

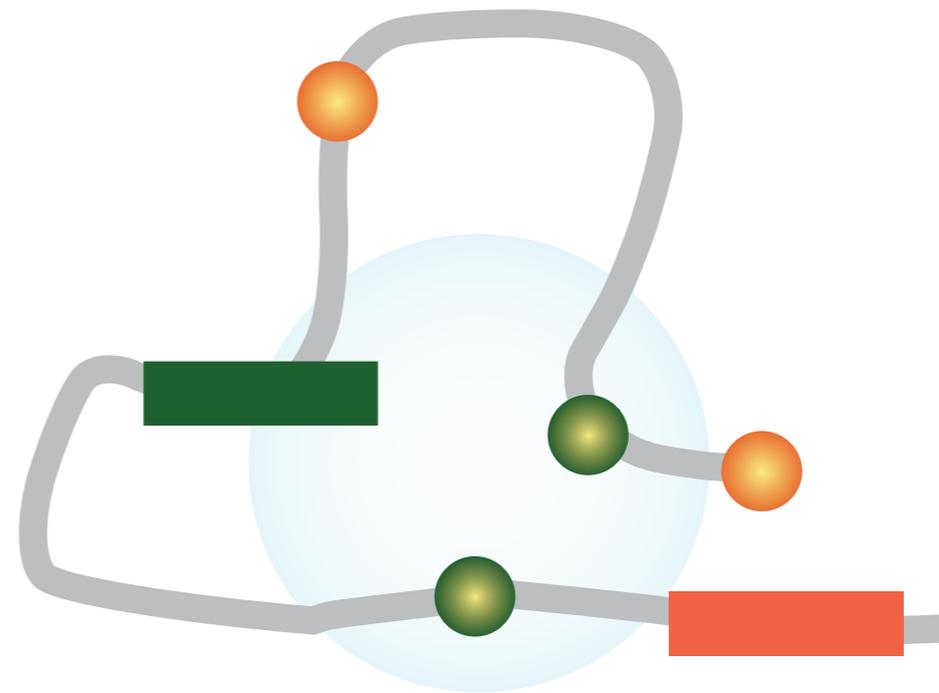
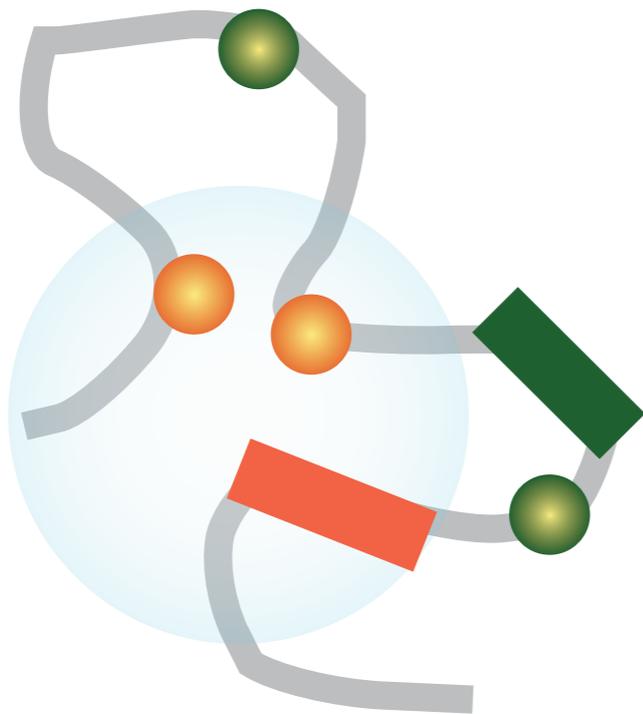


Visualizing the third dimension of genomes

Marc A. Martí-Renom

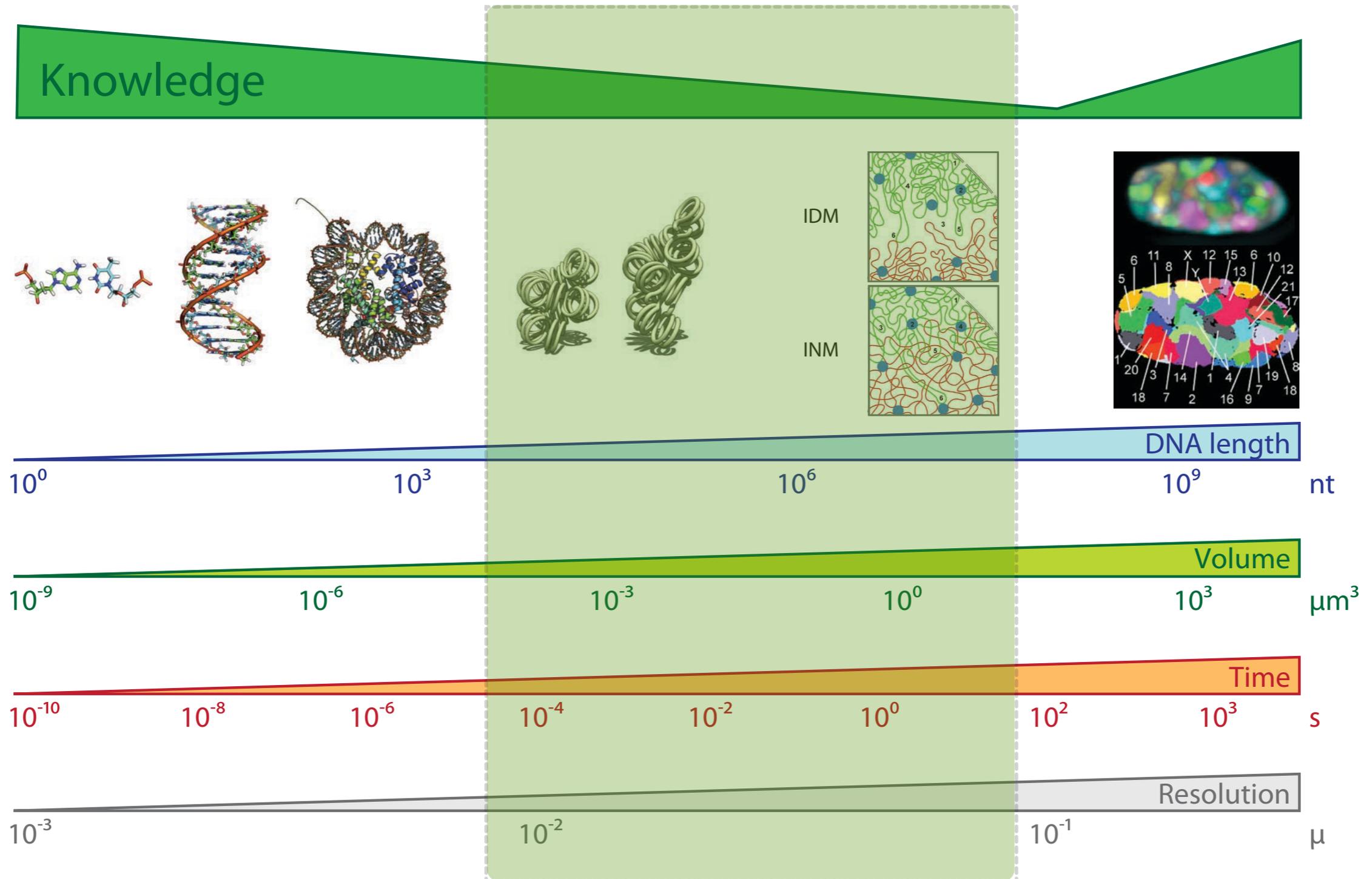
*Genome Biology Group (CNAG)
Structural Genomics Group (CRG)*





Resolution Gap

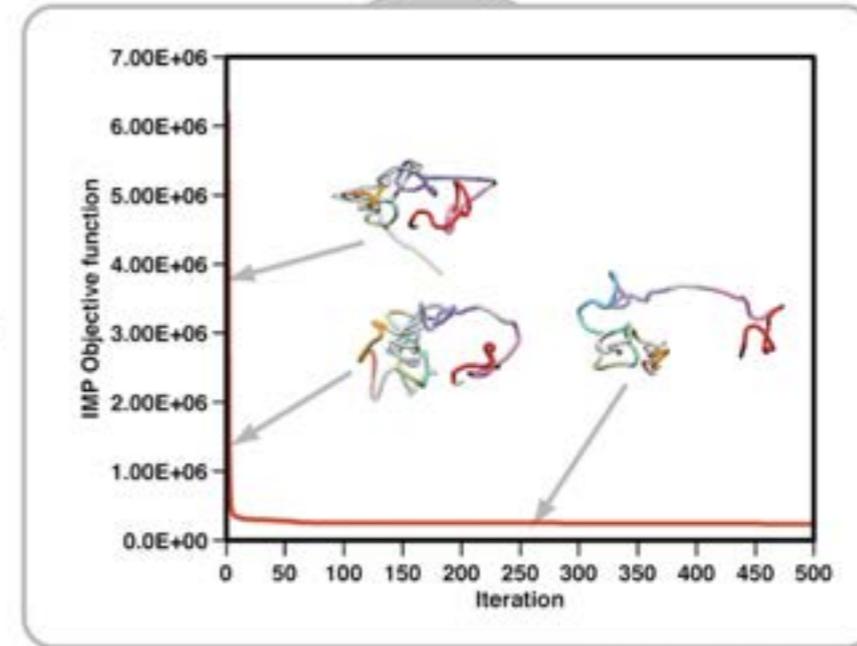
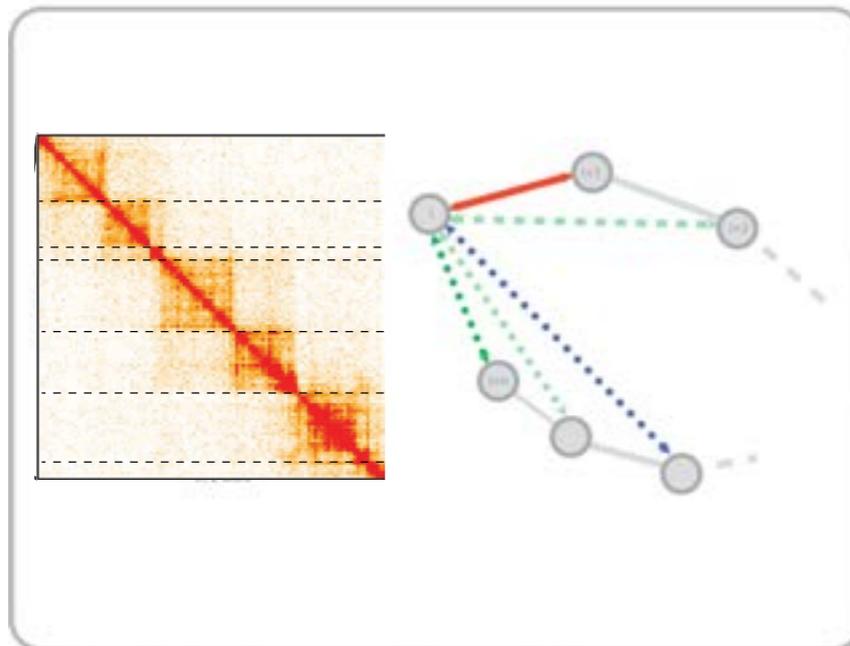
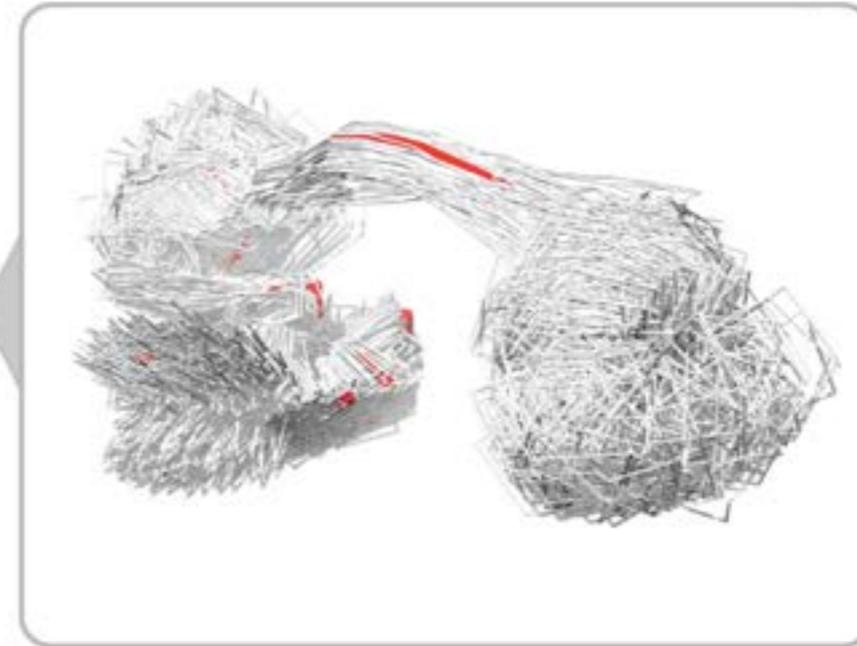
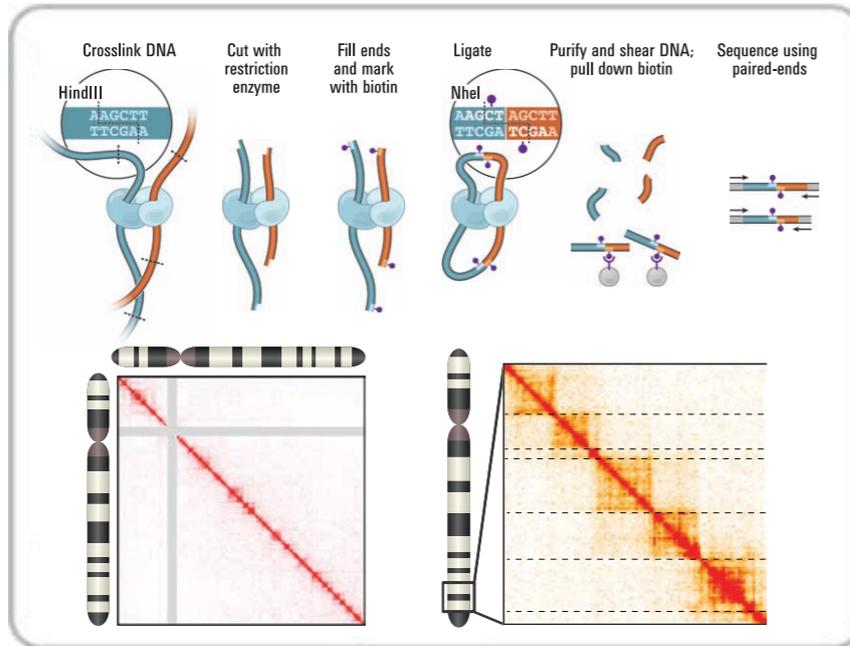
Marti-Renom, M. A. & Mirny, L. A. PLoS Comput Biol 7, e1002125 (2011)



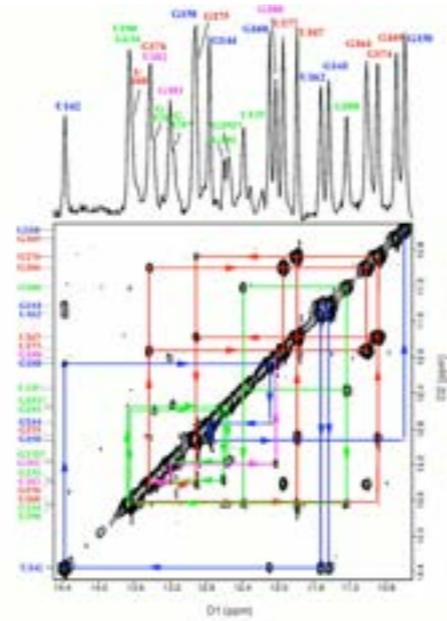
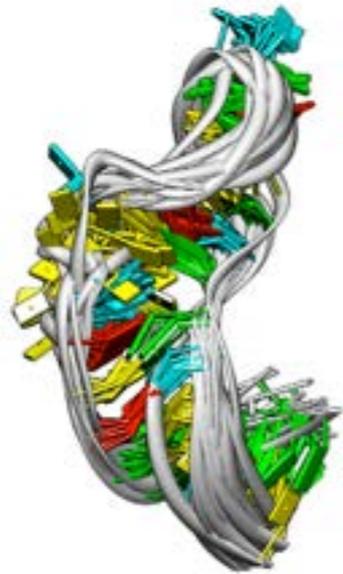
Hybrid Method

Baù, D. & Marti-Renom, M. A. *Methods* 58, 300–306 (2012).

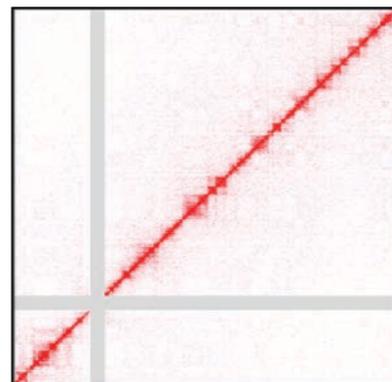
Experiments



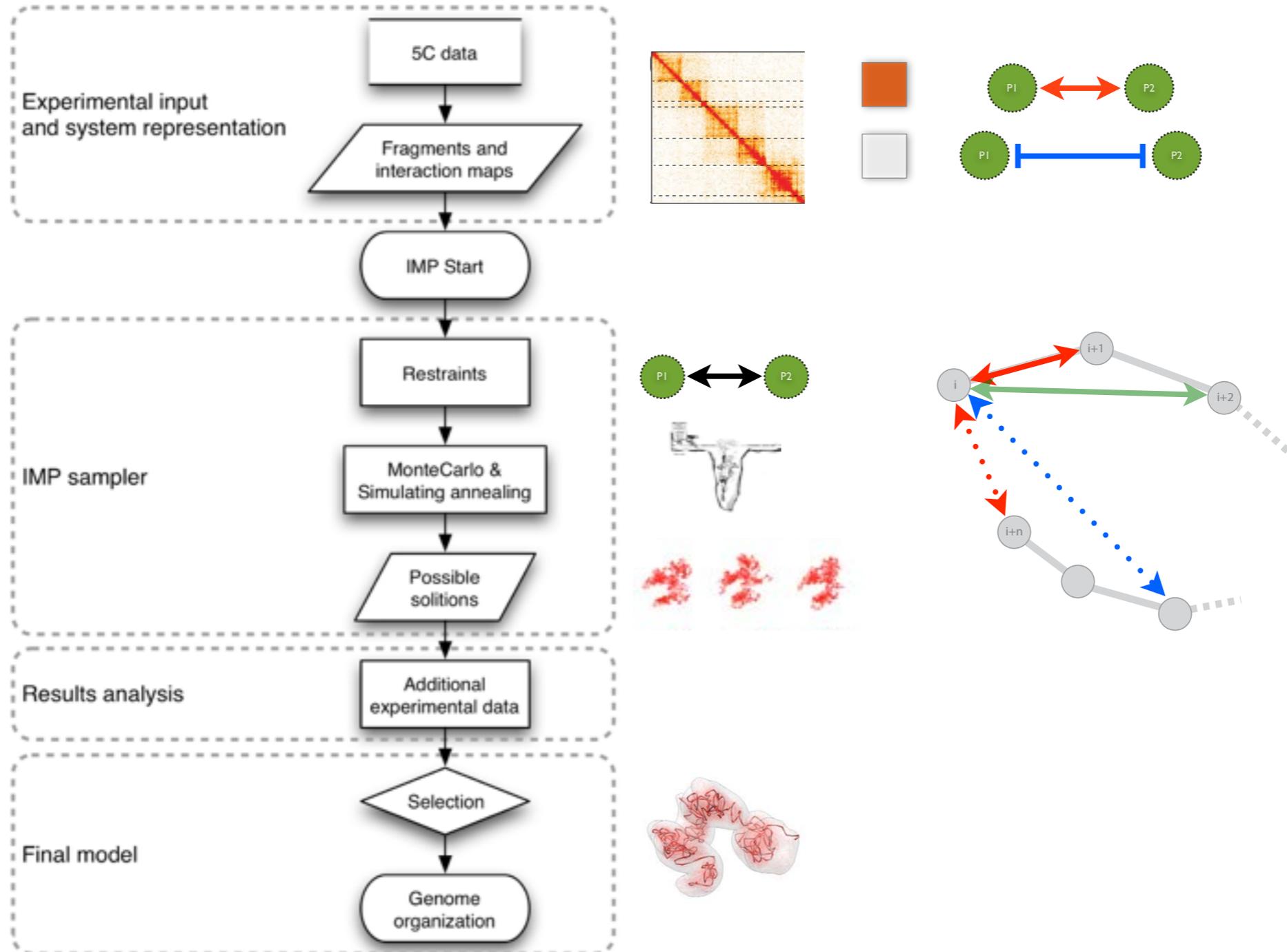
Computation



Biomolecular structure determination 2D-NOESY data

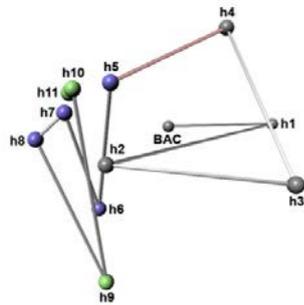


Chromosome structure determination 3C-based data

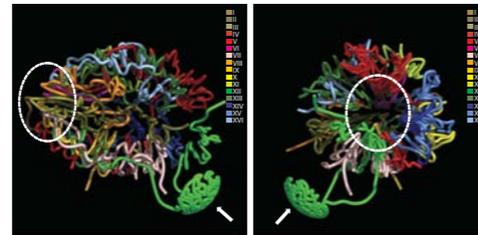


Visualizing 3D Genomes

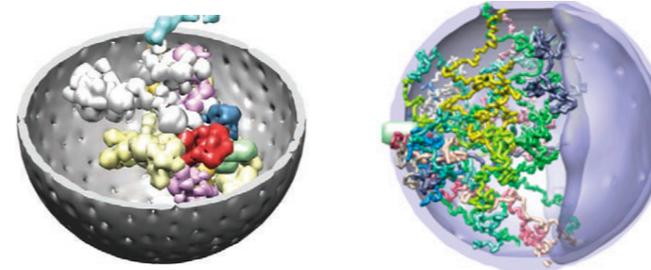
Jhunjunwala (2008) Cell



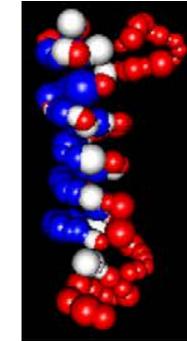
Duan (2010) Nature



Kalhor (2011) Nature Biotechnology
Tjong (2012) Genome Research

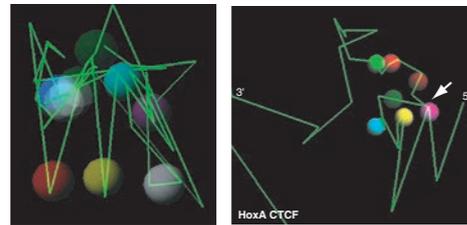


Hu (2013) PLoS Computational Biology

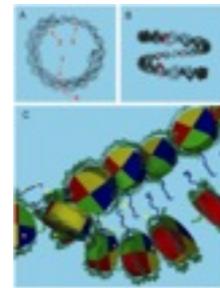


2008

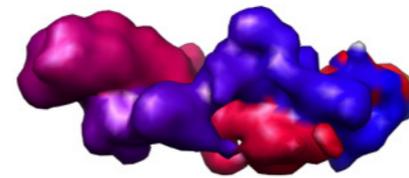
2014



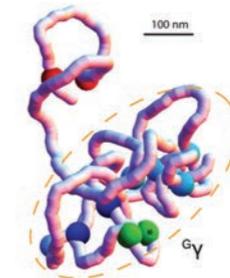
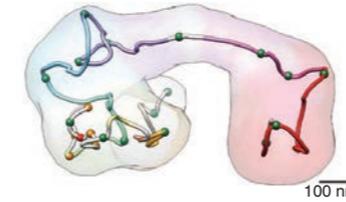
Fraser (2009) Genome Biology
Ferraiuolo (2010) Nucleic Acids Research



Asbury (2010) BMC Bioinformatics



Baù (2011) Nature Structural & Molecular Biology
Umbarger (2011) Molecular Cell



Junier (2012) Nucleic Acids Research

Diversity of representations
NO LINK to 1D and 2D data

What we need...

Connection to 1D and 2D data (**CellBase**)
Multi-scale representation (under development)

Cross-platform (**Greenhouse**)
Multi-screen support (**Greenhouse**)
Hand-gesture support (**Greenhouse** + **kinect/leap**)



greenhouse
ALPHA



John Underkoffler



OBLONG's Greenhouse

<http://greenhouse.oblong.com>

OMEagination

Gesture based 3D visualization of brain structures and activity.

Created in collaboration with University of California San Francisco and Lawrence Berkeley National Laboratory as part of the OME Precision Medicine Summit using Oblong Greenhouse SDK, FSLView, and a consumer depth sensor.

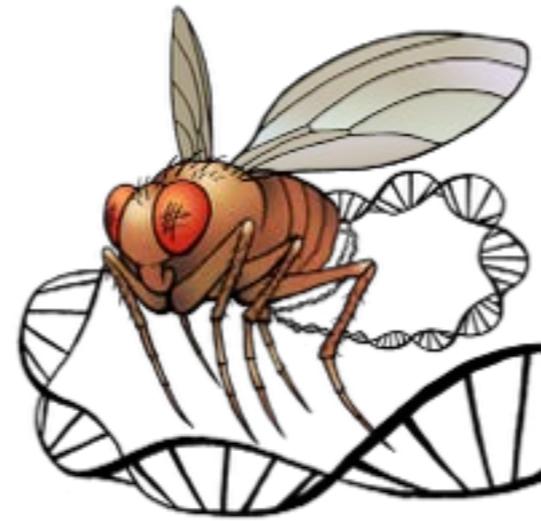
Collaborating on the project: Bill Seeley, Jesse Brown, and Andrew Trujillo from UCSF MEMORY AND AGING CENTER; Leonid Olikier (Future Technologies Group), Gunther Weber (Visualization Group and the NERSC Analytics Team), Aydın Buluç (Applied Mathematics & Scientific Computing), and Daniela Ushizima (Vis/Analytics Group) from LAWRENCE BERKELEY NATIONAL LABORATORY; Stacey Chang (Health & Wellness practice) from IDEO; Kwin Kramer, David Kung, Sarah Vieweg, John Carpenter, Corey Porter, Mattie Ruth Kramer Backman, and Michael Schuresko from OBLONG INDUSTRIES.

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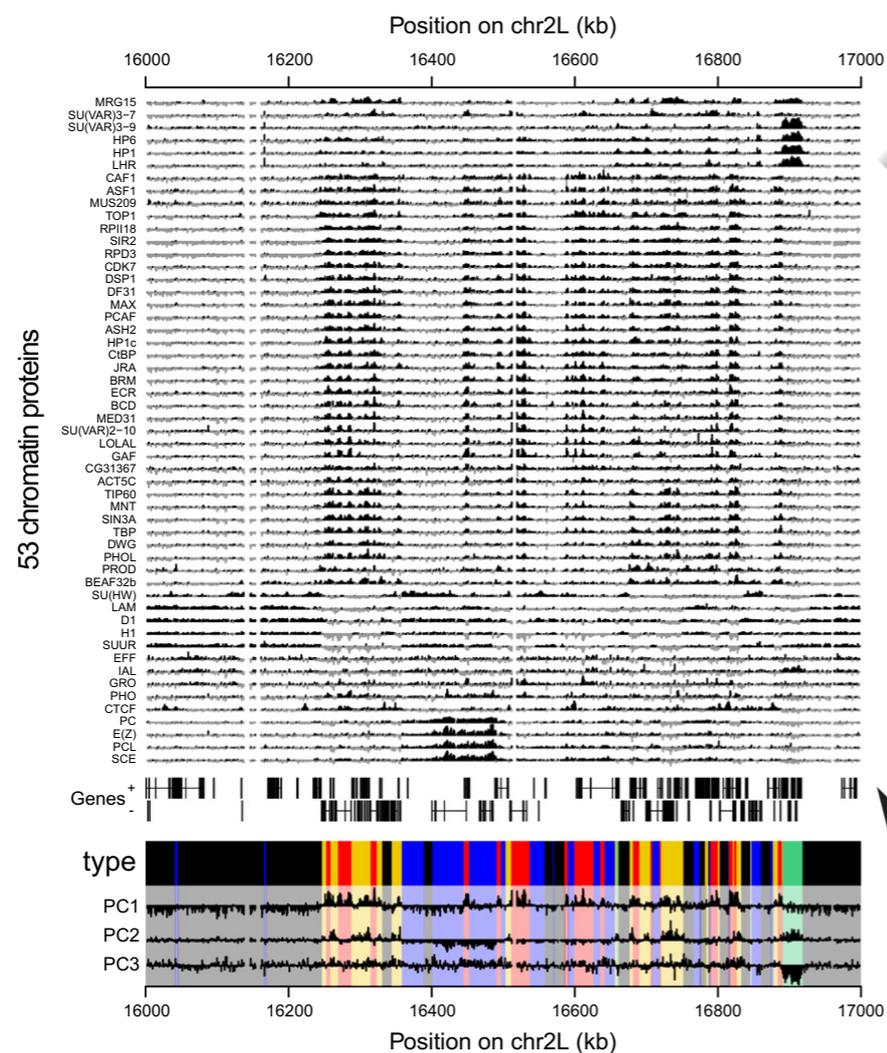
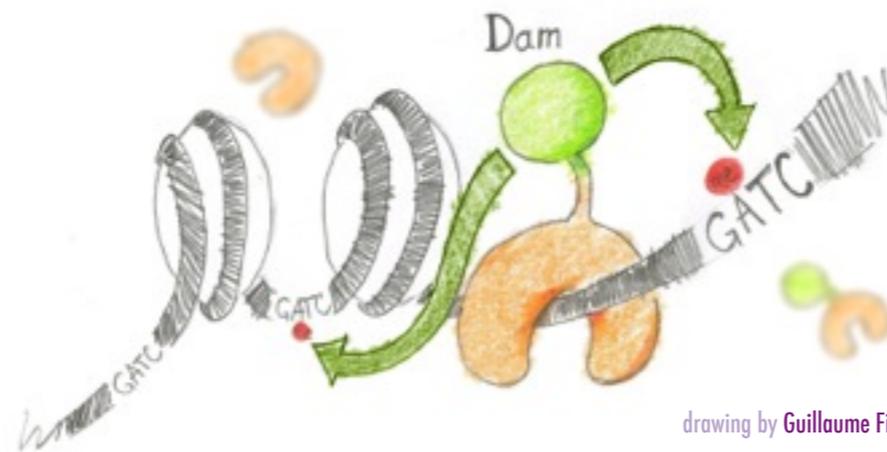
UCSF / LBNL developed using Greenhouse

Structuring the **COLORs** of chromatin

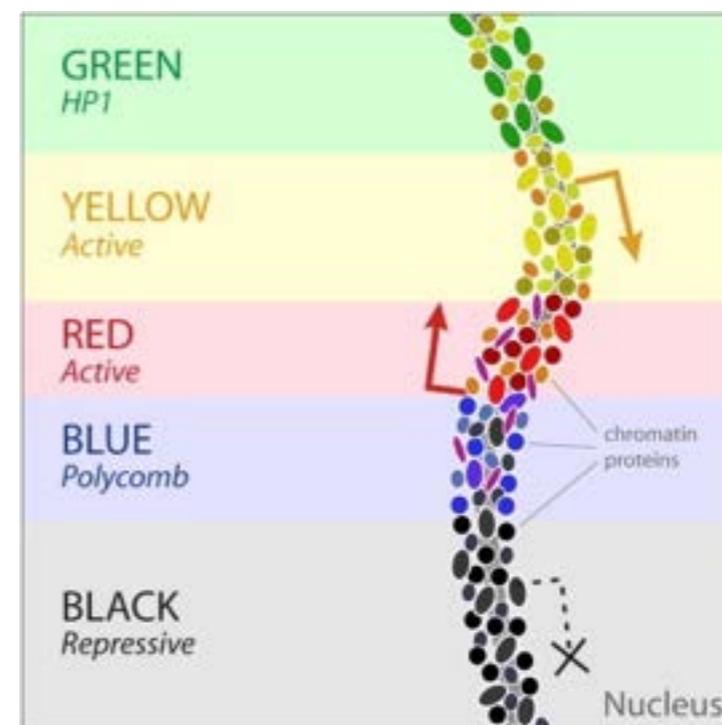
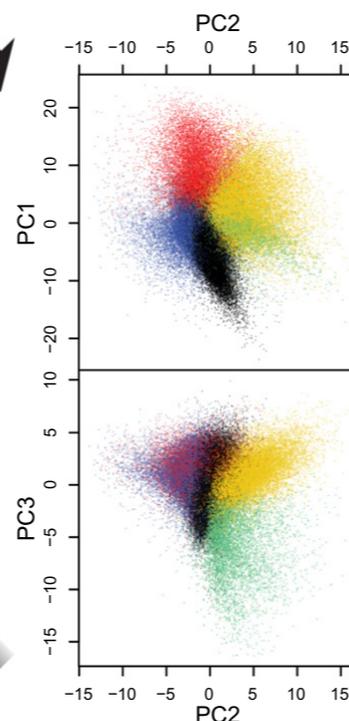


Fly Chromatin COLORs

Filion et al. (2010). Cell, 143(2), 212-224.

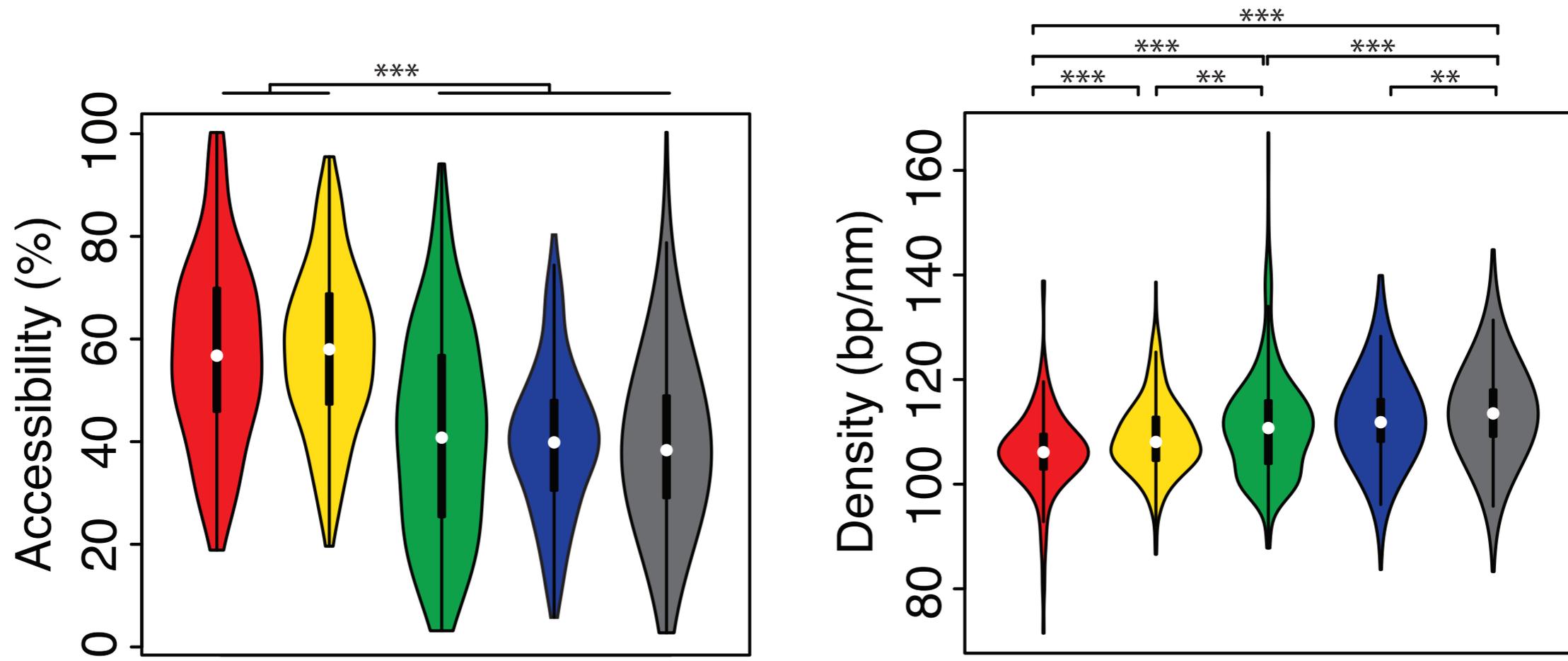


Principal component analysis

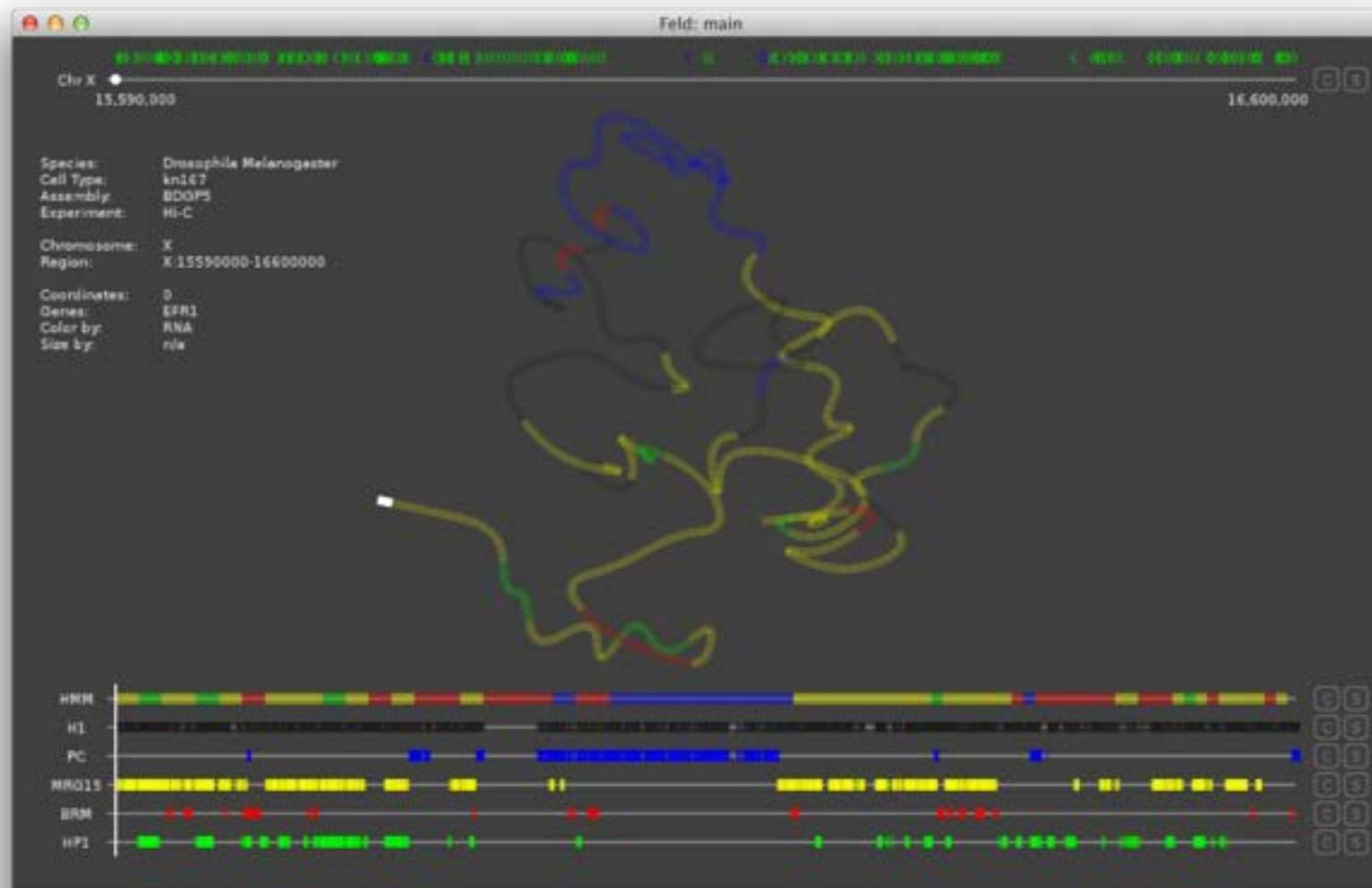
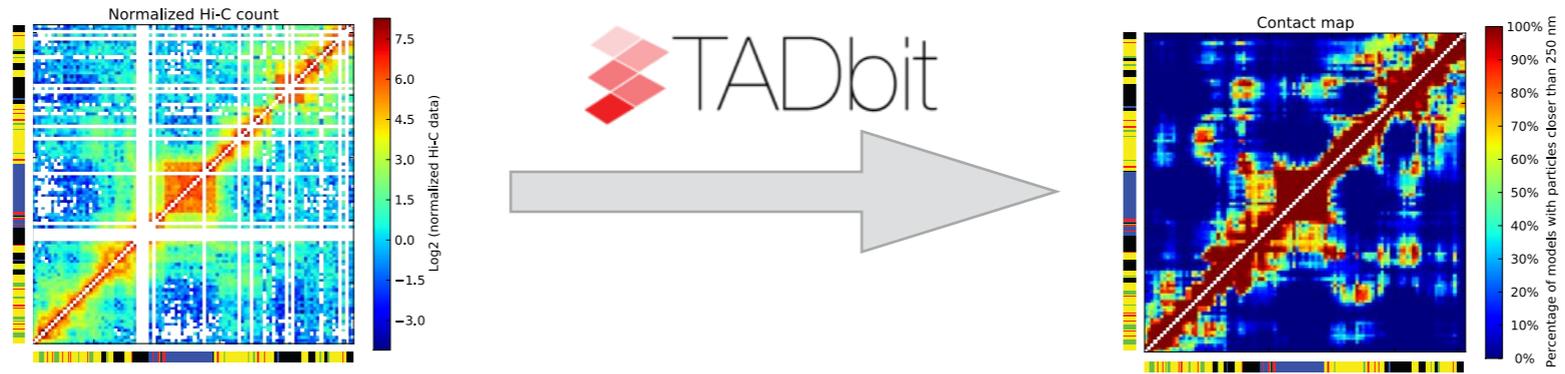


Hidden Markov model

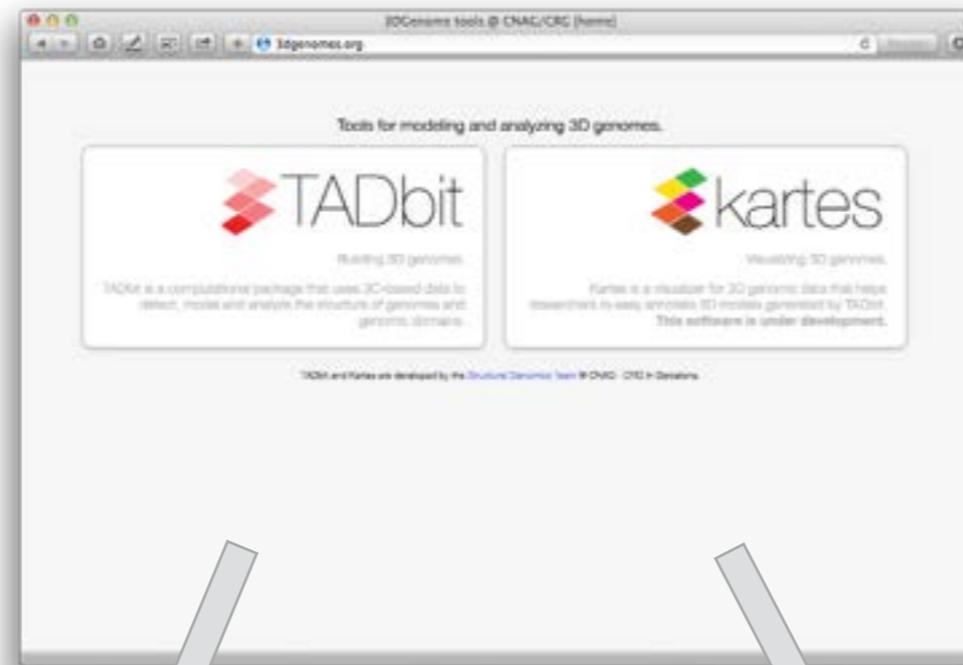
The STRUCTURE of **COLORs** in the fly genome



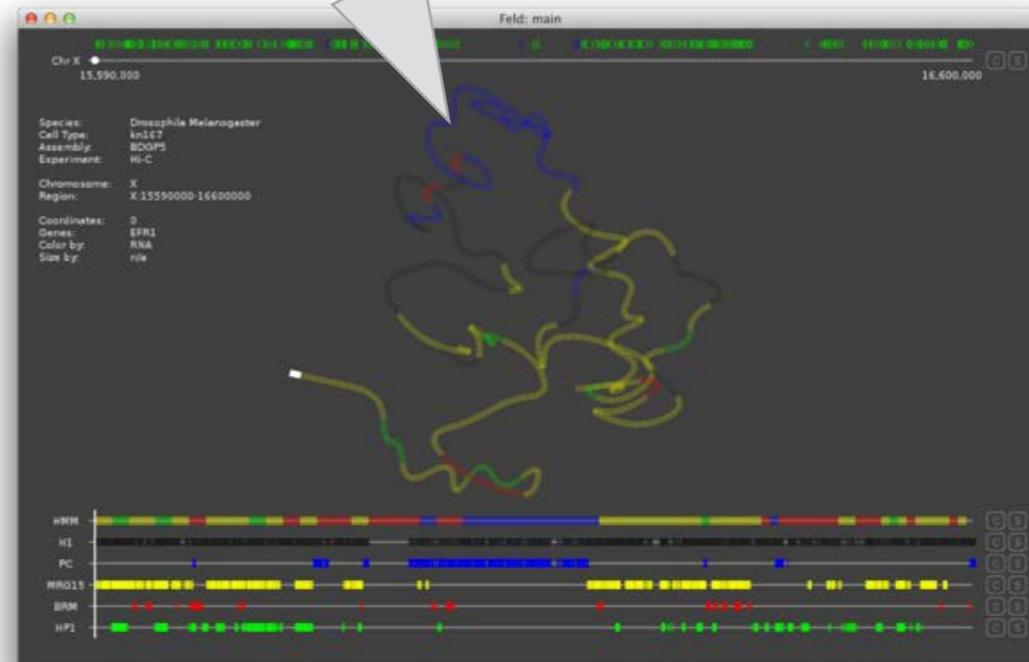
kartes demo



<http://3DGenomes.org>



#	START	END	START	END	START	END
1	X:15500001	15600000	-4997.512	-14445.484	6862.561	
2	X:15600001	15650000	-4938.434	-14470.804	6934.828	
3	X:15610001	15620000	-4978.555	-14415.340	7002.625	
4	X:15620001	15630000	-4935.936	-14318.296	7005.981	
5	X:15630001	15640000	-4976.995	-14358.728	7075.177	
6	X:15640001	15650000	-4884.587	-14327.883	7075.855	
7	X:15650001	15660000	-4938.424	-14392.395	7137.914	
8	X:15660001	15670000	-4858.193	-14408.717	7187.532	
9	X:15670001	15680000	-4856.283	-14347.263	7267.829	
10	X:15680001	15690000	-4776.328	-14380.240	7356.217	
11	X:15690001	15700000	-4821.549	-14452.505	7283.907	
12	X:15700001	15710000	-4852.525	-14541.284	7187.583	
13	X:15710001	15720000	-4907.808	-14583.200	7119.326	
14	X:15720001	15730000	-4919.553	-14541.712	7077.894	
15	X:15730001	15740000	-4848.228	-14596.950	7055.235	
16	X:15740001	15750000	-4759.283	-14533.379	7055.379	
17	X:15750001	15760000	-4788.704	-14478.629	7082.837	
18	X:15760001	15770000	-4698.692	-14520.434	7018.915	
19	X:15770001	15780000	-4738.675	-14508.357	6928.896	
20	X:15780001	15790000	-4734.581	-14436.217	6988.335	
21	X:15790001	15800000	-4757.711	-14448.468	6904.603	
22	X:15800001	15810000	-4748.483	-14357.549	6958.223	
23	X:15810001	15820000	-4784.942	-14286.947	6988.400	
24	X:15820001	15830000	-4818.842	-14245.789	6837.868	
25	X:15830001	15840000	-4751.912	-14241.125	6966.872	



Open positions soon
<http://marciuslab.org>

Acknowledgments



Mike Goodstadt
Francisco Martínez-Jiménez

François Serra
Davide Baù

François le Dily
David Dufour
Gireesh Bogu



Miguel Beato
Thomas Graf
Guillaume Filion

<http://3DGenomes.org>
<http://marciuslab.org>
<http://cnag.cat> · <http://crg.cat>

