

Supporting Information

## **Fluorogenic RNA Aptamers: a Nano-platform for Fabrication of Simple and Combinatorial Logic Gates.**

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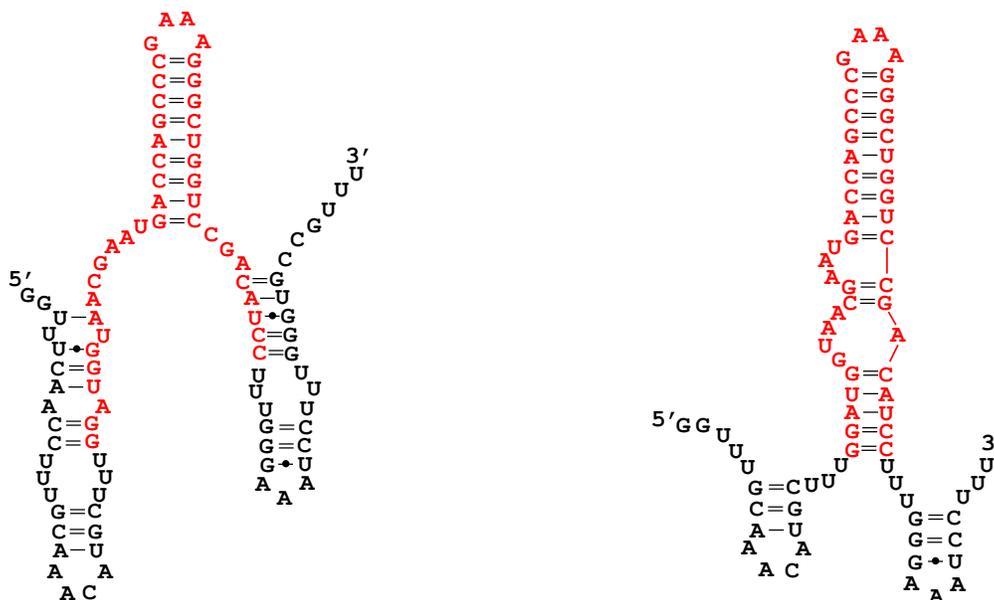
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**Table 1.** List of DNA and RNA sequences used to create logic gates and half adder.

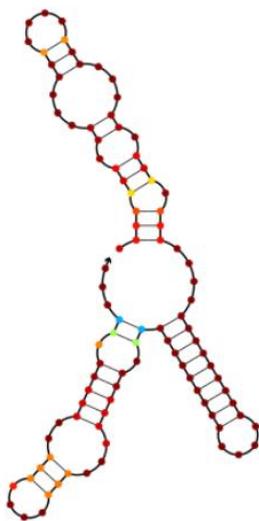
Name	Sequence 5' - 3'
RNA AND/OR gate	gguuuc <u>aaacuuugcaaac</u> augcuuu <b>GGAUGGUAACGAAUGACCAGCCCGAAAGGGCUGGUCCGACAUC</b> cuuugggaaa <u>uccuuugggugccguuu</u> *
DNA AND_input A DNA AND_input B	GTAAGCTTTGGTTGA (15 nt) <u>AAACAGCGTCCAGAGGAT</u> (18 nt)
DNA OR_input A DNA OR_input B	GCATGTTTGCAAAGGTTGAAA (21 nt) AAACGGCGTCCAAAGGATTTCCC (22 nt)
RNA NAND/NOR gate	gguuugcaaac <u>augcuuu</u> <b>GGAUGGUAACGAAUGACCAGCCCGAAAGGGCUGGUCCGACAUC</b> cuuugggaaa <u>uccuuu</u>
DNA NAND_input A DNA NAND_input B	<u>CTATAGCATGTTTGC</u> (15 NT) <u>TTGATTTCCCTTTGGT</u> (16 NT)
DNA NOR_input A DNA NOR_input B	<u>CCATCCAAAGCATGTTTGCAA</u> (22NT) <u>AAAGGATTTCCCAAAGGATGTCCGACC</u> (27 NT)
RNA half adder Strand #1	GGUGCCC <u>GCUGACCGGAGACGGUCAAAUAGAGCAC</u> <b>AGGAUGGUAACGAAUGACCA</b> <b>GCCC</b> GAGGUCGC <u>GACCUUCUUUCCUCGCGACUCGAAUGUUUCUUUCGAGGUCC</u> CCCC <u>GUAUCUGUCGAGUAGAGUGUGGGCUCGCACGCGGCUGCC</u> (155 nt)
RNA half adder Strand #2	<b>GGCGGCTGCCGCGCAGAGACGGUCGGGUCCAGAU</b> AUUGGAUCUUUCGCCUUUCCG CGAUACGGGCCAACGAUGGGUUUGAAGGUCGCGACAA <b>GGGCUGGTCCGACA</b> UCCCA CA CAAATAGAGT GTGGGCCGAG CAGCGGCACC (144 nt)
RNA half adder strand #3	GGUGCCC <u>GCUGACCGGAGACGGUCAAAUAGAGCAC</u> <b>AGGAUGGUAACGAAUGACCA</b> <b>GCCC</b> GAGGGCGACCUCGUUUUGUACCAGCAUCCUCUUAUAAGUUUUGGCGAAAGAU CCCC <u>GUAUCUGUCGAGUAGAGUGUGGGCUCGCACGCGGCUGCC</u> (155 nt)
RNA half adder strand #4	<b>GGCGGCTGCCGCGCAGAGACGGUCGGGUCCAGAU</b> AUUGGGCGACCUCGUUUUCCG GGAUAUGGUCUCGGCCAACUUUCGAGGUCGCCCA <b>AGGGCUGGUCCGACA</b> UCCACA CAAUAAGAGUGUGGGCCGAGCAGCGGCAGC (142 nt)
RNA half adder strand #5	GGAUGCUGGUACUUUUGUUGGCCGAGACCAUAUCCCGUUUUGAAACAUUUCGAGUC GCGAGGGUUUUC <u>CCAUCGUUGGCCCGUAUCGCGUUUCUUAUGAAGA</u> (103 nt)
AND_DNA Inhibitor	ATAACAGCGCGTAGGGCCACGCTGCCGCTGCTCGGCCACACTCTATTTGACCG GGATGTCGGACCAGCTGGTCATTCCTTACCATCCACACTCTATTTGACCGTCTCC GGTCAGCGGGCAGCGAGCCCTACGCGCTGTTAT (144 NT)
XOR_DNA Inhibitor	GGCAGCCGCGTGTGCCGCTGGCTCGGCCACACTCTATTTGACCGTCCGGTGCAGCTGC GCGGCGAGCCCTA (72 NT)
Input A_5' INPUT	ATAACAGCGCGTAGGGCTCGCCGGCCCGCTGACCGGAGACGGTCAAATAGAGTGTG (56 NT)
Input B_3' INPUT	CGGTCAAATAGAGTGTGGGCCGAGCAGCGGCAGCGTGGCCCTACGCGCTGTTAT (54 NT)

\* Lower letters indicate interfering (AND/OR Logic Gates) and non interfering (NAND/NOR logic gates) nucleotides. RNA nucleotides forming MG structural motif colored in red. RNA nucleotides that correspond to the Broccoli aptamer are in green color.

**Figure S1.** Secondary structures of designed AND/OR (left) and NAND/NOR (right) gates predicted by *mfold* and NUPAC. The 2D structure of the MG aptamer region is highlighted by the red colored nucleotides and by a rectangle.

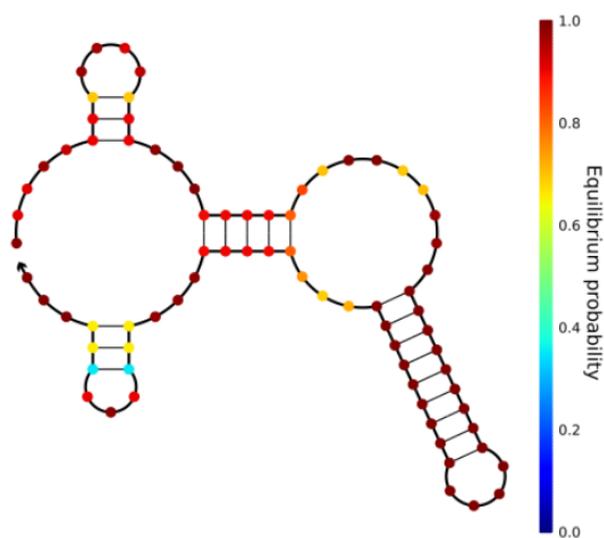


MFE structure at 22.0 C



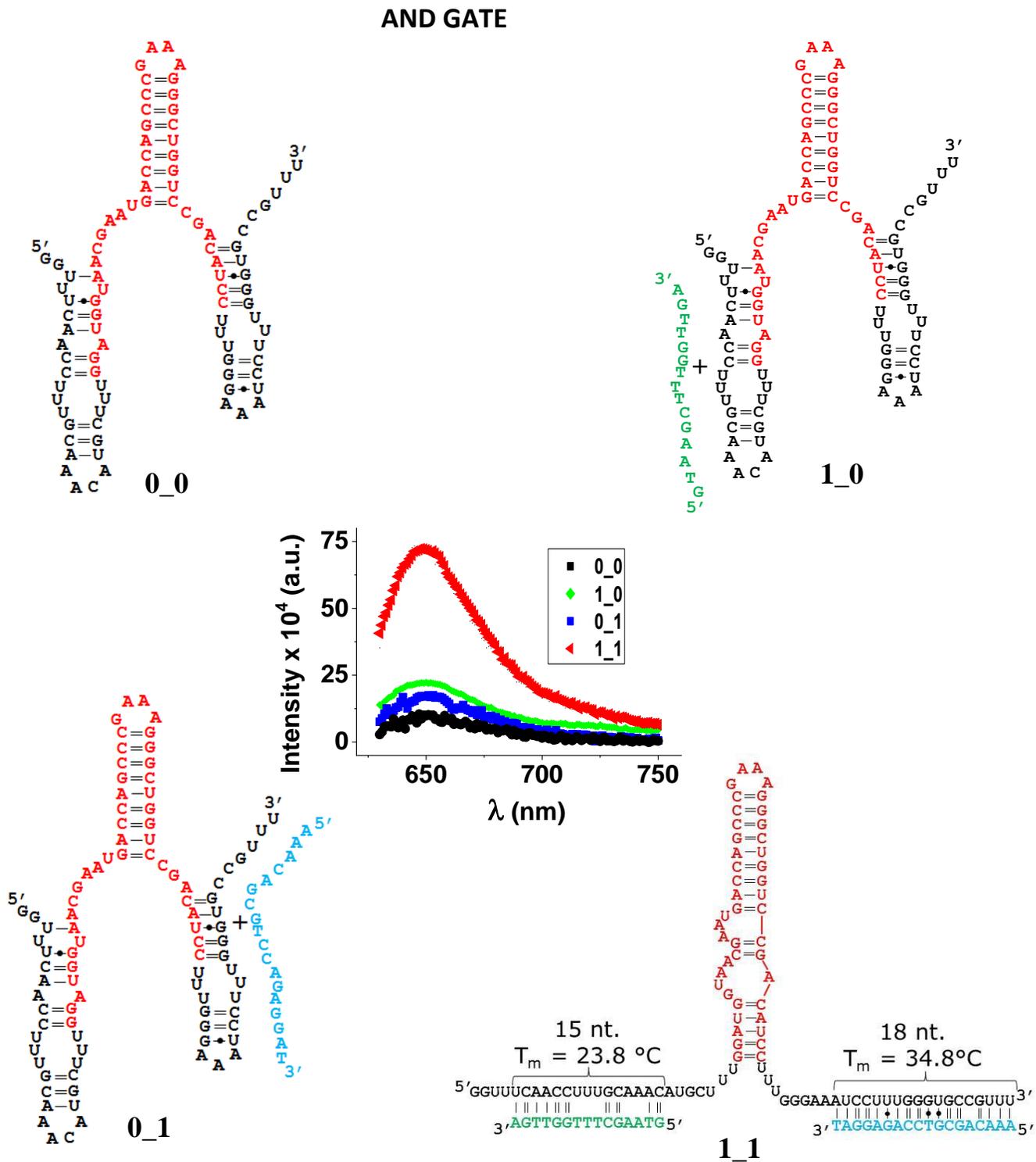
Free energy of secondary structure: -48.75 kcal/mol

MFE structure at 22.0 C

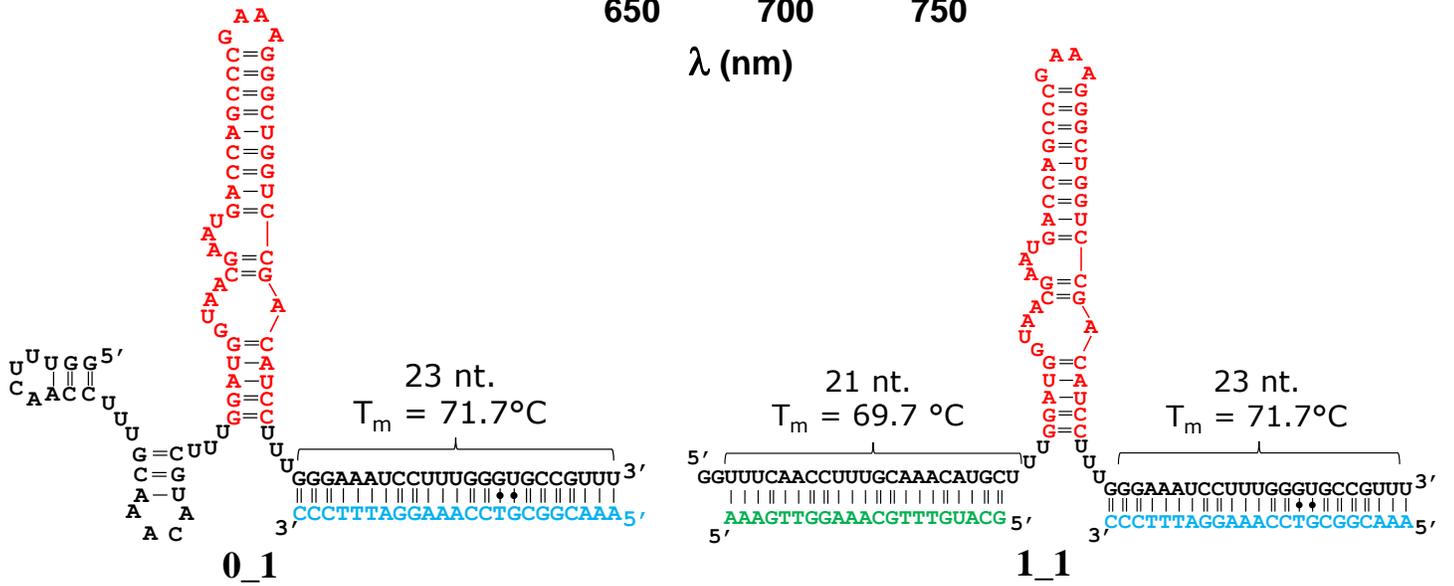
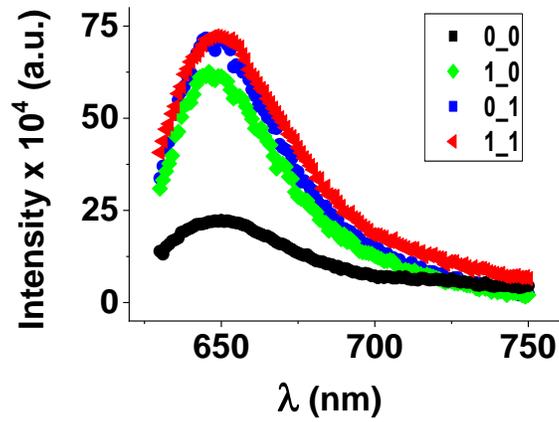
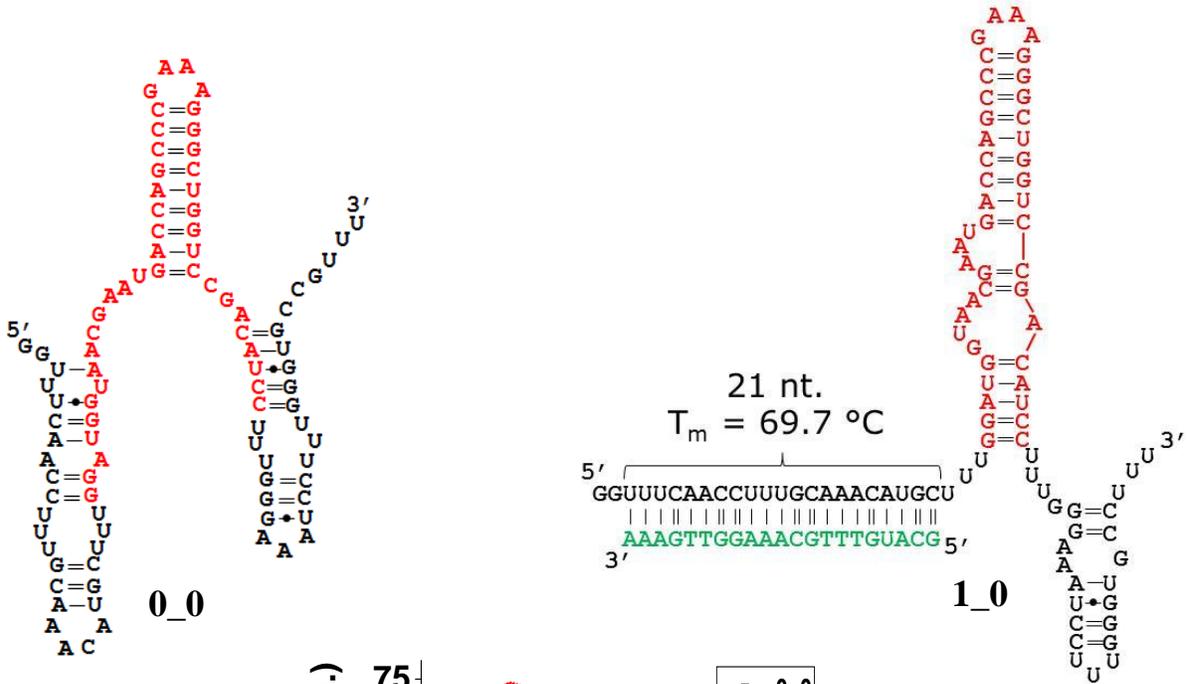


Free energy of secondary structure: -37.84 kcal/mol

**Figure S2.** Predicted secondary structures of designed AND and OR gates complexes with and without inputs and their corresponding fluorescence intensities.

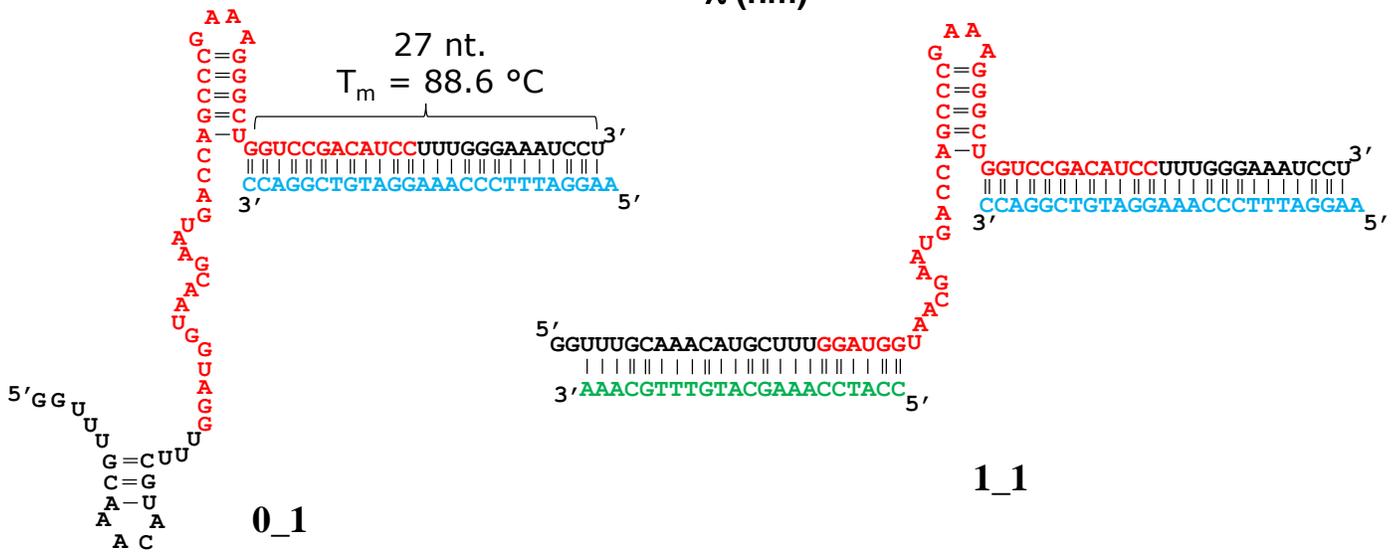
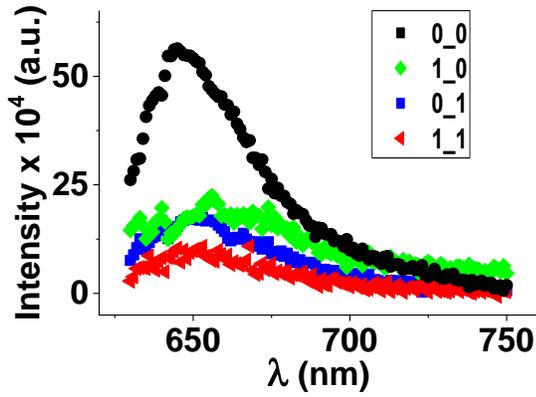
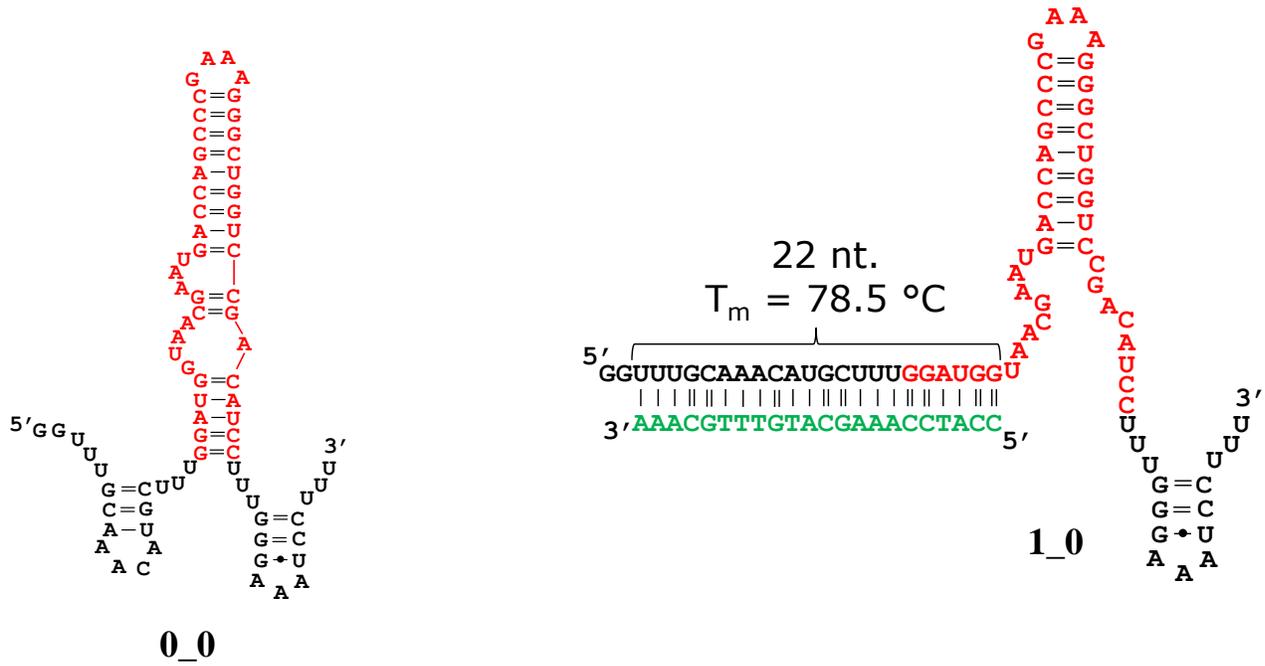


# OR GATE

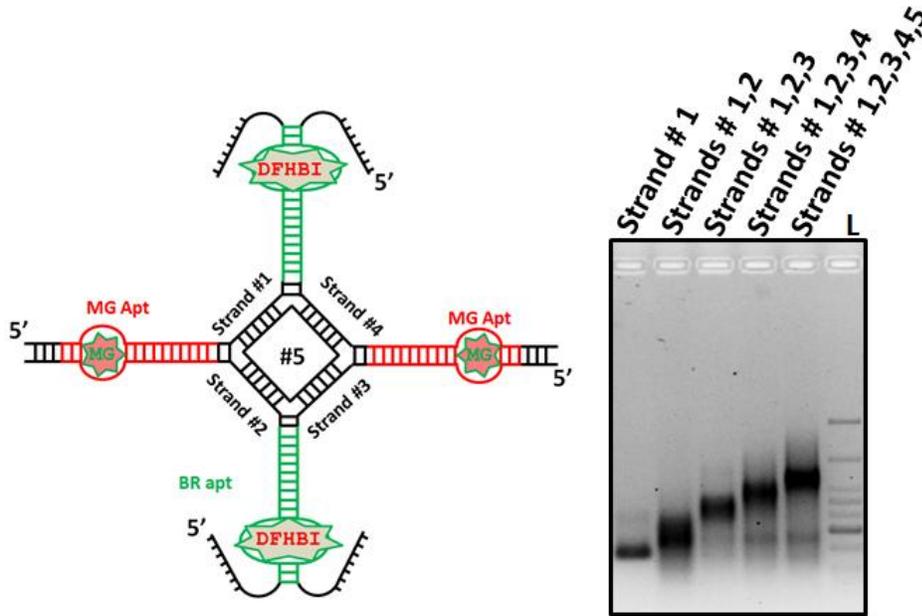




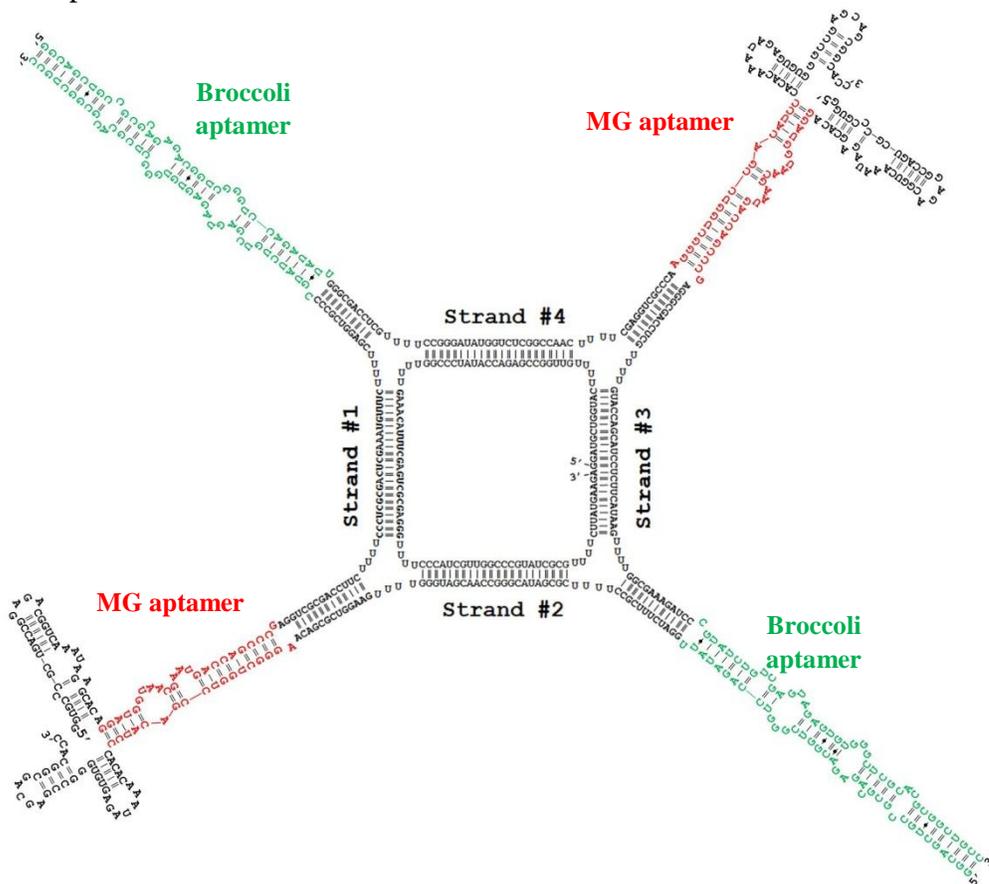
# NOR GATE



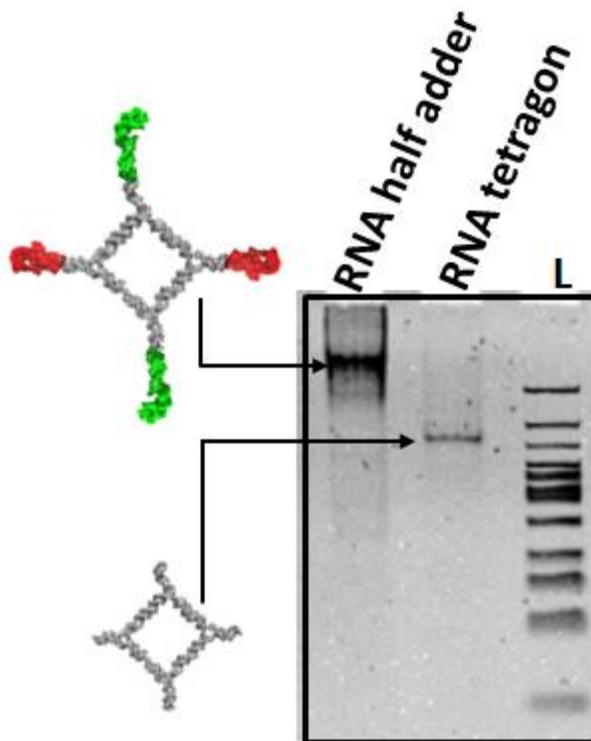
**Figure S3.** Assembly assay of RNA half adder with no DNA inhibitor strands evaluated by 3% agarose gel. Lane L refers to DNA ladder (Low Molecular Weight, New England Biolabs), representative 2D structure of the RNA complex is shown on the left.



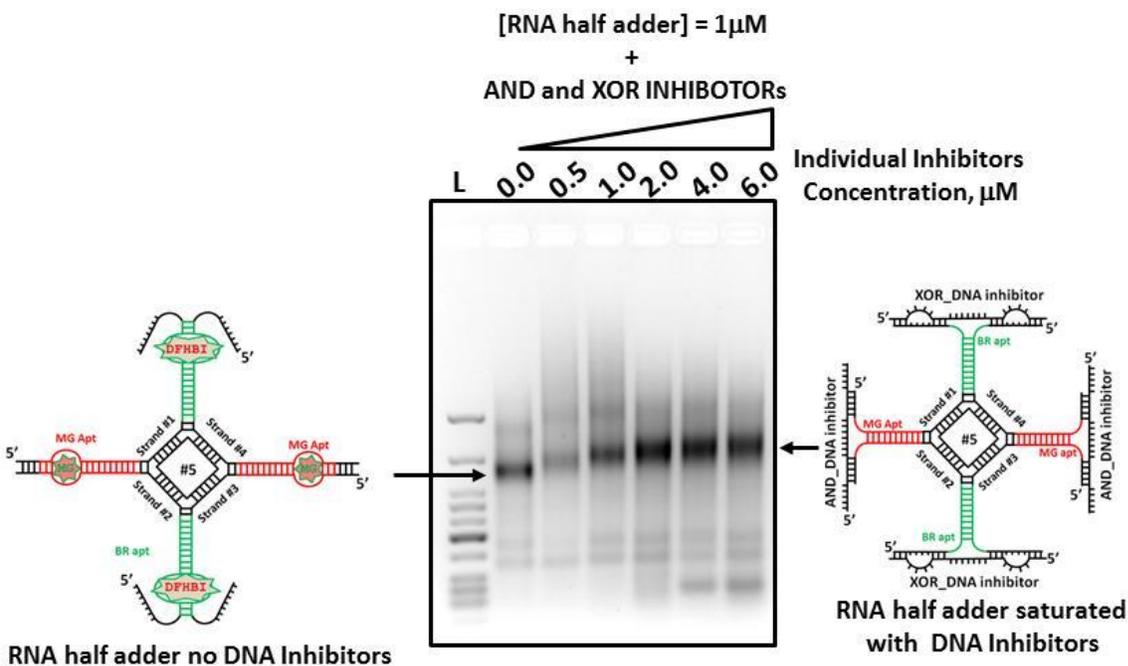
**Figure S4.** Secondary structure and sequences of designed Half-Adder RNA system with no Inhibitors present.



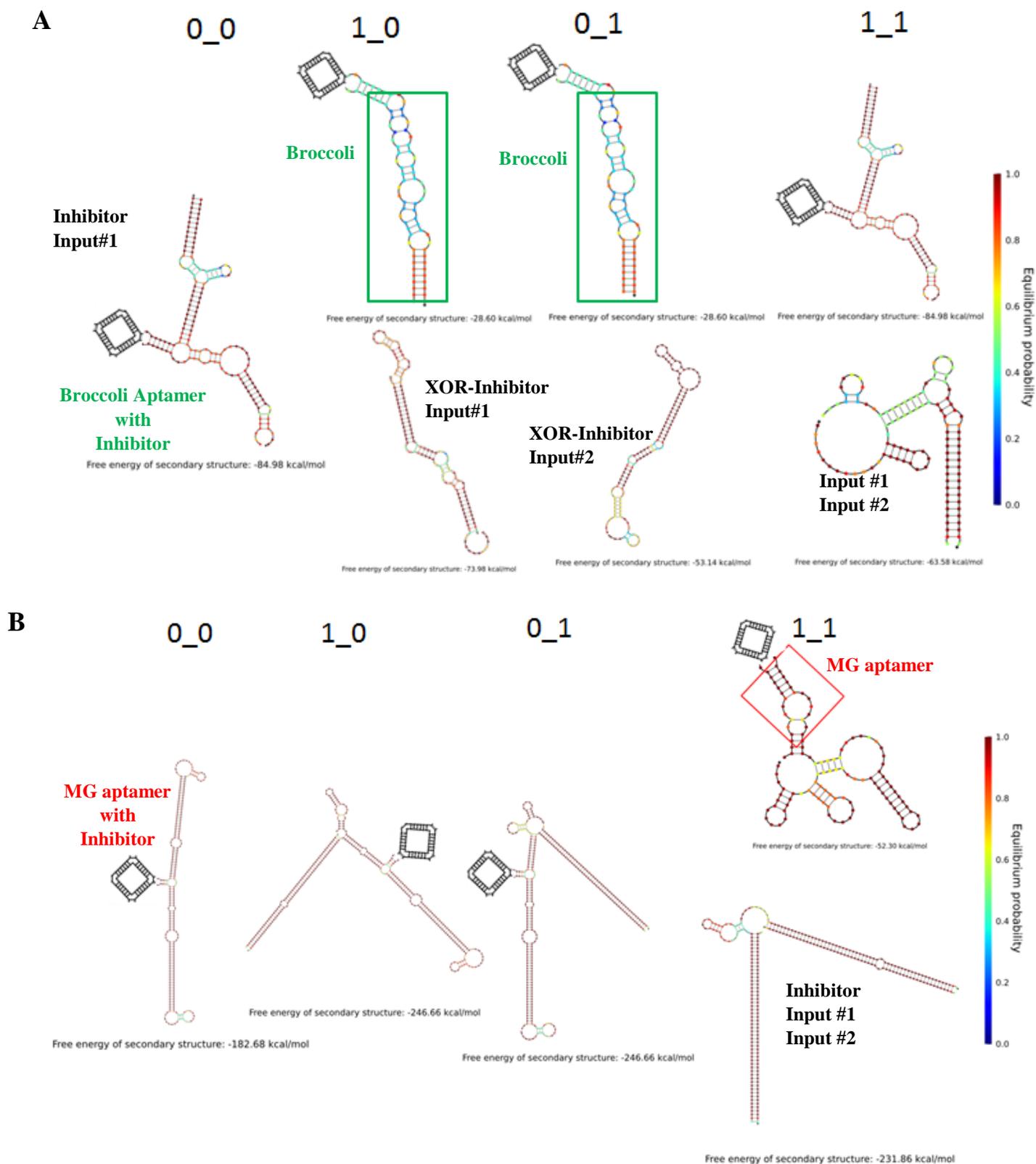
**Figure S5.** Comparison of electrophoretic mobilities of RNA half adder and RNA tetragon. Evaluation performed on native 7% gel. Lane L refers to DNA ladder (Low Molecular Weight, New England Biolabs).



**Figure S6.** Assembly assay of RNA half adder with increasing concentration of DNA XOR and AND inhibitors mixture evaluated by 3% agarose gel. Lane L refers to DNA ladder (Low Molecular Weight, New England Biolabs).



**Figure S7.** Computed 2D structures of the designed half adder containing XOR and AND logic gates with their inhibitors as a function of either input or presence of both. For the simplicity, the structure of the tetragon is shown with either (A) Broccoli aptamer or (B) MG RNA aptamer. Highlighted by the green and red boxes are the correctly folded 2D structures of Broccoli aptamer and MG aptamers, respectively. The structures were obtained from NUPAC program.



**Figure S8.** Time dependent fluorescence intensity of the AND gate (RNA MG aptamer) of the half adder in presence of two DNA inputs. To the preassembled tetragonal half added ( $1 \mu\text{M}$ ) containing XOR and AND inhibitors ( $2 \mu\text{M}$ ) a small volume of both DNA inputs A and B were added to achieve  $5 \mu\text{M}$  final concentration of each. The fluorescence measured at different time intervals at  $22 \text{ }^\circ\text{C}$ .

