

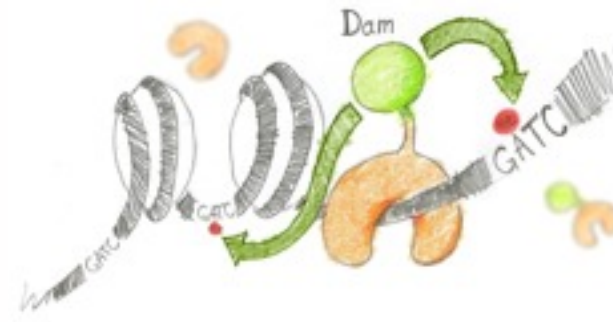
Do colors have a structure?

Davide Baù

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

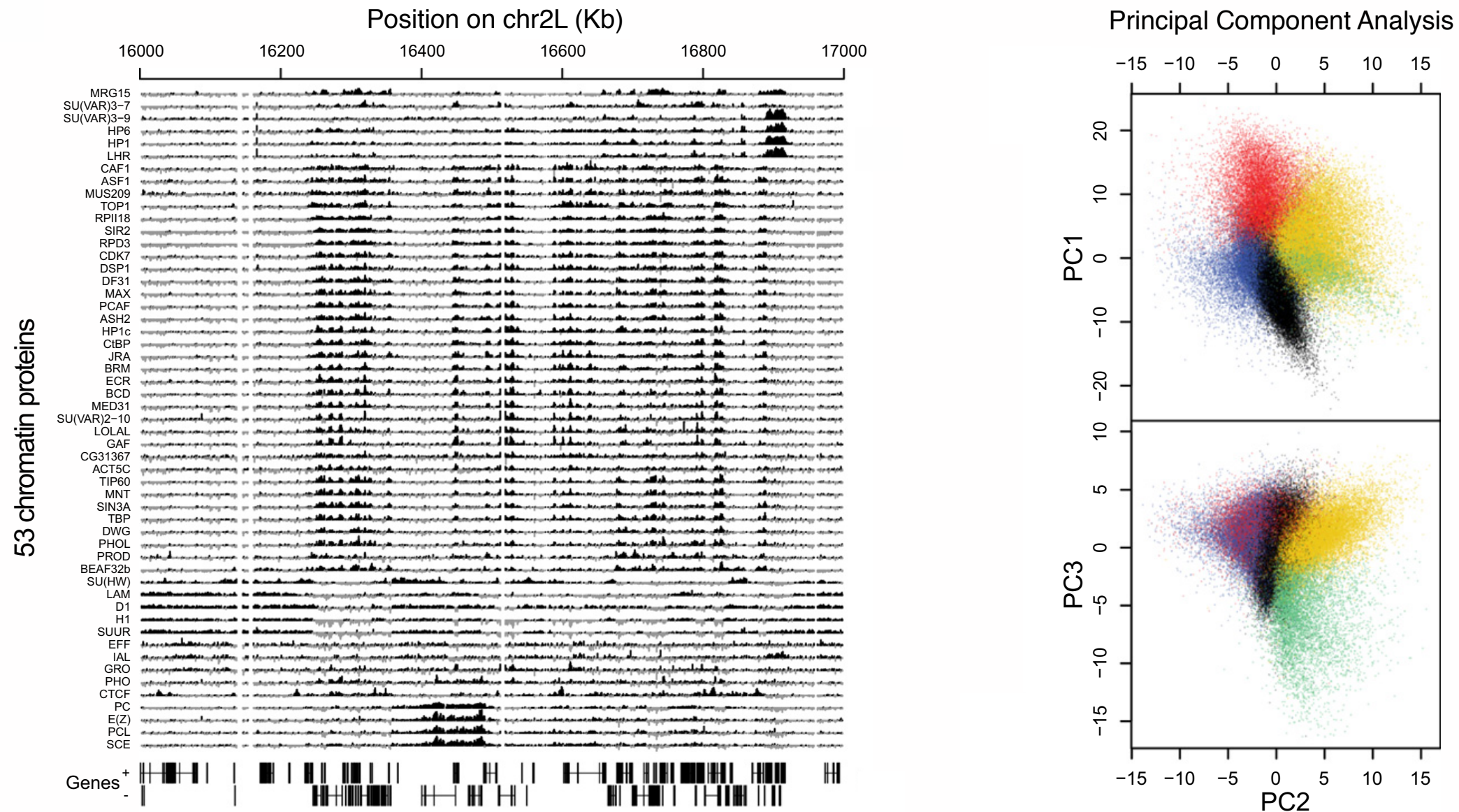


Are the 5-type chromatin colors structurally different?



Derivation of the 5-type chromatin color

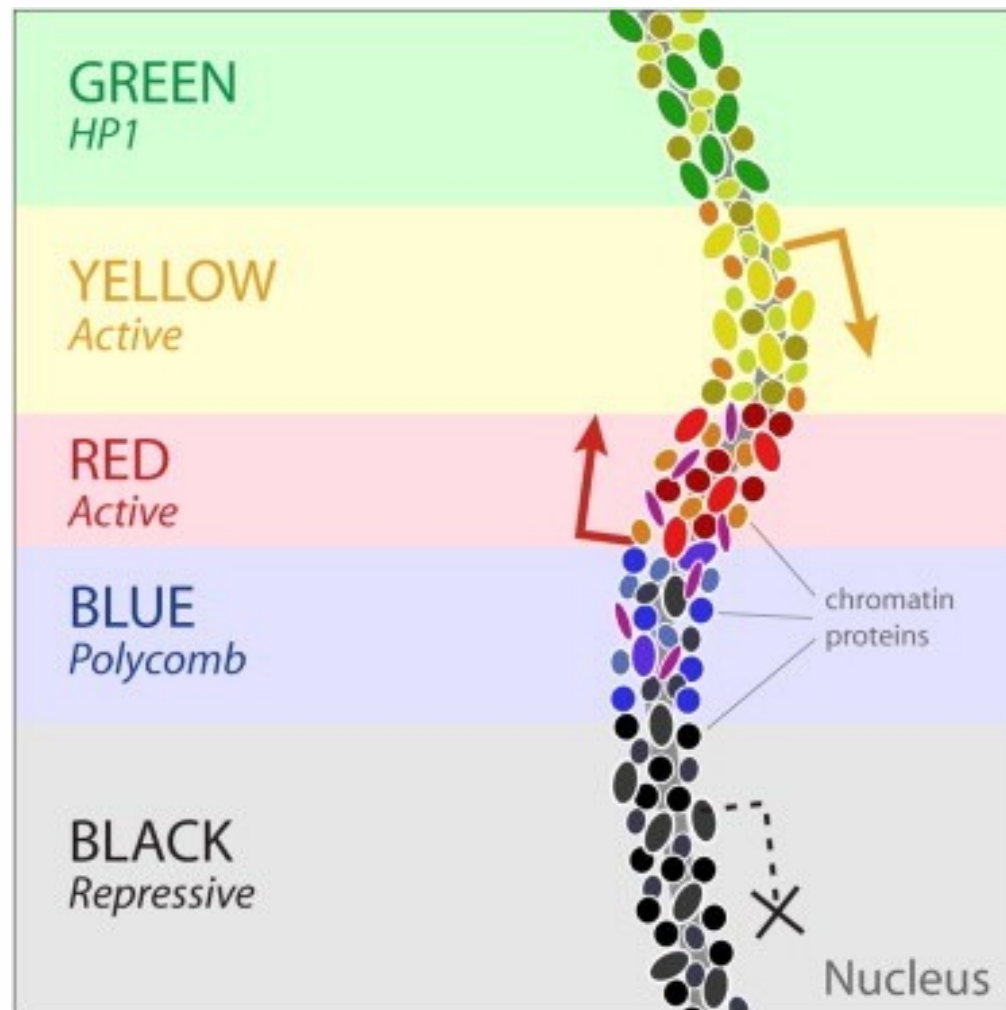
Filion et al. (2010). Cell, 143(2), 212–224



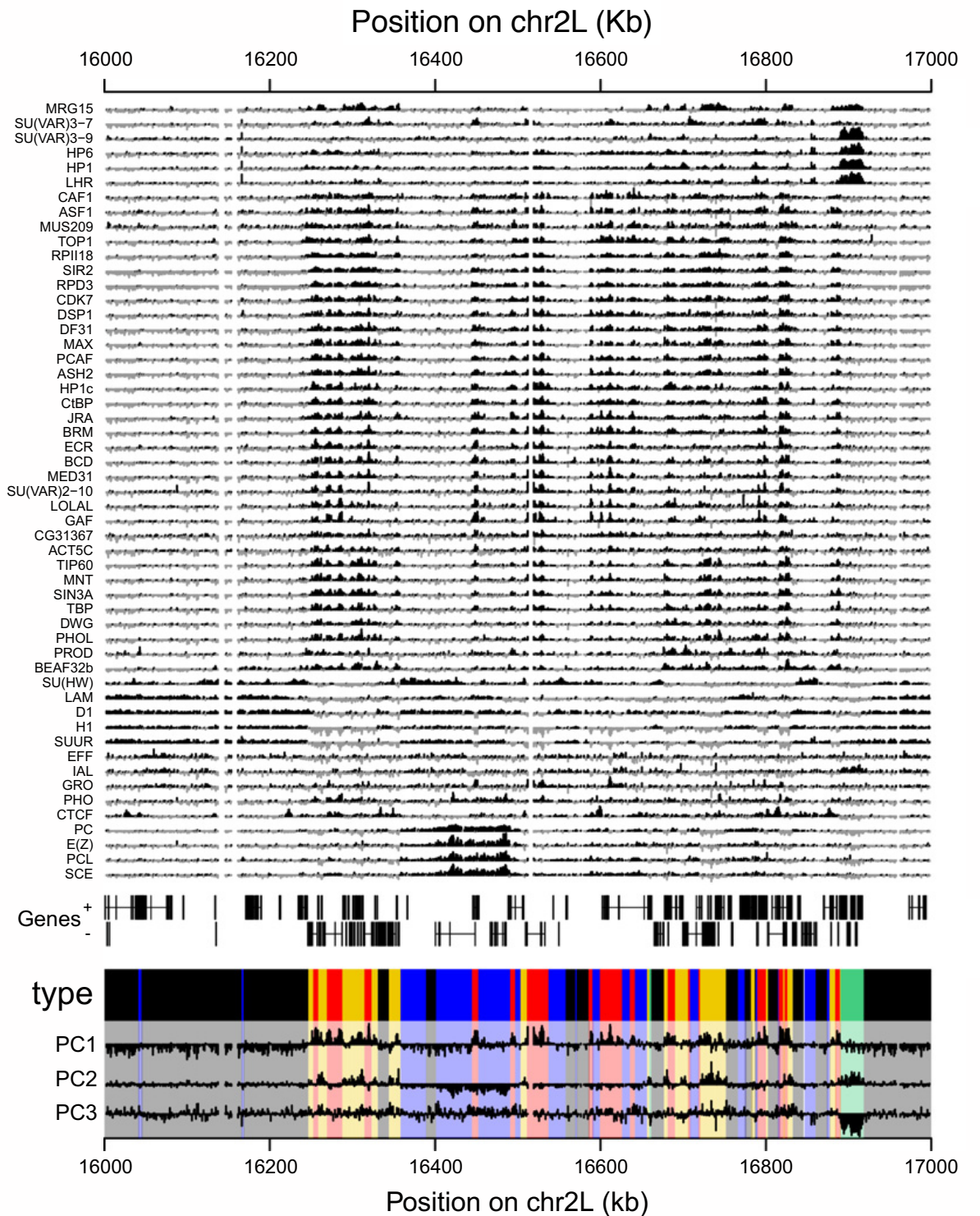
Derivation of the 5-type chromatin colors

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

Color definitions

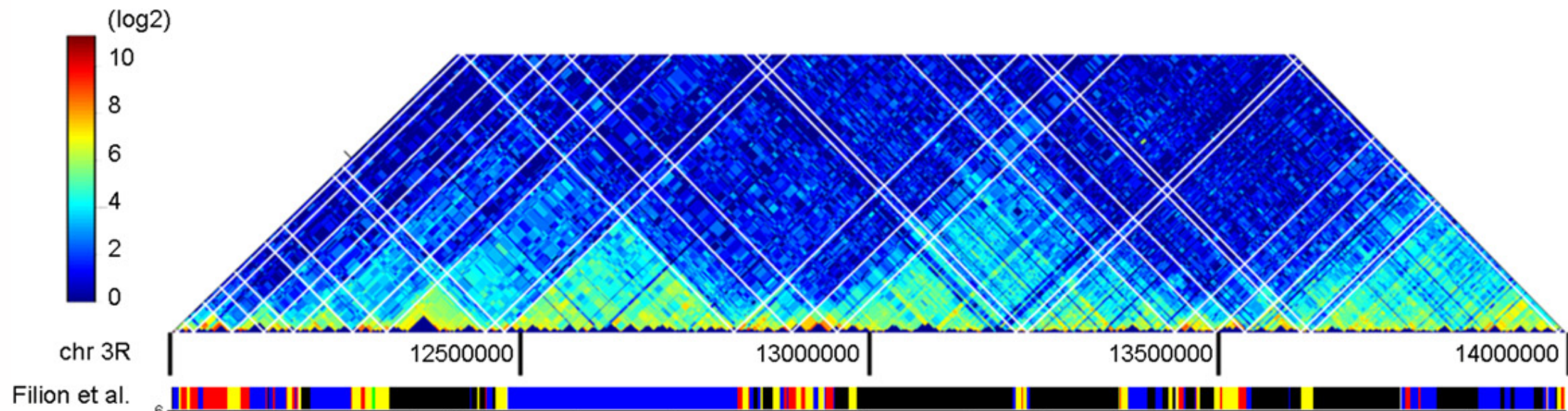


53 chromatin proteins

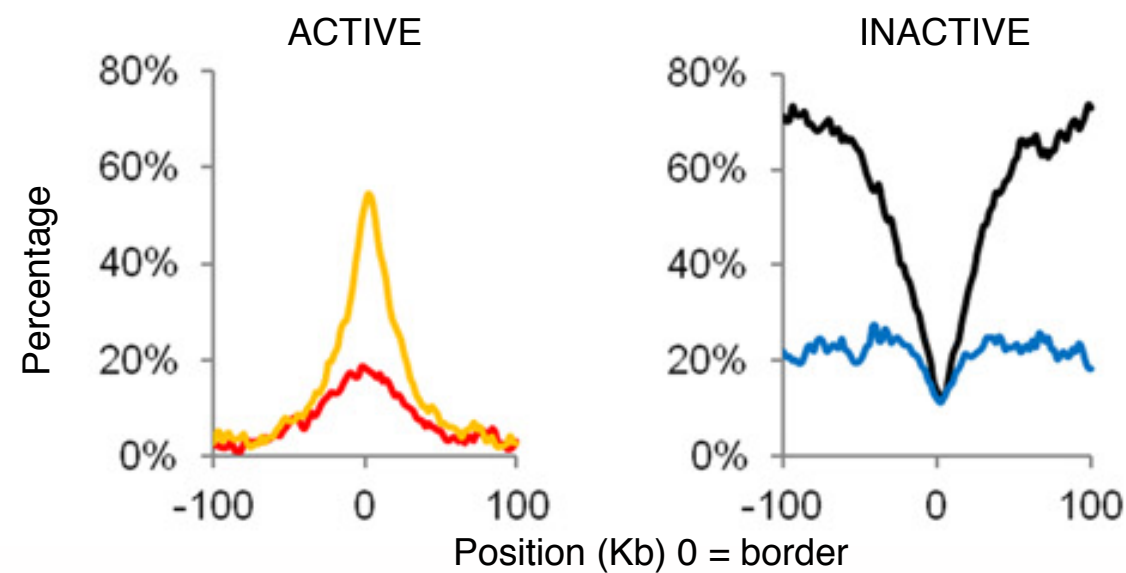


Are chromatin colors functional domains?

Hou et al. (2012). *Molecular Cell*, 48(3), 471–484

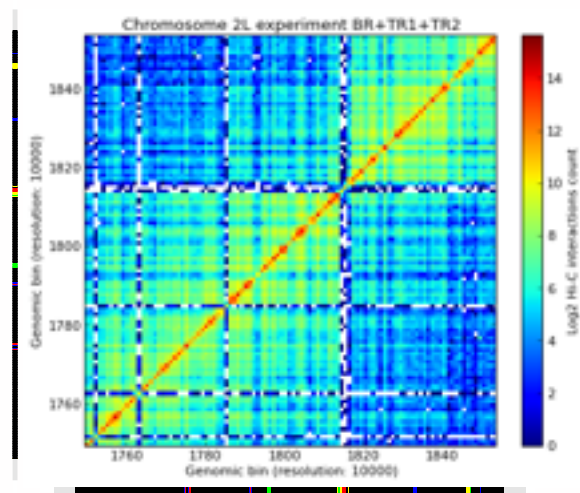
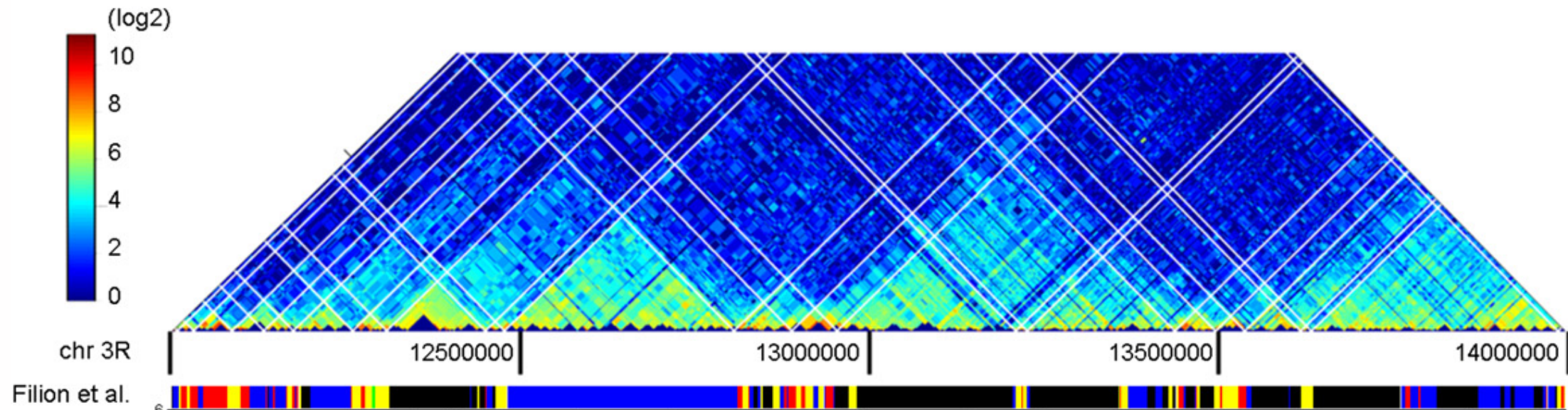


Percentage of chromatin surrounding TAD borders

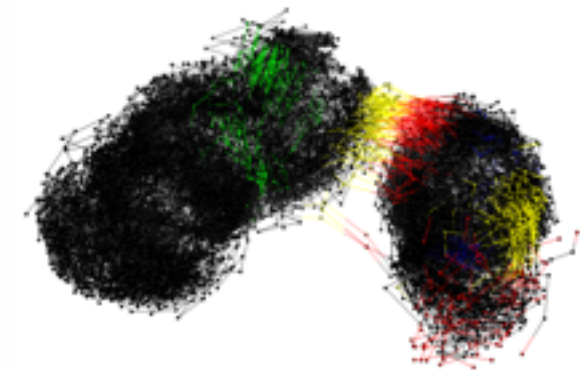


Are chromatin colors functional domains?

Hou et al. (2012). *Molecular Cell*, 48(3), 471–484

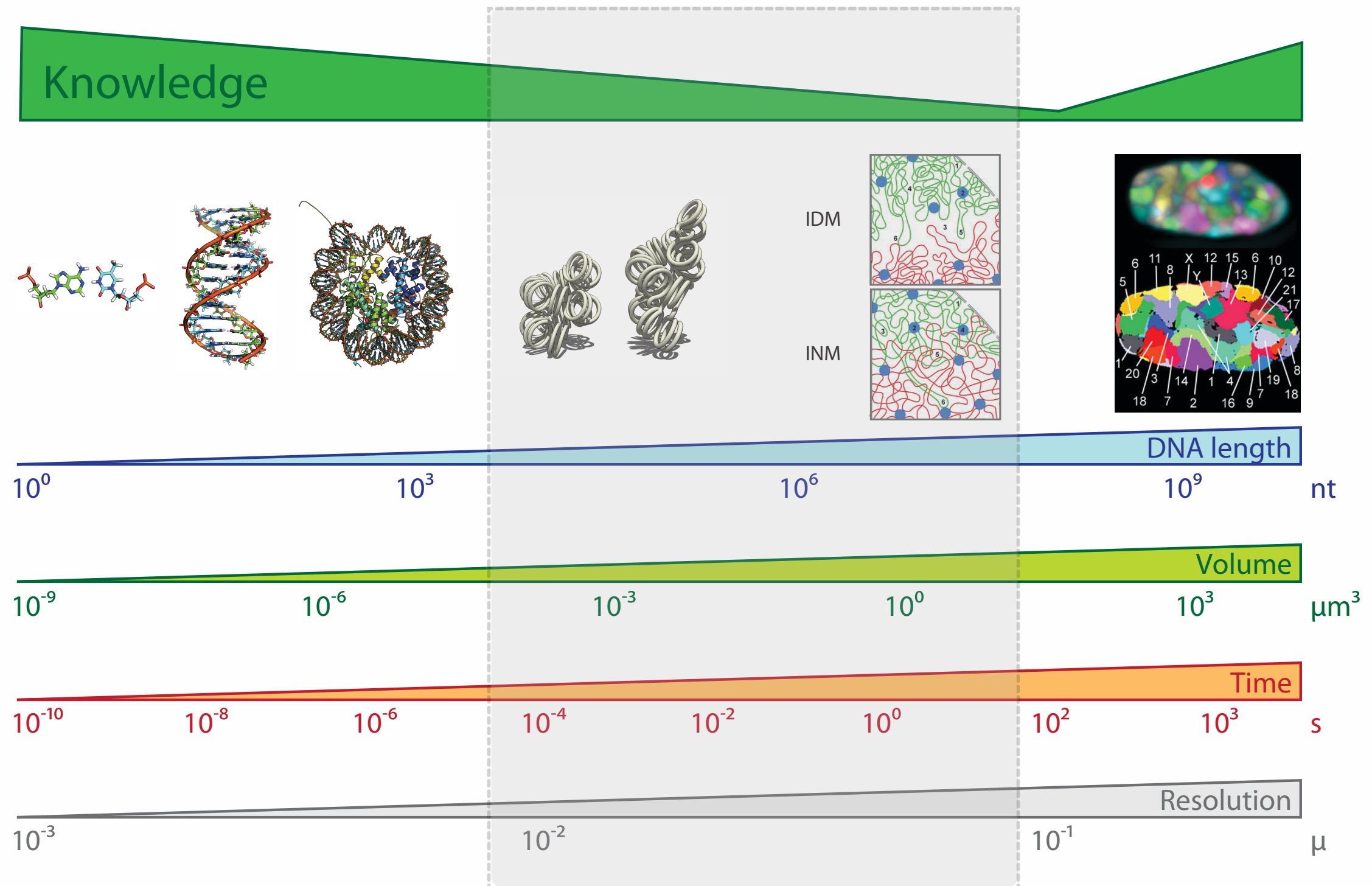


50 ~1Mb
regions



Resolution gap

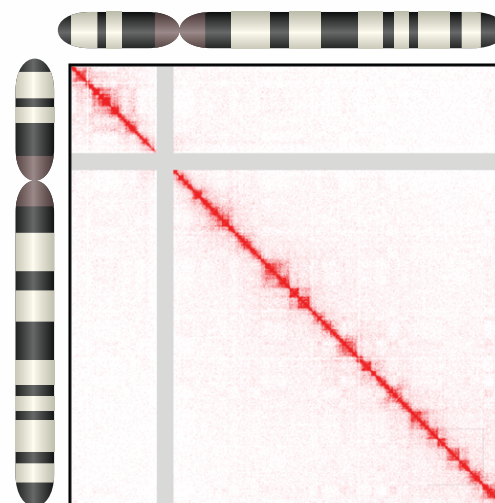
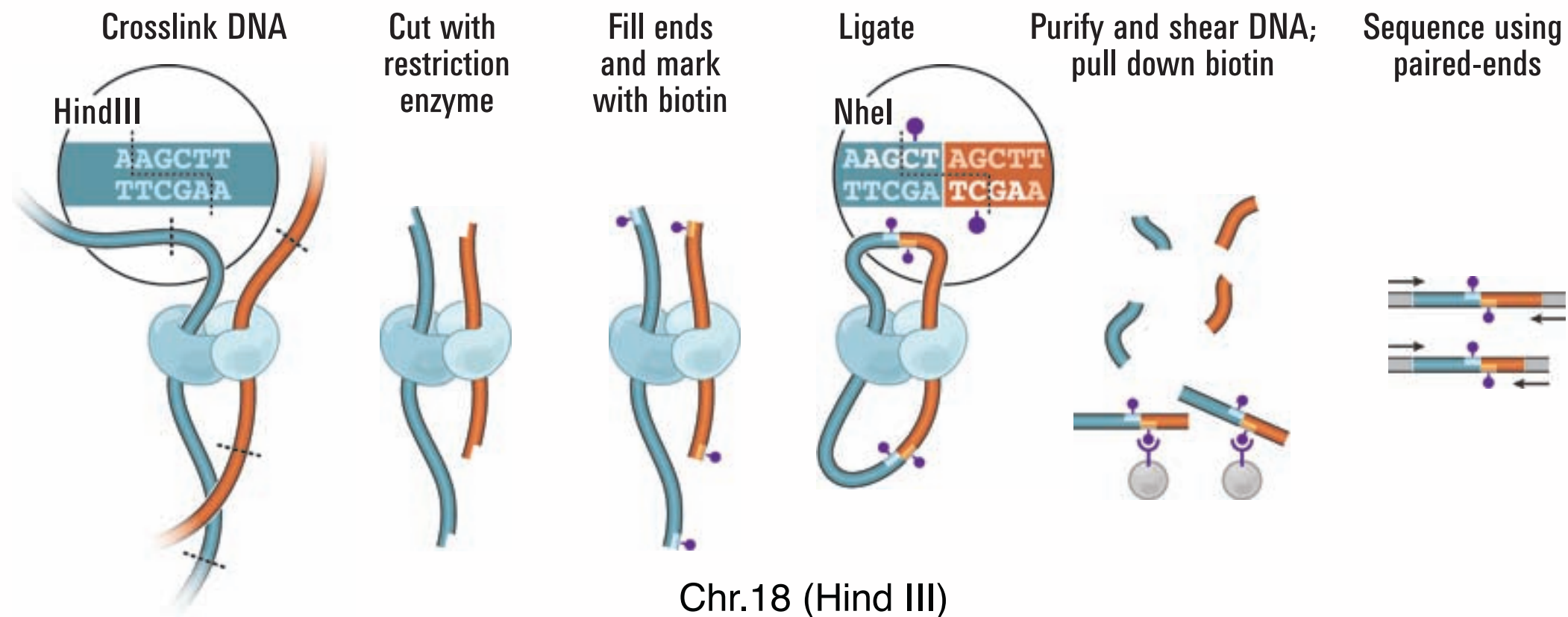
Marti-Renom, M. A. & Mirny, L. A. PLoS Comput Biol 7, e1002125 (2011)



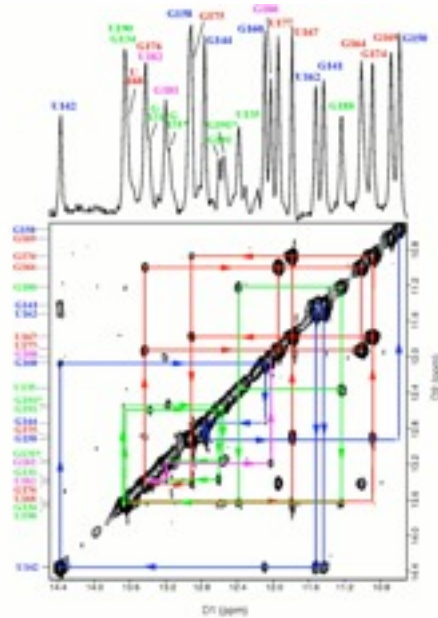
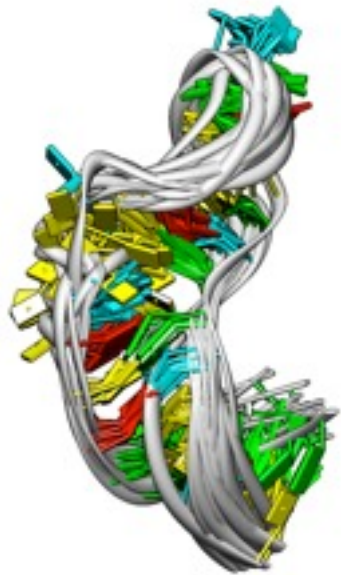
Hi-C technology

Lieberman-Aiden, E. et al. Science 326, 289–293 (2009)

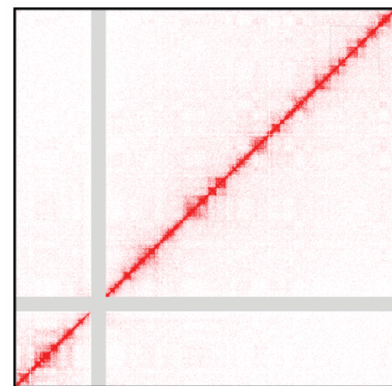
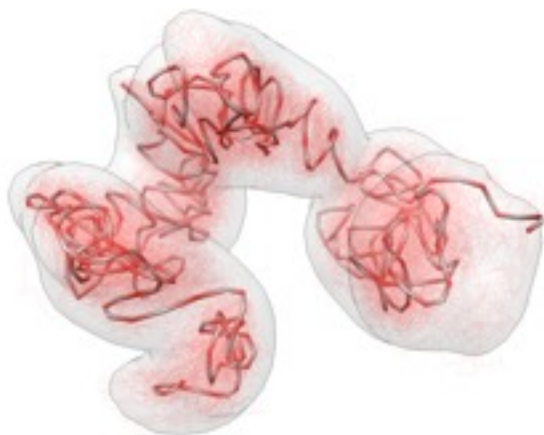
<http://3dg.umassmed.edu>



Structure determination using Hi-C data



Biomolecular structure determination
2D-NOESY data

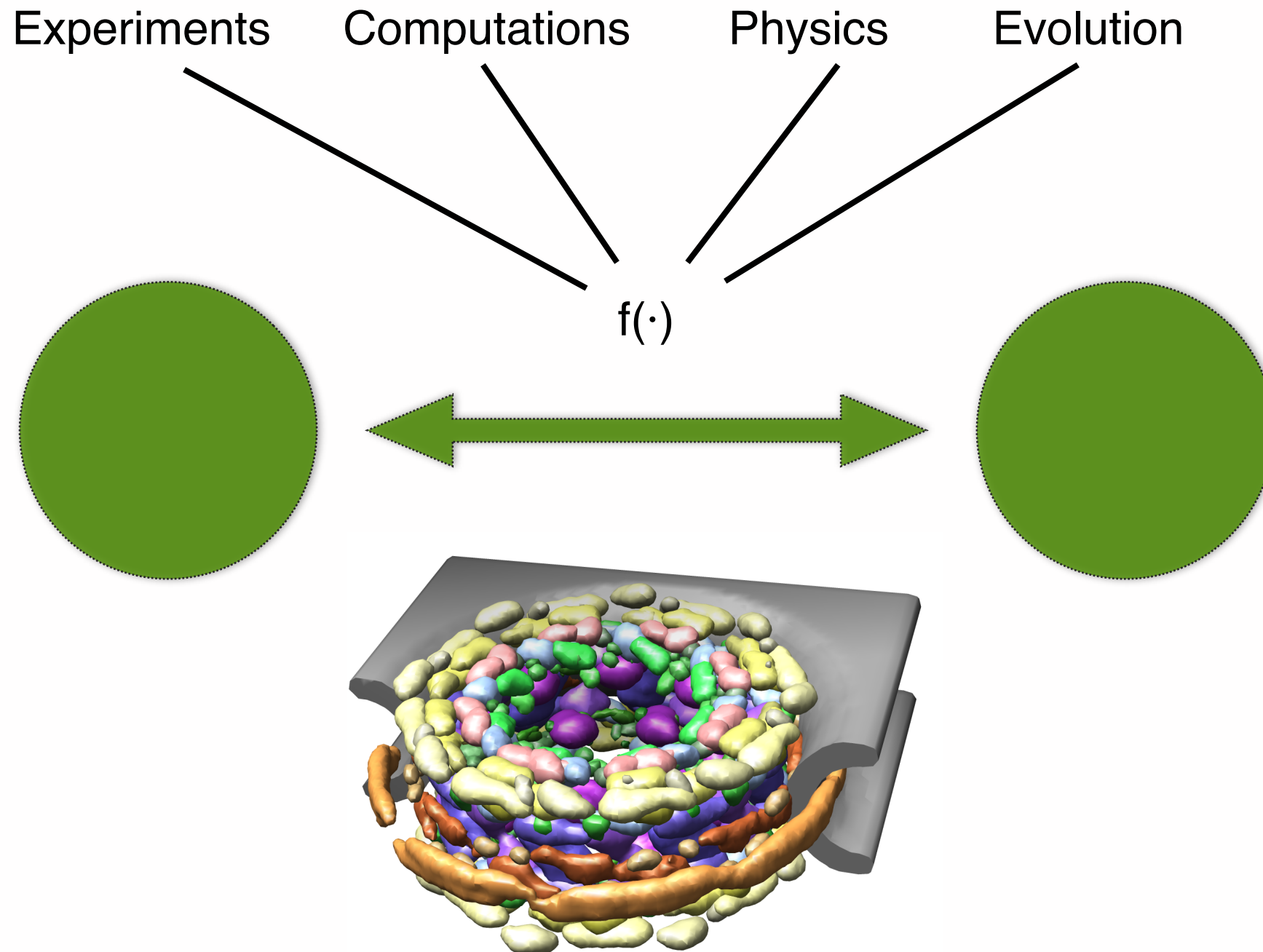


Chromosome structure determination
3C-based data

The Integrative Modeling Platform framework

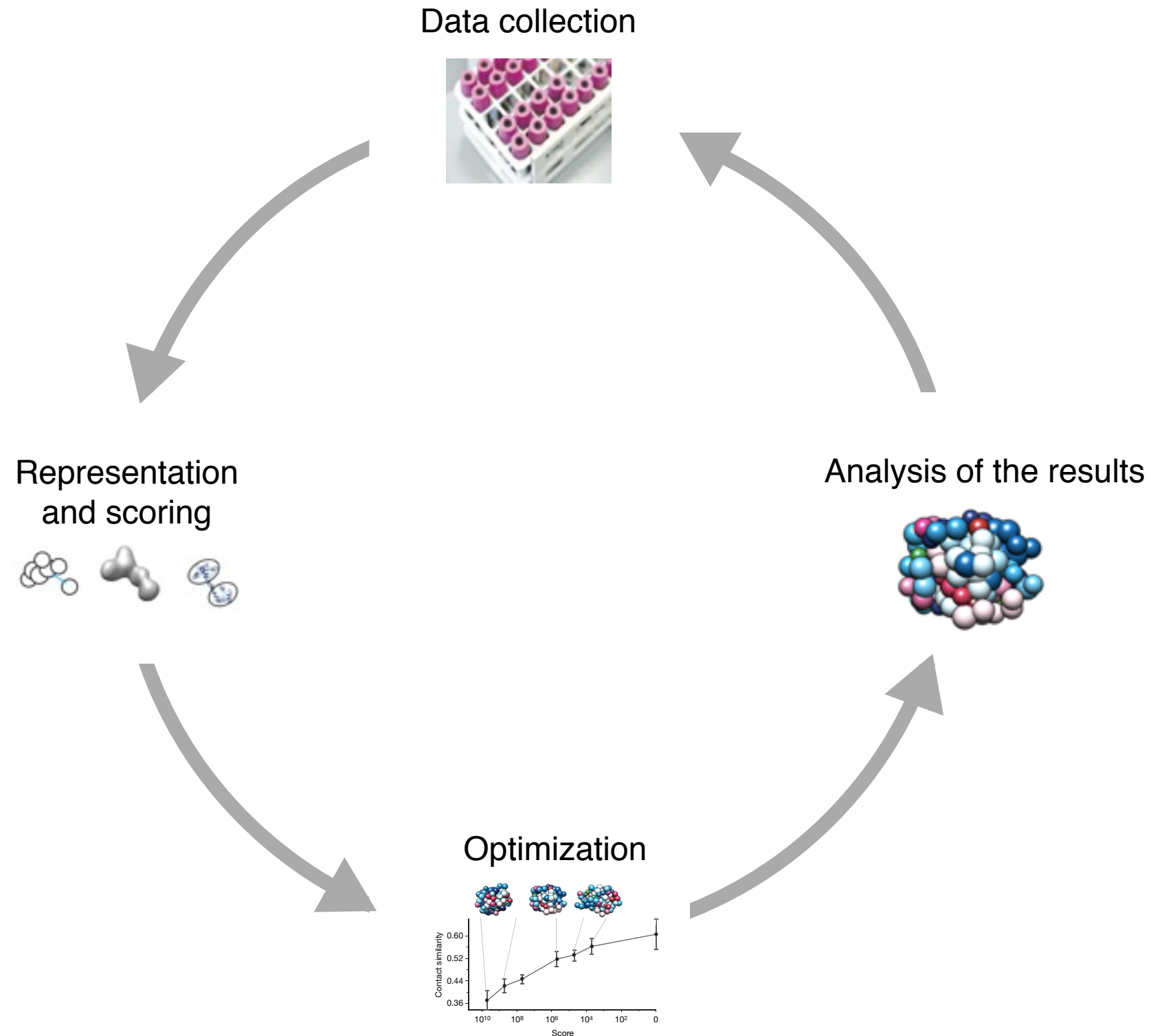
<http://www.integrativemodeling.org>

Russel, D. et al. PLOS Biology 10, e1001244 (2012)



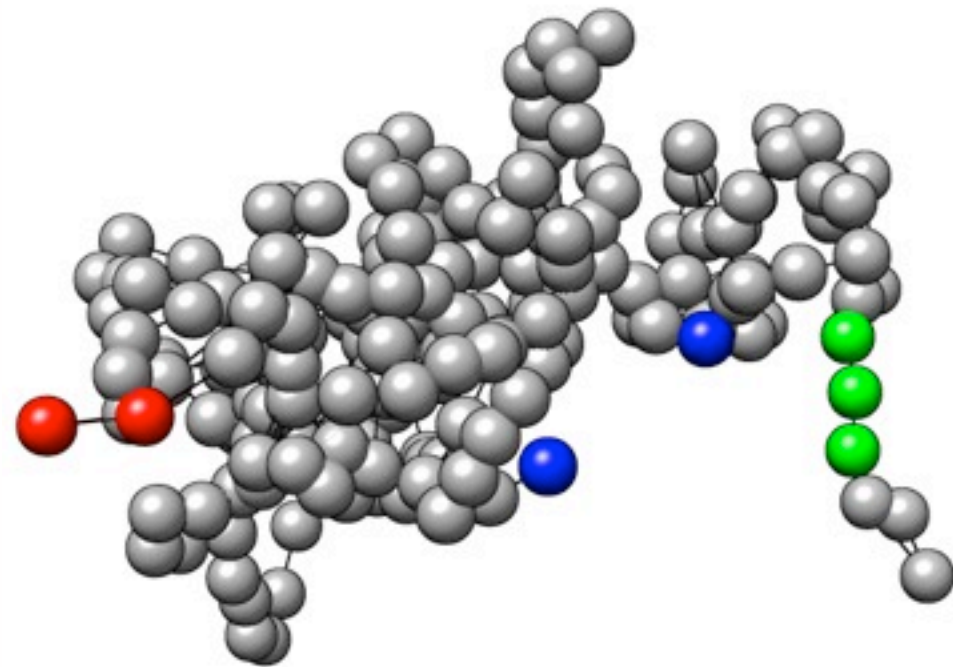
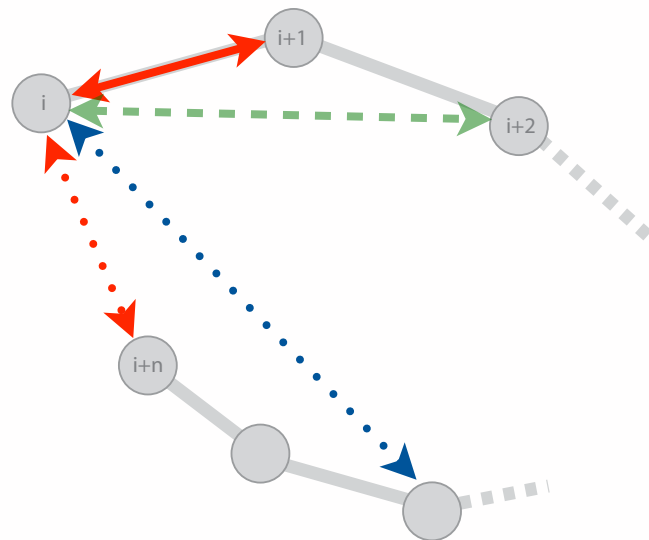
From Alber, F. et al. Nature 450, 695–701 (2007).

The four stages of integrative modeling



Representation

Constituent parts of the molecule



$$d < d_0$$



$$d = d_0$$



$$d > d_0$$



Representation

Constituent parts of the molecule

Harmonic

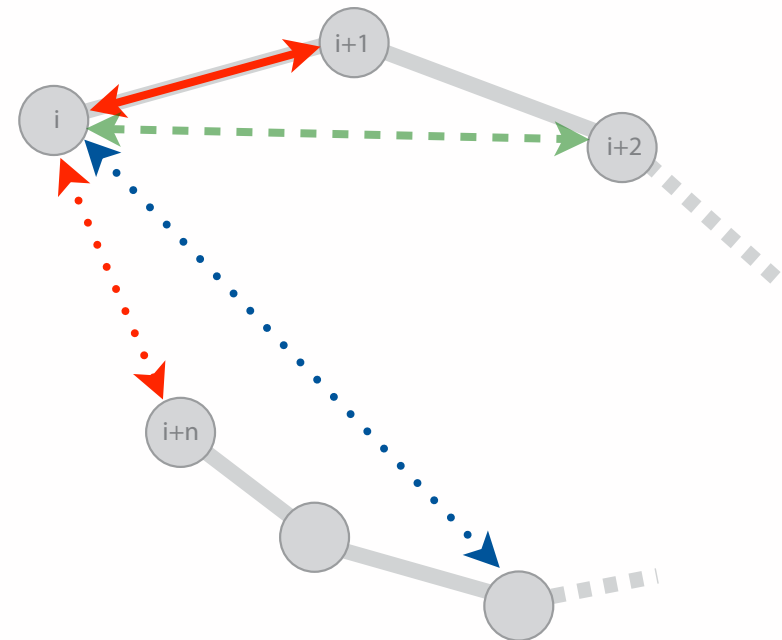
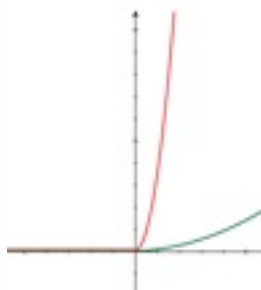
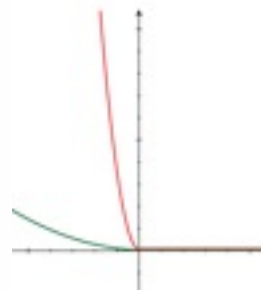
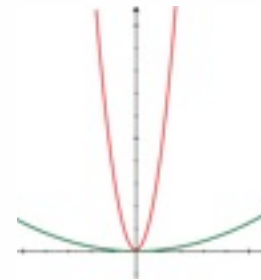
$$H_{i,j} = k(d_{i,j} - d_{i,j}^0)^2$$

Harmonic Lower Bound

$$\begin{cases} \text{if } d_{i,j} \leq d_{i,j}^0; & lbH_{i,j} = k(d_{i,j} - d_{i,j}^0)^2 \\ \text{if } d_{i,j} > d_{i,j}^0; & lbH_{i,j} = 0 \end{cases}$$

Harmonic Upper Bound

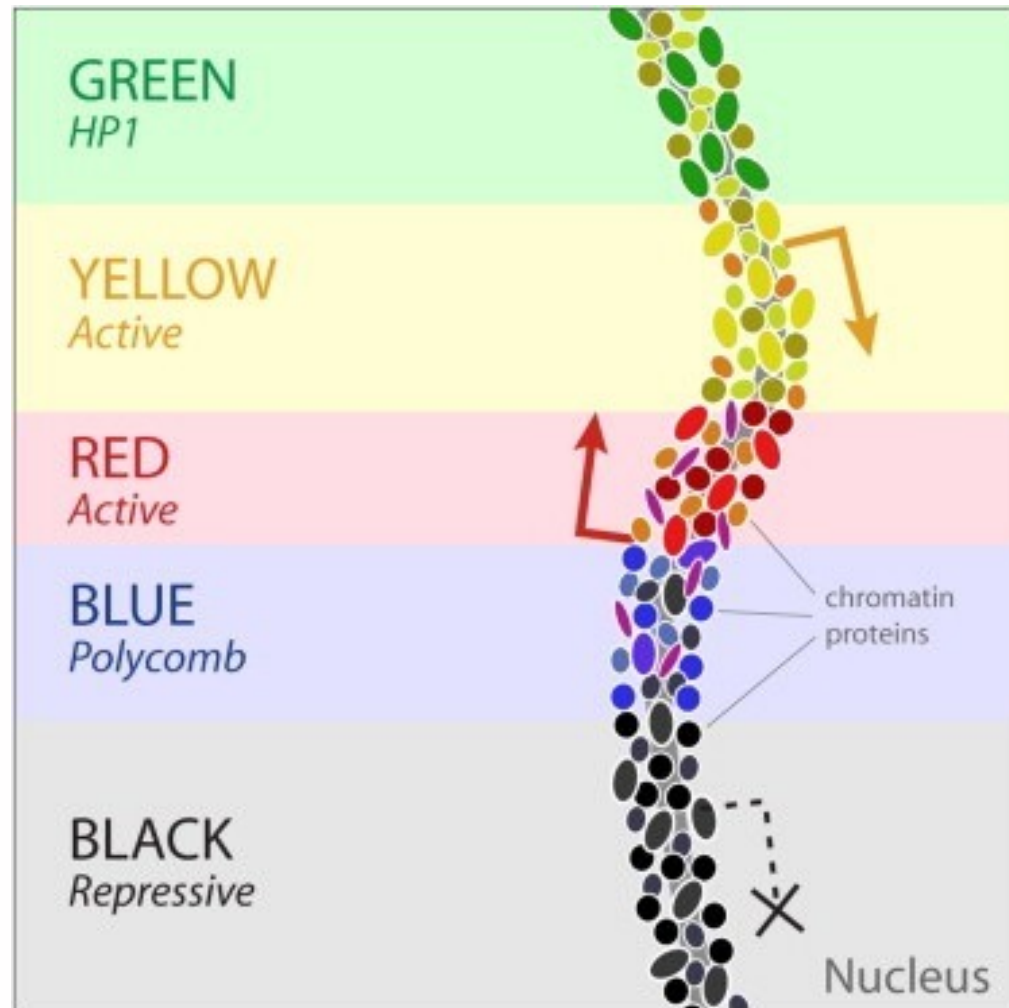
$$\begin{cases} \text{if } d_{i,j} \geq d_{i,j}^0; & ubH_{i,j} = k(d_{i,j} - d_{i,j}^0)^2 \\ \text{if } d_{i,j} < d_{i,j}^0; & ubH_{i,j} = 0 \end{cases}$$



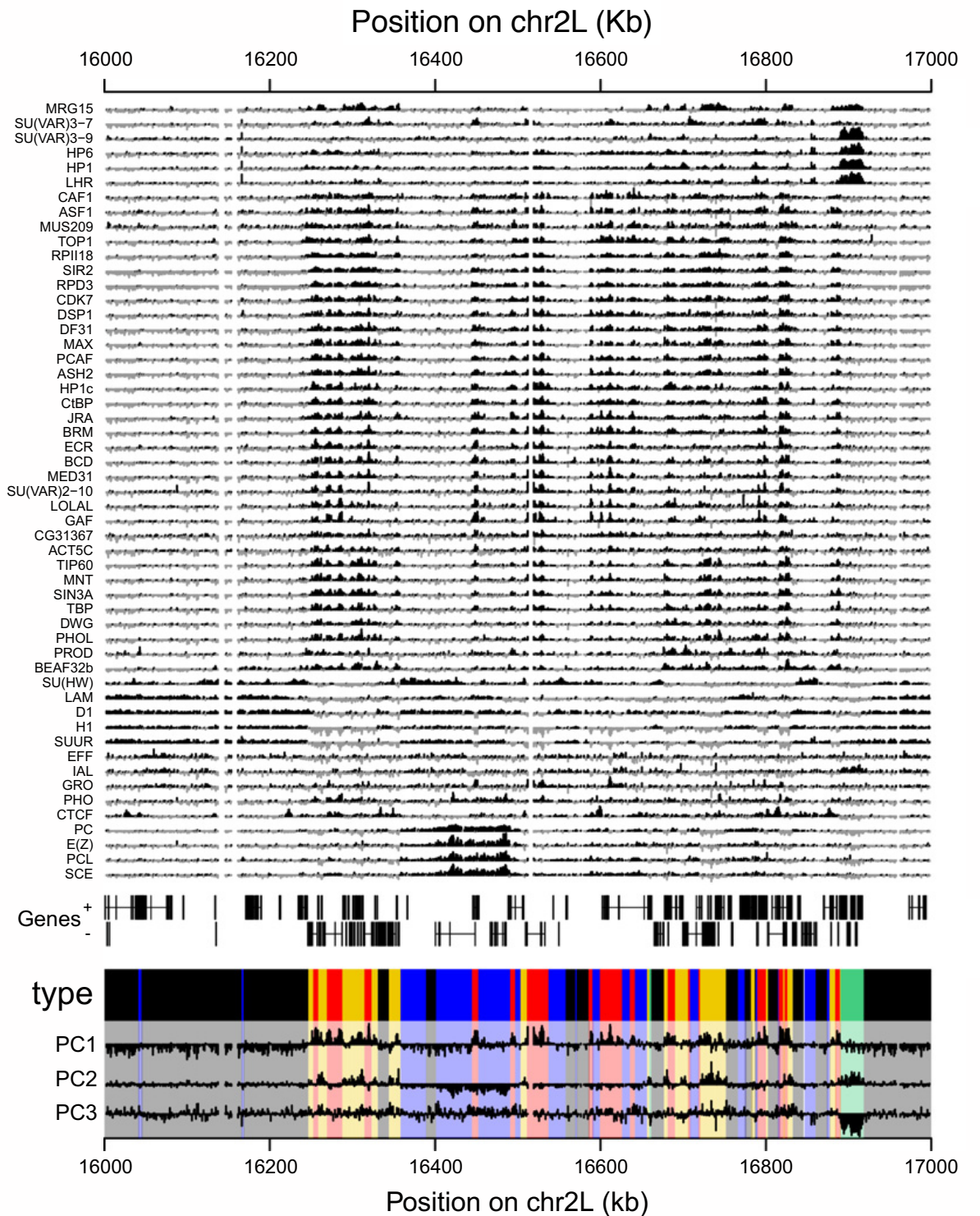
3D modeling of the 5-type chromatin colors

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

Color definitions

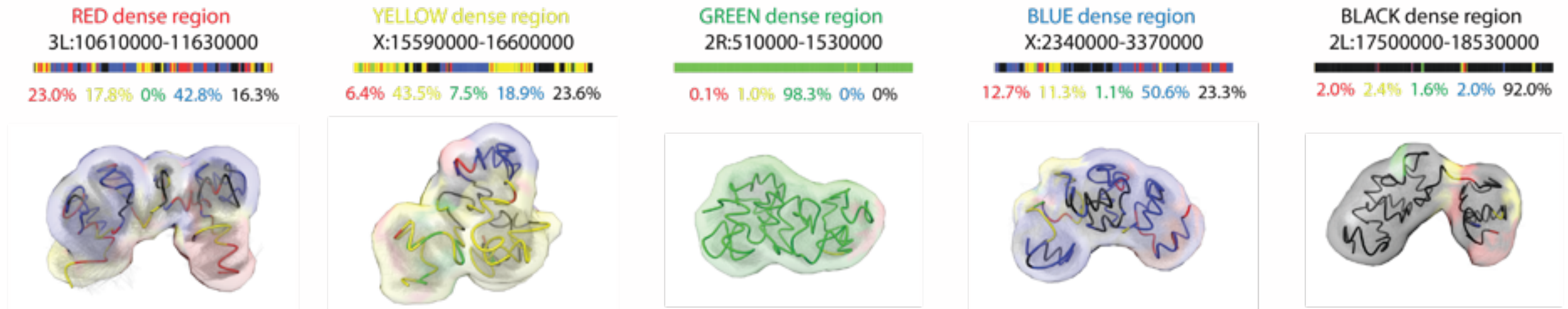


53 chromatin proteins



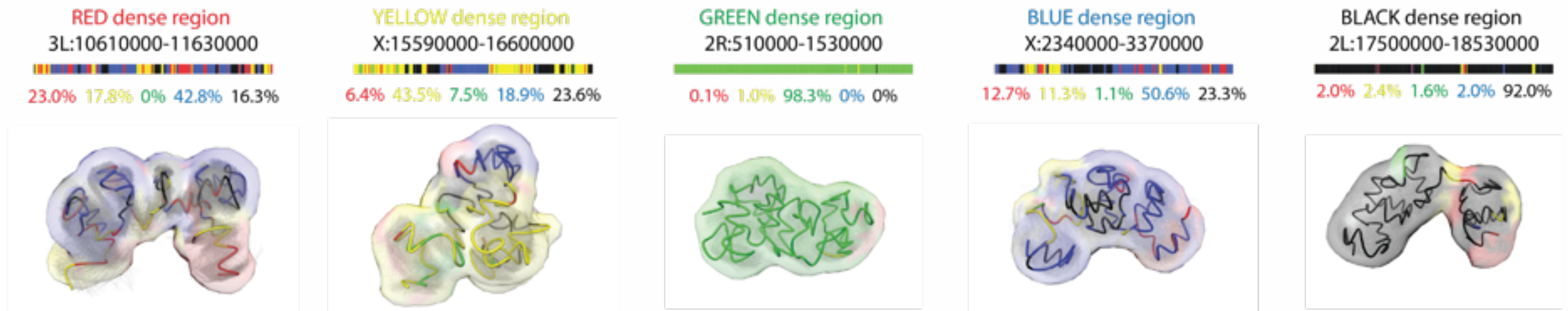
Structural properties

50 1Mb regions. 10 enriched for each color



Structural properties

50 1Mb regions. 10 enriched for each color

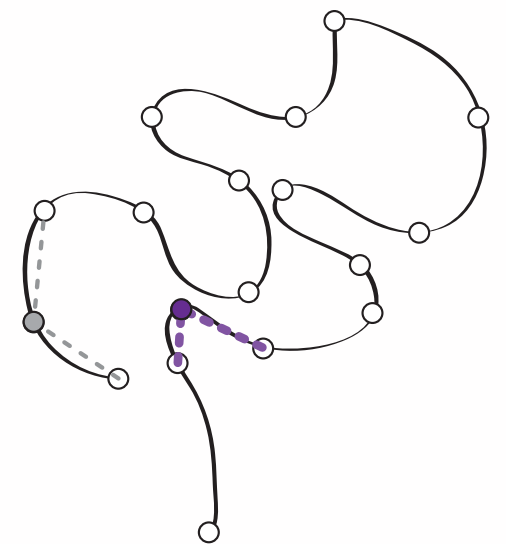
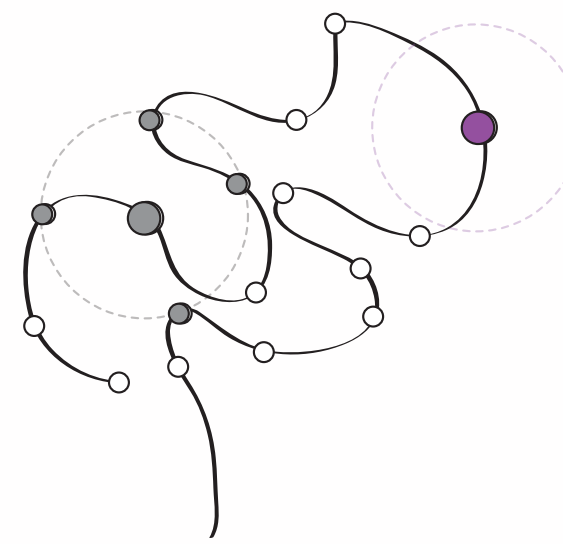
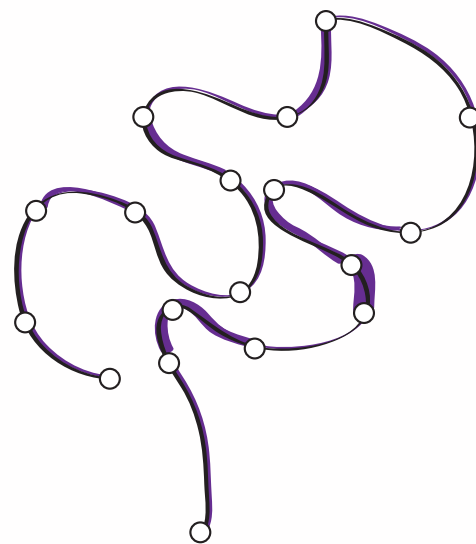
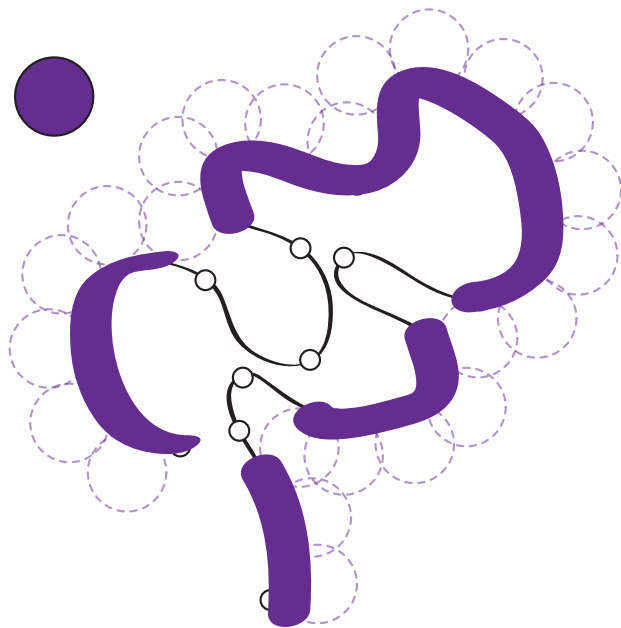


Accessibility (%)

Density (bp/nm)

Interactions

Angle

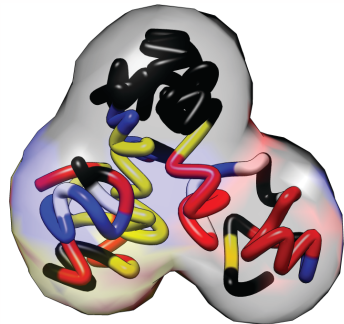


Structural properties

50 1Mb regions. 10 enriched for each color

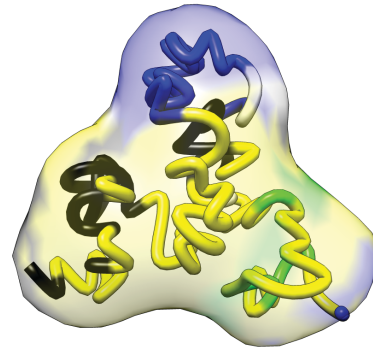
RED dense region
3R:18920000-19920000

22% 17% 0% 11% 45% 6%



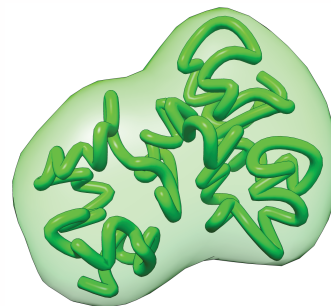
YELLOW dense region
X:15590000-16600000

0% 48% 4% 20% 26% 3%



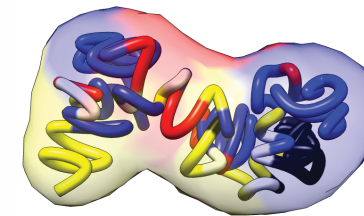
GREEN dense region
2R:510000-1530000

0% 0% 100% 0% 0% 0%



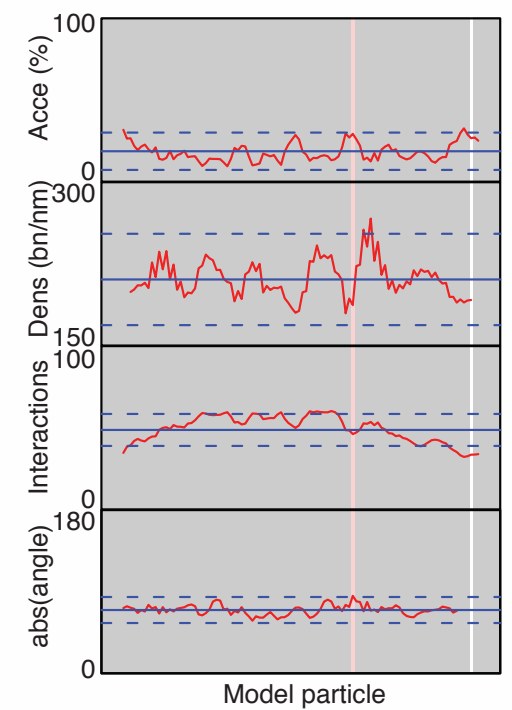
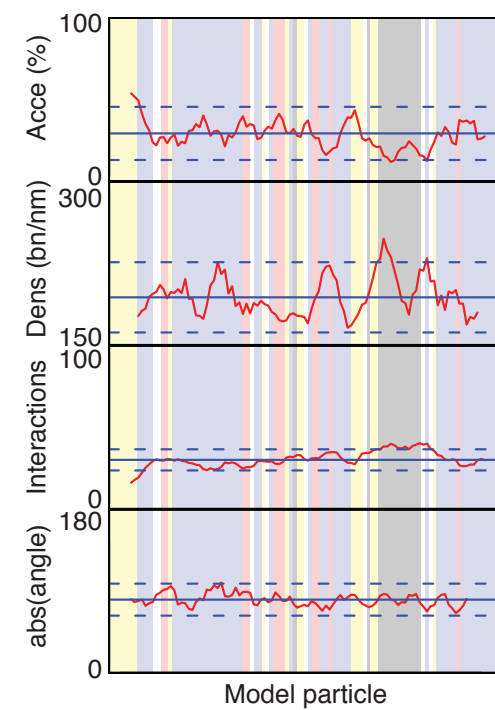
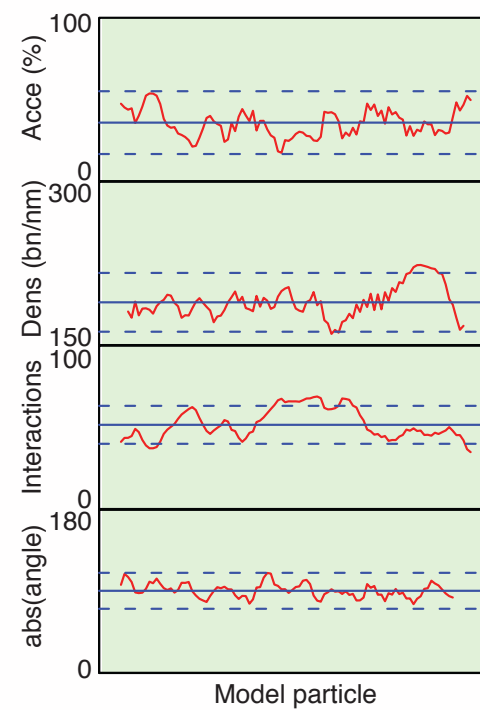
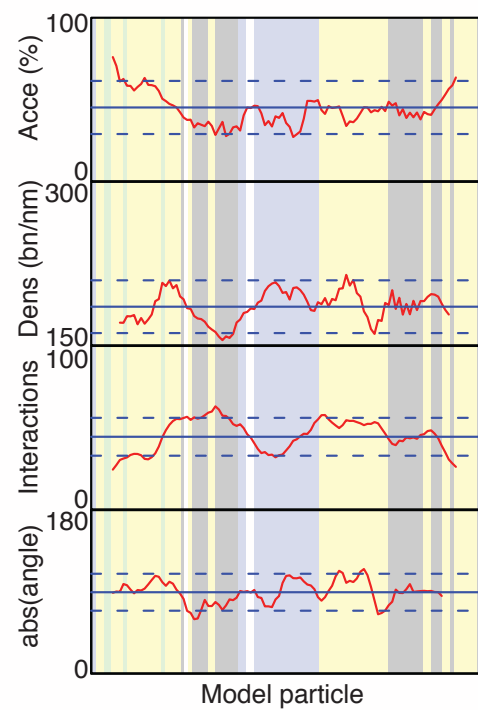
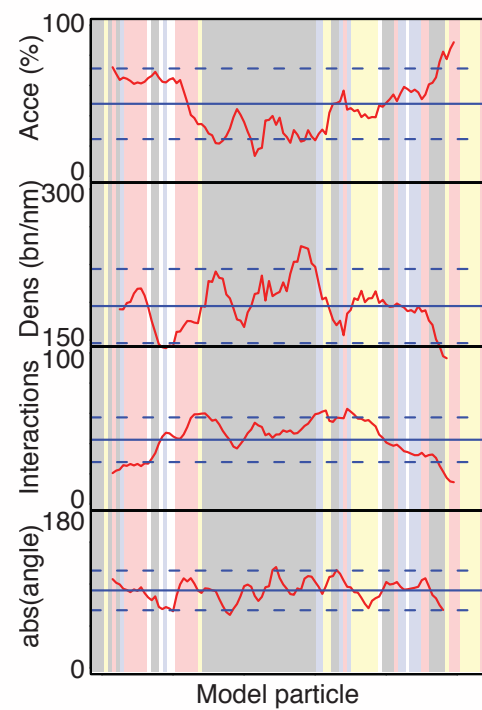
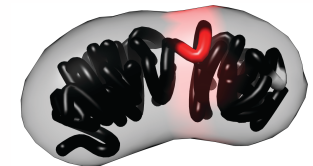
BLUE dense region
3L:210000-1230000

11% 17% 0% 52% 13% 0%

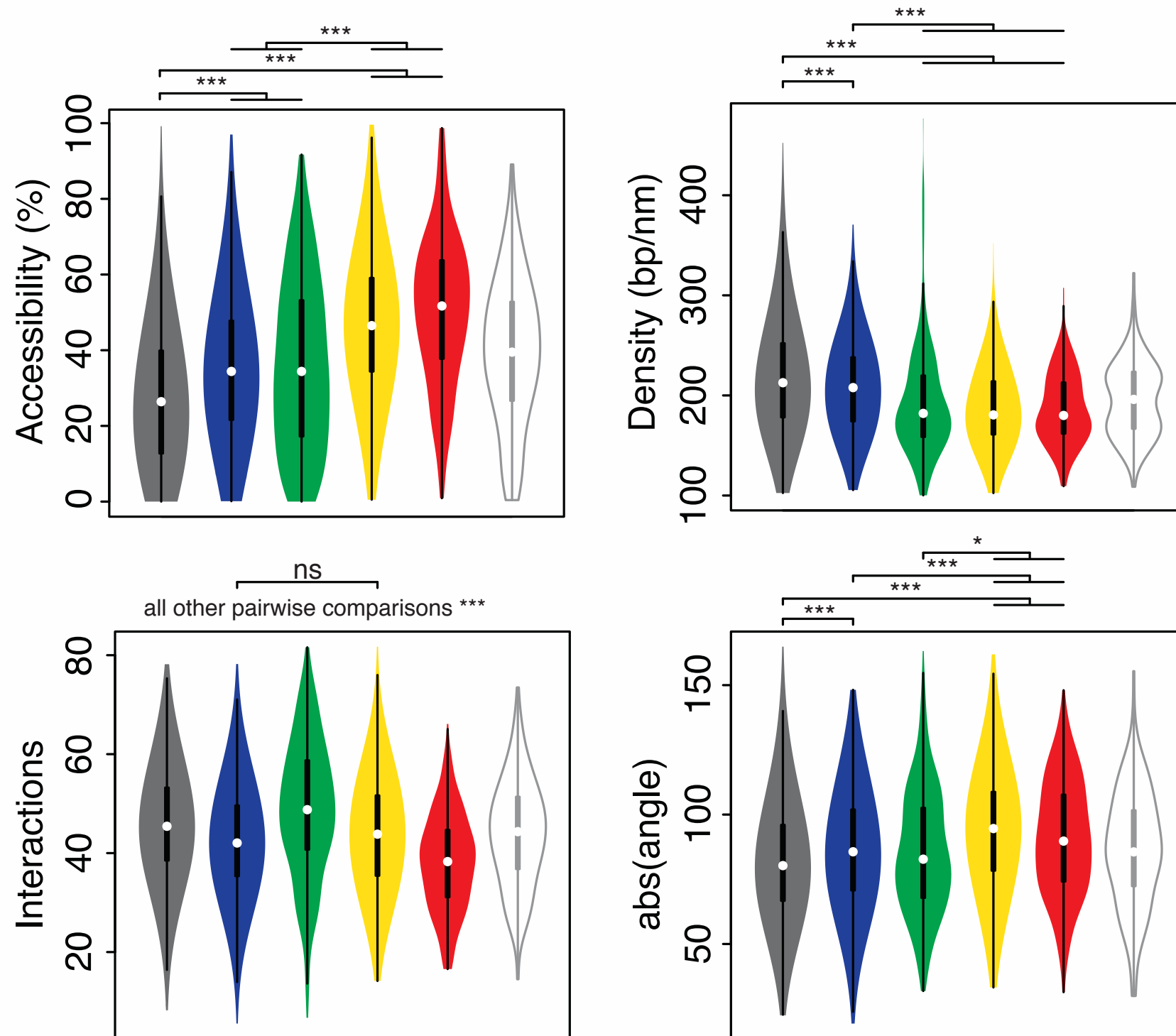


BLACK dense region
2L:17500000-18530000

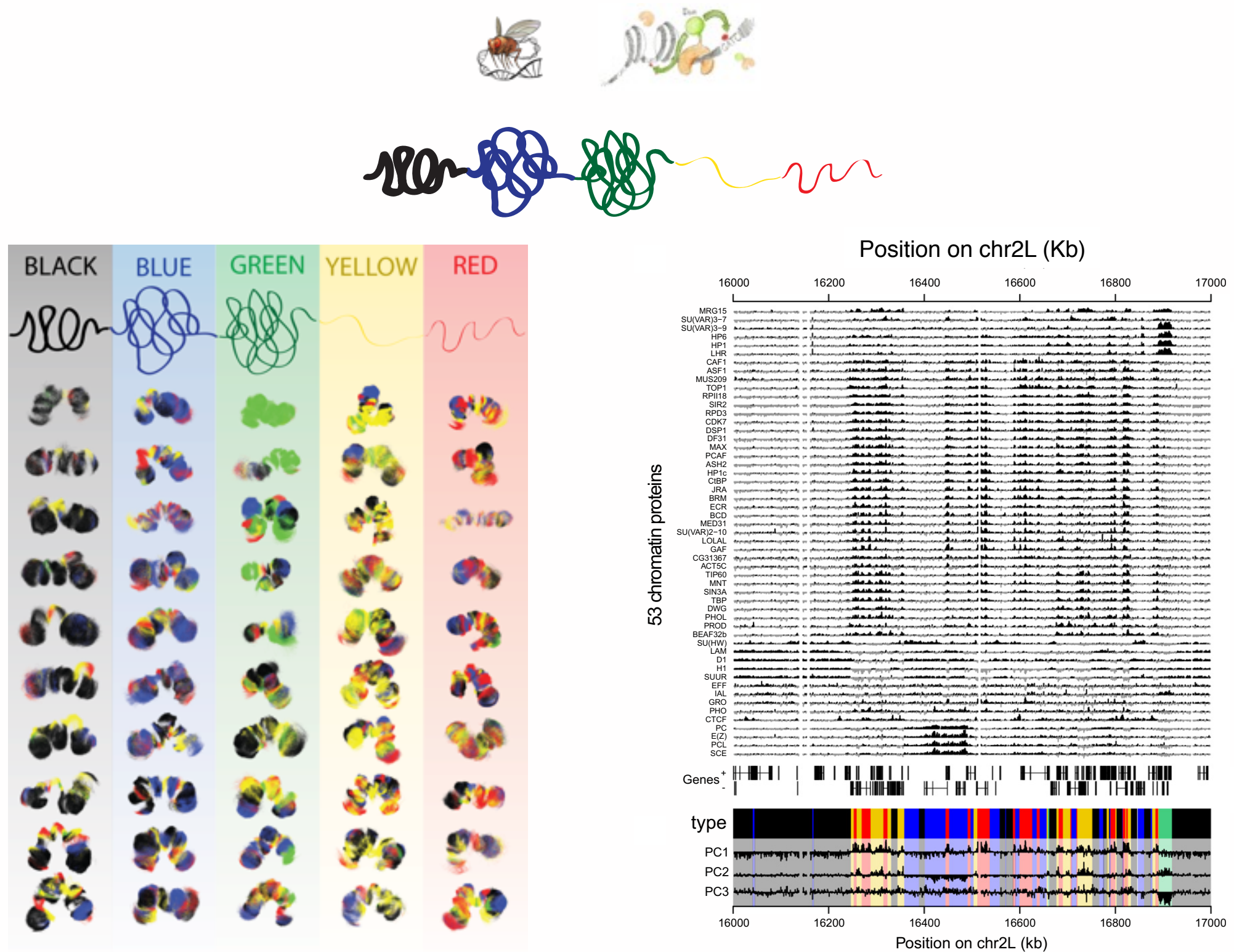
1% 0% 0% 0% 98% 1%



Structural features of the 5-colors



The 5-type chromatin colors structurally different





Nov 24th-27th Lisbon



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Instituto Gulbenkian de Ciência

<http://gtpb.igc.gulbenkian.pt>

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Guillaume Filion

Gene Regulation, Stem Cells and Cancer
Centre de Regulació Genòmica
Barcelona, Spain

