

C-Band LINAC Module Developments

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The SwissFEL C-band main linac consists of 26 modules and accelerates, at a repetition rate of 100 Hz, two electron bunches, spaced by 28 ns, from 350 MeV up to 5.8 GeV. Each module is composed of four 2-meter long constant gradient accelerating structures each with 113 cells, one 50 MW klystron and one Barrel Open Cavity (BOC) pulse compressor.

The choice to operate at the American C-band frequency of 5712 MHz was dictated by the large availability in the market of the klystrons and RF components at this frequency. While klystrons and waveguides are procured from commercial companies, the accelerating structures and pulse compressor are developed in house for future industrialization. A strong R&D program was launched, from the RF design, manufacturing to the high power tests, exploiting ultra-precise turning and outstanding high gradient and breakdown rate (BDR) results, proving the reliability of the C-band technology at 100 Hz repetition rate.

Four short (13 cells) constant impedance structures were successfully produced without implementing dimple tuning features. Gradients as high as 35 MV/m (large iris design) and 57 MV/m (small iris design) were achieved at 1 μ s pulse length, about three times the nominal value, limited only by the available 50 MW klystron power. The very first 2-meter long accelerating structure also confirms the high-precision machining and the choice to avoid dimple tuning.

The BOC prototype represents a further impressive C-band technology result: for 50 MW klystron power and 3 μ s pulse length, at 100 Hz repetition rate, a compressed pulse up to 300 MW peak was measured in phase jump mode. For the same pulse length and 40 MW klystron power, an encouraging BDR of $5 \cdot 10^{-7}$ was obtained.

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