BUDGET JUSTIFICATION

In order to establish DAC x-ray capability at the NSLS-II, we envision that the scope of the experimental effort envisioned will require a beamline scientist and postdoctoral researcher, as well as a modest amount of equipment (i.e., most of the equipment needed to begin DAC x-ray operations at NSLS-II will use existing equipment). Funds are also requested for travel for PIs Chen and Lee to NSLS-II as well as for the 3 PIs, beamline scientist and postdoc to travel to the annual COMPRES Meeting. Details are itemized below.

PERSONNEL

In order to keep costs at a minimum, the PIs are not requesting any salary, but do request travel funds (see below). Personnel costs are limited to a beamline scientist and postdoctoral researcher in Year 1, transitioning to two beamline scientists in Years 2-5.

Beamline Scientist (TBD), 12 months:
Key responsibilities:

- Support commissioning and operations of laser-heated diamond-anvil cell (LHDAC) operations at beamline (initially at XPD).
- Provide general user support for LHDAC experiments.
- Engage in beamline control and data acquisition/analysis software development, implementation and testing.
- Build a strong LHDAC science program at NSLS-II beamlines.
- Reach out and engage with beamline users to promote a strong science program.

Postdoctoral Researcher (TBD), 12 months: The postdoc will facilitate LHDAC temperature measurements and careful sample design and preparation.

Salaries are subject to a 3% increase per year.

FRINGE BENEFITS

Fringe benefits are calculated at 33.22%.

TRAVEL

Funds are requested for the PIs Chen and Lee to travel to NSLS-II 5 times per year. During these visits, the three PIs will be able to meet (PI Parise is local) with the beamline scientist(s) and postdoc and discuss design and implementation of the laser-heating setup, temperature measurement system, x-ray focusing and so forth.

Additionally, funds are requested for the postdoc, beamline scientist and PIs Chen, Lee and Parise to travel to the Annual COMPRES Meeting.

	Trip 1 (Chen to BNL)	Trip 2 (Lee to BNL)	Trip 3 (Annual Meeting)
Airfare (roundtrip)	300	150	300
Lodging ($/day)	100	100	150
Per Diem ($/day)	35	35	
Transportation ($/day)	40		40
Airport Parking ($/day)	15		15

	Number of Trips	Number of Days	Number of Persons	Airfare	Lodging	Per Diem	Transportation	Total
Trip 1	5	5	1	$1500	$2500	$875	$1375	$6250
Trip 2	5	5	1	$750	$2500	$875		$4125
Trip 3	1	5	5	$1500	$3750		$1375	$6625
					Total Travel per Year			**$17,000**

EQUIPMENT

We plan to use existing equipment from X17, FIS, GSECARS and HPCAT that have already been purchased by COMPRES previously, or that are no longer in use. A few new pieces of equipment will be purchased to support functionality of the beamline LHDAC capabilities as well as users in the offline lab space.

Beamline Hutch

KB Mirrors: We have a couple of options for KB mirrors in the hutch. On XPD, the mirror that they are planning on purchasing will yield a spot size of 25□m x 10□m, much too large for LHDAC experiments. A smaller size is achievable at the expense of flux with the use of slits and pinholes. Under certain assumptions of primary beam divergence, mirror lengths etc, the estimated flux is 3.1×10^{11} ph/s within 50×20 μm^2 (per Eric Dooryhee, XPD Group Leader) Another option for KB mirrors is to use the existing KB mirror from X17 or use a now retired mirror from HPCAT (yields an ~5□m x 7□m spot size) . In either scenario, we have not requested funds for new KB mirrors at this time.

Slits & Pinholes: Funds for pinholes to decrease the x-ray beamsize at XPD are requested in Year 1. Existing slits and pinholes from X17 will be used if in working order.

Detectors: Initially, we do not request funds for a detector, but instead will use an existing MAR CCD 165 currently not in use from GSECARS.

Portable Laser-Heating System: In view of the current discussion on the unavailability of previous laser-heating system at X17, we instead will build a portable laser-heating system. Based on the portable

laser-heating system design by Shen et al., (2010), we would like to implement something similar with double-sided laser heating (requiring two 100 W fiber lasers) with a single spectrograph that holds two detectors. For the double-sided laser heating, the two detectors will be "visible" CCDs (~200-900 nm) one for each laser-heating side rather than an InGaAs detector. This will allow us to measure temperatures as low as ~1000 K. We have budgeted $130k in Year 1 for this endeavor.

Motor Control: We are requesting funding for motor control in the hutch. This will require ~40 motors to control not just the DAC position, but also manipulation of the table, various slits, laser-heating setup and the like. We have budgeted $90,000 for this in Year 1.

Preparation Lab/Offline capabilities

In order to facilitate use by LHDAC users, the offline IR space will be converted into a space for LHDAC users equipped with DACs, anvils, microscopes, EDM, ruby system, Raman spectroscopy, offline centering station, laser cutting tool and, with time, a gas loading system. These costs are itemized below.

DACs: Several symmetric-type diamond-anvil cells, will be purchased for user and beamline scientist use. We have budgeted $20k for 4 DACs and auxiliary pieces including a pair of anvils per DAC in Year 1. In later years, DACs that are smaller and lighter will be required to be used at HXN, CHX. We have budgeted $20k for design and manufacture of 8 of these new design DACs.

Microscope: There is an existing Leica microscope from X17. We have added funds to purchase a second microscope equipped with a camera as well as a PC to run the camera: $15,000.

EDM: To facilitate making gasket holes, the existing micro-EDM from X17 will be used.

Ruby System: The existing ruby system from X17 will be used to measure pressure.

Raman: An existing offline Raman system currently installed in the offline IR setup can also be used for pressure calibration as well as Raman spectroscopy.

Offline centering: In order to facilitate DAC centering between ruby, Raman and the beamline, we plan to have an offline centering tool equipped with motor controls, a PC, and microscope optics. We have budgeted $15k for this in Year 1.

Laser cutting tool: We have requested funds for a laser-cutting tool for gasket and sample preparation. Total costs budgeted include hardware, software and labor based on the design by (Hrubiak et al., 2015) at $50k.

Gas Loading: We have included gas loading capabilities in the current budget, however, not until Year 3 in order to spread the costs out. We budget $170k based on the design at GSECARS. Until then, users will be able to take advantage of the COMPRES gas loading mail-in system that is currently in place.

OTHER

There are many other expenses that will be incurred when running a high-pressure LHDAC lab which we list below.

Materials & Supplies	
Other – diamond anvils	$12,000/year
Other – diamond repolishing	$2000/year
Other – rhenium foils, calibrants, compressed gases	$2000/year
Other – acetone, ethanol, needles, other incidentals	$1490/year
Other – Lab Space	$10,000/year
Other – Consulting/Technical Support	$20,000- 30,000/year
Other – Publication charges	$1000/year for Years 3-5

Diamond anvils are a necessary expense for our project. Eight pairs of anvils will be purchased each year as needed for a cost of $1500/pair. At the highest pressures and temperatures, the anvils may be damaged even for successful experiments. Some damage can be repaired by polishing (~$200/anvil).

We have included nominal funds for sample expenses such as metal foils for gaskets and pressure calibrants. We have also included other incidental expenses such as ethanol, needles and cotton swabs.

We include an annual lab space charge which is charged by NSLS-II for all lab space. There is a 3% annual increase.

We also request funds in technical and consulting support that go beyond the expertise of the PIs, beamline scientist and postdoc. In the early years, we request $30k/year, decreasing to $20k/year in latter years.

We include nominal publication charges in the last three years for any technical papers that will result from the new LHDAC abilities at NSLS-II.

INDIRECT COSTS:

Indirect costs are calculated at FIU's federally negotiated rate of 26% of modified total direct costs. DHHS agreement dated 8/15/2016.

Year 1 costs: $571,714
Year 2 costs: $410,523
Year 3 costs: $519,561
Year 4 costs: $344,973
Year 5 costs: $353,224

5 year total costs: $2,199,995

Leverage fund from HPSTAR: $1,100, 000 (commitment letter attached)
Requested fund from COMPRES: $1,099,995