ESS LINAC + H^- MODIFICATIONS

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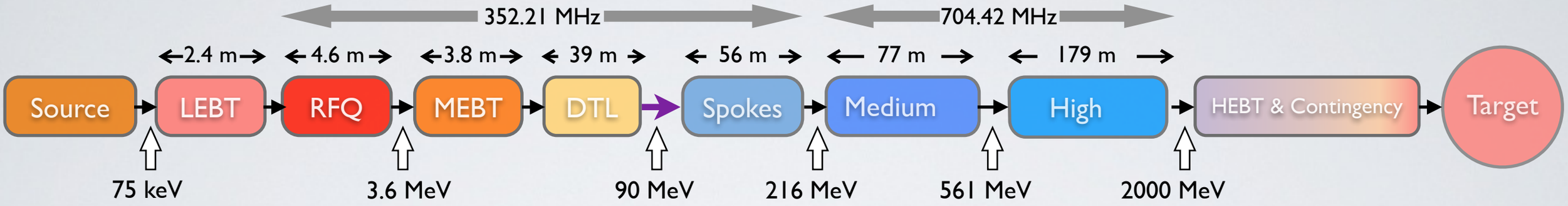
ESS LINAC

- Power: 5 MW
- Energy: 2.0 GeV
- Current: 62.5 mA
- Repetition rate: 14 Hz
- Pulse length: 2.86 ms
- Duty cycle: 4%
- High reliability (>95%)
- Ions: p

ESS LAYOUT

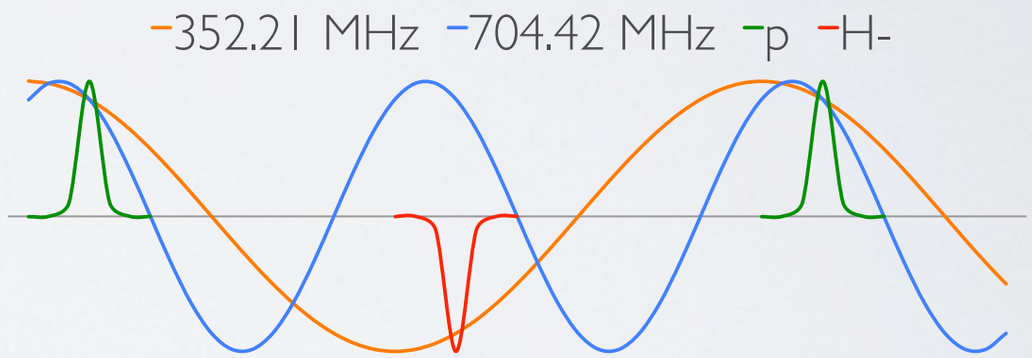


	Length (m)	W_in (MeV)	F (MHz)	β Geometric	No. Sections	T (K)
LEBT	2.38	0.075	--	--	1	~300
RFQ	4.6	0.075	352.21	--	1	~300
MEBT	3.83	3.62	352.21	--	1	~300
DTL	38.9	3.62	352.21	--	5	~300
LEDP + Spoke	55.9	89.8	352.21	0.50	13	~2
Medium Beta	76.7	216.3	704.42	0.67	9	~2
High Beta	178.9	561.5	704.42	0.86	21	~2
Contingency	119.3	2000	704.42	(0.86)	14	~300 / ~2
~~Upgrade~~	~~59.6~~	~~2000~~	~~704.42~~	~~(0.86)~~	~~7~~	~~~300 / ~2~~

28 HERTZ

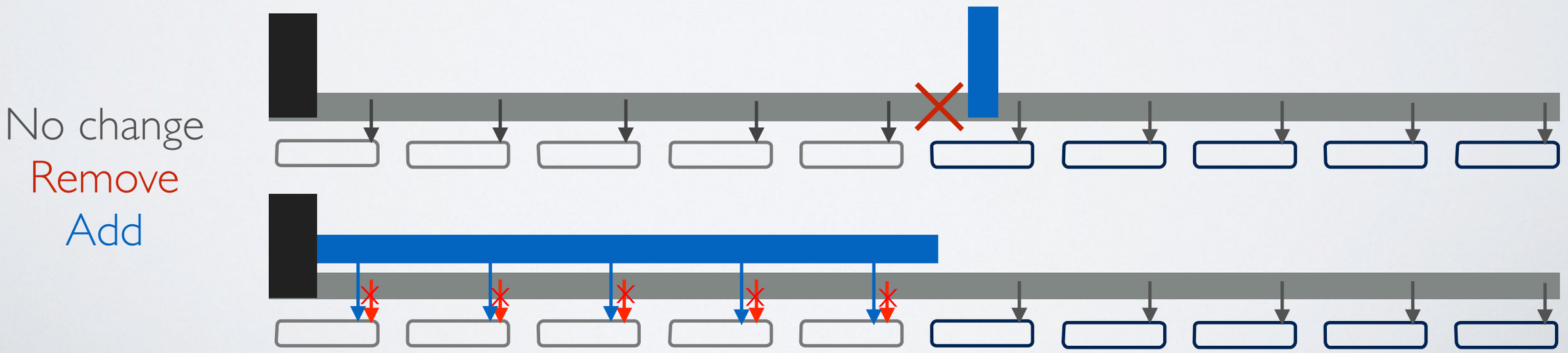
- Cryogenics
  - Cryomodule
  - Cryoline
  - Cryoplant
- RF
  - Power sources
- Beam physics
  - H- stripping and transport
- Front end
  - Ion source
  - RFQ
  - MEBT
  - DTL
- Controls, MPS

The linac can not work with interweaved proton and H- beams at **14 Hz** due to x2 frequency jump.



CRYO

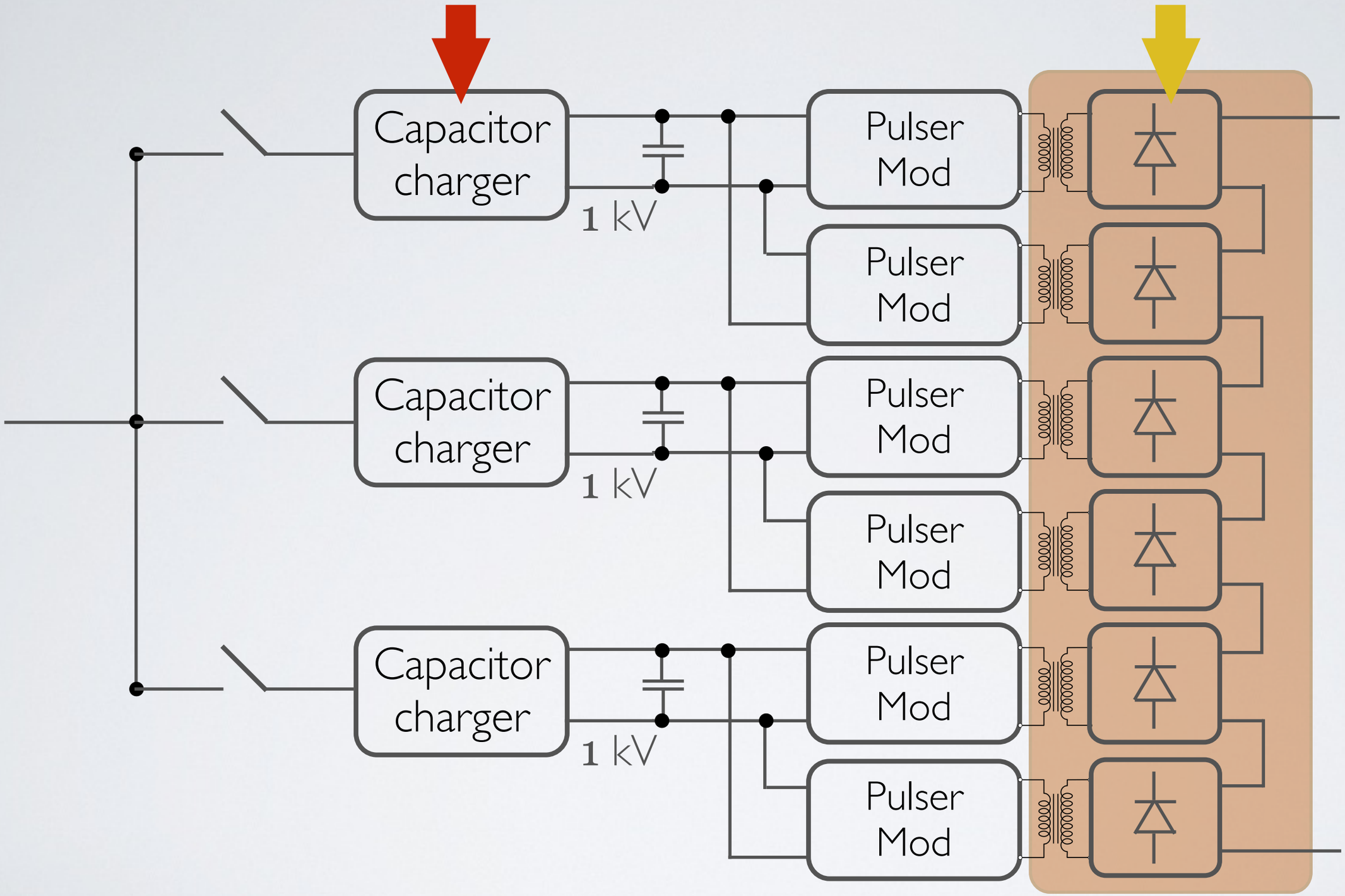
- Cryomodules
  - Spoke: Should be checked
  - Medium beta: Should be checked
  - High beta: Should be checked
- Cryo-line
  - Main line: No changes required
  - Distribution line: Should be re-configured or parallel line needed
- Cryoplant: An additional cryoplant needed



RF

- Beam: It is the source of all changes!
- Cavity: No changes needed in the design
- Coupler: Should be checked
- Waveguides: Are OK
- Circulators: Are OK
  - loads: Should be checked if could take more load
- Klystron: The Collector should probably be scaled (Solid States?)
- Modulator: *See next slide!*
  - Klystron gallery: Should be checked
- Transformers: Additional ones could be installed when needed
- Power grid: More power needed

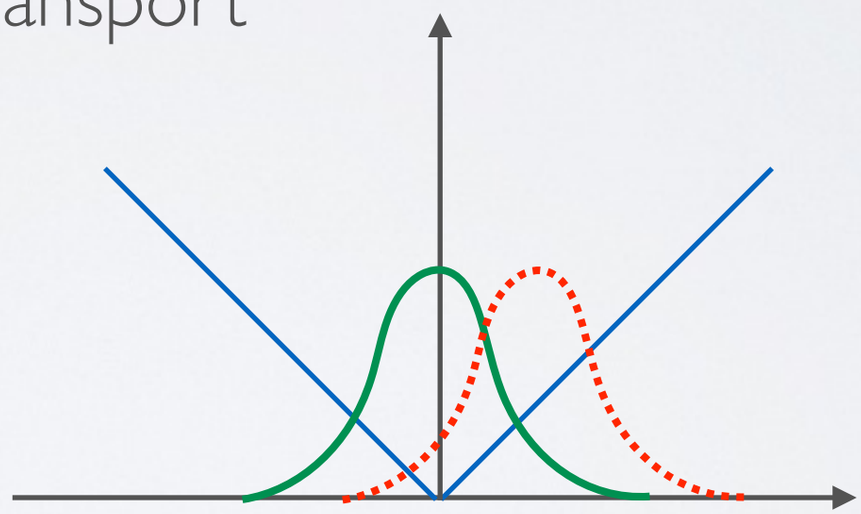
MODULATORS



Thanks to Carlos Martins

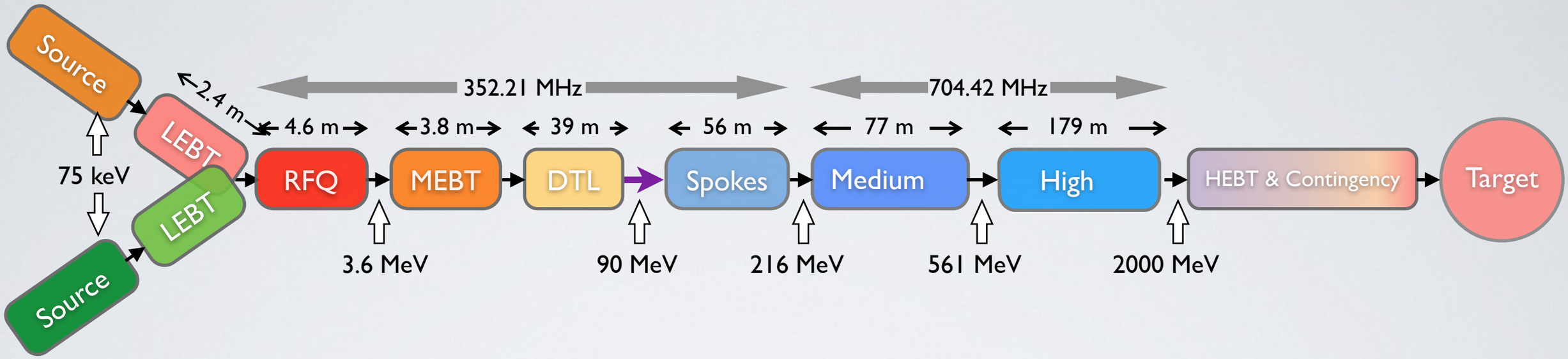
BEAM PHYSICS

- Transport of the H- along the linac
  - Matching
  - Stripping calculations
  - Loss ratios (Total loss of p + H- < 1w/m)
- Setting the tolerances for H- transport



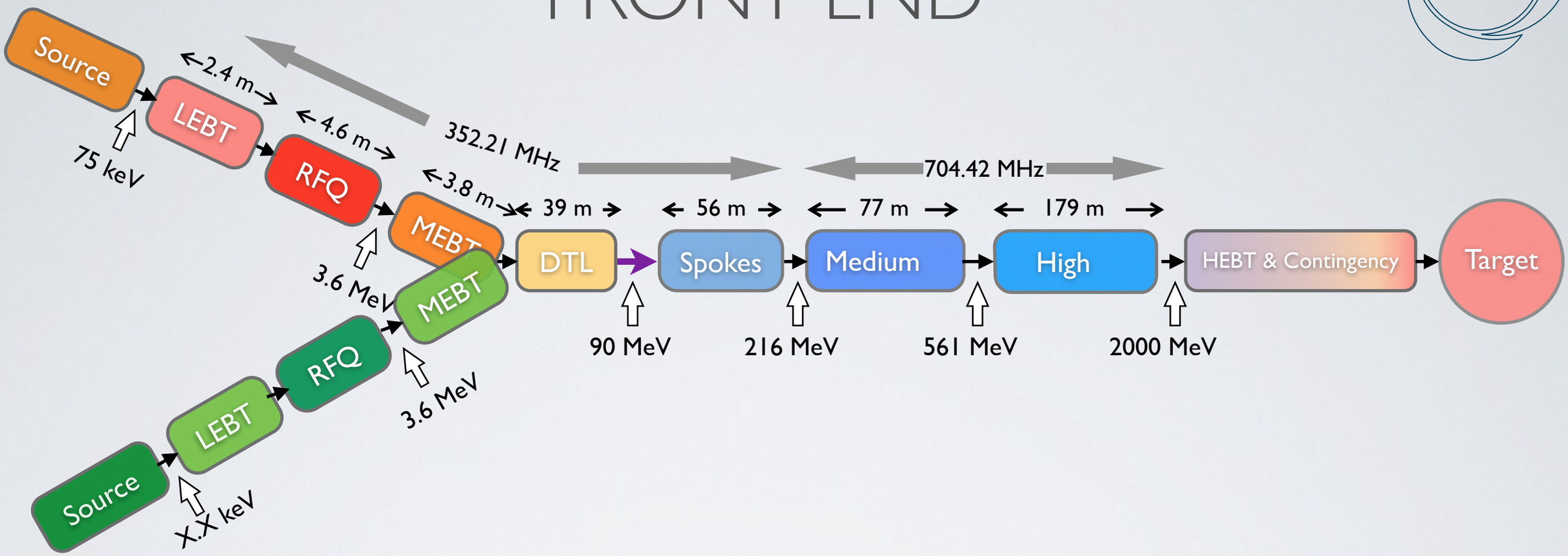
- Selecting the best position to merge the two beams

FRONT END



- Source: An H- source is needed
- LEBT: **Do we merge the beams here?**
- RFQ
  - The cooling capacity should be checked
  - ~~Depending on best merging position a new RFQ might be needed~~
- MEBT: We could also merge the beams here!
- DTL: Current calculations indicate that the cooling should be enough

FRONT END



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SNS LOSSES

- H^- case
  - The H^- losses are ~2–7x10^{-5} part of all particles along the SNS SC linac.
  - For the ESS linac, a similar ratio gives:
    $5x10^{-5} \times 5x10^{6} = 250$ w, or ~0.8-1 w/m
- p case
  - The proton losses are ~1x10^{-5} using the production optics, and 0.5x10^{-5} for the design optics.
  - For the ESS linac, a similar ratio gives:
    $0.5x10^{-5} \times 5x10^{6} = 25$ w, or ~0.1 w/m
- This results to 0.9-1.1 w/m of total losses, excluding the losses in the fault scenarios

CONTROL AND MPS

- Time generator is designed for 14 Hz
- MPS could work at higher rep. rate, given the timing system is adjusted
- Control system could either be designed today to accept higher rep. rates
- If the neutrinos can wait more than 10-15 years, then a new control system should/could replace the whole system.
- On the beam diagnostics, an earlier definition/requirement for the higher rep. rates is preferable. (SNS experience).

CONCLUSION

- A quick decision on the choice of several components could save time and money in case of a future upgrade to 28 Hz.

- However, some of these modifications, or choices, though not very demanding, are not cost neutral either.

THANK YOU!

Comments/Questions?