INSTALLATION REPORT- OPTICS
PGM – NIST

FMB ORDER-NO. 20080444
DRAWING-NO. 356-00

Place:	NSLS II
Date:	18/07/2016-29/07/2016
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Distribution:	NSLS II, FMB

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18.07.2016 Works before installation

Date No.	*Item / Action*	*Result / Status*	*Remark*
1.	PGM chamber was aligned by laser tracker (only the height)		executed by NSLS - 2015
2.	Chamber was closed, no drives and no pump were installed		Checked by FMB

19.07.2017 Chamber alignment

Date No.	*Item / Action*	*Result / Status*	*Remark*
3.	Installation of the ion pump and gate valve	chamber was taken off from the granite by fork lift truck; ion pump was installed by fork lift truck; chamber was moved back on the granite	executed by NSLS and FMB
4.	Alignment of the chamber	was executed with laser tracker	executed by NSLS
5.	Installation of motion controller	was mounted into the NSLS rack	executed by FMB
6.	Removing of the chamber lid	was removed with fork lift truck	executed by NSLS
7.	Installation of HPMC-1 motion control and control computer	The following devices have been installed into equipment rack RGA3: - motion controller (HPMC-1, S/N 2009-0012) - power supply (PS-HPMC, S/N: S001296) - control computer (1U) - drawer with mouse and keyboard The computer monitor was connected and left inside the rack for demonstration.	executed by FMB

20.07.2016 Installation of the drives

Date No.	*Item / Action*	*Result / Status*	*Remark*
8.	Floor lines/ height marks for alignment of the optics	Installation of the floor lines and height marks with laser tracker (height 1400mm, floor line as representation of the beam path 4m behind the PGM downstream)	executed by NSLS
9.	Installation of a clean tent	Clean tent was moved over the monochromator.	executed by NSLS

10.	Checking of the inner mechanism	Bearings for the pitch movement and linear bearings and cages have shown no damages, all movements by hand were smooth, no damages were determined	executed by FMB
11.	Installation of the Pitch drives	Transport looks removed, drives were installed at the chamber,	executed by FMB
12.	Installation of the horizontal drives	Transport looks removed, drives were installed at the chamber	executed by FMB
13.	Testing of the limit switches	All limit switches tests were successful	executed by FMB
14.	Testing of the motion controller	The "HPMC-1" motion controller delivered with the monochromator by FMB was found not functioning. The incorporated DeltaTau Brick Controller immediately shows a "Watchdog Error" as soon as it is powered on. DeltaTau has been contacted and confirmed that it needs to be sent in for repair. The warranty that FMB gave on the electronics has been expired.	executed and FMB
15.	Alternative motion controller: "GeoBrickLV-NSLS2" borrowed from the CSX beamline	A "DeltaTau GeoBrickLV NSLS2" motion controller, a "DeltaTau Quad Power Supply" and readout electronic for the RON905UHV pitch encoders from Heidenhain had been borrow from the CSX Beamline. The following adaptions have been made in order to control the NIST SST PGM with the Geo Brick LV motion controller: - make of two adapter cables for the encoders on the translation drives - make of two adapter cables for the encoders on the pitch drives - modification of the four motor/limit field cables, pins changed on motion controller side of the cable: J -> H and M -> L - connection of an external 5V encoder power supply to the GeoBrickLV. Note that the voltage needed be set to at least 5.4 VDC on the power supply in order to provide sufficient power to the RON905UHV pitch encoders. - Collision switch wiring has been changed in the monochromator patch panel	

21.07.2016 Checking of the Limit switch positions/ optics installation

Date No.	*Item / Action*	*Result / Status*	*Remark*
16.	Determination of the limit	Grating pitch drive (horizontal = 0 position):	executed

	switches positions from the pitch drives to the optics horizontal (zero) positions. All optics were aligned with the clino bevel.	from 0 to upper limit (plus): 2361200cts from 0 to lower limit (minus): -24553510cts Mirror pitch drive: from 0 to upper limit (plus): 3437830cts from 0 to lower limit (minus): -19468410cts (RON905UHV encoder: 1638400 cts/deg)	by FMB
17.	Measuring of the distances between the pitch drive nuts to the blocks with the limit switches with to horizontal moved optics (optics were aligned to 0 deg with clino bevel)	From mirror pitch drive nut to the upper limit switch block: 21,52mm. From grating pitch drive nut to the upper limit switch block: 25,87mm.	executed by FMB
18.	Gaskets	FMB delivered five gaskets with the monochromator (packing list from 2012). During the installation these gaskets could not be found. The old gasket has been used instead. FMB recommends NSLS to order five new gaskets for this PGM. It is not possible to use gaskets from the CSX PGMs because these are too large.	
19.	Thermo couples positions	Outside at the flanges all thermo couples are labeled from 1 to 5. In downstream beam direction: No 1 = empty grating holder No 2 = grating right - 1200 l/mm No 3 = grating middle - 600 l/mm No 4 = grating left – 250 l/mm No 5 = mirror	executed by FMB
20.	Grating installation	Grating 250 l/mm is in the left holder (downstream beam direction), grating 600 l/mm is next right holder grating 1200 l/mm is in the next right holder grating holder on the very right side is empty. All gratings have arrows which indicates the direction of highest groove density – all these grating arrows show in downstream direction	Executed by FMB
21.	Mirror installation	Mirror was installed and the cooling tubes were connected.	Executed by FMB
22.	Control Software Demonstration	The EPICS control software for the monochromator has been demonstrated to a NSLS-2 controls engineer. High level functionality (such as energy move) has been shown and its integration into the beamline control system has been	Executed by FMB

		discussed.	

22.07.2016 Water pressure test at mirror cooling

Date No.	*Item / Action*	*Result / Status*	*Remark*
23.	Pressure test with 5,2bar (75 psi)/10min	No leak	executed by FMB
24.	Pressure test with 6,8bar (100 psi) /10min	No leak	executed by FMB
25.	Pressure test with 8,6bar (126 psi) /10min	No leak	executed by FMB
26.	Pressure test with 10,3bar (150 psi) /10min	No leak	executed by FMB

25.07.2016 Alignment of the Optics

Date No.	*Item / Action*	*Result / Status*	*Remark*
27.	Installation of clamps for the two pitch drives at the granite	executed	executed by FMB
28.	Taking out of the counter weight from mirror holder	Was removed, the eigenfrequencies were shifted from 27Hz to 41Hz	executed by FMB
29.	Installation of the autocollimator (AKF) to see the mirror surface and the backside of the gratings,	AKF was aligned to a fluid surface (black ink) and was set to 0 (the distance from the AKF to the gratings was about 250mm)	executed by FMB
30.	Installation of a auto level (to bring the height from the height mark outside the chamber (1415mm) to the PGM)	Was aligned	executed by FMB
31.	Alignment of grating (left) – 250l/mm	Was aligned to the height and to the AKF: AZ (roll): +1,6 arcsec EL (pitch): +4,7 arcsec	executed by FMB
32.	Alignment of grating (middle) – 600l/mm	Was aligned to the height and to the AKF: AZ (roll): +2,1 arcsec EL (pitch): -1,9 arcsec	executed by FMB

33.	Alignment of grating (right) – 1200l/mm	Was aligned to the height and to the AKF: AZ (roll): +1,3 arcsec EL (pitch): +0,3 arcsec	executed by FMB
34.	Realignment of the auto level to the height of the mirror surface: 1407,484mm	Was aligned	executed by FMB
35.	Alignment of the mirror	Was aligned to the height and to the AKF: AZ (roll): -3,2 arcsec EL (pitch): -2,4 arcsec	executed by FMB
36.	Testing of the collision switch (tested by multimeter)	Has triggered at mirror pos. of 0 deg and grating pos. of -2,8 deg (mirror and grating moved 2.8 deg towards each other).	executed by FMB
37.	Alignment of the theodolite to the NSLS – floor line	Was aligned	executed by FMB
38.	Alignment of all grating holders YAW orientations by theodolite	Were aligned (also the empty grating holder on the right)	executed by FMB
39.	Determining of the lateral gratings positions regarding to the encoder reference of the grating horizontal drive Left and right egdes mean the beginning and end of the substrate (not the optical surface!)	**Grating 250l/mm:** edge left: -153mm edge right: - 123,291mm **mid pos.: -138,3455mm** **Grating 600l/mm:** edge left: -89,1mm edge right: - 59,192mm **mid pos.: -74,146mm** **Grating 1200l/mm:** edge left: -25mm edge right: +4,836mm **mid pos.: -10,282mm** **Grating empty holder:** edge left: +39mm edge right: **mid pos.: +54mm**	executed by FMB

40.	Determining of the mirror coated strips positions regarding to the encoder reference of the mirror horizontal drive	Mirror substrate – left edge:1,774mm Start of gold stripe (left): 5,564mm End of gold stripe and start of carbon stripe: 24,158mm End of carbon stripe and start of Nickel stripe: 34,167mm End of Nickel stripe: 53,564mm Mirror substrate – right edge: 56,663mm **Mid of gold stripe: 14,861mm** **Mid of carbon stripe: 29,162mm** **Mid of nickel stripe: 43,865mm**	executed by FMB
41.	Checking of the limit positions of the mirror horizontal drive (positive = moved out of vessel)	Neg.: -5,228mm Pos.: +57,951mm Stroke: 63,179mm	executed by FMB
42.	Checking of the limit positions of the grating horizontal drive (positive = moved out of vessel)	Neg.: -155,052mm Pos.: +67,565mm Stroke: 222,617mm	executed by FMB
43.	Checking of the limit positions of the grating pitch drive (positive = moved up, negative = moved down)	Neg.: -14,986deg (-24553510cts) Pos.: +1,441deg (+2361120 cts) Stroke: 16,427deg (Grating horizontal pos. at 0deg)	executed by FMB
44.	Checking of the limit positions of the mirror pitch drive (positive = moved up, negative = moved down)	Neg.: -11,883deg (-19468410cts) Pos.: +2,096deg (+3434600cts) Stroke: 13,979deg (mirror horizontal pos. at 0deg)	executed by FMB

26.07.2016 TESTING, CABLING AND PREPARATION OF CHAMBER CLOSING

Date No.	*Item / Action*	*Result / Status*	*Remark*
45.	Decoupling pins	Ground pins from decoupling goes now to pin7, collision pins are (1,6) potentialfree	executed by FMB

		(dry contact)	
46.	Determination of pitch angles of the optics horizontal/zero positions on the RON905UHV encoder (1638400 cts/deg)	Grating pitch: **+73700 cts/ +0,045deg** Mirror pitch: **-34400cts/ -0,021deg**	executed by FMB

27.07.2016 CLOSING OF THE CHAMBER

Date No.	***Item / Action***	***Result / Status***	***Remark***
47.	closing the chamber	torque for chamber lid screws was 46 Nm	executed by FMB
48.	installation of the wobble sticks		executed by FMB
49.	Leak testing	With 1,4 x10-9 torr l/s (Gate valve was opened)	executed by FMB
50.	Control Software Demonstration	High level functionality of the control software has been demonstrated to C.Jaye: - Selection of gratings. - Selection of mirror stripe. - Energy move (“Energy Step”) - Step scan of the photon energy - On the fly scan of the photon energy Examplary scans have been performed: 600lines grating, 250 to 350 eV, 0.1 eV step Step scan: total scan time approx. 25min Per step approx. 0.3s of move time and 1.2s of overhead time was measured. The overhead time seems to be a delay caused by EPICS/sscan record/motor record/network communication. On the fly scan: Total scan time 10s (at 10 eV/s speed), 100s (at 1 eV/s) or 1000s (at 0.1 eV/s)	executed by FMB

28.07.2017 HANDOVER, ACCESSORIES

Date No.	*Item / Action*	*Result / Status*	*Remark*
51.	Final leak testing	With 2,8 x10-11 torr l/s (Gate valve was opened) Successful.	executed by FMB
52.	5x gaskets (for chamber main flange) - these have been missing on site	Not handed over	
53.	2x aluminum adapter towers for surveying	handed over	executed by FMB
54.	4 transport locks for the pitch drives (clamps for the bearing towers, 2 rod supports for pivot mechanism)	handed over	executed by FMB
55.	2x small pins (tubes) for the 3 fine adjusting screws of the mirror holder in air	handed over	executed by FMB
56.	counter weight from the mirror holder	handed over	executed by FMB
57.	TSP – ion pump controller	handed over (in the granite block)	executed by FMB
58.	Ion pump controller and MKS gauge controller with cables	Installed in rack RGA 2	executed by FMB
59.	Transport frame (for taking out of the PGM mechanism)	handed over	executed by FMB

NOTES ON ONGOING ACTIONS REGARDING THE MOTION CONTROLLER

A) Repair of FMB "HPMC-1" Motion Controller

The DeltaTau Brick Controller (inside the HPMC-1) is broken. FMB can take the it back to Berlin for repair. The repaired Brick Controller needs to be built into the HPMC-1 at NSLS2 again and configured unless the complete HPMC-1 controller is shipped to Berlin for repair. After that the closed loop control parameters need to be determined and optimized on site again with the monochromator for the HPMC-1. (The parameters determined during installation are valid for the GeoBrickLV only.)

The adaptions made during the installation to the monochromator (air-side) wiring in order to suit the GeoBrickLV need to be reverted.

Due to the dedicated stepper amplifiers inside the HPMC-1 a higher (double) movement speed compared to GeoBrickLV can be expected.

Regarding a possible fast integration with the undulator a Macro interface is advisable. The HPMC-1 currently has a Macro interface but it is RJ45 Macro (copper) and not the nowadays standard fibre-optical Macro interface.

In case the HPMC-1 controller gets shipped to Berlin for repair FMB can offer upgrading it from RJ45 Macro to fibre-optical Macro interface. This would allow an integration with the motion controller of the undulator which needs to also have fibre-optical Macro (such as the 'GeoBrickLV-NSLS2-Enhanced').

B) Use of the GeoBrickLV-NSLS2 for the monochromator

The installation has been made with a borrowed GeoBrickLV-NSLS2-Enhanced. A configuration exists to control the monochromator. Using the GeoBrickLV motion controller means following the current NSLS-2 standard and using the same motion controller like on CSX monochromators. It has a fibre-optical Macro interface which allows integration with the undulator.

The maximum movement speed is slower (half) compared to HPMC-1 which has dedicated stepper amplifiers. An exemplary scan (250 to 350 eV, 600 l/mm grating) with the GeoBrickLV has been tested and the maximum speed was 10 eV per second.

In order to use the GeoBrickLV for the monochromator two converters (Heidenhain EIB1512) to readout the RON905UHV pitch encoders are necessary. During installation they had been borrowed from the CSX beamline. FMB is able to make an offer for these converters. FMB is able to also make an offer for the GeoBrickLV-NSLS2-Enhanced controller unless a controller from the NSLS2 stores is taken. Please note that it has to be the “Enhanced” version of the GeoBrickLV-NSLS2 and it needs to have the Endat2.2 encoder option on at least 4 channels.

The monochromator has been successfully installed and aligned. All optics have been installed and aligned and their positions/offsets have been determined, documented and entered into the control software. The control software has been demonstrated to the customer.

Confirmed/ Bestätigt:

Datum: 28/07/2016

FMB-Berlin:…….. NSLS:……

Addendum to FMB Berlin PGM Install Report
M2 PGM pitch cannot go below 1.28 degrees incidence

Prior Pump down July 29, 2016
Line 46 PGM Install Report
M2: Set Mirror pitch -0.021 deg.

Feb. 9, 2018 GeoBrick mirror pitch set to 0 motor steps
(at -.021 deg. mirror pitch above)

Prior Pump down July 29, 2016
Line 44 PGM Install Report
M2: Mirror pitch positive limit +2.096 deg.

Feb. 9, 2018 GeoBrick mirror pitch hit positive limit
at +7,921,252 motor steps
(Calculate 3,741,734 motor steps/degree)

Feb. 9, 2018 install M2 positive hard stop

GeoBrick mirror pitch hits hard stop positive limit
at -4,715,471 motor steps

M2 Mirror Pitch Hard Stop = -1.28 deg.