

Ewan Kenneth Strome McRae

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Current Position

- 2023 – Present **Assistant Professor**, *Center for RNA Therapeutics, Houston Methodist Research Institute*, Houston, Texas, USA (P.I. of the [McRae lab](#); Department of Cardiovascular Sciences)
- 2023 – Present **Assistant Professor of Biochemistry in Medicine**, *Weill Cornell Medical College, Cornell University*
- 2023 – Present **Research Member**, *DeBakey Heart & Vascular Center; Dr. Mary and Ron Neal Cancer Center*

Education

- 2015 – 2019 **Ph.D.**, *University of Manitoba*
Thesis: [Discovery and characterization of quadruplex remodeling proteins](#)
Advisor: [Sean A. McKenna](#)
- 2009 – 2015 **B.Sc. Hons in Biochemistry**, *University of Manitoba*

Previous Positions

- 2022 – 2023 **Research Scientist**, *MRC-LMB, Cambridge, U.K.* (with [Phil Holliger](#) on cryo-EM of polymerase ribozymes)
- 2019 – 2022 **Postdoctoral Fellow**, *iNANO, Aarhus University*, Aarhus, Denmark (with [Ebbe Andersen](#) on cryo-EM of RNA origami)
- 2017 – 2018 **Teaching Assistant**, *University of Manitoba*, Winnipeg, Manitoba, Canada (Advanced Biochem Labs)
- 2014 – 2015 **Teaching Assistant**, *University of Manitoba* (Biochem 1 and 2 Labs)
- 2014 **Undergraduate Researcher**, *University of Manitoba*, Winnipeg, Manitoba, Canada (with [Sean A. McKenna](#))

Grants & Awards

- 2025 – 2029 Pew Biomedical Scholar
- 2023 – 2028 CPRIT - Recruitment of First-Time Tenure-Track Faculty Award
- 2019 – 2021 Natural Sciences and Engineering Research Council - Postdoctoral Fellowship
- 2017 – 2019 Natural Sciences and Engineering Research Council - Alexander Graham Bell Scholarship
- 2022 FNANO Conference - Best Oral Presentation Award
- 2018 RiboWest/RiboClub - Best Oral Presentation Award
- 2014 – 2019 Various Graduate student awards
- Distinguished Dissertation Award from University of Manitoba, Research Manitoba Studentship, Ernst and Ingrid Bock Graduate Award, Hugh J. Anderson Graduate Award in Chemistry, Theodore Peter Schaefer Graduate Award in Chemistry, Frank and Donna Hruska Prize, University of Manitoba Graduate Student Fellowship, Faculty of Science Award, University of Manitoba, Instrumental Analysis Award

2026

1. *Base modifications shift tertiary structure and activity in synthetic RNA origami and a natural ribozyme.*
Deepak Kumar Yadav, Haoyun Yang, Sukyeong Lee, and **Ewan K. S. McRae**
Nature communications, 2026, PMID: 42128887
2. *Label-Free Microfluidic Modulation Spectroscopy Monitors RNA Origami Structure and Stability.*
Phoebe S. Tsoi, Lathan Lucas, Allan Chris M. Ferreon, **Ewan K. S. McRae**, and
Josephine C. Ferreon
Biosensors, 2026, PMID: 41892058

2025

3. *Roles of dimeric intermediates in RNA-catalyzed rolling circle synthesis.*
Emil L. Kristoffersen, **Ewan K. S. McRae**, Niels R. Sørensen, Philipp Holliger, and Ebbe S. Andersen
Nucleic acids research, 2025, PMID: 40521664

2024

4. *Non-averaged single-molecule tertiary structures reveal RNA self-folding through individual-particle cryo-electron tomography.*
Jianfang Liu, **Ewan K. S. McRae**, Meng Zhang, Cody Geary, Ebbe Sloth Andersen, and Gang Ren
Nature communications, 2024, PMID: 39433544
5. *An RNA origami robot that traps and releases a fluorescent aptamer.*
Néstor Sampedro Vallina, **Ewan K. S. McRae**, Cody Geary, and Ebbe S. Andersen
Science advances, 2024, PMID: 38507482
6. *Cryo-EM structure and functional landscape of an RNA polymerase ribozyme.*
Ewan K. S. McRae, Christopher J. K. Wan, Emil L. Kristoffersen, Kalinka Hansen, Edoardo Gianni, Isaac Gallego, Joseph F. Curran, James Attwater, Philipp Holliger, and Ebbe S. Andersen
Proceedings of the National Academy of Sciences of the United States of America, 2024, PMID: 38207080

2023

7. *RNA target highlights in CASP15: Evaluation of predicted models by structure providers.*
Rachael C. Kretsch, Ebbe S. Andersen, Janusz M. Bujnicki, Wah Chiu, Rhiju Das, Bingnan Luo, Benoît Masquida, **Ewan K. S. McRae**, Griffin M. Schroeder, Zhaoming Su, Joseph E. Wedekind, Lily Xu, Kaiming Zhang, Ivan N. Zheludev, John Moulton, and Andriy Kryshtafovych
Proteins, 2023, PMID: 37466021
8. *Structure, folding and flexibility of co-transcriptional RNA origami.*
Ewan K. S. McRae, Helena Østergaard Rasmussen, Jianfang Liu, Andreas Bøggild, Michael T. A. Nguyen, Nestor Sampedro Vallina, Thomas Boesen, Jan Skov Pedersen, Gang Ren, Cody Geary, and Ebbe Sloth Andersen
Nature nanotechnology, 2023, PMID: 36849548
9. *RNA origami scaffolds facilitate cryo-EM characterization of a Broccoli-Pepper aptamer FRET pair.*
Néstor Sampedro Vallina, **Ewan K. S. McRae**, Bente Kring Hansen, Adrien Boussebayle, and Ebbe Sloth Andersen
Nucleic acids research, 2023, PMID: 36999628

10. *Tertiary structure of single-instant RNA molecule reveals folding landscape.*
Jianfang Liu, **Ewan K. S. McRae**, Meng Zhang, Cody Geary, Ebbe Sloth Andersen, and Gang Ren
bioRxiv : the preprint server for biology, 2023, PMID: 37292713
11. *An RNA Paranemic Crossover Triangle as A 3D Module for Cotranscriptional Nanoassembly.*
Néstor Sampedro Vallina, **Ewan K. S. McRae**, Cody Geary, and Ebbe Sloth Andersen
Small (Weinheim an der Bergstrasse, Germany), 2023, PMID: 36526605

2021

12. *RNA origami design tools enable cotranscriptional folding of kilobase-sized nanoscaffolds.*
Cody Geary, Guido Grossi, **Ewan K. S. McRae**, Paul W. K. Rothmund, and Ebbe S. Andersen
Nature chemistry, 2021, PMID: 33972754
13. *Monitoring Enzymatic RNA G-Quadruplex Unwinding Activities by Nuclease Sensitivity and Reverse Transcription Stop Assays.*
Ewan K. S. McRae, Steven J. Dupas, Negar Atefi, and Sean A. McKenna
Methods in molecular biology (Clifton, N.J.), 2021, PMID: 33201469

2020

14. *2D Saturation Transfer Difference NMR for Determination of Protein Binding Sites on RNA Guanine Quadruplexes.*
Ewan K. S. McRae, David E. Davidson, and Sean A. McKenna
Methods in molecular biology (Clifton, N.J.), 2020, PMID: 32681509
15. *An RNA guanine quadruplex regulated pathway to TRAIL-sensitization by DDX21.*
Ewan K. S. McRae, Steven J. Dupas, Evan P. Booy, Ramanaguru S. Piragasam, Richard P. Fahlman, and Sean A. McKenna
RNA (New York, N.Y.), 2020, PMID: 31653714

2019

16. *Binding and photodynamic action of the cationic zinc phthalocyanines with different types of DNA toward understanding of their cancer therapy activity.*
Ewan K. S. McRae, Dustin E. Nevenon, Sean A. McKenna, and Victor N. Nemykin
Journal of inorganic biochemistry, 2019, PMID: 31357069

2018

17. *Comprehensive analysis of the BC200 ribonucleoprotein reveals a reciprocal regulatory function with CSDE1/UNR.*
Evan P. Booy, **Ewan Ks McRae**, Peyman Ezzati, Taegi Choi, Daniel Gussakovsky, and Sean A. McKenna
Nucleic acids research, 2018, PMID: 30247708
18. *Insights into the RNA quadruplex binding specificity of DDX21.*
Ewan K. S. McRae, David E. Davidson, Steven J. Dupas, and Sean A. McKenna
Biochimica et biophysica acta. General subjects, 2018, PMID: 29906500
19. *Structure and hydrodynamics of a DNA G-quadruplex with a cytosine bulge.*
Markus Meier, Aniel Moya-Torres, Natalie J. Krahm, Matthew D. McDougall, George L. Orriss, **Ewan K. S. McRae**, Evan P. Booy, Kevin McEleney, Trushar R. Patel, Sean A. McKenna, and Jörg Stetefeld
Nucleic acids research, 2018, PMID: 29718405

2017

20. *On Characterizing the Interactions between Proteins and Guanine Quadruplex Structures of Nucleic Acids.*
Ewan K. S. McRae, Evan P. Booy, Gay Pauline Padilla-Meier, and Sean A. McKenna
Journal of nucleic acids, 2017, PMID: 29250441
21. *The long non-coding RNA BC200 (BCYRN1) is critical for cancer cell survival and proliferation.*
Evan P. Booy, **Ewan Ks McRae**, Amit Koul, Francis Lin, and Sean A. McKenna
Molecular cancer, 2017, PMID: 28651607
22. *Human DDX21 binds and unwinds RNA guanine quadruplexes.*
Ewan K. S. McRae, Evan P. Booy, Aniel Moya-Torres, Peyman Ezzati, Jörg Stetefeld, and Sean A. McKenna
Nucleic acids research, 2017, PMID: 28472472
23. *Impact of G-quadruplex loop conformation in the PITX1 mRNA on protein and small molecule interaction.*
Emmanuel O. Ariyo, Evan P. Booy, Edis Dzananovic, **Ewan K. McRae**, Markus Meier, Kevin McEleney, Jorg Stetefeld, and Sean A. McKenna
Biochemical and biophysical research communications, 2017, PMID: 28412358

2016

24. *RNA Helicase Associated with AU-rich Element (RHAU/DHX36) Interacts with the 3'-Tail of the Long Non-coding RNA BC200 (BCYRN1).*
Evan P. Booy, **Ewan K. S. McRae**, Ryan Howard, Soumya R. Deo, Emmanuel O. Ariyo, Edis Dzananovic, Markus Meier, Jörg Stetefeld, and Sean A. McKenna
The Journal of biological chemistry, 2016, PMID: 26740632

2015 and earlier

25. *Biophysical Characterization of G-Quadruplex Recognition in the PITX1 mRNA by the Specificity Domain of the Helicase RHAU.*
Emmanuel O. Ariyo, Evan P. Booy, Trushar R. Patel, Edis Dzananovic, **Ewan K. McRae**, Markus Meier, Kevin McEleney, Jorg Stetefeld, and Sean A. McKenna
PloS one, 2015, PMID: 26649896
26. *Biochemical characterization of G4 quadruplex telomerase RNA unwinding by the RNA helicase RHAU.*
Evan P. Booy, **Ewan K. S. McRae**, and Sean A. McKenna
Methods in molecular biology (Clifton, N.J.), 2015, PMID: 25579584

Oral Presentations

Invited Talks

1. *RNA by Design: Re-writing RNA motifs to re-program RNA function*, Pew Biomedical Programs 2026
Annual Meeting, Palm Springs, California, USA
2. *Base modifications reshape RNA folding landscapes and structure–function relationships in synthetic and natural RNAs*, RiboWest 2025 RNA Conference, Lethbridge, Alberta, Canada 2025
3. *Rational design of RNA nanostructures, towards therapeutic applications*, Manitoba Group in Protein Structure and Function, Winnipeg, Manitoba, Canada 2025
4. *Towards understanding the effects of modified nucleobases on RNA structure and function*, Gordon Research Conference: RNA Nanotechnology, Ventura, California, USA 2025
5. *Design of Structural RNA Elements for Applications in RNA Therapeutics*, Houston Methodist Research Institute, Cancer Center Work in Progress Meeting, Houston, Texas, USA 2022

6. *RiboNucleic Acids – Not just a one trick pony (The convergence of Basic and Applied research)*, 2022
Houston Methodist Research Institute, Center for RNA Therapeutics, Houston, Texas, USA
7. *Structurally informed RNA design methods and their application to the future of RNA therapeutics*, 2022
Houston Methodist Research Institute, Center for RNA Therapeutics, Houston, Texas, USA
8. *G-quadruplex recognition and regulation of translation by DDX21*, RiboClub Annual Meeting, Or- 2018
ford, Quebec, Canada
9. *Discovery and validation of new RNA quadruplex-binding proteins*, West Coast Bioanalytics Meet- 2016
ing, South San Francisco, United States

Other Oral Presentations.....

1. *Challenges associated with cryo-EM structure determination and modelling of RNA: a user's per- 2025*
spective, Pacific Northwest CryoEM Center Modelling Workshop, Portland Oregon, USA
2. *A primer on nucleic acids and their therapeutic applications*, BioTechnology Summer Camp, Uni- 2025
versity of Houston, Texas, USA
3. *Structural characterization of evolved RNA molecules*, Baylor College of Medicine, RNA Group 2024
Seminar Series, Houston, Texas, USA
4. *Programming RNA structure and function*, University of Houston, Biology and Biochemistry De- 2024
partmental Seminar Series, Houston, Texas, USA
5. *Application of RNA origami structural design for therapeutic purposes*, Houston Methodist Aca- 2023
demic Institute, Ernest H. Cockrell Boardroom, Houston, Texas, USA
6. *RNA origami as a structure prediction target*, CASP RNA structure Special Interest Group: virtual 2023
Meeting
7. *An overview of cryogenic electron microscopy for biological materials*, Houston Methodist Research 2023
Institute, Progress in Cardiovascular Sciences seminar series, Houston, Texas, USA
8. *High-resolution structures and conformational dynamics of RNA origami during folding*, 19th Annual 2022
Foundations in NanoScience conference, Oxford, U.K.
9. *Solution structure of co-transcriptional RNA origami reveals complex conformational landscapes*, 2021
4th Annual CryoNET symposium - Umea, Sweden
10. *RNA Origami Scaffolds as a Tool for Cryo-EM*, 3rd Annual CryoNET symposium, Aarhus, Denmark 2020
11. *Structural characterization of RNA origami*, RNA Aarhus - Aarhus, Denmark 2020
12. *The C-terminus of DDX21 recognizes the 2'OH of loop nucleotides in RNA guanine quadruplexes*, 2018
14th Annual RiboWest
13. *Human DDX21 binds and remodels RNA guanine quadruplexes*, 13th Annual RiboWest conference, 2017
Vancouver, Canada
14. *Validating suspected quadruplex-binding RNA helicase proteins*, 12th Annual RiboWest Conference, 2016
Lethbridge, Canada
15. *Characterization of the quadruplex resolving enzyme RHAU using molecular and structural biology 2014*
methods, 10th Annual RiboWest Conference, Lethbridge, Canada

Poster Presentations

1. *RNA Structure Function Lab*, Pew Biomedical Programs Annual Meeting, Palm Springs, California, 2026
USA - Presenter
2. *Programmable RNA Architecture Enhances Aptamer Binding and Enables Protein-Responsive 2026*
Translation, The RNA Society Annual Meeting, Montreal, Quebec, Canada - Presenter
3. *Utilizing 5'UTR for translational control of mRNA therapeutics*, The 30th Annual Meeting of the 2025
RNA Society, San Diego, California, USA - Corresponding Author
4. *3'UTR optimization through interactions with RNA-binding proteins for translational control of 2025*
mRNA therapeutics, The 30th Annual Meeting of the RNA Society, San Diego, California, USA -
Corresponding Author

5. *Base modifications reshape RNA folding landscapes and structure–function relationships in synthetic and natural RNAs*, The 30th Annual Meeting of the RNA Society, San Diego, California, USA - Presenter 2025
6. *Base modifications reshape RNA folding landscapes and structure–function relationships in synthetic and natural RNAs*, The Biophysical Society Annual Meeting, Los Angeles, California, USA - Presenter 2025
7. *The impact of T7 RNA polymerase class II pause site for mRNA Therapeutics*, 8th Annual NIH PCTC Cardiovascular Bioengineering symposium, Houston, Texas, USA - Middle Author 2024
8. *Towards understanding the effects of nucleobase modifications on RNA structure*, 8th Annual NIH PCTC Cardiovascular Bioengineering symposium, Houston, Texas, USA - Corresponding Author 2024
9. *UTR optimization for translational control of mRNA therapeutics*, 8th Annual NIH PCTC Cardiovascular Bioengineering symposium, Houston, Texas, USA - Corresponding Author 2024
10. *Structure Based Design of RNA Therapeutics*, Innovations in Cancer Prevention and Research Conference, Galveston, Texas, USA - Corresponding Author 2023
11. *Cryo-EM reconstructions of RNA origami reveal unexpected twist and slow-maturation process*, 27th Annual RNA society, Boulder, CO, USA 2022
12. *The C-terminus of DDX21 recognizes the 2' OH of loop nucleotides in RNA guanine quadruplexes*, 23rd Annual RNA Society, Berkeley, United States 2018
13. *Human DDX21 binds and remodels RNA guanine quadruplexes*, 22nd Annual Meeting of the RNA Society, Prague, Czech Republic 2017
14. *Validating suspected quadruplex-binding RNA helicase proteins*, Biophysical Society of Canada, Winnipeg, Canada 2016
15. *Non-coding RNA BC200 (BCRYN1) interacts with quadruplex resolving RNA helicase DHX36 and stabilizes unwound quadruplex through its cytosine rich region*, 20th Annual Meeting of the RNA Society, Madison, Wisconsin, United States 2015
16. *Recombinant Expression of the RHAU Helicase protein in E.coli*, Western Canadian Undergraduate Chemistry Conference, Victoria, Canada 2014

Teaching and Mentoring

BioTechnology Summer Camp, University of Houston Lecture and Workshop	2025
Bio-NanoScience course, Aarhus University, Lecture and lab	2021
Mentoring and training 2 undergraduate researchers at Aarhus University	2020 – 2021
B.Sc. course, Guest Lecturer - Bio-Analytical Methods, University of Manitoba	2018
B.Sc. course, Guest Lecturer - Biochemistry of Nucleic Acids, University of Manitoba	2018
Mentoring and training 7 undergraduate researchers under Dr. Sean McKenna	2015 – 2018

Professional Activities

Editorial and Advisory Boards.....

Nucleic Acids Research Early Career Investigator Advisory Board member, 2026 – 2028
Consulting Editor of online content for the Society for RNA Therapeutics, 2023 – 2025

Committee Memberships.....

Chair of the Educational Committee for The Society for RNA Therapeutics, 2026 – present
Early Careers Committee member, Biophysical Society, 2023 – present
Vice Chair for the Gulf Coast Consortium's Cellular and Molecular Biophysics group, 2023 – present

Peer Review.....

Reviewer for Nature Nanotechnology, 2024 – present

Reviewer for Nucleic Acids Research, 2026 – present

Professional Service.....

President of the Chemistry Graduate Students' Association, University of Manitoba, 2015 – 2018

Skills

Bio-analytical: ITC, MST, SEC, DLS, SAXS, NMR, EMSA, RT-qPCR, circular dichroism, electron microscopy

Computational: RNA structure prediction, RNA origami design, cryo-EM single-particle analysis, Biopython

Cell biology: Cloning, protein purification, in vitro transcription, translation reporter assays, cell viability assays, enzyme activity assays, Western blots