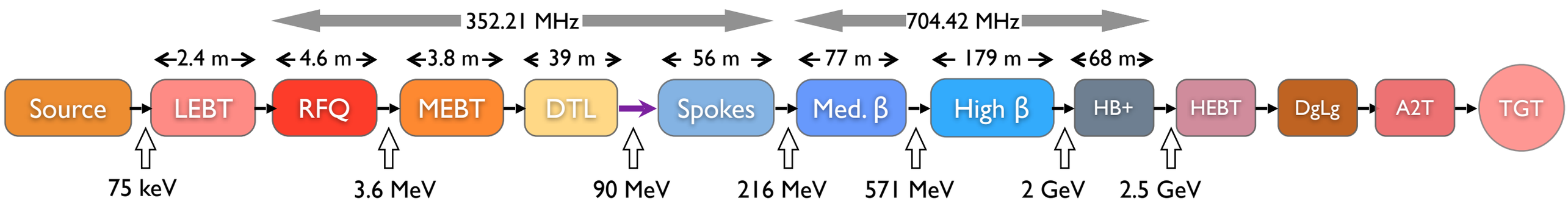
EUROPEAN SPALLATION SOURCE

28 Hz vs. 70 Hz

FEASIBILITY AT <10% DUTY CYCLE



H- source

Front End

SC cavities (couplers, cavities)

Cryogenics

RF (Modulators, SSA, Tubes), LLRF

Beam physics (Halo, losses)

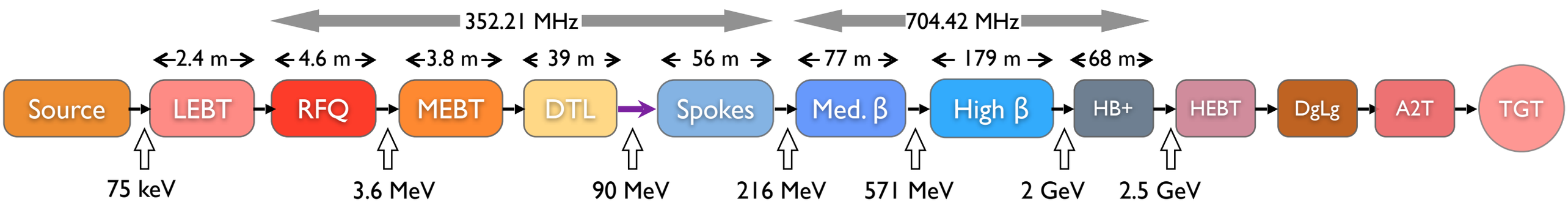
Operations, Reliability, Availability and Safety

L2R

Ring

R2T

Feasibility at >10% Duty Cycle



H- source

Front End

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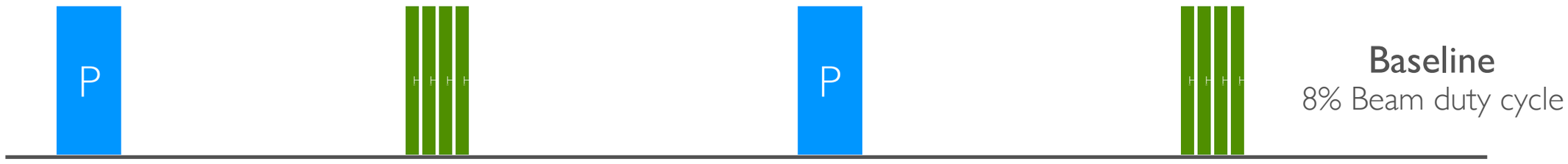
L2R

Ring

R2T

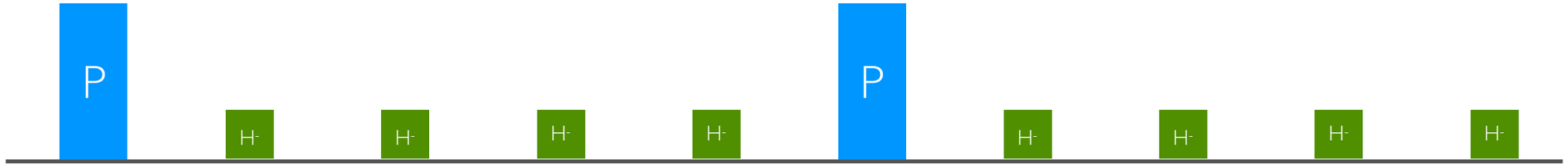
PULSING

A



Baseline
8% Beam duty cycle

B

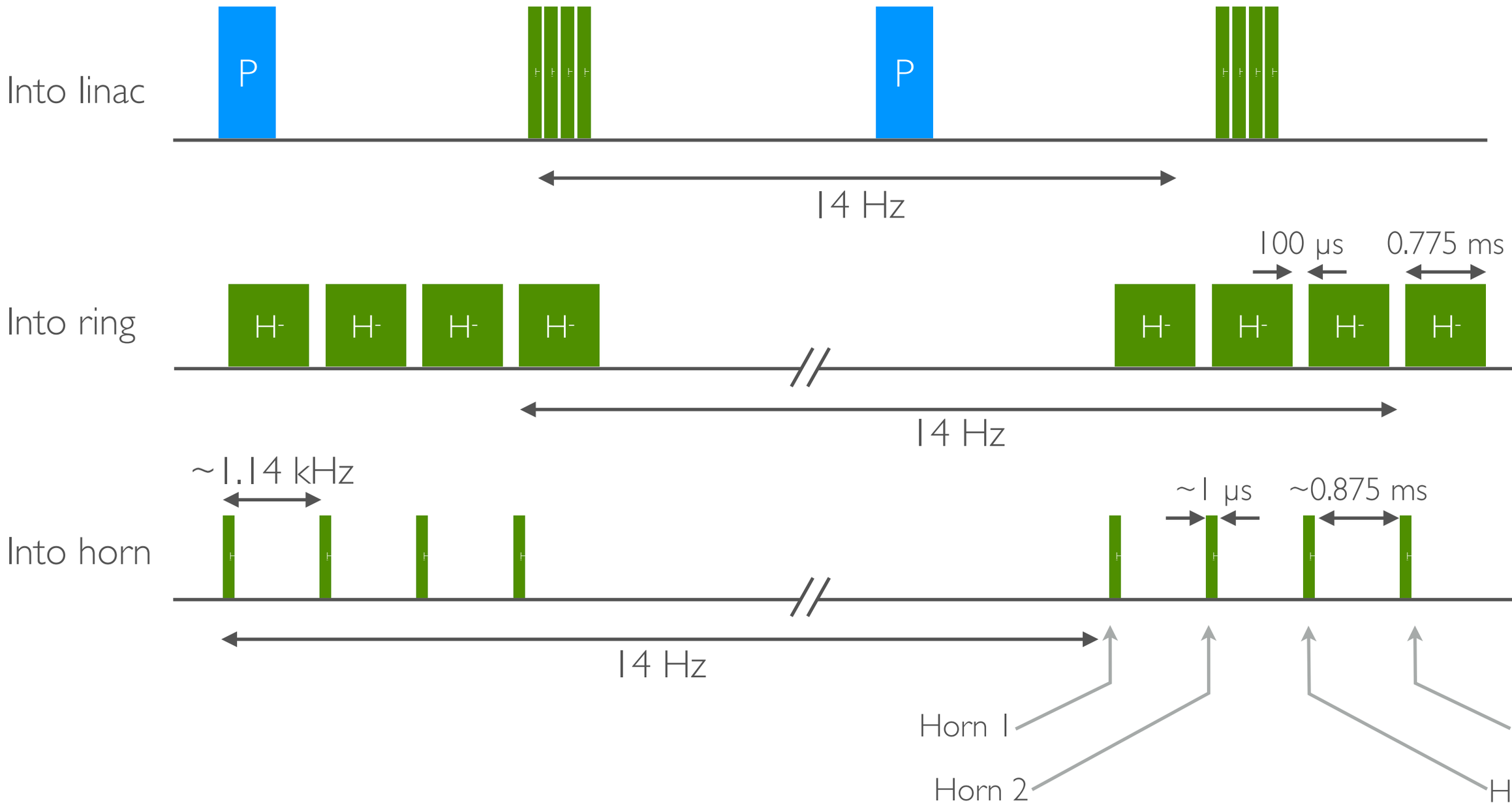


C

Note the new labels for different pulsing schemes. “A” is the baseline

PULSING II, A+ CASE

- Increasing the modulator pulse to 4 ms and the beam pulse length to 3.4 ms



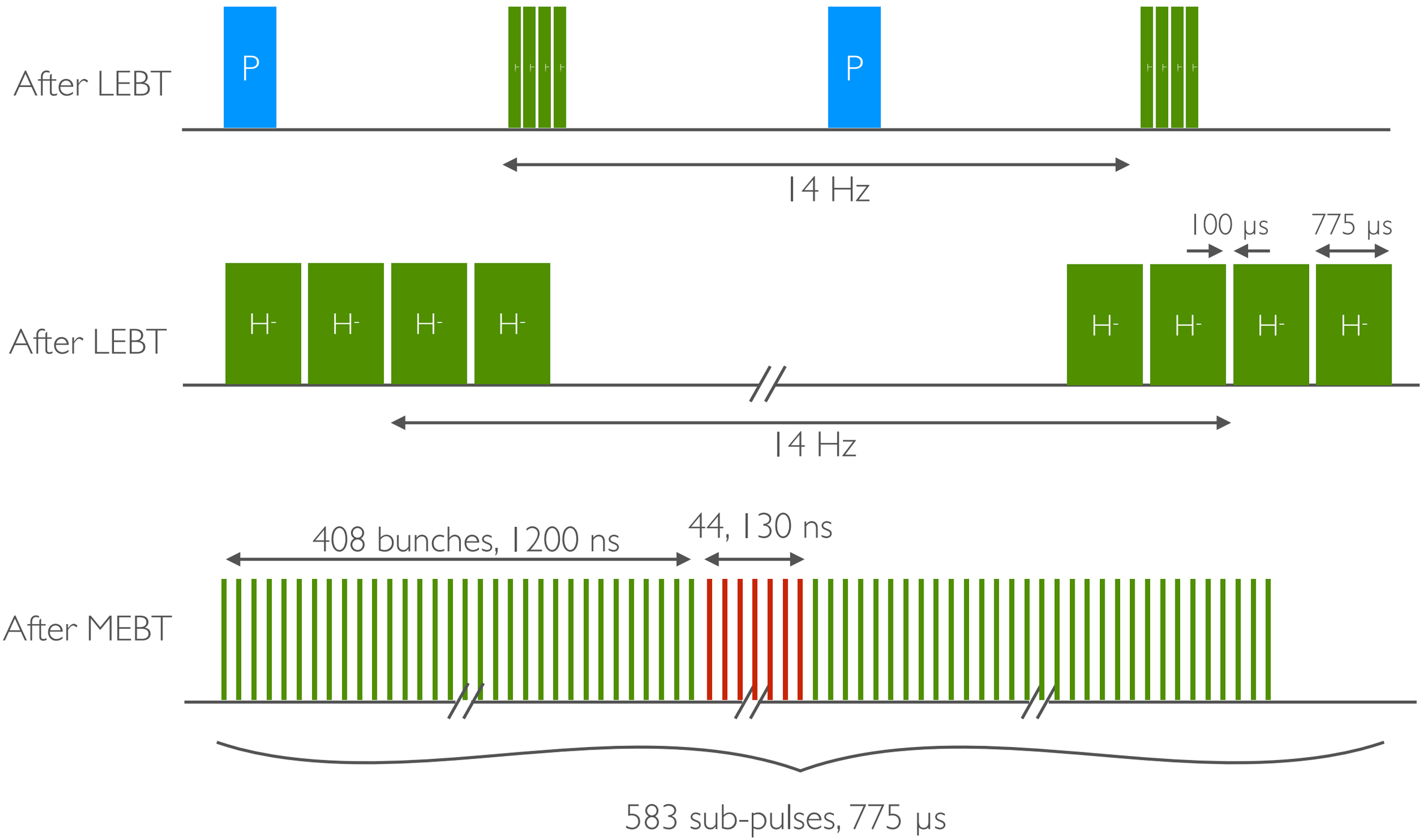
BEAM PARAMETERS

Scenario	A	A+
Sub-pulse length (ms)	0.65 x 4	0.775 x 4
Beam current# (mA)	60	50
Frequency (Hz)	14	14
Time between pulses (ms)	~72	~72
Time between batches (ms)	0.75	0.875
Batch frequency (Hz)	1333	1142
Particles per batch	$2.23 \cdot 10^{14}$	$2.23 \cdot 10^{14}$
Batches per macro pulse	4	4
Particles per macro pulse (72 ms /14 Hz)	$8.93 \cdot 10^{14}$	$8.93 \cdot 10^{14}$

Pros and Cons

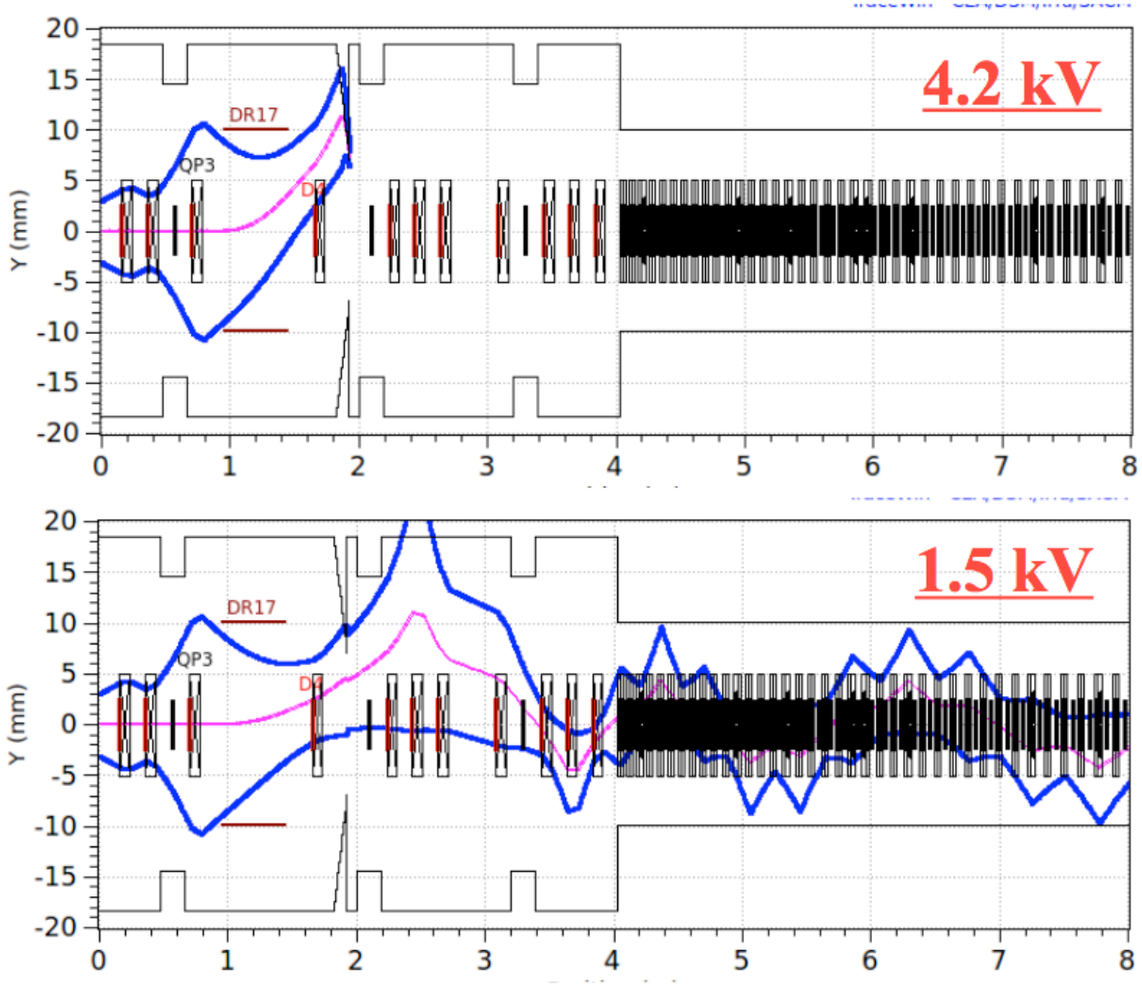
- Reduced peak current to 50 mA (20% reduction)
  - Beam current within the range of available H- sources
  - Beam losses due to intra beam stripping reduced by 40% (losses $\propto$ Current^2)
  - Reduced strain on the couplers
- Reduced batch frequency from 1.3 kHz to 1.1 kHz
- Increased duty cycle of the modulator from 9.8% to 10.5%

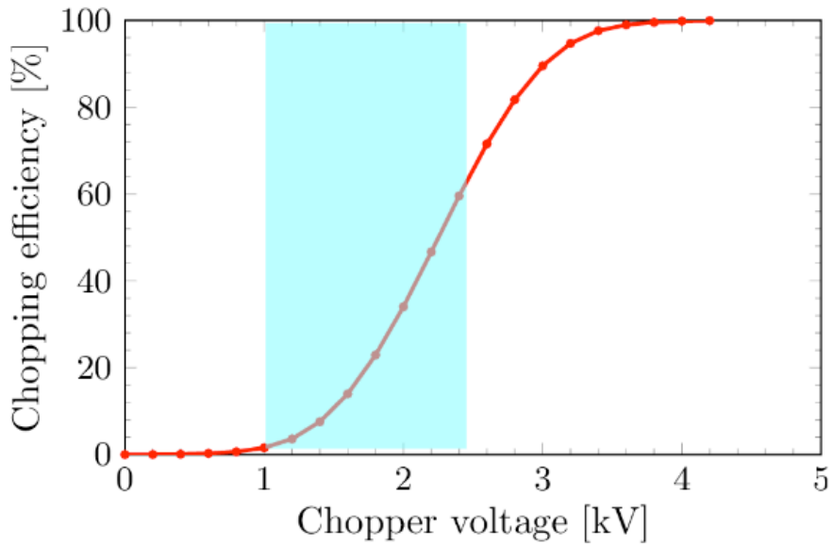
CHOPPING IN THE MEBT



CHOPPING, PROTON BEAM EXAMPLE

Rise/fall time and partially-chopped bunches





- Partially-chopped bunches are of concern for beam losses and a major factor to determine the rise/fall time.
- No clear threshold in terms of the beam losses and it seems rather a *political* decision of how much we are allowed to *use* the 1 W/m.
- SNS and JPARC are having no issue.

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Ryoichi Miyamoto

SUMMARY[2]

- The linac pulse length for option A could be sightly increased to relax the requirements on:
  - Ion source
  - Beam losses
  - Couplers
- Options B and C may require considerable changes in the linac which could prove to be showstoppers

- Further work:
  - MEBT design for chopping and the chopper design should be further studied
  - Losses should be further studied for the lower beam current and considering the H^0 transport

EUROPEAN SPALLATION SOURCE

With Special Thanks

to the IAP members, WP2, WP3 and DEB for the Comments, Suggestions and Discussions