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a. REPORT	b. ABSTRACT	c. THIS PAGE			Ben Bahr
UU	UU	UU	UU		19b. TELEPHONE NUMBER 910-775-4383

RPPR Final Report
as of 24-May-2023

Agency Code: 21XD

Proposal Number: 78207HCREP **Agreement Number: W911NF-21-1-0238**
INVESTIGATOR(S):

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Report Date: 31-Oct-2022 Date Received: 24-Mar-2023
Final Report for Period Beginning 08-May-2021 and Ending 31-Jul-2022
Title: High-Resolution Microscopy System for Training Under-Represented Minority Scholars
Begin Performance Period: 08-May-2021 **End Performance Period:** 31-Jul-2022
Report Term: 0-Other

Submitted By: Ben Bahr Email: bahr@uncp.edu
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Distribution Statement: 1-Approved for public release; distribution is unlimited.

STEM Degrees: 12 **STEM Participants:** 16

Major Goals: The funded new equipment is needed to support recent advances biomedical research at UNC-Pembroke. The top of the line cellular and subcellular imaging system is the vital tool needed for the acquisition of details describing i) intracellular alterations, ii) interactions between cells, as well as iii) adhesion dynamics underlying signal transduction between extracellular matrices and cytoskeletal components. Of the UNC-Pembroke professors and research mentors that will benefit from the new imaging platform, Dr. Ben Bahr runs a major lab that works on neuroscience projects studying military-related traumatic brain injury and toxin exposure. The important research is finding links that may increase the risk of Alzheimer's disease and other chronic neurological illnesses. He mentors a team of researchers focusing of an organophosphate toxin that is related to deadly nerve agents. Her work has demonstrated that organophosphate exposure induces distinct synaptic pathology before obvious cellular damage and perhaps underlying the long-term symptoms in survivors of nerve agent exposure. The research requires super resolution technology to understand morphological changes in astrocytes that appear to influence synapse maintenance in brain slice cultures. Other professors utilized the equipment for studies of aging and lifespan of nematodes, dynamics of structural networks that modulate the neuromuscular junction, and properties of nematode-bacteria interactions. The Super Resolution Imaging Platform will support future analyses of biomolecular and cellular interactions in multiple experimental models (e.g. organotypic tissue explants, primary cell cultures, unique cell lines, and iPSC-derived neurons).
Research Education to be Supported. The Super Resolution Imaging Platform will provide state-of-the-art cellular staining and signaling technology in order to enhance the training of student researchers and to strengthen their studies for publication in high-end journal, thus enhancing graduate school applications. Faculty are dedicated to meeting the academic needs of minority students including mentoring undergraduates in biological and chemical research with advanced technologies and giving them laboratory experience necessary for postgraduate education. Professor Bahr and other mentors at the UNC-Pembroke Biotech Center support 25-30 students/semester in mentored biomedical and biochemical research projects. The new imaging platform will further enhance their experience as they engage in cutting edge research and acquire the skills sought after by Ph.D. training programs and DOD-relevant job programs.

Accomplishments: Distinct Elements of Synaptopathology in Brain Tissue following Sub-Concussive Blasts from Detonated Military Explosives
PI: Ben A. Bahr, Ph.D.
The growing number of traumatic brain injury (TBI) cases associated with military service warrants the important study of blast-induced neuronal damage. With nearly equal number of astrocytes as there are neurons in the brain, it is vital to address changes that can occur to astrocytes following shock wave exposure produced by military explosives. Blast-induced TBIs are often associated with reduced cognitive and behavioral functions due to a

variety of factors. To elucidate the effects of explosive blasts, this proposal will study hippocampal slice cultures that were lowered into a water-filled blast chamber and 1.7-gram assemblies of cyclotrimethylene trinitramine (RDX) explosives detonated outside the chamber to create distinct shockwaves. Following previous studies (Smith et al., 2016; Almeida et al., 2021), Bahr and colleagues have been described that blast intensities from 1.7-g spherical RDX assemblies did not cause cell death or neuromorphological alterations when directed at hippocampal explants, the highly-controlled detonations did in fact cause marked reductions in synaptic markers that are also known to be down-regulated in cognitive disorders, including synaptophysin, GluR1, and synapsin IIb. Additionally, the new image platform supported by this funding support Bahr's research advances in other research projects, such as (i) discovery of positive modulators of autophagy-lysosomal proteases that contributed to promoted or prevent the synaptic integrity-associated cognition in brain aging or neurodegenerative diseases; (ii) excitotoxicity induced-seizure linked to synaptopathology; (iii) Deciphering the tau aggregation in the brain aging process.

Synapse Alterations and Corresponding Integrin Dynamics in Hippocampal Dendritic Zones following Organophosphate Exposure
PI: Karen LG Farizatto, Ph.D.
Astrocytes are involved in a wide variety of processes in the brain, reacting to health and disease states. Importantly, astrocytes respond to neurological injuries, seizure events and toxin exposure by mediating cellular alterations. Organophosphates (OP) account for the deadliest toxins that produce cholinergic crises leading to seizures, memory deficits, neuronal loss, and eventually death, while survivors ordinarily experience long-term neurological problems. The view of astrocyte's role during pathogenic response has been altered in the recent years, and the astrocytic responses linked to OP-mediated neuropathology have not been well explained. Here, the OP compound paraoxon (Pxn) was applied into hippocampal three-dimensional in vitro model in order to examine cell-type astrocytic responses in a paradigm of synaptotoxicity. Acute Pxn exposure induced reactive astrocytes expressing abundantly GFAP-positive labeling in correspondence with declines of pre-and-post-synaptic proteins. Note, the Pxn effect on synaptic markers was indeed found to be synapse-specific, noting no changes occurred in the neuronal density assessed by Nissl stain. The pattern correlation regarding to the increase in GFAP labeling whereas extent of presynaptic decline was observed across different dendritic view-fields. The robust increase of GFAP, up to two-folds in the analyzed hippocampal dendritic fields was accompanied by dystrophic changes in the pattern astrocyte's phenotype, including hypertrophy of cell body and processes, changes in the length of primary processes, and increased branching. The augmented β1 integrin signaling does not colocalize with astrocytic increase. OP-mediated distinctive reactive astrocytes also involved colocalization of astrocytic cell-type with the marker complement component C3, highly expressed in hypertrophic astrocytes (see Figure 3). These findings suggest that astrocytes responded to acute Pxn exposure and adopted reactive profiling, characteristics of astrocytosis.
Plants extracts as potential therapeutic agent to Parkinson' disease
PI: Courtney Carroll Alexander, PhD
Currently, we have optimized the imaging of the Parkinson's disease model worms, JVR406, which have an overexpression of GFP-alpha-synuclein. We observed the development of distinct puncta in the head region of young adult worms. We hypothesize that the puncta will increase with age. We are testing novel plant extracts on their ability to decrease the protein aggregation, as well as improve the phenotype of the animals (see figure 4).

The Effect of IGF-1 in Testicular Development and Growth Prepubertal Beef Bulls
PI: Nicolas Negrin Pereira, Ph.D.
Within a herd, the bull is the individual that bears the major responsibility in the overall fertility as it is normal that a single sire breeds between 25 to 60 cows. Potential daily sperm production (DSP) in the bull is determined by the size of the Sertoli cell (SC) population in the testicle. The key role played by SC in the nourishment and physical support of germ cells from the early formation of the primordial sex cords in the late embryonic stage and later throughout the whole spermatogenic process explains why the size of the cell population established before puberty determines the bull's DSP. Sertoli cells replicate at a specific window of time during the life of the individual. Once puberty is reached, SC stop multiplying, fixing the ceiling of daily sperm production. Although several local growth factors and hormones have been reported over the years to influence the number of immature SC in the developing testicle, IGF-1 has been identified as one of the most important. The application of rBST (recombinant Bovine Somatotropin) in dairy cows to increase milk production is common practice in the US. This effect is exerted through a rise in IGF-1 levels in blood and by increasing its action on target tissues. We hypothesize that an increment in IGF-1 stimulated by the administration of rBST in prepubertal bulls during the period of SC replication can increment the number of immature SC in the testis.
Others research that will start use the new image platform:
Dr. Len Holmes, Associate Professor

Dr. Len Holmes, Associate Professor, Chemistry/Physics, is a key member of UNCP's Biotechnology Research and Training Center and a member of the Department of Chemistry and Physics. A major aspect of his research involves the interaction of a nematode species (H. bacteriophora) with its bacterial symbiotic partner (P. luminescens). The addition of the confocal microscope system will greatly facilitate Professor Holmes' work on the nematode-bacteria interactions, using novel fluorescent probes and image analysis. The microscope will also jumpstart recent proposals to engineer the bacterial symbiont to express GFP as a function of reversible phase variation, thus to help explore the specific three-dimensional interactions between H. bacteriophora and P. luminescens.

Dr. Robert Poage, Professor
Dr. Robert Poage, full Professor in the Biology Department, recently stepped down from being Program Director of NIH-funded Research Initiative for Scientific Enhancement (RISE) Program at UNC-Pembroke in order to put more focus back into his research. In animal species, neurons control movements, sensations, and decisions. Neuronal communication is dependent upon ion channels, especially voltage-activated calcium channels. His lab is interested in synaptic plasticity, in regional specializations of neuronal membranes, and in how different cellular compartments are made capable of extremely rapid, chemical and electrical communication. One way to study this is with electrophysiological recording techniques that can record and manipulate the electrical state of a neuron or neurons. The new Super Resolution Imaging Platform for the Biotechnology Research and Training Center will help Dr. Poage with understanding neuronal circuitries and structural constraints governing circuitry.

Training Opportunities: The new imaging platform further enhanced their experience, after intense week of the optical microscopy and imaging training at the UNC-Pembroke Biotechnology and Training Center.
This three-day program event featured speakers from Nikon Instruments and an elite group of microscopy experts from Rockefeller University, UNC Wilmington, UNC Chapel Hill, Yale University, and Vanderbilt University. This event was developed in a partnership with the U.S. Department of Defense, Nikon Instruments, and sponsored by Bioimaging North America (BINA).
This course was designed principally for undergraduate research scientists in biological and medical sciences. The 3 days course focused on a comprehensive introduction to microscopy, with interactive lecturers, hands-on activities, and demonstrations to ensure that the students were train on state-of-art equipment's to support further biological and biomedical research and undergraduate training at UNC-Pembroke. Course attenders were benefit from the imaging platform at Bahr's Lab, comprised of a Nikon point scanning confocal A1R HD25 and C2 microscope, and with the high-resolution N-SIMe microscopy. Confocal microscopes are the most used tools in cell biology; specifically, neuroscience due to confocal ability to image deep into tissues with diffracted-limited resolution, and optical sectioning for 3D reconstructions of imaged samples. Also, the Bahr's lab imaging platform is equipped with the super-resolution N-SIMe system, which achieves an approximately two-fold improvement in resolution in the XY plane, compared to wide-field microscopy. Therefore, this course was dedicated to training the next generation of biomedical researchers to advance and expand research and teaching capabilities UNC-Pembroke. Thus, this new image platform provides undergraduate students engagement in cutting edge research and acquire the skills sought after by Ph.D. training programs and DOD-relevant job programs.
See here some quote from students that attend that course to highlight the importance of this unique events:
"Hi! My name is Iraysa Grijalva (Afro-American Woman) and I'm from the Dominican Republic. I'm an untraditional student and a senior at the University of North Carolina Pembroke. I came across the opportunity to participate in the BINA microscopy training. Microscopy allows us to see the tiniest organisms in our world that are otherwise naked to the human eye. And it gives the ability to deliver amazing and quality images. The opportunity to attend the BINA Optical Microscopy and Imaging training woke up a new interest for me and allowed me to see that microscopy can be a beautiful thing. In the near future, I would love to work in a diagnostic lab for infectious diseases and apply the hands-on knowledge gained at the BINA microscopy training and thereafter. Also, thanks so much for the training opportunity! It was great exposure and mind-opening I'm glad I could attend."

Minh H Giang - International student from Vietnam:
"I appreciated this microscopy workshop. I learned a lot these 3 days. I had never ever had any exposure to high qualified speaker so close to me like this before. I can consider that I am a lucky student to be here at this time. Pembroke does not offer us anything close to it, and it is great to see that BINA also is looking up for minorities."

Additionally, this course was highlight by international recognized microscopists, by one of the leader of the field vendor and by the Bioimaging North America society (see figure 6).

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Results Dissemination: Manuscripts submitted or in preparation to Peer-review journals
Almeida MF, Pait MC, Rentschler KM, Farizatto KLG, Norton CJ, & Bahr BA (2022) Specific dietary agent promotes synaptic resilience and protection against protein accumulation pathology through the autophagy-lysosomal pathway. Revised resubmission to FASEB J.

Farizatto KLG, Almeida MF, & Bahr BA (2022) Selective astrocytic changes linked to organophosphate-mediated early synaptotoxicity on hippocampal dendritic fields. Submitted to Acta Neuropathologica.

Ph.D. dissertation
Almeida, MF. (2022)The role of selected natural products in triggering the autophagy-lysosomal pathway to promote brain health. [Doctoral dissertation, University of North Carolina Wilmington, NC

Conference Abstracts/ Posters
1. Bahr BA and Almeida MF. Altered proteostasis and corresponding synaptopathy are commonalities across dementia risk-enhancing brain vulnerabilities including seizure-related neuronal activity, toxin exposures, traumatic injuries, and blast-mediated neurocompromise. 2022-S-11440-SfN Soc. Neurosci. Abstr. (2022).
2. Farizatto KLG, Tuton J, Almeida MF, and Bahr BA. Investigating cytoskeletal and adhesion dynamics associated with dementia risk factors arising from toxin exposures and seizure-related neuronal activity. 2022-S-8645-SfN Soc. Neurosci. Abstr. (2022).
3. Almeida MF, Rentschler KM, Pait MC, Long R, Minh GH, Clayman S, Farizatto KLG, and Bahr BA Non-pharmacologic avenue targeting the autophagy-lysosomal system to support proteostasis leads to synaptic and cognitive benefits in experimental models. 2022-S-11615-SfN Soc. Neurosci. Abstr. (2022).
4. Almeida MF, Strangman W, and Bahr BA. Distinct ginseng extracts produce disparate effects on proteostatic support through the autophagy-lysosomal pathway linked to synaptic resilience and cognitive health. Experimental Biology 2022. Abstract ID: R3521, Philadelphia, PA, 2022.
5. Almeida MF, Kinsey ST, and Bahr BA. Stimulation of autophagy and synaptic maintenance are commonalities induced by an exercise-mimetic and diet supplement to avoid initiators of age-related cognitive decline. Experimental Biology 2022, Abstract ID: R2596, Philadelphia, PA, 2022.
6. Viana M, Tuton J, Almeida MF, Bahr BA, and Farizatto KLG. Deterioration of hippocampal synapses mediated by ?1 integrin responses. In: Annual Biomedical Research Conference for Minority Students (ABRCMS), a virtual meeting, 2021.
7. Giang MH, Yorio M, Almeida MF, Norton CJ, Farizatto KLG, and Bahr BA. Military explosive blast shockwaves induce early astrocytic and synaptic alteration in Annual Biomedical Research Conference for Minority Students (ABRCMS) 2021.
8. Adams K, Clayman S, Almeida MF, Hwang J, Farizatto KLG, and Bahr BA. Boosting protein clearance machinery to avoid age-related cognitive decline. In: Annual Biomedical Research Conference for Minority Students (ABRCMS) 2021.
9. Grijalva I, Almeida MA, Bahr BA, and Smith SE. Pathway analysis for evaluating potential elements of the autophagy-lysosomal protein clearance system influenced by an Alzheimer's disease treatment strategy. In: Annual Biomedical Research Conference for Minority Students (ABRCMS), 2021.
10. Tuton JJ, Almeida MF, Bahr BA, and Farizatto KLG. Modulated integrin signaling plays a role in anticholinesterase-induced synaptopathy in hippocampal explants. In: Society for Neuroscience, Abstr., 2233, 2021, Chigaco, IL.
11. Almeida MF, Rentschler KM, Nguyen JL, Grijalva I, Dos Santos MA, Giang MH, Farizatto KLG, Ikonne US, and Bahr BA. Pharmacologic and non-pharmacologic enhancement avenues targeting the autophagy-lysosomal pathway increase cathepsin B activity, stimulate autophagic flux and improve synaptic resilience. In: Society for Neuroscience, Abstr., 1076, 2021, Chigaco, IL.
12. Almeida MF, Rentschler KM, Nguyen JL, Ivey CM, Ikonne US, Farizatto KLG, and Bahr BA. Pharmacologic activation of lysosomal enzyme cathepsin B reduces dementia-linked protein accumulation stress in the brain. In: FASEB Science Research Conference, 2021.
13. Almeida MF, Pait MC, Rentschler KM, Locklear JP, Norton CN, Farizatto KLG, and Bahr BA. Natural products enhance the A?-degrading hydrolase cathepsin B and improve synaptic resilience in a model of protein clearance dysfunction. In: FASEB Science Research Conference, 2021.
14. Almeida MF, Hwang J, Butler D, Pait MC, Rentscher KM, Locklear JP, Farizatto KLG, and Bahr BA. Disease-modifying approach through enhancement of lysosomal cathepsin protease reduces protein accumulation events and associated synaptopathology of Alzheimer's and Parkinson's diseases. The 15th International Conference on

Alzheimer`s and Parkinson`s Diseases (AD/PD 2021), abstract 1656 (2021).
15. Almeida MF, Piehler T, Pait MC, Norton CJ, Giang MH, Farizatto KLG, and Bahr BA. RDX blast shockwaves from detonated explosives produce correlative indicators of dementia risk, including tau pathology and NCAM breakdown products in the hippocampus. In: Society for Neuroscience (2020; conference postponed); Society for Neuroscience - Global Connectome: A Virtual Event, S262, 2021.

Presentations and invited talks
1. Brain health and Alzheimer's disease? – UNCP Mary Livermore Library Dec - 2022
2. Can we stop Alzheimer's disease? - Reynalda Rotary meets in Winston-Salem Sept- 2022
3. Aging in a dish to military blast exposures and Alzheimer-type synaptic pathology –
4. DUKE/UNC ADRC Forum Ideas Aug – 2022
5. The role of selected natural products in triggering the autophagy-lysosomal pathway to promote brain health - DUKE/UNC ADRC Forum Ideas Jul - 2022
6. Non-pharmacologic avenue targets the autophagy-lysosomal pathway to offset the synaptic decline in a brain explant model of age-related proteostatic stress – The 1st Annual Symposium for Learning about Alzheimer's disease-related Medical Research at Duke and UNC June – 2022

7. Blast exposure, a military-related vulnerability linked to dementia risk, produces distinct synaptic pathology - The 6th international forum on blast injury countermeasures (IFBIC) – May -2022

8. Stimulation of autophagy and synaptic maintenance are commonalities induced by an exercise-mimetic and diet supplement to avoid initiators of age-related cognitive decline –
9. Experimental Biology, American Society for Investigative Pathology (ASIP) - April – 2022

10. The role of selected natural products in triggering the autophagy-lysosomal pathway to promote brain health – UNC-Wilmington Biology Seminar Nov – 2021

Media cover of undergraduate training
The training program for the undergraduate students in Summer 2022 was covered by UNC-Pembroke Communications team, and also widely spread out from social media post form speaker, attended, and collaborators (see attached image of social posting)
https://www.uncp.edu/news/undergraduate-research-scholars-uncp-benefit-advanced-microscopy-training
"Undergraduate research scholars at UNCP benefit from advanced microscopy training"
June 13, 2022/ News
Student researchers at UNC Pembroke are benefiting from a unique opportunity this summer to experience advanced research through the lens of a state-of-the-art Structured Illumination Microscopy system, thanks to a partnership with the U.S. Department of Defense. The training program also received a small grant from BioImaging North America, a volunteer-based organization that supports bioimaging scientists in order to promote an inclusive and supportive community to share, advance and succeed together.
More than two dozen undergraduates, recent graduates and faculty recently participated in a first-ever high? resolution microscopy and imaging system training at the Biotechnology Research and Training Center. The three-day program organized by UNCP's Michael Almeida featured speakers from Nikon Instruments and an elite group of microscopy experts from New York University, UNC Wilmington, UNC-Chapel Hill and Vanderbilt University.

Honors and Awards: Bahr, 2021 Health Sciences Mentor Award from the Council on Undergraduate Research

In 2022, Professor Ben Bahr was elected as a member to Sigma Xi, the Scientific Research Honor Society founded in 1886.

Protocol Activity Status:

Technology Transfer: Nothing to Report

RPPR Final Report
as of 24-May-2023

Partners

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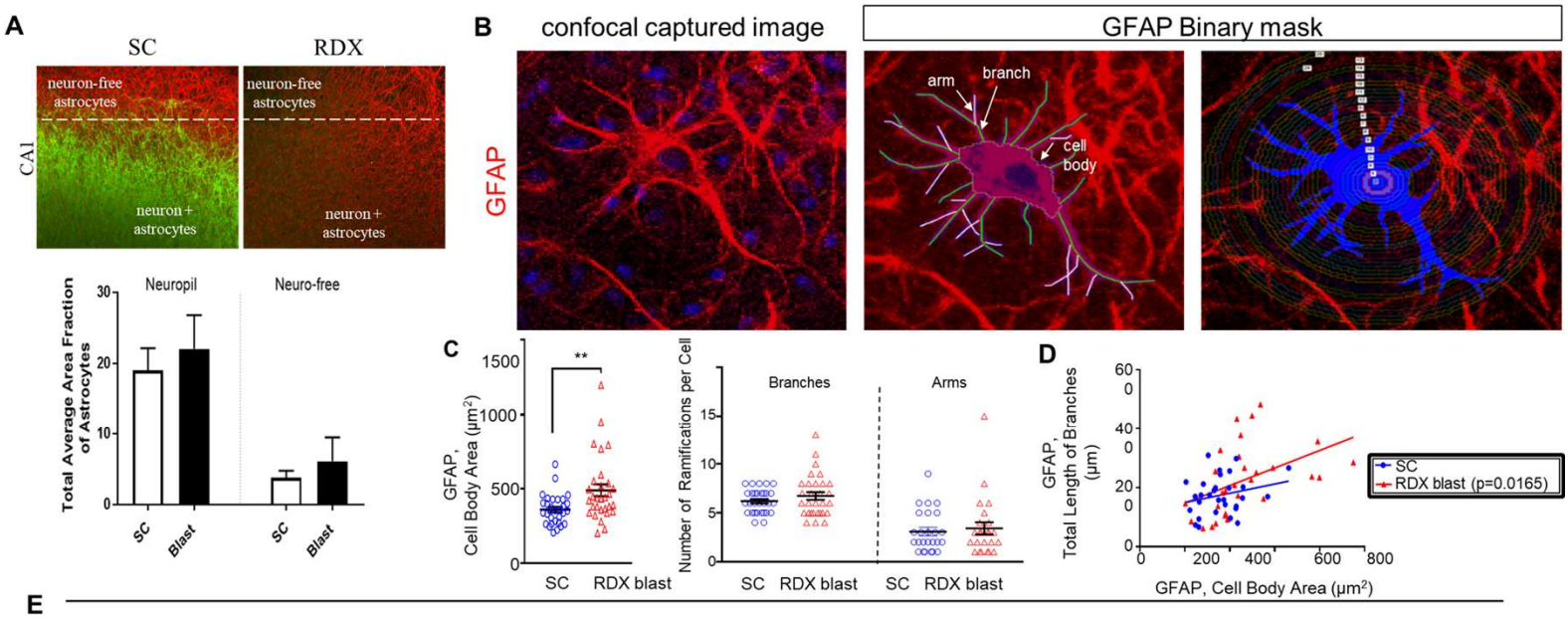
I certify that the information in the report is complete and accurate:
Signature: Ben A. Bahr, Ph.D.
Signature Date: 3/24/23 10:09PM

High-Resolution Microscopy System for Training Under-Represented Minority Scholars

Recipient of Award

University of North Carolina - Pembroke (Minority Serving Institution)
PI: Dr. Ben A. Bahr, William C. Friday Chair and Professor of Molecular Biology and Biochemistry
Biotechnology Research and Training Center, UNC-Pembroke

FIGURES FOR THE FINAL REPORT



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	Cell body area (μm^2)	Number of Primary branches	Number of Arms	Length (µm) of Primary branches	Length (µm) of Arms
SC (n=30)	358.4 ± 18.52	6.200 ± 0.2218	2.567 ± 0.4088	143.8 ± 8.327	30.60 ± 4.997
Blast (n=30)	488.3 ± 39.86**	6.733 ± 0.3952	2.733 ± 0.5611	192.5 ± 16.84*	47.69 ± 10.31

* Unpaired, two-tailed t test p=0.0121 ** Unpaired, two-tailed t test p=0.0045

Figure 1. RDX blast-induced astrocytic morphological changes alongside with synaptic deterioration. (A) Blast-exposed (RDX) or mock-control hippocampal cultured slices stained for synaptophysin (green) and GFAP (red) were assessed for area fraction in neuropil zone (neurons + astrocytes) and neuron-free zone (neuron-free astrocytes). (B) Representative single neuron-free zone astrocytes stained for DAPI (blue) and GFAP (red) were analyzed by state-of-arts techniques through NIS-Elements AR Software. (C) Correspondent measurements of area of cell body and number of arms and branches of individual astrocytes stained by GFAP for blast-exposed brain explants or control were assessed by NIS-Elements (**p<0.01). (D) Correlation between astrocytic cell body size and total length of branches for both treatments conditions. Data set of astrocyte morphological analyses between SC and RDX blast-exposed slices.

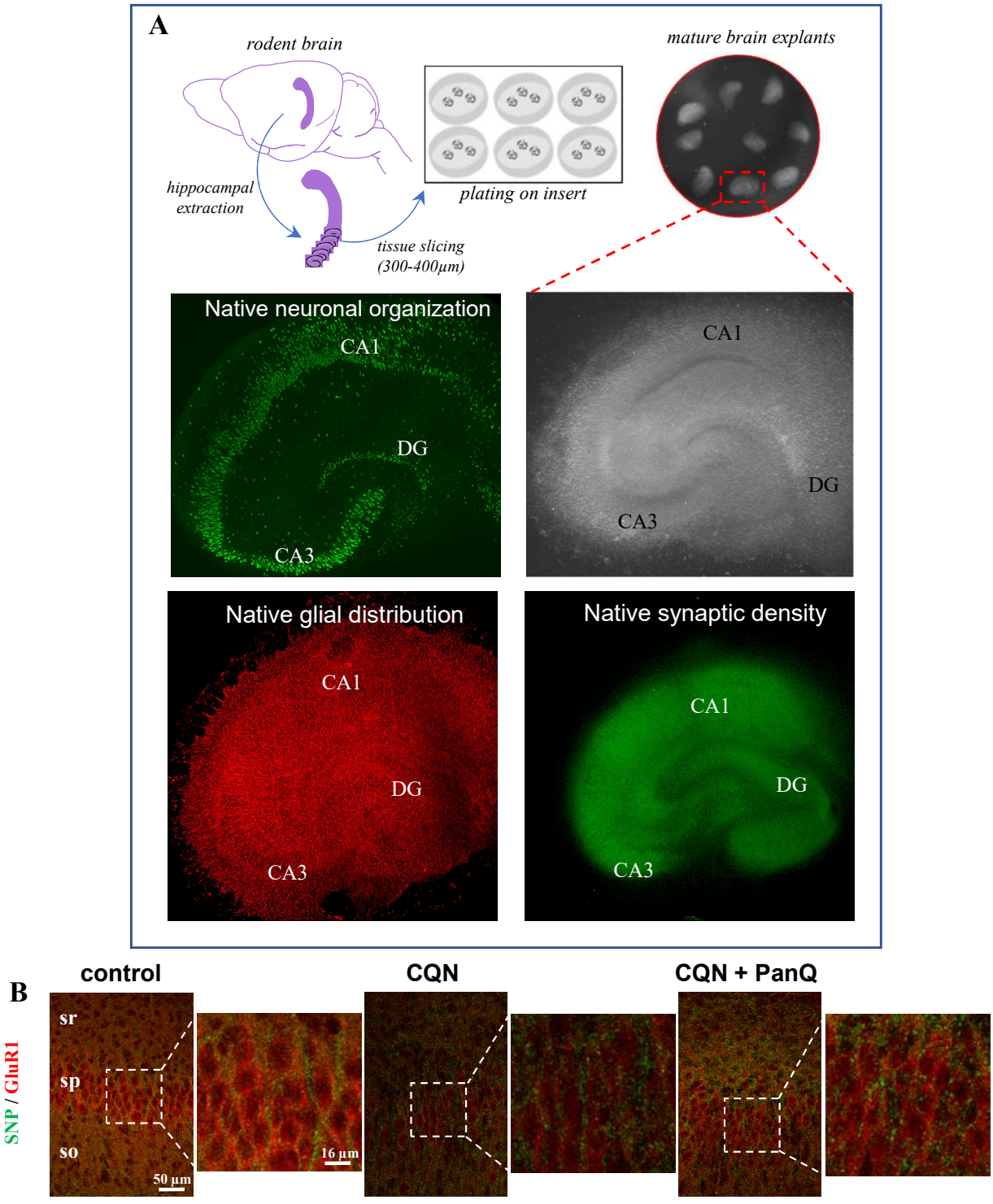


Figure 2. Bahr's Lab research that was improve with the new image platform. (A) The hippocampal slice cultures maintained the native organization, circuitry, and distinct maturation markers found in the adult hippocampus such as neuronal cellular morphology, synaptic circuitry and glial cell morphology and distribution. (B) PanQ-treated slices were less prone to synaptic decline due to chloroquine (CQN)-mediated protein accumulation stress.

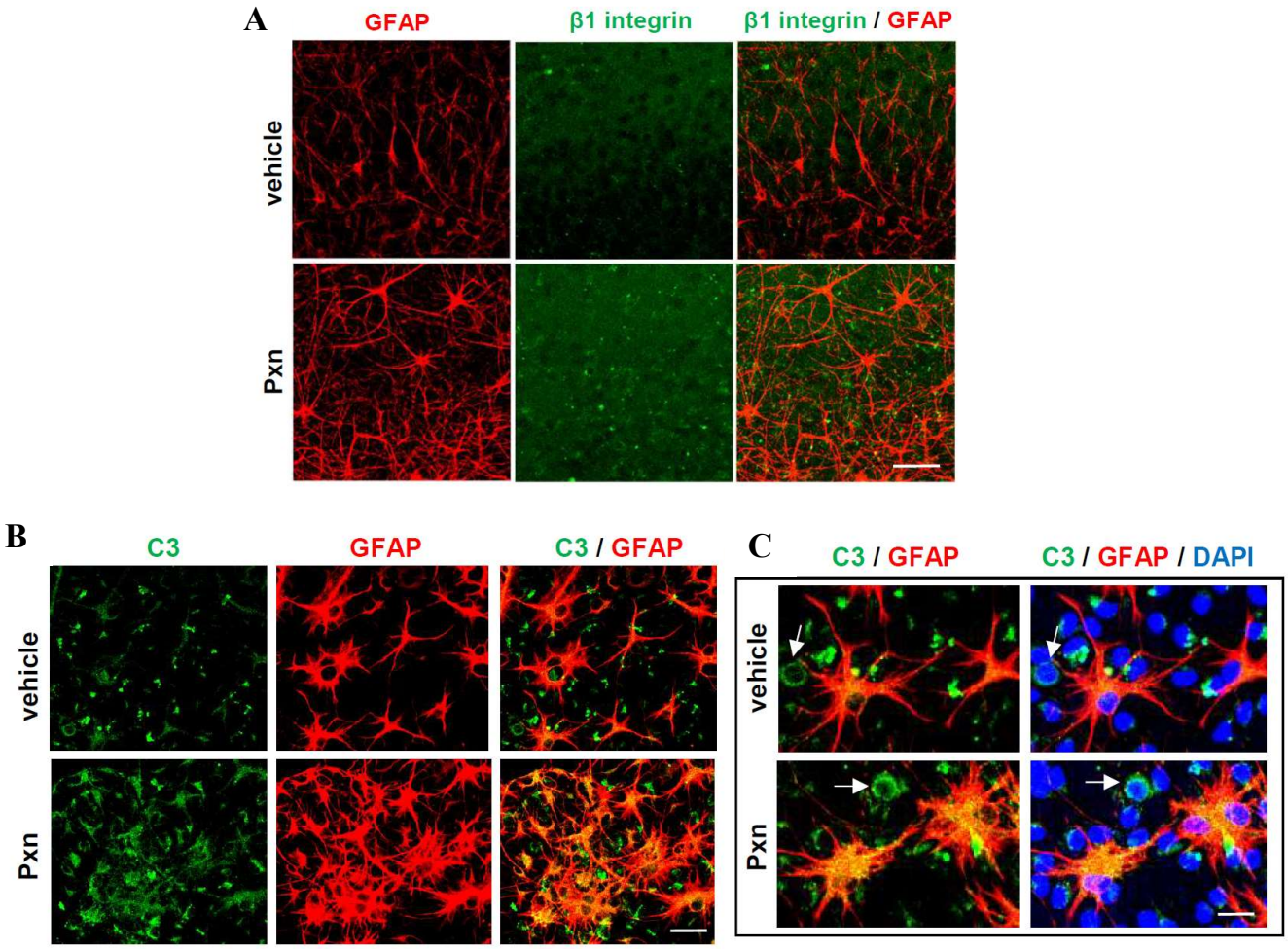


Figure 3. Pxn-induced reactive astrocytes is not mediated by an increase in the β1 integrin adhesion receptor and appears to elicit astrocytic A1 neurotoxic profile marked by increased co-localizatio of complement component C3. (A) Hippocampal slice cultures treated with vehicle or 200 μM Pxn for 24 h were immunostained for for β1 integrin and GFAP. (B) In addition, Pxn-treated slices were also assessed by immunostaining for complement component C3 (C3) and GFAP and images from the same dentate viewfield are shown with compressed maximal intensity projection. Images above CA1 subfield are shown in maximal intensity projection from acquired z-stacks. (C) Additionally, high resolution z-stacks images from a confocal microscopy show that C3 is also secreted by other cell types (see white arrows). Size bars: 25 μm (A), 50 μm (B); 20 μm (C).

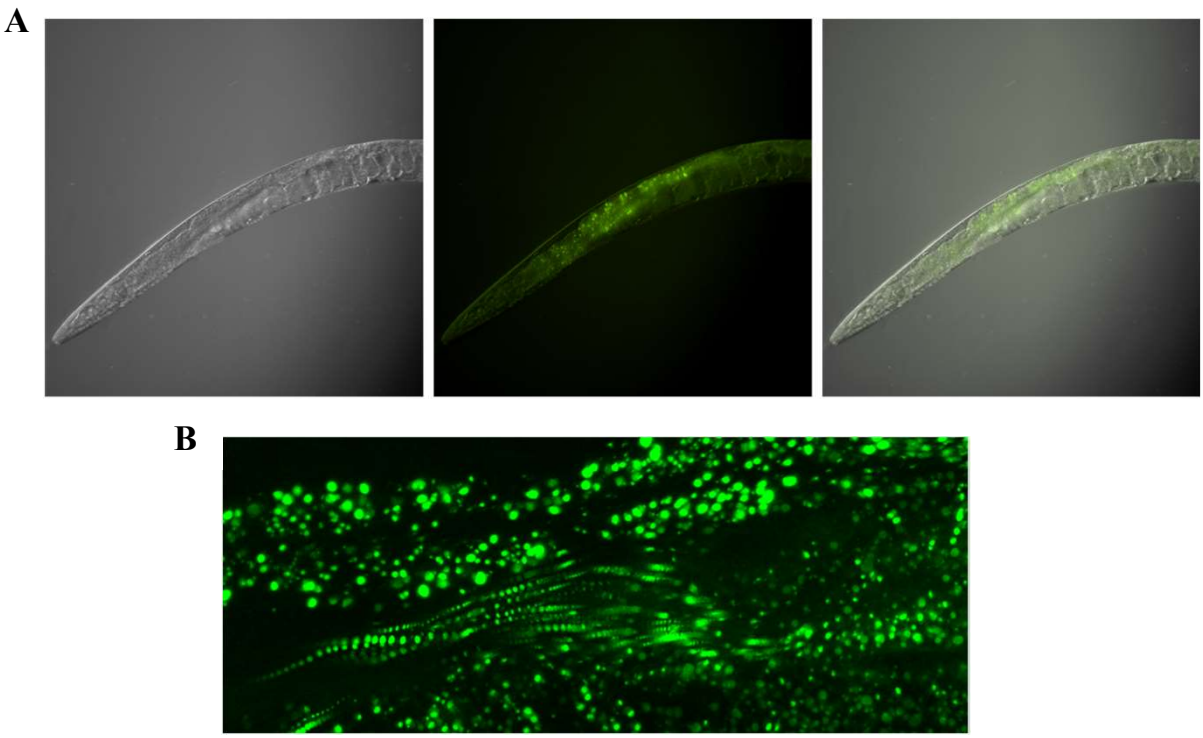


Figure 4. (A) Young adult JVR406 nematodes that contain a GFP-alpha-synuclein overexpression were imaged. GFP puncta show synuclein protein aggregates. (B) GFP puncta are well defined and easily quantified.

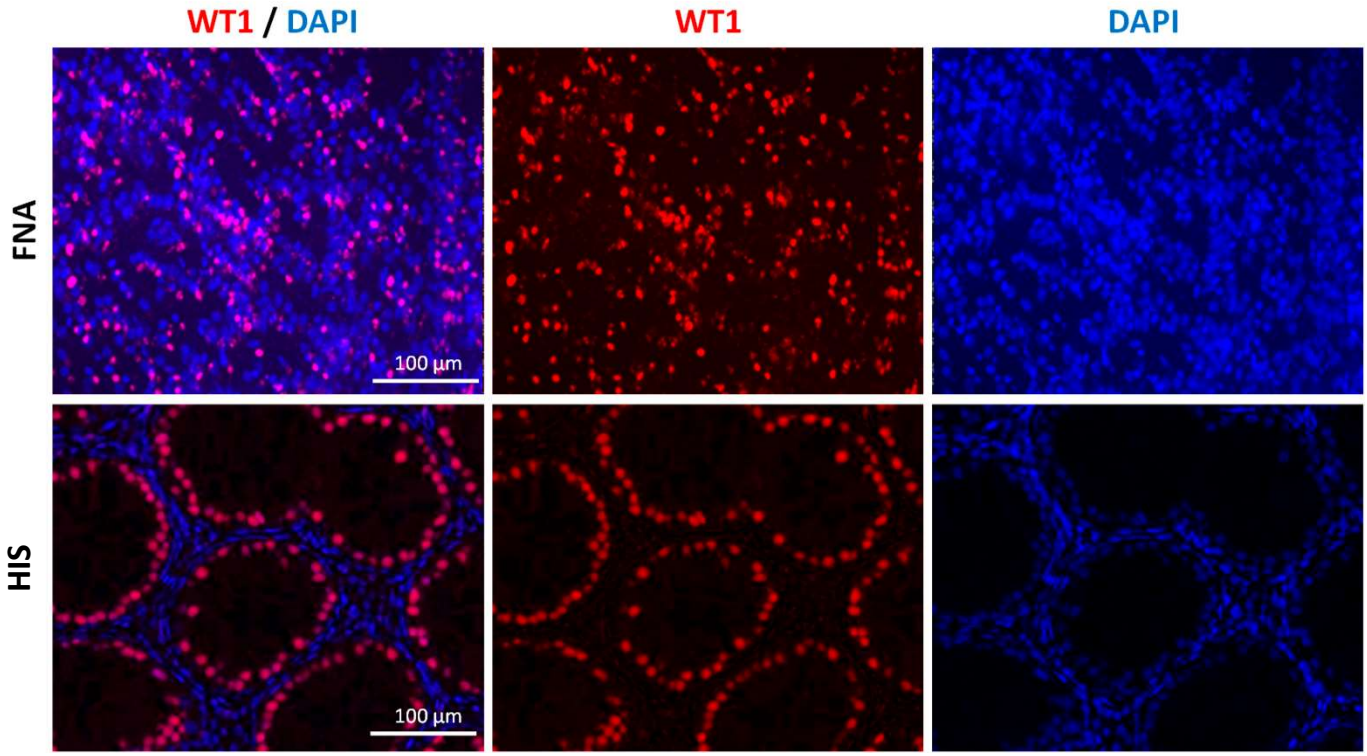


Figure 5. Confocal microscopy IF images (20x, NA 0.75) correspond to testicular samples obtained using 22G FNA (FNA; up) and Conventional tissue section (HIS; down) stained with anti-WT1 (Cy5) as specific Sertoli Cell marker and DAPI as a counterstain (Negrin Pereira et al. *In process*)

Undergraduate research scholars at UNCP benefit from advanced microscopy training

June 13, 2022 / News

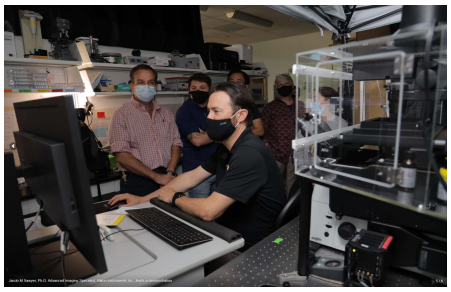
Dr. Michelle Itano, a renowned Chan Zuckerberg Initiative Imaging Scientist, gives a presentation to UNCP researchers during a microscopy training session

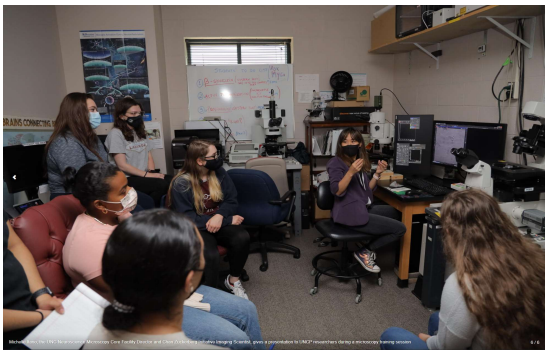
Student researchers at UNC Pembroke are benefiting from a unique opportunity this summer to experience advanced research through the lens of a state-of-the-art Structured Illumination Microscopy system, thanks to a partnership with the U.S. Department of Defense.

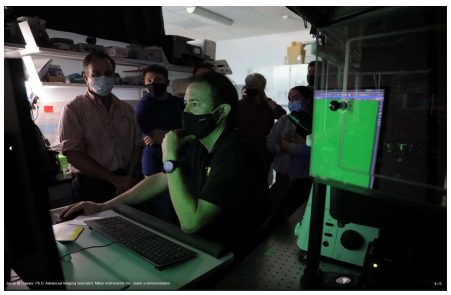
The training program also received a small grant from BioImaging North America, a volunteer-based organization that supports bioimaging scientists in order to promote an inclusive and supportive community to share, advance and succeed together.

More than two dozen undergraduates, recent graduates and faculty recently participated in a first-ever high-resolution microscopy and imaging system training at the Biotechnology Research and Training Center.

The three-day program organized by UNCP's Michael Almeida featured speakers from Nikon Instruments and an elite group of microscopy experts from New York University, UNC Wilmington, UNC-Chapel Hill and Vanderbilt







BioImaging North America @BioimagingNA · Jun 21

Replying to @MichelleItano @FalmeidaMichael and @UNCPBiotechAD

Very proud to have supported this opportunity!🎉🔬

Congratulations on the success of the workshop @FalmeidaMichael, @MichelleItano, @AlisonJNorth!👏

#BINASupport

1 · 3

Nikon Instruments @NikonInst · Jun 16

We had a wonderful time participating in the first-ever high-resolution #Microscopy and imaging system training course at @uncpembroke – let's do it again next year! Click for more information: bit.ly/3MW7Q9x

2 · 10

Alison North @AlisonJNorth · May 24

Such a pleasure to be involved Michael! Loving that you are doing this!!!

> **Michael Falmeida** @FalmeidaMichael · May 23
>
> I am so glad that It started. First Microscope and imaging training for Undergraduate students at @uncpembroke @UNCPBiotechAD. supported by @BioimagingNA and @NikonInst. Thank you @AlisonJNorth, Alison Taylor and @MichelleItano to make the first day amazing. pic.twitter.com/HNAvNkoaLn

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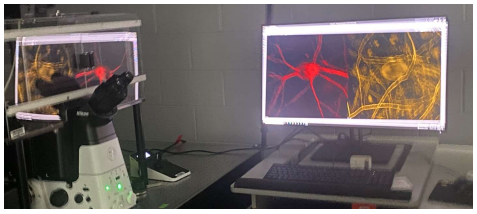

Michelle Itano @MichelleItano · Jun 21

🎉 A huge highlight of the summer! Thanks for letting me take part! @FalmeidaMichael @UNCPBiotechAD 🎉

> **UNCP College of Arts and Sciences** @uncpcas · Jun 21
>
> Proud of our team that brought this highly successful microscope training workshop to campus! The program aims to increase the number of graduates, including underrepresented minorities, in science, technology, engineering and math. Well done all! #UNCP #Microscopes
>
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Michelle Itano @MichelleItano · May 25

I don't know if the students I had the honor of being with today know how much their curiosity, engagement and intelligence has meant to me... especially today when I woke with a heavy and broken heart. Thank you all! #TheFutureIsBright #ImagingTheFuture

> **Michael Falmeida** @FalmeidaMichael · May 25
>
> Looking at live cell are always cool, but it is much better when you hear how to do and optimize it from @MichelleItano @BioimagingNA @cziscience @NikonInst @UNCPBiotechAD
> pic.twitter.com/U1YxUfPcNk