DESIGN, CONSTRUCTION AND COMMISSIONIG OF A NEG COATED WIGGLER VACUUM CHAMBER FOR THE LNLS STORAGE RING

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Abstract

We present the design of the vacuum chamber for the LNLS 2T Hybrid Wiggler. The chamber is a 3m long, 1.2mm thick 316L SS tube, which was mechanically pressed into an elliptical shape from an originally round tube. In order to provide the necessary mechanical tolerances, the rather flexible tube is welded to lateral supports that run the complete length of the chamber. Special care has been given to the mechanical and magnetic characterization of the chamber and the inner surface of the chamber was NEG-coated at the ESRF. We present the installation procedure as well the vacuum conditioning charge evolution.

INTRODUCTION

All beamlines at LNLS synchrotron light source use radiation from a bending magnet (1.67 T with critical photon energy at 2.084keV). The new insertion device, a multipolar wiggler source [1], will provide a high flux photon beam for the Protein Crystallography.

The main vacuum difficulties are the small dimensions, the great aspect ratio with cross section and the length of the insertion device chamber and the mechanical quality of the maximum vertical external and internal dimension. The magnet gap specification is a compromise between the conflicting requirements of largest possible peak field (which demands small gaps) and good injection efficiency an beam lifetime, which favours larger gaps [2] (see fig. 1). The material choice was the stainless steel 316 L and 316LN, due to their high mechanical stress and low magnetic permeability (<1,005) properties [3].

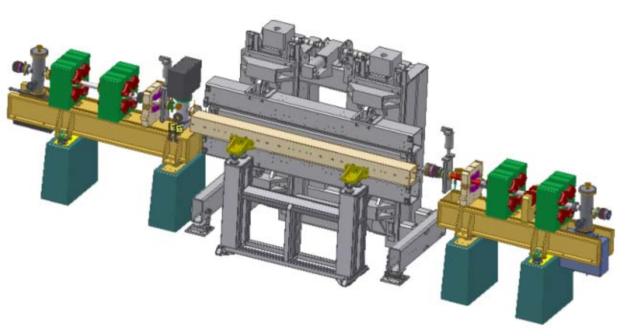

Fig. 1 CAD draws of the final version of the chamber and support in the wiggler magnet.

WIGGLER VACUUM CHAMBER

The elliptical tube (21,0mm x 73,2mm, 3,0m long) received a thermal treatment (1120°C), to ensure the magnetic permeability after the mechanical conformation. All the laterals were made of 316LN SS. The main difficulty was to adjust the tube with the continuous support for welding at one side and the other side with 2mm thickness ribs with a distance of 40mm. The acceptance of the magnetic permeability of the weld was estimated by the ferrite content, less than 2%. This chamber was sent to the ESRF Vacuum Group for the NEG deposition in their facility as part of cooperation between ESRF and LNLS (see fig. 2).

Fig. 2 Wiggler vacuum chamber during NEG deposition at ESRF.

The first activation was made at ESRF as procedure for checking the NEG quality. The final pressure was in 10^{-10}mbar range with an ion pump.

Installation

During the 2004 shutdown, the wiggler chamber was installed in a straight sector previously prepared with 2 sector valves, it means the installation could be done without to vent any other part of the ring. Before the baking a pre-alignment was done and the cooling system of the sector connected.(see fig. 3). The activation of NEG was done at 180°C during 24hours with a turbo-molecular pump. The final pressure was 3. 10^{-10}mbar

0-7803-8859-3/05/$20.00

Fig. 3 NEG activation of the wiggler chamber during installation

After the baking and the final alignment, the wiggler magnet was installed. The first operation to close the gap was performed to check the interlock system of minimum gap (see fig. 4).

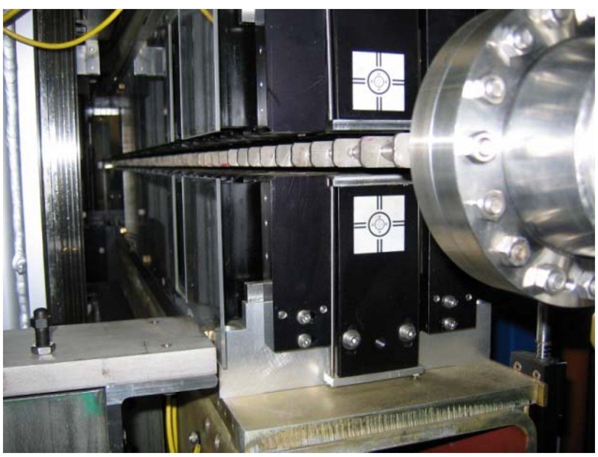

Fig. 4 Minimum gap of the wiggler with the vacuum chamber

Vacuum conditioning

The lifetime before and after the installation of the vacuum chamber was recorded and compared with the project specification, we expected to have the same value after 2Ah of accumulated dose. The expected result came only with 4Ah, showing we have used some optimistic considerations (see fig. 5). During the shutdown the installation of other new vacuum chambers, decrease the lifetime to 4.5hours (3382Ah of charge), priori the installation.

During the shutdown the machine runs to others test up to 3620Ah, having a lifetime of 23hours. At this moment, the wiggler magnet was closed for the first time and some influence in the lifetime was observed. The influence came from the sector up to the dipole chamber, without the NEG deposition and a high flux of photons (see fig. 6). In this position the specification was 30Ah of accumulated dose for conditioning.

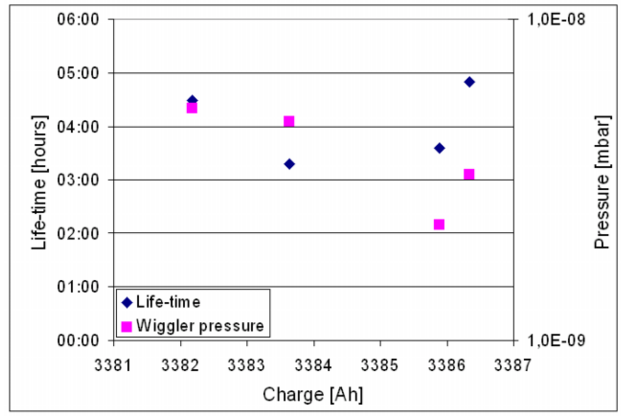

Fig. 5 Evolution of the lifetime after and before the installation of wiggler chamber.

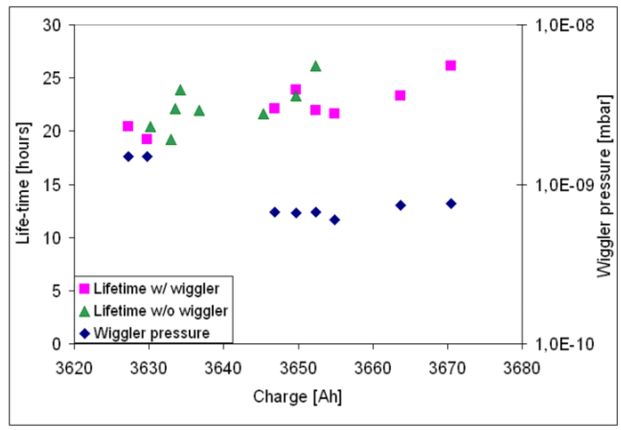

Fig. 6 Evolution of the lifetime with and without the closed gap.

CONCLUSION

The project, construction and deposition of NEG satisfy the project requirements, small conditioning time. After the installation and activation, the final pressure statically and dynamically shows a good agreement with the expected. A new vacuum chamber for undulator will be build and prepared in the same way.

ACKNOWLEDGMENTS

The authors would like to thank Roberto Kersevan and Michael Hahn from ESRF Vacuum Group for the cooperation opportunity, discussion and expertise in vacuum technology.

REFERENCES

[1] L. Lin et al, *A hybrid wiggler for protein crystallography at the LNLS synchrotron light source*, MeT 01/2003 LNLS.

[2] P. F. Tavares, *Consideration on the minimum gap for the LNLS multipolar wiggler*, CT 03/2001 LNLS.

[3] M.J.Ferreira et al, Design of 2T Wiggler Vacuum Chamber for the LNLS Storage Ring, EPAC 2004, p. 300.