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Paolo Craievich et al. :: RF section :: Paul Scherrer Institut

SwissFEL/Porthos energy linac upgrades (first thoughts)

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Locations considered for an energy linac upgrade

- End of Linac 3
- Porthos Linac (only in the Porthos beamline)
- Injector

Linac 3 energy upgrade

Actual klystron gallery (no change)

- *Final consideration will depend on the available space in the bunker!! We can change the number of structures for klystron.*
- We have space for 3 additional HV modulators in the klystron gallery
- Option C.1: 2-3 C-band klystrons (actual C-band module) → 500-750 MeV – limited by the available space in the tunnel
- Option X.1: 3 X-band klystrons with 4 cavities per module → 600 MeV – High gradient
- Option X.2: 3 klystron with 8 cavities instead of 4 (~850 MeV) – Low gradient - complex waveguide network – to be checked the space into the tunnel

Extension Linac 3 klystron gallery

- Option C.2: 10-12 structures with 1 klystron with 2 structures, 5-6 klystrons → 875-1050 MeV (20-24m) – same consideration on the available space into the tunnel
- Option X.3: 5 klystrons with 4 cavities per module → 1 GeV (16 m)

New Porthos Linac

- First question: What is the space available? 30 m (transfer line) + 30 m before undulators?
- New service area (HV modulators, power supplies, etc...) is necessary
- Linac **up to 2 GeV** (only Porthos Linac), we can easily scale to 1 GeV:
 - Option P.1: C-band, 1 klystron, 4 structures, 8 RF modules (31.5 MV/m), 64 m – (actual SwissFEL linac)
 - Option P.2: C-band, 1 klystron, 2 structures, ~11 RF modules (44 MV/m), 44 m
 - Option P.3: X-band: 1 klystron, 4 structures, 10 RF modules (62 MV/m), 32 m
- We can have different configurations with energy **between 1 GeV and 2 GeV**
- Cost estimate for RF systems is on-going

Energy upgrade at the Injector

- For each option the energy gain reduction due to the RF tuning for 4-bunches has to be estimated
- SINSB05:
 - 1 C-band SF module 240 MeV, bunch compression at 540 MeV – to be check the space into the tunnel (+240 MeV)
 - 1 S-band FERMI module (RF pulse compressor) ~200 MeV, bunch compression at 500 MeV (+ 200 MeV)
- SINSB03-04 with FERMI module and RF pulse compressor: +200 MeV
- New C-band injector, 3 RF module, bunch compression at ~<700 MeV – also new RF gun, +400 MeV, similar situation in S-band frequency considering the upgrade of SINSB03-04-05
 - To be checked the bunch compression, linearization and BC1 magnets

→ S-band RF structures + BOC is simpler and less cost effective solution to have ~400 MeV more energy at the injector