PAUL SCHERRER INSTITUT

PSI

Sven Reiche, Eugenio Ferrari & Eduard Prat :: SwissFEL Beam Dynamics

Options for Porthos – First Ideas

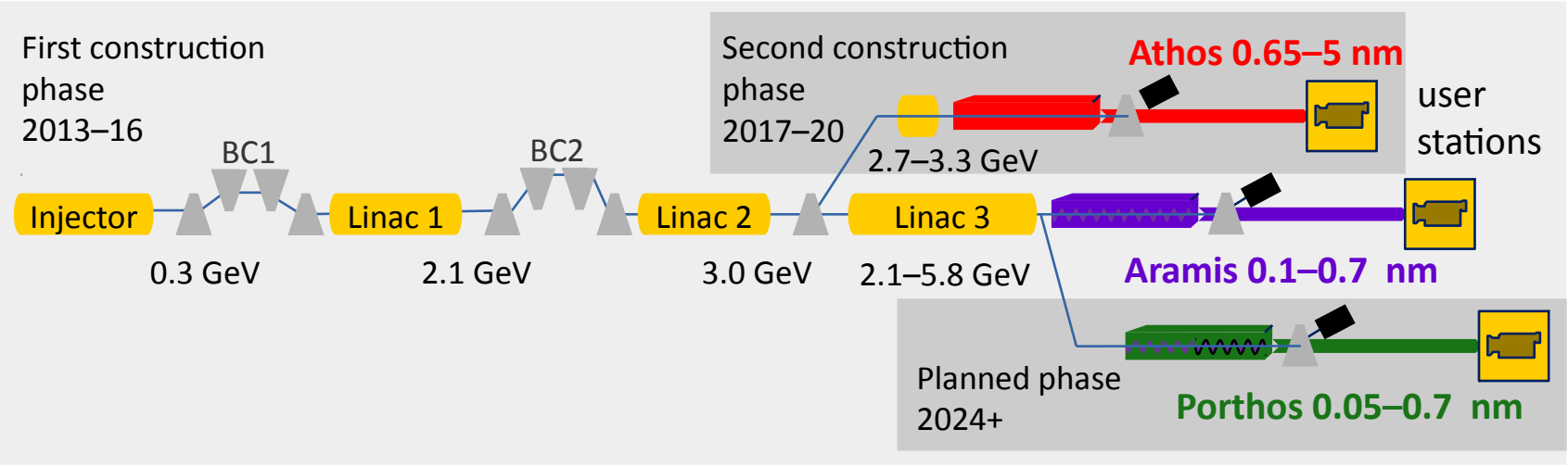
SwissFEL Layout

Athos:

Soft X-ray FEL, λ=0.65–5.0 nm

Variable polarization, Apple-X undulators

First users 2021



Linac:

Pulse duration : 1–20 fs

Electron energy : up to 5.8 GeV

Electron bunch charge: 10–200 pC

Repetition rate: 100 Hz (2-bunches)

Aramis:

Hard X-ray FEL, λ=0.1–0.7 nm

Linear polarization, variable gap, in-vacuum undulators

First users 2018

Porthos:

Hard X-ray FEL, λ=0.05–0.7 nm

Linear polarization, fix gap, super conducting undulators

Start of construction: 2025+

Conclusion from User Workshop

Pushing Photon Energies beyond 20 keV

1. Approach: Standard undulator technology with harmonic lasing

λ_U=2 cm, K_{max}=2, E = 7 GeV

Fundamental up to 13 keV, 3rd harmonic up to 22.5 keV

2. Approach: HTS undulator technology

λ_U=1.5 cm, K_{max}=4, E = 7 GeV

Fundamental up to 19 keV, 3rd harmonic up to 27 keV

3. Approach: Standard undulator with HTS afterburner

λ_U=2 cm, K_{max}=2, E = 7 GeV

λ_U=1.0 cm, K_{max}=2.5, E = 7 GeV

Up to 30 keV

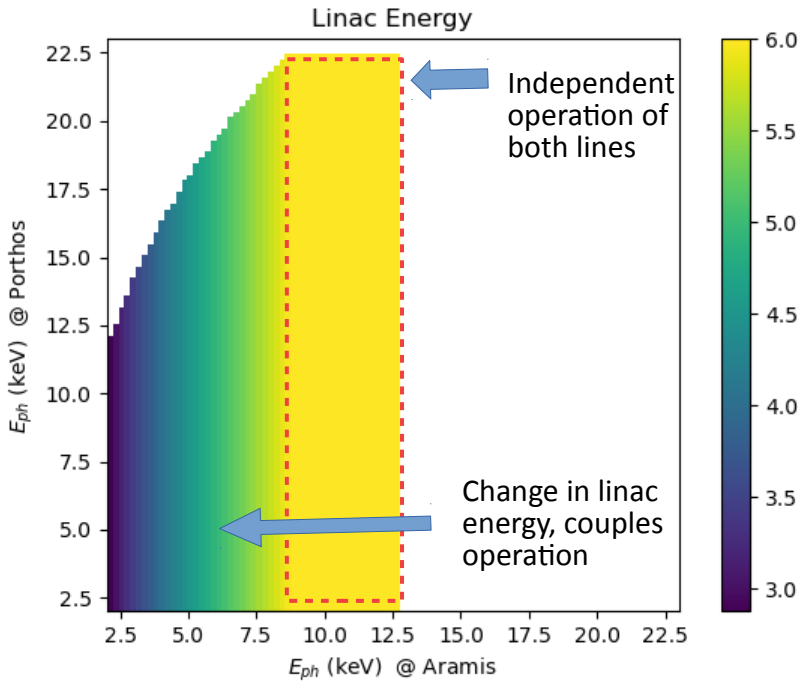
Conclusion from User Workshop

Pushing Photon Energies beyond 20 keV:

→ ***Coupling of Aramis and Porthos Operation***

e.g. Aramis at 2 keV and Porthos at 20 keV will not be possible simultaneously

Tuning diagram for Main Linac (example for HTS undulator)

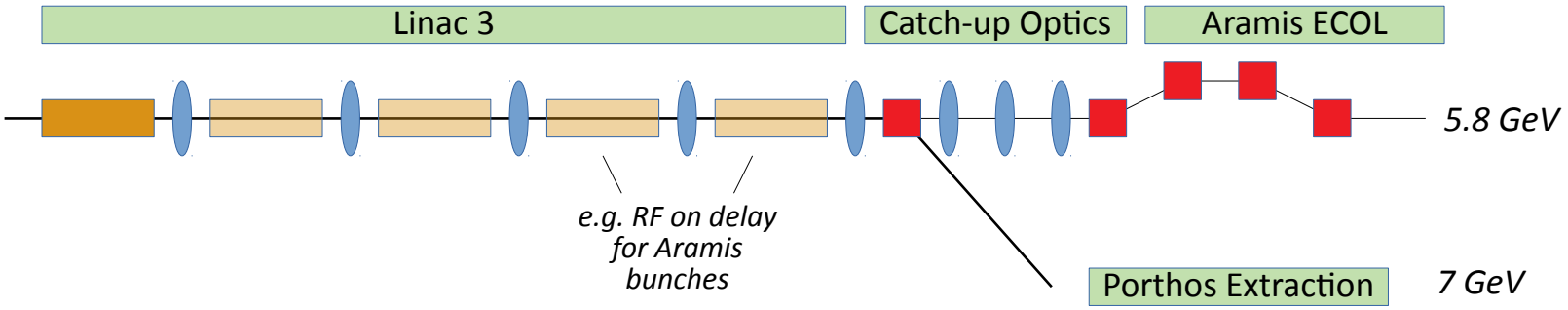


Solving Coupled Operation

User might accept 50 Hz operation:

- No 3rd bunch acceleration (Aramis and Porthos are driven by same bunch)
- Easier switching between Aramis and Porthos
- Solves coupled operation by putting Linac 3 RF on delay for low energy beam
- Both beamlines benefit from energy upgrade (S30CB14-S30CB16)

Example:



Should allow uneven distribution between lines (e.g. 90 Hz for Aramis photon delivery, 10 Hz for Porthos set-up & optimization)

Some users favor LCLS model of 12 hour photon delivery and 12 hour access/rest, swapping with other user station.