The Children’s Tumor Foundation is pleased to announce the funding of nine Young Investigator Awards (YIA) for the 2022-2024 cycle.

**SIMGE ACAR**
Washington University

*Global Protein Changes Associated with Chr8 Gain in MPNST*

Malignant peripheral nerve sheath tumors (MPNST) are one of the common malignancies in individuals with NF1 and are associated with poor overall survival. Unlike plexiform neurofibromas, MPNSTs have an extra copy of chromosome 8 (Chr8q gain), which is hypothesized to induce genome-wide perturbations that specifically promote cancer progression. This study will analyze cells with Chr8q gain along MPNST samples from patients to test the above hypothesis and to characterize the molecular changes caused by this phenomenon.

**HALEY HARDIN**
University of Central Florida

*Evaluation of BRD4 Inhibitors for Use in Combination with Kinase Inhibitors for NF2 Schwannomas*

NF2 tumors respond to treatment with MEK inhibitors but eventually develop drug resistance. This study will evaluate a MEK-BRD4 inhibitor combination therapy for drug response in NF2 compared to MEK inhibitor monotherapy. Specifically, this study will investigate the drug resistance mechanism by examining the role of BRD4 in regulating the expression of resistance-mediating genes and will test various MEK-BRD4 inhibitor combinations to identify new drug combinations for NF2.

**CHARLENE ILTIS**
Memorial Sloan Kettering Cancer Center

*Characterization of the Molecular Mechanisms Conferring Resistance to Treatment on NF1-associated MPNST*

MPNSTs in the context of NF1 are often the result of malignant transformation of benign precursor lesions including plexiform neurofibromas. The proposed project will characterize a rare MPNST population with stem-cell like properties that is essential for tumor initiation and relapse, and elimination of which promotes tumor shrinkage and abolishes tumor relapse. This study can provide deeper insights into MPNST development and new therapies for targeting them.

**TONCI IVANISEVIC**
Vlaams Instituut voor Biotechnologie, Belgium

*The Role of LZTR1 in Schwannomatosis Development and Progression*

Pathogenic variants in the LZTR1 gene account for up to 40% of the cases of familial schwannomatosis. However, the molecular mechanisms by which these variants predispose to schwannomas are still unknown. This project will perform multi-omic analyses of an LZTR1-deleted schwannoma model to identify the interactions between the RAS/MAPK and Hippo pathways during schwannoma development and progression. It will also develop clinically relevant 3D models of schwannomatosis to assess candidate drugs as monotherapy or in combination with Hippo pathway inhibitors.
PAUL JONES  
Washington University  

*Early Detection and Model Development of NF1-MPNST Using Liquid Biopsy of cfDNA*

MPNSTs are the leading cause of death in NF1 patients but current methods to detect them, especially the early-stage ones, and track their progression are insufficient. This project aims to develop an assay based on cell-free DNA analysis that will more sensitively detect early-stage MPNST formation. It will further apply this assay in mouse models to understand tumor evolution, treatment response, and resistance mechanisms.

ERICA LEIF  
Alliant International University  

*The Impact of Self-Determination Theory on Increasing Health-Promoting Behaviors in Adults with NF1*

NF1 is a complex health condition with multiple clinical manifestations including debilitating chronic pain. By applying the self-determination theory, which suggests autonomy, competence, and relatedness as main psychological needs for growth and change, this study will investigate NF1-associated pain and the contribution of a wide range of factors to successful self-management of pain.

NAMRATA RAUT  
Cincinnati Children’s Hospital Medical Center  

*The Role of Schwann Cells in the Onset of Pain due to NF1*

The majority of NF1 patients experience moderate to severe neuropathic pain. However, the underlying mechanisms of pain development are not fully understood. The proposed study will examine the specific cell types and mechanisms involved in neuropathic pain development in NF1. Using preclinical mouse models, this study will test whether growth factors produced by Schwann cells together with select immune cell populations that infiltrate the affected peripheral nerves contribute to neuropathic pain-like behaviors.

NIPUNIKA SOMATILAKA  
The University of Texas Southwestern Medical Center  

*From Cold to Hot: Reprogramming Tumor Microenvironment to Target NF1 Malignancies*

MPNSTs associated with NF1 respond poorly to chemotherapy and radiotherapy. Immunotherapy drugs are also not effective against MPNSTs because these tumors are ‘cold,’ lacking T cells and other immune cells near or within the tumor. The present study aims to reprogram the MPNST microenvironment such that they are converted from non-T cell ‘cold’ tumors into T cell-rich ‘hot’ tumors. This will be achieved by activating the STING-IFN pathway using known small molecule agonists. This study will then test various combinations of STING agonists and immune checkpoint blockers to determine their efficacy in treating MPNST.

DEREK WONG  
University Health Network, Canada  

*Integrated Analysis of Plasma Whole Genome Sequencing for the Early Detection of Malignant Tumours in Patients with NF1*

The clinical manifestations of NF1 are diverse and range in severity from mild (e.g., skin discoloration) to very serious (e.g., cancer). Clinicians need new ways to identify NF1 patients requiring heightened surveillance or treatment. The objective of this study is to develop an assay that utilizes cell-free DNA (cfDNA) to monitor NF1 disease severity and identify tumors with malignant potential. This assay will integrate two technologies that enable more thorough genetic and epigenetic profiling of cfDNA and will potentially allow physicians to deliver personalized, risk-adapted care to NF1 patients.
YOUNG INVESTIGATOR AWARDS 2021

The Children’s Tumor Foundation is pleased to announce the funding of six Young Investigator Awards (YIA) for the 2021-2023 cycle.

**JORDAN KOHLMEYER**
The University of Iowa

**Defining the RABL6A-YAP Axis in MPNST Pathogenesis and Therapy**

NF1 patients are at increased risk of developing malignant peripheral nerve sheath tumors (MPNSTs) due to the possibility of neurofibroma transformation. This study aims to evaluate two powerful cancer pathways, RABL6A and the Hippo pathway, whose dysregulation promotes MPNST pathogenesis. We will investigate how RABL6A regulates the YAP protein to promote MPNST development, and will develop new combination therapies for MPNSTs that will have reduced toxicity and high efficacy.

**LINDY ZHANG**
Johns Hopkins University School of Medicine

**The Effects of RAS Signaling Pathway Inhibitors on Tumor Cells and the Tumor Immune Microenvironment in MPNSTs**

NF1-associated MPNSTs are resistant to MEK inhibition monotherapy because of activation of alternate cancer signaling pathways. This study will test combinations of MEK inhibitors, SHP2 inhibitors, and CDK inhibitors, which target different signaling pathways, to treat MPNSTs. Additionally, we will investigate the role of the tumor microenvironment and the impact of various inhibitors on immune cells to design trials of drugs.

**SARA PARDEJ**
University of Wisconsin-Milwaukee

**Neural Underpinnings of Attention in Children with NF1**

Attention difficulties are a common cognitive phenotype in children with NF1, yet very little is known about the underlying neural mechanisms. This research will test the feasibility of electroencephalography (EEG) approaches in children with NF1 to identify potential biomarkers of attention problems. By studying differences in neural functioning between children with NF1, their peers, and children with ADHD, we hope to find unique functioning patterns that can effectively track the impact of medical and psychosocial interventions affecting attention in NF1.

**JAMIE GRIT**
Van Andel Research Institute

**Targeting inflammatory signaling in cutaneous neurofibromas**

Cutaneous neurofibromas (CNF) are a major cause of morbidity in NF1 and clinically behave very differently than plexiform neurofibromas (PNF). Since CNFs rely more on inflammation than the strong MEK signaling that typifies PNFs, they may need different treatment approaches. This study will test diclofenac, an anti-inflammatory COX2 inhibitor ointment, on CNFs, and will determine patient experience and tumor response after treatment.

**ISABELLE LOGAN**
Oregon State University

**Signaling Pathways Regulated by Nitrated Proteins as Novel Therapeutic Targets for NF2**

Nitrated proteins are a novel category of NF2 tumor targets as they play a key role in schwannoma growth and are not present in normal cells. The goals of this project are to investigate the regulation of signaling pathways by nitrilation and to identify the specific nitrated protein(s) that support NF2 tumor cell survival. Besides NF2, these proteins could be new targets in conditions such as glioblastoma, breast cancer, and colon cancer, where protein nitrilation is involved in proliferation.

**FILIPP KULIKOV**
Russian National Research Medical University

**Exploiting Cytotoxic Role of Nuclear Rac1 to Develop Targeted Antitumor Therapy of NF2-Associated Tumor**

There is no specific treatment for NF2 other than non-specific radiotherapy and surgery, which can sometimes be ineffective due to remote localization of tumor. This proposal will determine the mechanism by which statins and bisphosphonates induce Rac1 translocation into the nucleus, thereby causing cell death. We will also investigate the effectiveness of a statin-bisphosphonate combination therapy for NF2-associated tumors.
YOUNG INVESTIGATOR AWARDS 2020

The Children’s Tumor Foundation is pleased to announce the funding of eight Young Investigator Awards (YIA) for the 2020-2022 cycle. Of the eight applications that were selected for funding, six were focused on NF1, one on NF2, and one on schwannomatosis.

MATTHEW SALE
University of California, San Francisco

*Unveiling the Molecular Mechanisms of Neurofibromin Regulation for Therapeutic Targeting in Neurofibromatosis Type 1*

This proposal is based on the observation that neurofibromin is directly phosphorylated by ERK kinases. Matthew Sale will investigate if ERK-mediated phosphorylation negatively regulates neurofibromin function and if so, the mechanistic details of ERK-neurofibromin interaction and regulation.

FRANCESCO CISCATO
University of Padua, Italy

*Hexokinase 2 Displacement from Mitochondria-Associated Membranes as a New Antineoplastic Approach in NF1-related tumors*

Hexokinase 2 (HK2), a key metabolic enzyme overexpressed in cancers, displays antiapoptotic properties upon its binding to mitochondria. In this project, Francesco Ciscato aims to optimize and test in NF1 model systems a new chemotherapeutic peptide that would specifically displace HK2, thereby promoting tumor cell death.

KEVIN BRUEMMER
Stanford University

*Mapping and Identifying the Roles of Protein Glycosylation in Neurofibromatosis Type 1*

Glycosylation, which is the addition of sugar molecules to proteins, is an important post-translational modification that has not been studied in NF1 model systems. This proposal aims to create new chemical biology techniques to better characterize glycosylation using cell models derived from NF1 patients. Studying glycosylation may open up new avenues for therapeutic development by identifying new target pathways.

GAVIN MCGIVNEY
University of Iowa

*Impact of PRC2 Loss on Glutamine Metabolism in MPNSTs*

PRC2 mutations occur in 60% of MPNSTs and glutamine metabolism is an important pathway in MPNSTs with PRC2 loss. This study will examine the dysregulation of glutamine metabolism in PRC2-mutant MPNSTs and examine efficacy of the glutaminase inhibitor CB-839, which is currently in Phase II clinical trials for NF1-mutant tumors.
LIYAM LARABA  
University of Plymouth  

The Use of Novel YAP/TEAD Hippo Pathway Inhibitors to Target Merlin Null Tumors  

The Hippo signalling pathway is an important pathway in driving NF2 tumor development. Liyam Laraba, in collaboration with Vivace Therapeutics will investigate the effectiveness of a novel class of YAP-TEAD targeting compounds in animal models of NF2 meningioma and schwannoma. These compounds have already shown to be very effective at blocking non-NF2 tumor growth and with no visible side-effects, and thus hold promise for NF2-related tumors.

JENNIFER PATRITTI  
Cincinnati Medical Center  

Understanding the Role of Purinergic Signaling on Tumor Formation in a Mouse Model of Neurofibromatosis Type 1  

P2RY14 is a purinergic receptor that is overexpressed in Schwann cell precursor-like tumor initiating cells. The objective of this study is to investigate the role of P2RY14 in driving neurofibroma growth and to use an NF1 mouse model to test if P2RY14 inhibitors can be used as a treatment for NF1 tumors.

LAUREL BLACK  
Medical University of South Carolina  

Malignant Peripheral Nerve Sheath Tumors Achilles Heel: Combinatorial Targeting of ERBB3 and Calcium Signaling  

ErbB3 and calmodulin (CaM) are necessary Ras-dependent and -independent signaling proteins required for MPNST survival. These pathways are dysregulated in MPNST cells but not in normal non-cancerous cells. Laurel Black will investigate the role that ErbB3 and calcium-mediated signaling pathways play in regulating cellular proliferation and survival in MPNSTs and the effect of simultaneously inhibiting them.

ARAM KO  
Columbia University  

Identification and Functional Characterization of the Substrates of LZTR1  

LZTR1 is a substrate adaptor protein of the CUL3 ubiquitin ligase complex, which regulates protein turnover by attaching ubiquitin molecules to protein substrates. LZTR1 mutations are identified in a significant number of schwannomatosis patients. This proposal aims to identify and functionally characterize the substrates of the LZTR1 ubiquitin ligase complex and decipher how mechanistically LZTR1 operates to prevent tumor development in normal neural cells.
HARISH VASUDEVAN
University of California, San Francisco

“Elucidating the clonal architecture and functional impact of genetic variants in MPNSTs using single cell genomics”

Malignant peripheral nerve sheath tumors (MPNSTs) are rare but aggressive tumors associated with NF1. There are currently no molecular biomarkers or targeted therapies available for MPNSTs due to the rarity of these tumors and incomplete understanding of their molecular composition. The overall aim of Dr. Vasudevan’s proposed work is to use high throughput sequencing in single cells to characterize the molecular heterogeneity in MPNSTs at the DNA, RNA, and protein levels as well as evaluate the functional effect of these changes in primary Schwann cells. Given the heterogeneous nature of MPNSTs, single cell analyses will be critical to define clinically relevant tumor subpopulations, mutational co-occurrence, and rare genetic variants.

JORDAN KOHLMEYER
University of Iowa

“The RABL6A-RB1 pathway in MPNST pathogenesis and therapy”

The overall objective of this study is to determine the role of RABL6A, a novel oncogenic GTPase, in regulating the retinoblastoma (RB1) tumor suppressor signaling. Preliminary work by Ms. Kohlmeyer support the hypothesis that RABL6A drives MPNST pathogenesis by RB1 inactivation, and therefore, the RABL6A-RB1 pathway can be an important, new therapeutic target. This study will determine the mechanisms and biological significance of RB1 pathway regulation by RABL6A in MPNSTs and the value of targeting this pathway to develop novel MPNST therapies.
The Children’s Tumor Foundation is pleased to announce the funding of five Young Investigator Awards (YIA) for 2018. The YIA is the Foundation’s oldest research award program and serves to advance the understanding of the biology of NF1, NF2, and schwannomatosis.

The NF Research Initiative (NFRI) and David Miller, MD, PhD, of Boston Children’s Hospital are funding two of this year’s YIAs in full. The NFRI is a newly established initiative that will focus exclusively on malignant peripheral nerve sheath tumors (MPNSTs).

**FUND BY NFRI**

**JAMIE GRIT**
Van Andel Research Institute

“Genetic and molecular mechanisms of targeted therapy resistance in NF1-associated MPNSTs”

Understanding how MPNSTs develop and progress in individuals with NF1 is key to understanding how to effectively treat these aggressive tumors. The goal of this proposal is to identify how RAS signaling is different between MPNSTs with mutations in NF1, compared to those with mutations in both NF1 and p53 genes. The most important result of this study will be the identification of a drug combination that blocks RAS signaling and stops MPNST growth even in p53 mutant tumors.

**DONG HYUK KI, PhD**
Dana Farber Cancer Institute

“The role of cap-dependent translation in NF1-associated MPNSTs”

The focus of this proposal is to test several drugs specific to the eIF4E pathway for antitumor activity and toxicity, and to also identify key proteins that depend on this pathway for expression. This study will clarify the mechanisms underlying the activity of mTOR inhibitors against NF1-associated MPNSTs, potentially leading to new and complimentary strategies to inhibit these pathways.

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**MICHÈLLE WEGSCHEID**
Washington University School of Medicine

“Employing human induced pluripotent stem cells (hiPSCs) to define brain developmental defects in NF1”

The overall objective of this project is to understand how germline NF1 mutations affect the human brain. Ms. Wegscheid will employ stem cell cultures to characterize the cellular and tissue abnormalities in brain development due to different NF1 gene mutations.

**SARAH CATHERINE BORRIE, PhD**
Katholieke Universiteit Leuven

“Deciphering and treating ASD-like social behavior deficits in mouse models for NF1”

NF1 patients frequently have cognitive and behavioral problems, with many having a diagnosis for autism spectrum disorder (ASD). This project will utilize Nf1 and Spred1 transgenic mouse models to further our understanding of mechanisms underlying autism spectrum disorder in patients with NF1, and will investigate possible treatment options.
2017 Young Investigator Awardees

The NF Research Initiative (NFRI) and David Miller, MD, PhD, of Boston Children’s Hospital are funding the 2017 Young Investigator Awards (YIAs) in full. The NFRI is a newly established initiative that will focus exclusively on malignant peripheral nerve sheath tumors (MPNSTs). Dr. Miller looked to CTF and its established YIA program as a resource that can readily identify young basic researchers through our outstanding peer-review process, and administrate the grants through our grant management systems.

Kyle Brandon Williams, PhD, University of Minnesota
Exploiting Synthetic Lethality to Reveal Novel Vulnerabilities in NF1 Tumorigenesis
Award amount: $108,000

New technologies such as next-generation sequencing, gene knockout libraries, and proteomics profiling now allow researchers to apply great power to the study of human cells in culture and disease modeling.

Dr. Williams has a human cell line that is deficient for the NF1 gene, which is an outstanding research tool. He proposes to use these cells to look for drugs that could combine with the promising MEK inhibitors to preferentially kill the NF1-deficient cells. This could identify new, targeted combination therapies for potential clinical use. In addition to mutations in the NF1 gene, it has been established that other mutations are required for malignant tumors (such as MPNSTs) to develop in NF1 patients. Through this YIA, Dr. Williams will take their existing NF1-mutated cell models and engineer them to be more “MPNST-like” by incorporating some of those other mutations. Testing drugs in these cells will give additional confidence that these drugs will be effective against more aggressive and malignant tumors. This work will develop their NF1 drug discovery pipeline further and should allow identified drugs to more rapidly progress into clinical trials for people suffering from complications of NF1.

Lai Man (Natalie) Wu, PhD, Cincinnati Children’s Hospital Medical Center
Molecular and Signaling Mechanisms of Malignant Transformation in Peripheral Nerve Sheath Tumors
Award amount: $108,000

Dr. Wu’s initial study shows that a pathway, called Hippo, goes awry in MPNST tumors. Moreover, recent studies have reported nonsense mutations of LATS1, a Hippo-signaling molecule and a known tumor suppressor, in patients with nerve sheath tumors. This suggests that abnormal Hippo signaling activity may contribute to nerve sheath tumor growth. The goal of this study is to learn how Hippo pathway malfunction in Schwann cells causes MPNSTs, and to discover drug targets to treat these aggressive tumors.

Understanding how abnormal Hippo signaling drives Schwann cells to become cancer cells may aid the discovery of promising drug targets against MPNSTs. Dr. Wu will use a state-of-the-art genome-wide target screen to identify molecules and pathways directly regulated by the Hippo pathway during tumor formation. She will further devise treatment strategies to modulate the activity of Hippo. In principle, this research emerges as a new paradigm in MPNST research and will have practical benefits that aid us in finding key therapeutic targets to effectively cure MPNST.

Believe

Because of your gifts, young scientists are pursuing NF research.

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JOHN ELLIOTT ROBINSON, MD, PHD
California Institute of Technology
“Utilizing CLARITY, optogenetics, and novel viral vectors to deconstruct and reverse ADHD-like phenotypes associated with neurofibromatosis type 1”

This project will use technologically advanced methods for brain mapping to discover how abnormal development of circuits involved in decision-making and motivated behaviors produces cognitive symptoms in NF1, including learning disabilities, ADHD, etc., which affect up to 80% of individuals with NF1. Through the use of CLARITY on the whole brain (a tissue clearing method allowing individual neurons to be mapped across long distances), and optogenetics (a technique precisely controlling neuronal activity with pulses of blue light), the project will take important steps toward determining the NF1 connectome (a kind of “wiring diagram”), and fill in important gaps in understanding how abnormalities in specific brain circuits produce symptoms of NF1.

STEPHANIE BOULEY
Dartmouth University
“Targeting tumors with NF1 loss via modulation of autophagy”

Plexiform neurofibromas, a common NF1-specific tumor type, have the ability to develop into the more aggressive tumor type malignant peripheral nerve sheath tumors (MPNSTs), for which there are few treatment options. Loss of NF1 has been shown to be important in the development of a number of cancer types, including MPNSTs, due to its role as a tumor suppressor. While the loss of tumor suppressing genes like NF1 can help cancer cells survive, they can also introduce vulnerabilities into a cell. This lab has developed a novel way to identify the Achilles heel of cancer cells that have lost NF1, and has identified at least one drug that potentially can target tumors with NF1 loss, such as MPNSTs. The focus of this proposal is to identify how this drug works in cancer cells with NF1 loss and to determine if it could be a useful drug against tumors with NF1 loss.

IONICA MASGRAS, PHD
University of Padua
“TRAPping the metabolic adaptations of NF1-associated tumors”

The overall focus of this research will be on an unexplored aspect of NF: the unprecedented possibility that NF1-associated tumors develop as a result of their metabolic changes. The goal is to shed light on a new mechanism by which loss of neurofibromin function in NF1 patients leads to cancer onset and on a possible therapeutic strategy involving the inhibition of molecules such as TRAP1, a protein that plays a key role in uncontrolled growth of cells, potentially reversing these tumor metabolic adaptations.

JEAN-PHILIPPE BROSSEAU, PHD
University of Texas Southwestern Medical Center
“Fibroblasts: the missing gap in NF”

This project plans to explain the contributions of fibroblasts, which are connective tissue cells required for tumor formation, to the development of neurofibromas. Anti-fibrosis and anti-cancer drugs that reduce the number of fibroblasts significantly enhance patient survival. This proposal intends to transfer this knowledge in the context of neurofibromas, opening the door to a wide array of clinically approved drugs already effectively targeting fibroblasts in classic organ fibrosis and cancer.
The Children’s Tumor Foundation is pleased to announce the funding of six Young Investigator Awards (YIA) for 2015. The YIA is the Foundation’s oldest research award program and serves to advance understanding of the biology of NF1, NF2, and schwannomatosis. Of the six awardees, three are pre-doctoral students and three are post-doctoral fellows. The title of the awardees’ application indicates the focus of the research that will be funded through this award.

**LEI XING** is a fifth-year postdoctoral fellow at the University of North Carolina, School of Medicine.

**MAPK/ERK Hyperactivation on Neural Circuit Development in NF1**

Dr. Xing will test the effect of layer V neuron activation in a genetic mouse model with upregulated ERK/MAPK signaling, which should mimic the effect of reduced neurofibromin activity. He hypothesizes that this may help us understand, and potentially be a marker for, the presence of NF1 features such as cognitive and psychomotor delays.

**EBRAHIM TAAHEI SEYEDMOHAMMAD** is a predoctoral student at Vanderbilt University.

**The Inhibitory Role of Integrin beta3 in NF1 Impaired Osteogenesis**

This student will use a tibial dysplasia mouse model to test whether the increased integrin beta3 that he found in NF1-deficient osteoprogenitor cells prevents them from differentiating into osteoblasts, leading to the failure of NF-related bone lesions to heal. He will subsequently test whether knocking down integrin beta3 production can lead to increased fracture healing.

**DIPAK N. PATIL** is a third-year postdoctoral fellow at the Scripps Research Institute.

**Understanding the G Protein Coupled Receptor (GPCR) Driven Interaction of NF1 with G Proteins**

This project will perform experiments based on observations that activated GPCRs can inhibit neurofibromin’s GAP activity by binding G protein subunits, which will lead to better understanding of the molecular mechanism involved in this important signaling regulation. This could lead to new targets for NF1 therapies.

**MARISA ANN FUSE** is a predoctoral student at the University of Central Florida.

**In Vivo Testing of FDA-Approved Drugs for NF2**

The project leverages the work already being done in screening drug libraries, focusing on the potential PI3K and mTOR inhibitors that kill/suppress NF2-deficient schwannoma cells in vitro. This student will then test these drugs for effectiveness.

**VANESSA MERKER** is a predoctoral student at Massachusetts General Hospital.

**Coordinating Care for Patients with Schwannomatosis - Assessing the Field and Identifying Opportunities for Improvement**

This student will investigate how schwannomatosis patients navigate the health care system with the long term goal of educating the medical community and patient population to improve patient access to appropriate medical care.

**AUBIN MOUTAL** is a second-year postdoctoral fellow at the University of Arizona (Tucson).

**Molecular Targeting of Migraine in the NF1 Population.**

Dr. Moutal will study the interaction of the CRMP2 protein and neurofibromin, to determine whether its perturbation (by reduction of neurofibromin) could be related to migraine in patients with NF1. This work could lead to therapies specifically effective in NF1 or be of general use for migraine headache (or potentially be useful in understanding other NF1 features).
RESEARCH NEWS

The Children’s Tumor Foundation is pleased to announce the funding of eight Young Investigator Awards (YIA) for 2014. YIA recipients focus on using animal models and cell and tissue cultures to advance understanding of the biology of NF1, NF2, and schwannomatosis, which is the first step toward better treatments for neurofibromatosis.

2014 Young Investigator Award Recipients

Chung-Ping Liao, PhD, University of Texas Southwestern
Tumor Microenvironment and Stem Cell Factor Contributions in Neurofibroma Development

Dr. Liao is a postdoctoral fellow in the laboratory of Dr. Lu Le at the University of Texas Southwestern. Dr. Le studied with Dr. Luis Parada there, and has now established his own independent research lab. His project will use NF1 mouse models to better understand the cell microenvironment conducive to neurofibroma development, including the role of a growth factor called stem cell factor. Better knowledge about the influences in the tissue surrounding neurofibroma cells may lead to new therapeutic targets and strategies.

Manuel López Aranda, PhD, University of California, Los Angeles
The Possible Role of Immune Activation in Autism Phenotypes in NF1

Dr. López Aranda is a postdoctoral fellow with Dr. Alcino Silva, at the University of California, Los Angeles. Dr. Silva is an established neuroscience investigator who performs basic and clinical research in NF1-related learning. In this project, to test a new hypothesis, the role of the immune system will be examined in NF1 patients who also have features of autism. If they find a link, it opens a line of research to consider therapies that modulate the immune system, as a potential intervention in children with NF1 that are on the autism spectrum.

Clare Malone, Brigham & Women’s Hospital
Identifying Novel Drug Combinations that Target Cancer Cell Vulnerabilities in Malignant Peripheral Nerve Sheath Tumors

Clare Malone is a graduate student with Dr. Karen Cichowski, a well-established NF1 investigator at the Brigham and Women’s Hospital in Boston. Ms. Malone’s thesis project is focused on finding drug combinations that can best kill MPNST cells, based on understanding of altered pathways in these tumors. Her work will involve study of cell lines as well as testing in mouse models. Since single agents are not proving very effective for NF1 patients with MPNST, effective combinations need to be investigated.

Mariska van Lier, Netherlands Institute for Neuroscience
Altered Critical Period for Ocular Dominance Plasticity in Heterozygous NF1 Mutant Mice

Mariska van Lier is a graduate student in the laboratory of Dr. Christiaan Levelt, at the Netherlands Institute for Neuroscience in Amsterdam (and new to the NF field). Ms. van Lier’s project will study the critical period of neuronal plasticity in mutant NF1 using synapse development in the visual cortex as a model. The hypothesis is that the critical period in NF1 mice closes too soon compared to wild type mice. If true, they will investigate environmental and pharmaceutical interventions that could modulate this period, and this will also lead to investigations of this phenomenon in children with NF1.

Krishna Chinthalapudi, PhD, Scripps Research Institute
Lipid-Directed Control of Merlin Tumor Suppressor Functions

Krishna Chinthalapudi, PhD is a postdoctoral fellow in the laboratory of Dr. Tina Izard, a researcher at the Scripps Research Institute. Dr. Izard is relatively new to the NF2 field, bringing her expertise in cell biology in merlin-related pathways. This project will examine the role of lipids in controlling merlin’s functions, which may shed light on possible new therapeutic targets and approaches for NF2.
Experimental research in the labs began on May 1st and Sage Bionetworks has populated the Synodos Data Warehouse with pre-existing NF2 data, so work is well underway in this exciting new initiative. For more information please visit www.ctf.org/synodos
research news

2013 Young Investigator Award Recipients

2013 Postdoctoral Awardees

Lu Zhou, Peninsula School of Medicine and Dentistry, UK
KSR1 as a Potential Therapeutic Target for Both NF1 and NF2

NF1 patients can develop plexiform neurofibromas (benign tumors that grow along nerves) which can become malignant peripheral nerve sheath tumors (MPNST) in 10% of cases. NF2 patients are likely to develop tumors of the Schwann cells called schwannomas, which lead to significant medical problems. Currently, there is no approved drug therapy for these complications of NF1 and NF2. This project will use cell cultures to explore the tumor-suppressing activity of Kinase Suppressor of Ras 1 (KSR1) as a new approach for the treatment of both NF1 and NF2.

Kairong Li, University of Alabama
Characterizing Novel NF1 Mouse Models and Developing New Therapeutic Interventions

The approach of using drugs that interact with a mutated gene or its gene product, with the goal of restoring gene function, has proved feasible in genetic disorders such as cystic fibrosis and Duchenne muscular dystrophy. This project will develop new mouse models mimicking human NF1 mutations to enable preclinical testing of such gene or protein-targeted NF1 therapeutics. It will focus on mice with mutations like those in NF1 patients in which there is a premature “stop signal.” This type of mutation occurs in approximately 20% of people with NF1. The researchers will study mice with premature stop mutations, and test the ability of a group of drugs called “nonsense suppressors” to allow normal protein to be produced in these mice.

Su Ting, University of Chicago
Dissecting Merlin-mediated Regulation of the Hippo Growth Control Pathway Using FRET-based Biosensors

Loss of the NF2 tumor suppressor protein Merlin leads to tumor formation in humans and mice, and tissue overgrowth in Drosophila (fruitflies). Merlin is thought to regulate the activity of the Hippo growth control pathway that controls organ size and tissue stability. Due to a lack of laboratory methods for studying Hippo pathway kinase activity, we do not know exactly how Merlin regulates the Hippo pathway. The researchers plan to develop optical biosensors that measure the activity of Hippo pathway kinases with high resolution. They will use these to explore the role of Merlin in regulating the Hippo pathway during normal development, and in suppressing tumor formation in humans.

Christine Chiasson MacKenzie, Harvard University, Massachusetts General Hospital
Mechanical Organization of the Cell Cortex by the Tumor Suppressor NF2/Merlin

This researcher’s group has recently discovered that the protein that is missing in NF2, Merlin, helps to organize the physical properties of the cell by restricting the function of the ERM family of proteins. Based on these findings, the researcher proposes a novel and unifying hypothesis: that the multiple features of NF2 are related to a failure of cells to appropriately respond to mechanical stimuli. She will use innovative bioengineering approaches to manipulate the mechanical environment experienced by cells and investigate how mechanical stimuli impact the activity of known Merlin-regulated signaling pathways in the presence or absence of Merlin. These studies will set the stage for future efforts to match the appropriate therapeutic strategy to a specific tumor type.

William Guerrant, The Scripps Research Institute, Florida
Small Molecule Inhibition of the Hippo-YAP Pathway as a Therapeutic Strategy in NF2

Currently, treatment options for NF2 are scarce. There is a pressing need for NF2 drugs. The Hippo-YAP pathway is involved in NF2 and has recently been shown to interact with many other important pathways that can cause cancer. It has therefore become an important new target for cancer researchers. The project will screen a 640,000 plus “library” of chemical compounds to identify inhibitors of the pro-growth signaling Hippo-YAP pathway and test the most promising inhibitors of human NF2 tumors in mouse models, with the goal of developing validated drugs for NF2 treatment.
Shuning He, Harvard University, Dana-Farber Cancer Institute
In Vivo Analysis of the NF1 Tumor Suppressor in Neurofibromatosis

It is known that part of the NF1 protein down-regulates the function of another protein, called RAS, which can promote tumor formation when it is expressed at high levels. However, the functions of other regions of the NF1 protein have yet to be discovered. This project will study new functions of NF1 and how NF1 is involved in neurofibromatosis formation using a zebrafish model. When the functions of NF1 proteins are inhibited in zebrafish, they develop abnormally with defects that mirror the human disorder. The zebrafish model promises to be meaningful for the study of NF1 in humans and the development of improved therapies for patients with NF1.

Wei Mo, University of Texas Southwestern Medical Center
MPNST, a Disease of the Stem Cell?

Recently, the concept of cancer stem cells has arisen in multiple professional journals in the biomedical field and has been widely discussed as an important topic of public health. The traditional tumor growth model holds that every cancer cell has unlimited dividing and metastasis potential. However, it is difficult to explain tumor relapse after classical anti-tumor treatments such as chemo- and radiotherapies because the majority of the highly proliferative cancer cells are killed upon treatment. The cancer stem cell hypothesis can better explain tumor recurrence following treatment. Cancer stem cells (CSCs) represent a small population in cancers with self-renewal capability and maintain tumor heterogeneity. Malignant peripheral nerve sheath tumors (MPNSTs) are highly aggressive and lethal tumors that develop in 2-5% of NF1 patients. There is now opportunity to develop innovative and novel therapies for these tumors, if the CSC model is applicable to MPNST growth. The identification of CSCs in MPNSTs would suggest that a more aggressive treatment plan targeting the CSCs would be effective, and could lead to improved treatments for NF1 patients who develop MPNSTs.

Matthew Karolak, Vanderbilt University
FGFR1 and Neurofibromin Interactions During Endochondral Bone Formation

Approximately 30% of NF1 patients will have some type of abnormality related to skeletal development, bone remodeling, and bone fracture repair. Following fracture, these NF1 patients typically have healing abnormalities. In some cases, they are required to undergo multiple surgeries to achieve fracture healing. Frequently these attempts are still unsuccessful, may require limb amputation, and are associated with high morbidity. The molecular mechanisms underlying many of the skeletal aspects of NF1 remain unknown, and largely untreated with drugs. This project will test the hypothesis that FGF Receptor 1 signaling in chondrocytes (the bone cells contributing to bone elongation during growth and the first steps of bone repair following fracture) is under the control of neurofibromin (the protein mutated in NF1 patients). If correct, this will identify a novel target against which pharmacological drugs targeting FGFR1 could be used to promote proper fracture healing in NF1 patients. In this study, tissue culture experiments will examine which FGFR1 signaling events are regulated by neurofibromin. A second part of this study will test whether inhibiting FGFR1 in a mouse model promotes bone healing. It will use a newly developed method to deliver an FGFR1 inhibitor at the fracture site in a controlled (slow release) and local manner. Overall, this study will determine the feasibility of the approach of blocking FGFR1 during the early phases of bone healing in NF1 patients in order to promote proper fracture healing and stable bone union following fracture.

Christine Kivlin, University of Texas, MD Anderson Cancer Center
PARP Inhibitors for the Treatment of NF1-associated MPNST

A malignant peripheral nerve sheath tumor (MPNST) is the most aggressive consequence of NF1. Currently, the only treatment for MPNST is surgery, if feasible. Additionally, about 50% of the patients develop metastases, which have a poor survival rate (20-50% five-year survival rate). This project will evaluate the use of Poly ADP Ribose Polymerases, or PARP inhibitors to treat MPNSTs. PARP inhibitors are proteins that play an essential role in the repair of DNA damage. Recent evidence suggests that cancers have specific defects in DNA repair pathways that may predispose for sensitivity to various classes of cytotoxic agents, such as PARP inhibitors. Preliminary data from this laboratory strongly suggest that an MPNST is sensitive to the effects of AZD2281, a PARP inhibitor. The goal of this project is to further evaluate the effects of PARP inhibition on MPNSTs in cell lines and animal models. It also aims to identify why MPNST cells are sensitive to PARP inhibition. Understanding the mechanisms responsible for sensitivity would enhance our ability to identify MPNST patients that will most benefit from treatment with PARP inhibitors.
Children’s Tumor Foundation Invests $884,000 in Neurofibromatosis Research and Development

The Children’s Tumor Foundation is delighted to announce the funding of 11 Young Investigator Awardees (YIA) for the 2012 round. YIA research focuses on basic and translational biology of NF1, NF2, and schwannomatosis.

The 2012 YIA recipients include six postdoctoral and five predoctoral awardees.

**YIA Postdoctoral Awardees**

Jean De La Croix Ndong  
**Vanderbilt University**  
The Nf1ox-/- mice and CNP: a new inducible pre-clinical model and a novel strategy to understand and treat NF1 tibial pseudoarthrosis.

Yuan Wang  
**University of Michigan**  
Therapeutic intervention of NF1-associated cognitive deficits and optic nerve gliomas during early postnatal stages.

Rebecca Dodd  
**Duke University Medical Center**  
Investigating tumor biology in a novel mouse model of inducible NF1-driven soft-tissue sarcoma.

Tao Sun  
**Washington University in St Louis, School of Medicine, Department of Pediatrics**  
Sex differences in cyclic AMP signaling impact NF1-associated gliomagenesis.

Pamela Vanderzalm  
**The University of Chicago**  
Dissecting merlin function at the membrane.

Rebecca Lock  
**Brigham and Women’s Hospital, Inc.**  
Developing novel therapies for malignant peripheral nerve sheath tumors.

**YIA Predoctoral Awardees**

Richard Hugh Frost Bender  
**Washington University in St Louis**  
Neurofibromin ras-molecule specific regulation of neural stem cells.

Amish Patel  
**UT Southwestern Medical Center**  
Epigenetic mechanisms underlie malignant peripheral nerve sheath tumor development.

Jeff Gehlhausen  
**Indiana University**  
Generation of a novel, accurate murine model of neurofibromatosis type 2 and the genetic validation of a therapeutic target for schwannoma development.

Gerald Sun  
**Johns Hopkins University**  
Neurofibromin 1 and regulation of neural stem cell fate choice.

Alexander Schulz  
**Fritz Lipmann Institute, Jena, Germany**  
Axonal merlin regulates Schwann cell behavior via neuregulin signalling.

**LOOKING FORWARD**

Here are a few events that may be of interest. For a complete listing or more information, please see www.ctf.org/calendar.

- **09/13 - Little Rock, AR**  
  Dancing with Our Stars  
  Red Carpet for Research Event

- **09/16 - Beaverton, OR**  
  End of Summer Picnic

- **09/16 - St. Louis, MO**  
  Porsche Club of America Auto Show

- **09/30 - Boston, MA**  
  NF Symposium at Massachusetts General Hospital

- **10/06 - Westport, CT**  
  Fourth Annual Saugatuck Cup

- **10/08 - Washington, D.C.**  
  CureNFwithJack Golf Classic

- **10/19 - Rocklin, CA**  
  Third Annual Fiesta Night

**A Night to Remember**

Children’s Tumor Foundation  
Annual New England Fall Gala

Saturday, October 13, 2012

7:00 PM – Cocktails  
8:00 PM – Dinner

Hyatt Regency Cambridge  
575 Memorial Drive, Cambridge, MA

Silent and Live Auctions  
Music • Dancing

For more information: John Heropoulos  
617-456-4706 or jheropoulos@ctf.org
Children's Tumor Foundation Invests $500,000 in New Neurofibromatosis Research

The Children’s Tumor Foundation is delighted to announce the funding of SIX Young Investigator Awardees for the 2011 round. The recipients include three postdoctoral awardees and three graduate students; three focused on aspects of NF1 including tumors, bone dysplasia and learning disabilities; and three focused on NF2 or schwannomatosis. Four awardees are US-based and two are international.

Young Investigator Awards provide the recipient with two years of salary support plus a $5,000 travel stipend to attend the NF Conference and other meetings. The 2011 Awardees represent an investment for the Children’s Tumor Foundation of just under $500,000.

**POSTDOCTORAL AWARDEES**

Miriam Smith, Ph.D.
University of Manchester, United Kingdom
*Project: Identification of novel genes predisposing to schwannomas and meningiomas by exome*

Jonathan Payne, Ph.D.
University of Sydney, Australia
*Project: The Neural Basis and Treatment of Reading Disability in Children with NF1*

Jianzhong Yu, Ph.D.
Johns Hopkins University
*Project: Molecular genetic characterization of the Merlin tumor suppressor protein complex*

**PREDOCTORAL AWARDEES**

Alejandra Petrilli Guinart
University of Central Florida
*Project: LIM kinase – a potential therapeutic target for NF2*

Steven Rhodes
Indiana University School of Medicine
*Project: Targeting the hematopoietic bone microenvironment in the treatment of NF1 pseudarthrosis*

Adrienne Watson
University of Minnesota
*Project: Understanding the Role of Wnt Signaling in Malignant Peripheral Nerve Sheath Tumors*
2010 Young Investigator Awards
From NF2 Models in L.A. to Learning Disabilities in The Netherlands

The Young Investigator Award (YIA) highlights the Children’s Tumor Foundation’s enduring commitment to bringing new scientists into NF research. Six young individuals have been selected as YIAs. The award provides two years of salary funding plus a travel allowance to support attendance at NF-related research meetings such as the annual NF Conference. The six 2010 YIA projects are summarized below:

Nicolas-Xavier Bonne, M.D.
House Ear Institute
Use of radiosurgery and radiotherapy for NF2 management is highly controversial, with some physicians utilizing this and others not. There are differences of opinion as to whether observation, microsurgery or radiosurgery is more effective in hearing preservation, and whether this treatment may induce malignancy. Dr. Bonne will use NF2 mouse models to endeavor to address these important questions, treating the mice with radiotherapy and evaluating the short- and long-term outcomes.

Thomas DeRaedt, Ph.D.
Harvard Medical School/Brigham and Women’s Hospital
Malignant Peripheral Nerve Sheath Tumors (MPNSTs) are a rare but devastating and lethal tumor that can develop in NF1 from pleomorphic neurofibromas. Building on the established finding that Rapamycin will have some effect on inhibiting NF1 tumor growth, Dr. DeRaedt uses mouse models of MPNSTs to test new combination drug treatment approaches for these difficult to manage tumors.

Jean Gouzi, Ph.D.
Harvard Medical School/Massachusetts General Hospital
Dr. Gouzi takes new approaches to understanding NF1-related learning disabilities by using the fruit fly to look at novel genetic regions that have been identified and may have a role in regulating NF1 gene function. Fruit flies make terrific models for studying learning behavior as have well established genetic homology (parallels) with humans allowing for the translation of results from flies to humans; and they can be assigned tasks and responses measured. As a result, by using flies with different genetic mutations or after they have received a drug treatment, new genes may be identified that are contributing to the learning defect and therefore represent future candidate drug targets.

Azar Omrani, Ph.D.
Erasmus Medical Center, The Netherlands
Dr. Omrani seeks to better understand learning disabilities in NF1 with an eye on developing clinical interventions (the primary focus of the laboratory in which she will be doing this research). She will focus on a special modified version of NF1 protein which is generated by a specific NF1 genetic element called exon9a and which plays an important role in regulating neuronal function in the normal brain. Mice lacking exon9a have learning deficits and Dr. Omrani will focus on whether understanding this can be harnessed to develop treatments for persons with NF1 learning disabilities.

Maryam Jahanshahi (pre-doctoral awardee)
Mount Sinai School of Medicine, New York
Study will utilize fly models of NF2 to examine the potential roles of new NF2 gene regulators in causing cell growth, with the goal of identifying new drug targets for NF2 treatment. Of particular interest Ms. Jahanshahi will endeavor to identify genes that are expressed at different levels in different individuals and may help explain why NF2 can affect persons with different levels of severity.

Sherry Phillips (pre-doctoral awardee)
Indiana University
Ms. Phillips focuses on an important but understudied aspect of NF1, which is to understand the fundamental causes of why individuals with NF1 can experience enhanced pain. This study focuses on cell signaling elements adenyly cyclase (AC) and cAMP, and the underpinnings of their role in NF1 pain. The goal is to determine why there are enhanced pain sensations in NF1 and help elucidate future clinical management approaches.