

Ribocentre Databases for functional RNAs

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www.rnacentre.org

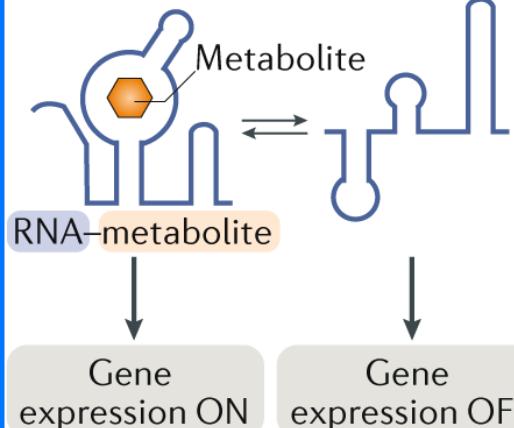
Computational Approaches to RNA Structure and Function
Ribonucleic acid
Buenos Aires, Argentina
Banasque, Spain

26 July 2024

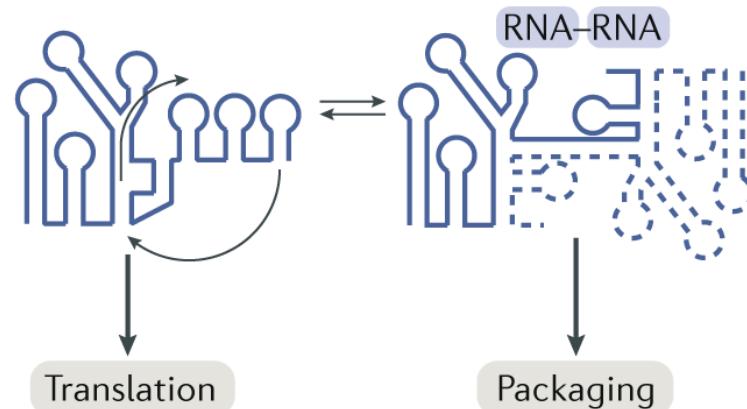


Understanding RNA: structure - function

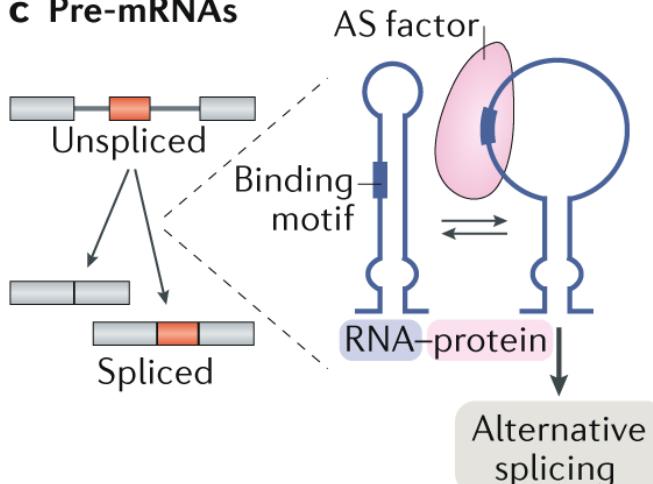
a Riboswitches



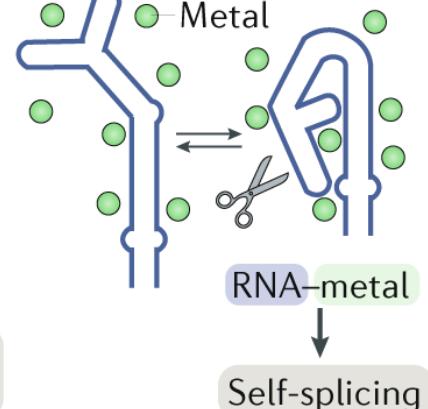
b HIV-1 genome



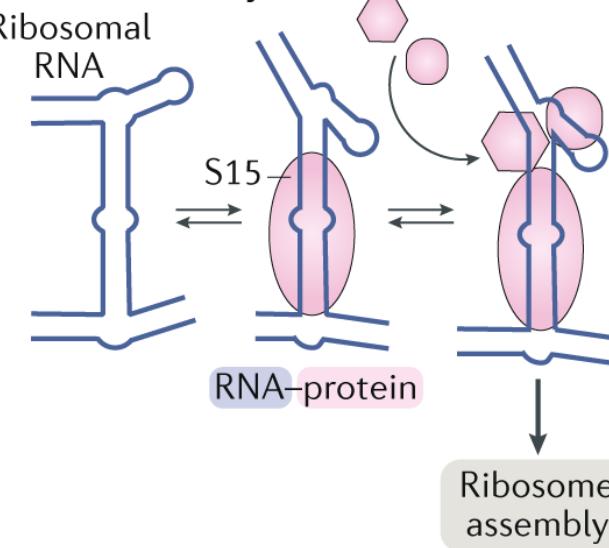
c Pre-mRNAs



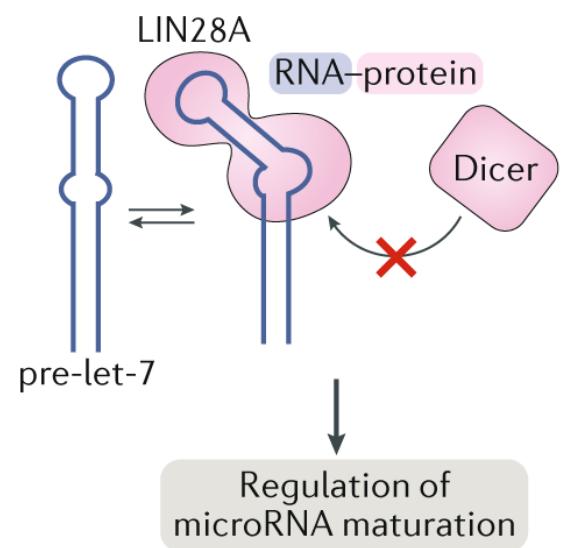
d Ribozymes



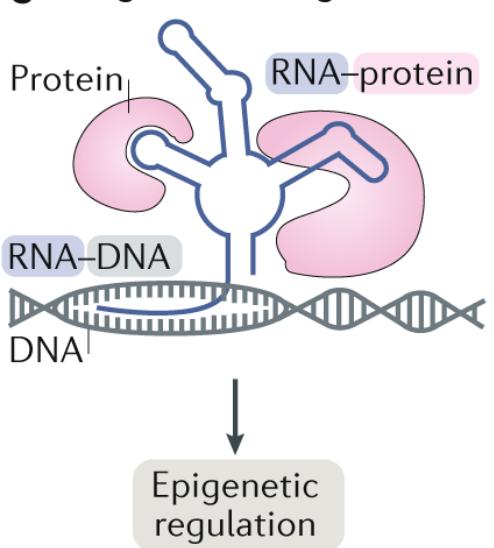
e RNP assembly



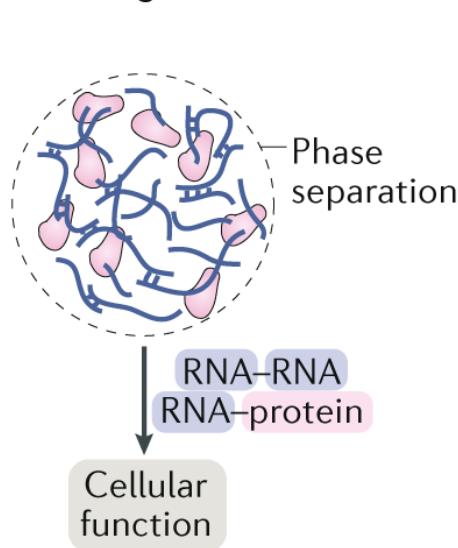
f MicroRNAs



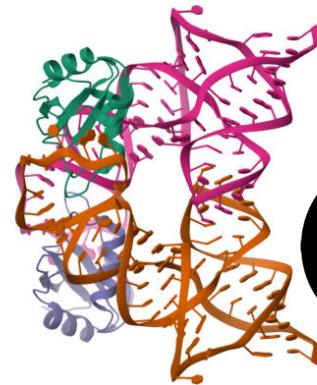
g Long non-coding RNAs



h RNA granules



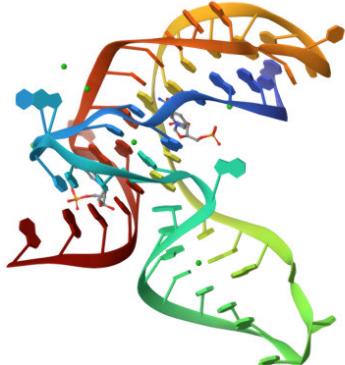
Understanding RNA: structure - function



Ribo
centre

7qr4 HDV-like **ribozyme**

Ribo
centre



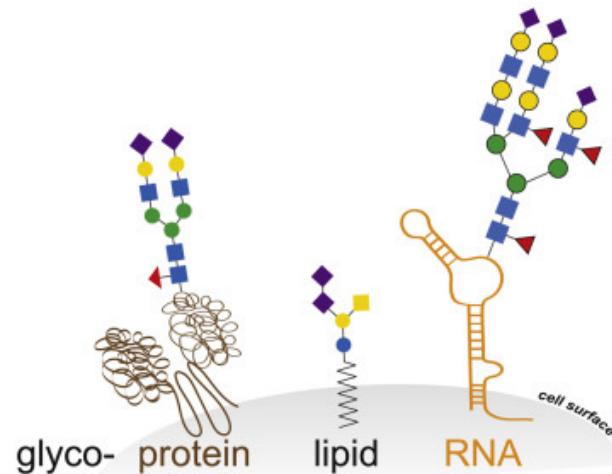
Ribo
switch

8hb8 NAD-II **riboswitch**

Chichau Miao@Guangzhou Laboratory

Ribo
aptamer

7eoj Pepper **Aptamer**



GlycoRNA

Cell 184,12, p3109-3124.E22, 2021

www.ribocentre.org

The Nobel Prize in Chemistry 1989

DNA \Rightarrow **RNA** \Rightarrow **protein**

genetic information transmitter of genetic information and biocatalyst biocatalyst

(Nobel Prize in 1989)

15 ribozymes



Photo from the Nobel Foundation archive.
Sidney Altman
Prize share: 1/2

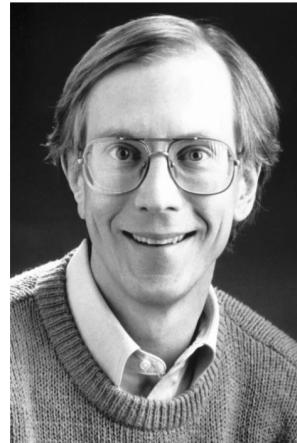
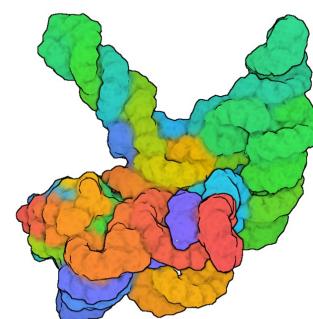
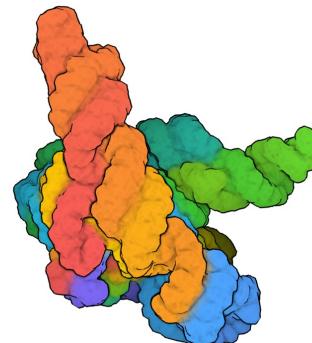


Photo from the Nobel Foundation archive.
Thomas R. Cech
Prize share: 1/2

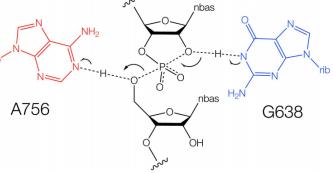
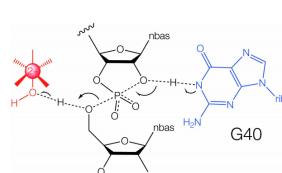
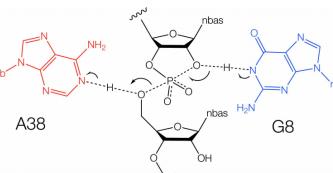
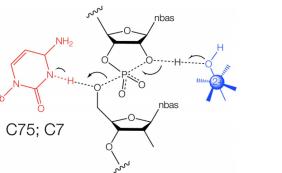
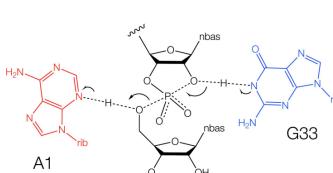
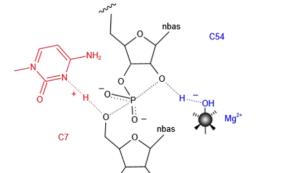
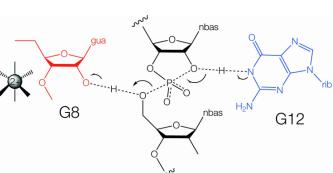
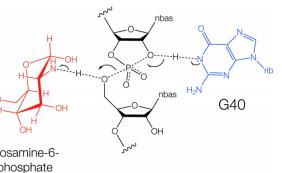


RNase P

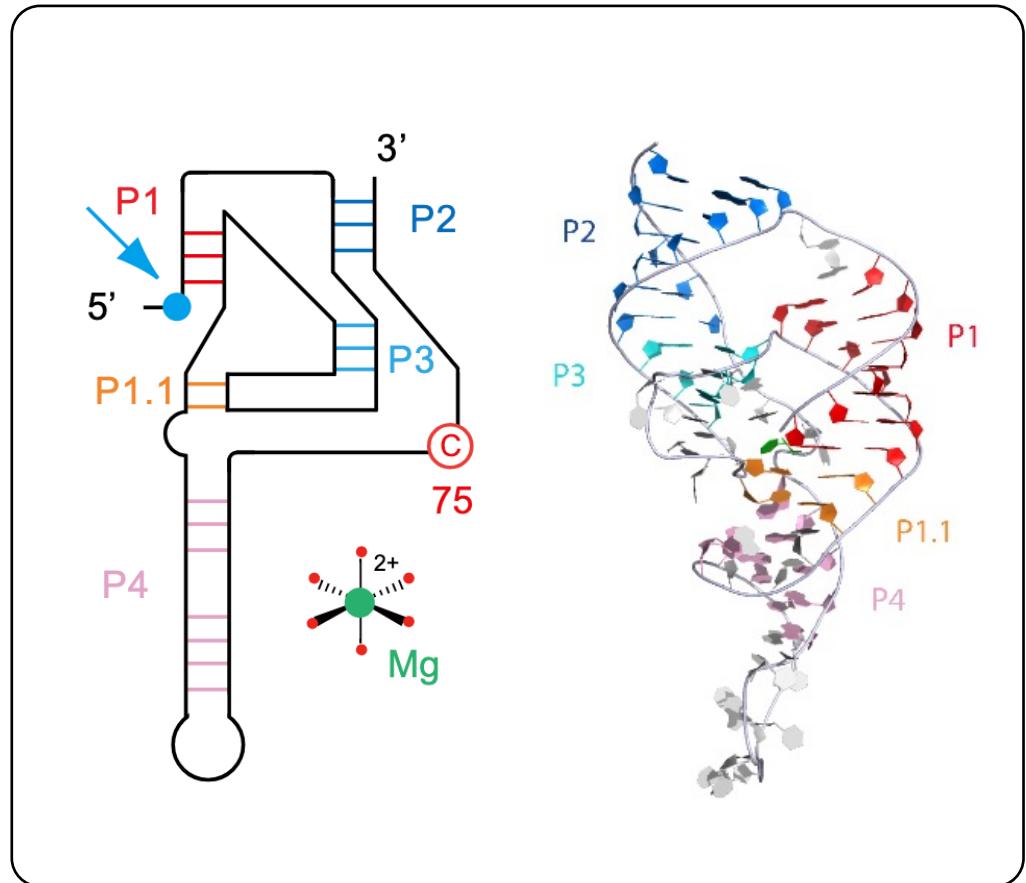


Self-splicing

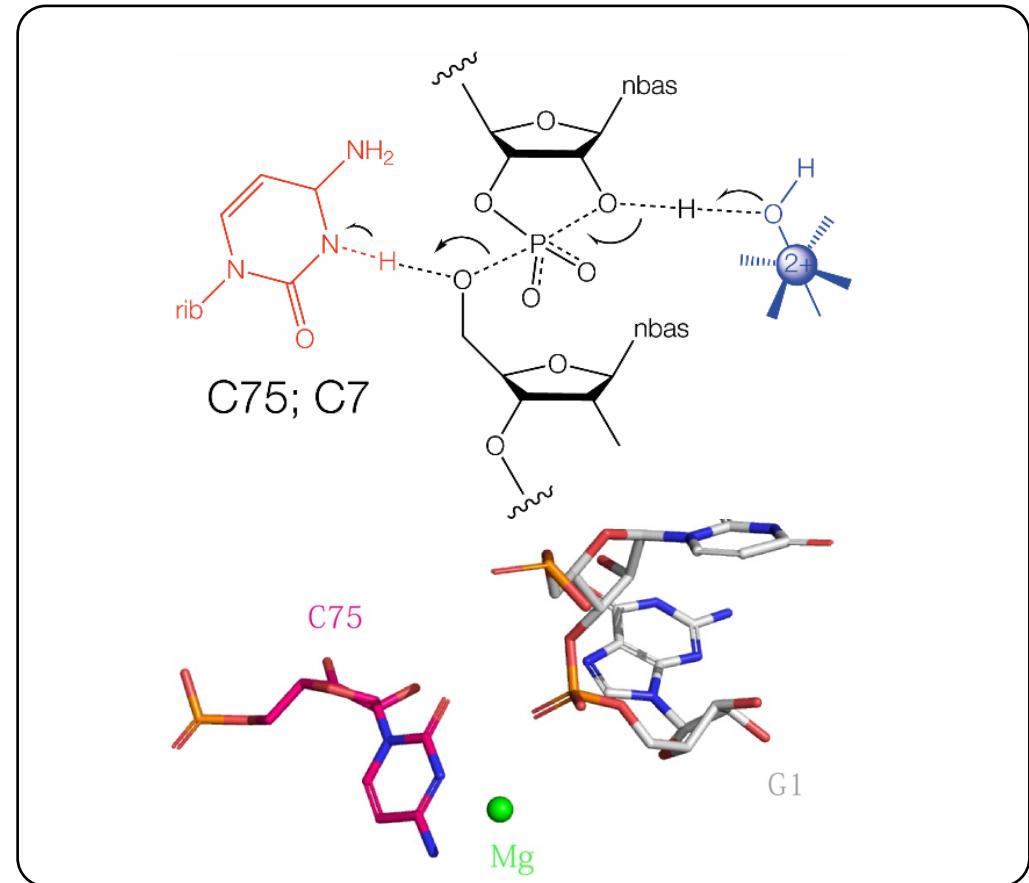
Summary of the catalysis

Ribozyme	Acid	Base	Catalytic centre	Notes	Ribozyme	Acid	Base	Catalytic centre	Notes
VS	A N1	G N1			Pistol	Mg ²⁺ H ₂ O	G N1		
Hairpin	A N1	G N1			HDV	C N3	Mg ²⁺ OH ⁻		
Twister	A N3	G N1		Acid adjacent to scissile P	Twister-sister	C N3?	Mg ²⁺ OH ⁻		
Hammerhead	O 2'	G N1		O2' activated by Mg ²⁺	Glms	Glc6p amine	G N1		Use of a coenzyme

HDV: a showcase

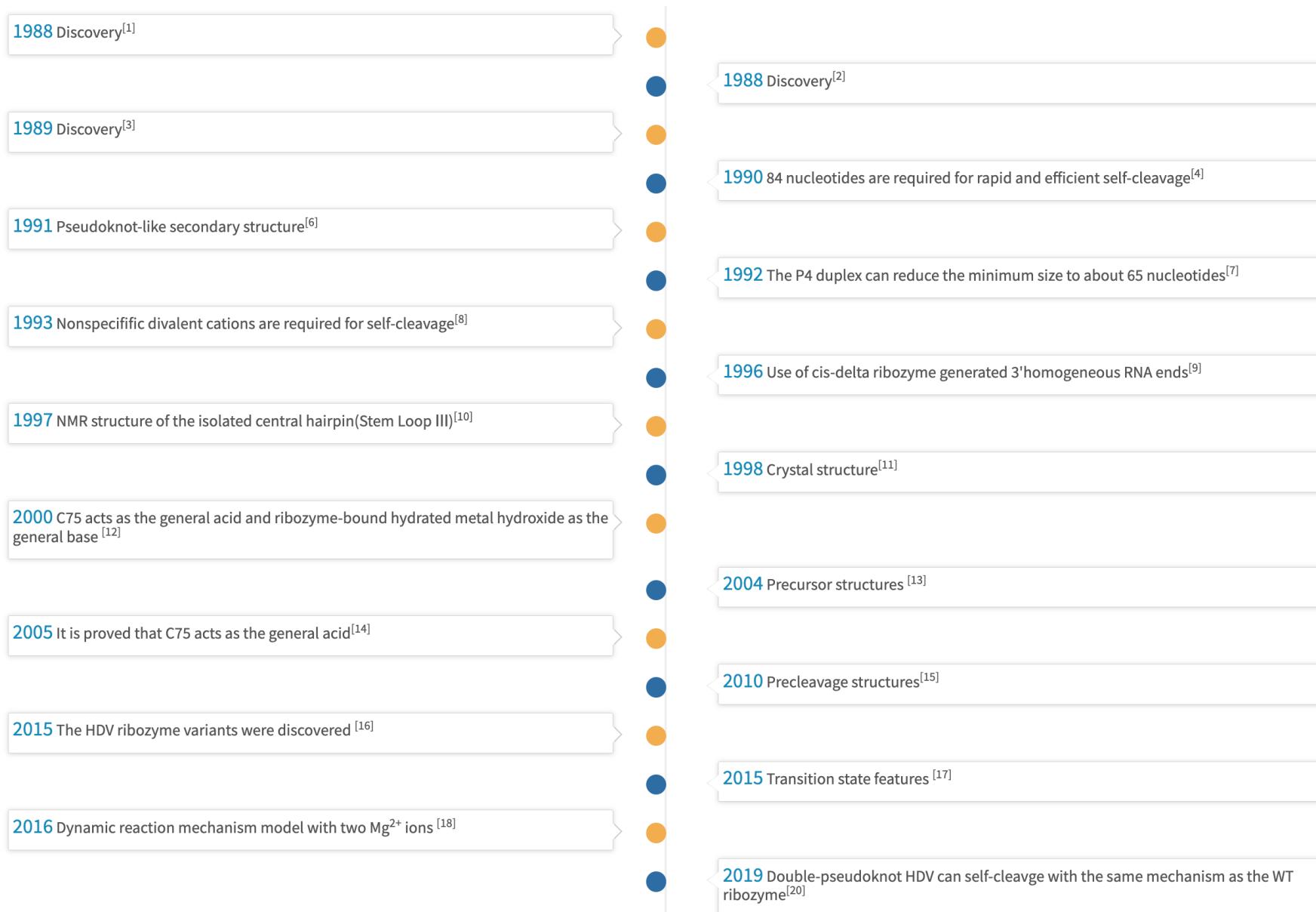


Structure



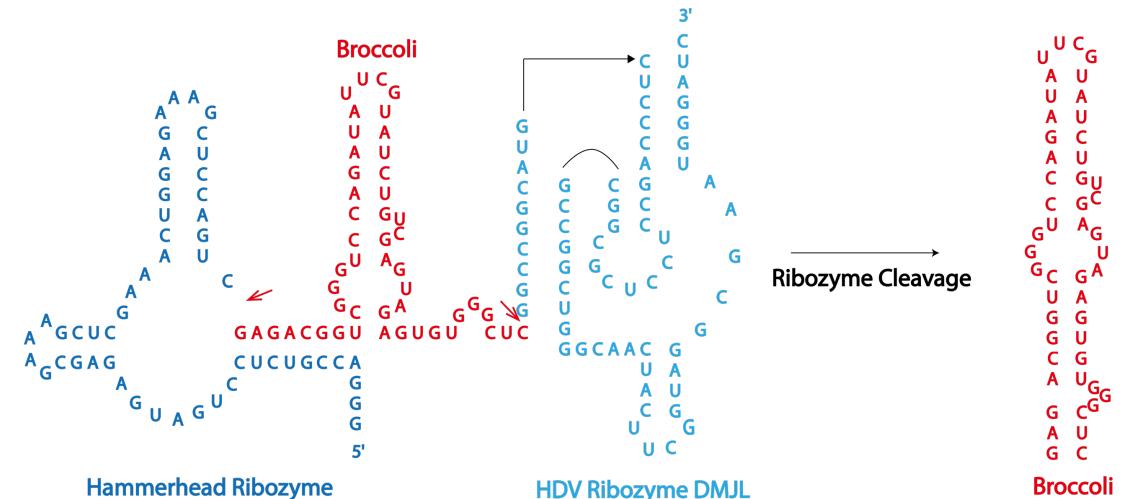
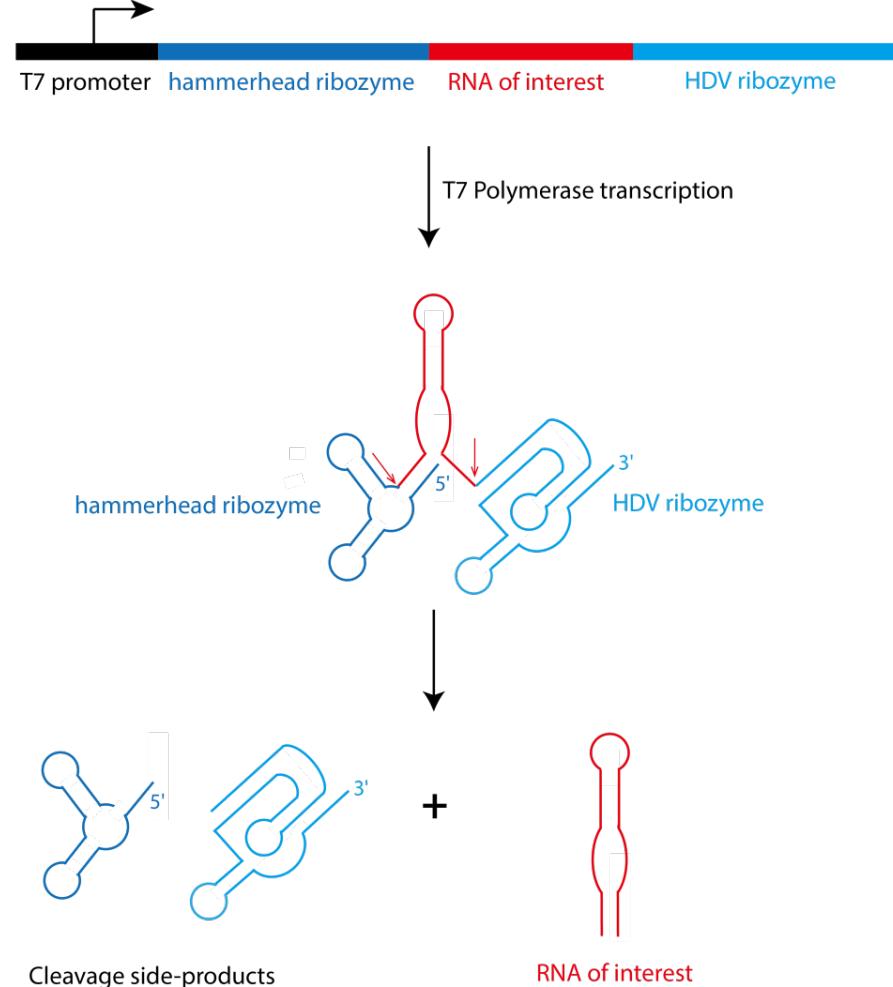
Function

The research history of each RNA



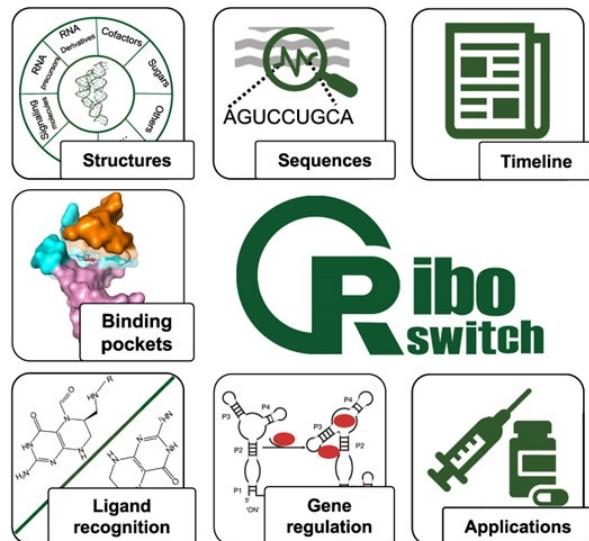
Application: How to make use of the RNA

HDV as a showcase as a tool for designed RNA

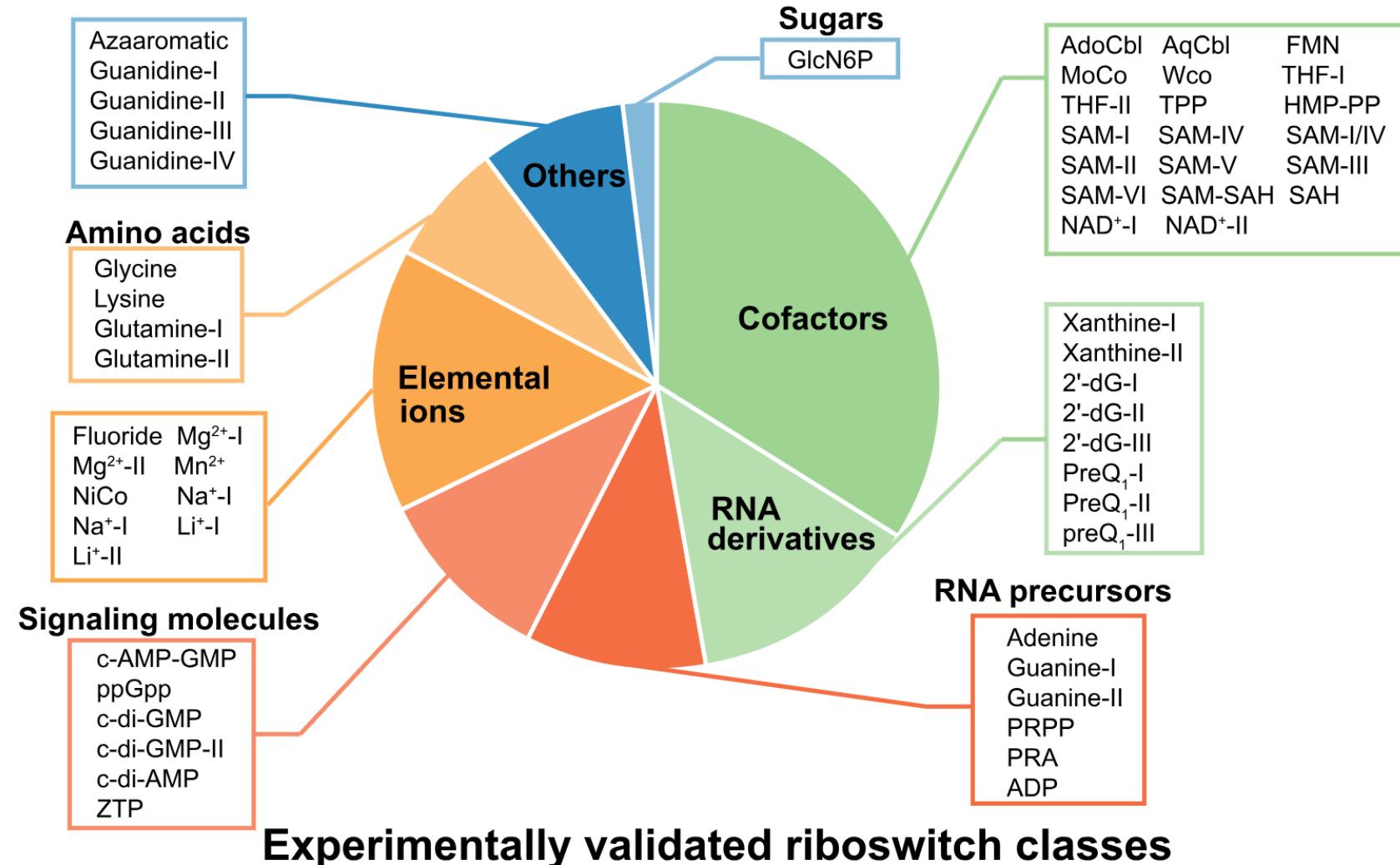


Ribocentre-switch: A **riboswitch** database

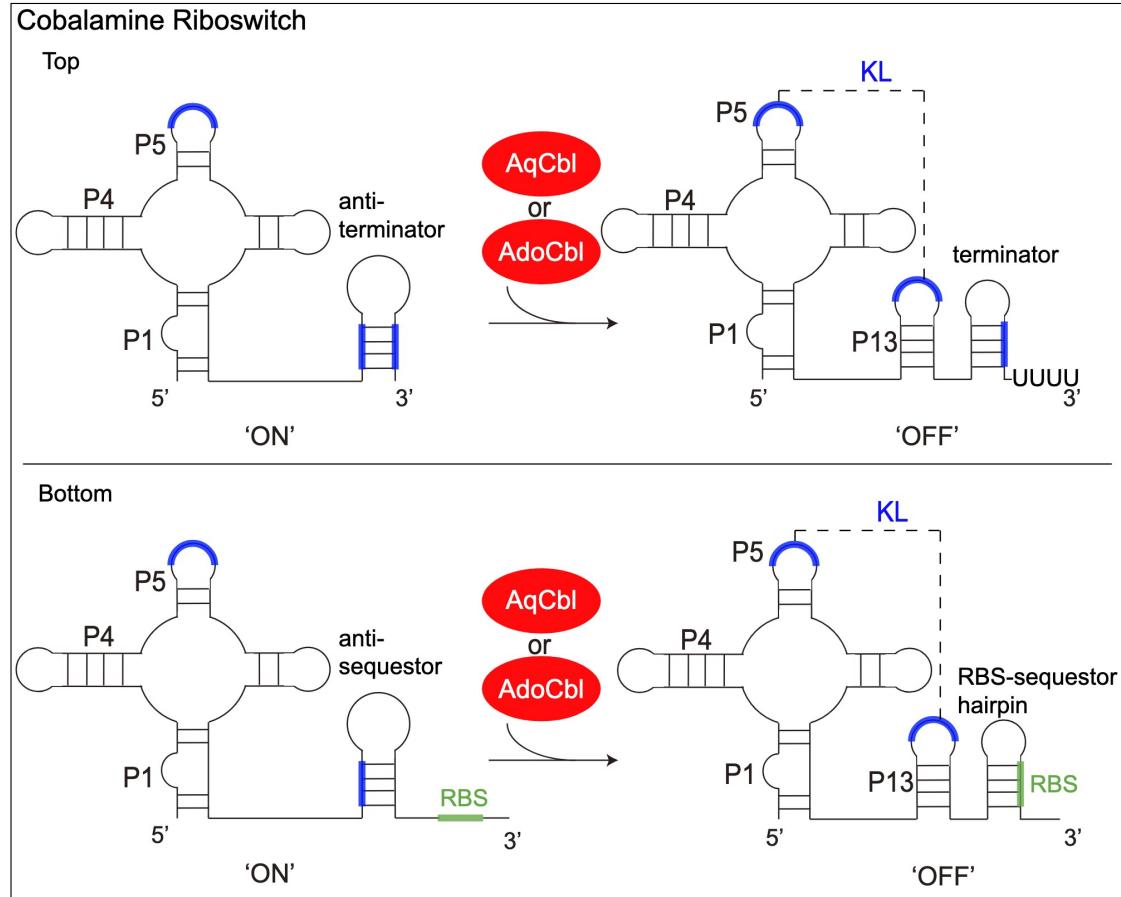
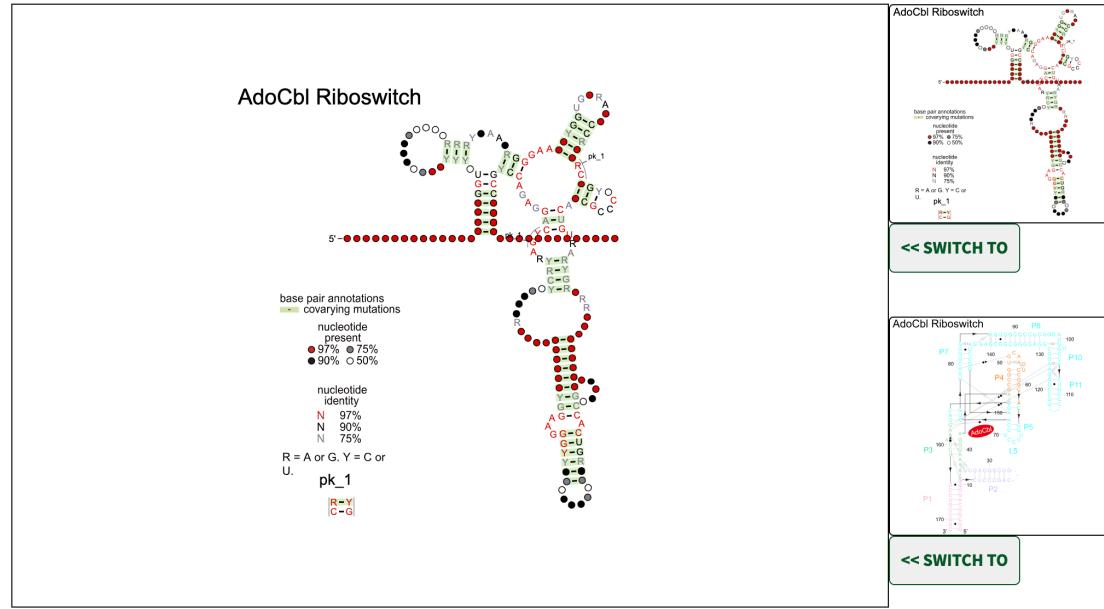
riboswitch.ribocentre.org



51
riboswitches



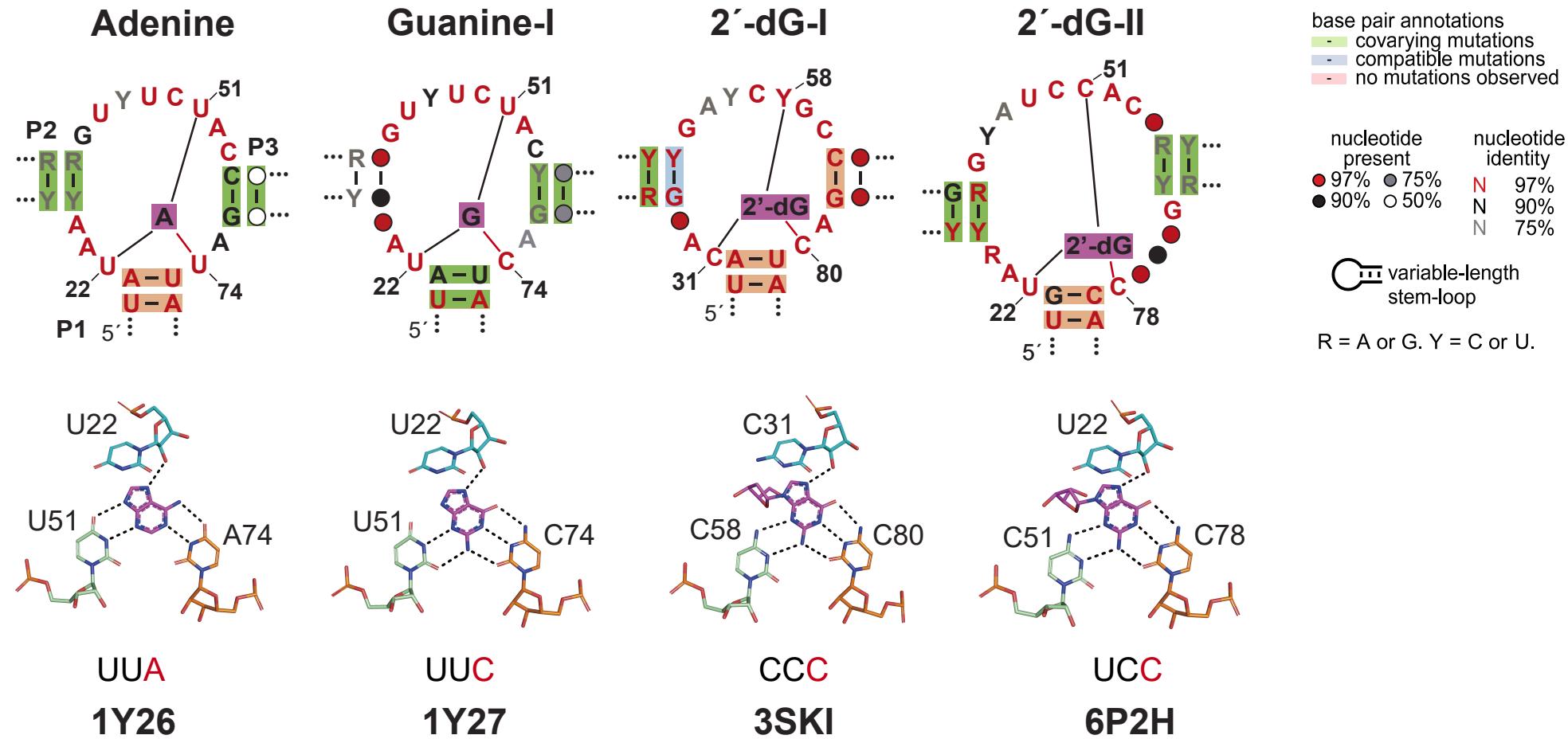
improved visualization than ribozyme



2D structure

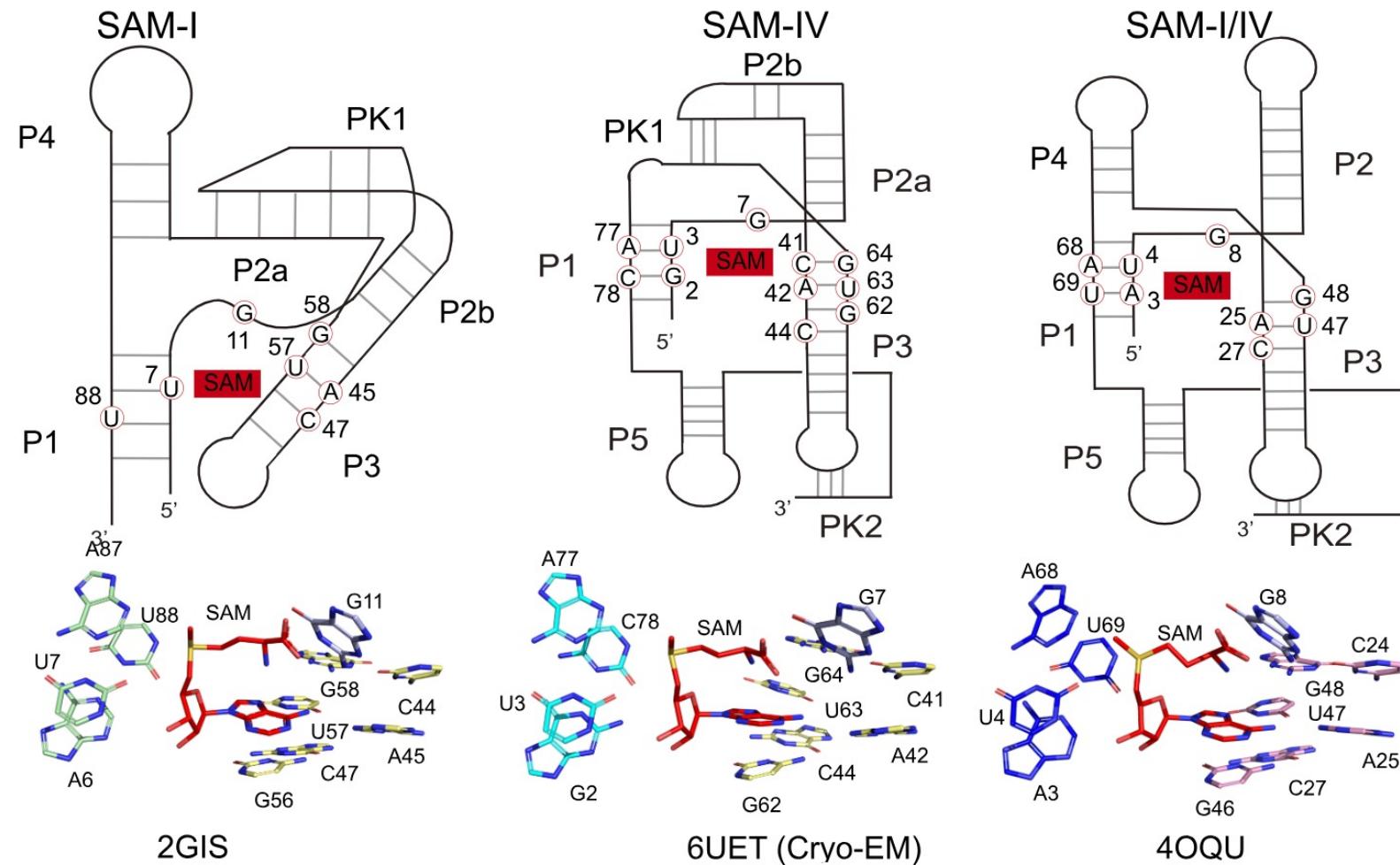
Mechanism summary

Ribocentre-switch: A riboswitch database



Summary of the binding pockets in purine riboswitch family

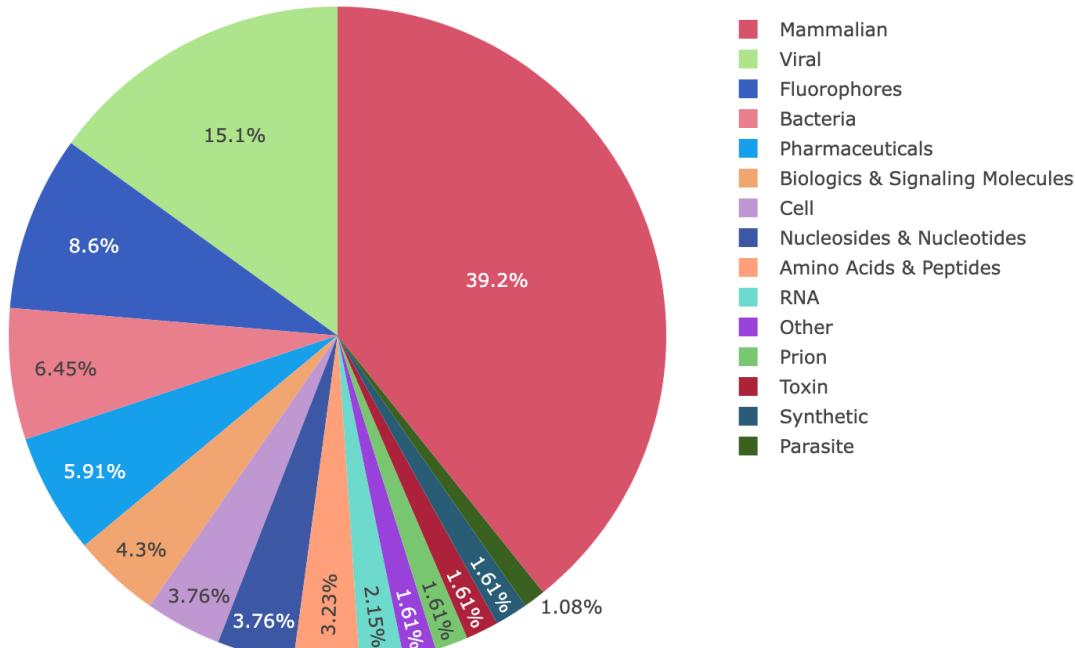
Ribocentre-switch: A **riboswitch** database



Comparison of the binding site of SAM-I family riboswitches

Ribocentre-Aptamer: An aptamer database

aptamer.ribocentre.org



183 aptamers

15 categories

51 w. structures

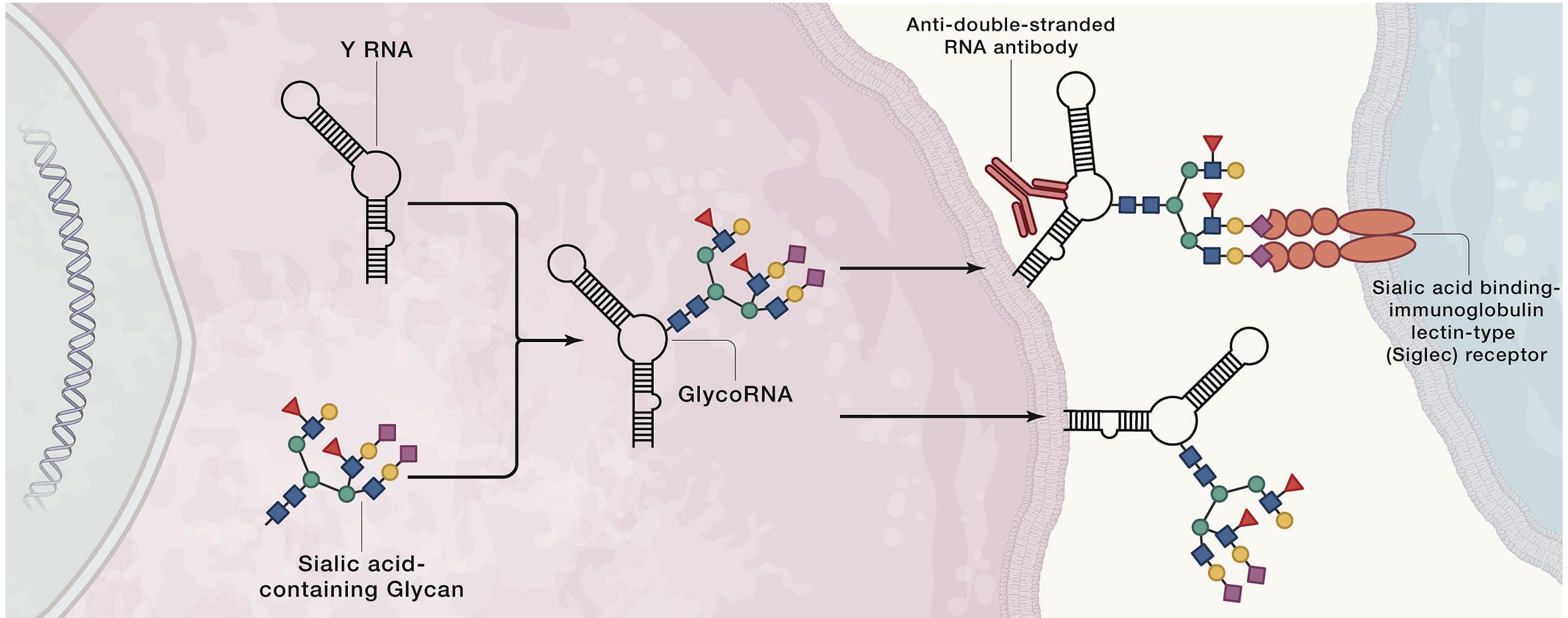
Citrulline	Arginine	Chili	TMR	Mango	Mango III	Spinach	Corn	DIR2s
Pepper	MG	Clivias	Beetroot	FMN	VITAMIN B12	5HTP	Riboflavin	Biotin
AML1	GCP II	eIF4A	GRK2	Human IgG	NF-kappaB	Thrombin	Lysozyme	GlnRs
Factor Xa	ATP	GTP	Tetracycline	Neomycin B	Streptomycin	Theophylline	Tobramycin	Hfq
ribosomal protein S8	TetR	RNA polymerase (Pol) II	HIV-1 REV peptide	Tat peptides	HTLV-1 arginine-rich Rex peptide	HIV-1 TAR RNA	Bacteriophage MS2 coat protein	Bovine prion



GlycoRNAdb: A GlycoRNA database

glycorna.ribocentre.org

- GlycoRNAs are present on the **cell surface**, influencing **molecular recognition** and being associated with autoimmune **diseases**.



GlycoRNAdb: A GlycoRNA database



CellPress

Cell 184, 3109–3124, June 10, 2021

Cell
Article

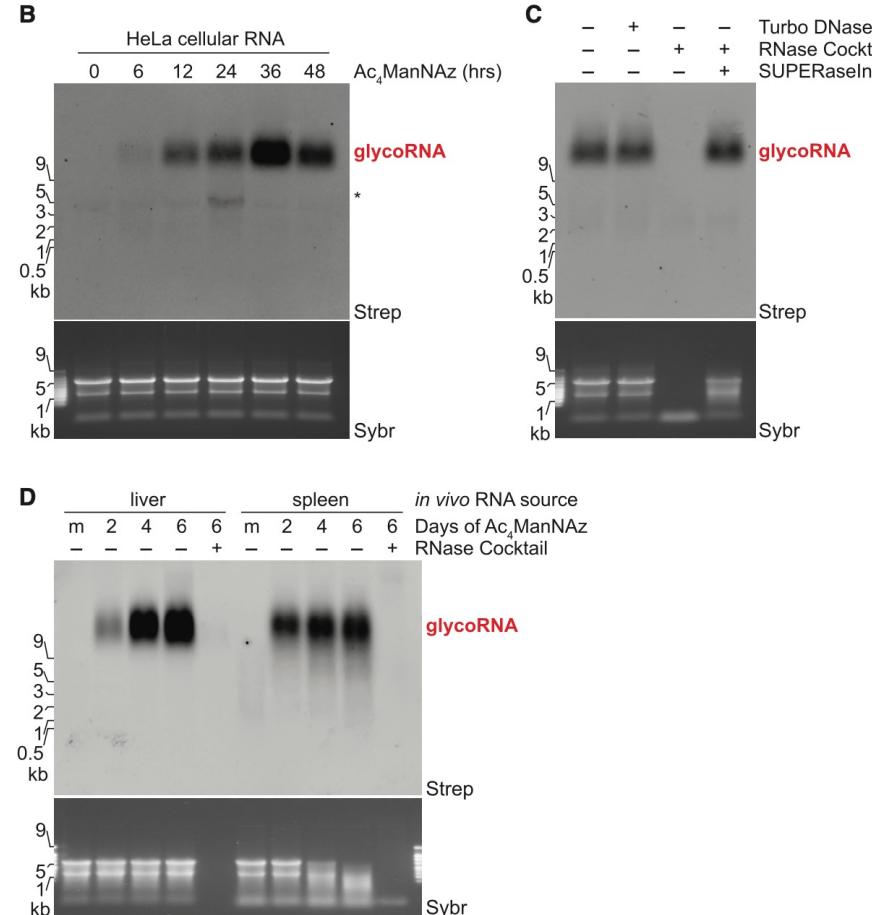
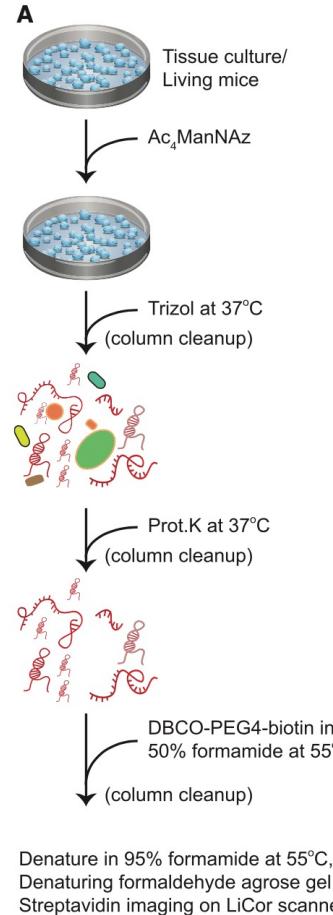
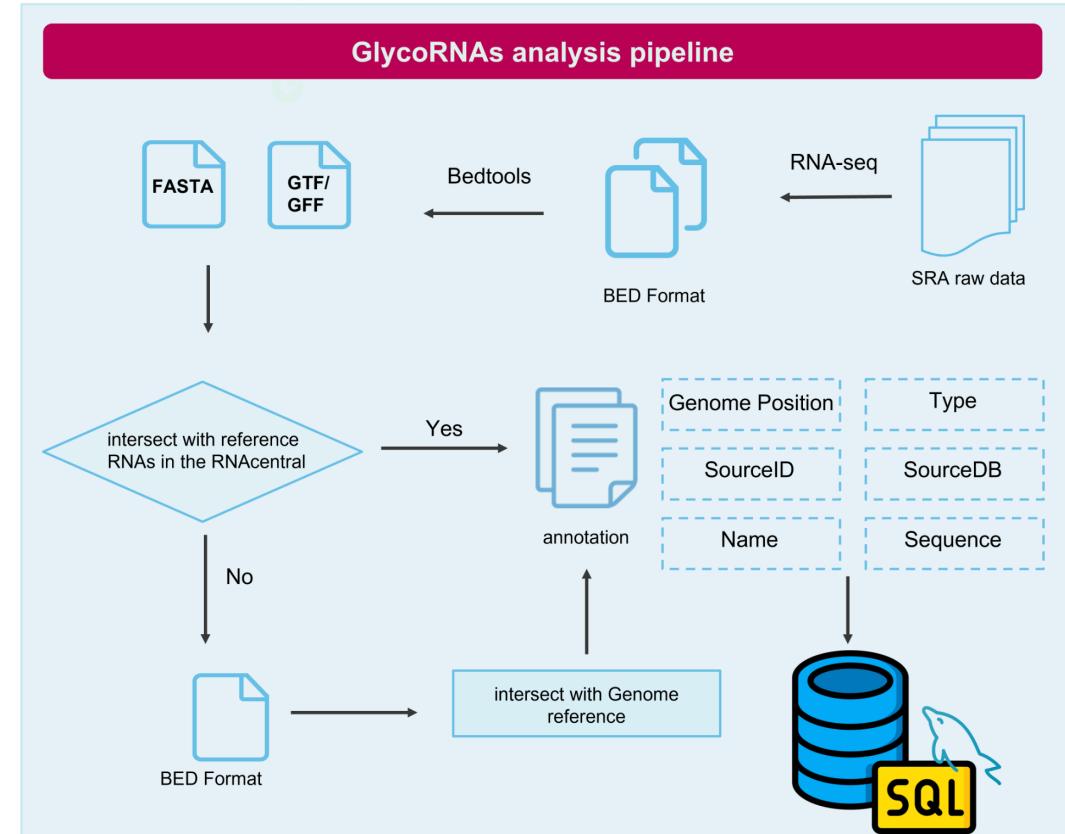


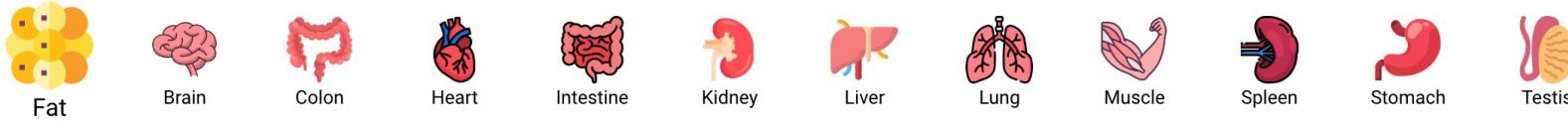
Figure 1. Ac₄ManNAz, a glycan reporter, incorporates into mammalian cellular RNA

Reporter system for GlycoRNA detection



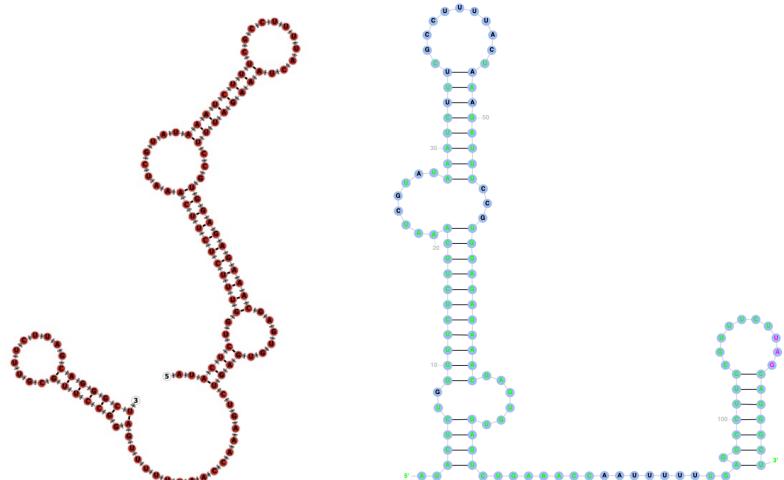
A standardized analysis pipeline

GlycoRNAdb: A GlycoRNA database

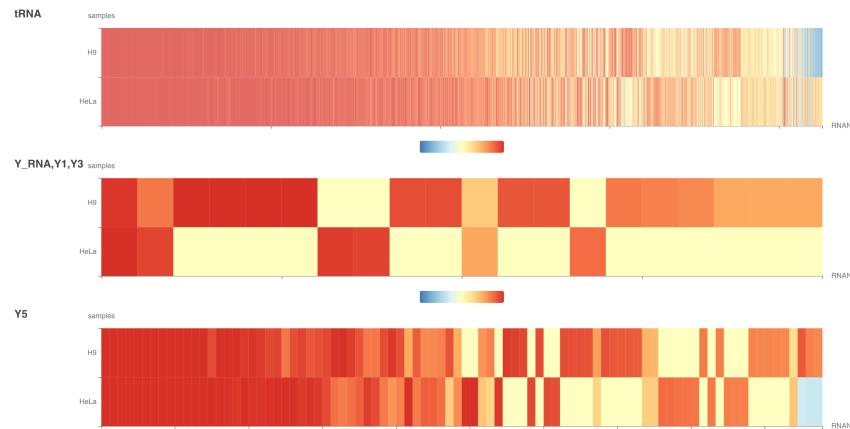


GSE id	Samples	Title	Organism	Summary	Reference
GSE136967	4	Ac4ManNAz enriched small RNAs	Homo sapiens	Ac4ManNAz enriched small RNAs in HeLa and H9 ES cells	PMID:34004145
					DETAILS
GSM ID	Cell Line	Condition/Treatment	Title	Sample type	Library strategy
GSM4064120	HeLa	Input	HeLa_SmallRNA_Input	Input small RNAs	ncRNA-Seq
GSM4064121	HeLa	ManNAz enriched	HeLa_SmallRNA_ManNAz-enrich	ManNAz enriched small RNAs	ncRNA-Seq
GSM4064122	H9 embryonic stem cells	Input	HeLa_SmallRNA_Input	Input small RNAs	ncRNA-Seq
GSM4064123	H9 embryonic stem cells	ManNAz enriched	HeLa_SmallRNA_ManNAz-enrich	ManNAz enriched small RNAs	ncRNA-Seq
Records per page: 5 ▾ 1-4 of 4					
HIDE DETAILS	GO TO THE ARTICLE >				

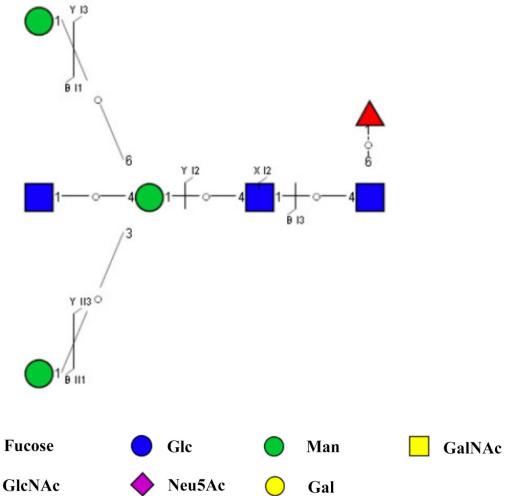
Study information



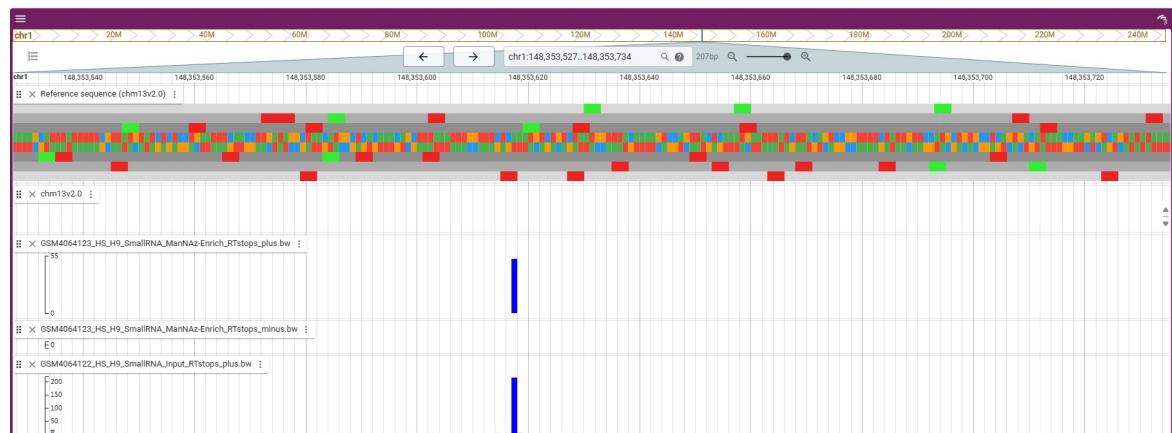
2D Structure



Expression level



Glycan topology



Genome location

Websites

Ribozyme is designed to curate comprehensive information of all natural ribozymes. Ribozymes are good systems for understanding the sequence - structure - function relationship of RNA molecules, since ribozymes are found in the genomes of species from all kingdoms of life and play a role in important reactions such as peptide-bond formation, RNA splicing, transfer RNA biosynthesis, and viral replication. This is therefore an excellent time to summarize these properties, and our new web-based database will make this generally accessible.

In addition to a brief introduction to ribozymes, the **riboswitch** section will give a review of vital breakthroughs in the field of ribozyme research and its applications. The **riboswitch** section is a regulatory segment of a messenger RNA molecule that binds a small molecule, resulting in a change in the production of the proteins encoded by the mRNA. Welcome to the Ribozyme switch database!

Cite us:
Jia Deng, Xinhong Shi, Jiumei Peng, Xianlin He, Xiaoshe Chen, Mengchun Li, Kaowei Lin, Wengjin Liao, Yuanjin Huang, Taijiao Jiang, David M. Lilley, Zhichao Miao, and Lin Huang.
Ribozyme: a database of ribozymes
Nucleic Acids Research, gkaa440, <https://doi.org/10.1093/nar/gkaa440>

The following content of ribozymes information is adapted from Wikipedia.

Discovery, **Structure**, **Activities**, **And More**

Structure and mechanism

Visualization:

Ribozyme-switch is a regulatory segment of a messenger RNA molecule that binds a small molecule, resulting in a change in the production of the proteins encoded by the mRNA. Welcome to the Ribozyme switch database!

News:

- 11 October 2023: Ribozyme switch paper online, please see the link Nucleic Acids Research, gkaa440, <https://doi.org/10.1093/nar/gkaa440>.
- 17 July 2023: Ribozyme updated to v1.5, thanks to the sequence search function from RNACentre.
- 16 June 2023: Ribozyme updated to v1.4, add dynamic visualizations.
- 28 July 2022: Ribozyme updated to v1.3, add dynamic interactive visualizations.
- 18 July 2022: Ribozyme updated to v1.2, add dynamic interactive visualizations.
- 25 June 2022: Ribozyme updated to v1.2, add Catalysis section.
- 12 June 2022: Ribozyme updated to v1.1, add Applications section.
- 22 June 2022: Ribozyme updated to v1.0, add Applications section.
- ... see all News

Statistics of structure determination and phasing methods for riboswitches

Riboswitch is a regulatory segment of a messenger RNA molecule that binds a small molecule, resulting in a change in the production of the proteins encoded by the mRNA. Thus, a mRNA that contains a riboswitch is directly involved in regulating its own activity, in response to the concentrations of its effector molecule. The discovery of riboswitches has led to the ability to bind small molecules, and discriminate against closely related analogs, expanding the known natural capabilities of RNA beyond its ability to code for proteins, catalyze reactions, or bind to other RNA molecules. In addition, the known sequence of the mRNA "riboswitch" specified that they directly sense small-molecule metabolite concentrations. Although this definition remains incomplete, some biologists have used a broader definition that includes other cis-regulatory RNAs. However, this article will discuss only metabolite-binding riboswitches. Most known riboswitches occur in bacteria, but functional riboswitches of one type (the TPP riboswitch) have been discovered in archaea, plants and certain fungi. TPP riboswitches have been found in *Escherichia coli*, *Staphylococcus aureus*, *Arabidopsis thaliana*, *Saccharomyces cerevisiae*, and *Wheat*.

Ribozyme is designed to curate comprehensive information of all natural ribozymes. Ribozymes are good systems for understanding the sequence - structure - function relationship of RNA molecules, since ribozymes are found in the genomes of species from all kingdoms of life and play a role in important reactions such as peptide-bond formation, RNA splicing, transfer RNA biosynthesis, and viral replication. This is therefore an excellent time to summarize these properties, and our new web-based database will make this generally accessible (Accessing the Ribozyme).

Search by sequence (Continuously updated)

* Powered by RNACentre | Local alignment using nimmer
Enter RNA/DNA sequence (with an optional description in FASTA format) or protein sequence
[Search] [Clear] [Close pop-up window]

Ribozyme-aptamer is a database of RNA aptamers. RNA aptamers are present on the cell surface, influencing molecular recognition and being associated with autoimmune diseases. GlycoRNA typically comprises small RNAs, including tRNA, YRNA, srRNA, rRNA, and snoRNA. The GlycoRNA Database provides RNA structure and sequence databases (GlycoRNA), so that users can obtain glycan information. This database is a public resource for researchers, providing users with useful resources to facilitate deeper understanding of GlycoRNA functions and mechanisms. Users can access the GlycoRNA Database to stay updated on the latest advancements in the field of glycoRNA research and obtain newly analyzed data related to glycoRNA.

Aptamers Structured

Ribozyme-aptamer is a publicly accessible aptamer database and searchable database containing comprehensive information on all Aptamers. RNA aptamers are oligonucleotides that bind affinity and specificity to target molecules, which are expected to become a new generation of therapeutic molecules and targeted delivery materials.

Ribozyme is designed to contain comprehensive information of all natural ribozymes. Ribozymes are good systems for understanding the sequence - structure - function relationship of RNA molecules, since ribozymes are found in the genomes of species from all kingdoms of life and play a role in important reactions such as peptide-bond formation, RNA splicing, transfer RNA biosynthesis, and viral replication. This is therefore an excellent time to summarize these properties, and our new web-based database will make this generally accessible (Accessing the Ribozyme).

Ribozyme is a regulatory segment of a messenger RNA molecule that binds a small molecule, resulting in a change in the production of the proteins encoded by the mRNA. Thus, a mRNA that contains a ribozyme is directly involved in regulating its own activity, in response to the concentrations of its effector molecule. The discovery of ribozymes has led to the ability to bind small molecules, and discriminate against closely related analogs, expanding the known natural capabilities of RNA beyond its ability to code for proteins, catalyze reactions, or bind to other RNA molecules. (Accessing the Ribozyme)

Cite us
Zhichao Miao, Lin Huang.
Ribozyme-aptamer: a database of aptamers.
ArXiv 18

Welcome to GlycoRNA Database!

Welcome to GlycoRNA Database! This database provides information related to GlycoRNA. GlycoRNA refers to RNA molecules that are modified by glycans. They are present on the cell surface, influencing molecular recognition and being associated with autoimmune diseases. GlycoRNA typically comprises small RNAs, including tRNA, YRNA, srRNA, rRNA, and snoRNA. The GlycoRNA Database provides RNA structure and sequence databases (GlycoRNA), so that users can obtain glycan information. This database is a public resource for researchers, providing users with useful resources to facilitate deeper understanding of GlycoRNA functions and mechanisms. Users can access the GlycoRNA Database to stay updated on the latest advancements in the field of glycoRNA research and obtain newly analyzed data related to glycoRNA.

DataSets

Human Sequence

Structure

Download Datasets

Literature search

PubMed

GEO

Cell surface RNA

RNA modified with glycans

www.riboswitch.org
riboswitch
aptamer
glycorna

.ribocentre.org :

ribozyme
riboswitch
aptamer
glycoRNA

Deng et al. NAR 2022
Bu et al. NAR 2023

Mega-database copilot search



广州实验室
Guangzhou
Laboratory

The screenshot shows a web-based AI chatbot interface. At the top, it says "WebBot" with a dropdown arrow. Below the name is a circular profile picture of a colorful abstract design. The bot's name, "WebBot", is displayed again below the picture. A brief description follows: "WebBot, an intelligent customer service robot, can easily improve user service efficiency." Underneath, there are two user messages: "What databases do we have?" and "Hello, what can I do for you?". At the bottom, there is a button labeled "新建对话" (New Conversation) with a plus sign icon, a text input field containing "输入你的问题或需求" (Input your question or requirement), and a send button icon. A small cursor arrow is visible near the bottom center of the interface.

Contact me if interested.

Acknowledgements

Miao lab:

- Yaohuang Shi (PhD) Ribocentre
- Fan Bu(PhD) Ribocentre-switch
- Ying Ao (Master)
 - Ribocentre-aptamer & GlycoRNADB
- Linyan Hu (PhD) Copilot search

Blake Sweeney (search engine)

Lin Huang (SYSU)

- Ribocentre
- Ribocentre-switch
- Ribocentre-aptamer



Ling-ling Zheng (SYSU)

- GlycoRNADB



Fundings

R&D Programs of Guangzhou Laboratory

- GZNL2024A01002
- GZNL2023A01006
- SRPG22-003
- SRPG22-006
- SRPG22-007
- HWYQ23-003

Natural Science Foundation of China

- 32270707

National Key R&D Programs of China

- 2021YFF1200903
- 2023YFF1204701

RNA Society



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ACADEMIC SALON

Guangzhou RNA Club

We are a group of scientists interested in all things RNA. We promote new research from within the South China area and beyond, for the advancement of RNA science and training. Guangzhou RNA club (Seminars & Symposiums), aiming to associate the RNA research society in South China with the global RNA SOCIETY.

You will be invited! Thanks!

Welcome to join!

Latest Academic Events Calendar



官方网址

简介

我们是一群对RNA感兴趣的科学家。我们致力于推动华南地区的RNA研究，促进与其他地区研究人员的交流，旨在将华南地区的RNA研究与国际RNA学会联系起来。同时促进合作交流，培养青年科学家（博士、博士后），我们期待更多的RNA领域的研究人员加入我们，共同推动RNA领域的研究。

活动介绍

- 每月研讨会:** 一到两小时，包括两次演讲：一位高级 PI (约 30-40 分钟)，另一位来自初级 PI、博士后或学生 (约 20 分钟)，然后是问题和讨论部分 (约 20-30 分钟)。
- 年度座谈会:** 每年7月中的一整天，将有8到10位国内外的高级PI参加，展示与讨论RNA领域最前沿的学术问题，研究进展。
- 不定期的学术交流会**

根据前期会议参与同学申请情况，13位同学已免费获得了2023年国际RNA学会学生会员的资格 (36 USD/year)！欢迎大家加入我们，关注我们的微信公众号和B站账号，回顾往期精彩视频，及时获取讲座资讯，观看直播，线上提问，与RNA领域知名学者面对面！

往期嘉宾 (部分)



主持人



Sponsors



EPI BIOTEK 表观生物



国家重点研发计划



Chichau Miao@Guangzhou Laboratory



国家重点研发计划
国家生物数据中心（大湾区节点）

Openings:

Computational Biology

- 2025 PhD students (3)
- Co-PI (2)
- Postdocs (3)
- RA (3)
- Interns

Biochemistry

- Postdocs (2)

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Thanks!

