

Libera

# Libera Brilliance Single Pass

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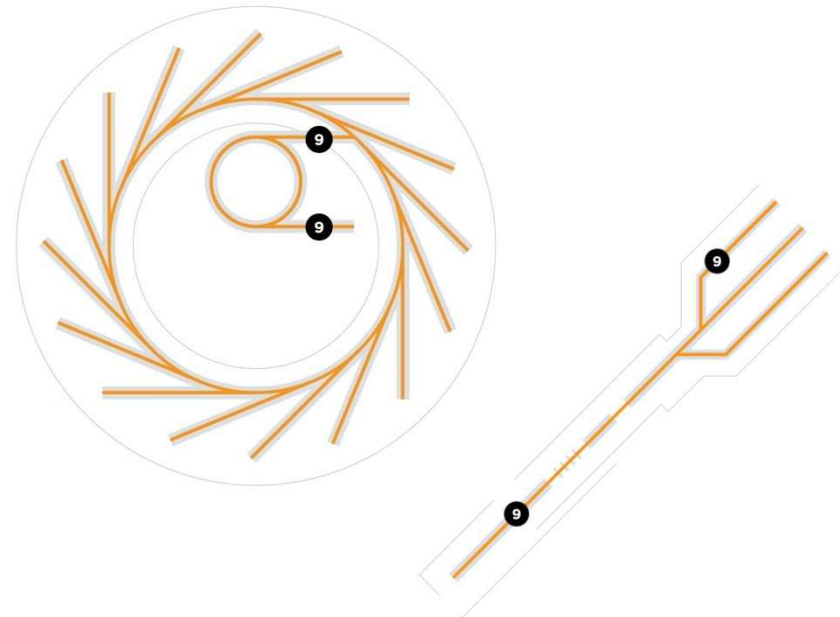
- What is Libera Brilliance Single Pass
- Datapaths and Signal Processing
- Performance and Tests
- Extended Use
- Future Plans

## What it is Used for?

- Monitoring of the beam position and charge
  - **Single bunch**
  - **Train of uniform bunches**
  - **Train of various bunch patterns**
- Machine optimization
- Machine commissioning
  - **Operation with low charges (few pC)**
- Building of Fast Feedback / Feed Forward loops

## Where it can be Used?

- Stripline and button pickups
- Field of FEL machines
  - **Beam position monitor in LINACs**
  - **Beam charge measurement**
- Synchrotron light sources
  - **Injection efficiency measurements**
  - **Beam position monitor applications in LINACs and transfer lines**
- ERL machines
  - **Beam position and charge monitor**



Libera Brilliance Single Pass

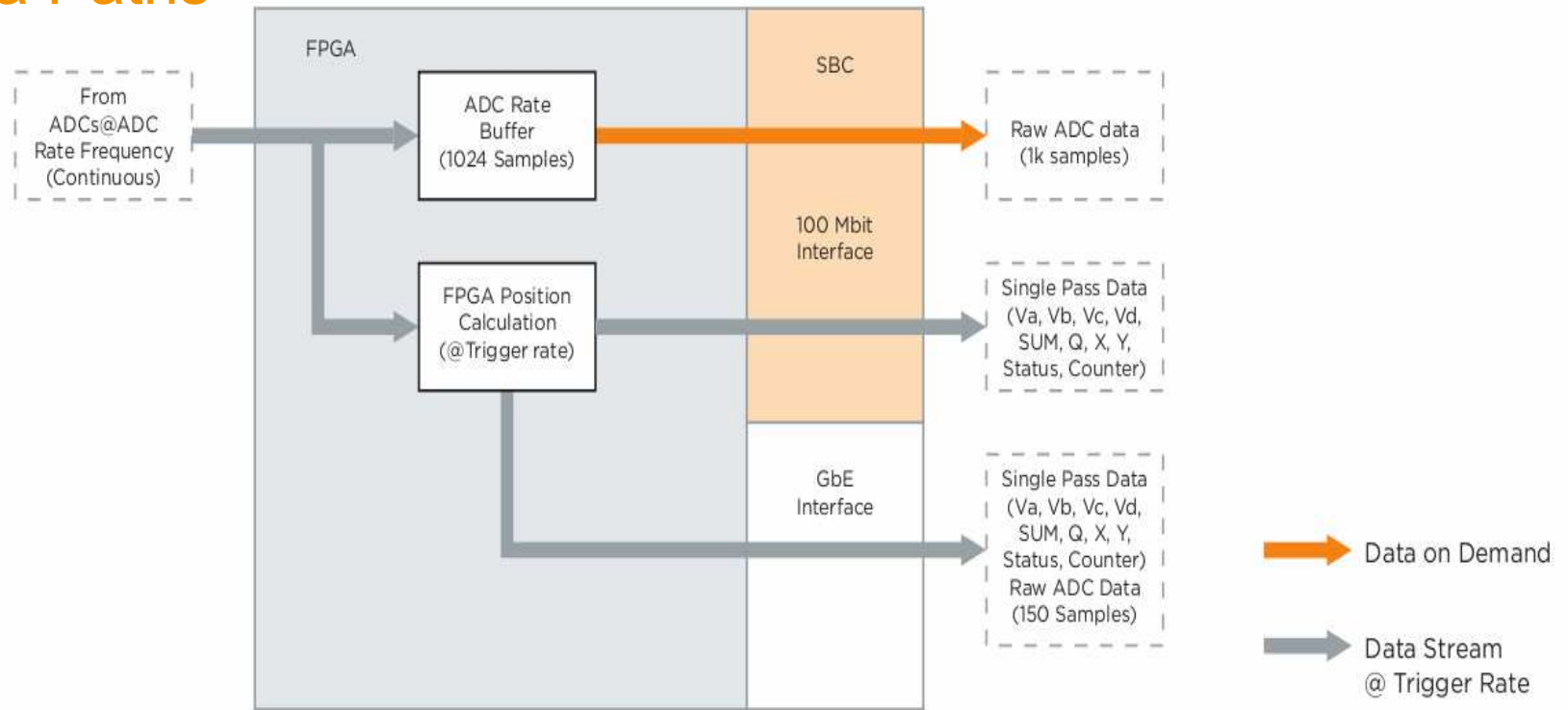
**Libera**

## Libera Brilliance Single Pass



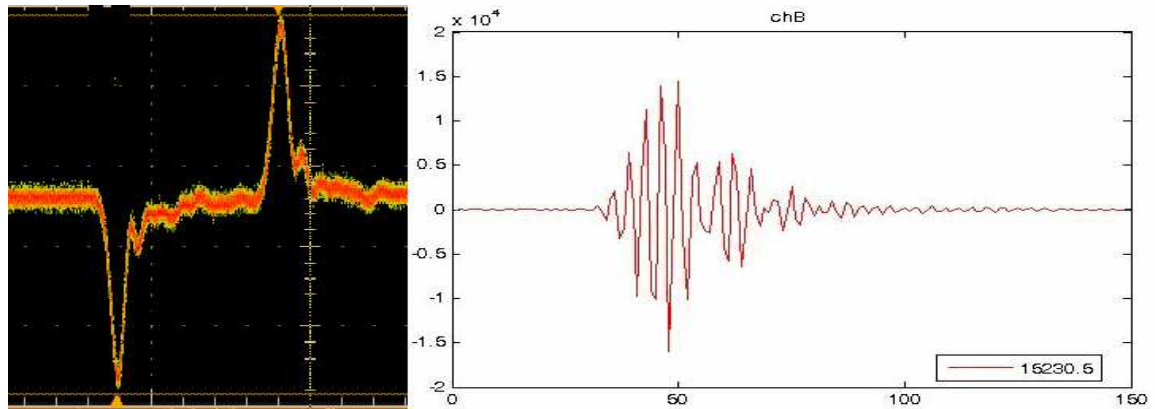
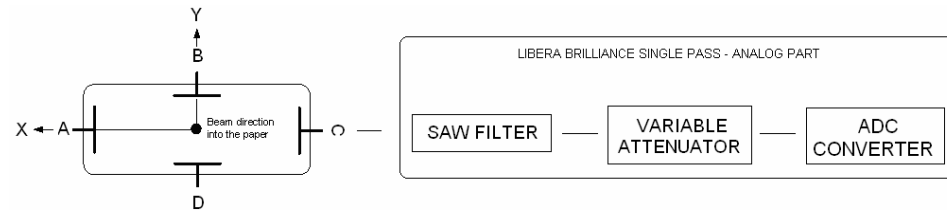
- **Built on the proven and broadly used Libera Platform A architecture**
- **Experience and support from the Libera community**
- **Easy to integrate in the Control System**
- **Easy to integrate in the fast feedback or feed-forward system**

# Data Paths



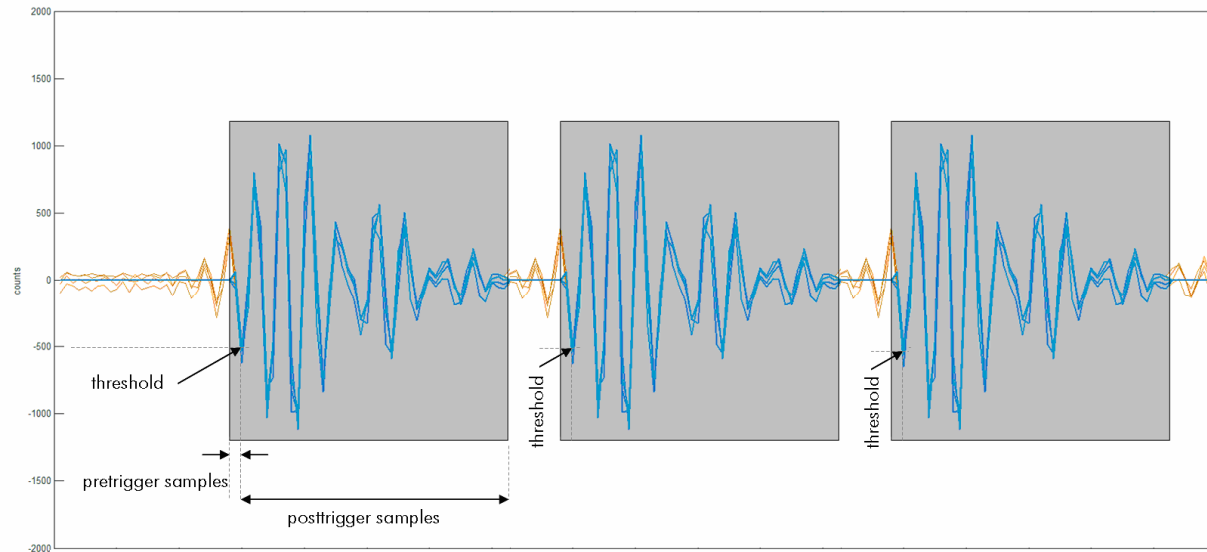
# Analog and Digital Signal Processing

- 4 RF chains
  - SAW filters
  - Variable attenuators
  - 16 Bit resolution



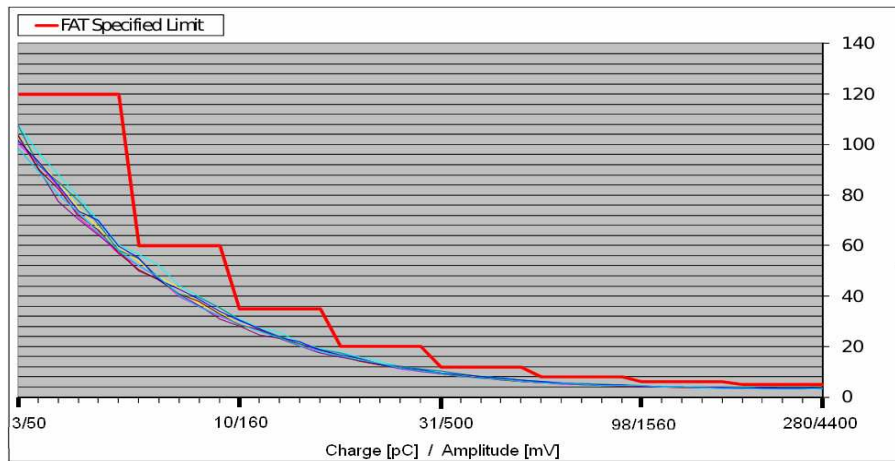
## Data Acquisition and Extraction

- Threshold (level, below which we consider the signal as noise)
- Pretrigger
- Posttrigger
- Data averaging





# Performance Specifications

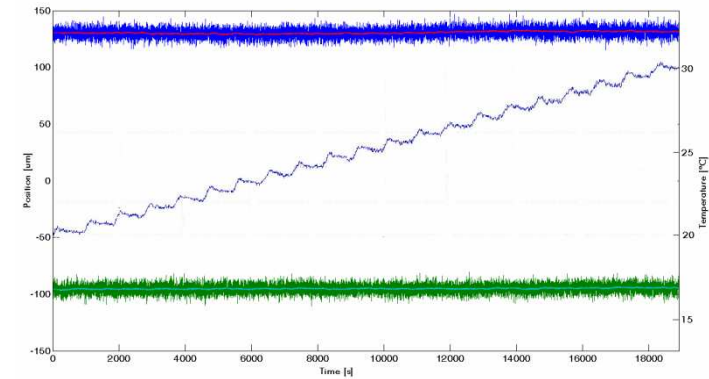
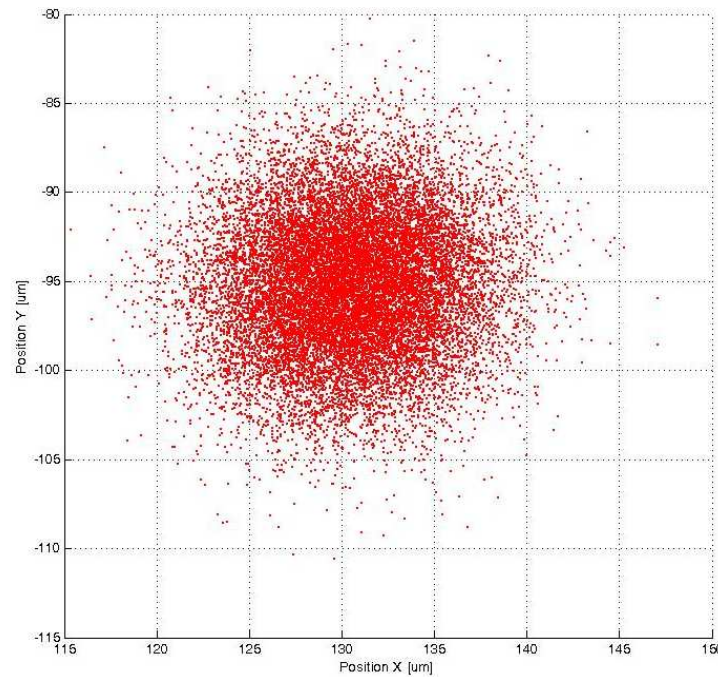


Estim.Charge [pC]	Measured Peak [mV]	Libera Level Setting	ADC Counts ( $\pm 1000$ )	Required position RMS ( $\mu\text{m}$ )	Typical position RMS ( $\mu\text{m}$ )
<b>280</b>	4400	-10	15000	5	3
<b>98</b>	1560	-19	15000	6	4
<b>31</b>	500	-29	15000	12	9
<b>10</b>	160	-31	7000	35	33

## Long Term Position Stability (5h at 20°C – 30C)

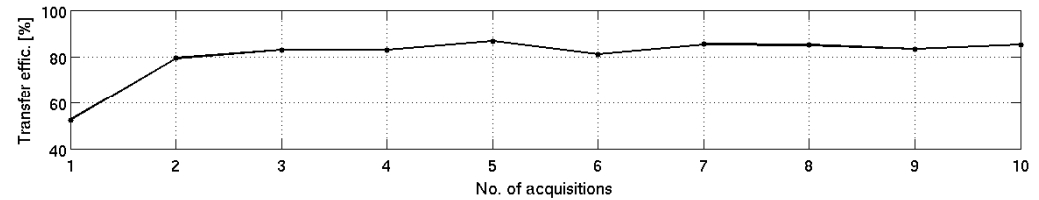
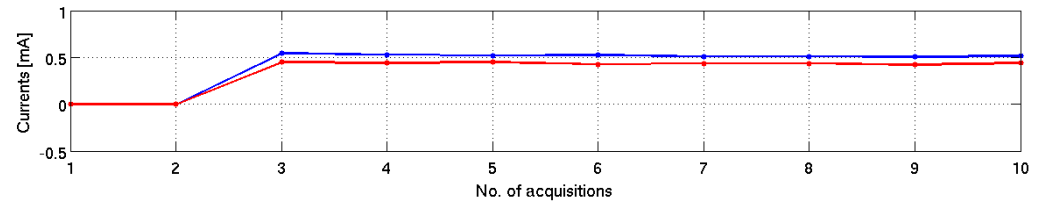
$X_{rms} = 3.9509 \mu m$   
 $Y_{rms} = 3.7738 \mu m$

$X_{mean} = 130.4766 \mu m$   
 $Y_{mean} = -95.2049 \mu m$

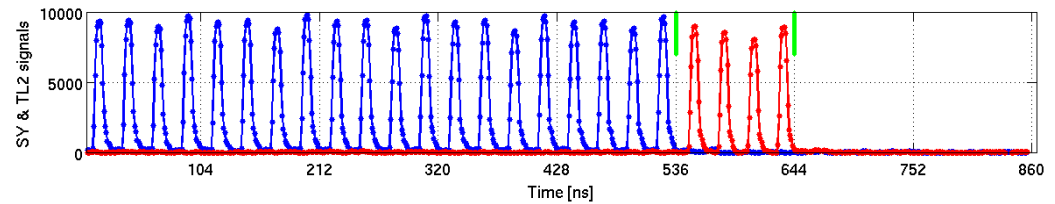


# Injection Efficiency Measurements

- Installed at ESRF injection system
- Modified unit



Blue: Four bunch fill, circulating in the booster  
Red: Four bunches, extracted to TL2 transfer line

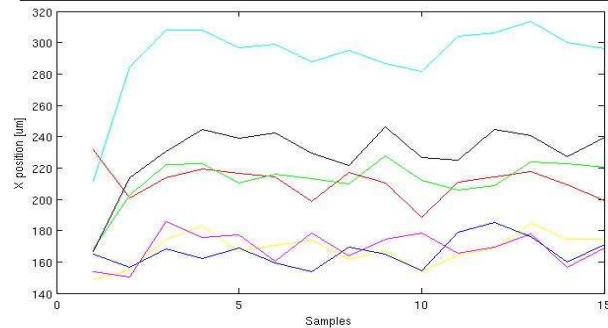


# Bunch Train Position Measurements

Tested at DESY – FLASH stripline sensors

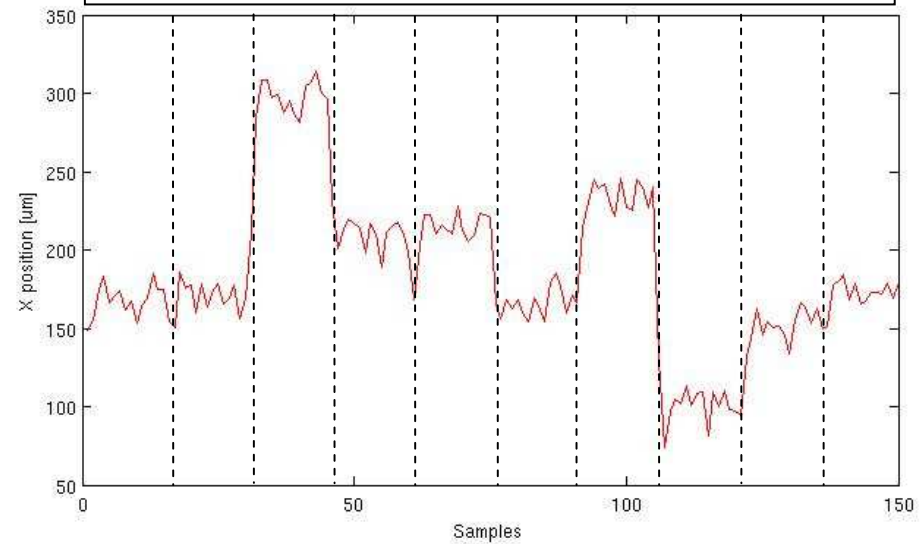
- Micropulse frequency: 1 MHz
- Macropulse frequency: 10 Hz
- No. of bunches in Macropulse: 30
- Bunch Charge: 0.55 nC
- Stripline output amplitude: 3 V pp
- Geometrical coefficients set in Libera Kx, Ky: 10 mm
- Averaging: 2 bunches

- Average bunch train X position rms = 10  $\mu\text{m}$  (9  $\mu\text{m}$  – 24  $\mu\text{m}$ )  
 - Eight bunch trains on the same graph



WW

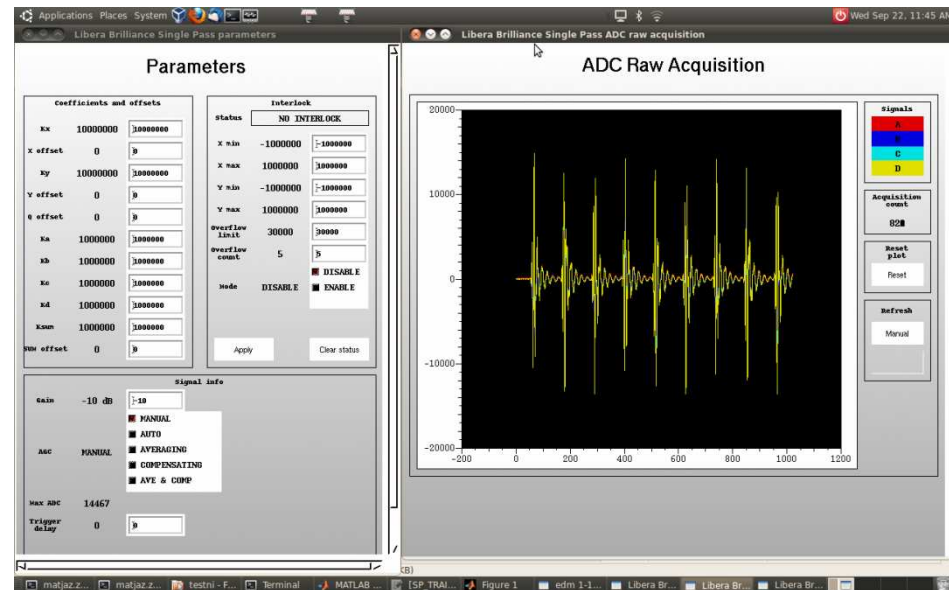
- Ten consecutive bunch trains, X position  
 - Noticeable variations among consecutive train positions after the first chicane is observed



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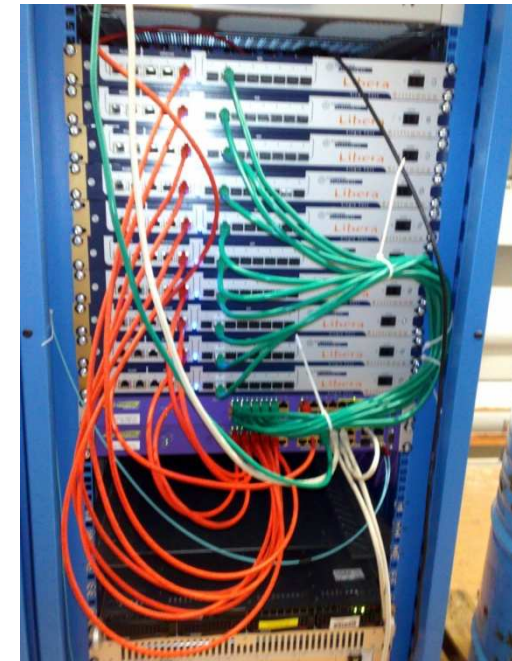
## Benefits

- **All-in-one**
  - Analog signal processing
  - Digitalization
  - Digital signal processing
  - Fast GbE interface
  
- **User-friendly features**
  - Automatic gain control
  - EPICS driver
  - GUI - EPICS EDM Panels
  - Generic server
  - TANGO Server



## Field Experience

- More than 50 units installed on LINAC at FERMI@Elettra (Italy)
- Successfully used as injection efficiency monitor at ESRF (France)
- Successfully used at IHEP (China)
- To be used on NSRL (China)
- Tested on FLASH LINAC (Germany), meets requirements
- Successfully tested at KEK Linac (Japan), Spring 8 (Japan), etc.



## Libera Single Pass E

- New machines with more demanding operational modes
- High repetition and higher RF single pass machines
  - 1,5 GHz FELs
  - Higher repetition rates (kHz)
- ERLs
  - 1,3 – 1,5 GHz
  - Separation of accelerated/decelerated beam
- Classic single pass machines

