ESRF Phase II – New storage ring project Magnet support and Girder design

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- → ***An accurate and stable positioning of magnets (0.5-1.2 tons on girder)***
- → ***Test of the main mechanical components (wedges) for magnets and girder***
- → ***Overview of the girder equipped with magnets***

Magnets positioning

◆ ***Alignments requirements to keep the orbit performances :***

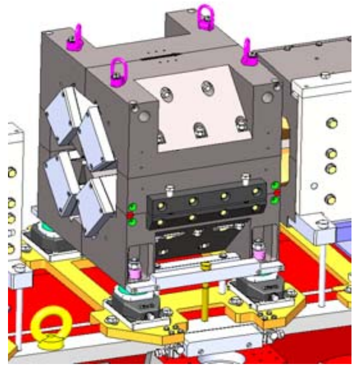
	ΔY (rms)	ΔZ (rms)	Δroll(ΘX)
Magnet to magnet	50μm	50μm	200μrad

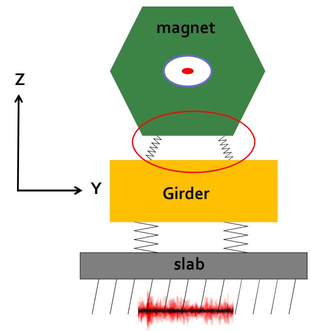
◆ ***Important considerations:***

- Easy to install (handling, pre-alignment, magnet disassembly for service)
- Fast, accurate, easy to align (not only with 3 points support, minimize clamping effect)
- Y and Z independent adjustments
- High stiffness and rigidity
- Design goal first frequency > 50Hz → requires multiple support points (more than 3)
- Long term stability

◆ ***Challenges are:***

- Lack of space between magnets
- Ease of alignment is not compatible with high rigidity → compromise (design criteria 50Hz)
- Dimensions : weight, height of magnets





Magnets positioning – Designs worldwide

Adjusting mechanical screws

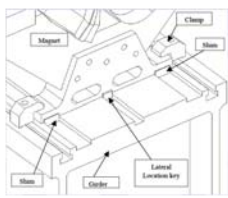
ESRF, SNLS II…

PROS
- ❑ compactness
- ❑ cost

CONS
- ❑ difficult to align (time consuming)
- ❑ clamping effect
- ❑stiffness
- ❑< 50µm accuracy difficult to achieve

Mechanical SHIMS

Soleil, Alba, Diamond

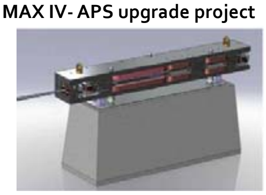


PROS
- ❑ High stiffness
- ❑ compactness
- ❑ clamping effect is acceptable (10µm)
- ❑ Long term stability
- ❑ flexibility

CONS
- ❑ Need high number of shims and measurements (time and manpower)

Monolithic design

MAX IV- APS upgrade project

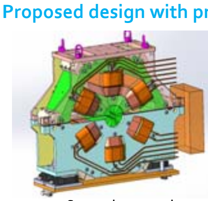


Several magnets functions are in one machined block

PROS
- ❑ high compactness
- ❑ fast alignment (one block)

CONS
- ❑ internal alignment precision ?
- ❑ no flexibility
- ❑ maintenance

Proposed design with preloaded wedges



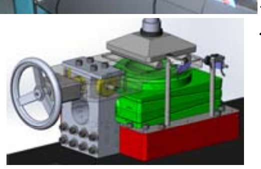
Sextupole mounted on 3 preloaded (2tons) precision conical wedges.

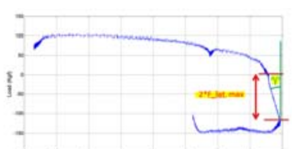
Preload 2 tons with Belleville spring washers

PROS
- ❑No clamping effect
- ❑Easy and fast to align
- ❑ high vertical stiffness (2000N/µm)
- ❑Multiple points support
- ❑ Z and Y independent
- ❑ compactness in vertical
- ❑Commercial units

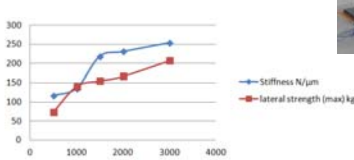
CONS
- ❑ horizontal stiffness is unknown → characterization = Mechanical and Vibration tests
- ❑ Need high preload (>2 tons)

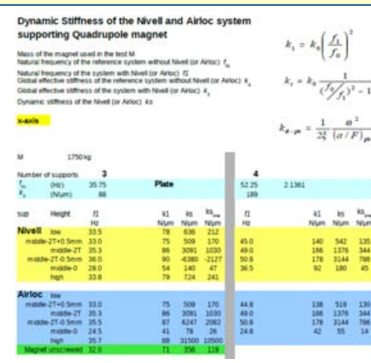
Tests bench to measure transverse stiffness of wedges – Mechanical and vibrations tests





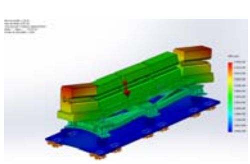
Typical stiffness measurement on magnet wedges





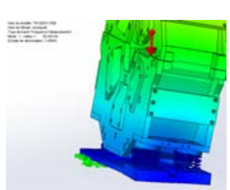
FEA calculations on magnets / girder

Dipole



Wedges stiffness=> Kz=1000N/µm
Ky=50N/µm
6*wedges
F=79 Hz
3*wedges
F=49 Hz

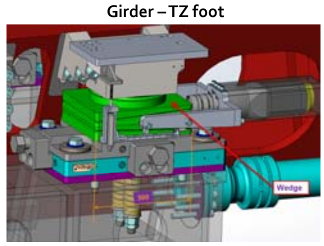
Sextupole



Wedges stiffness=> Kz=1000N/µm
Ky=50N/µm
3 wedges
F=39 Hz

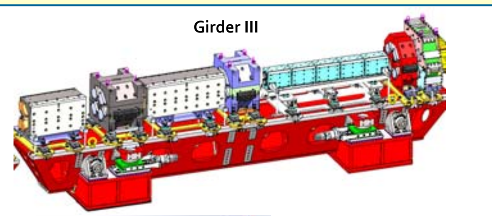
Wedges stiffness=> Kz=1000N/µm
Ky=100N/µm
3 wedges
F=45 Hz

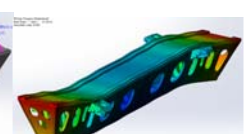
Girder – TZ foot



Z support for girder
→ Preload = 2 -4 tons
→ Load (weight) = 3 tons
Wedges (max load 40 tons) stiffness =
→ 1200 N/µm in X-Y (horizontal)
→ 1700 N/µm in Z (vertical)

Girder III





1° frequency: 47.2 Hz
(girder + 6000kg load)