Innovative Mechanical Engineering Developments for SOLEIL Insertion Devices

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• Synchrotron SOLEIL’s storage ring

• WSV50 In-vacuum wiggler

• U18 In-vacuum cryogenic undulator
• Storage ring key parameters:
  • Energy: 2.75 GeV
  • Current: 500 mA
  • Circumference: 354 m
WSV50 In-vacuum wiggler

Hybrid In-vacuum wiggler
2.1 T NdFeB permanent magnets
Vanadium Permendur poles
Minimum gap: 5.5 mm
Magnetic forces between girders at minimum gap:

!! 8.5 tons !!

Huge bulky frame

Counterforce system

Magnetic:
- Non-linear compensation
- Expensive
- Field interferences

Spring based:
- Less expensive
- Linear compensation
WSV50 In-vacuum wiggler

2x40 non-magnetic springs

Graph showing force vs. gap with lines for Counter Force, Magnetic Force, and Residual Force.
WSV50 In-vacuum wiggler

Adjusting shims
WSV50 In-vacuum wiggler

<table>
<thead>
<tr>
<th>Type of spring</th>
<th>Cycle number</th>
<th>Cycle Duration</th>
<th>ΔR [%]</th>
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<tbody>
<tr>
<td>Long</td>
<td>1</td>
<td>170 h</td>
<td>-0.23</td>
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<tr>
<td></td>
<td>190</td>
<td>2 h</td>
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<tr>
<td></td>
<td>5000</td>
<td>26 s</td>
<td>-0.09</td>
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<tr>
<td>Short</td>
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<td>170 h</td>
<td>-0.06</td>
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<tr>
<td></td>
<td>500</td>
<td>5 s</td>
<td>-0.03</td>
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<tr>
<td></td>
<td>5000</td>
<td>22 s</td>
<td>-0.02</td>
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</table>
WSV50 In-vacuum wiggler
WSV50 In-vacuum wiggler

Courtesy of M. Sebdaoui, O. Marcouille & L. Chapuis
WSV50 In-vacuum wiggler

Non-magnetic 316L
Hyper-quenched
Vibration and heat treated

Electron-beam welding
U18 In-vacuum cryogenic undulator
Cooling down the magnets on an In-vacuum undulator?! 

The magnetic field of CR53 (Pr2Fe14B) magnets at 77 K is 10% higher than the one at room temperature

Courtesy of C. Benabderrahmane
LN2 cooling circuit

SS-Al. transition part (explosion bonding)

Extruded Al. Girder

Courtesy of D. Zerbib
U18 In-vacuum cryogenic undulator
U18 In-vacuum cryogenic undulator

T = 294 K
P = 8 W
LN2
T = 77 K

P = 11 W
Vacuum Chamber
T = 294 K

T = 294 K

LN2
T = 77 K

Rad.
Uniform temperature on the in-vacuum girder

Courtesy of J-P. Daguerre & A. Hamza
In-vacuum measurement system

- Tooling Vacuum Chamber
- Transparent window for alignment
- Laser
- Out-vacuum measurement system support base
ACKNOWLEDGMENTS

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AND ALL MEDSI2012 STAFF
THANK YOU FOR YOUR ATTENTION