



Identifying RNA 3D motifs with **ARTEM**

Eugene F. Baulin

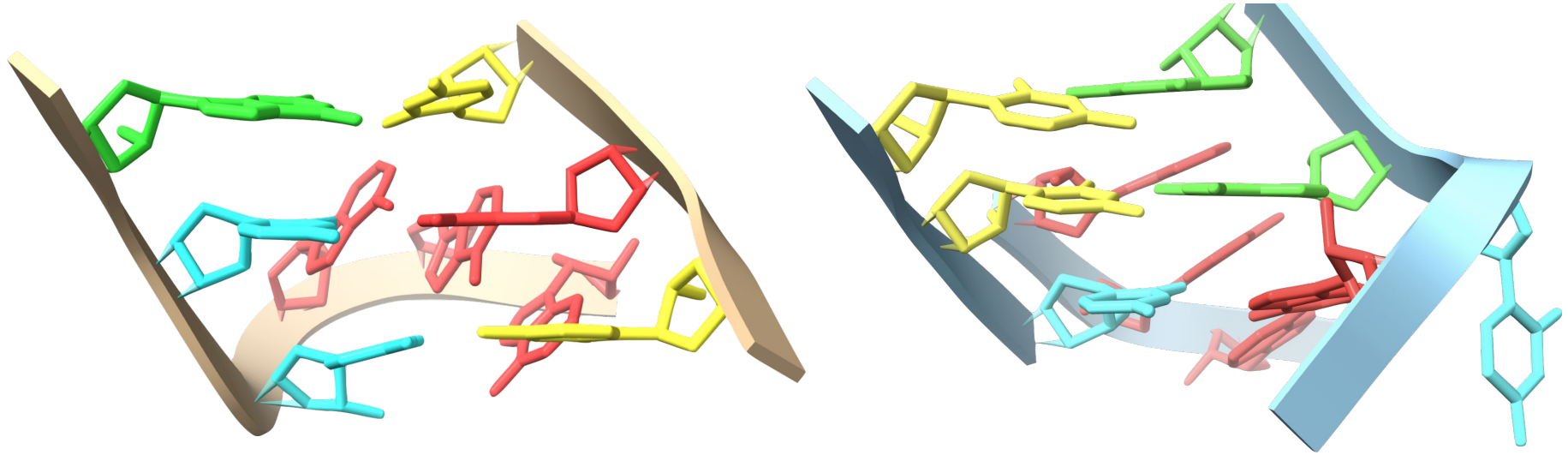
Laboratory of RNA Algorithms

The International Institute of Molecular Mechanisms and Machines

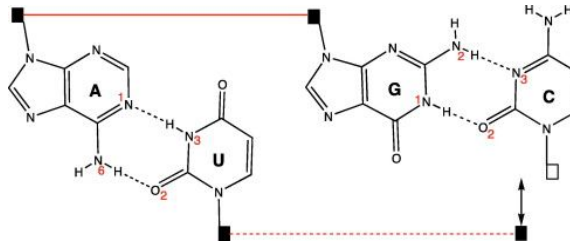
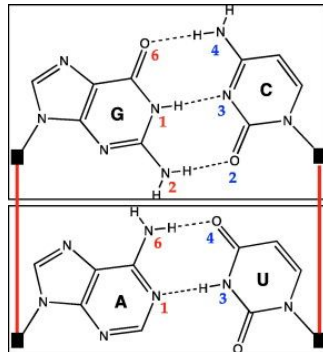
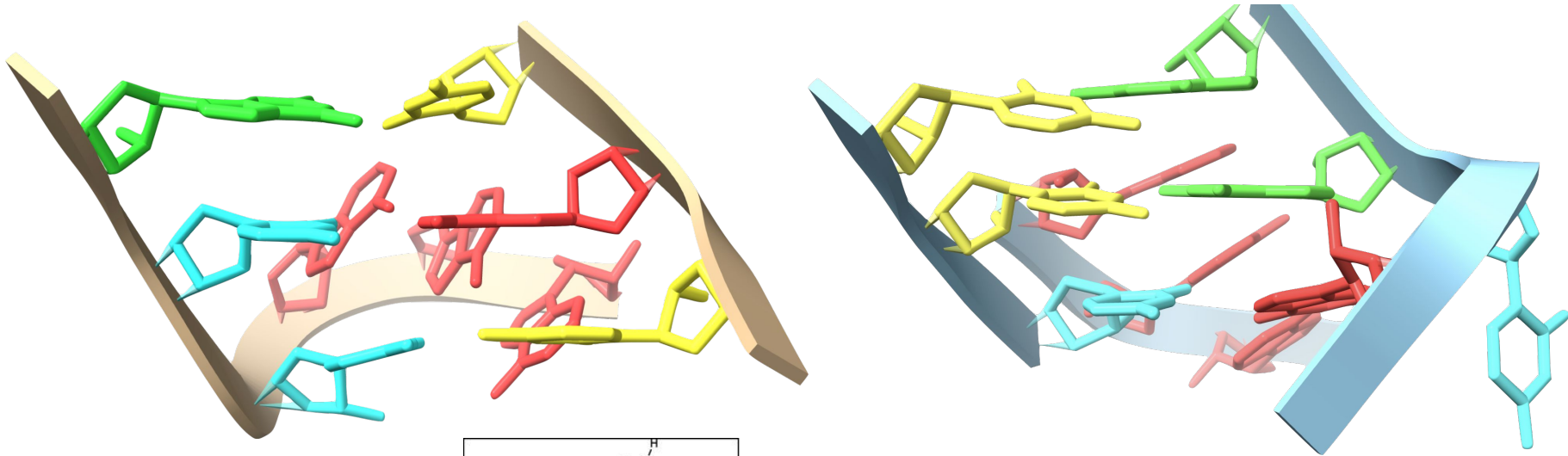
Polish Academy of Sciences

Benasque, 5-17 July 2026

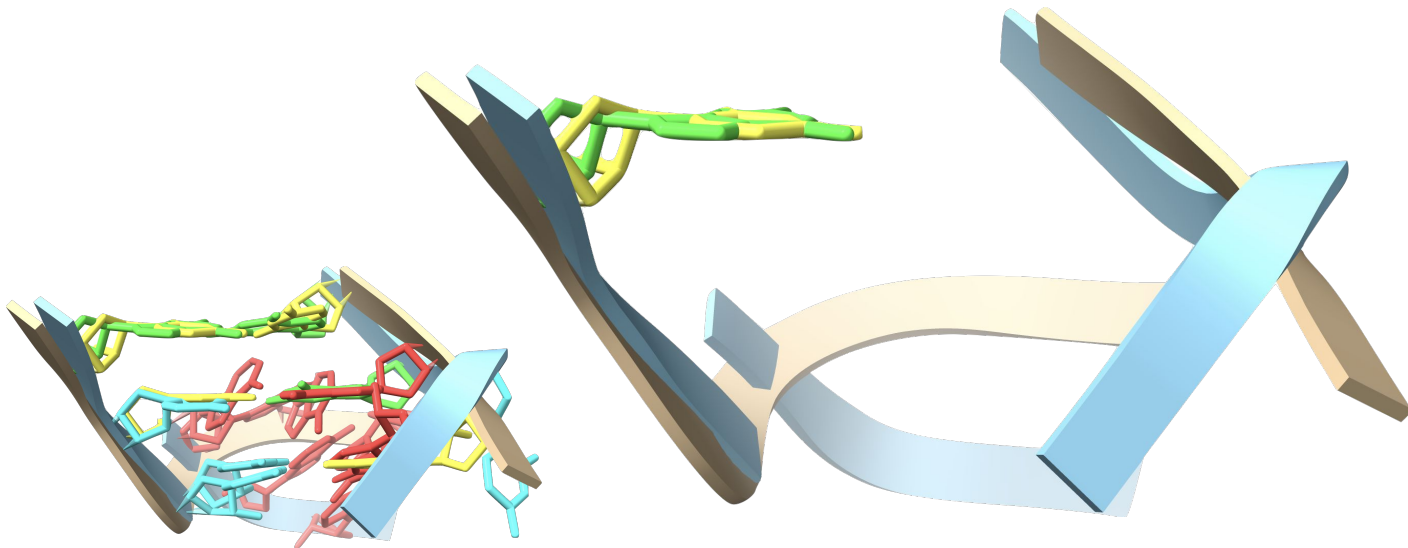
How similar are these RNA fragments?



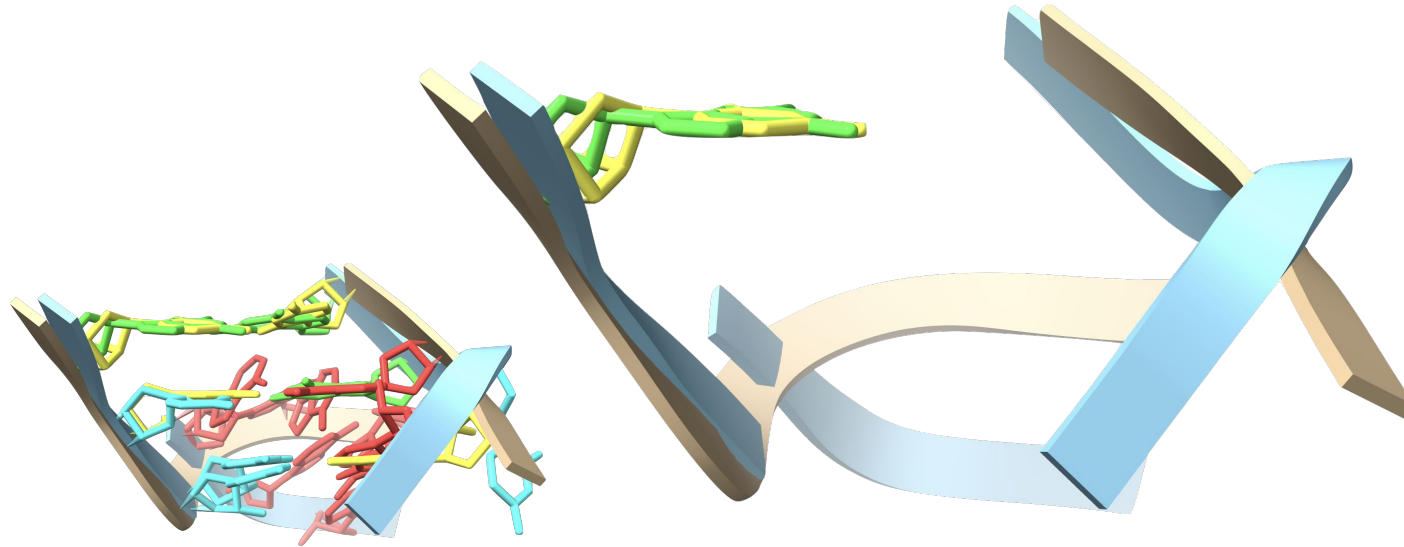
How to not rely on anything but isostericity?



Assumption



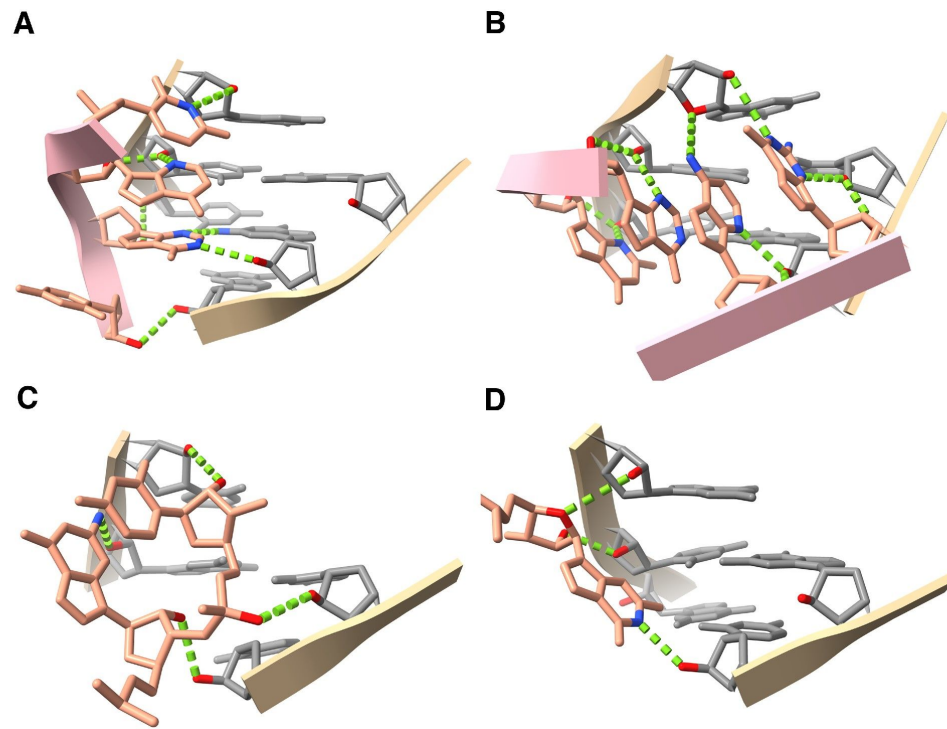
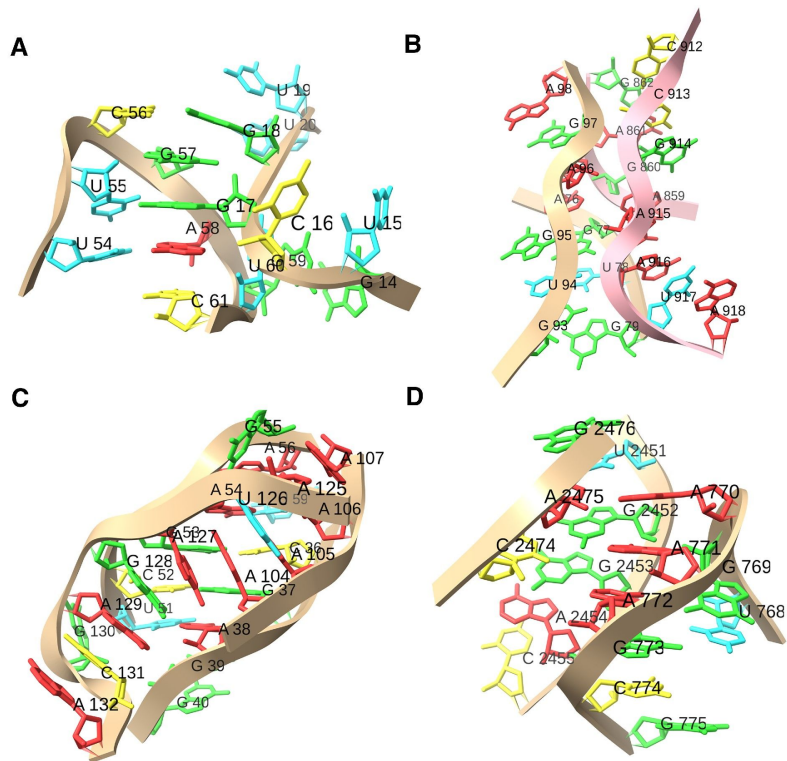
In a good superposition of two structurally similar RNA 3D motifs at least one residue-residue match has an RMSD close to zero.



**Aligning
RNA
Tertiary
Motifs**

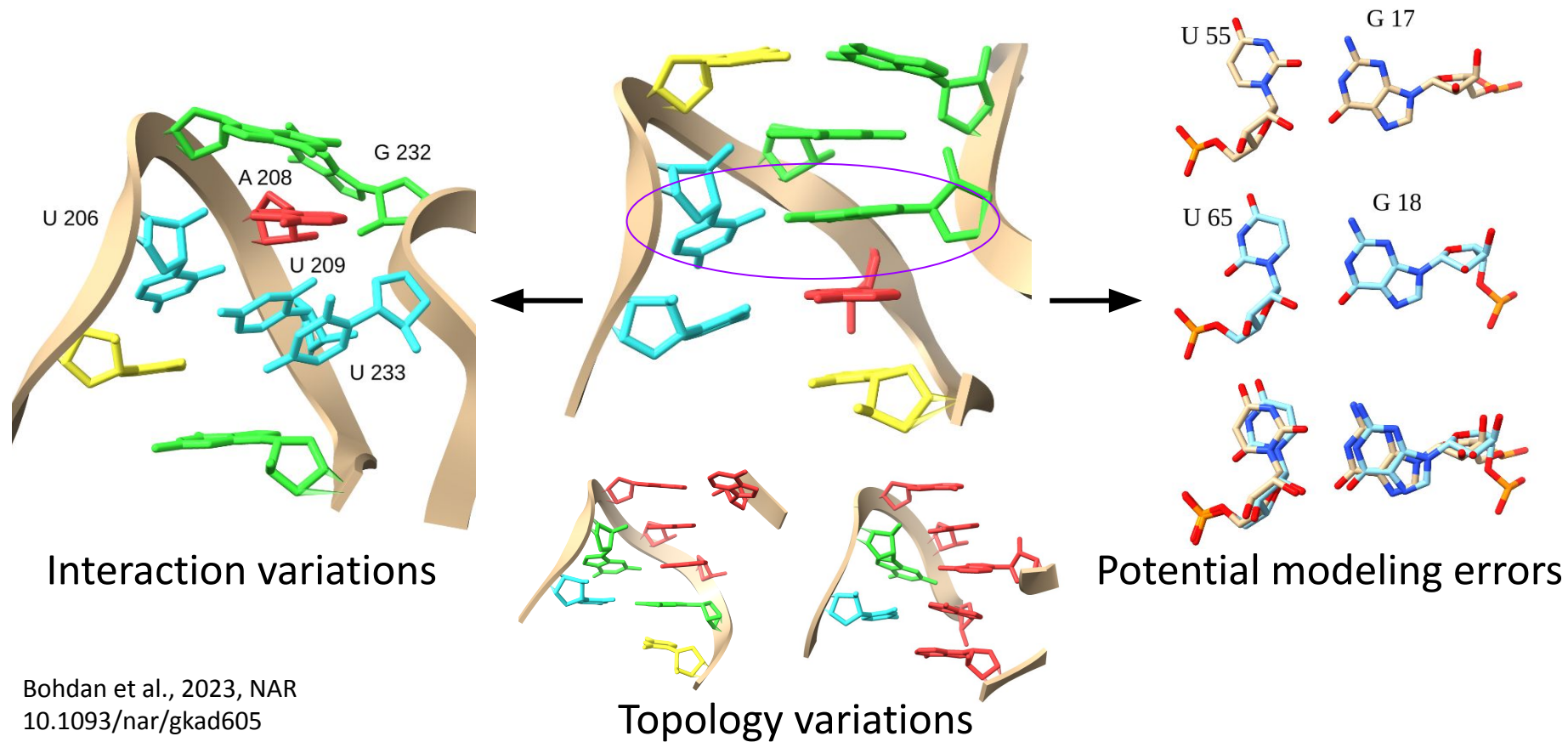
Try all $N \times M$ residue-residue superpositions
and choose the best one.

Case 1: Long-range modules

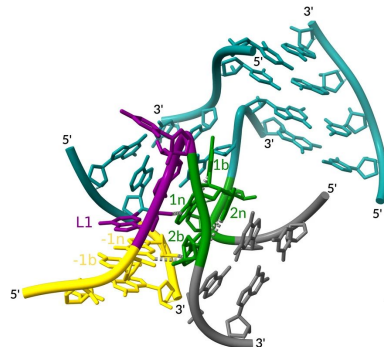
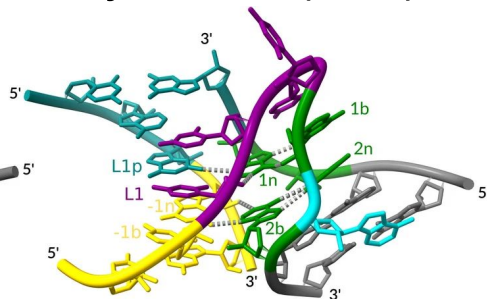
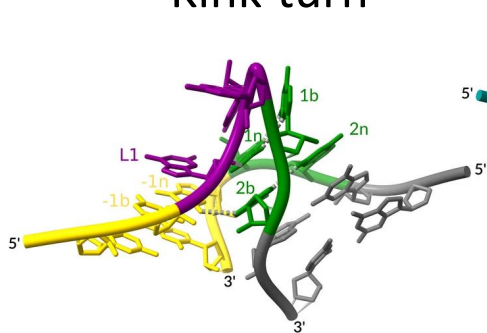




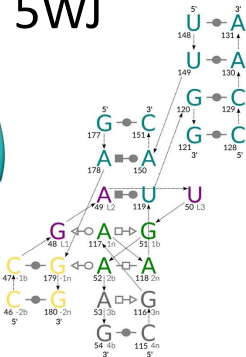
Case 2: D-loop/T-loop interaction motif



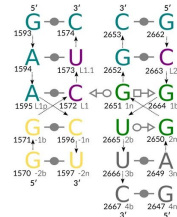
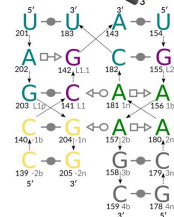
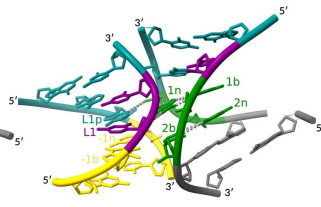
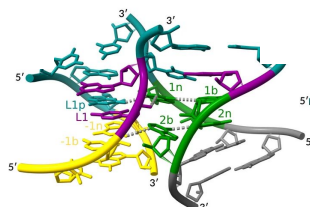
K-junction (3WJ)



5WJ



No-kink variants

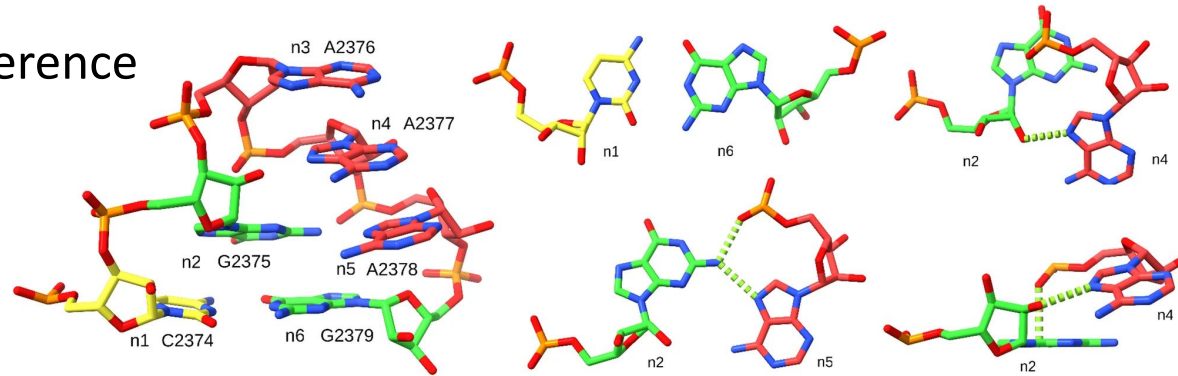


8

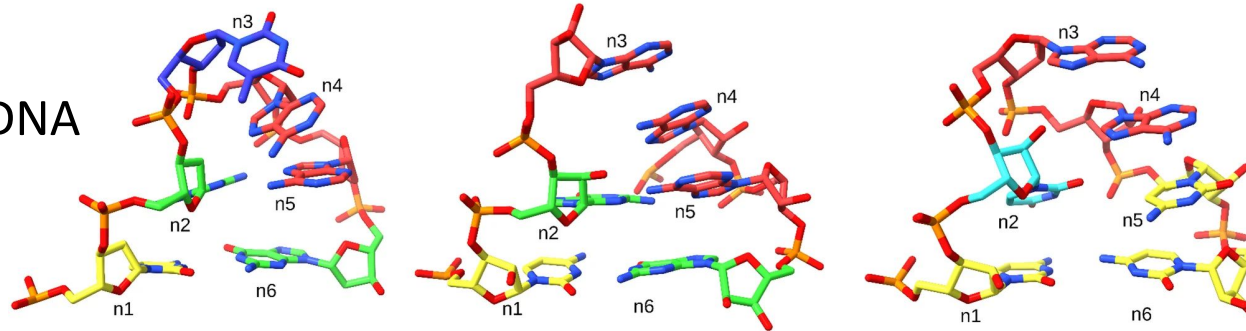
Case 4: GNRA-like motifs



GNRA reference



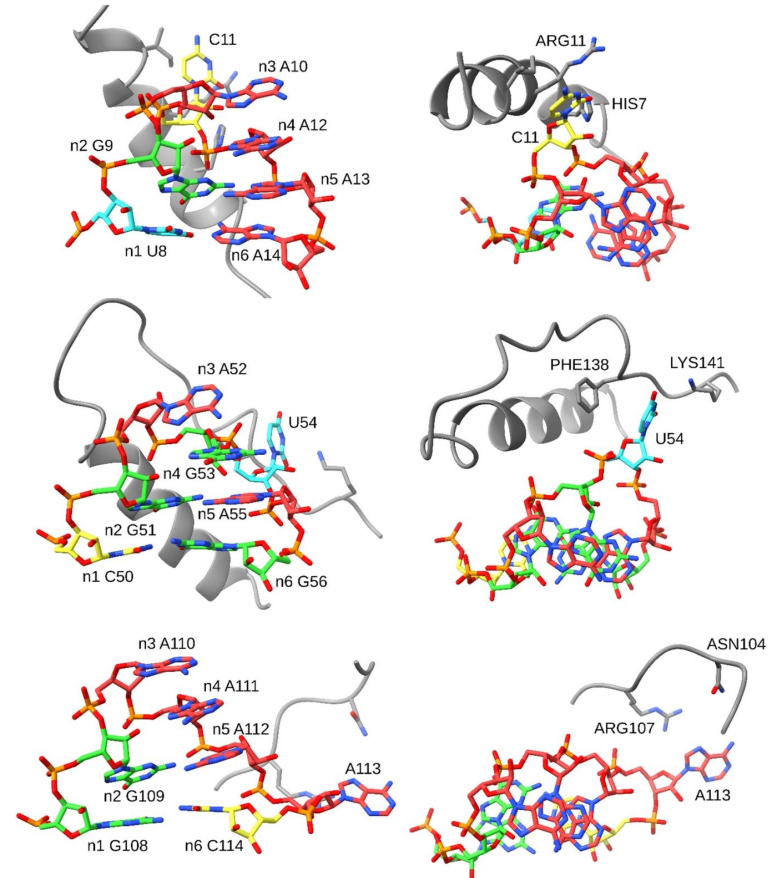
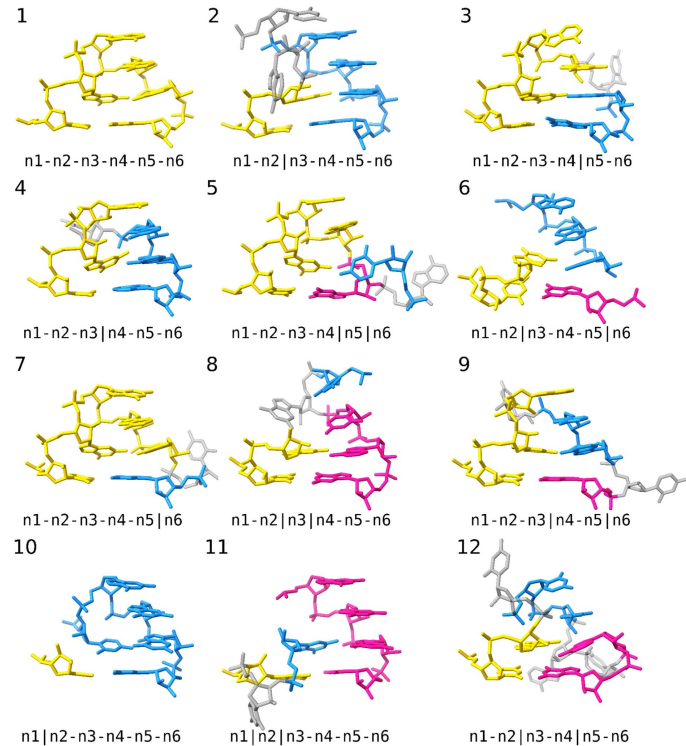
DNA



UAA/GAN loop

CUAACC hexaloop

Case 4: GNRA-like motifs





Derivatives (Past)

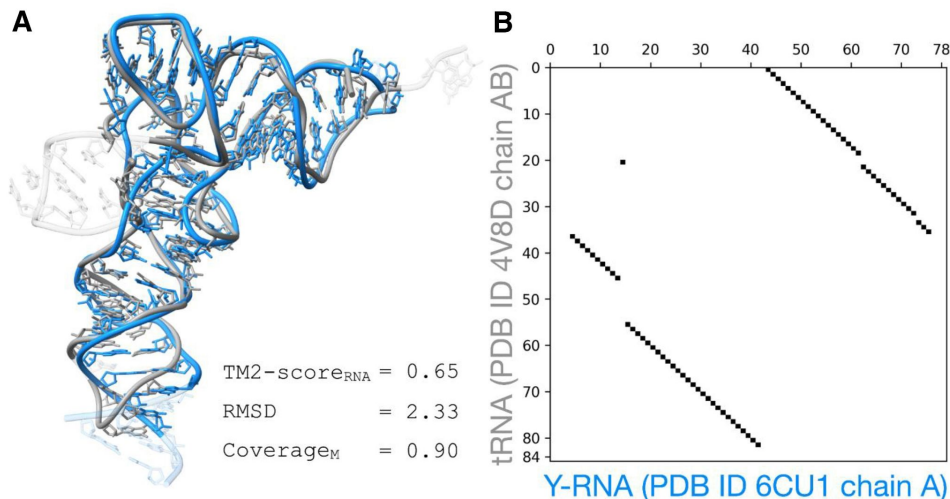
ARTEMIS: a method for topology-independent superposition of RNA 3D structures and structure-based sequence alignment

[Davyd R Bohdan](#) , [Janusz M Bujnicki](#) , [Eugene F Baulin](#) 

Nucleic Acids Research, Volume 52, Issue 18, 14 October 2024, Pages 10850–10861,

<https://doi.org/10.1093/nar/gkaf758>

Published: 11 September 2024 **Article history** ▼

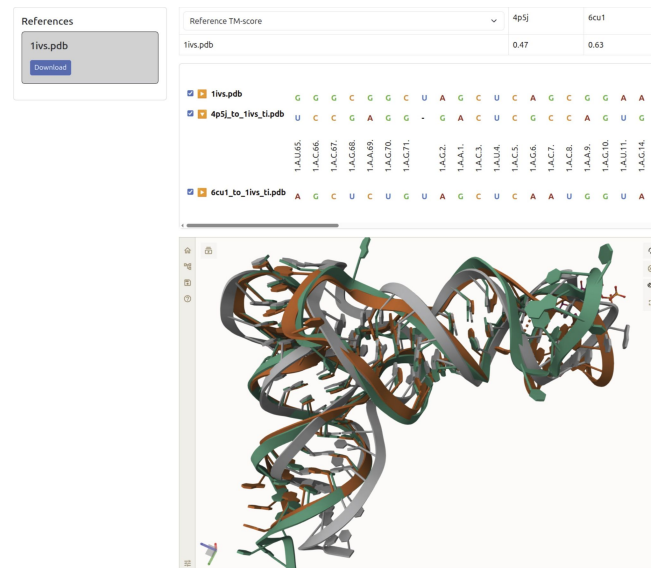


ARTEM server: an online tool for nucleic acid 3D motif searches, 3D structure superposition and structure-based alignment

[Dominik Sordyl](#), [Jan Cielesz](#), [Davyd R Bohdan](#), [Eugene F Baulin](#) , [Janusz M Bujnicki](#) 

Nucleic Acids Research, gkag428, <https://doi.org/10.1093/nar/gkag428>

Published: 05 May 2026 **Article history** ▼



Derivatives (Future)



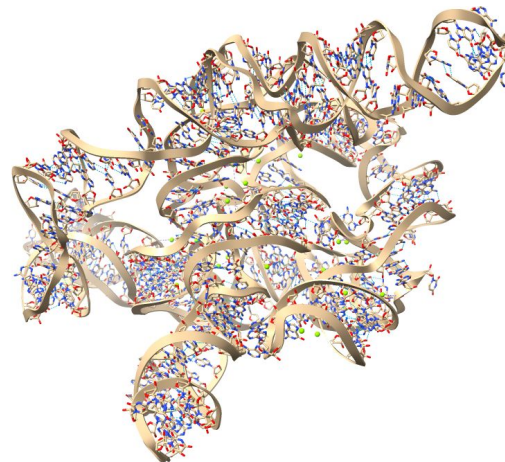
LARNATE



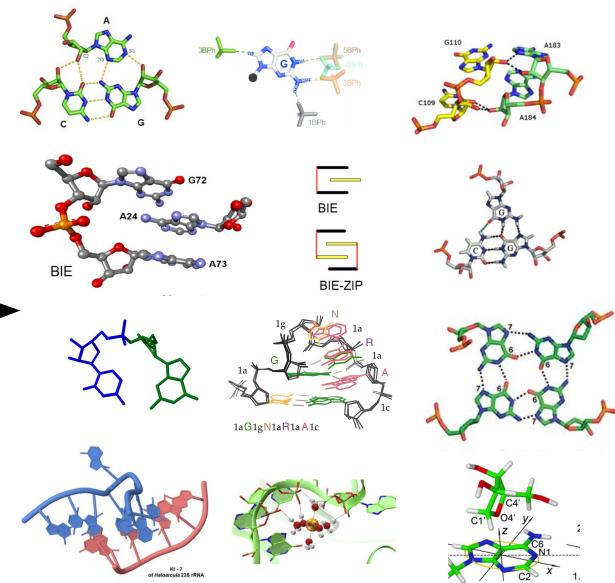
vs. (ARTEM)



new motifs



ARTEMANN



Derivatives (Future)



LARNATE

RCSB **PDB**
PROTEIN DATA BANK

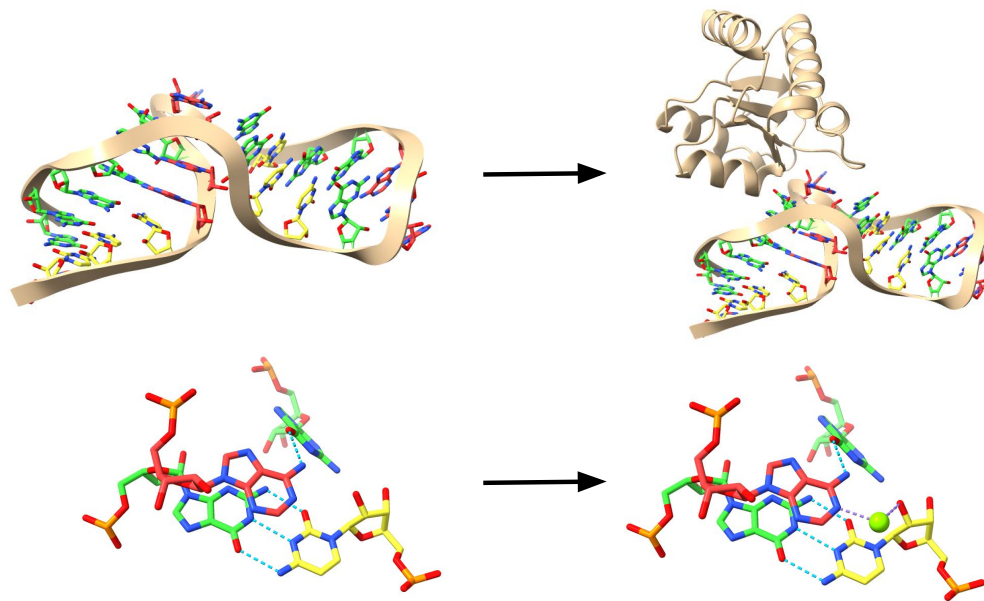
vs. (ARTEM)

RCSB **PDB**
PROTEIN DATA BANK



new motifs

ARTEMANN



Acknowledgments



Janusz Bujnicki

Davyd Bohdan
Valeria Voronina
Dominik Sordyl
Jan Cielesz
Dawid Kowalski
Milena Serwatka
Julia Świerczyńska
Zuzanna Żyra



Kunal Shewani

Maksim Serdakov

 <https://github.com/febos/wiki>



ALTF-525-2022 fellowship
to Eugene Baulin

Thank you!



2017/25/B/NZ2/01294 to Janusz Bujnicki
2024/53/B/NZ2/02718 to Eugene Baulin
2024/55/D/NZ2/02049 to Eugene Baulin