High Power RF

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Overview

- Introduction High Power RF System
- Klystron
- Modulator
- RF Waveguide Distribution

Introduction High Power RF System

- Task:

  Conversion of AC Line Power to Pulsed RF Power and distribution of the Pulsed RF Power to the cavities of the Linear Collider

- Structure:

  Several RF Station consisting of certain components make up the RF System of a linear collider (total RF pulse power:~1-10GW)

  The number of station depends on the maximum power which can be handled reliably by one station (and of course on availablity of components, costs etc)

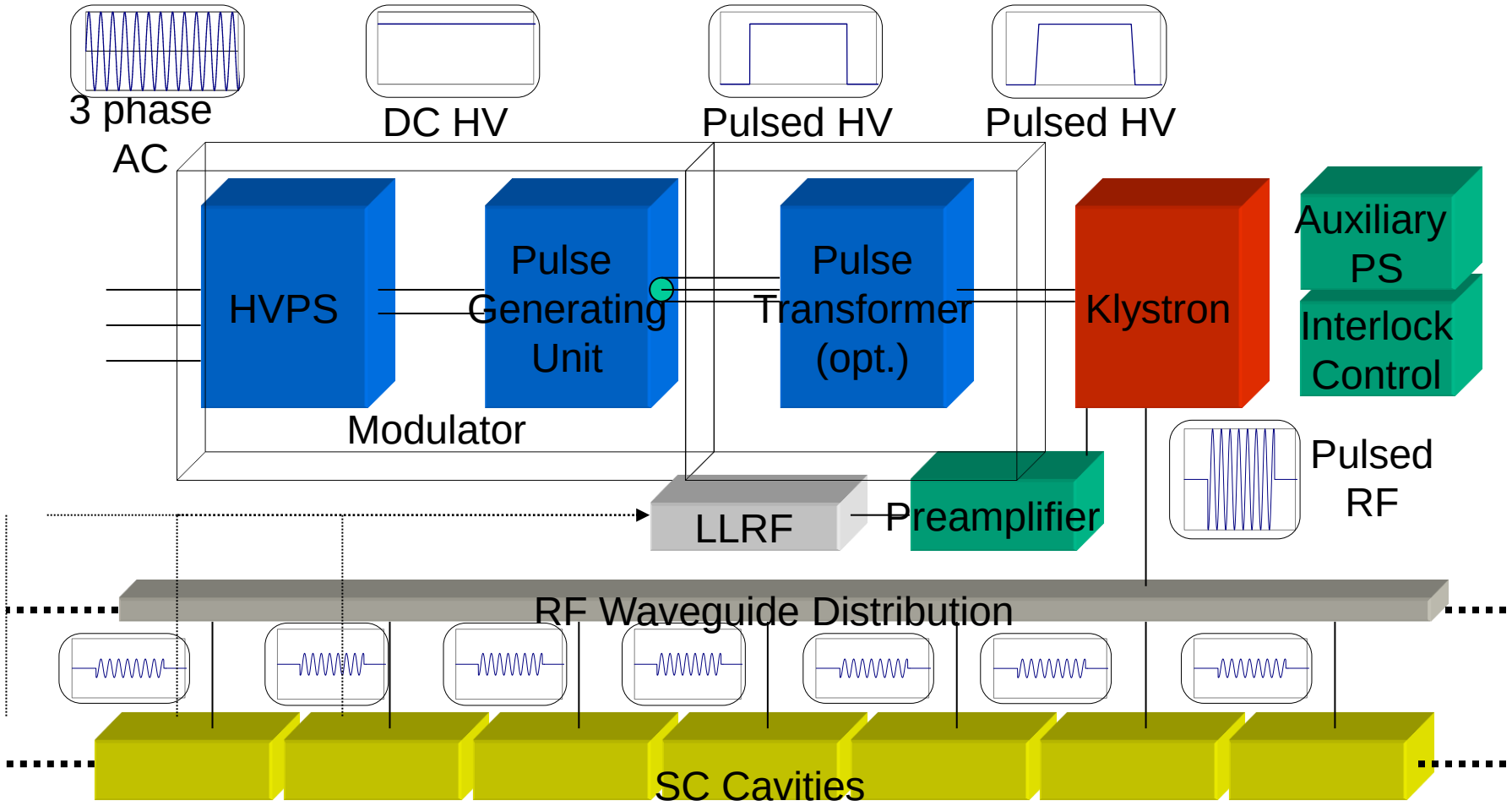
- Pulse Power per Station: ~100kW to ~1-10MW (ILC) to ~100MW (norm. cond. acc.)

- Pulse Width: (~1μs for norm. cond. acc. to) ~1ms (ILC)

- Repetition Rate: ~1Hz to ~10Hz (ILC) ~100Hz(norm. cond. acc.)

- Average power per Station: ~100kW (ILC)

RF Station Components (1)



RF Station Components (2)

- Modulator:

  HVPS: Conversion of AC line voltage (~400V AC) to DC HV (~1-10kV (100kV))

  Pulse Generating Unit: Conversion of DC HV (~1-10kV (100kV)) to Pulsed HV (~1-10kV (100kV))

  Pulse Transformer: Transformation of Pulsed HV (typ. ~10kV) to higher Pulsed HV (~100kV)
- Klystron:

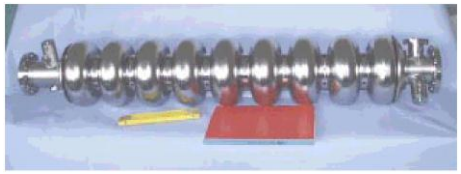
  Conversion of Pulsed HV (~100kV) to pulsed RF (~10MW)
- RF Waveguide Distribution:

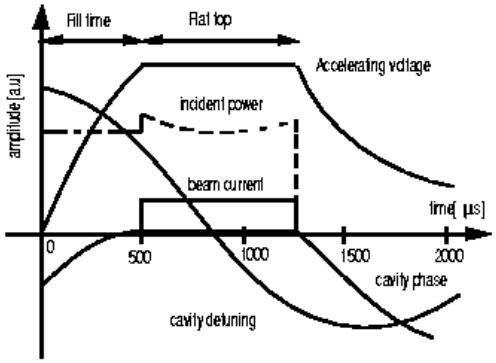
  Distribution of RF power (~10MW) to the cavities (~100kW)
- Other
- Auxiliary PS: Certain voltages for the klystron ion pumps or the klystron solenoid
- Interlock and Controls: Protection and Control
- LLRF: Control of phase, shape and amplitude (other lecture this school)
- Preamplifier: Amplification of ~1mW RF to ~100W RF

TESLA 500 RF Requirements

TDR 2001 (ILC Baseline is similar)

Number of sc cavities:	21024 total
Frequency:	1.3GHz (L-Band)
Power per cavity:	231kW
Gradient at 500GeV:	23.4MV/m
Power per 36 cavities (3 cryo modules):	8.3MW
Power per RF station:	**9.7MW** (including 6% losses in waveguides and circulators and a regulation reserve of 10%)
Number of RF stations:	**572**
Macro beam pulse duration:	950ms
RF pulse duration:	**1.37ms**
Repetition rate:	**5Hz**
Average RF power per station:	**66.5kW**

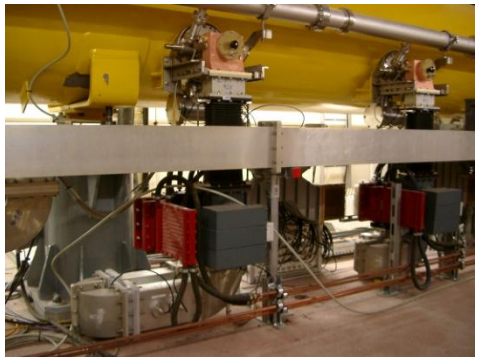




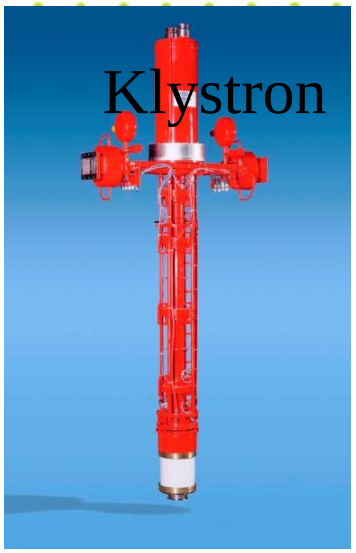
For TESLA 800 the number of stations must be doubled. The gradient is 35MV/m.

RF System Components

developed for Tesla and installed at TTF



RF Waveguide Distribution



Modulator

Pulse Transformer