Biophys

Biological applications of methods of theoretical physics
Linea 6, from 2005

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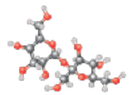
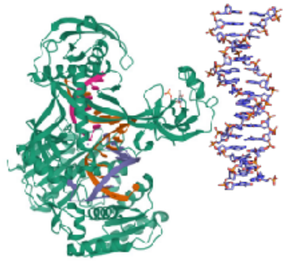
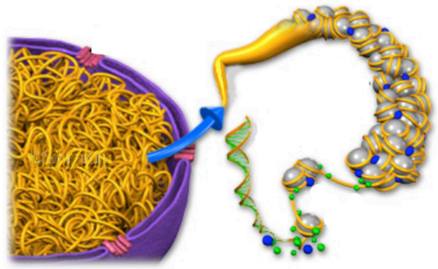
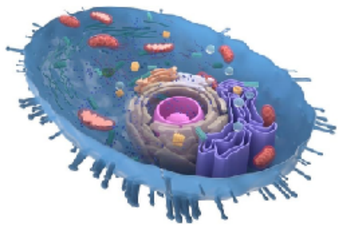
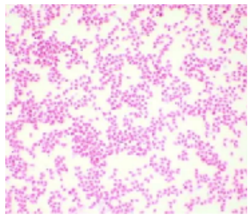
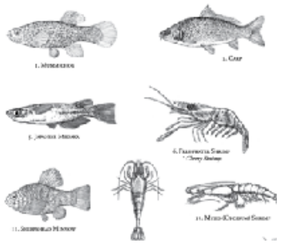
Marco Cosentino Lagomarsino (PA)
Edoardo Marchi (dott)

Publications last 5 years:
1 Nature
1 Science
1 Nature Str. Mol. Biol.
1 Nature Physics
...
...
2 Biophys. J.
2 Phys. Rev. Res.
3 Phys. Rev. E


10^{-10} m | 10^{-8} m | 10^{-7} m | 10^{-5} m | 10^{-3} m | 1 m | 10^{2} m

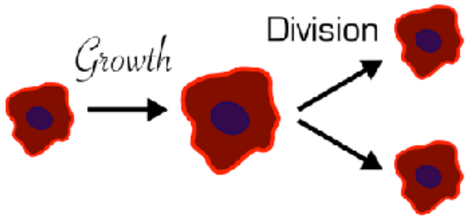
10^{-12} s | 10^{-6} s | 1 s | 10^{5} s | | | 10^{8} s

10^{-2} eV | | | 10^{2} eV | | | 10^{19} eV

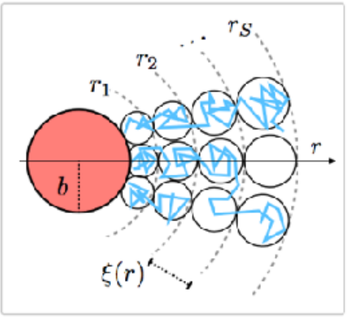
(classical physics: complex systems & statistical mechanics)

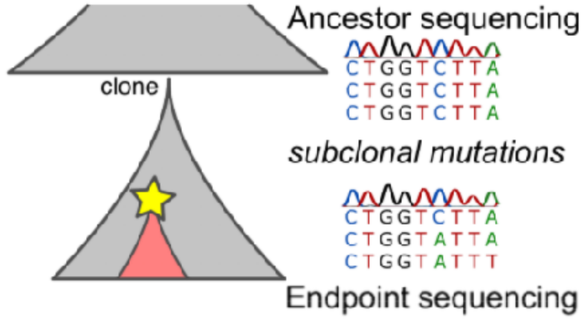
“Statistical Physics of Cells and Genomes” - PI: Marco Cosentino Lagomarsino

Theory group, based on *statistical physics* expertise
Tight experimental collaborations

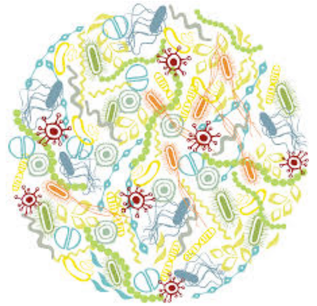


Core topics: qPhysiology
(single-) cell growth
(single-) cell cycle progression
Chromosome organization





Additional topics: qEvo
Persistence and mutation phenotypes
Evo-genomics of microbial communities




MCL

$\frac{d\ell}{dt}$ *Current Members*


Ludovico Calabrese

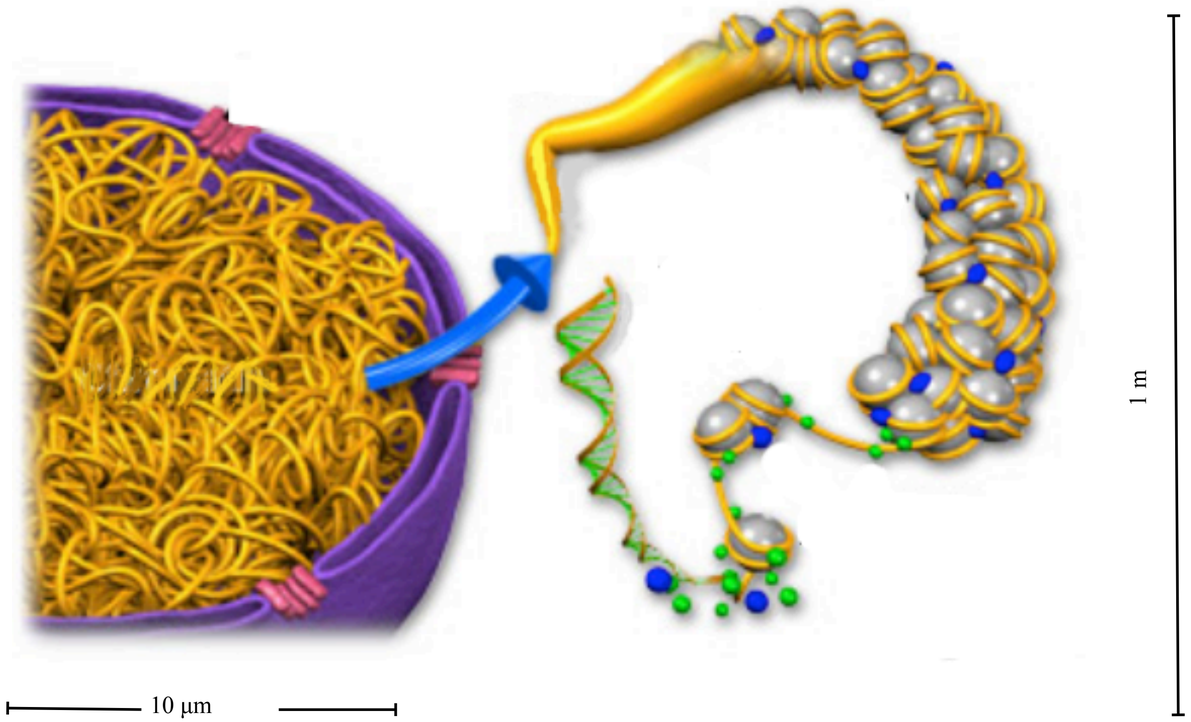

Simone Pompei


Rossana Droghetti


Mattia Corigliano


Giorgio Tallarico

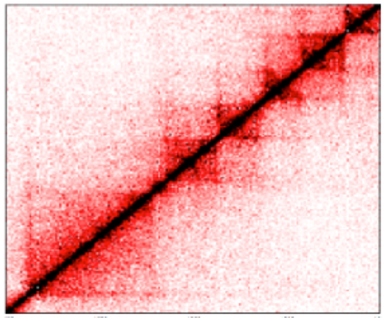
“Conformational properties of chromatin” - PI: Guido Tiana



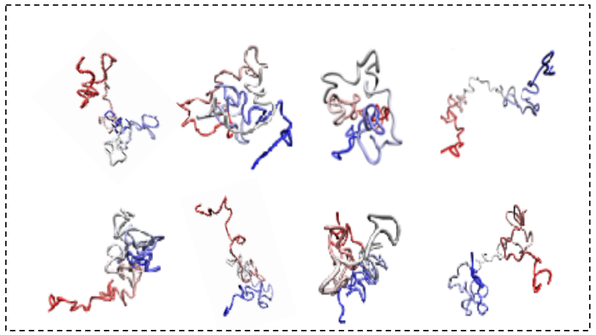
- very complex system
- relevant for genetic control
- related to disease

“Conformational properties of chromatin” - PI: Guido Tiana

1) Derive conformations from experimental data ⋯⋯▸ inverse statistical problems

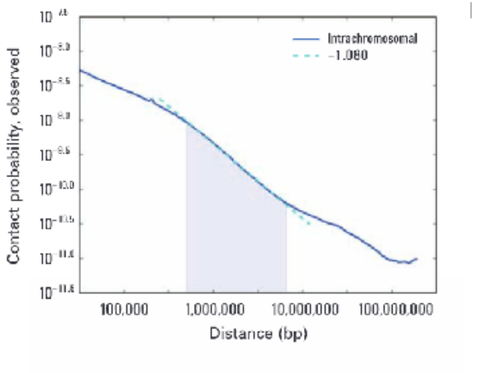


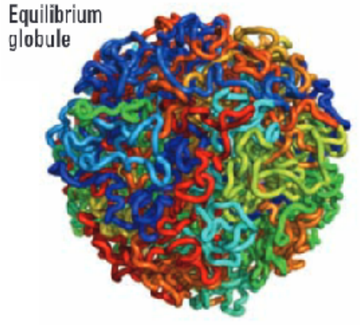
HiC experiment



- ill-posed problems
- methods based on maximum entropy
- equilibrium statistical mechanics
- computationally intensive

2) Understand scaling laws ⋯⋯▸ polymer physics

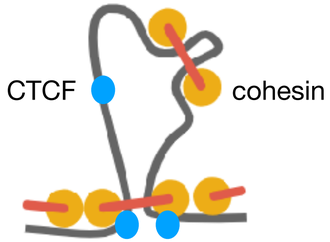




- both analytical and computational

“Conformational properties of chromatin” - PI: Guido Tiana

3) Model interactions ⋯⋯▸ stochastic processes



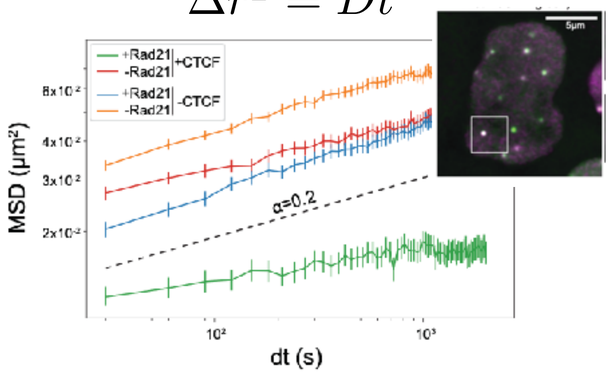
$$\frac{dp_{i,j}}{dt} = k_{\text{on}}\delta_{|i-j|,1} - k_{\text{off}}p_{i,j} + k\tilde{\delta}^{-}_{i+1}p_{i+1,j} - k\tilde{\delta}^{-}_{i}p_{i,j} + k\tilde{\delta}^{+}_{j-1}p_{i,j-1} - k\tilde{\delta}^{-}_{j}p_{i,j},$$

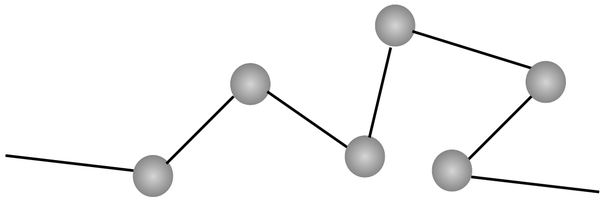
$$\longrightarrow \quad p_{k_c-n,k_c+m} = \binom{n+m-1}{m} {}_2F_1(1, 1-n, 1+m, -1) \times \left(\frac{k}{k_{\text{off}}+2k}\right)^{m+n-1} p_0,$$

- obtain an effective model (...simpler)
- explains the power law in contact probability

3) Study anomalous diffusion ⋯⋯▸ again polymer physics

$$\overline{\Delta r^2} = Dt^{\alpha}$$





- extend Rouse model (analytical)
- MD simulations