.

Bunch profile at SC linac output, compared to Gaussian and parabolic.

