

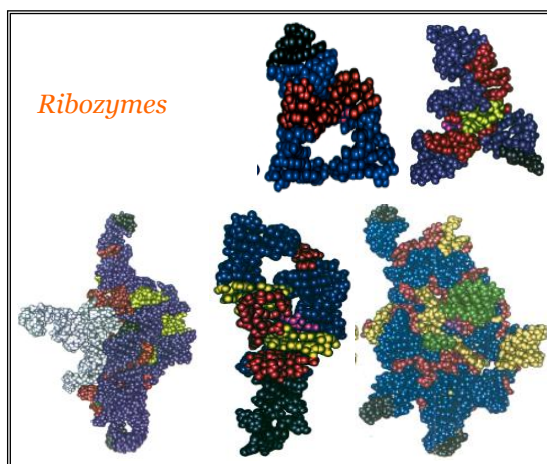
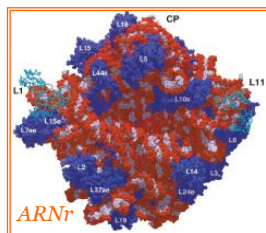
Structure de l'ARN et motifs structuraux

Alain Denise

LRI et IGM Orsay, Université Paris-Sud 11, INRIA

M2 BIBS

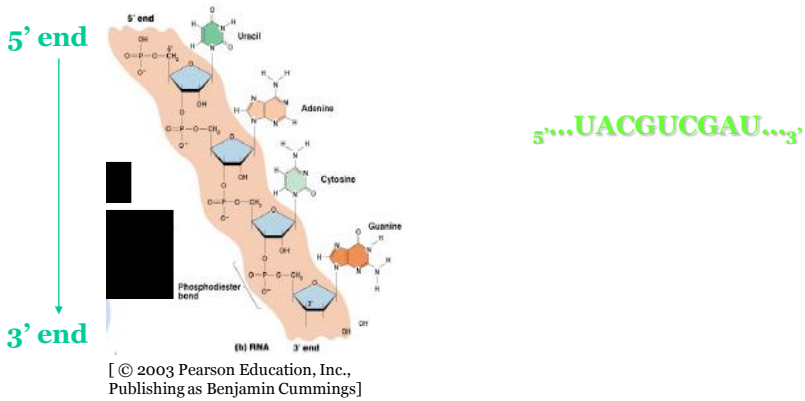
Structure de l'ARN



[Catalytic RNA, F. Walter & E. Westhof, els, 2002]

Structure de l'ARN

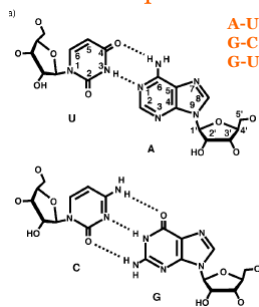
ARN = une chaîne de nucléotides qui



Structure de l'ARN

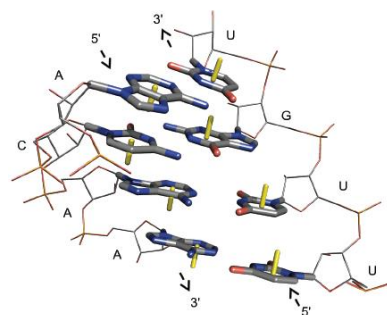
qui se replie en hélices type A

Appariements WC
canoniques



[Tertiary motifs in RNA structure and folding,
J. Doudna et al., Angew Chem Int Ed Engl. 1999]

Stacking



ET

[Base stacking annotation, F. Major & P. Thibault,
presented at the RNA ontology consortium workshop, RNA
society meeting, Seattle WA, June 19-20 2006]

Structure de l'ARN

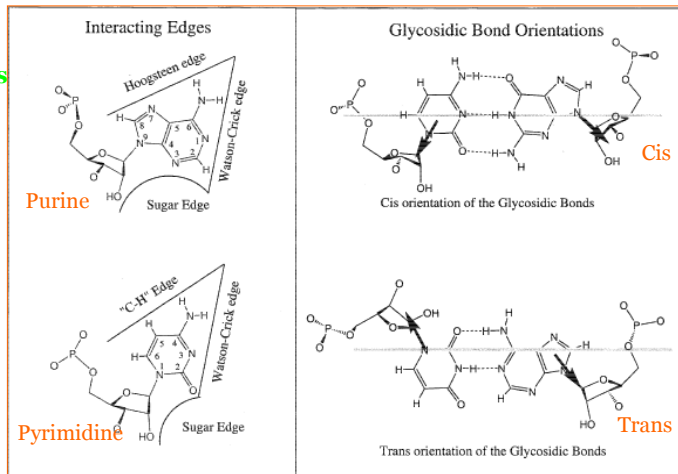
Nomenclature Leontis-Westhof (LW)

3 Interacting Edges

- Hoogsteen (H)
- Watson-Crick (W)
- Sugar (S)

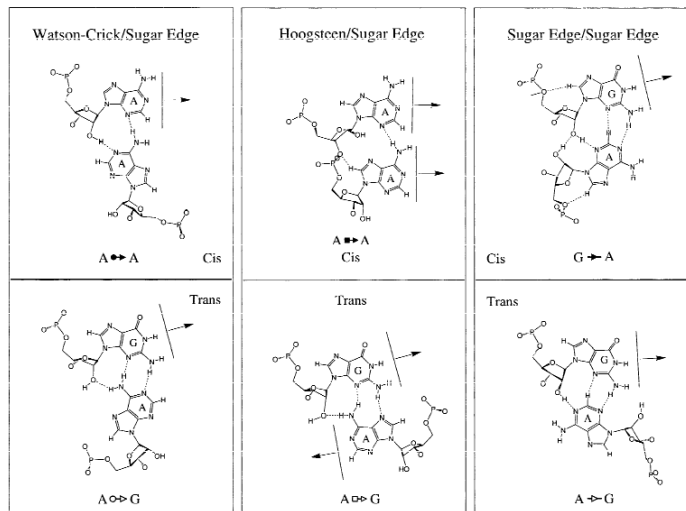
2 Orientations

- Cis
- Trans



[The Non-WC base pairs and their isostericity matrices, Leontis et al., NAR 2002]

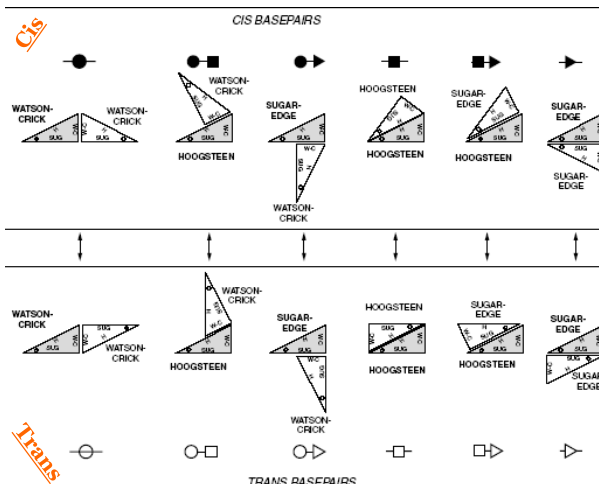
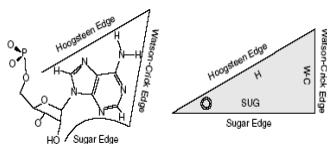
Liaisons non canoniques



[Leontis & Westhof, RNA 2001]

Nomenclature Leontis Westhof (LW)

12 Familles



[The annotation of RNA Motifs, N.B. Leontis & E. Westhof, Conference Review 2000]

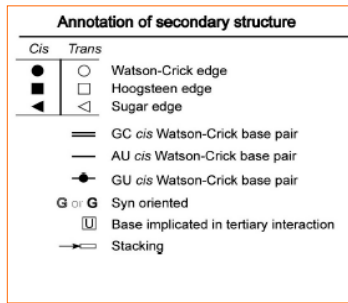
Nomenclature Leontis Westhof (LW)

Annotation

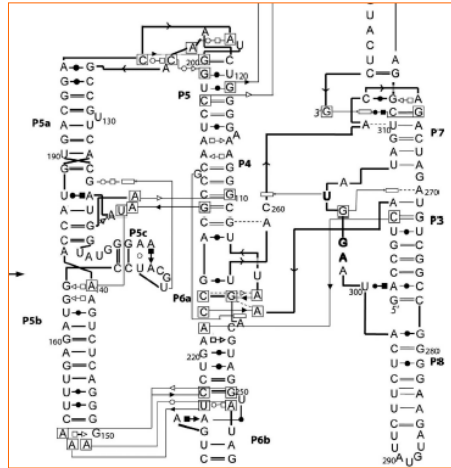
No.	Glycosidic bond orientation	Interacting edges	Symbol	Default local strand orientation
1	cis	Watson-Crick/Watson-Crick	●	Anti-parallel
2	trans	Watson-Crick/Watson-Crick	○	Parallel
3	cis	Watson-Crick/Hoogsteen	●■	Parallel
4	trans	Watson-Crick/Hoogsteen	○□	Anti-parallel
5	cis	Watson-Crick/Sugar edge	●➤	Anti-parallel
6	trans	Watson-Crick/Sugar edge	○➤	Parallel
7	cis	Hoogsteen/Hoogsteen	■	Anti-parallel
8	trans	Hoogsteen/Hoogsteen	□	Parallel
9	cis	Hoogsteen/Sugar edge	■➤	Parallel
10	trans	Hoogsteen/Sugar edge	□➤	Anti-parallel
11	cis	Sugar edge/Sugar edge	➤	Anti-parallel
12	trans	Sugar edge/Sugar edge	➤	Parallel

[The annotation of RNA Motifs, NB. Leontis & E. Westhof, Comparative and functional genomics, 2002]

Nomenclature Leontis Westhof (LW)

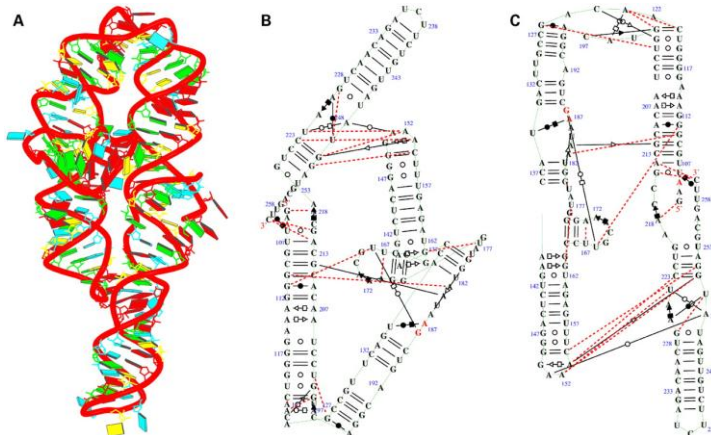


Graphe d'ARN = graphe de degré borné, étiqueté sur les sommets et sur les arêtes, contenant un chemin hamiltonien (connu).



Group I intron (detail). [The interaction Networks of structured RNAs, A. Lescoute & E. Westhof, NAR 2006]

De la 3D au graphe d'ARN



RNAView [H. Yang et al., NAR 2003]

(aussi: MC-annotate [P. Gendron et al., J Mol Biol 2001])

Comment l'ARN se replie-t-il ?

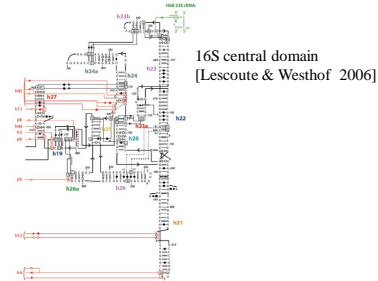
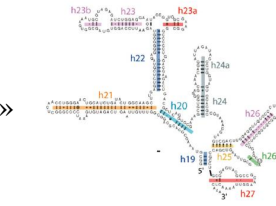
- Vers une conformation d'énergie libre minimale
- De façon hiérarchique :

1. les interactions fortes et « locales »

= structure secondaire
(sans pseudo-noeud)

2. les interactions faibles les interactions à longue portée

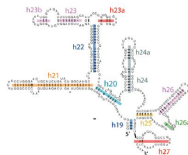
= structure 3D



[Tinoco et al. J. Mol. Biol. 1999]

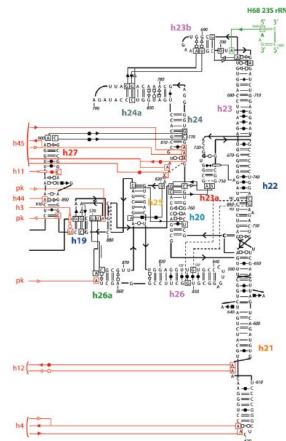
Interactions canoniques et non canoniques

- Les interactions canoniques forment les hélices et déterminent la structure secondaire.



- Les interactions non canoniques
 - forment les **motifs structuraux**,
 - sont responsables de la plupart des interactions entre les éléments de la structure secondaire.

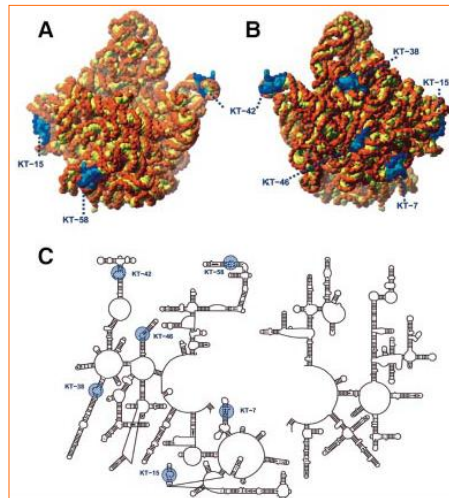
16S central domain
[Lescoute & Westhof 2006]



Motifs structuraux

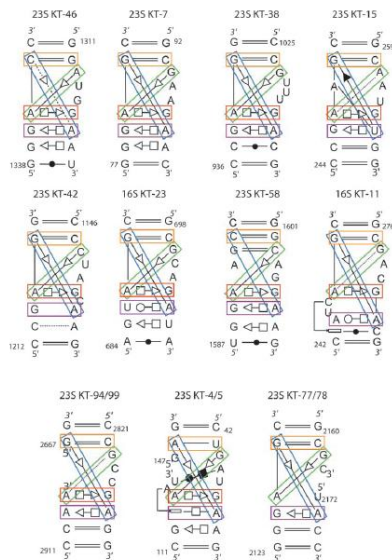
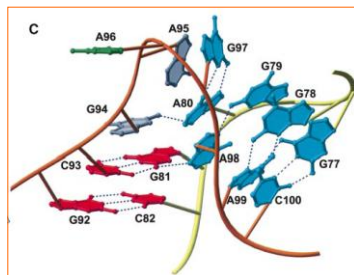
« Small, recurrent, stacked arrays of isosteric basepairs that intersperse the 2D structural elements (internal, junction, terminal loops) and fold into essentially identical 3D structures »

[Leontis & Westhof 2001]

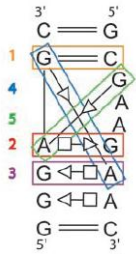


[The kink-turn: a new RNA secondary structure motif, D.J. Klein et al., The EMBO journal, 2001]

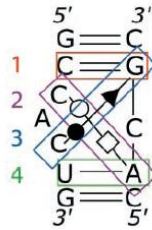
Exemple : le Kink-turn



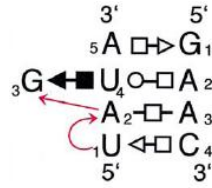
Quelques motifs structuraux



Kink-turn

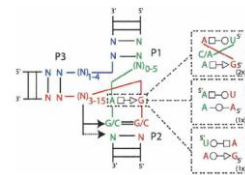
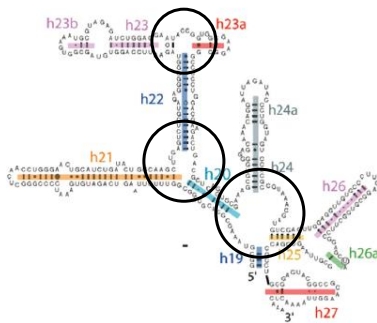


C-loop

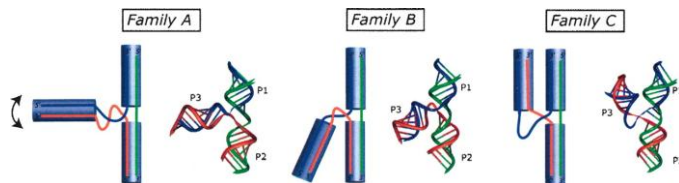


Sarcin-ricin

Les jonctions



Jonction triple
famille A



[Lescoute & Westhof, RNA 2006]