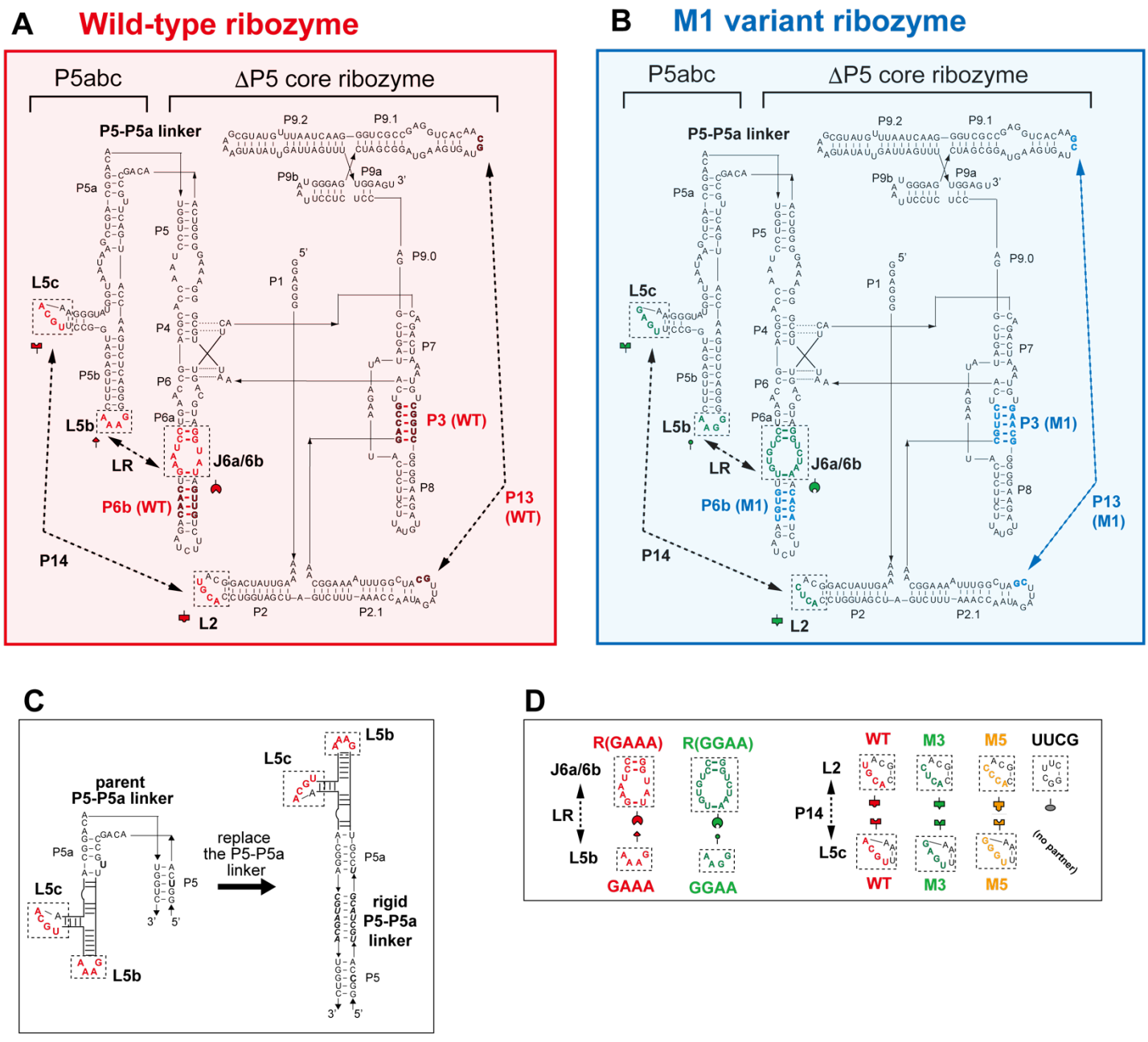

Figure S1

Sequences and secondary structures of the *Tetrahymena* group I ribozymes and their structural elements used for modular engineering in this study.

(A, B) Secondary structures of the wild-type *Tetrahymena* ribozyme (A) and its variant (M1 type) ribozyme (B). Lines with two arrowheads indicate tertiary interactions. Nucleotides shown in red in A and green in B participate directly in tertiary interactions between the P5abc module and ΔP5 module. Nucleotides shown in bold are structural elements (P3, P6b, and P13) that differ between the wild-type and M1 type.

(C) Nucleotide sequences of the parent P5-P5a linker region and a rigid variant used in RzM.

(D) Nucleotide sequences of RNA motifs involved in J6a/6b-L5b and L2-L5b tertiary interactions. Corresponding icons used for indication of RzM:RzM interfaces are also shown.

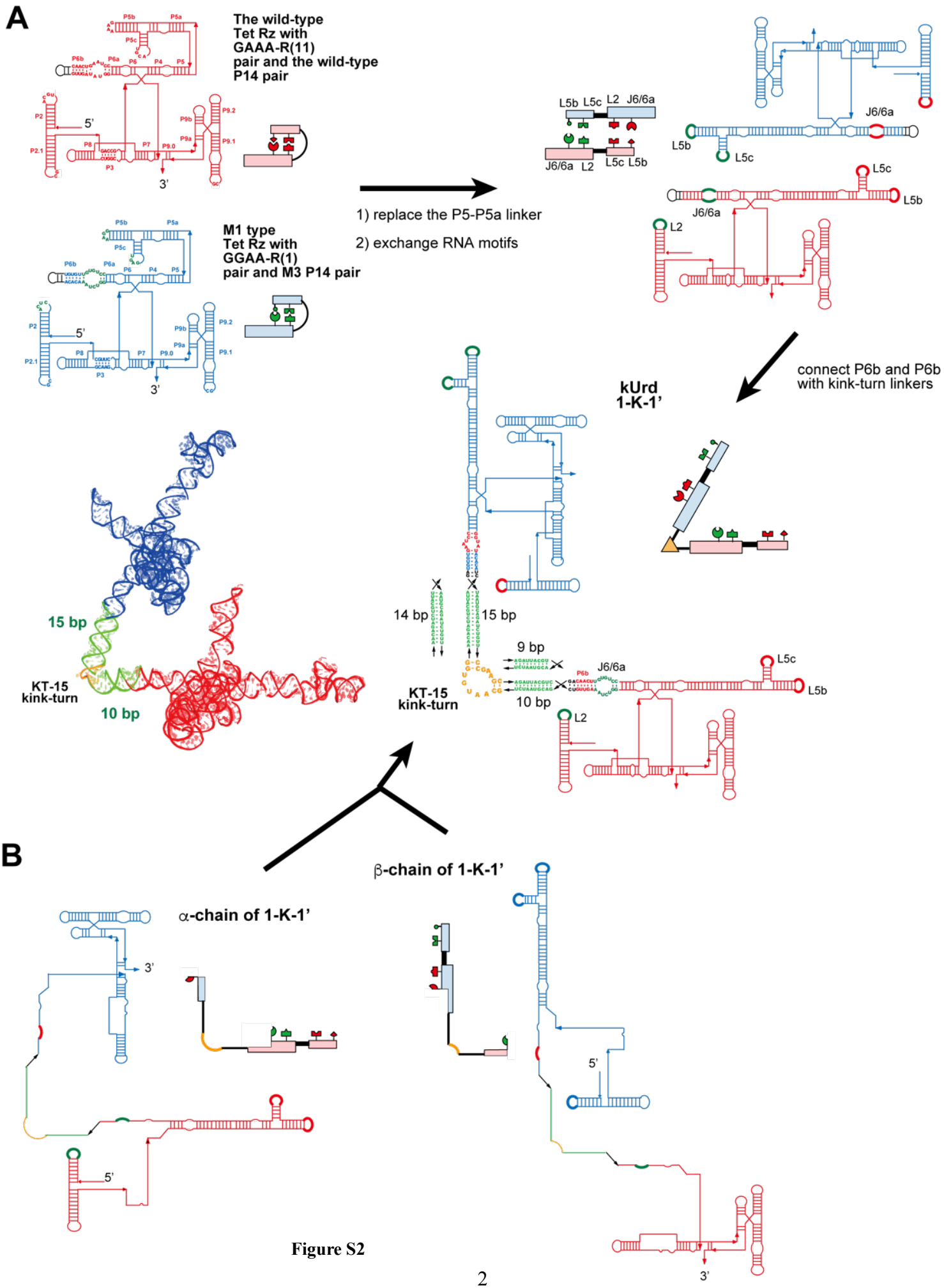
A
The wild-type Tet Rz with GAAA-R(11) pair and the wild-type P14 pair
M1 type Tet Rz with GGAA-R(1) pair and M3 P14 pair
1) replace the P5-P5a linker
2) exchange RNA motifs
connect P6b and P6b with kink-turn linkers
kUrd 1-K-1'
15 bp
10 bp
KT-15 kink-turn
14 bp
15 bp
9 bp
10 bp
KT-15 kink-turn
B
α-chain of 1-K-1'
β-chain of 1-K-1'

Figure S2

Figure S2
Scheme of rational redesign of unimolecular *Tetrahymena* ribozymes to generate kUrd **1-K-1′**.
(A) Stepwise redesign of wild-type and M1 type ribozymes to construct kUrd **1-K-1′**.
(B) Formation of kUrd **1-K-1′** through assembly of its α- and β-chains.

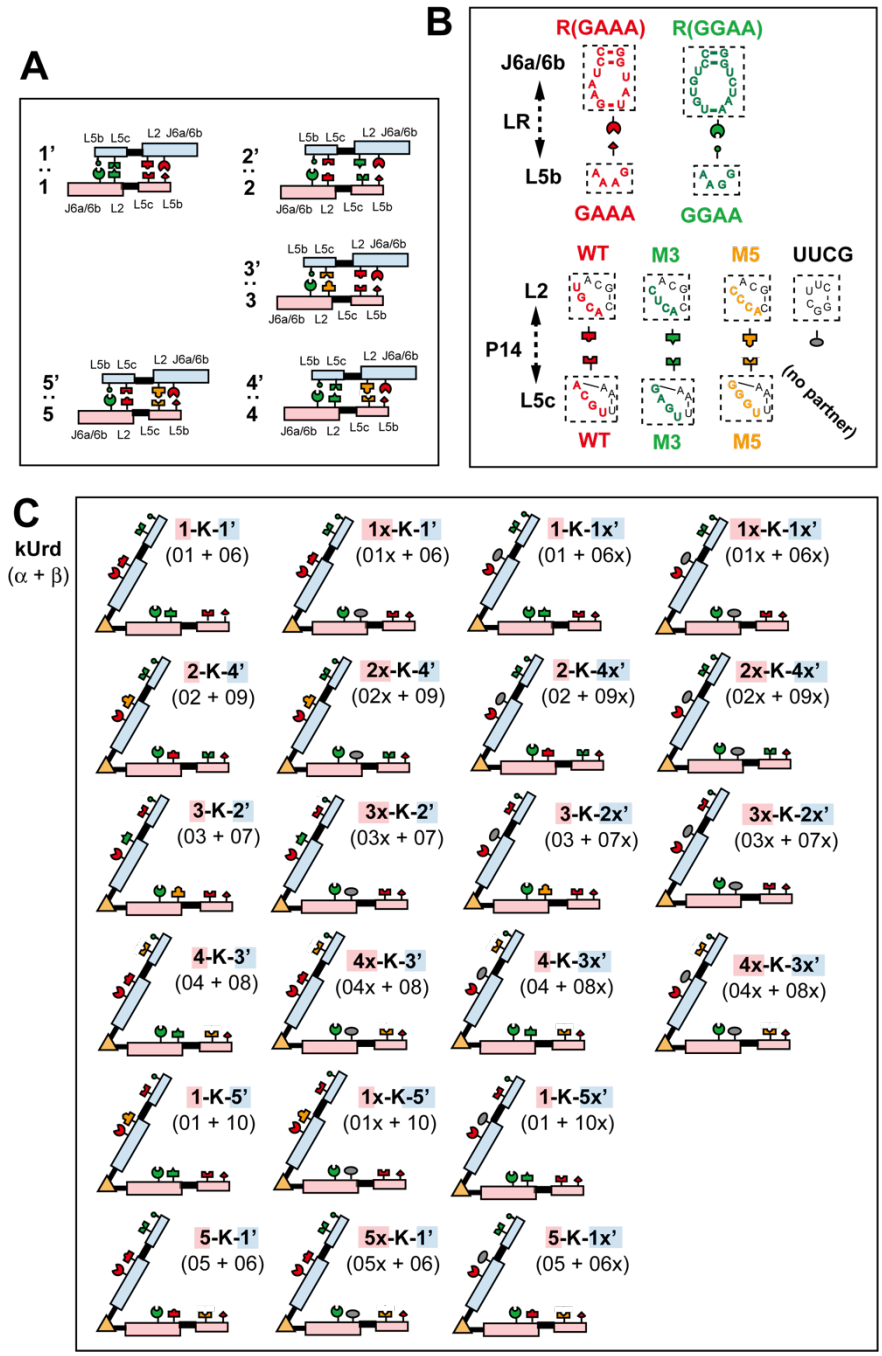

Figure S3
Kink-turn unit ribozyme dimers (kUrds) employed in this study.
(A) Five distinct pairs of RzM:RzM interfaces used in this study.
(B) Nucleotide sequences of RNA motifs involved in J6a/6b-L5b and L2-L5b tertiary interactions. Corresponding icons used for indication of RzM:RzM interfaces are also shown.
(C) Structural organization of kUrds employed in this study. Each kUrd is formed by the assembly of two RNA-chains (α- and β-chains), identity of which is shown in parentheses by the number used in Table S1.

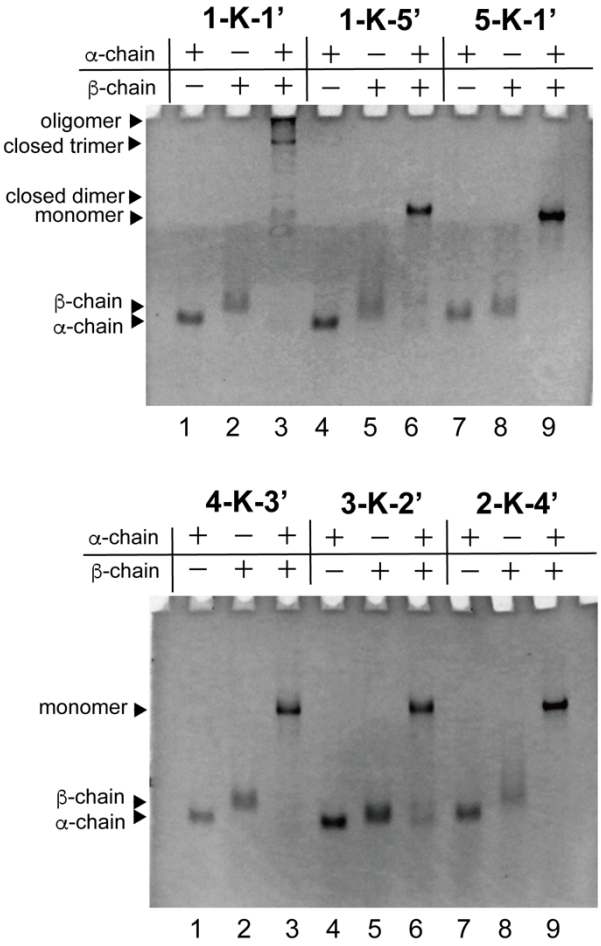

Figure S4
Formation of kUrds through the assembly of their α-chain and β-chain RNAs.
EMSA of α-chain RNA, β-chain RNA and their equimolar mixture of each kUrds used for homopolymerization (top), diblock copolymerization (top), and triblock copolymerization (bottom). EMSA were performed with 0.125 μM each RNA chain in the presence of 15 mM Mg^{2+}. RNAs were visualized by ethidium bromide staining.

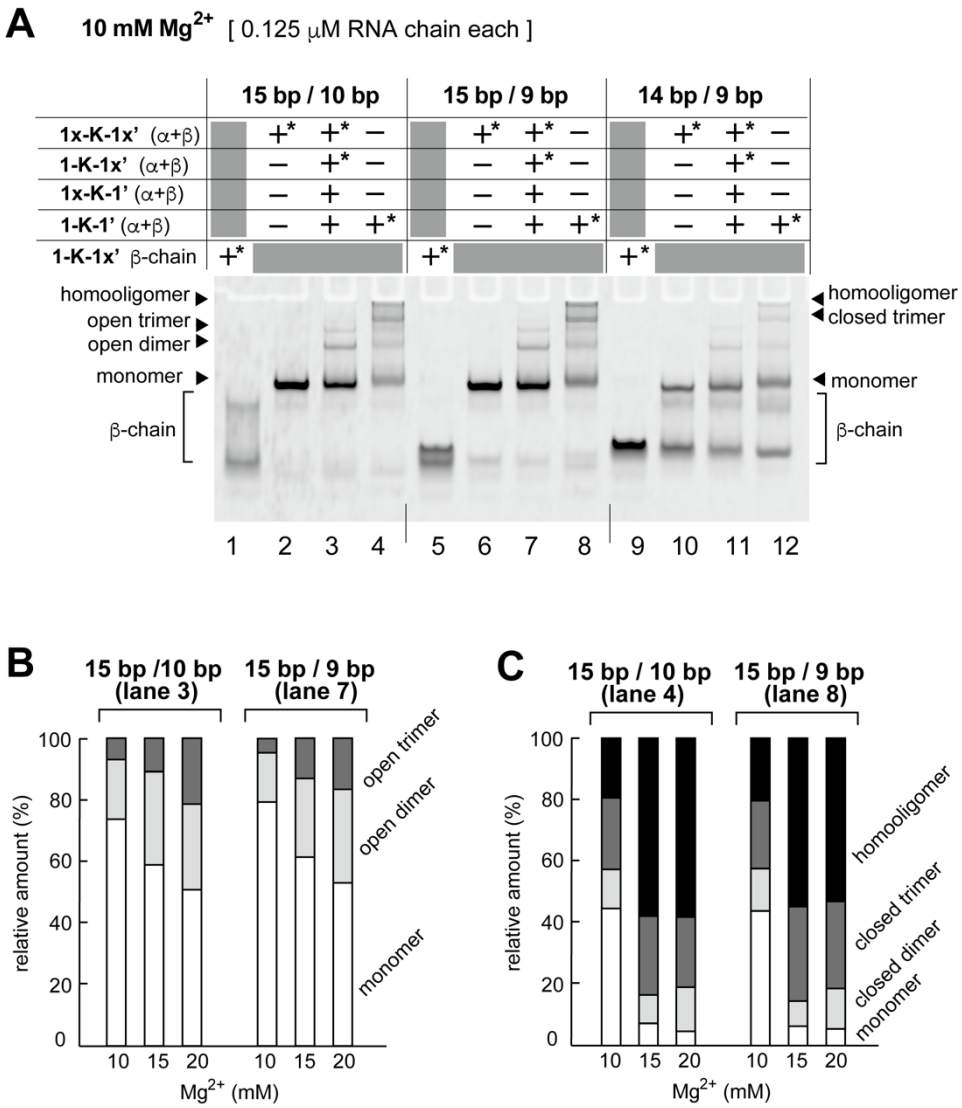

Figure S5
Oligomerization of **1-K-1'** and its mutants.
(A) EMSA of **1-K-1′** homopolymers formed in the presence of 10 mM Mg^{2+}. Asterisks indicate RNA chains labeled with BODIPY fluorophore.
(B) Relative amounts of monomers and open oligomers of kUrds in the presence of different concentration of Mg^{2+}. Relative amounts were calculated from lanes 3 and 7 of Figures S5A, 2B, and 2C.
(C) Relative amounts of monomeric and closed oligomers of kUrds in the presence of different concentration of Mg^{2+}. Relative amounts were calculated from lanes 4 and 8 of Figures S5A, 2B, and 2C.

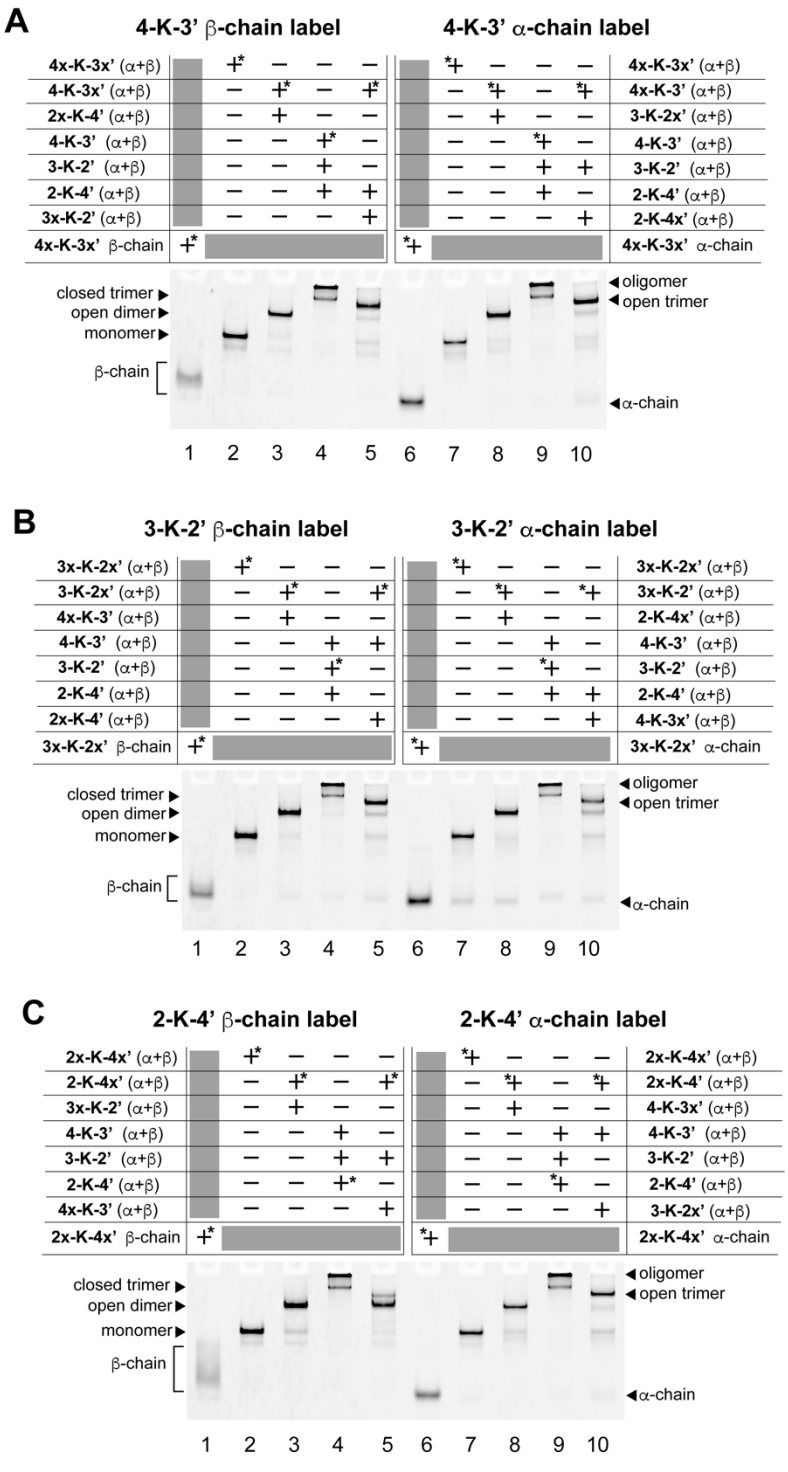

Figure S6
EMSA of triblock kUrd copolymers formed in the presence of 20 mM Mg^{2+}.
Asterisks indicate RNA chains labeled with BODIPY fluorophore.
(A) EMSA of triblock kUrd copolymers labeled with β-chain (left) or α-chain (right) of **4-K-3′**.
(B) EMSA of triblock kUrd copolymers labeled with β-chain (left) or α-chain (right) of **3-K-2′**.
(C) EMSA of triblock kUrd copolymers labeled with β-chain (left) or α-chain (right) of **2-K-4′**.

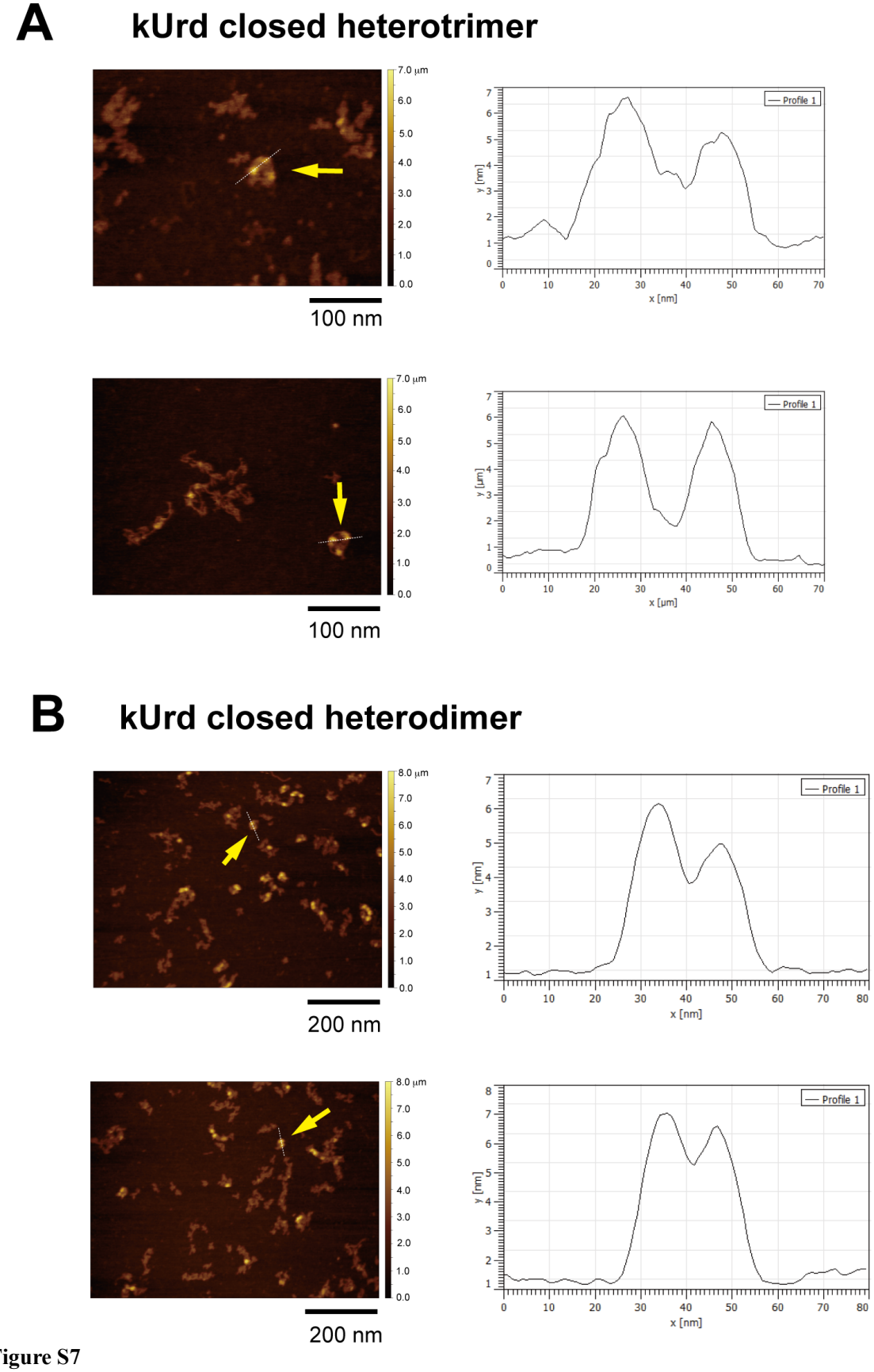

Figure S7
AFM images of the closed heterotrimer and heterodimer and their cross sections.
(A) AFM images of the closed heterotrimer (indicated by an yellow arrow) with 17.5 mM Mg^{2+} and their cross sections.
(B) AFM images of the closed heterodimer (indicated by an yellow arrow) with 17.5 mM Mg^{2+} and their cross sections.

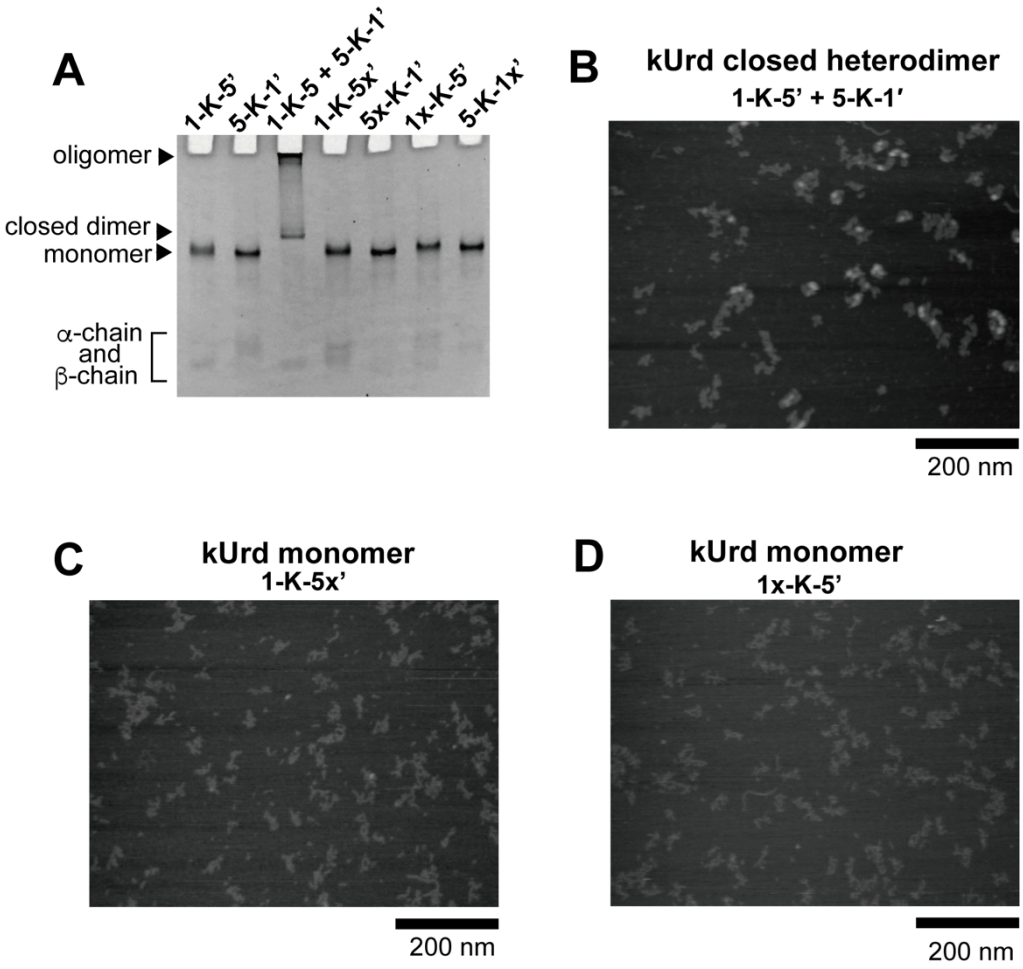

Figure S8
AFM images of the closed heterodimer and its mutant monomers
(A) EMSA of kUrds in the presence of 17.5 mM Mg^{2+}. RNAs were visualized by ethidium bromide staining.
(B) AFM imaging of a mixture of equal amounts of 1-K-5' and 5-K-1' in the presence of 17.5 mM Mg^{2+}.
(C) AFM imaging of 1-K-5x' in the presence of 17.5 mM Mg^{2+}.
(D) AFM imaging of 1x-K-5' in the presence of 17.5 mM Mg^{2+}.

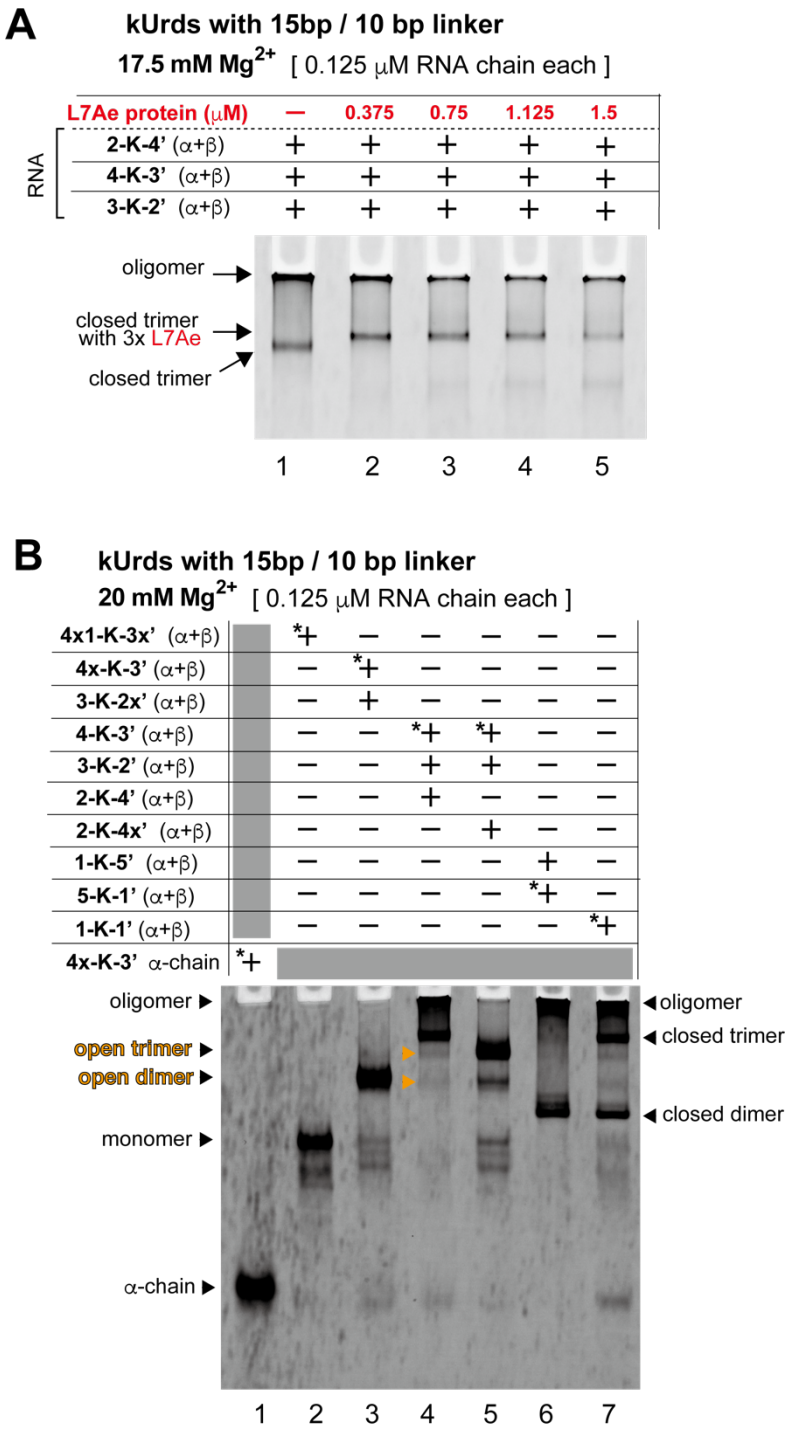

Figure S9
Complex formation of L7Ae proteins with KT-15 kink-turn motifs in a closed kUrd heterotrimer.
(A) EMSA of a closed kUrd heterotrimer in the absence and presence of L7Ae protein.
(B) EMSA of a closed kUrd heterotrimer in the absence and presence of L7Ae protein and L7Ae-EGFP fusion protein. Orange arrows indicate bands corresponding to open forms of kUrd dimer and trimer.

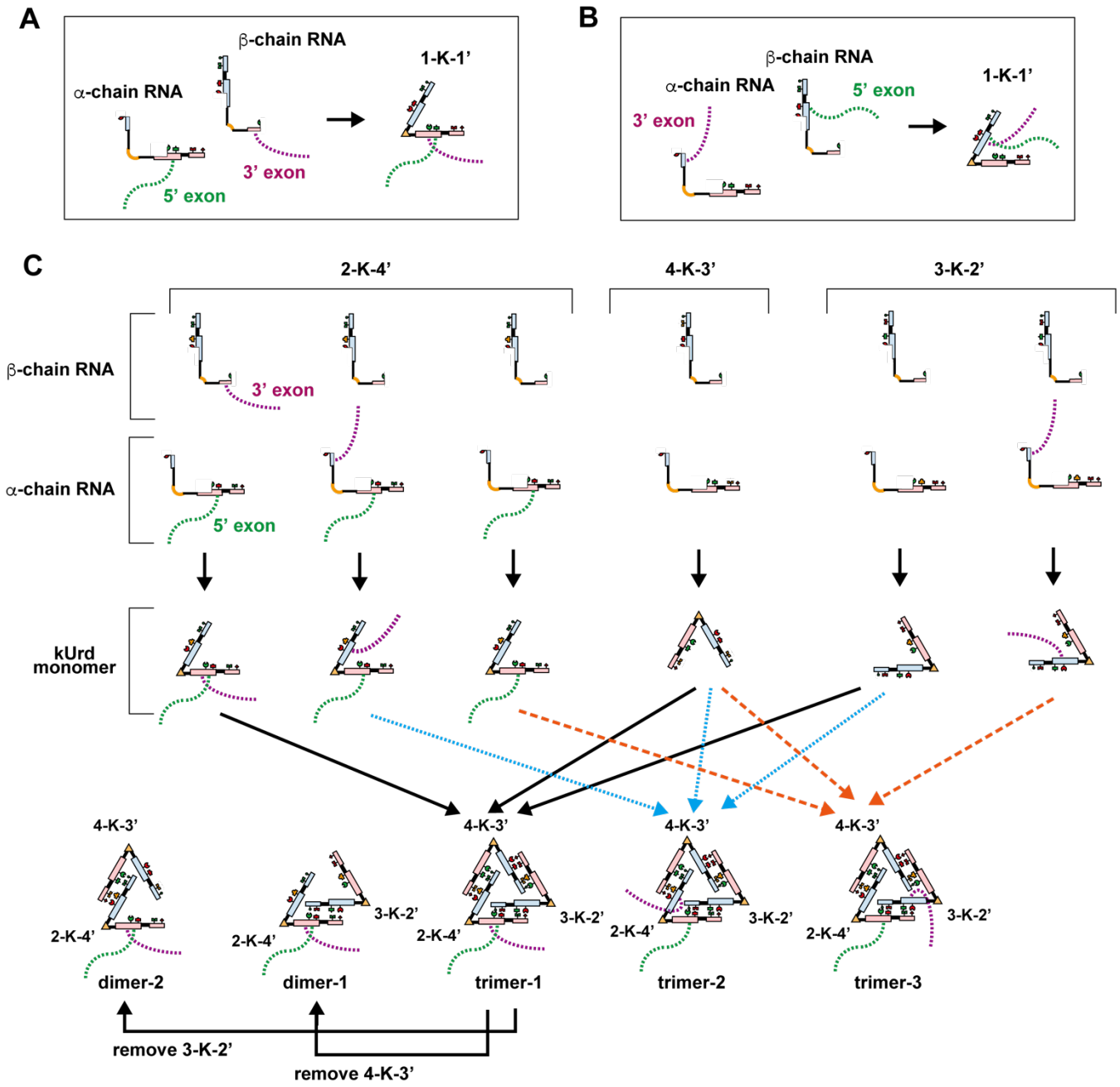

Figure S10

Closed kUrd trimers and their partial dimers used for analysis of the *trans*-splicing reaction.

(A) Formation of **1-K-1′** possessing the 5′ exon and 3′ exon in its α-chain and β-chain, respectively, to provide the wild-type ΔP5 ribozyme unit.

(B) Formation of **1-K-1′** possessing the 5′ exon and 3′ exon in its β-chain and α-chain, respectively, to provide the M1 type ΔP5 ribozyme unit.

(C) Formation of kUrd monomers used in analysis of *trans*-splicing reaction promoted by ribozyme unit 2 in triblock kUrd copolymer.

Table S1

Nucleotide sequences of α- and β-chain RNAs employed for EMSA, AFM imaging, and activity assays

NNNNN:	P1 substrate recognition element, type-a: 5'GGAGGG3', type-b: 5'GUGGCU3'
thick underline:	sequence for KT-15 motif
wavy underline:	sequence for the two linker duplexes connecting KT-15 motif and two RzM units
dashed underline:	sequence for M1 ribozyme unit
bold italic:	nucleotides removed in modulation of the length of the two linker duplexes
AGCUAGCU:	nucleotides forming RNA motifs that specify RzM:RzM interfaces

01 α-chain for 1-K-1', 1-K-1x', 1-K-5 and 1-K-5x', which provides type-a P1 to 1

NNNNNNAAAAGUUAUCAGGCACUCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAG***G***AC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUU***A***CUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

01x α-chain of 1x-K-1'and 1x-K-1x', which provides type-a P1 to 1x

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUGCA
UCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAG***G***ACGU
AAUCUGCAAUGUGGAACAGAUCUGCAUU***A***CUACACAUAUGGAUGCAGUUCACAGACU
AAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

02 α-chain of 2-K-4' and 2-K-4x', which provides P1 to 2

NNNNNNAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGAC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

02x α-chain of 2x-K-4' and 2x-K-4x', which provides type-a P1 to 2x

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUGCA
UCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACGU
AAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGAC
UAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

03 α-chain of 3-K-2' and 3-K-2x', which provides P1 to 3

NNNNNNAAAAGUUAUCAGGCACCCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG

UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGAC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

03x α-chain of 3x-K-2' and 3x-K2x', which provides type-a P1 to 3x

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUGCA
UCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACGU
AAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGAC
UAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

04 α-chain of 4-K-3' and 4-K3x', which provides P1 to 4

NNNNNNAAAAGUUAUCAGGCACUCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGAC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

04x α-chain of 4x-K-3' and 4x-K-3x', which provides type-a P1 to 4x

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUGCA
UCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACGU
AAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGAC
UAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

05 α-chain of 5-K-1', which provides type-a P1 to 5

GGAGGGAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGAC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

05x α-chain of 5x-K-1', which provides type-a P1 to 5

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUGCA
UCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACGU
AAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGAC
UAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUUG

UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

06 β-chain of 1-K-1', 1x-K-1', 5-K-1' and 5x-K-1', which provides type-a P1 to 1'

GGAGGGAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAG*U*AAU
GCAGAUCUGUUCCGAAGCAGAUUACGU*C*CUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

06x β-chain of 1-K-1x' and 1x-K-1x', which provides type-a P1 to 1x'

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUCGA
UCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAG*U*AAUGC
AGAUCUGUUCCGAAGCAGAUUACGU*C*CUGUUGAAAUCUGGAUGCAGUUCACAGACU
AAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

07 β-chain of 3-K-2' and 3x-K-2' which provides P1 to 2'

NNNNNNAAAAGUUAUCAGGCACUCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAU
GCAGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

07x β-chain of 3-K-2'x and 3x-K-2x' which provides type-a P1 to 2x'

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUCGA
UCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAUGC
AGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGACU
AAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

08 β-chain of 4-K-3' and 4x-K-3', which provides P1 to 3'

NNNNNNAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAU
GCAGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

08x β-chain of 4-K-3x' and 4x-K-3x', which provides type-a P1 to 3x'

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUCGA

UCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGGGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAUGC
AGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGACU
AAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

09 β-chain for 2-K-4' and 2x-K-4', which provides P1 to 4'

NNNNNNAAAAGUUAUCAGGCACCCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAU
GCAGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

09x β-chain for 2-K-4x' and 2x-K-4x', which provides type-a P1 to 4x'

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUCGA
UCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAUGC
AGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGACU
AAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

10 β-chain of 1-K-5', which provides type-a P1 to 5'

GGAGGGAAAAGUUAUCAGGCACCCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAU
GCAGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

10x β-chain of 1-K-5x', which provides type-a P1 to 5'

GGAGGGAAAAGUUAUCAGCUUCGGCUGGUAGCUAGUCUUUAAACCAAUAGAUUCGA
UCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGUC
AGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUAAG
CUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAUGC
AGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGACU
AAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCUU
AAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUGU
AUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

Table S2
Nucleotide sequences of α- and β-chain RNAs employed for *trans*-splicing reaction to yield Spinach aptamer

black letters:	nucleotides belonging to kUrd
red letters:	nucleotides belonging to Spinach aptamer
GAGUGU GCACUC :	5' splice-site recognition elements forming P1 duplex
thick underline:	sequence for KT-15 motif

α-chain of 2-K-4' to provide 5'-exon to 2

GGGACGCGACUGAAUGAAAUGGUGAAGGACGGGUCCAGUAGUUCGCUACUGUUGAG
UAGAGUGUAAAUAGCAAUAUUGGAGUUA
GCACUCAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUGC
AUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGU
CAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUAA
GCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACG
UAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGA
CUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCC
UUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUU
GUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU

α-chain of 2-K-4' to provide 5'-exon to 2 and 3'-exon to 4'

GGGACGCGACUGAAUGAAAUGGUGAAGGACGGGUCCAGUAGUUCGCUACUGUUGAG
UAGAGUGUAAAUAGCAAUAUUGGAGUUA
GCACUCAAAAGUUAUCAGGCAUGCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUGC
AUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCGU
CAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUAA
GCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGACG
UAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAGA
CUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCC
UUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUUU
GUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGUACUCGGAGCUCCGUAACUAGUCGC
GUC

α-chain of 3-K-2' to provide 3'-exon to 2'

GGAGGGAAAAGUUAUCAGGCACCCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUG
CAUCGGUUUAAAAGGCAAGACCGUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGAAACUUUGAGAUGGCCUUGCAAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUGUGUUCAACAGGAC
GUAAUCUGCAAUGUGGAACAGAUCUGCAUUACUACACAUAUGGAUGCAGUUCACAG
ACUAAAUGUGAACGGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUC
CUUAAUGGGAGCUAGCGGAUGAAGUGAUCGAACACUGGAGCCGCUGGGAACUAAUU
UGUAUGCGAAAGUAUAUUGAUUAGUUUUGGAGU
ACUCGGAGCUCCGUAACUAGUCGCGUC

β-chain of 2-K-4' to provide 3'-exon to 2

GGAGGGAAAAGUUAUCAGGCACCCACCUGGUAGCUAGUCUUUAAACCAAUAGAUUC
GAUCGGUUUAAAAGGCAACGUUCUCAAAUUGCGGGAAAGGGGUCAUGCUACGUCCG
UCAGUACCAAGUCUCAGGGGGAACUUUGAGAUGGCCUUGAGAAGGGUAUGGUAAUA
AGCUGACGGACGUAGCAUGGUCCUAACCACGCAGCCAAGUCCUAAGUGUGUAGUAAU
GCAGAUCUGUUCCGAAGCAGAUUACGUCCUGUUGAAAUCUGGAUGCAGUUCACAGAC
UAAAUGUCGGUCGGGGAAGAUGUAUUCUUCUCAUAAGAUAUAGUCGGACCUCUCCU
UAAUGGGAGCUAGCGGAUGAAGUGAUGCAACACUGGAGCCGCUGGGAACUAAUUUG
UAUGCGAAAGUAUAUUGAUUAGUUUUGGAGUACUCGGAGCUCCGUAACUAGUCGCG
UC