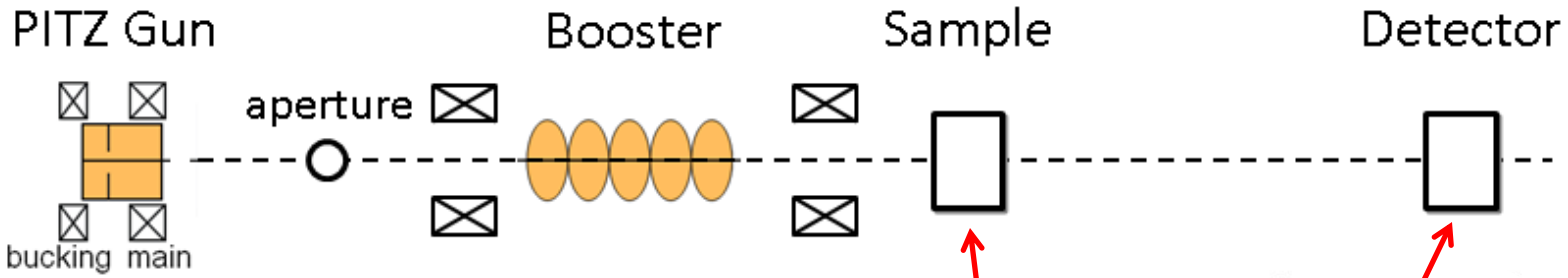
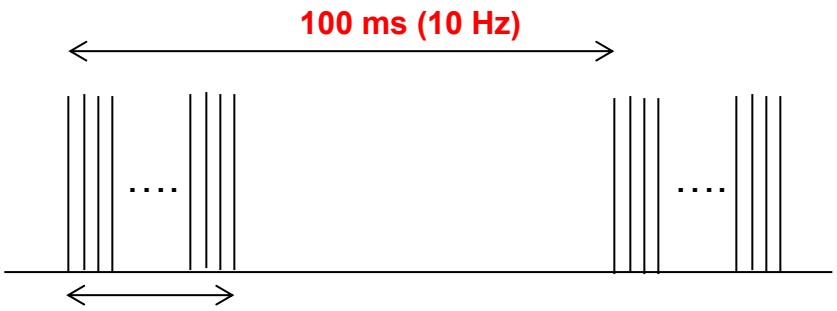
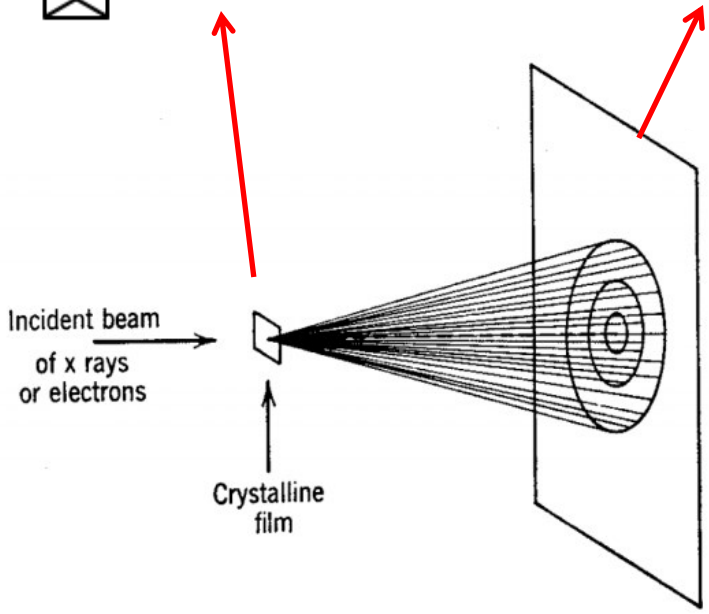
Simulation of MeV Femtosecond electron diffraction performance based on PITZ beamline





~1 ms long bunch train at **~MHz**



Houjun Qian for the PITZ team

20.07.17, 5th ST3 workshop

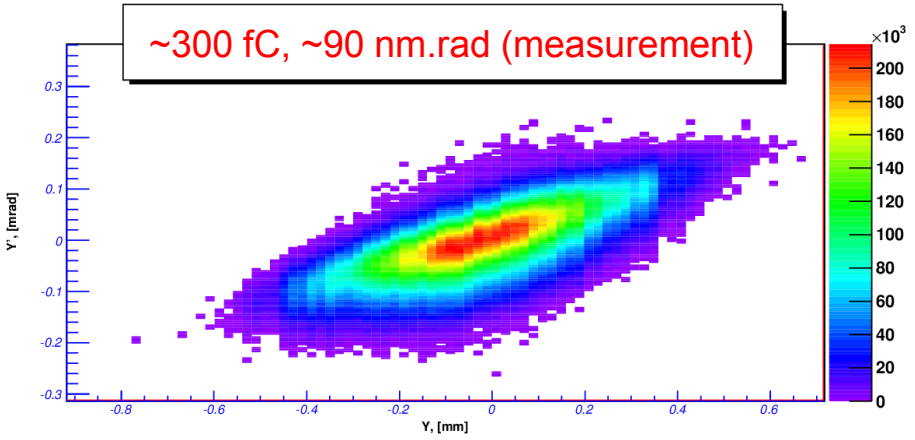
HELMHOLTZ ASSOCIATION

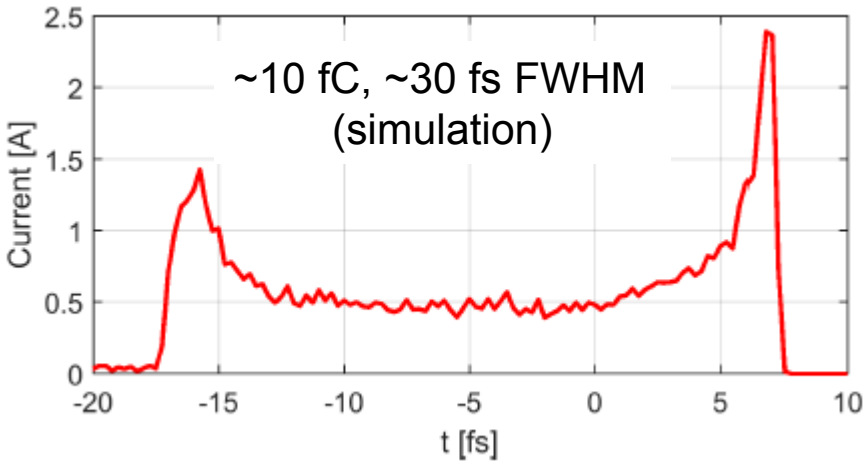
DESY

Optimization for nm thin film UED

- Simulation of two operation modes

Beam at sample	'Single shot' (irreversible UED)	'High coherence' (micro-nano UED)	Unit
Energy (tunable)	~4		MeV
Wavelength (tunable)	~0.3		pm
Bunch FWHM length	<50		fs
Pulse rate (tunable)	~10^4		pulse/s
Electron per pulse	~100 (10^6 e^-)	~0.1 (10^3 e^-)	fC/pulse
Normalized emittance	20	0.2	nm.rad
Beam rms size (tunable)	100	1	um
Reciprocal space resolution*	0.05		$Å^{-1}$
Source size at cathode	200	2	μm





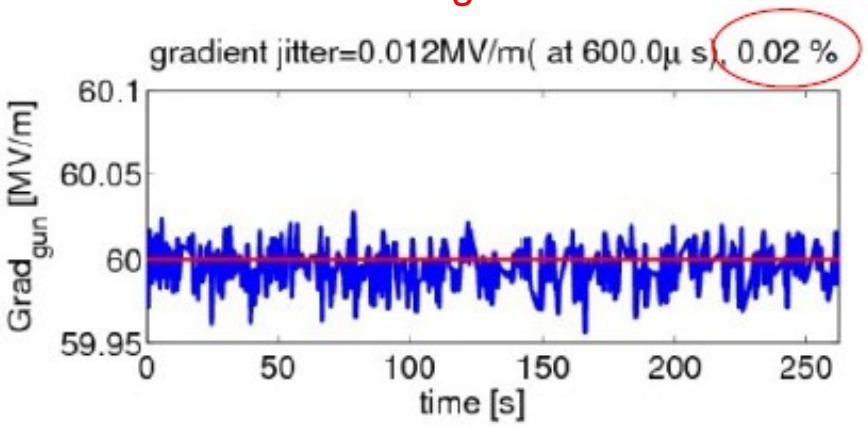
Estimation of time resolution of electron diffraction

$$\tau_{pump-probe} = \sqrt{\tau_e^2 + \tau_{eTOA}^2 + \tau_{laser}^2 + \tau_{laserTOA}^2 + \tau_{VM}^2}$$

- τ_e: Electron bunch length
- τ_{eTOA}: Electron arrival jitter
- τ_{laser}: Pump laser pulse length
- $\tau_{laserTOA}$: Pump laser arrival jitter
- τ_{VM}: Pump laser & electron velocity mismatch in sample

- Pump laser pulse length: **~300 fs FWHM, PHAROS (→ ~30 fs)**
- Pump laser arrival jitter: under testing
- Electron beam bunch length: <50 fs FWHM
- Electron beam arrival jitter: ~100 fs FWHM

Gun gradient



Booster phase