OUTLINE

IPAC 2022 Report

20/06/2022 Thomas Perron

Plasma based accelerators

-A step has been made in performance, mainly in DP/P
Some experiments show a DP/P of 0.1%.

-Plenty of projects of plasma based accelerators foresee to deliver beam to users or to be used as injectors within the 10-15 next years.

- The beam energy you obtain is limited by the energy contained in the driver beam (either laser or particles).

Plasma Wake 2

Presentation of Prof E. Chiadroni on monday morning. EuPRAXIA project

Nice table found in docs on EUPRAXIASITE. (TDR I think)

	E [GeV]	ΔE/E [%]	Q [pC]	σ_τ [fs]	ε_n [mm mrad]	f [Hz]
Operational						
FLASH Forward [99]	0.4–1.25		50–800	50–6,000	1–3	4×10^4–3×10^6
SPARC_LAB [100]	0.03–0.15	0.1–0.2	20–1,000	1×10^4–2×10^4	1–5	10
CLEAR (CERN) [101]	0.06–0.22	<0.2	10–500	1.67×10^3–8×10^3	3–20	1–25
Planned / under development / commissioning						
FACET II [96,97]	10	0.4–1.8	500–3,000	3.3–333		1–30
SINBAD-ARES [98]	0.1		0.5–200	0.8–10	<0.5	50
ELI-Beamlines (HELL) [95]	0.1–5	0.1–10	10–1×10^5	1–10		10
EuPRAXIA	0.1–5.9	0.1–4	20–100	0.8–12	0.1–1.5	20–100

In china: Chen Lin (PKU, Beijing) CLAPA Facility.
Plasma injector for CEPC in the frame of IHEP (45Gev, 1nc)

Plasma wake 3

Some projects for SR injectors:

- Design of a prototype laser-plasma injector for the DESY-II synchrotron

S. A. Antipov, A. Ferran Pousa, I. Agapov, R. Brinkmann, A. R. Maier, S. Jalas, L. Jeppe, M. Kirchen, A. Martinez de la Ossa, M. Thévenet, P. Winkler.

-Status Report of the 50 MeV LPA-Based Injector at ATHENA for a Compact Storage Ring
Eva Panofski (DESY, Hamburg)

In any case a High energy beam or laser is needed.

Pro: We have the tunnel (the empty part of the linac tunnel)
Con: No experience and no real need. No in-house MJ laser.

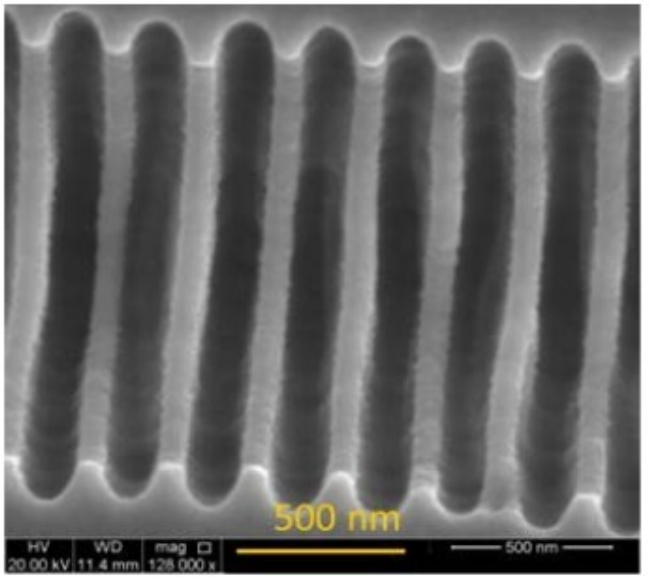
Accelerator on a chip

Growing community for the Scientific case: atosecond science and medical applications.

30Gev/m acceleration demonstrated... but over 120 microm.

Still very low charge, low energy, large energy spread etc... but fits into a shoo box.

https://achip.stanford.edu/

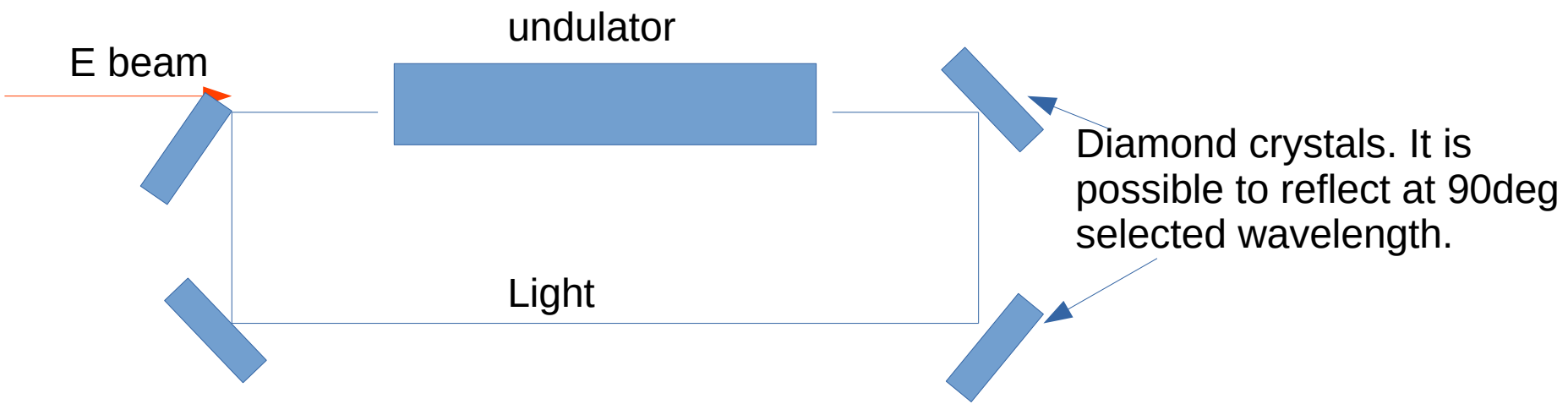


Courtesy Yves bellouard

FEL based on circular accelerators

Gabriel Marcus (SLAC)
Towards Cavity-Based X-ray Free-Electron Lasers

Recycle the X ray photon beam emitted by an undulator to seed an FEL.



RF structures

mm-Wave Structure Development for High Gradient Acceleration (Annika Gabriel slac)

Small rf cavities machined in cooper. Like accelerator on a chip at a mm scale. 150MV/M gradient measured for a 100Ghz cavity structure.

RF photogun c-band structure. 1 Structure does first acceleration and then bunching. Could be interesting for us.
Martina Carillo (Sapienza University of Rome, Rome) .

Soleil MIK results

ID: 2528 - THPOPT039, SUSPMF022 Performance Report of the SOLEIL Multipole Injection Kicker

Randy Ollier (SOLEIL, Gif-sur-Yvette)

Very successful. H perturbation down to almost nothing, but V kick observed and not understood.

Mitigation: A kicker applies a V kick on the second turn and cancels the perturbation.

The MIK is heating (up to 180DegC) asymmetrically. Downstream is the worse. They are waiting to dismount the device for visual check of coating and traces of sparking.

Table 3: Main Design Specifications of the MIK

Parameter	Value
Hor./vert. beam stay clear (mm)	46.8 / 7.8
Total length (flange-to-flange) (mm)	400
Magnetic length (mm)	304
Magnetic field at target position (mT/kA)	24.85
Hor./vert. field free region (µm)	800 / 100
Pulse duration (µs)	2.4

Other topics

Har Lobach (ANL) experience with single electron

They started to do physics with the light produced by a single electron.

For machine studies, they could measure rf phase jitter.

TOMX commissioning

2 years waiting for ASN approval.

Gun: in-house rf photo gun. Max charge 100pC because of ASN,
1nc foreseen.
Emittance= 40nm.rad
Output E = 5MeV

Miscellaneous

- Virtual diagnostics for longitudinal profile Adi Hanuka (SLAC)
(use neural network to create a virtual diagnostic that extrapolates beam profile for from available measurements)

- Beam halo monitor, Gaku Mitsuka KEK-B. Nice presentation of the optics set up.

-Rotating sextupole for coupling correction (could be rotating quad for coupling correction in booster for us) Mika Masuzawa (KEKb).

-Novel in-vacuum undulator design based on REBCO wires (Erik Jan Wallén, LBNL). New modular elliptically polarized undulators.

Sad news

Tandem accelerator in Munich will be decommisioned and cut into small metal pieces !!!

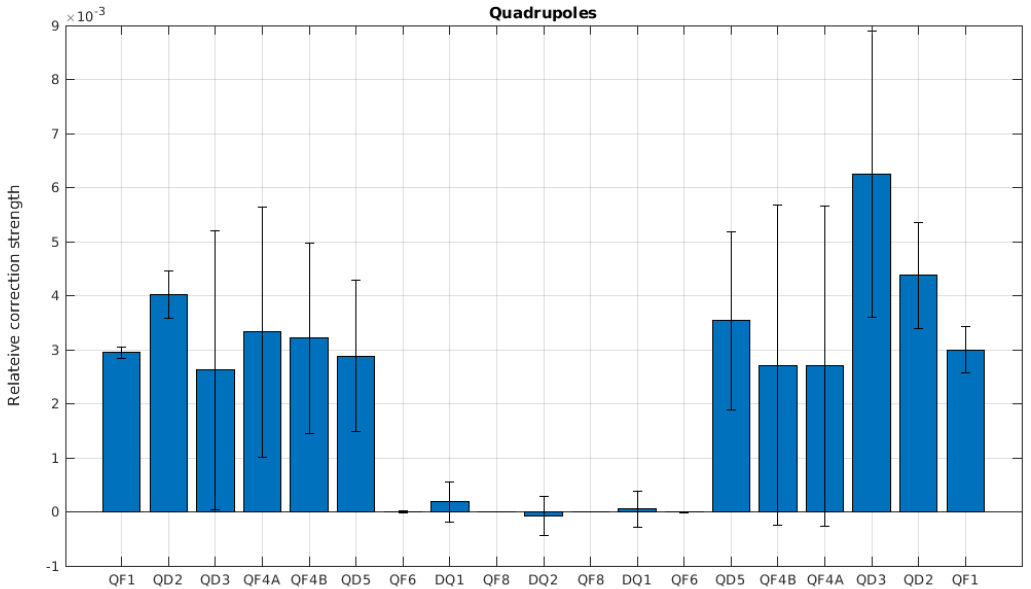
25 MEV acceleration based on two stage DC high voltage acceleration.

Accelerates everything that can be negatively ionized.

- 5-10cm stainless steel walls
- 6 Bar of highly toxic SF6 gas
- Up to 12MV dc voltage involved.
- first beam in 1970

Considered as obsolete.

Energy mismatch of the modeled machine



Quadrupole correction is in almost all cases trying to increase the initial magnet strength.

Do we have an energy mismatch between the model and the real machine?

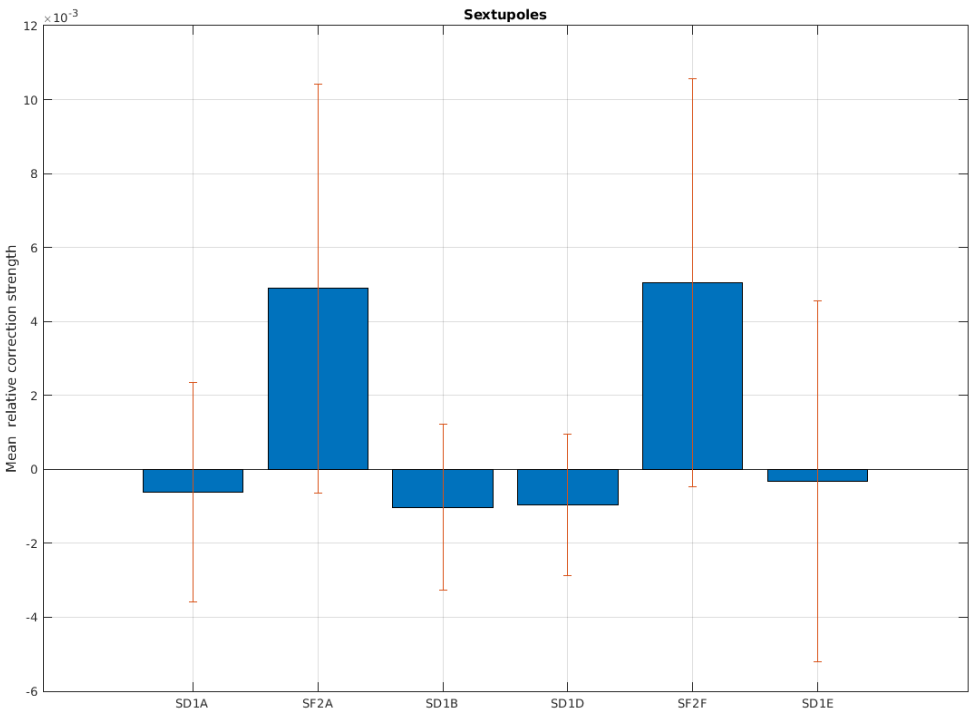
rescaled DQ1 + 3e-3 (correction strength)
strength= -1.91m-1

rescaled DQ2 - 5e-3
strength=-1.26m-1

Confluence of 23/01/2020.

The central part behaves differently: could it be linked to the DQ calibration change done during commissioning??

Energy mismatch: sextupoles



Same observation for sextupoles.

Except that the vertical sextupoles are less affected affected.

It can be explained by simulation:

In the theoretical model without errors introducing a 2/1000 energy offset (not via DP/P) and re-adjusting the tunes:

$\Delta\xi h=-1.15 \qquad \Delta\xi v=0.05$

Energy missmatch 3

Comparison of the betamodel of the theory folder and the actual machine with the settings correponding to this given betamodel is of interest.

Work to be continued, but it looks like we should adapt our Bρ for the current to strength conversion of all quads (except DQ's) and sextupoles by 1-2/1000.