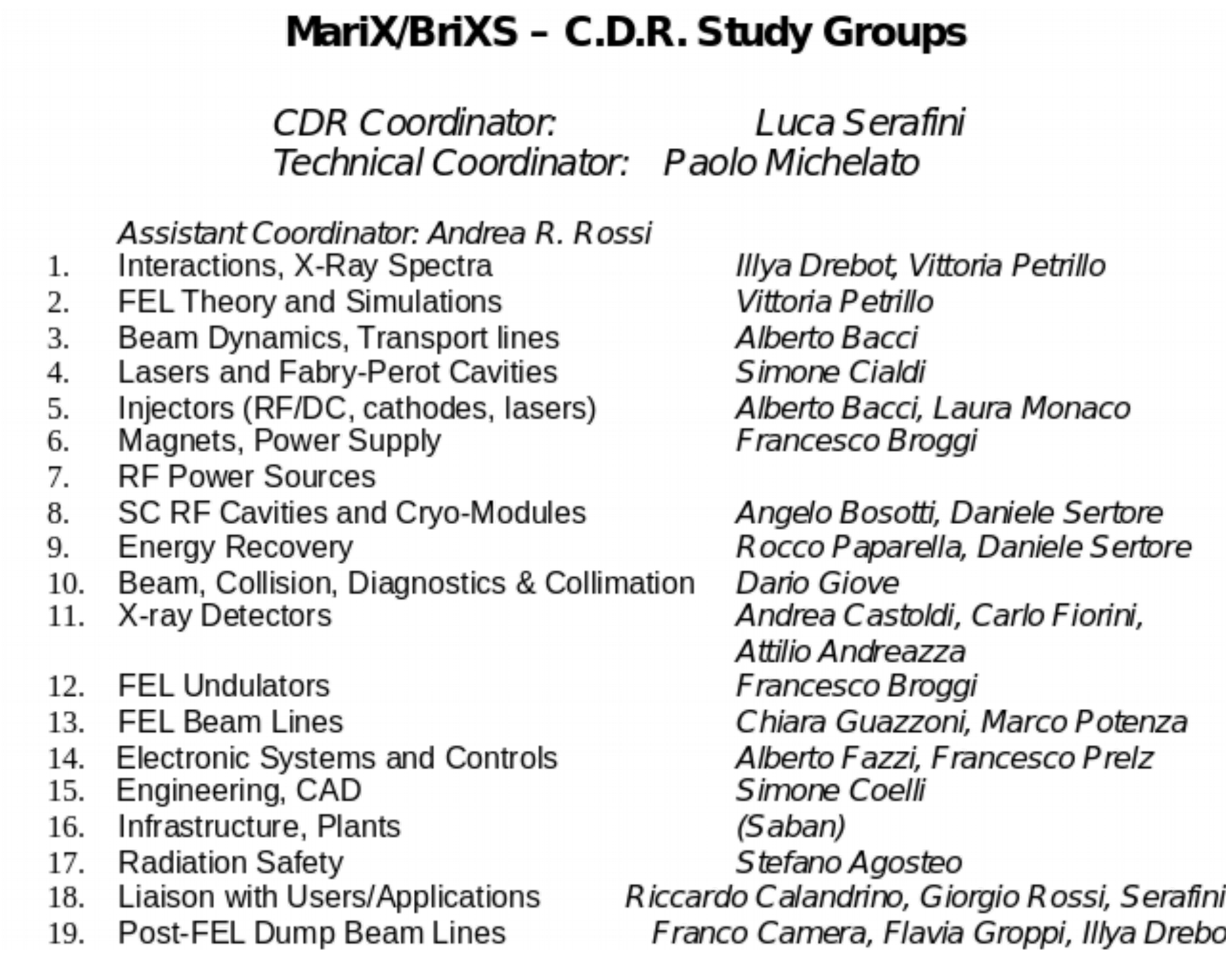
INFN
MILANO
Istituto Nazionale di Fisica Nucleare
Sezione di Milano

M.A.R.I.X.

Multi-disciplinary Advanced Research Infra-structure with X-rays

WG6 - WG12 Status



MariX/BriXS – C.D.R. Study Groups

CDR Coordinator: Luca Serafini
Technical Coordinator: Paolo Michelato

Assistant Coordinator: Andrea R. Rossi

1.	Interactions, X-Ray Spectra	*Illya Drebot, Vittoria Petrillo*
2.	FEL Theory and Simulations	*Vittoria Petrillo*
3.	Beam Dynamics, Transport lines	*Alberto Bacci*
4.	Lasers and Fabry-Perot Cavities	*Simone Cialdi*
5.	Injectors (RF/DC, cathodes, lasers)	*Alberto Bacci, Laura Monaco*
6.	Magnets, Power Supply	*Francesco Broggi*
7.	RF Power Sources	
8.	SC RF Cavities and Cryo-Modules	*Angelo Bosotti, Daniele Sertore*
9.	Energy Recovery	*Rocco Paparella, Daniele Sertore*
10.	Beam, Collision, Diagnostics & Collimation	*Dario Giove*
11.	X-ray Detectors	*Andrea Castoldi, Carlo Fiorini, Attilio Andreazza*
12.	FEL Undulators	*Francesco Broggi*
13.	FEL Beam Lines	*Chiara Guazzoni, Marco Potenza*
14.	Electronic Systems and Controls	*Alberto Fazzi, Francesco Prelz*
15.	Engineering, CAD	*Simone Coelli*
16.	Infrastructure, Plants	*(Saban)*
17.	Radiation Safety	*Stefano Agosteo*
18.	Liaison with Users/Applications	*Riccardo Calandrino, Giorgio Rossi, Serafini*
19.	Post-FEL Dump Beam Lines	*Franco Camera, Flavia Groppi, Illya Drebo*

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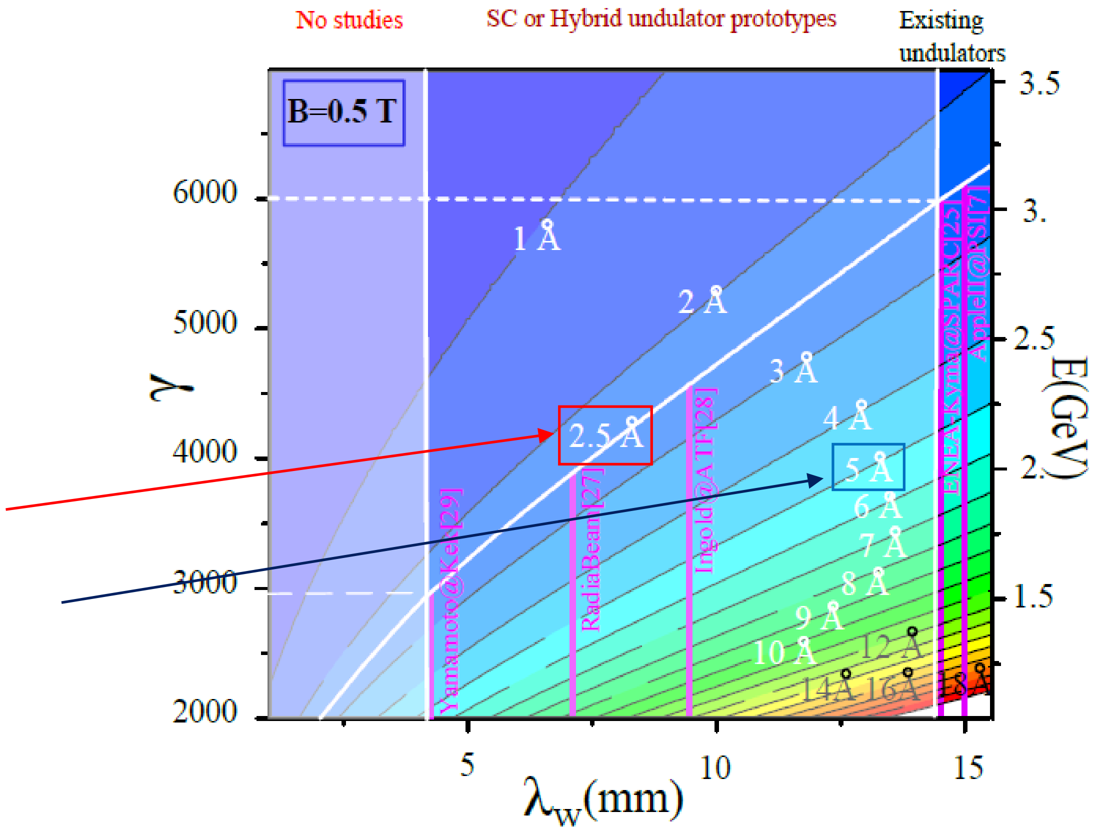
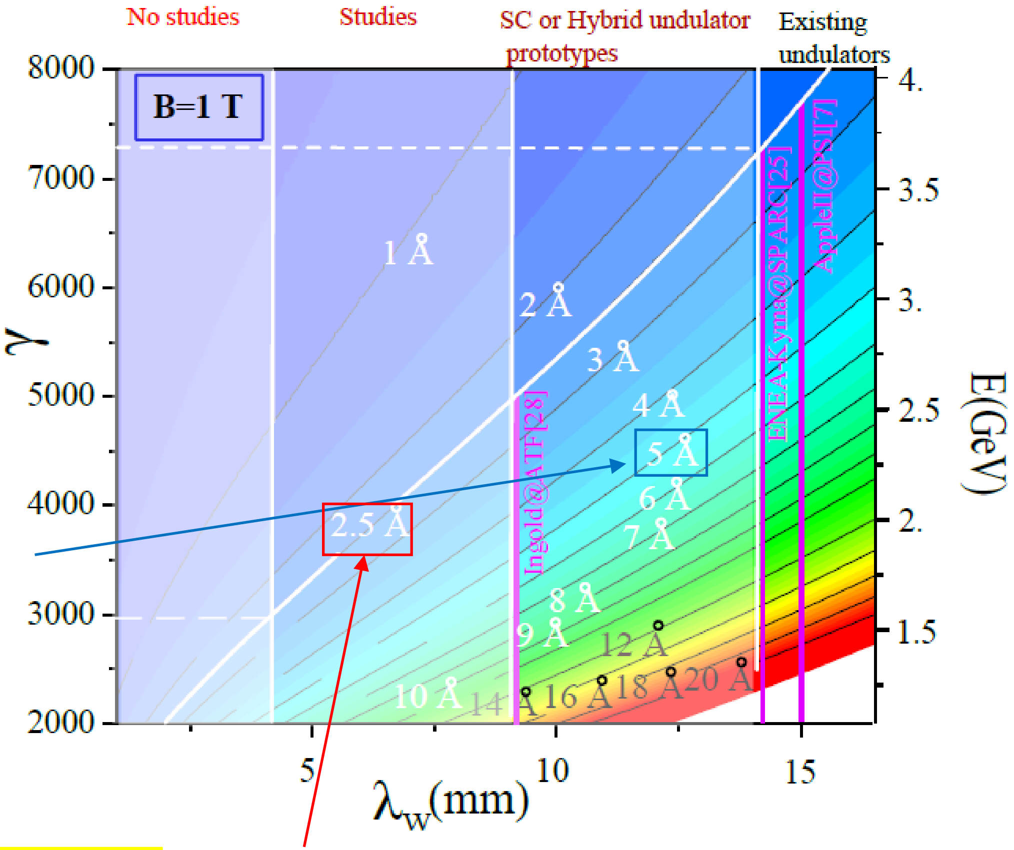
- Magnets – Power Supply

WG12

FEL undulators





Courtesy V. Petrillo

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FEL undulators

In base alla criogenia la massima energia del fascio è di 2.3 GeV. Quindi, secondo la relazione

$$\lambda = \frac{\lambda_w}{2\gamma^2}(1 + a_w^2)$$

Con

$$a_w = \frac{K}{\sqrt{2}} = \frac{eB\lambda_w}{2\sqrt{2}\pi m_e c} \qquad K = \frac{eB\lambda_w}{2\pi m_e c}$$

Possibili ondulatori commerciali o quasi commerciali sono RADIABEAM o KIMA

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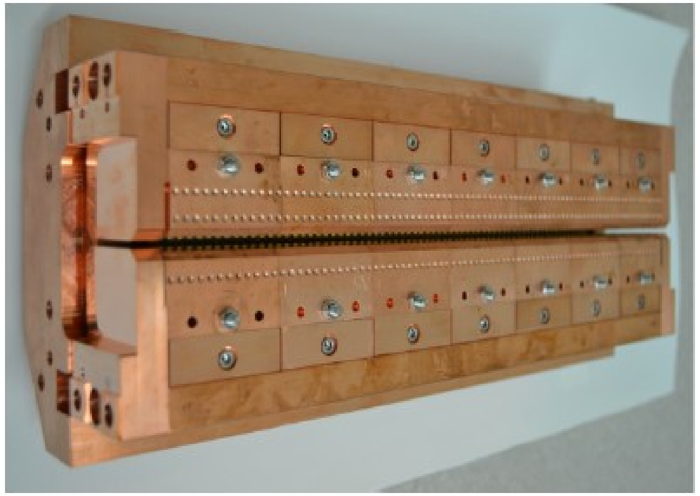
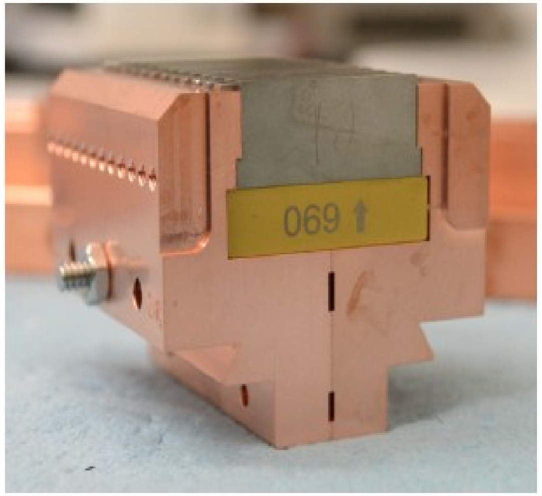
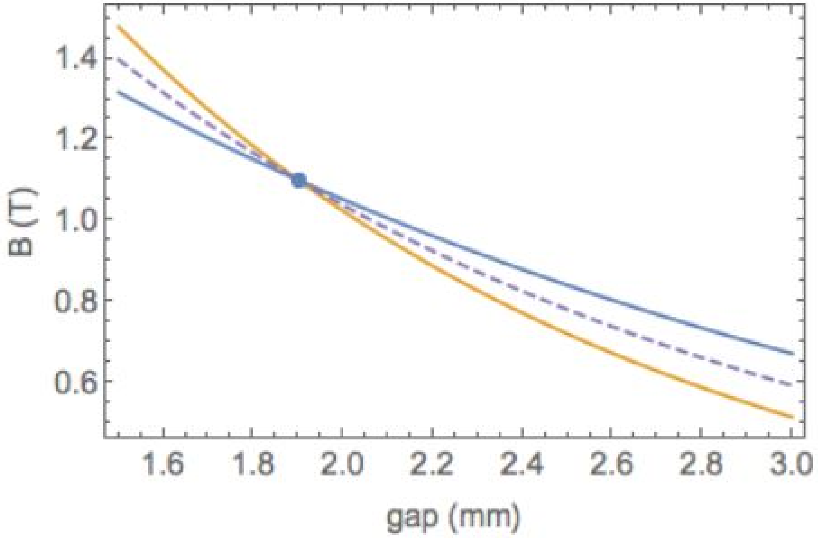
Ondulatore RADIABEAM





Prototype Parameter	Value
Period length	7 mm
Field strength (room temp.)	1.1 T
Full gap height	1.9 mm
Undulator Parameter, K_U	0.72
Number of periods, N_u	42
Magnet material	PrFeB
Pole material	Vanadium Permendur



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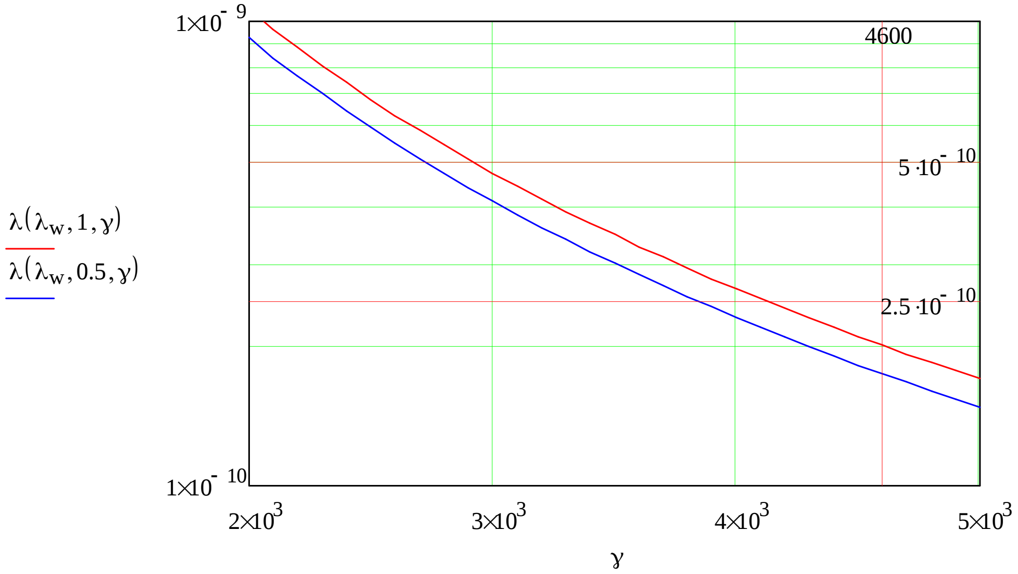
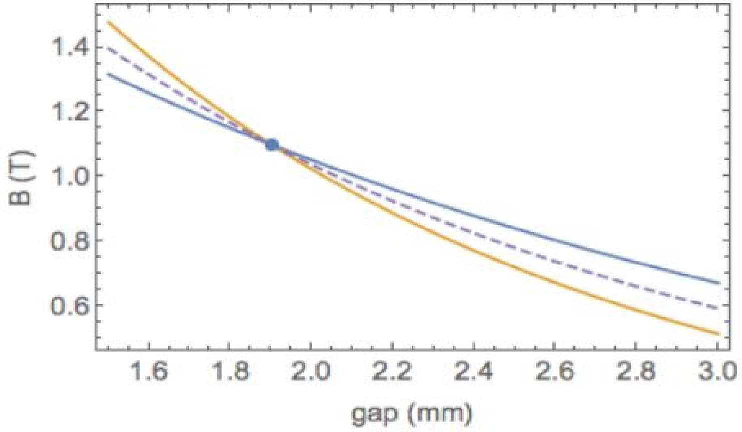
Ondulatore RADIABEAM

λ_w=7 mm





λ=2.5 x 10^{-10} m	B=1 T	γ=4120	(2.1 GeV)	a_w= 0.47	K=0.66	g=2 mm	g/λ_w =0.29
λ=5 x 10^{-10} m	B=1 T	γ= 2900	(1.48 GeV)				
λ=2.5 x 10^{-10} m	B=0.6 T	γ= 3840	(2.0 GeV)	a_w= 0.23	K=0.33	g=3 mm	g/λ_w =0.43
λ=5 x 10^{-10} m	B=0.6 T	γ= 2710	(1.4 GeV)				

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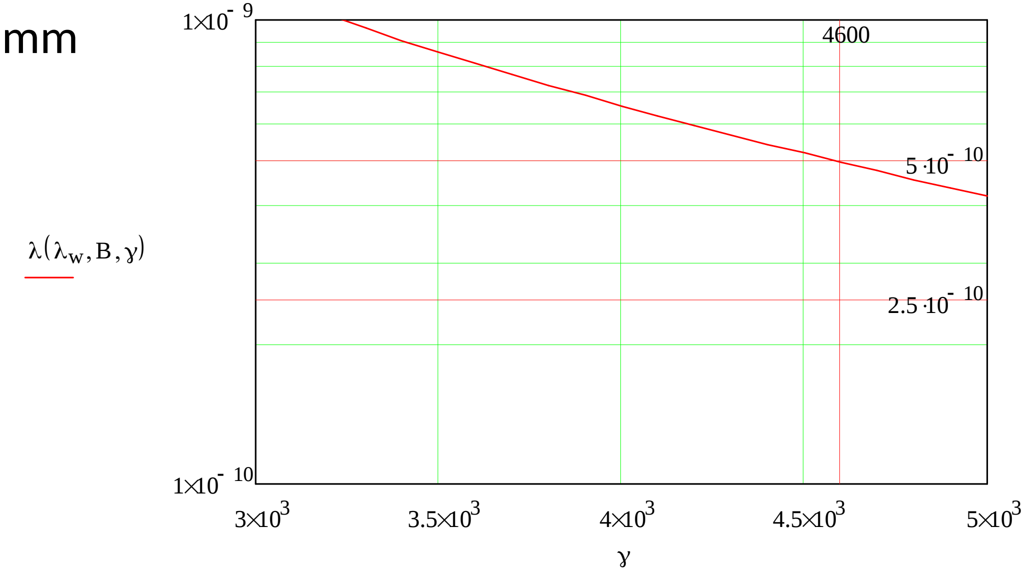
Ondulatore KYMA

λ_w=14 mm gap= 5 mm



λ=5 x 10^{-10} m B=0.76 T γ=4567 (2.33 GeV) a_w=0.7 K=1. g=3 mm g/λ_w =0.357

User	Number of Devices	Type	Number of Periods	Period Lenght [mm]	Peak Field [T]	Operational GAP [mm]	EL. Beam Energy [GeV]	Physical dimensions [LWH - mm3]	Weight [kg]	Control System	Status
Centro Ricerche ENEA di Frascati Italy, EU	1	LPU	100	14.00	0.59	5 (fixed)	0.50	150x80x180	900	N/A	Operating

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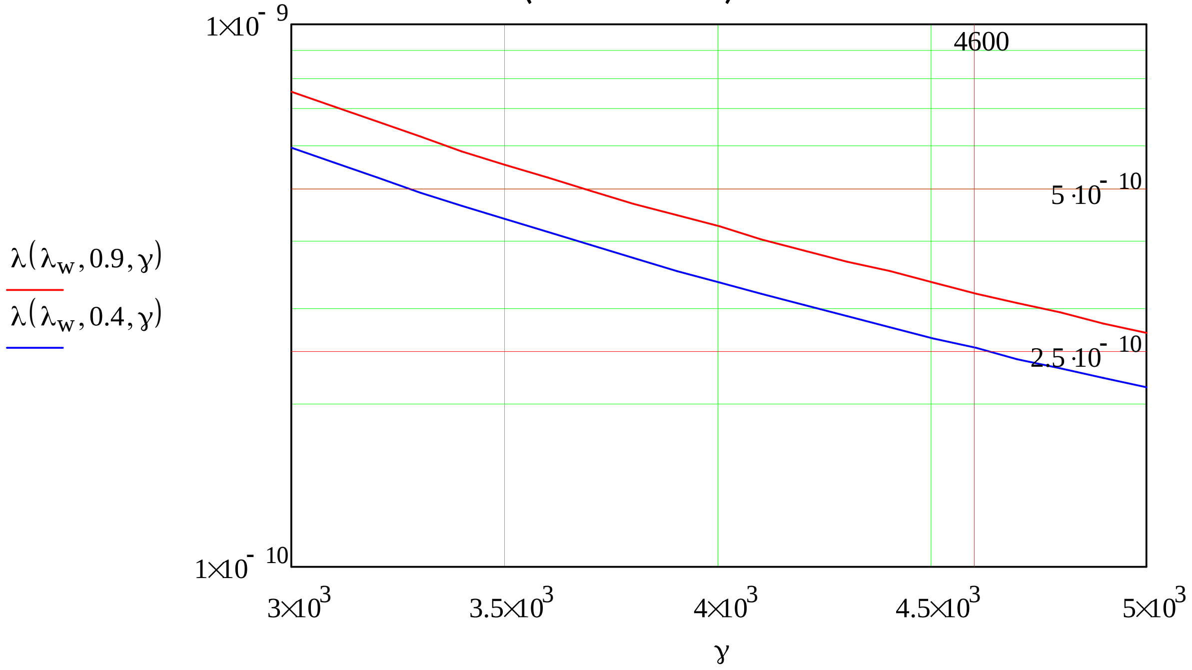
Ondulatore KIMA2 (da definirsi)

λ_w=10 mm

gap=3 (B=0.9 T) - 5 mm (B=0.4 T)
(variabile)



λ=5 x 10^{-10} m B=0.9 T γ=3675 (1.88 GeV) a_w=0.6 K=0.84 g=3 mm g/λ_w =0.3

λ=5 x 10^{-10} m B=0.4 T γ=3270 (1.67 GeV) a_w=0.26 K=0.37 g=5 mm g/λ_w =0.5

λ=2.5 x 10^{-10} m B=0.4 T γ=4620 (2.36 GeV) a_w=0.26 K=0.37 g=5 mm g/λ_w =0.5

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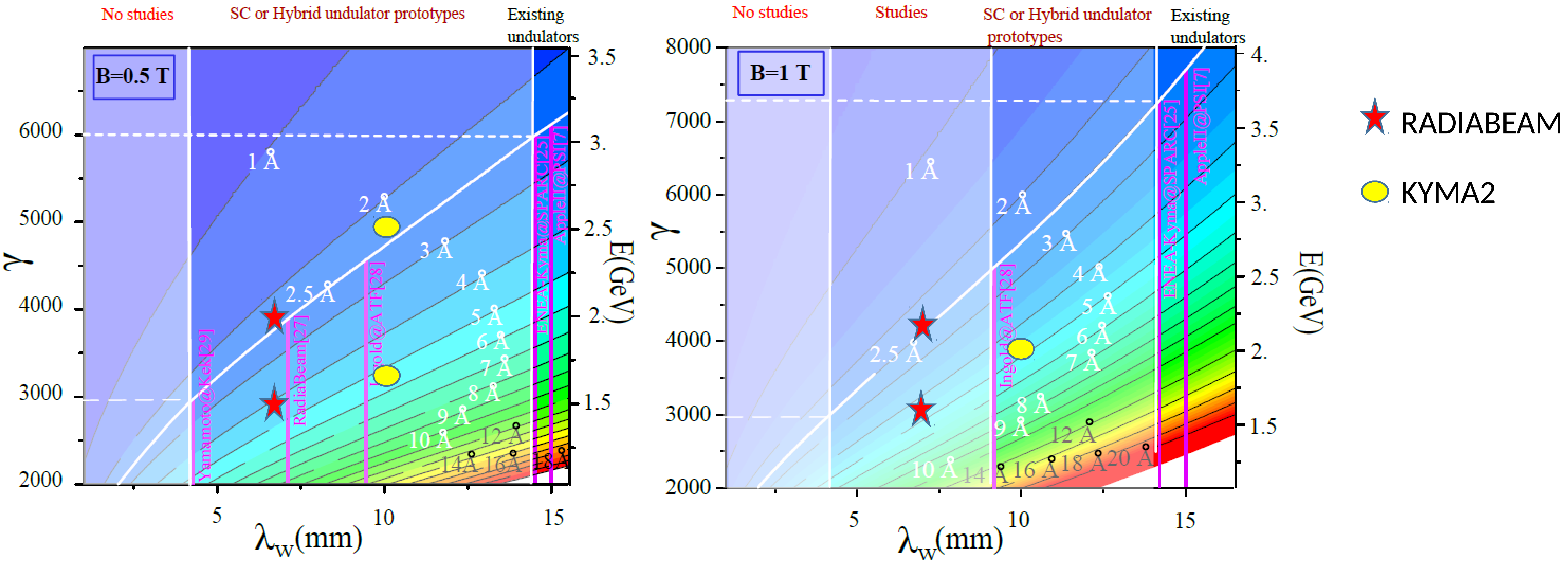
FEL undulators



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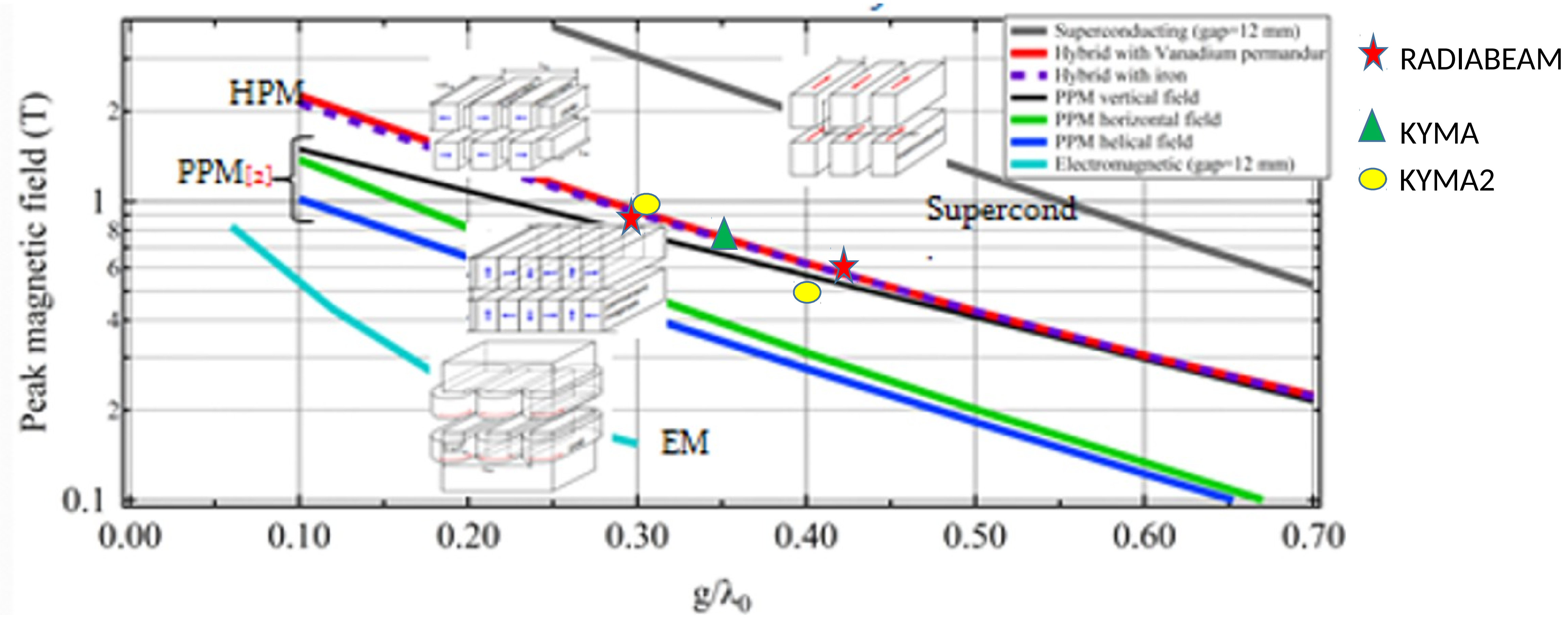
FEL undulators



Picture from G. Dattoli

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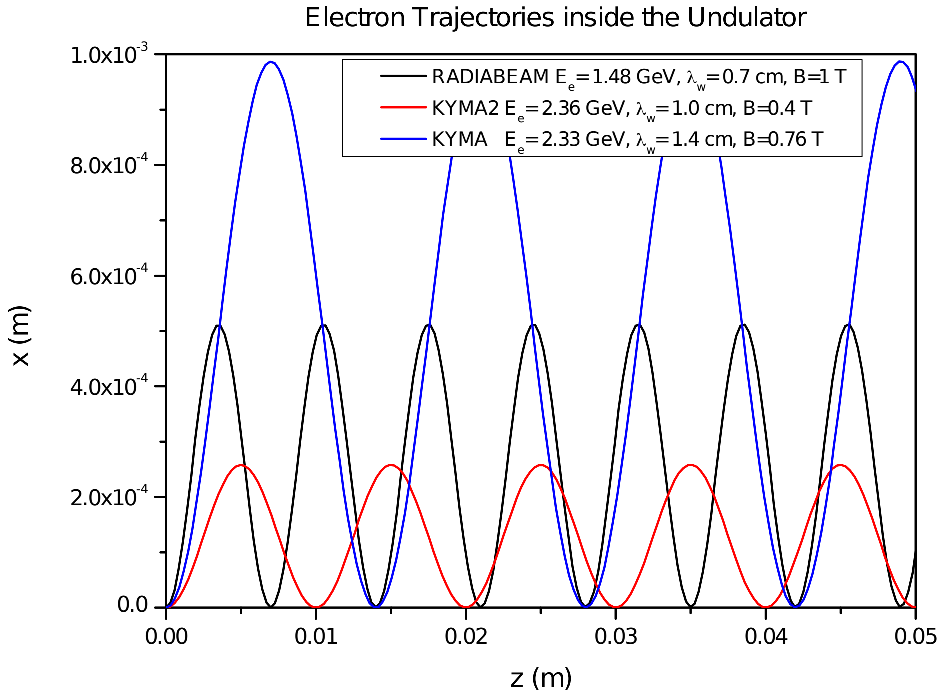
FEL undulators

Da qui risultano le seguenti traiettorie (calcolo classico, trascurate le perdite per radiazione etc.)



Omogeneità di campo richiesta +/- 1 mm.

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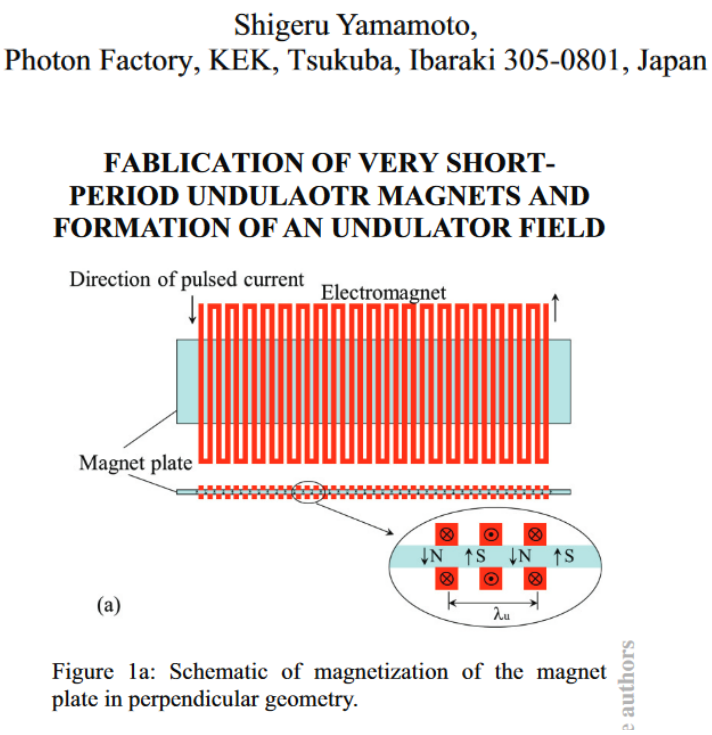
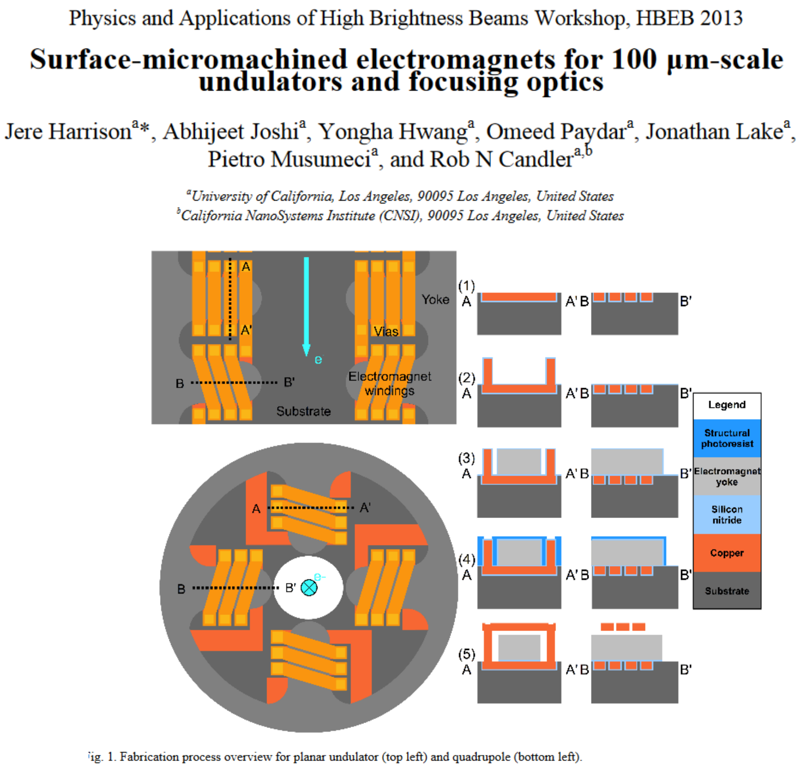
Exotic undulators



Shigeru Yamamoto,
Photon Factory, KEK, Tsukuba, Ibaraki 305-0801, Japan

FABLICATION OF VERY SHORT-PERIOD UNDULAOTR MAGNETS AND FORMATION OF AN UNDULATOR FIELD

Figure 1a: Schematic of magnetization of the magnet plate in perpendicular geometry.



Physics and Applications of High Brightness Beams Workshop, HBEB 2013

Surface-micromachined electromagnets for 100 μm-scale undulators and focusing optics

Jere Harrison[a]*, Abhijeet Joshi[a], Yongha Hwang[a], Omeed Paydar[a], Jonathan Lake[a], Pietro Musumeci[a], and Rob N Candler[a,b]

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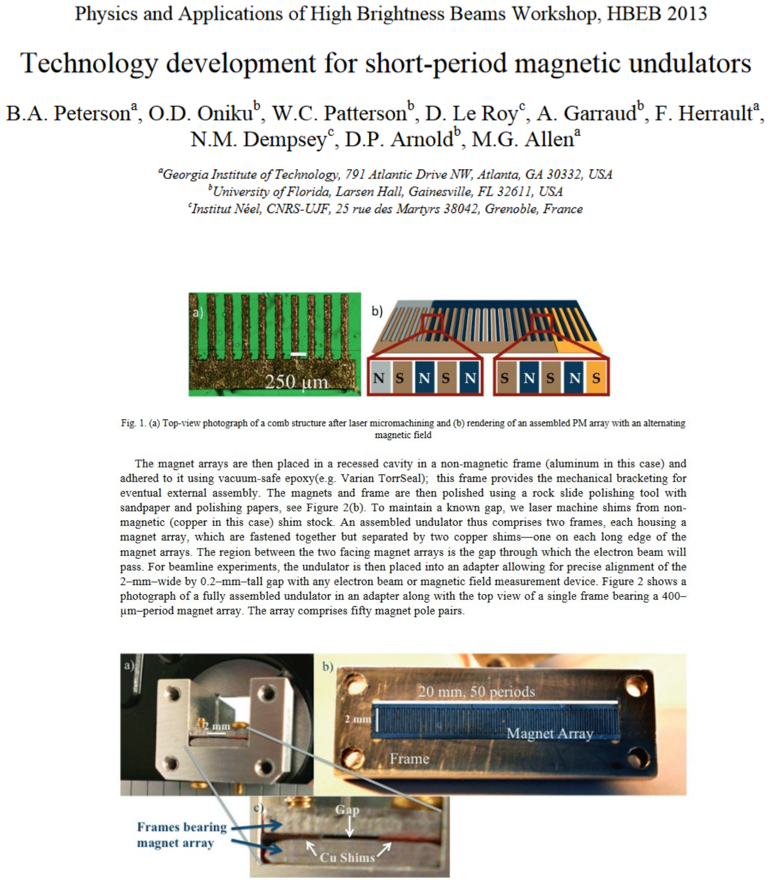
ig. 1. Fabrication process overview for planar undulator (top left) and quadrupole (bottom left).



Physics and Applications of High Brightness Beams Workshop, HBEB 2013

Technology development for short-period magnetic undulators

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Fig. 1. (a) Top-view photograph of a comb structure after laser micromachining and (b) rendering of an assembled PM array with an alternating magnetic field

The magnet arrays are then placed in a recessed cavity in a non-magnetic frame (aluminum in this case) and adhered to it using vacuum-safe epoxy(e.g. Varian TorrSeal); this frame provides the mechanical bracketing for eventual external assembly. The magnets and frame are then polished using a rock slide polishing tool with sandpaper and polishing papers, see Figure 2(b). To maintain a known gap, we laser machine shims from non-magnetic (copper in this case) shim stock. An assembled undulator thus comprises two frames, each housing a magnet array, which are fastened together but separated by two copper shims—one on each long edge of the magnet arrays. The region between the two facing magnet arrays is the gap through which the electron beam will pass. For beamline experiments, the undulator is then placed into an adapter allowing for precise alignment of the 2–mm–wide by 0.2–mm–tall gap with any electron beam or magnetic field measurement device. Figure 2 shows a photograph of a fully assembled undulator in an adapter along with the top view of a single frame bearing a 400–μm–period magnet array. The array comprises fifty magnet pole pairs.

Plasma undulators - Etc.ect