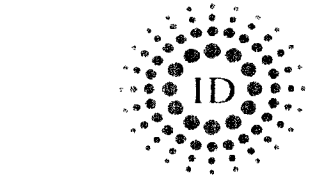
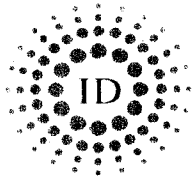


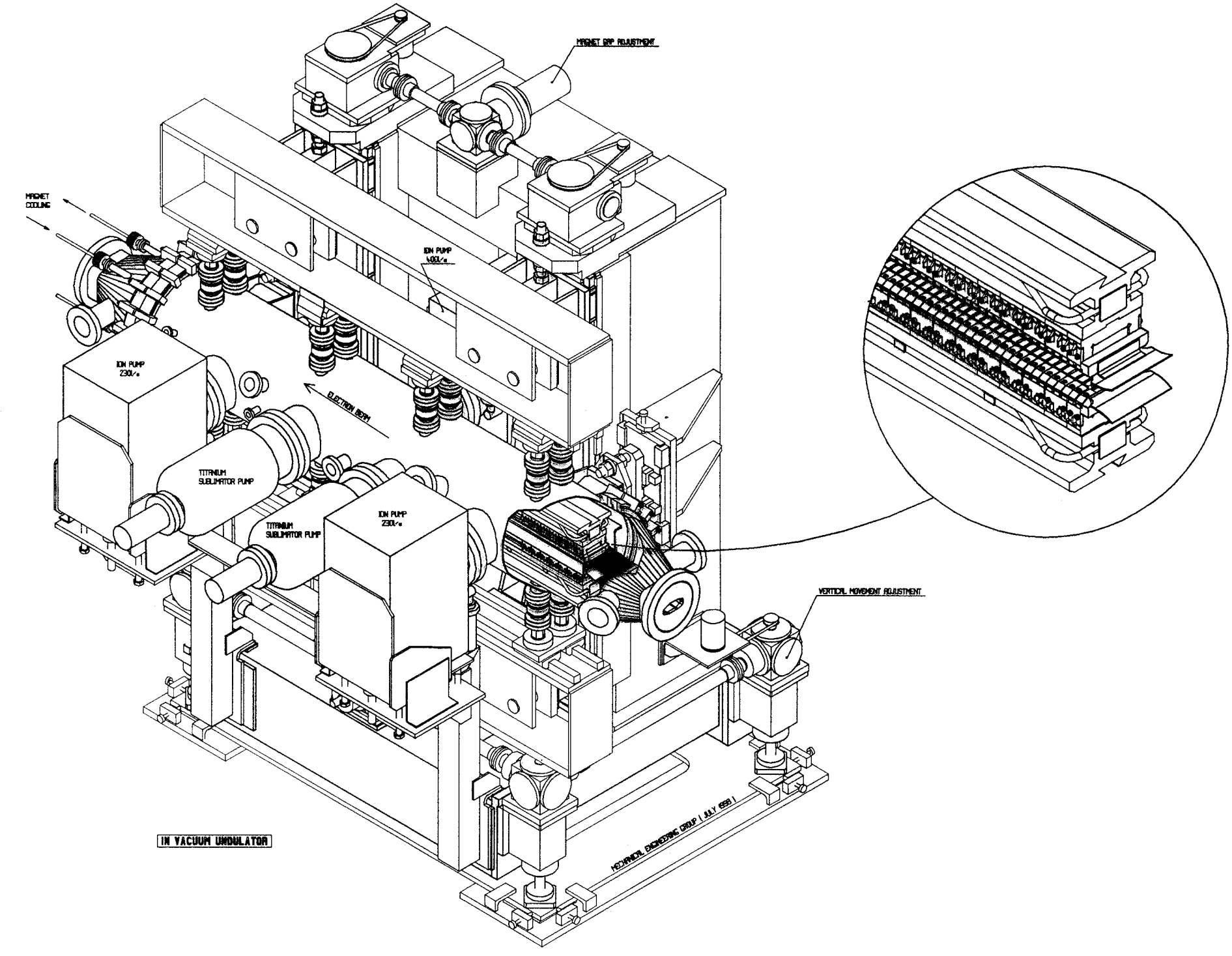
Experience with an In-Vacuum Undulator

P. Van Vaerenbergh, J. Chavanne, P. Elleaume,
ESRF



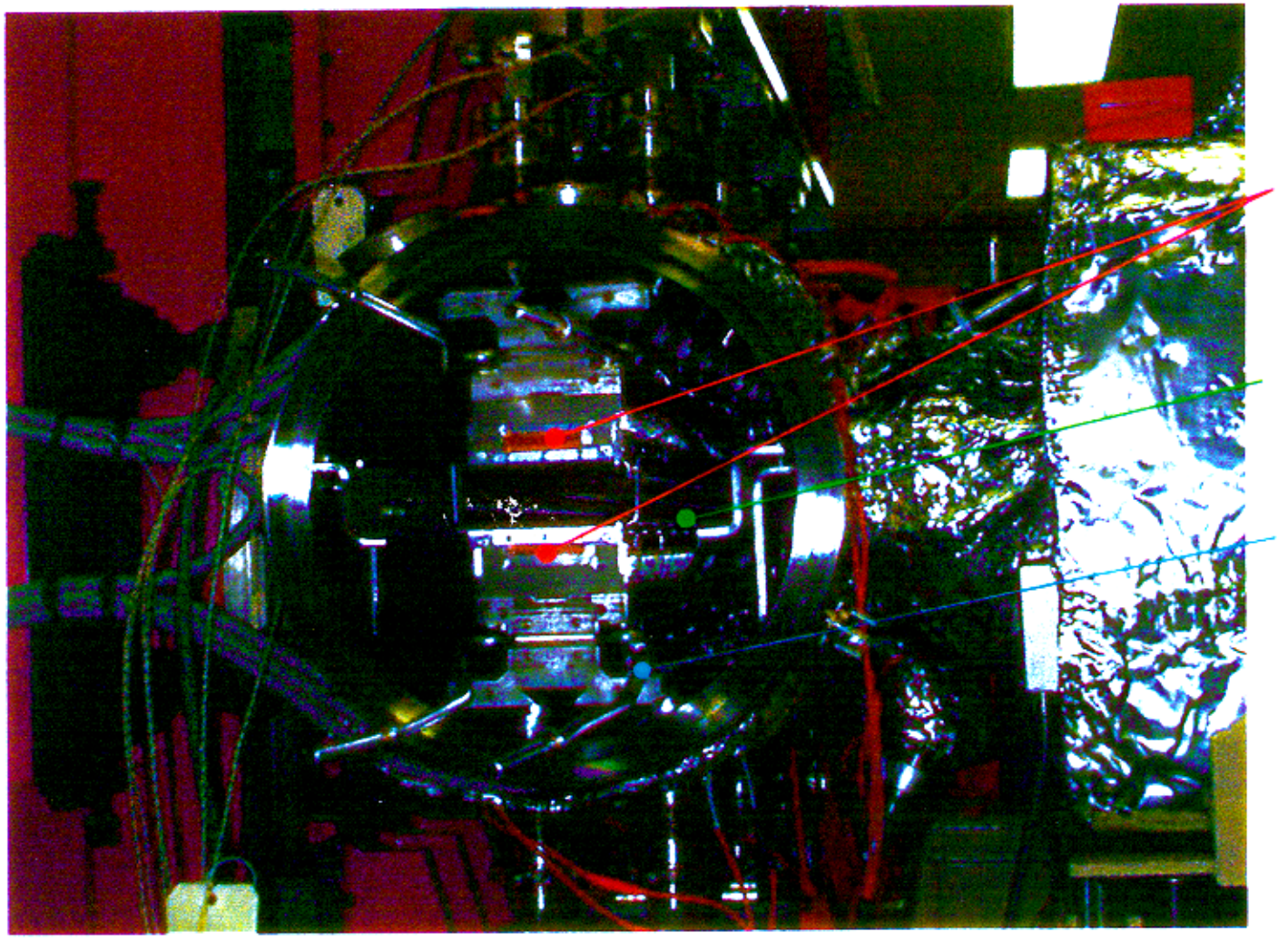
Magnetic Design of the In-vacuum Undulator

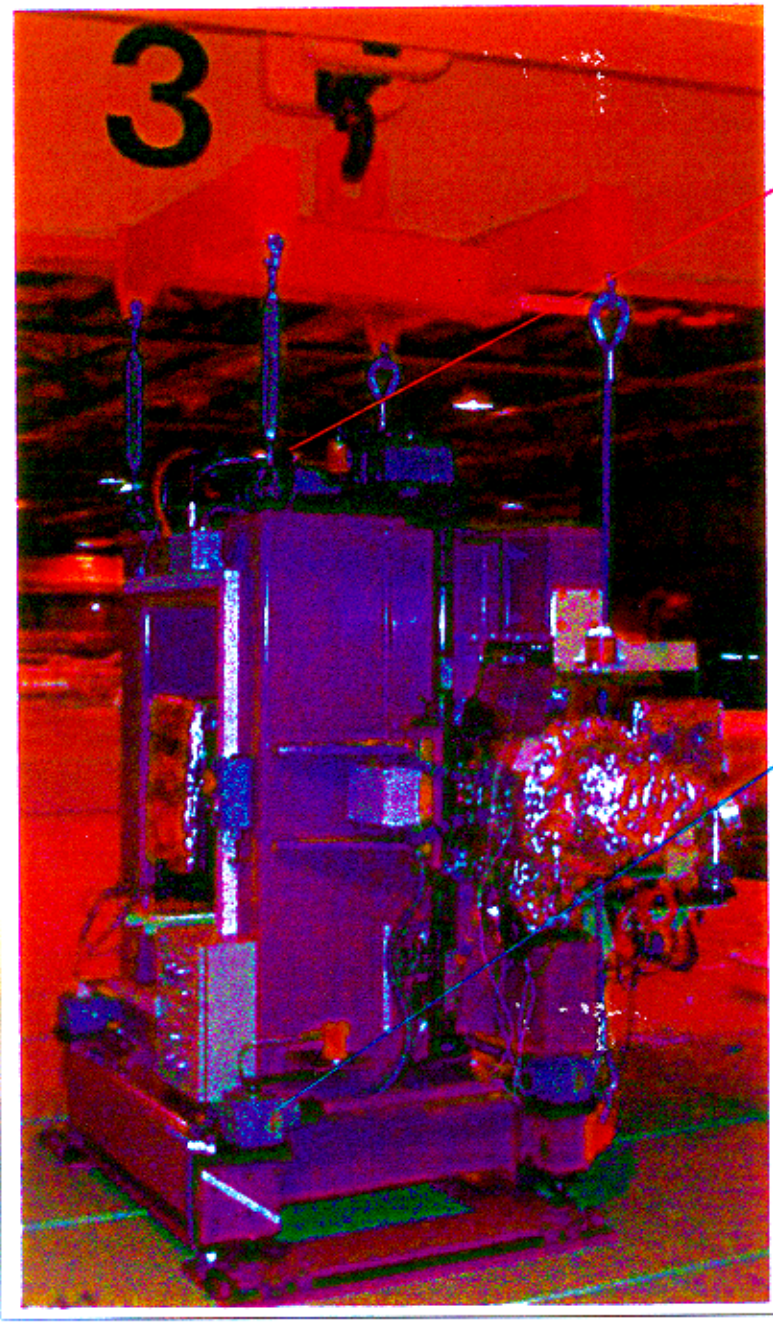
- Period : 23 mm
- Type : Hybrid
- Magnetic Material : Sm_2CO_{17}
  - Br ~ 1.05 T
  - More Resistant to radiation Damage than NdFeB
- Pole : ARMCO steel
- Length = 1.6 m (69 periods)
- Gap Variable between 2 & 30 mm (B = 0.68 T @ 8 mm)


MAGNET GAP ADJUSTMENT
MAGNET COOLING
ION PUMP 400 l/s
ION PUMP 230 l/s
ELECTRON BEAM
TITANIUM SUBLIMATOR PUMP
TITANIUM SUBLIMATOR PUMP
ION PUMP 230 l/s
VERTICAL MOVEMENT ADJUSTMENT
IN VACUUM UNDULATOR
MECHANICAL ENGINEERING GROUP (JULY 1998)

In Vacuum Undulator

Inside the vacuum chamber ...





In Vacuum Undulator

Gap Motorisation

Designed for:

0 < Gap < 30 mm
Max Speed: 1mm/s

Actual limitation (2/99):

8 < Gap < 30 mm

Offset Motorisation

Designed for:

-5 < Offset < +5 mm
Max Speed: 0.5 mm/s

Actual limitation (2/99):

-3 < Offset < +3 mm

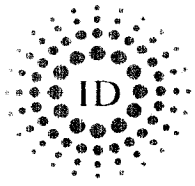
Electron Beam Lifetime

- 2/3 Filling I = 200 mA

Gap [mm]	Lifetime [Hours]
7	43
6	43
5	39

- 16 bunches I = 85 mA

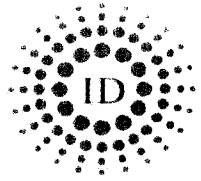
Gap [mm]	Lifetime [Hours]
7	8
6	8
5	8
4.5	7
4	6



Shimming

- Due to a tight planning and a lack of time, no shimming was applied :
  - A residual horizontal (vertical) field integral variation with gap of 150 (30) Gcm was observed and corrected with coils
  - A reduction of the angular flux on the high harmonic numbers is predicted from the field measurement :

Harm	Ratio
1	0.97
3	0.74
5	0.6
7	0.5



Conclusion

- If one accepts a 10% (0%) reduction of the lifetime, the minimum gap is 5 mm (6 mm) significantly smaller than the 11 mm gap of a fixed gap chamber.
- In-vacuum undulators produce a spectrum shifted to higher energies and may compete with some wigglers (ID11 Beamline of the ESRF).
- It is nevertheless a more expensive,risky and inflexible technical solution.