Postdoc position on

**Inference of RNA structure and function from sequence data**

Laboratory of Physics of the Ecole Normale Supérieure, under the supervision of

Simona Cocco and Rémi Monasson

**Context and project:** RNA, long recognized as a crucial intermediate in the fundamental  biological process of production of proteins from genetic material (DNA) is also involved in many catalytic and enzymatic processes. In this context, a fundamental question is to relate the sequence of RNA molecule to its structural and functional properties. The sequence
content must encode the 3D conformation of RNA (and alternative
conformations e.g. resulting from binding to a ligand), In addition, the
sequence is subject to functional constraints due to the need to achieve
catalytic activity and specific interactions with other molecules or
chemical species (RNA, proteins, DNA, ions..). RNAs designed by nature and obtained by sequencing many evolutionary distinct organisms can be used to unveil the constraints acting on RNA. Combining this sequence data available in databases such as RFAM with statistical physics and computational methods will allow us to reconstruct the landscape associated to a given function and structure. Our approach will also be tested on well-controlled RNA sequence data obtained from in vitro selection (selex). In turn, we will exploit the reconstructed landscapes to design new RNA sequences, whose structural and functional properties will be experimentally tested. The latter scope is part of the currently very active field of design in material sciences, chemistry and biomedicine.

**Practical information:**

This post-doc is funded  by the ANR Decrypted for 18 months and should start in Spring 2021. The recruited postdoc will work in collaboration with Simona Cocco and Rémi Monasson, in the Statistical Physics and Inference for Biology group in the Laboratory of Physics of the Ecole Normale Supérieure. She/he will also benefit from the collaboration with Bruno Sargueil (CiTCoM, Paris Descartes University ) and Yann Ponty (LIX, Ecole Polytechnique ).

**How to apply:**

The candidate should have a PhD (or have it completed before the start
of the position) in a relevant field, and a strong experience in  theoretical physics, statistical physics or bioinformatic and machine learning. To apply, please send a CV and a cover letter describing your interests and previous work to

simona.cocco@phys.ens.fr and remi.monasson@phys.ens.fr

**Bibliography:**

[1]Inverse Statistical Physics of Protein Sequences: A Key Issues Review.S. Cocco, C. Feinauer, M. Figliuzzi, R. Monasson, M. Weigt. [Reports on Progress in Physics 81, 032601 (2018).](http://www.phys.ens.fr/~monasson/Articles/a107.pdf)

[2] Direct-Coupling Analysis of nucleotide coevolution facilitates RNA secondary and tertiary structure predictionE. De Leonardis, S. Lutz, S. Ratz, S. Cocco, R. Monasson, A. Schug, M. Weigt [Nucleic Acid Research, doi: 10.1093/nar/gkv932 (2015)](http://www.phys.ens.fr/~monasson/Articles/a97.pdf) ([supplemental text](http://www.phys.ens.fr/~monasson/Articles/a97-si1.pdf) and [supplemental figures](http://www.phys.ens.fr/~monasson/Articles/a97-si2.pdf))

[3] 3D RNA and Functional Interactions from Evolutionary Couplings. Weinreb, C., Riesselman, A.J., Ingraham, J.B., Gross, T., Sander, C. and Marks, D.S. Cell 165(4), pp. 963–975 (2016).

[4] An evolution-based model for designing chorismate mutase enzymes

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