



# *High Power RF*

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# *Overview*

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

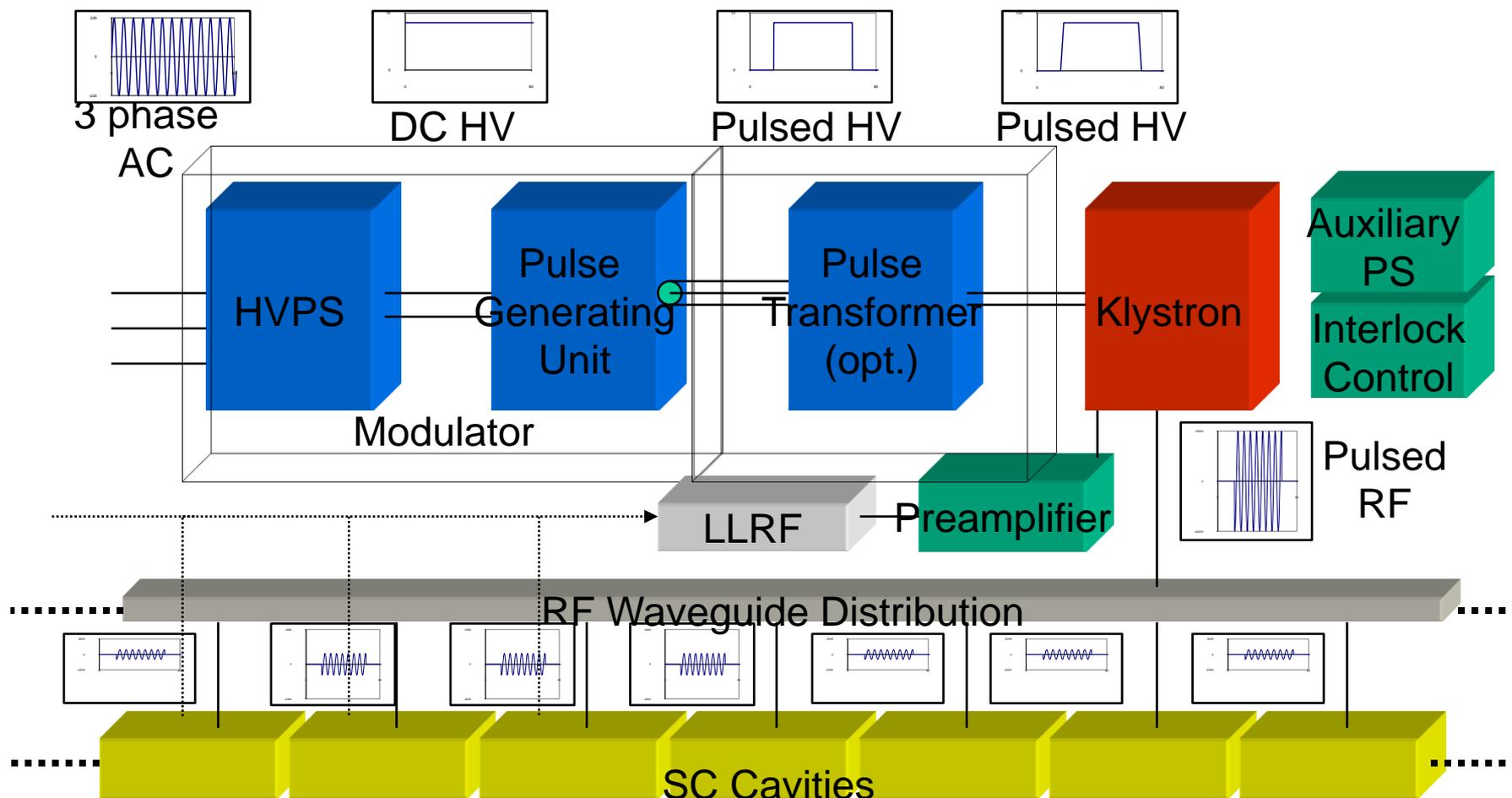


## *Introduction High Power RF System*

- 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 availability of components, costs etc)
- Pulse Power per Station: ~100kW to ~1-10MW (ILC) to ~100MW (norm. cond. acc.)
- Pulse Width: (~1 $\mu$ s 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)*

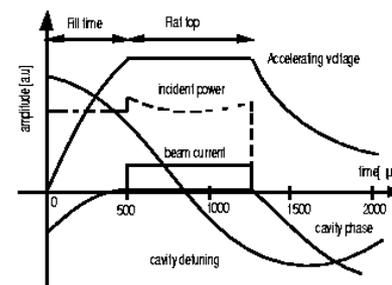
- Modulator:
  - HVPS: Conversion of AC line voltage ( $\sim 400\text{V AC}$ ) to DC HV ( $\sim 1\text{-}10\text{kV}$  ( $100\text{kV}$ ))
  - Pulse Generating Unit: Conversion of DC HV ( $\sim 1\text{-}10\text{kV}$  ( $100\text{kV}$ )) to Pulsed HV ( $\sim 1\text{-}10\text{kV}$  ( $100\text{kV}$ ))
  - Pulse Transformer: Transformation of Pulsed HV (typ.  $\sim 10\text{kV}$ ) to higher Pulsed HV ( $\sim 100\text{kV}$ )
- Klystron:
  - Conversion of Pulsed HV ( $\sim 100\text{kV}$ ) to pulsed RF ( $\sim 10\text{MW}$ )
- RF Waveguide Distribution:
  - Distribution of RF power ( $\sim 10\text{MW}$ ) to the cavities ( $\sim 100\text{kW}$ )
- 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  $\sim 1\text{mW}$  RF to  $\sim 100\text{W}$  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:	<b>9.7MW</b> (including 6% losses in waveguides and circulators and a regulation reserve of 10%)
Number of RF stations:	<b>572</b>
Macro beam pulse duration:	950ms
RF pulse duration:	<b>1.37ms</b>
Repetition rate:	<b>5Hz</b>
Average RF power per station:	<b>66.5kW</b>



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*



Klystron

RF Waveguide Distribution



Modulator



Pulse Transformer