Curriculum Vitae

RIHE LIU, PH.D.

a) PERSONAL

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b) EDUCATION AND TRAINING

B.Sc. in Polymer Physics, 07/1988, University of Science and Technology of China, Hefei, China
M.Sc. in Biochemistry, 05/1995, University of California at San Diego/Salk Institute for Biological Studies
Ph.D. in Biochemistry, 12/1996, University of California at San Diego/Salk Institute for Biological Studies (Ph.D. Advisor: Leslie E. Orgel)
Postdoctoral Fellow in Molecular Biology and Genetics, 02/1997-12/2001, Harvard Medical School, Massachusetts General Hospital & Howard Hughes Medical Institute (Postdoctoral Advisor: Jack W. Szostak)

c) PROFESSIONAL EXPERIENCE

Associate Professor, Eshelman School of Pharmacy, University of North Carolina at Chapel Hill (12/2008-)
Associate Professor, Carolina Center for Genome Sciences, University of North Carolina at Chapel Hill (12/2008-)
Assistant Professor, School of Pharmacy, University of North Carolina at Chapel Hill (12/2001-2008)
Assistant Professor, Carolina Center for Genome Sciences, University of North Carolina at Chapel Hill (12/2001-2008)
Research Associate with Professor Jack W. Szostak, Howard Hughes Medical Institute, Harvard Medical School and Massachusetts General Hospital (03/2000-12/2001)
Postdoctoral Fellow with Professor Jack W. Szostak, Harvard Medical School and Massachusetts General Hospital (02/1997-02/2000)
Graduate Student (Ph.D. Program in Biochemistry) with Professor Leslie E. Orgel, The Salk Institute for Biological Studies and University of California at San Diego (1992-1996)

d) HONORS AND MEMBER OF PROFESSIONAL ASSOCIATIONS

Academic Excellence Award in Research, UNC Eshelman School of Pharmacy, 2005 - 2015
Research Scholar Grant Award, American Cancer Society, 2006-2009
Damon Runyon-Walter Winchell Fellowship, The Cancer Research Fund, 1997-2000
NASA NSCORT Predoctoral Fellowship, 1993-1996

Professional Memberships

American Chemical Society
American Association for Cancer Research
American Association for the Advancement of Science
American Association of Pharmaceutical Scientists
American Society of Gene & Cell Therapy
International Society for the Study of the Origin of Life

e) BIBLIOGRAPHY AND PRODUCTS OF SCHOLARSHIP

e1) Peer-reviewed Publications (* Corresponding author)

1. Wang, Y., Tiruthani, K., Li, S., Hu, M., Zhong, G., Tang, Y., Roy, S., Zhang, L., Tan, J., Liao, C., Liu, R.* "mRNA Delivery of a Bispecific Single-domain Antibody to Polarize Tumor-associated Macrophages and Synergize the Immunotherapy against Liver Malignancies", *Advanced Materials*, 2021, **33**(23): e2007603. doi: 10.1002/adma.202007603. PMID:33945178.

2. Liu, Y., Tiruthani, K., Wang, M., Zhou, X., Qiu, N., Xiong, Y., Pecot, C.V., Liu, R.*, Huang, L.* “Tumor-targeted Gene Therapy with Lipid Nanoparticles Inhibits Tumor-associated Adipocytes and Remodels the Immunosuppressive Tumor Microenvironment in Triple-negative Breast Cancer”, *Nanoscale Horizons*, 2021 **6**(4): 319-329. doi: 10.1039/d0nh00588f. PMID: 33587080.

3. Xiong, X., Song, W., Shen, L., Wang, Y., Zhang, J., Hu, M., Liu, Y., Li, J., Musetti, S., Liu, R., Huang, L.* "Oral Metformin and Polymetformin Reprogram Immunosuppressive Microenvironment and Boost Immune Checkpoint Inhibitor Therapy in Colorectal Cancer", *Advanced Therapeutics*, **3** (12): 2000168, 2020. https://doi.org/10.1002/adtp.202000168.

4. Das, M., Zhou, X., Liu, Y., Das, A., Vincent, B.G., Li, J., Liu, R., Huang, L.* “Tumor Neoantigen Heterogeneity Impacts Bystander Immune Inhibition of Pancreatic Cancer Growth”, *Translational Oncology,* **13**(12): 100856, 2020. doi: 10.1016/j.tranon.2020.100856. Epub 2020 Aug 28. PMID: 32862105.

5. Wang, H., Qin, M., Liu, R., Ding, X., Chen, I.S.Y., Jiang, Y.* “Characterization of a Bifunctional Synthetic RNA Aptamer and a Truncated Form for Ability to Inhibit Growth of Non-Small Cell Lung Cancer”, *Sci Rep.* **9**(1): 18836, 2019. doi: 10.1038/s41598-019-55280-x. PMID: 31827170.

6. Hu, M., Wang, Y., Xu, L., An, S., Tang, Y., Zhou, X., Li, J., Liu, R., Huang, L.* “Relaxin Gene Delivery Mitigates Liver Metastasis and Synergizes with Check Point Therapy”, *Nature Communications*, **10**(1): 2993, 2019. doi: 10.1038/s41467-019-10893-8. PMID: 31278269.

7. Song, W., Liu, R., Huang, L. “Response to Comment on "Trapping of Lipopolysaccharide to Promote Immunotherapy against Colorectal Cancer and Attenuate Liver Metastasis", *Advanced Materials*, **31**(28): e1902569, 2019. doi: 10.1002/adma.201902569. Epub 2019 Jun 3. PMID: 31155768.

8. Ahn, S., Li, J., Sun, C., Gao, K., Hirabayashi, K., Li, H., Savoldo, B., Liu, R.*, Dotti, G.* “Cancer Immunotherapy with T cells Carrying Bispecific Receptors that Mimic Antibodies”, *Cancer Immunology Research,* **7**(5): 773-783, 2019. doi: 10.1158/2326-6066.CIR-18-0636. Epub 2019 Mar 6. PMID: 30842091.

9. Du, H., Hirabayashi, K., Ahn, S., Kren, N.P., Montgomery, S.A., Wang, X., Tiruthani, K., Mirlekar, R., Michaud, D., Greene, K., Herrera, S.G., Xu, Y., Sun, C., Chen, Y., Ma, X., Ferrone, C.R., Pylayeva-Gupta, Y., Yeh, J.J., Liu, R., Savoldo, B., Ferrone, S., Dotti, G.* “Antitumor Responses in the Absence of Toxicity in Solid Tumors by Targeting B7-H3 via Chimeric Antigen Receptor T Cells”, *Cancer Cell*, **35**(2): 221-237.e8, 2019. doi: 10.1016/j.ccell.2019.01.002. PMID: 30753824.

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12. Song, W., Tiruthani, K., Wang, Y., Shen, L., Hu, M., Dorosheva, O., Qiu, K., Kinghorn, K., Liu, R.*, Huang, L.* “Trapping Lipopolysaccharide to Promote Immunotherapy against Colorectal Cancer and Attenuate Liver Metastasis”, *Advanced Materials*, **30**(52): e1805007, 2018. doi: 10.1002/adma.201805007. PMID:30387230.

13. Wang, Y., Song, W., Hu, M., An, S., Xu, L., Li, J., Kinghorn, K. A., Liu, R.*, Huang, L.* “Nanoparticle-mediated HMGA1 Silencing Promotes Lymphocyte Infiltration and Boosts Checkpoint Blockade

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19. Brantley, S.J., Cotten, S.W., Lamson, D.R., Smith, G.R., Liu, R.*, Williams, K.P.* "Discovery of Small Molecule Inhibitors for the *C. Elegans* Caspase CED-3 by High-Throughput Screening", *Biochem Biophys Res Commun.,* **491**(3): 773-779, 2017. doi: 10.1016/j.bbrc.2017.07.100. Epub 2017 Jul 18. PMID: 28733033.

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32. Kim, D.K., Yan, Y., Valencia, C.A., and Liu, R.* “Heptameric Targeting Ligands against EGFR and HER2 with High Stability and Avidity”, *PLOS One,* **7**(8): e43077, 2012. Epub 2012 Aug 9. PMID: 22912791.

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43. Park, K., Morieux, P., Salomé, C., Cotten, S.W., Reamtong, O., Eyers, C., Gaskell, S.J., Stables, J.P., Liu, R.*, and Kohn, H.* “Lacosamide Isothiocyanate-based Agents: Novel Agents to Target and Identify Lacosamide Receptors”, *Journal of Medicinal Chemistry*, **52**(21): 6897-6911, 2009. PMID: 19795888.

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47. Valencia, C.A., Cotten, S. W., and Liu, R.***** “mRNA Display-based Selections for Proteins with Desired Functions: A Protease-Substrate Case Study”, (Review), *Biotechnology Progress*, **24**(3): 561-569, 2008. PMID: 18471027.

48. Dong, B. and Liu, R.***** “Characterization of Endogenous and Recombinant Human Calpain-10”, *Biochimie*, **90**(9): 1362-1371, 2008. PMID: 18452715.

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Submitted

1. Dorosheva, O., McCabe, M., Zou, J., Charpentier, T., Sondek, J.*, and Liu, R.* "Evolved Inhibitory Decoy Targeting Constitutively Active $G\alpha_q$ Signaling in Uveal Melanoma", *Nature Communications*, In revision.

2. Wang, Y., Hu, M., Li, S., Yang, Y., McCabe, E., Zhang, L., Withrow, A.M., Ting, J., Liu, R.* "*mRNA Delivery of a Constitutively Active STING Mimic for Antitumor Immunity Through Exosome-driven Signaling*", Submitted to *Nature Nanotechnology*.

e2) Intellectual Properties/Patents

1. Liu, R., Wang, Y., Tiruthani, K. PCT U.S. Application No. 62/944,849, “Affinity Molecules that Direct the Metabolism and Polarization of Macrophages and Synergize the Immune Checkpoint Blockade Therapy”, 2020.

2. Liu, R., Sondek, J., Dorosheva, O., Zou, J. McCabe, E., Charpentier, T. U.S. Provisional Patent Application No. 63/002,028, “Inhibitors of Galpha-Q for Treatment of Uveal Melanoma”, 2020

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6. Wang, H., Liu, R., Jiang, Y. WO/2017/162185, “Ribonucleic Acid Aptamer Having Inhibitory Effect on Non-Small Cell Lung Cancer, and Pharmaceutical Composition Comprising Same”.

7. Liu, R. WO 2012/162426 A1 and US20140086835, “Methods and Compositions for Heptameric Targeting Ligands”.

8. Liu, R. PCT/US2014/058257 and WO/2015/048724, “Methods and Compositions for Self-assembly System of Nanoparticles and Microparticles for Multi-targeting specificity”.

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16. Szostak, J.W., Roberts, R., and Liu, R. U. S. Patent 6,207,446 (2001), “Selection of Proteins Using RNA-Protein Fusions”.

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e3) Invited Talks/Presentations

“mRNA Delivery of an Evolved Bispecific Single Domain Antibody to Synergize the Immune Checkpoint Blockade Therapy for Liver Malignancies”, May 12, 2021, The American Society of Gene & Cell Therapy (ASGCT) 24th Annual Meeting.

“mRNA Delivery of an Evolved Bispecific Single Domain Antibody to Synergize the Immune Checkpoint Blockade Therapy”, April 09, 2021, Division of Biological Chemistry, ACS Spring 2021 National Meeting.

“Evolved Inhibitory Decoy Targeting Constitutively Active Galpha-q Signaling in Metastatic Uveal Melanoma”, September 25th, 2020, ACS BIOL Cross-Division Virtual Live Content Event ChemistsLive.

“T Cells Redirected with Modular Biepitopic and Bispecific Antibody Mimic Receptors”, September 3, 2020, PEGS Boston Summit (The Essential Protein Engineering and Cell Therapy Summit).

“T Cells Redirected with Highly Modular Biepitopic and Bispecific Antibody Mimic Receptors for Cancer Immunotherapy”, August 18, 2020, Division of Biochemical Technology, ACS Fall 2020 National Meeting.

“Evolved Inhibitory Decoy Targeting Constitutively Active Galpha-q Signaling in Metastatic Uveal Melanoma”, August 17, 2020, Division of Biological Chemistry, ACS Fall 2020 National Meeting.

“Novel Immunomodulators for Treating Solid Tumors”, September 20, 2019, University of Macau.

“Engineering Protein Probes and Traps for Cellular Signaling and Immunotherapeutic Studies”, January 14, 2019, Chinese University of Hong Kong

“Novel LPS Trap in Cancer Immunotherapy”, April 02, 2019, Division of Biochemical Technology, ACS National Meeting, Orlando, FL.

“Therapeutic Aptamer Based on 2’-Fully Modified RNAs and Novel Selection Strategies”, August 3, 2018, Aptamers in Boulder Symposium, Colorado.

“Revoke Immunosuppression of Tumor Microenvironment Using Engineered Molecular Traps”, March 21, 2018, ACS National Meeting, New Orleans.

“Directed Evolution of a LOV-Trap for Deciphering Intracellular Signaling Pathways”, July 17, 2016; The Protein Society 30th Anniversary Symposium in Baltimore, MD.

“Highly Stable Aptamers Directly Selected from a 2′-Fully Modified RNA Library”, June 24, 2016, Aptamers in Bordeaux, France.

“Development of Novel Targeting Ligands for Imaging and Theranostic Applications”, April 29, 2013, University of North Carolina at Charlotte.

“Search Natural Proteome for Functional Proteins and Select Novel Targeting Ligands for Imaging and Theranostic Applications”, Chemical Biology Symposium, April 26, 2013, Virginia Commonwealth University.

“Federal and State Funding Opportunities”, Panel Co-Chair, Carolina Institute for Nanomedicine and UNC/NCSU Biomedical Engineering Discussion Forum, December 11, 2012, NC Biotech Center, RTP.

“Targeting Ligands for Theranostic Applications and Cancer Biomarker Identification”, November 16, 2012, The Annual NCI Alliance for Nanotechnology in Cancer Investigators’ Meeting, Houston, TX.

“Novel Theranostic Molecules and Their Applications”, April 15, 2012, Peking Union Medical College, Chinese Academy of Medical Sciences, China.

“Targeting Ligands for Nanoparticles”, September 22, 2011, The Annual NCI Alliance for Nanotechnology in Cancer Investigators’ Meeting, Boston, MA.

“Novel Targeting Ligands for Nanoparticles”, December 01, 2010, 2010 MRS Fall Meeting, Boston, MA.

“Combinatorial Biochemical Approaches to Identify Proteins with Desired Functions”, June 10, 2010, Chinese Chemical Society National Meeting, Xiamen, China.

“Novel Methods for the Development of Cancer Biomarker-Binding Targeting Ligands”, May 06, 2009, Suzhou Biopharmaceutical Center, Peking Union Medical College.

“Identification of Drug Targets Through a Combination of Proteomic and Chemical Biology Approaches”, December 09, 2009, Department of Pharmaceutical Sciences, University of Maryland.

“Proteins with Desired Functions from the Proteomes of Human and Model Organisms”, April 17, 2009, Department of Biochemistry, Duke University.

“Identification of Member-specific Natural Substrate Repertoire of Caspases and Caspase-like Proteases from the Human and *C. elegans* Proteomes”, October 21, 2007, 5th General Meeting of the International Proteolysis Society, Patras, Greece.

“Identification of Proteins with Desired Functions from the Proteome of Human and Model Organisms”, September 14, 2007, Department of Chemistry and Biochemistry, Arizona State University.

"Proteome-wide Identification of Member-specific Natural Substrate Repertoire of Caspases and Other Proteases", August 22, 2007, Division of Biochemical Technology, American Chemical Society National Meeting, Boston, MA.

“Scanning the Proteomes of Human and Model Organisms for Functional Proteins”, July 12, 2007, Children’s Memorial Research Center, Northwestern University, Chicago, IL.

“Proteome-wide Identification of Proteins with Desired Functions”, June 29, 2007, Comprehensive Cancer Center, University of California at Irvine, Irvine, CA.

“Proteome-wide Identification of Proteins with Desired Functions”, June 26, 2007, Department of Chemistry, Georgia State University, Atlanta, GA.

“Proteome-wide Identification of Functional Proteins Using mRNA-display”, April 23, 2007, Center of Marine Biotechnology, University of Maryland, Baltimore, MD.

“Caspases and Granzyme-B as Drug Targets”, April 12, 2007, BRITE Center, North Carolina Center University, Durham, NC.

“Scanning the Human Proteome for Caspase Substrates using mRNA-display”, July 06, 2006, Gordon Research Conferences on Proteolytic Enzyme and Their Inhibitors, New London, NH.

“Functional Molecules from Libraries”, October 31, 2003, VivoQuest, Inc., Valley Cottage, NY.

"Pursuing a Career in Protein Recognition", September 8, 2003, Division of Professional Relations, American Chemical Society National Meeting, New York, NY.

f) TEACHING AND RESEARCH TRAINING ACTIVITIES

f1) TEACHING:

Pharm.D. Courses:

PHCY422: **Pharmaceutical Biochemistry 2** (130-160 Pharm.D. students). 2002-2016 (Spring), 6 lecture hours, 12 hours drug recitation.

PHCY425: Medicinal Chemistry 3 (130-160 Pharm.D. students). 2003-2016 (Fall), 2 lecture hours.

PHCY503: **Molecular Foundations of Drug Action** (140-150 Pharm.D. students). 2015-2016 (Fall), 3 lecture hours; 2017 (Fall), 2.5 lecture hours; 2018 (Fall), 0.5 lecture hour.

Ph.D. Courses:

MEDC169/MEDC833: Molecular Target-based Drug Discovery II (6-10 graduate students). 2004-2013 (Fall), Coordinator, 12 lecture hours, 6 recitation hours, 2 individual meeting hours.

CBMC804A: Biochemical Foundations of Chemical Biology (6-12 graduate students). 2014-2021 (Spring), Co-coordinator, 10 lecture hours.

CBMC804B: Biochemical Foundations of Chemical Biology Journal Club (6-12 graduate students). Coordinator (2014-2018), co-coordinator (2019-2021)
2014-2021 (Spring), 11 recitation hours, 5 individual meeting hours.

MOPH864: Advances in Drug Delivery (10-15 graduate students). 2011-2019 (Fall, offered every other year) 1.5 lecture hours.

MOPH868: Advances in Drug Discovery and Nanomedicine (8-12 graduate students). 2016-2017 (Fall), 1.5 lecture hours.

f2) Research Training:

Current Lab Members:

Ying, Wang, Ph.D. (2018 - current)
Pankaj Srivastava, Ph.D. (2021 - current)
Annan Sun (Undergraduate student)
Andrew Michael Withrow (Undergraduate student)
Breanna Alexis Blake (Undergraduate student)
Emily Dai (Undergraduate student)

Former Graduate Students and Postdoctoral Trainees:

Steven Wesley Cotten, Ph.D., Former Graduate student (2005-2010),
Sarah Claypool, Ph.D., Former Graduate Student (2010-2015)
Adam Friedman, Ph.D., Former Graduate Student (2010-2015)
Rachel Y. Zhou, Former Graduate Student (2013-2016)
Oleksandra Dorosheva, Ph.D., Former Graduate Student (2015-2019)
Ellie McCabe, Ph.D., Former Postdoc (2019-2020)
Sourav Roy, Ph.D., Former Postdoc (2018-2020)
Jingjing Li, Ph.D., Former Postdoc (2016-2019)
Karthik Tiruthani, Ph.D., Former Postdoc (2016-2018)
Keliang Gao, Ph.D., Former Postdoc (2016-2018)
Jianwei Zou, Ph.D., Former Postdoc (2010-2014)
Dongwook Kim, Ph.D., Former Postdoc (2009-2014)
Rong Wang, Ph.D., Former Postdoc (2009-2011)
Hui William Chen, Ph.D., Former Postdoc (2009-2011)
Yitang Yan, Ph.D., Former Postdoc (2007-2009)

Jim Aloor, Ph.D., Former Postdoc (2006-2007)
Jinzhu Duan, Ph.D., Former postdoc (2006-2008)
Baocheng Huang, Ph.D., Former Postdoc (2005-2007)
Biao Dong, Ph.D., Former Postdoc (2004-2007)
Hao Pang, Ph.D., Former Postdoc (2004-2005)
C. Alexander Valencia, Ph.D., Former Postdoc (2004-2009)
Yan Ke, Ph.D., Former Postdoc (2004-2005)
Xinchun Shen, Ph.D., Former Postdoc (2003-2006)

Ph.D. Thesis Committees

Pierre Morieux (CBMC)
Steven Cotten (CBMC)
Amber King (CBMC)
Rima Hajjo (CBMC)
Saurabh Wadhwa (MOPH)
Joana Soares (CBMC)
Oana Lungu (Pharmacology)
Yang Liu (MOPH)
Morgan Chapman (CBMC)
Adam Friedman (BBSP and CBMC)
Sarah Claypool (CBMC)
Rachel Zhou (CBMC)
Colin O'Banion (BBSP and CBMC)
Paul Michael Himes (CBMC)
Tyler Jay Goodwin (MOPH)
Tejash Vijay Patel (MOPH)
Qi Liu (MOPH)
Oleksandra Dorosheva (CBMC)
Christopher Holmquist (CBMC)
Christina Parker (MOPH)
Steven Fleming (CBMC)
Manisit Das (MOPH)
Jimmy Fay (MOPH)
Sarah Ahn (Immunology)
Sara Musetti (MOPH)
Mengzhe Wang (Bioengineering)
Randolph Qian (MOPH)
Matthew Fleming (CBMC)
Jacob Larson (CBMC)
Jarrett Michael Pelton (CBMC)
Jon-Michael Beasley
Michelle Denise Thomas
Sara Rose Wasserman

g) GRANTS

ACTIVE:

R21 AI163793-01 (PI: Liu) 07/09/21 – 06/30/23 1.2 Cal Months
NIH/NIAID $275,000 Direct Costs

Trimerization of the N-terminal Domain of ACE2 for Bifunctional Trapping of Future SARS-CoV-2 Variants

This project is directed at developing a novel class of SARS-CoV-2 trapping molecules that have the potential to be universally applied to block hACE2-mediated infection by SARS CoV-2 or other coronaviruses.

EII-2021 (PI: Liu; Co-innovator: Abuin) 08/01/21 – 07/31/23 1.2 Cal Month
Eshelman Institute for Innovation $499,323 Direct Costs
Engineering a Pro-LEAP2 Therapeutic for the Treatment of Obesity
This project aims to develop an innovative class of anti-obesity biologic by systematic engineering of LEAP2 peptide to achieve sustained release and higher potency using a combination of directed molecular evolution strategies.

UCRF-Tier 2 (PI: Liu) 05/01/20 – 04/30/22 1.8 Cal Months
University Cancer Research Fund $175,000 Direct Costs
Novel STING Mimic for Combination Immunotherapy of TNBC and EOC
The goal of this proposal is to locally deliver the mRNA of a novel STING agonist in the TME for the immunotherapy of TNBC and EOC.

RX03202109 (PI: Liu) 06/01/20 – 05/31/22 1.2 Cal Months
Eshelman Institute for Innovation $200,000 Direct Costs
A Pro-STING Agonist that is Activated in Tumor Microenvironment
The goal of this proposal is to develop and deliver an mRNA-coded pro-STING agonist that will be activated only in the TME but not in normal cells for treating solid tumors.

R01EB022596-01A1 (PI: Jin Xie; Role: Co-I) 4/1/17 – 3/31/22 0.5 Cal Month
University of Georgia/NIH
Nanoscintillator-based X-ray Sensitizers to Enable Efficient NSCLC Treatment with X-ray
The goal of this proposal is to integrate EGFR PET and FLT/FMISO PET with X-PDT treatment of lung cancer.

PENDING:
R01EB032865 (PI: Liu) 04/01/22 – 03/31/27 3.6 Cal Months
NIH/NIBIB/NCI $2,906,494 Total Costs
Wholly Protein-based Self-assembly Nanoplatform for TNBC-specific Combination Therapy
This project is directed at developing an innovative nanoplatform wholly composed of recombinant proteins, and using it for combination therapeutic studies for triple-negative breast cancer.
SRG review completed: 11.0 percentile

R01EY034149 (PI: Liu) 07/01/22 – 06/30/27 3.0 Cal Months
NIH/NEI/NCI $3,726,946 Total Costs
Liver-tropic Delivery of mRNA Therapeutics for Combination Therapy of Metastatic Uveal Melanoma
This project is directed at developing liver-tropic mRNA/LNP therapeutics for the mechanistic and combination therapeutic studies on metastatic uveal melanoma in the liver.

COMPLETED:
1R01GM120291 (MPI: Sondek/Liu) 9/1/16 – 8/31/21 1.5 Cal Months
NIH/NIGMS $402,856 Direct Costs to Liu Lab
Inhibition of GTPases and G Proteins to Treat Human Disease
The goal of this proposal is to integrate several developing technologies to potently and selectively target constitutively active GTPases in cancers.

RX03812125 (PI: Liu) 6/01/18 – 5/31/21 1.2 Cal Months
Eshelman Institute for Innovation $500,000 Direct Costs
A Wholly Protein-Based Self-Assembly Nanoplatform for Tunable Cancer Immunotherapy
The goal of this proposal is to develop an innovative nanomedicine that is wholly composed of proteins for tunable combination immunotherapy.

NCI STTR Subcontract (PI: Liu) 5/01/18 – 1/31/21 0.96 Cal Month
NIH and Panacise Bio, Inc $111,553 Direct Costs
Innovative TME-specific Pro-CAR T-cells for Immunotherapy of Solid Tumors
This STTR subcontract aims to characterize the pro-CAR T-cells that are developed at the Panacise Bio Inc. at the molecular and the cellular levels.

5U01CA198910-04 (MPI: Kabanov/Liu/Bronich) 8/14/15 – 7/31/20 1.0 Cal Months
NIH/NCI ~$200,000 Direct Costs to Liu Lab
Targeted Core Shell Nanogels for Triple Negative Breast Cancer
The goal of this proposal is to use biodegradable nanogels that carry potent chemotherapeutic agents and are decorated with novel polypeptide antagonists to EFGR and HER3 receptors displayed in the TNBC.

5U54CA198999-02 (MPI: Huang/Tepper) 9/01/15 – 7/31/20 0.6 Cal Month
NIH (Role: Co-Investigator Project 1)
Nano Approaches to Modulate Host Cell Response for Cancer Therapy
The goal of this proposal was to develop targeted methods for the delivery of biologics, immunologic- modifiers and chemotherapies against melanoma and non-small cell lung cancers, utilizing innovative nanotechnologies developed at UNC-Chapel Hill.

Contract Project 4/01/2018 – 3/31/2020 0.6 Cal Month
OncoTrap, Inc. (MPI: Li/Liu); $121,407 Direct Costs
Evaluation of OncoTrap's Drug Candidate in Tumor Bearing Mouse Model
The major goal of this project was to evaluate the pharmacokinetics and toxicities of the drug candidate developed in the OncoTrap Inc.

RX03712112 (PI: Liu) 6/01/17 – 12/31/19 0.24 Cal Month
Eshelman Institute for Innovation $200,000 Direct Costs
Biepitopic and Bispecific Chimeric Antigen Receptors for T-Cell Therapy
The major goal of this project was to develop novel CAR-T cells with bispecificity and biepitopicity for the treatment of pancreatic cancer.

MCC078RHL1 (PI: Liu) 8/01/18 – 7/31/19 0.6 Cal Month
Carolina CCNE $50,000 Direct Costs
Nano-delivery of the mRNA of an Evolved Gαq-inhibitory Decoy Protein for the Treatment of Liver Metastasis of Uveal Melanoma
The major goal of this project was to deliver the mRNA of an evolved Gαq-inhibitory protein therapeutics to a liver metastatic uveal melanoma mouse model.

RX03612118 (PI: Liu) 6/01/16 – 11/30/18 1.2 Cal Months
Eshelman Institute for Innovation $200,000 Direct Costs
Novel Single Domain Antibody Mimics for Targeted Cancer Therapy
The major goal of this project was to develop novel targeting ligands that can be integrated with Chemo/cytokine traps for precise immunotherapies against malignant tumors.

RX03512418 (MPI: Huang/Liu) 10/01/15 – 03/30/18 1.8 Cal Months
Eshelman Institute for Innovation $630,000 Direct Costs, $315,000 to Liu Lab
Priming the Liver to Resist Cancer Metastasis
The major goal of this project was to develop novel CXCL12 traps and deliver the pDNA using nanoplatforms for the treatment of liver metastasis of colorectal cancer.

R01CA157738 (PI: Liu) 12/01/11 – 11/30/17 1.8 Cal Months
NIH/NCI $1,037,500 Direct Costs
Novel Single Domain Antibodies with Multivalency and Multispecificity

The major goal of this project was to develop innovative targeting ligands that recognize and bind HER family members with desired avidity and multispecificity.

Templeton Fund (PI: Cartier; Co-Investigator: Liu) 3/01/16 – 11/30/18 1.2 Cal Months
The Foundation for Applied Molecular Evolution (FfAME)
Templated Cross Catalysis by Oligopeptides and Oligonucleotides
The major goal of this project was to study the possible complementary interactions between oligonucleotides and oligopeptides for their roles in the origin of life.

RX03512111 (PI: Liu) 10/01/15 – 09/30/16 0.6 Cal Month
Eshelman Institute for Innovation $50,000 Direct Costs
Decipher a Highly Specific Biomarker for Targeted Treatment of Pancreatic Cancer
The major goal of this project was to identify the biomarker on the surface of pancreatic cancer cells that interacts with a highly PDAC-specific aptamer developed in the Liu lab.

U54 CA151652 (PI: Liu) 09/01/10 – 08/31/16 1.2 Cal Months
NIH/NCI $450,000 Direct Costs
The Targeting Ligand Core of the Carolina Center of Cancer Nanotechnology Excellence (C-CCNE)
The major goal of the Targeting Ligand Core was to develop novel ErbB-binding antibody mimics and 2'-fluoro RNA aptamers for the targeted delivery of various nanoparticles.

R21 AI092228 (PI: Liu) 12/01/10 – 11/30/13 1.2 Cal Months
NIH/NIAID $275,000 Direct Costs
Novel Anti-allergic Single-domain Antibody Against IgE
The major goal of this project was to develop a new generation of IgE-Fc-binding single-domain antibodies (SDAs) that are based on the monomeric human V_H domain for anti-allergic treatment.

R21 DA025702 (PI: Liu) 09/20/08 – 01/31/12 1.8 Cal Months
NIH/NIDA $400,000 Direct Costs
Identification of the Interactom of Methylated Histones from Human Proteome
The major goal of this project was to identify and characterize the interactomes of the methylated histone tails at a proteome wide scale.

R01 NS054112 (PI: Kohn; Co-PI: Liu) 07/01/06 – 06/30/11 1.8 Cal Month
NIH/NINDS $900,000 Direct Costs
Methods to Identify Targets of the Neurological Agent (R)-Lacosamide
The major goal of this project was to identify and characterize the targets of the anti-epilepsy drug lacosamide through a combination of chemical and biological approaches.

U54 CA119343 (PI: Liu) 09/30/05 – 08/31/10 1.2 Cal Month
NIH/NCI $600,000 Direct Costs
The Combinatorial Library Research Core of the Carolina Center of Cancer Nanotechnology Excellence
The major goal of the Combinatorial Library Research Core was to develop a series of protein, peptide or oligonucleotide aptamers that display high affinity and selectivity for several cancer biomarkers, using different combinatorial library screening approaches.

ACS RSG-TBE-110472 (PI: Liu) 01/01/06 – 12/31/10 2.4 Cal Months
American Cancer Society $600,000 Direct Costs
Novel Calmodulin-binding Proteins in Regulating Ubiquitin-Proteasome System
The major goal of this project was to investigate novel regulation mechanisms of critical steps in the ubiquitin-proteasome system, including ubiquitination, multi-ubiquitin chain recognition, and degradation, by Ca^{2+}/CaM.

R01 NS047650 (PI: Liu) 01/01/04 – 12/31/09 3.0 Cal Months

NIH/NINDS $1,040,625 Direct Costs

Identification of Caspase Substrates from Human Proteome

The major goal of this project was to identify novel substrates of a series of different caspases from human proteome and using them to study the caspase-induced apoptotic pathways.

R21 DK067480 (PI: Liu) 04/01/04 – 03/31/07 1.8 Cal Months
NIH/NIDDK $193,796 Direct Costs

Identifying Calpain-10 Substrates from Human Proteome

The major goal of this project was to identify the potential substrates of calpain-10 from human proteome.

h) PROFESSIONAL SERVICE

For Division and School (does not include SAC)

1. Coordinator CBMC Cumulative Examination Committee (2004-present)
2. Member of the CBMC Graduate Program Admission Committee (2011-present)
3. Member of the ESOP Conflicts of Interest Committee (2012-present)
4. Member of the ESOP Scholarship Committee (2015-2018)
5. Member of the Curriculum Committee at CBMC (2012)
6. Mentor for all the First Year BBSP Students interested in the Pharmaceutical Sciences Program (2012-2015)
7. Member of the Committee for Internationalization (2011- 2012)
8. Member of the Organization Committee for Chapel Hill PharmSci 2015
9. Member of the Search Committee for the Chair of MOPH (2015-2016)

For University

Member Laboratory and Chemical Safety Committee (2008-present)
Member of the BBSP Program Quantitative Admission Committee (2011-2014)
Member of Lineberger Cancer Center “Out of the Box” committee for Year 2020-2025 strategic planning

As Scientific Journal Reviewer

Peer reviewer for scholarly journals: Nature Chemical Biology, Nature Communications, Science Translational Medicine, PNAS, Cell Chemical Biology, JACS, Advanced Materials, Trends in Pharmacological Sciences, Nucleic Acids Research, Chemistry and Biology, Cell Chemical Biology, Cellular & Molecular Immunology, Advanced Functional Materials, Theranostics, Nano Today, Journal of Biological Chemistry, Oncogene; Biotechnology and Bioengineering, ChemBioChem; FEBS Letters; Molecular Systems Biology; Journal of Controlled Release; Methods; Trends in Biotechnology; Journal of Nucleic Acids, Critical Reviews in Biotechnology, Current Cancer Drug Targets, Biochemistry, and other journals.

As Guest Journal Editor: Special Issue “*In Vitro* Protein Selection” (June 2013), *Methods* Journal.

As Grant Reviewer

Grants reviewer for Ad Hoc reviewer for NIH Study Sections and National Science Foundation,
NIH Cancer Biotherapeutics Development (CBD), March 24-25, 2022
NIH Cancer Biotherapeutics Development (CBD), November 15-16, 2021
NIH Cancer Biotherapeutics Development (CBD), June 24-25, 2021
NIH Cancer Biotherapeutics Development (CBD), March 18-19, 2021
NIH ZRG1 OTC-E, May 01, 2019
NSF CHE/CLP, March 24, 2014
NIH ZRG1 BST-N (50), July 11-12, 2013
NIH ZRG1 BCMB-A (51), May 31, 2012
NIH ZRG1 IMST-G (10), March 12, 2012
NIDA/NIH (ZDA1 JXR-D (06), June 05, 2009