A: Fundamentals of Life

- Definition of Life
- Logic of Molecular Biology
- History of Biology
- Becoming alive
- Soup of Life
- Selection: before and in life
- Three faces of Entropy
- Death and equilibrium
- Missing non-equilibrium
- Structure of Origin of Life
- Modes of non-equilibrium
- Examples of evolution

B: Physics for Chemistry

Polymerization
- Theory of polymerization
- P. by fast cooling
- P. by stacking with 3’-5’-Ph.
- Activation groups
- P. on clay
- P. by thermophoresis
- Phase transitions with DNA
- Sedimentation of DNA
- Drying and its problems
- Elegance of air interface

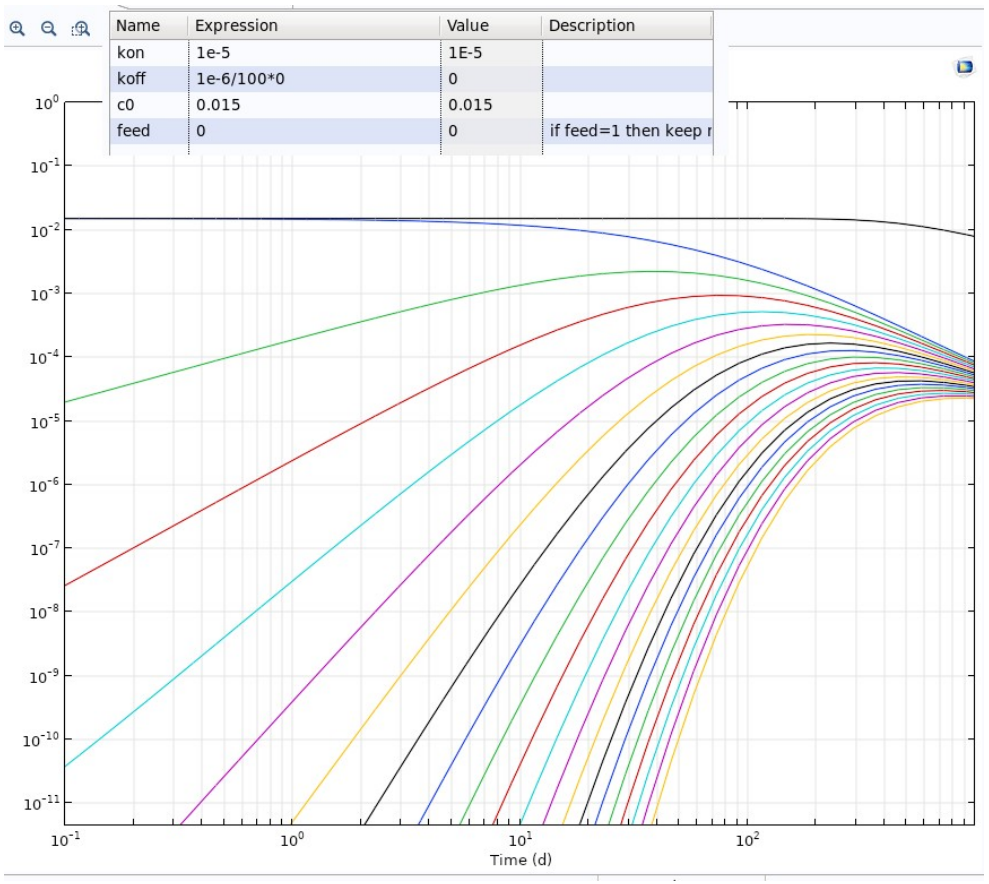
Replication
- Templated polymerization
- Ligation
- Strand separation problem
- PCR in convection
- Ribo-PCR in convection

C: Evolution Machines

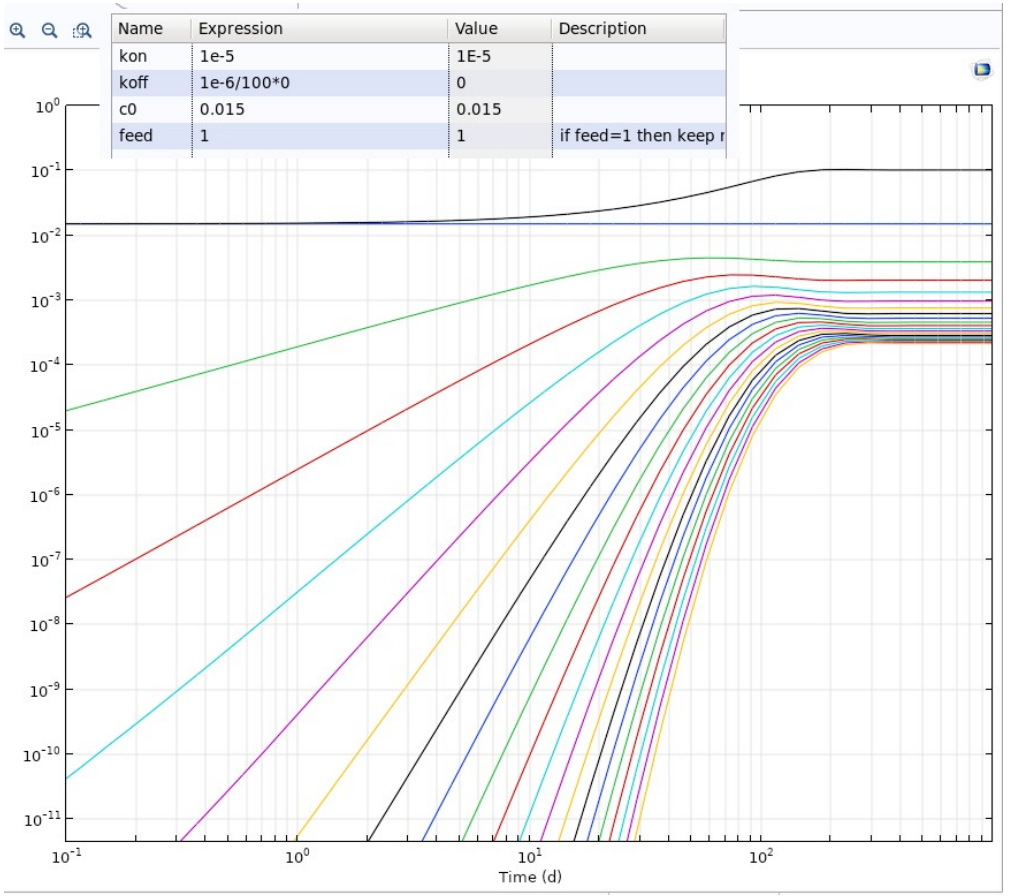
Replication with accumulation
- Case of Ribo-PCR
- Spiegelman problem
- Case of trapped PCR
- Trapped PCR with flow
- Feeding problem
- Replication with heated tRNA
- Replication in driven Fog

Rebustness of evolution
- Error threshold
- Instability of four bases
- Hypercycles with ligation
- Spont. Symmetry breaking
- Spont. sequence selection
- Cooperation within cells

Theory of polymerization

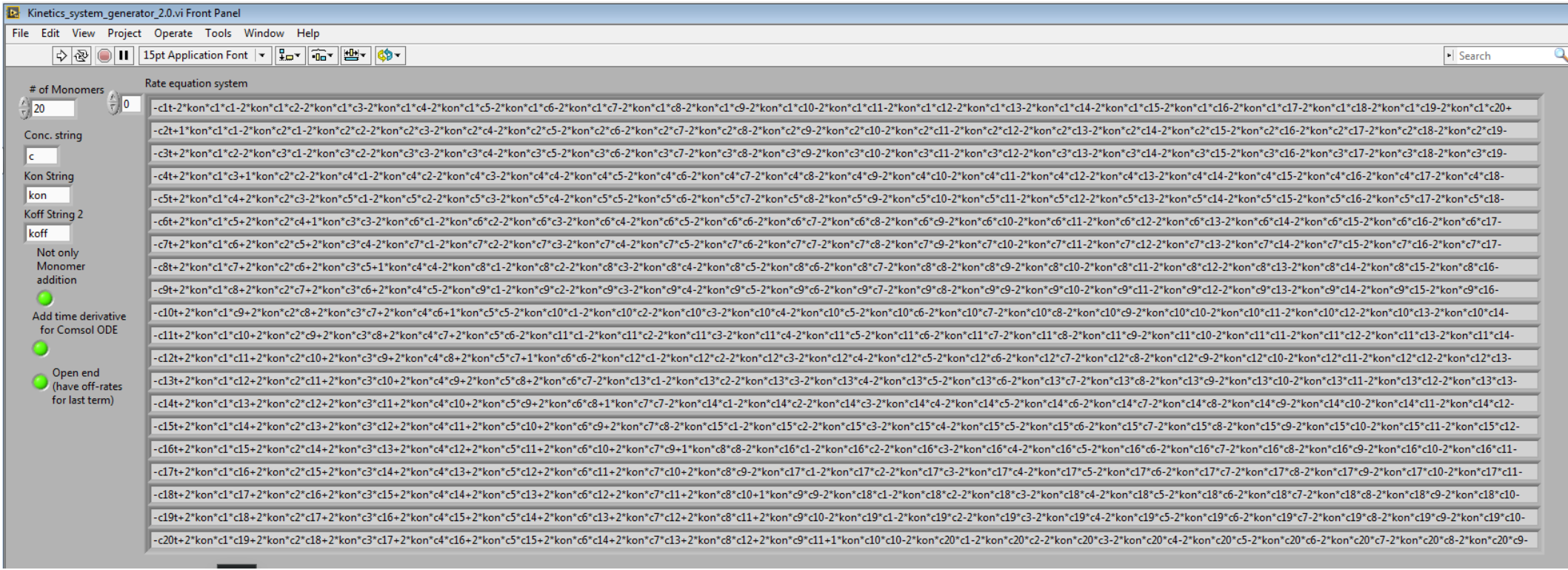


Comsol no feeding of monomers



Comsol with feeding of monomers

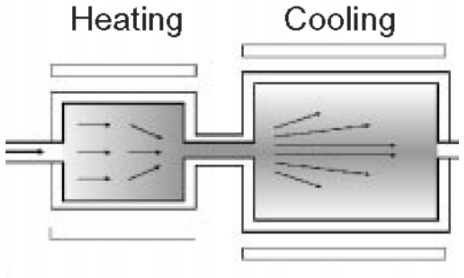
Theory of polymerization

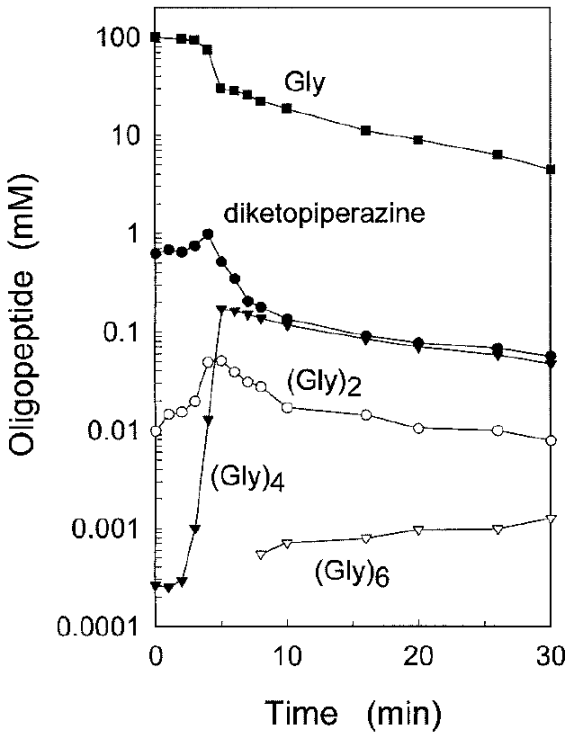


Creating kinetic terms with a LabView program

Esoteric?
Protein Polymerization
by fast cooling

Matsuno: Polymerisation by fast cooling





Koichiro Matsuno, Science 283, 831 (1999)

Polymerization on clay
Needs ion washing: Correct mechanism?

Ferris: Clay-based polymerisation

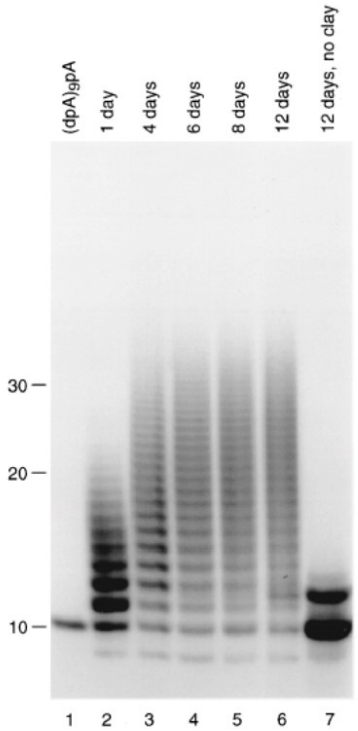
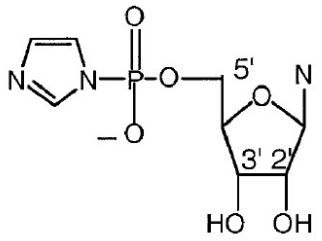


Figure 2. Gel electrophoresis of the elongation of ^{32}pdA(pdA)$_8$pA with ImpA in microcentrifuge tubes. Lane 1, ^{32}pdA(pdA)$_8$pA; lanes 2–6 elongation in the presence of montmorillonite; lane 7, elongation in the absence of montmorillonite.



On the **surface of negative charged montmorillonite** clay, energy rich nucleotide-primers can undergo efficient polymerization. One can reach **30-50-mers within some days**. Surfaces are therefore interesting places for catalysis of prebiotic reactions since they can enhance the concentration of the molecules. Problem is the removal of the polymerized species from the surface and replication priming.

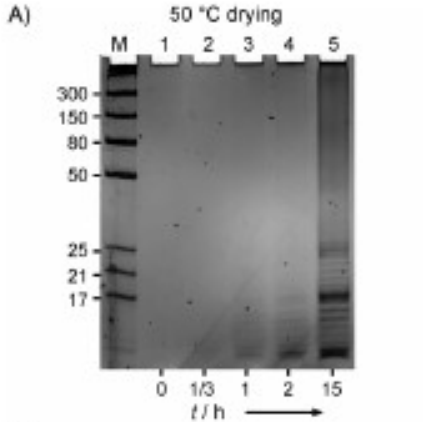
James P. Ferris: Origins of Life and Evolution of the Biosphere **32:** 311–332, 2002.

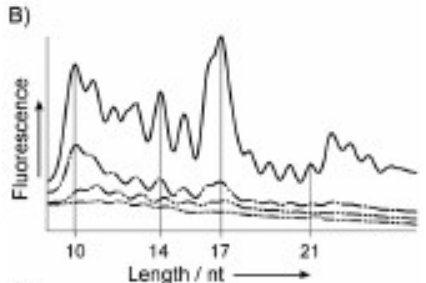
Polymerization by drying of 3’-5’ cyclic G-Nucleotide

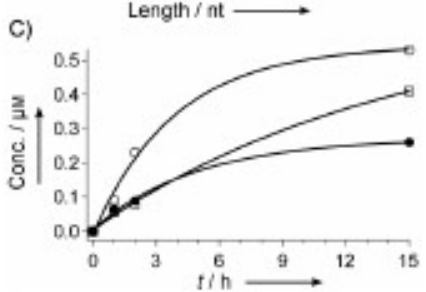
DOI: 10.1002/cbic.201300773

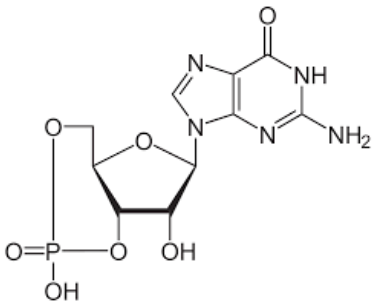
Dry Polymerization of 3′,5′-Cyclic GMP to Long Strands of RNA

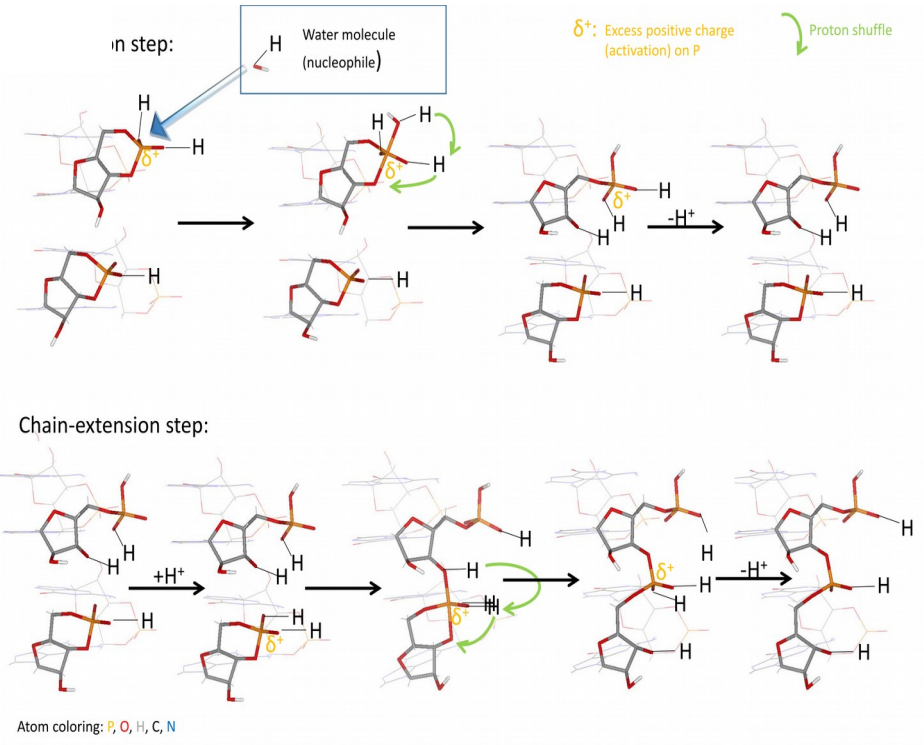
Matthias Morasch,[a] Christof B. Mast,[a] Johannes K. Langer,[a] Pierre Schilcher,[b] and Dieter Braun*[a]











See papers by di Mauro and Judith Sponer

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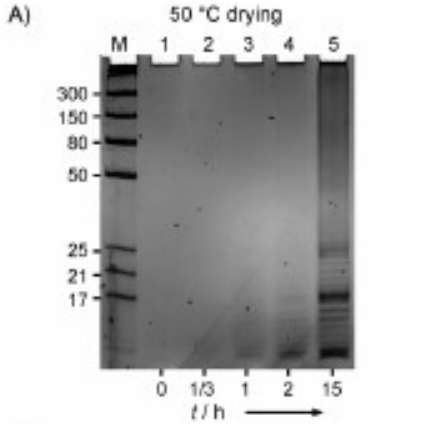

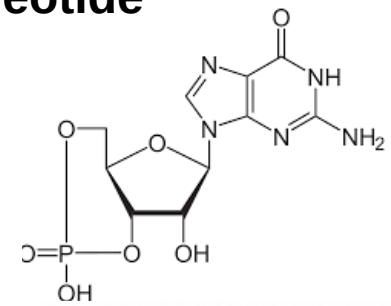

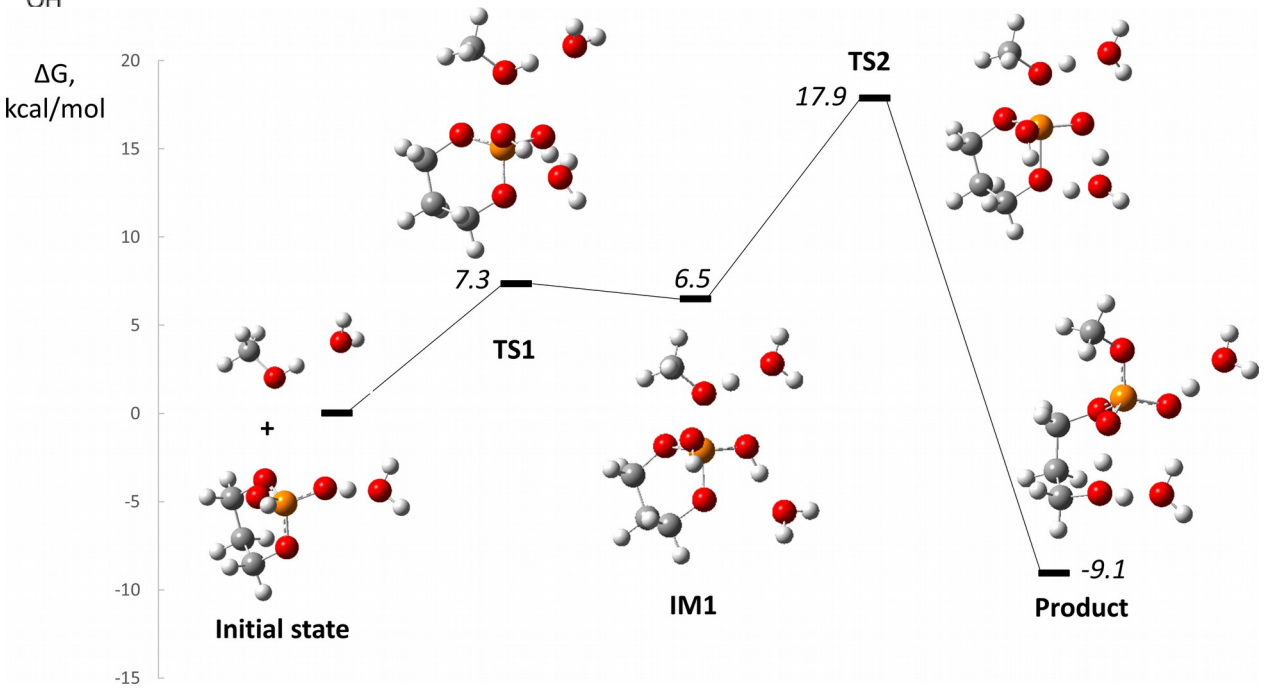

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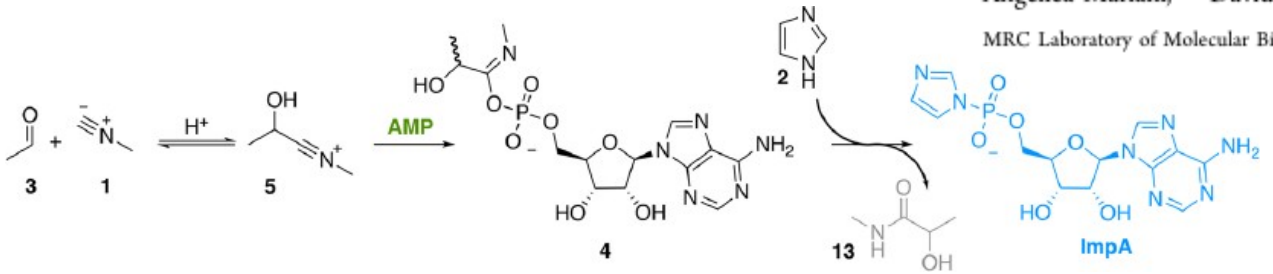
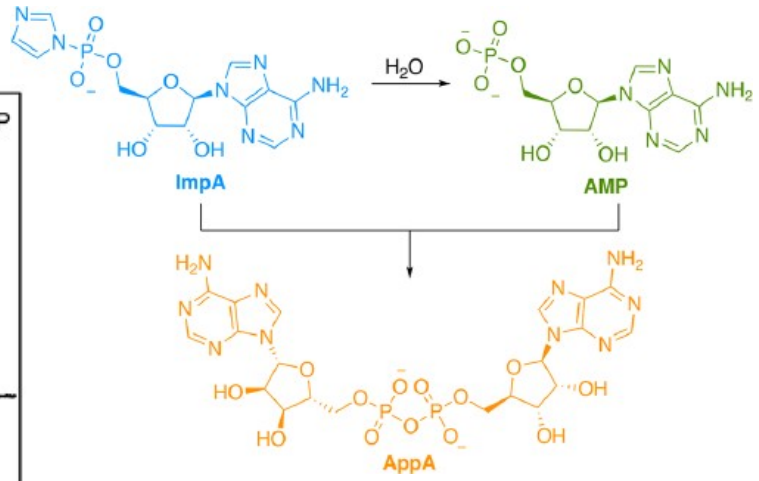
Activation group: in situ possible?

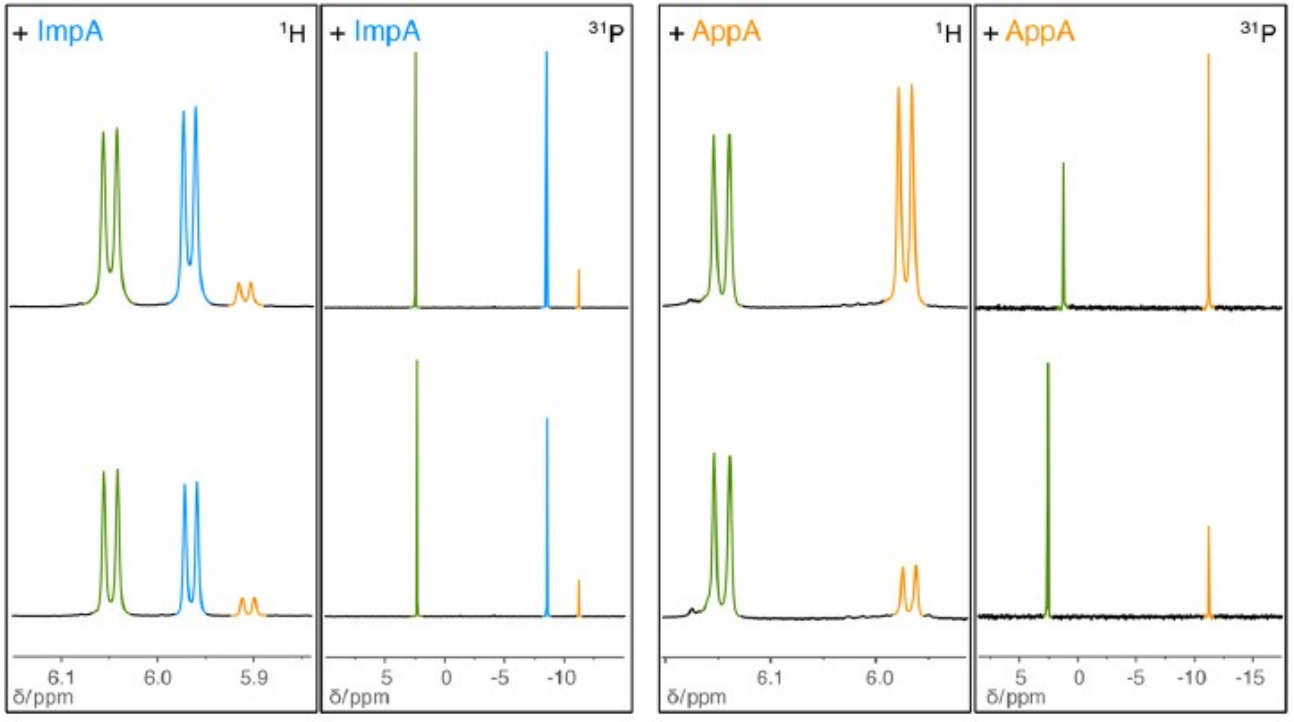
A Light-Releasable Potentially Prebiotic Nucleotide Activating Agent

Angelica Mariani,[†] David A. Russell,[†] Thomas Javelle, and John D. Sutherland[*]

MRC Laboratory of Molecular Biology, Francis Crick Avenue, Cambridge Biomedical Campus, Cambridge CB2 0QH, U.K.







Polymerization boost by Thermophoretic Trap