



WP5: Undulators Cost Matrix

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Undulators cost Matrix general aspects

- cost for undulators depend on series or single devices
- cost overview filled with data from labs and industry
- industry (design, full systems, components, ...)
 - no new developments, but production of established system
 - requires Tech Transfer
- price per m and for saturation (10x gain length)
- price tags will give some orientation also for scaling
- optimum especially for soft x-rays is not too long but more modules
 - even if the price for undulator is higher



Undulators for Compact Light: Hard x-ray: planar

short period, small gap:

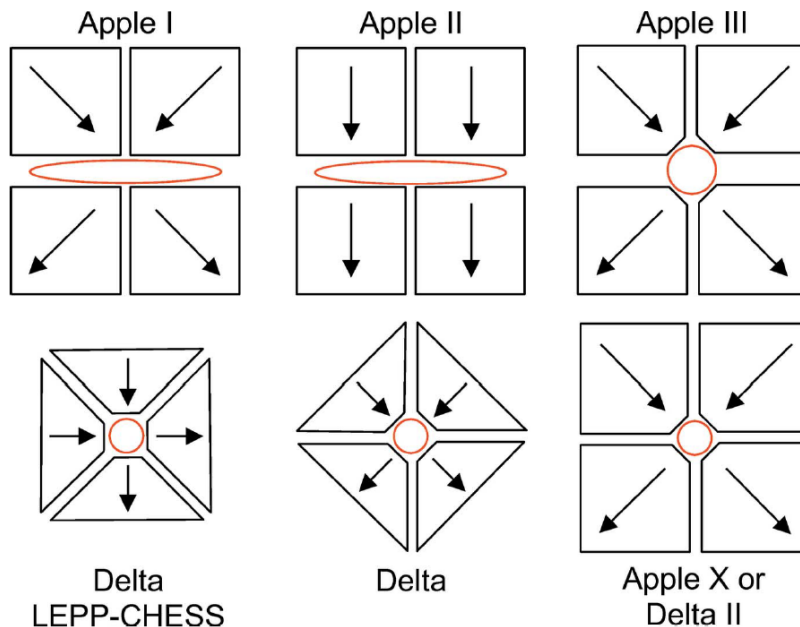
- in-vacuum
- cryogenic in-vacuum @ LN2
- classical sc
- High Temperature sc (HTS)



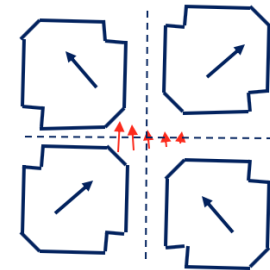
Undulators for Compact Light: Soft x-ray: variable polarization

short to medium period, small gap:

- planar out of vac FEL with polarized afterburner only
- APPLE II (also in-vac under construction at HZB)
- APPLE X with gradient control
- fixed gap DELTA



gradient control by individual
radial settings of magnet arrays:





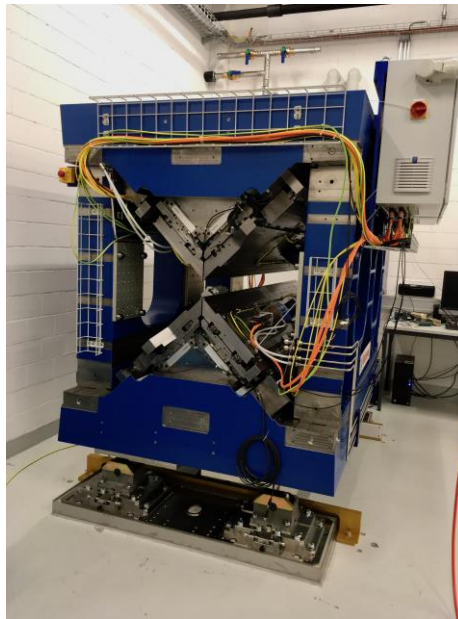
J. Bahrdt et al., In-Vacuum APPLE II undulator, IPAC2018, Vancouver (2018)

Undulators for Compact Light: Soft x-ray: variable polarization

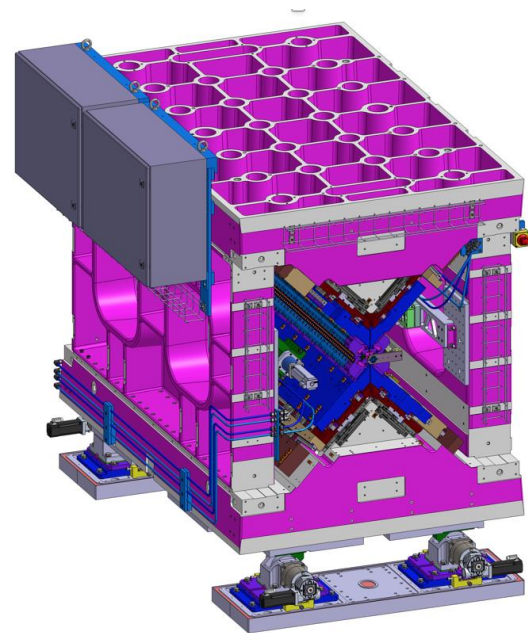
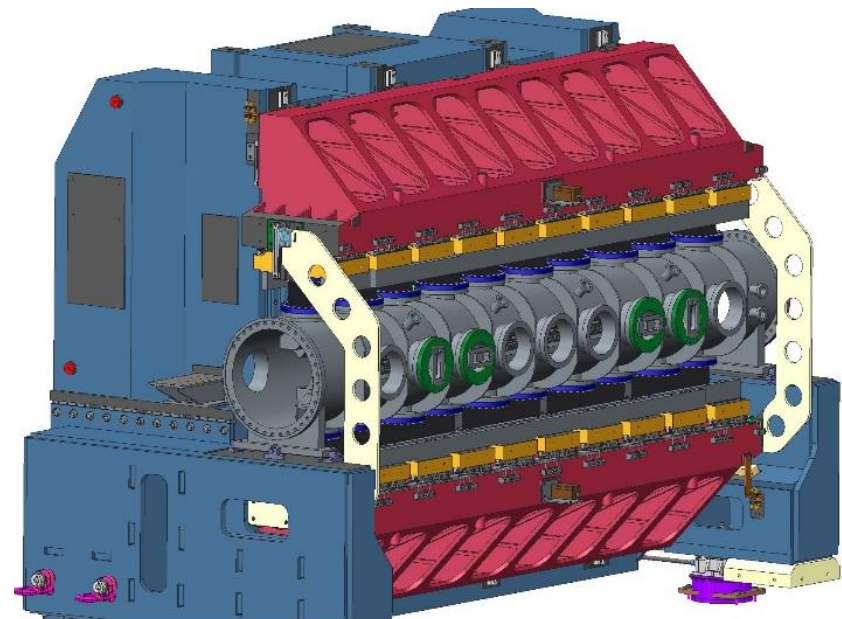
short to medium period, small gap:

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APPLE X UE38 SwissFEL



in-vac APPLE II @ HZB for BESSY II
(Johannes Bahrdt, Atoosa Meseck)





	out of vac	in-vac	in-vac	CPMU	SC NbTi / SC Nb3SN	HTS
Performance: K (λ/gap/L)	80/13/2	15/4/4	2m			
Design	1M	100 MM	2 M			
Fabrication by Lab		800 / 13units				
Magnetarray	200	300	200			
Support	300	380	300			
Drive System / Controls	50	50	50			
Vacuum System		70	50			
Optimization		4MM				
Fabrication by Company	460/1- 700/1		1100/1			
Installation / Infrastructure		400 + x floor				
Fabrication Time by company / by Lab	12/12	18/12	14/18			
Operation / Maintenance						
price / m [€]	230 – 350	200	600 /550			
total price [M€] / saturation length [m]	0.46 - 0.7	12	1.2 / 1.1			



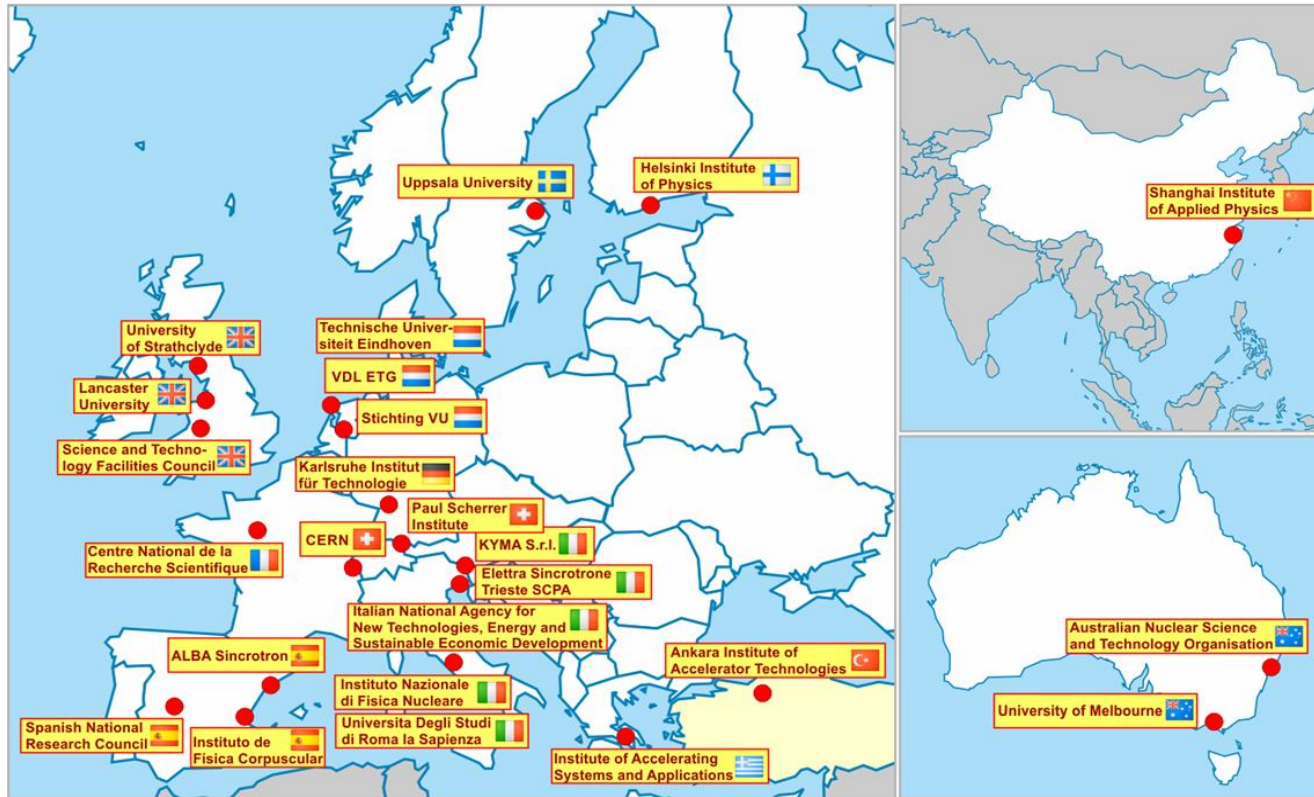
	APPLE II	APPLE II	APPLE III	APPLE III	in vac	CPMU	SCAPE
Performance: K (λ/gap/L)	70/14/2	-/-/2	-/-/2	38/6.5/2			
Design	1 M			60MM			
Fabrication by Lab				600 / 16			
Magnetarray	200			130			
Support	300			420			
Drive System / Controls	50			20			
Vacuum System				30			
Optimization	1 M						
Fabrication by Company	800	560	760				
Installation / Infrastructure	2d			70			
Fabrication Time by company / by Lab	12/18			24/24			
Operation / Maintenance							
price / m [€]	400	280	380	300			
total price [M€]/ saturation length [m]	0.8	0.56	0.76	10			



Thank you!

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