New Designs of electromagnetic undulators at SOLEIL

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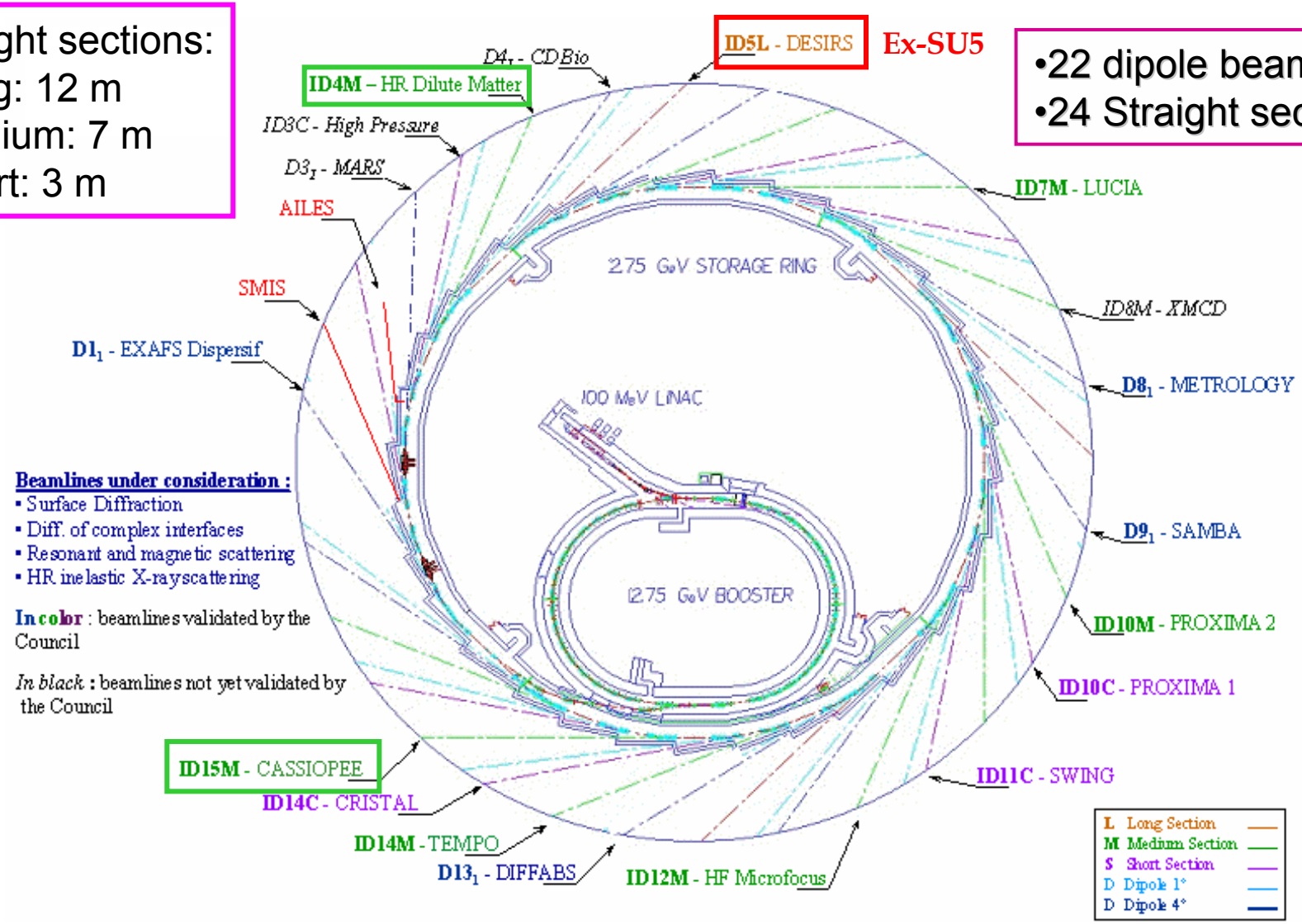
Beam lines implementation at SOLEIL

Straight sections:
- Long: 12 m
- Medium: 7 m
- Short: 3 m

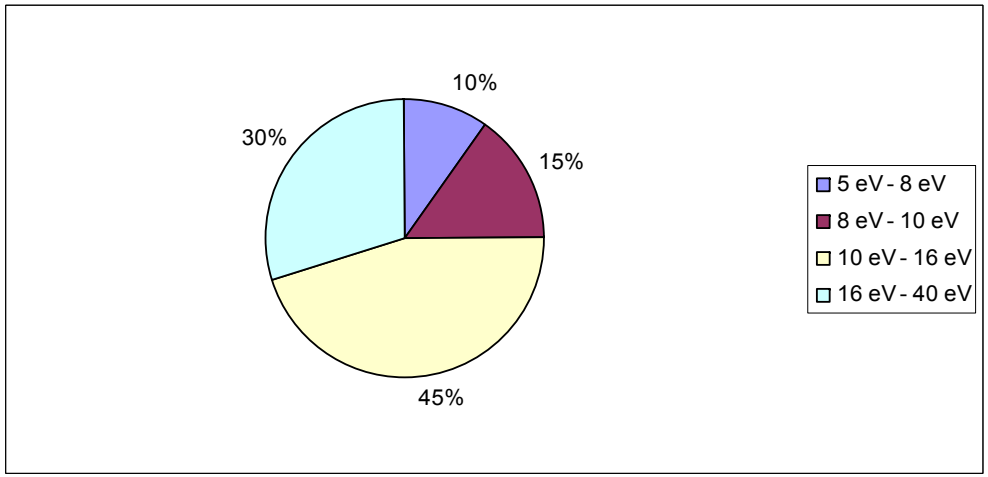
- 22 dipole beamlines
- 24 Straight sections

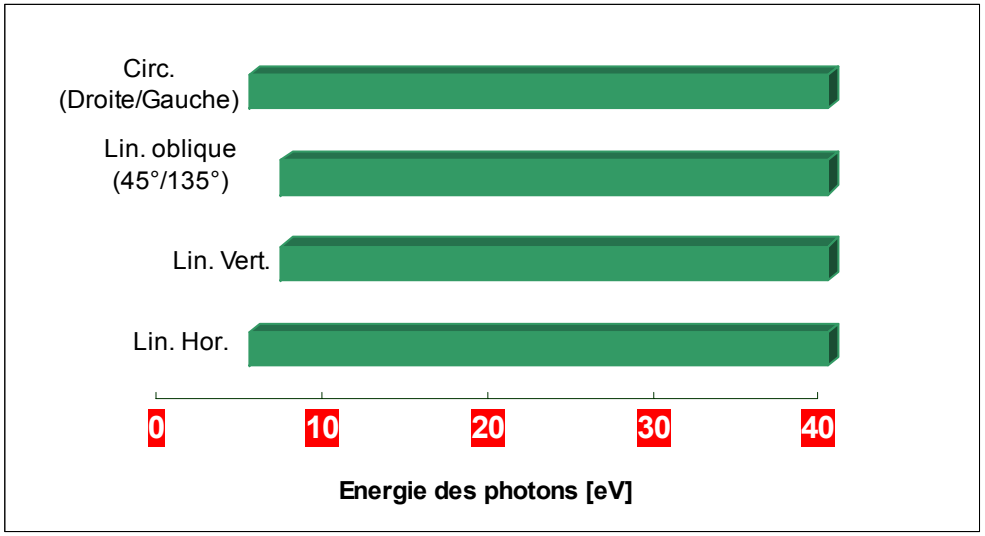


HU640

- Experimental needs
- Beam line transmission
- Magnetic design of HU640
- Optical performances

Exp. Needs





Courtesy of L. Nahon-SOLEIL

Needs

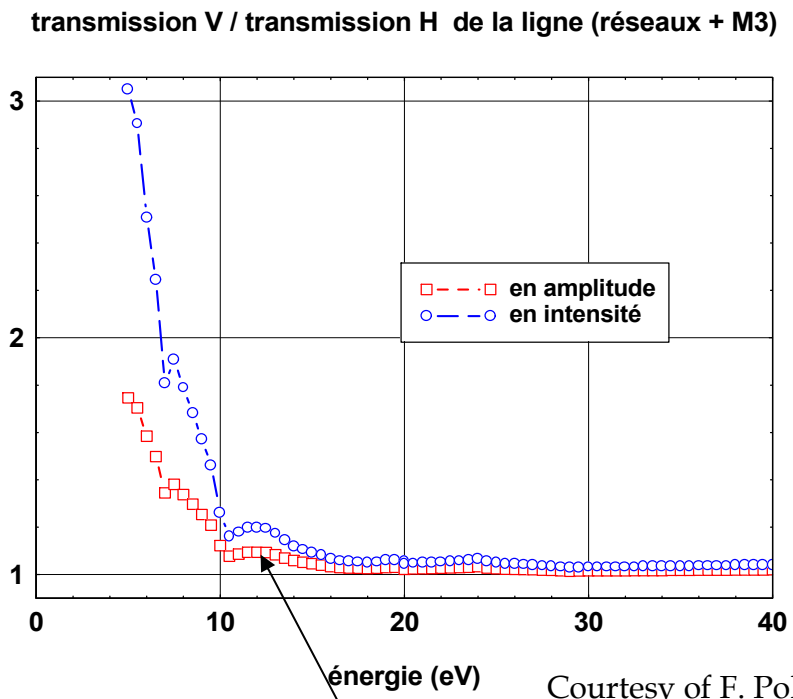
- Spectral range: 5 eV-40eV
- All kinds of polar. States
- Low radiated power
- Pol. Switch: 1 Hz (Duty cycle: ½)

- Tunable magnetic field
- Adjustable phase shift between field components
- Low field and large period

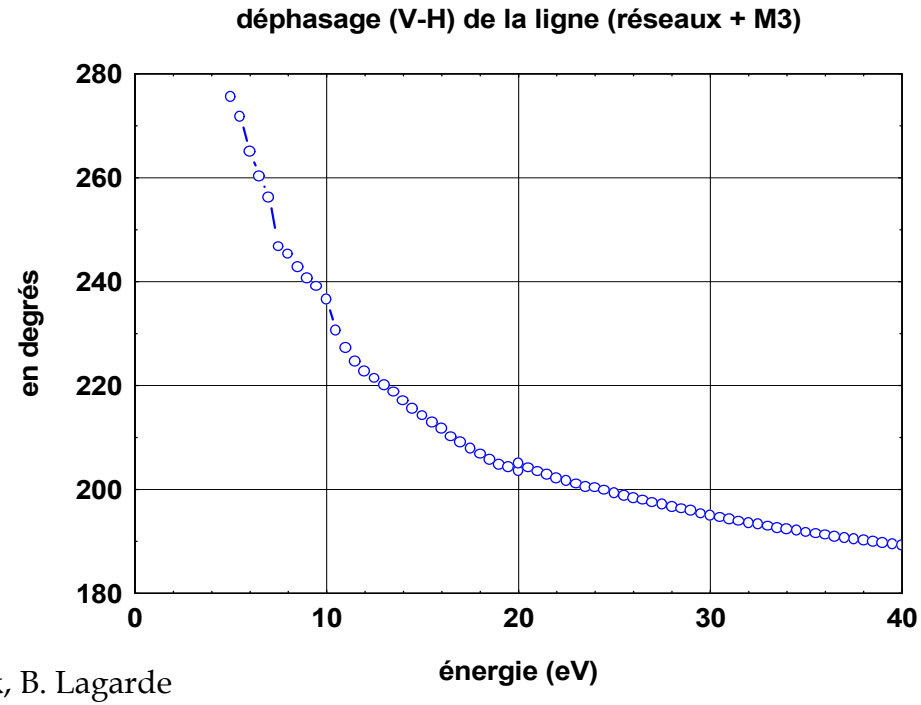
Electromagnetic undulator

Beam line transmission

σ and π polar. transmission



Phase shift between σ and π

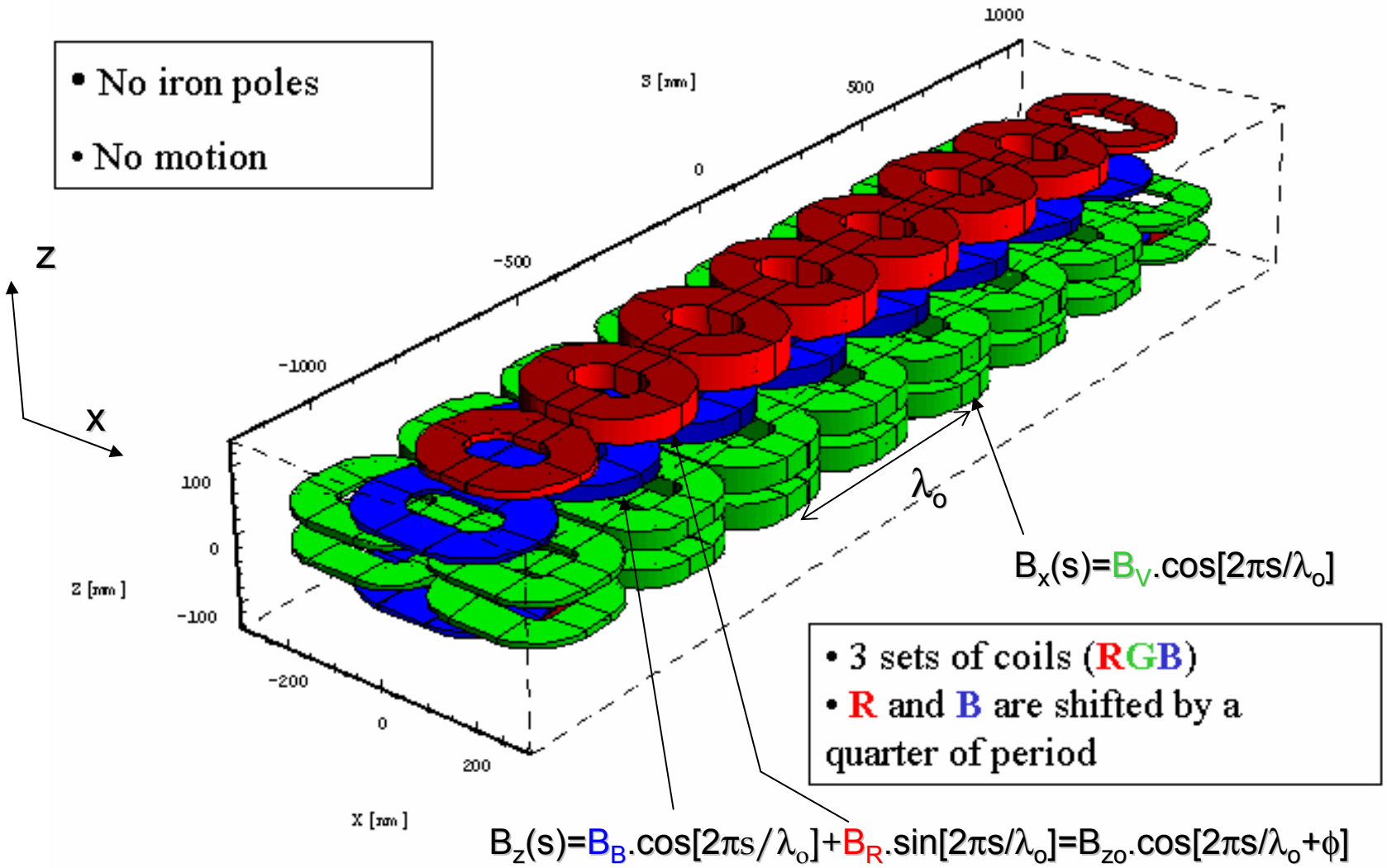


Courtesy of F. Polack, B. Lagarde and L. Nahon-SOLEIL

Continuously adjustable Phase shift

σ Amplitude/π Amplitude = B_z/B_x

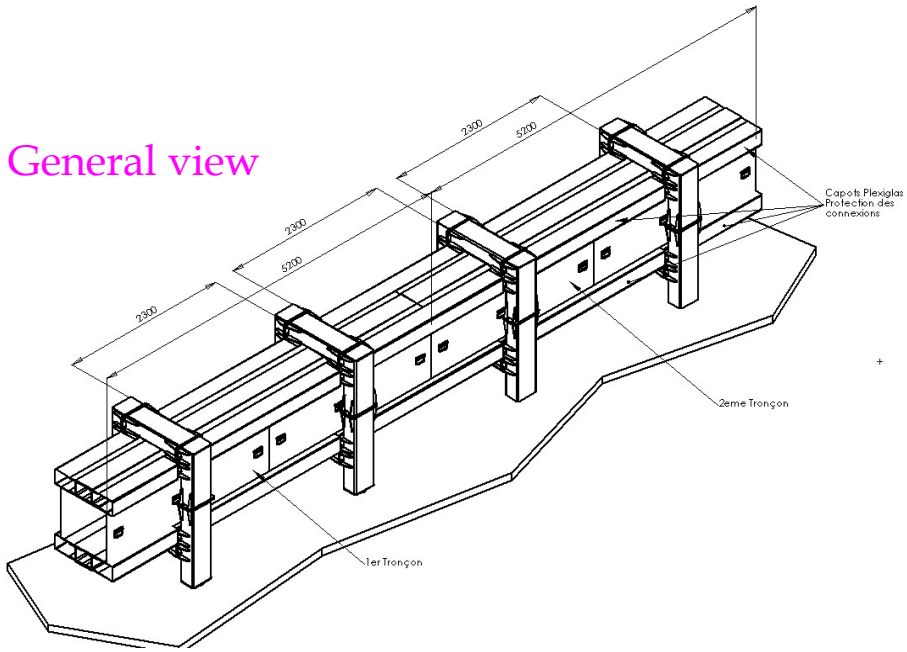
HU640 principle of operation



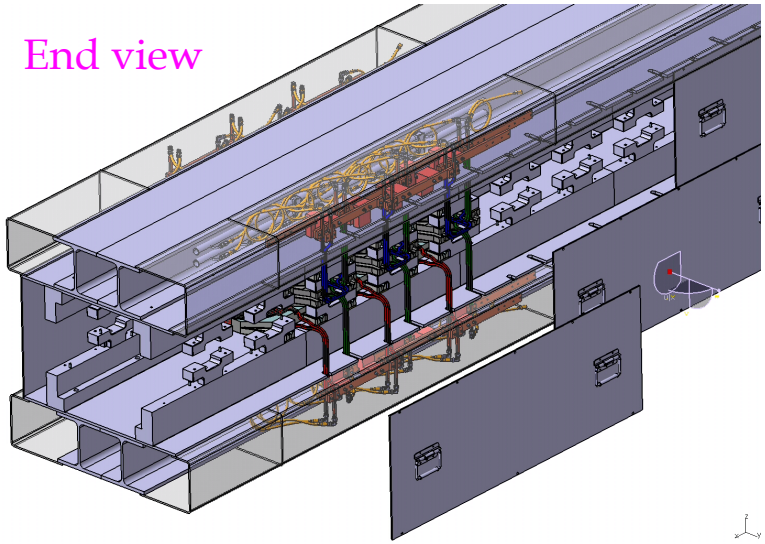
Radia code: http://www.esrf.fr

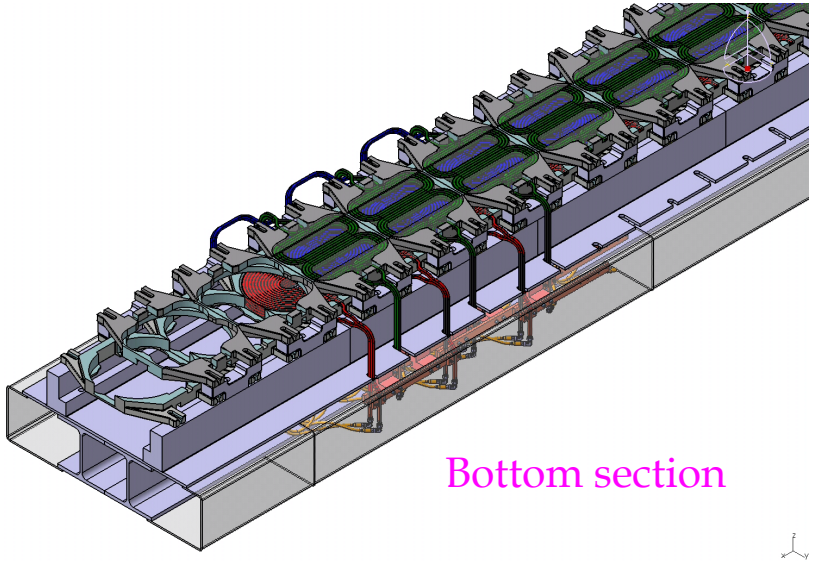
HU640: Mechanical structure

General view



End view





Bottom section

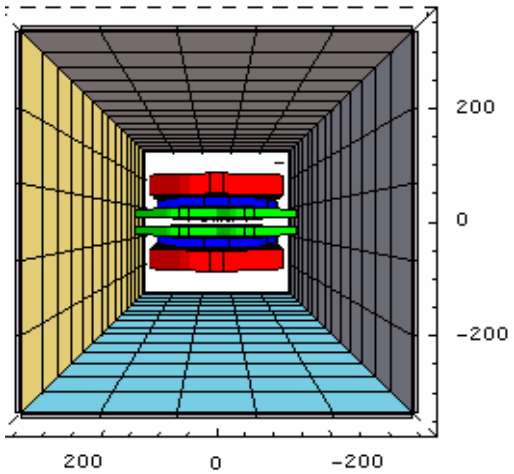
Courtesy of
J-L. Marlats et al. SOLEIL

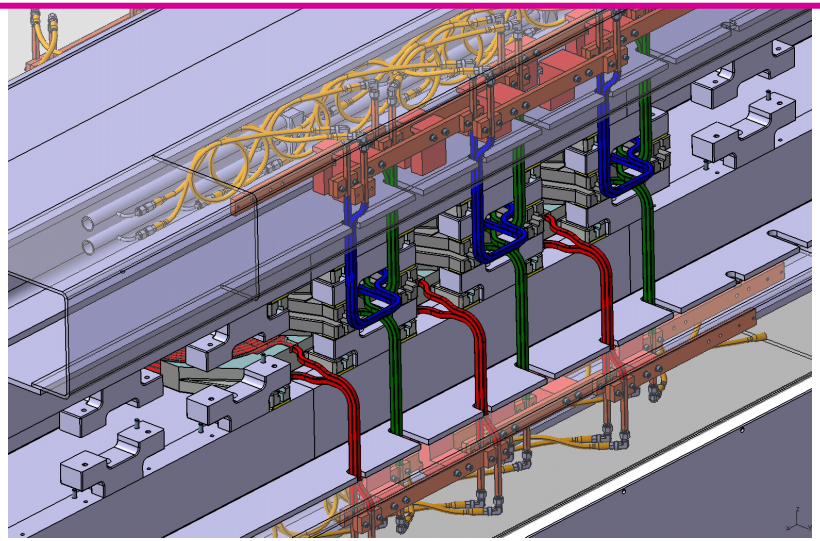
HU640: Mag. Shielding

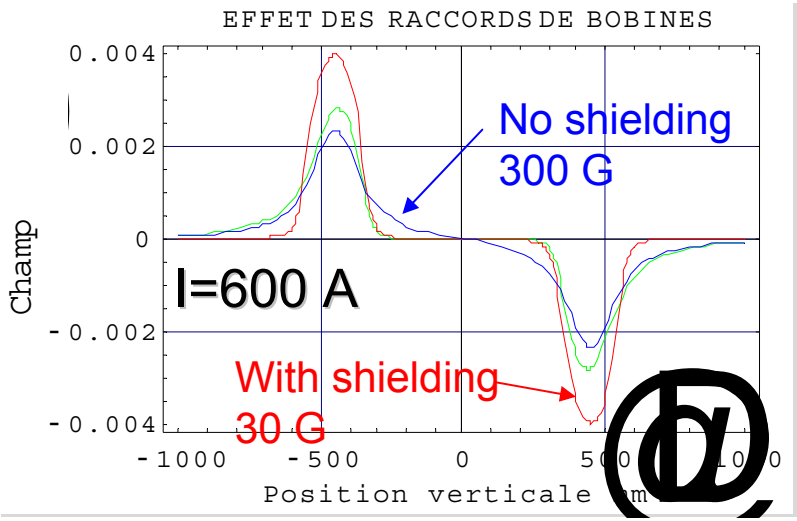
- Characteristics
  - Soft Iron
  - Geometry: 700 x 700 mm^2 x 10.4 m
  - Width: 5 mm
- Reducing the magnetic disturbances caused by the ID
- Reducing the external mag. disturbances level on the mag. Axis (Earth, electrical wires*)

*Electrical wires=Squew Quad. (has to be < **70 G**)=**effect on the beam**

Cross section



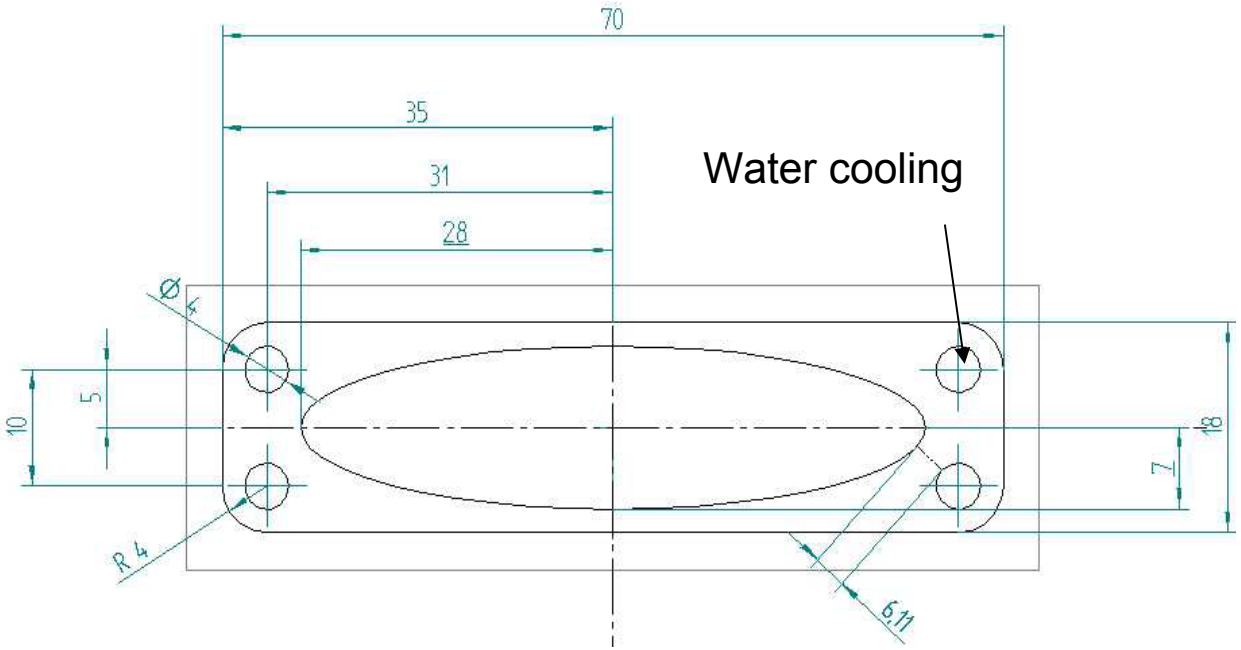




HU640: Vacuum vessel

- Extruded Aluminium
- Internal: 14 mm (Vert.) x 56 mm (Hor.)
- External: 18 mm (Vert.) x 70 mm Hor.)
- Length: 12 m

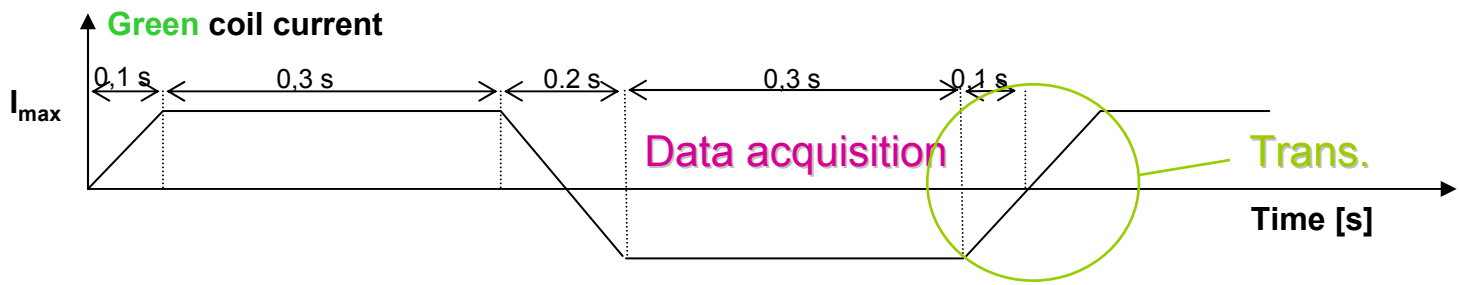
•NEG Pumping
(possible additional pumping)
•CERN collaboration



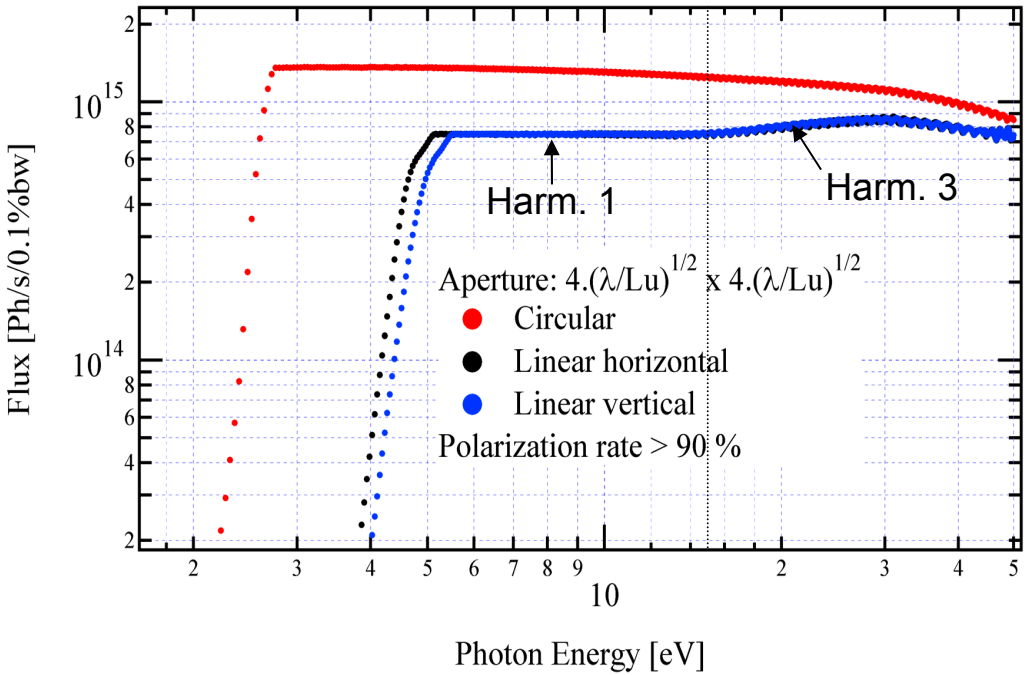
Cross section

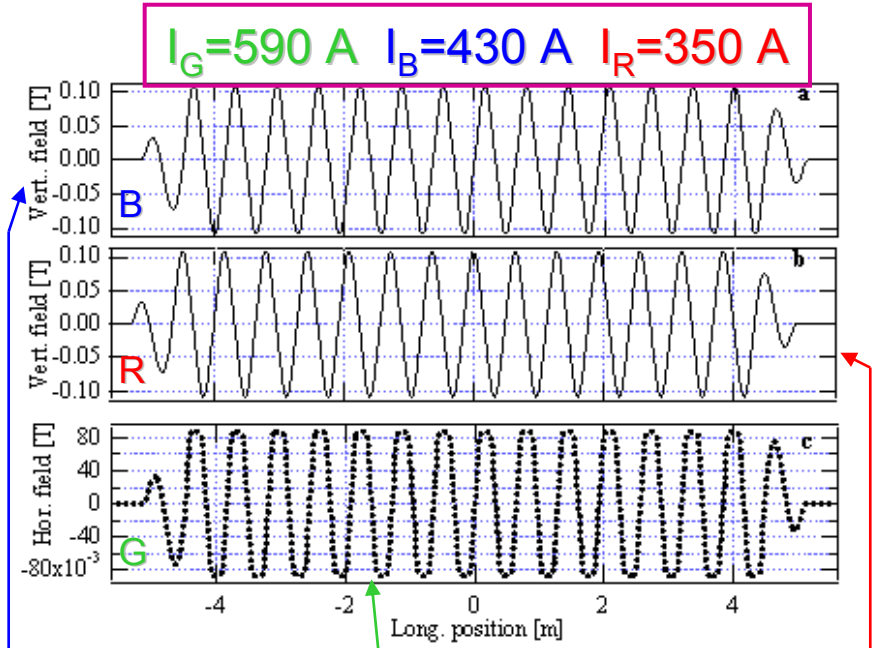
Main characteristics

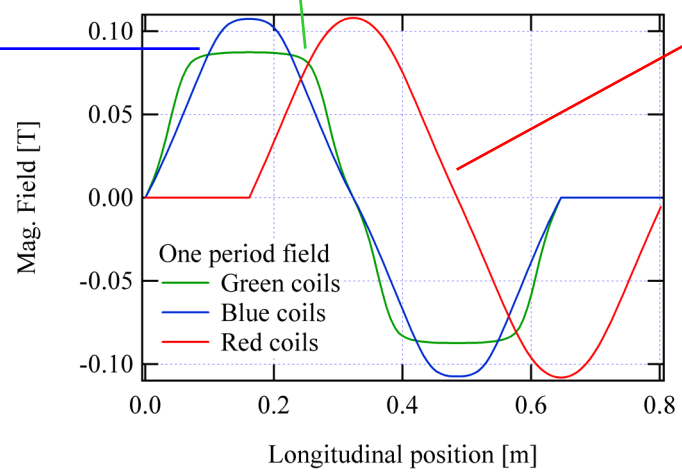
Technology	Electromagnetic –Impregnated coils –Water cooled
Period [mm]	640
Period number	14 + 2 correction periods
Magnetic field : –B_x component [T] –B_z component [T]	 0.092 0.11
AC operation : –Repetition rate[Hz] –Rising time (- /+ Imax to + Imax) [s]	 1 0.2
Power Supplies	**+/- 600 A / 100 V (GREEN COILS)** **+/- 440 A / 120 V (BLUE COILS)** **165 kW** **+/- 360 A / 190 V (RED COILS)**



Maximum Flux and polarization

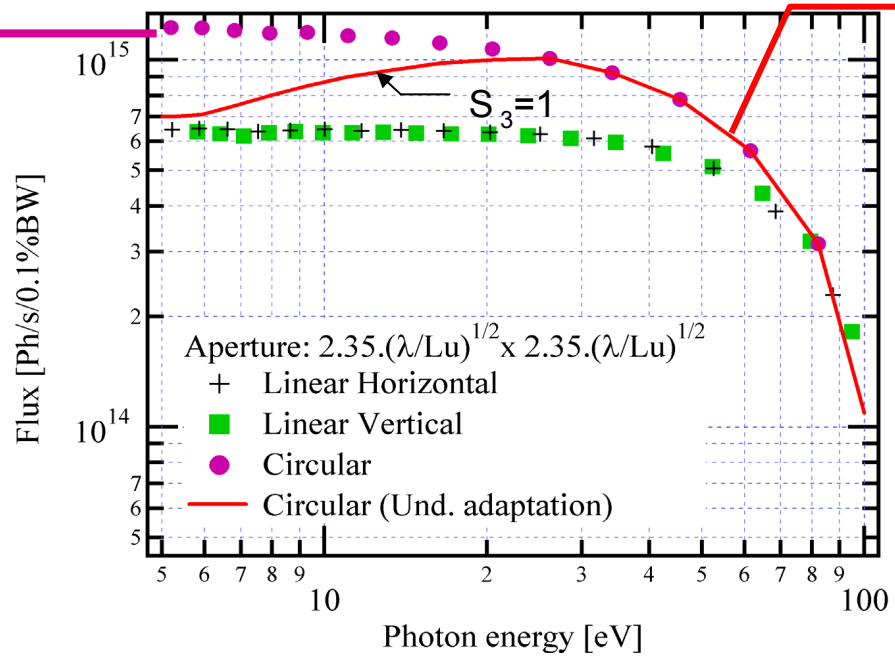




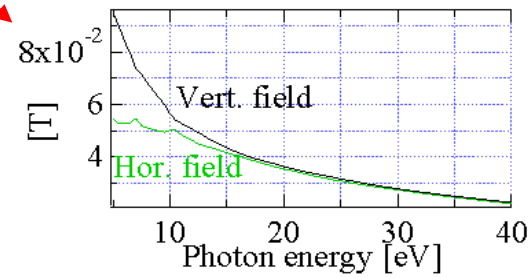


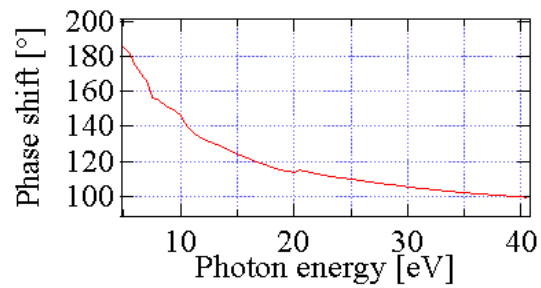
Max. Polarization rate and flux

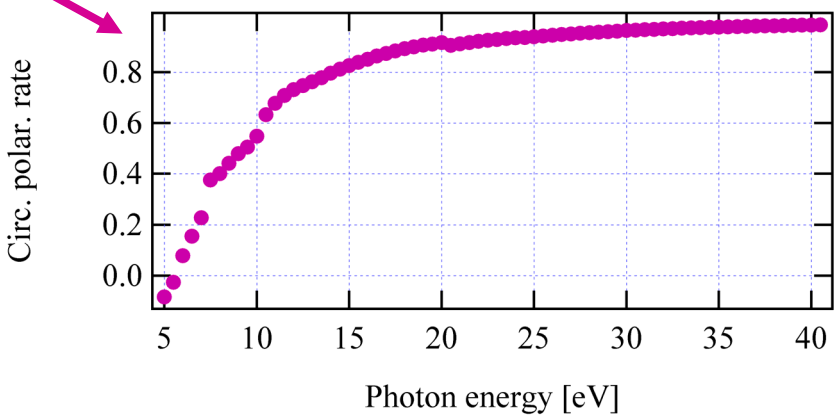
Flux on the fundamental harmonic



Circ. Polar. Operation







SRW code: http://www.esrf.fr

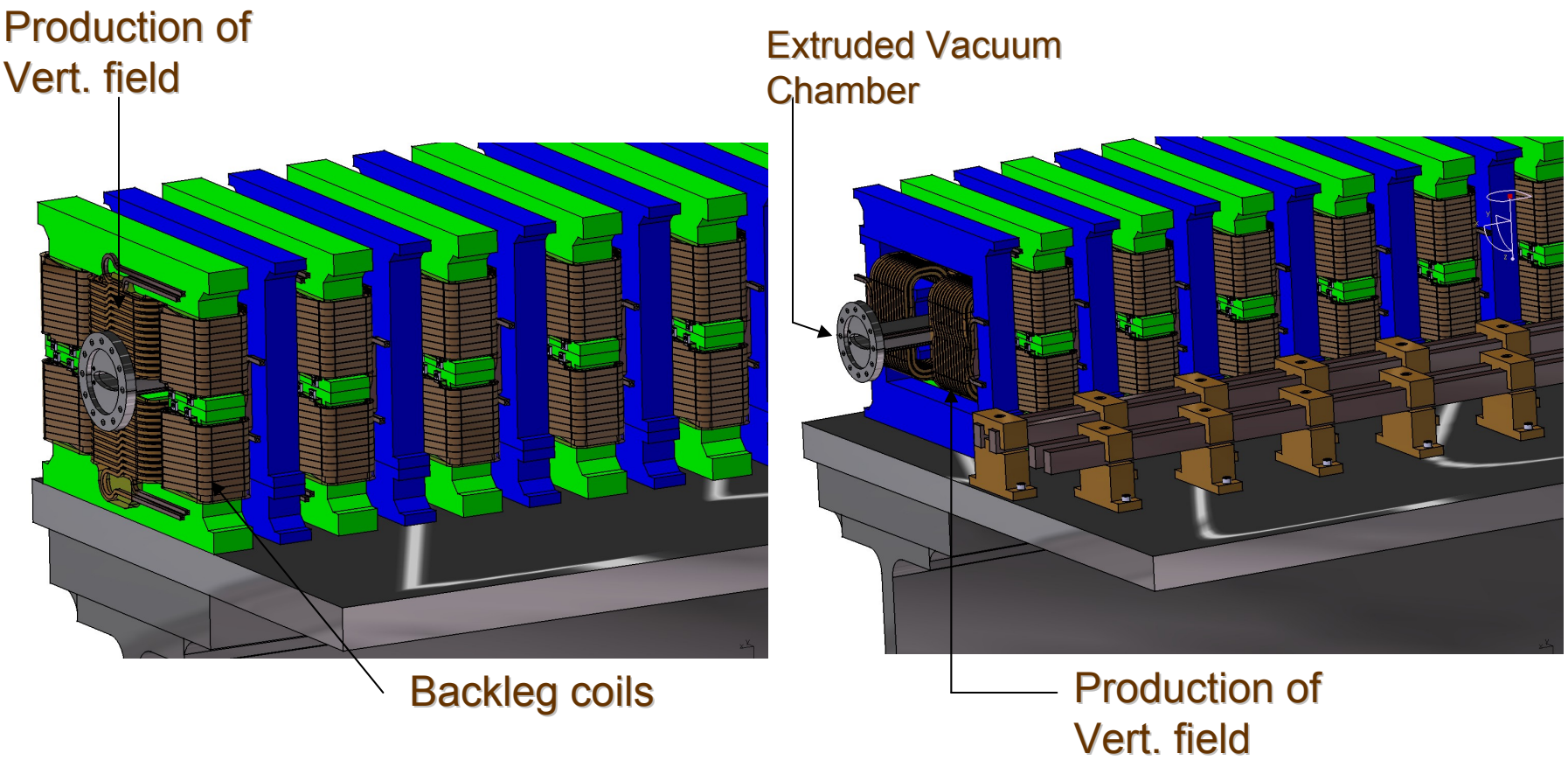
HU256

- Magnetic design of HU256
- Flux and polarization
- Quasi-periodic operation

Exp. needs

- Spectral Range: 10 eV- 200 eV
- Polarization:
  - Lin. Hor. (10 eV - 200 eV)
  - Lin.Vert. (20 eV – 200 eV)
  - Circ. (10 eV – 200 eV)
- Harmonic rejection

Magnetic design

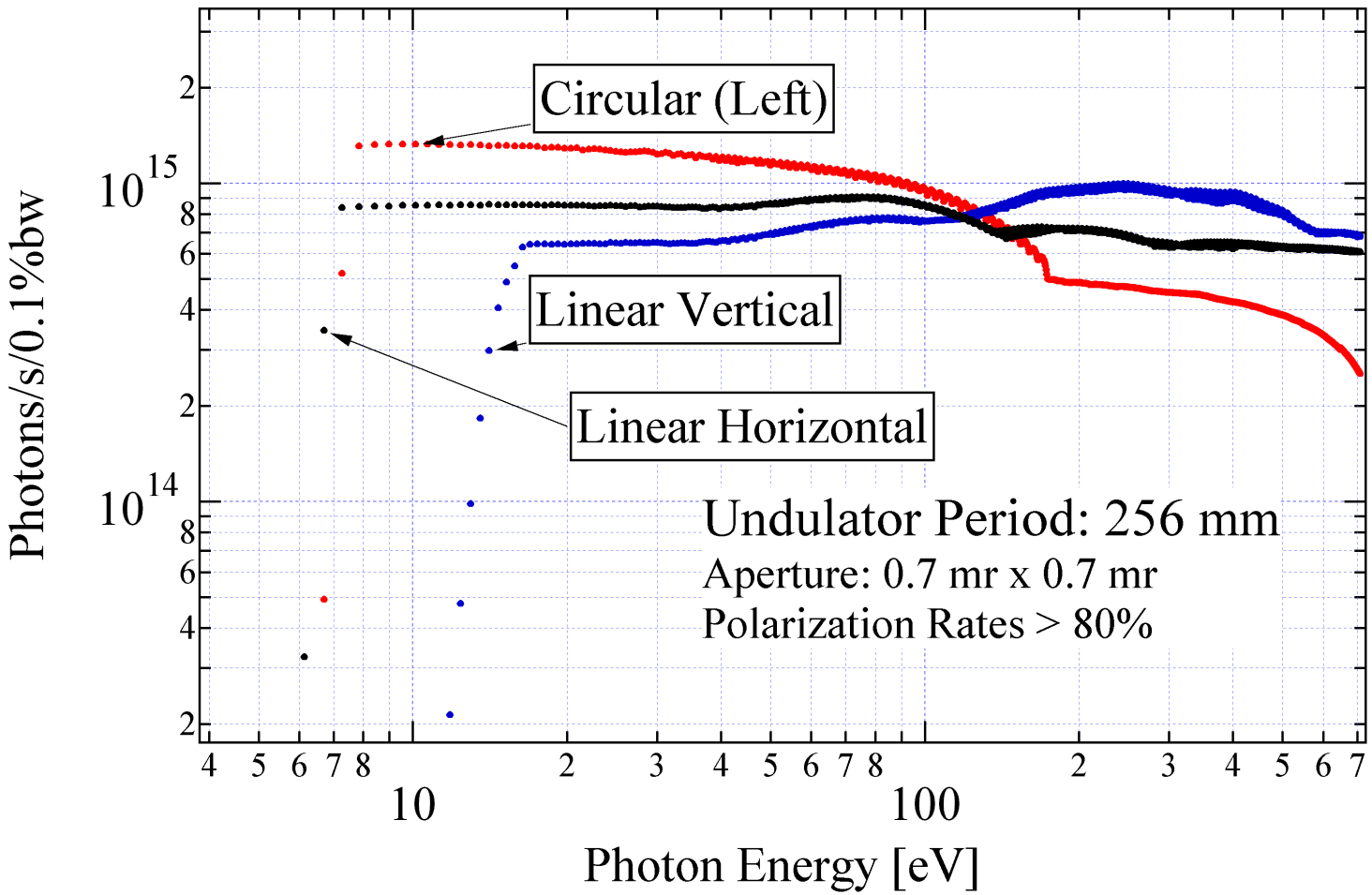


Courtesy of J-L. Marlats
et al. SOLEIL

Magnetic parameters

Technology	Electromagnetic •Impregnated coils •Water cooling
Period [mm]	256
Period number	12 + 2 correction periods
Gap [mm]	Constant : 16 Vert. / 56 Hor.
Magnetic field : •Composante B_x [T] •Composante B_z [T]	 0.275 0.4
Power supplies : •B_x •B_z •QP OPERATION	 350 A / 150 V 150 A / 70 V 6 x 10 A / 4 V

Flux and polarization



Harmonic rejection

- Periodicity modulation (Spring 8)
- Magnetic field modulation
  - PPM and Hybrid IDs: ELETTRA, ESRF, BESSY II
  - Electro. IDs : SLS and soon SOLEIL
- Main goal: Varying slightly the radiation phase in order to **shift** and **reduce** the harmonics without substantial loss on the fundamental
- Very efficient technique for small aperture (SLS)

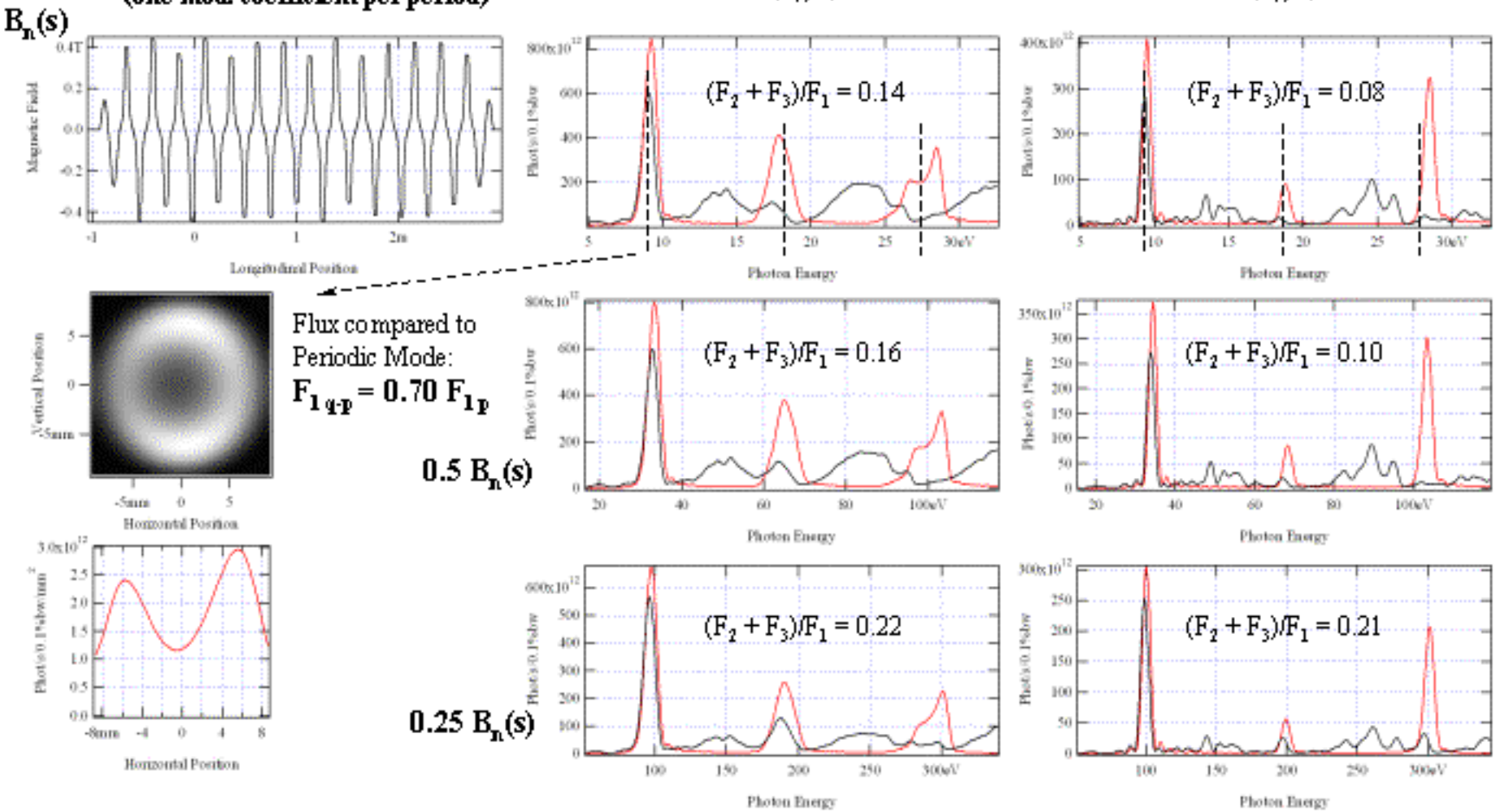
HU256 Preliminary Simulations: Spectral Flux in a Quasi-Periodic Mode

Vertical Magnetic Field

Modulation: B_{min}= 0.88 B_0, B_{max}= 1.10 B_0
(one mod. coefficient per period)

Spectral Flux through a Finite Aperture

$3\cdot(\lambda_1/L)^{1/2}$ $1.5\cdot(\lambda_1/L)^{1/2}$



Flux compared to Periodic Mode:
$F_{1\,q\text{-}p} = 0.70\ F_{1\,p}$

HU640 and HU256 Milestones

- Call for tender in Sept. 2003
- Delivery in Nov. 2004
- Magnetic measurements: Dec. 2004-July 2005
- On-site installation: Aug. 2005

Acknowledgments

Drawing Group
J-L. Marlats, X. Daussan, L. Bouillie
Alignment Group
A. Lestrade
Vacuum Group
C. Herbeaux,V. Le Roux
Optics Group
B. Lagarde, F. Polack
Power Supplies Group
J-M. Godefroy, P. Gros
Infrastructure Group
P. Kieffer, P. Goy
AND
USERS
L. Nahon, A. Taleb, M. Simon