Protein determinants of chromosome domains

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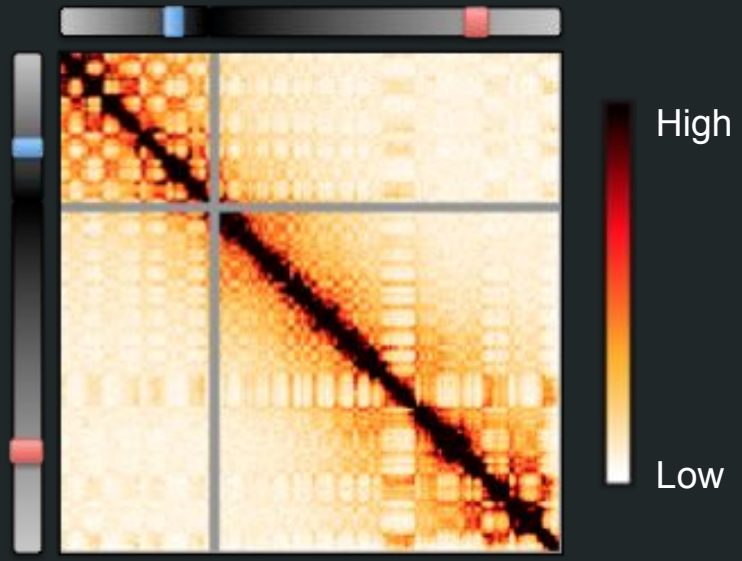
MIT PRIMES Presentation
May 22, 2016

Background

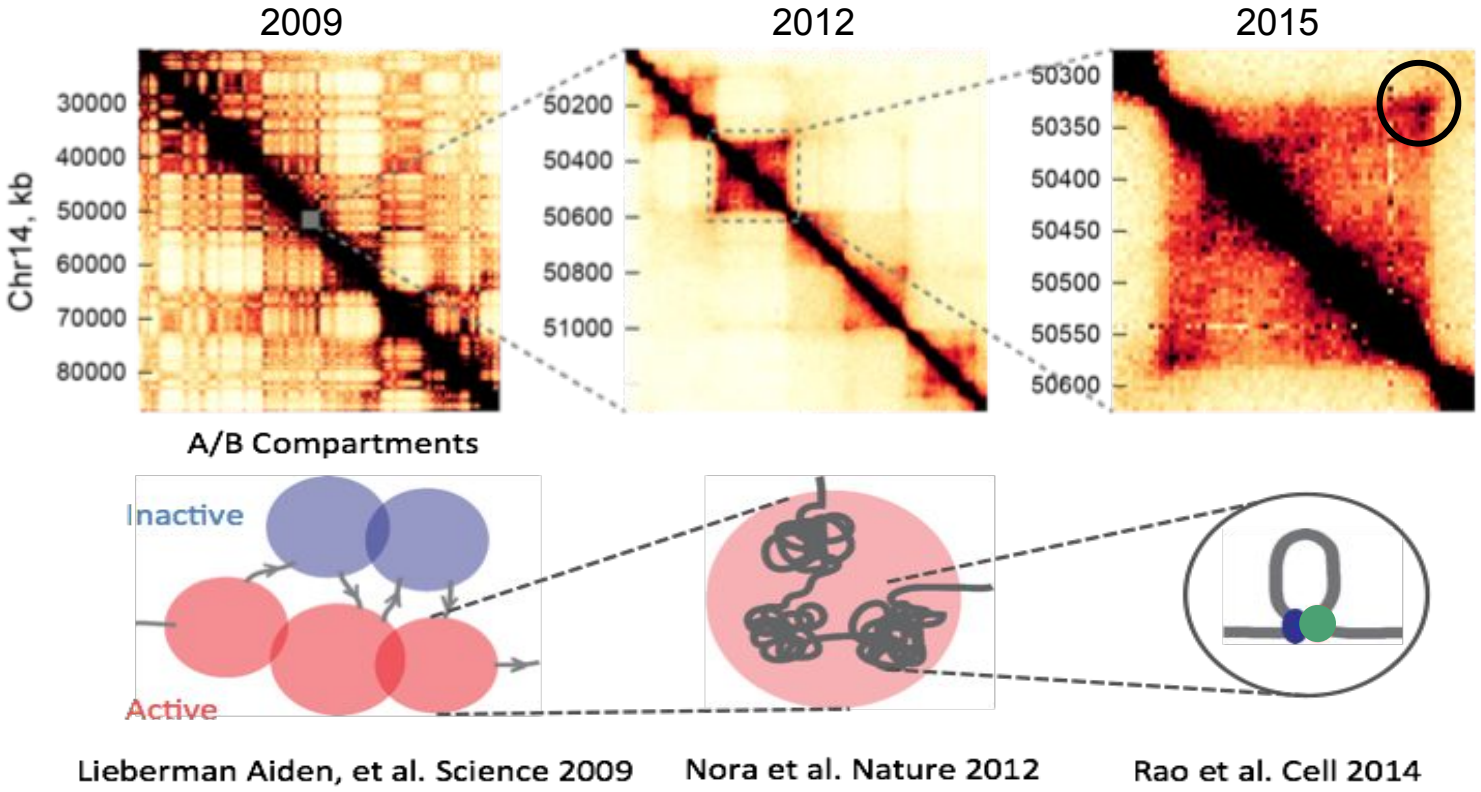
Hi-C

Loops and domains

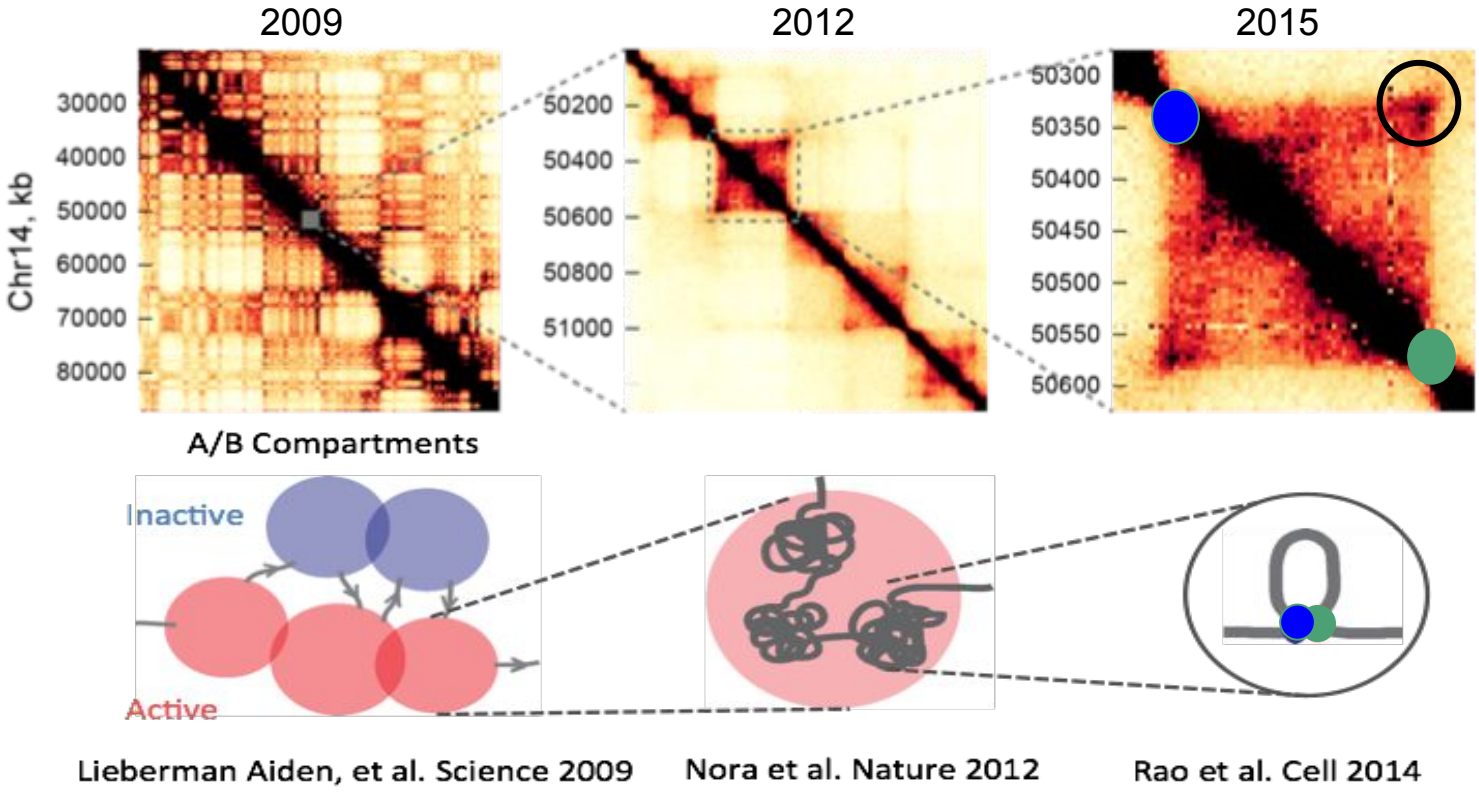
Chromosome contact maps



Loops and domains

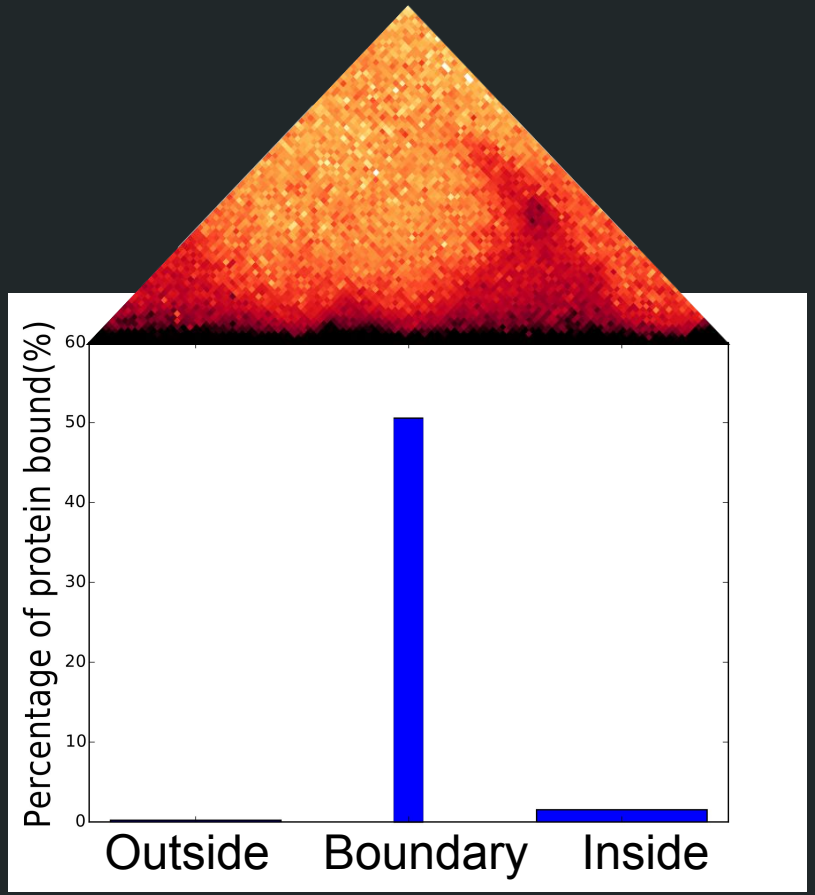


Loops and domains



DNA - Binding Proteins

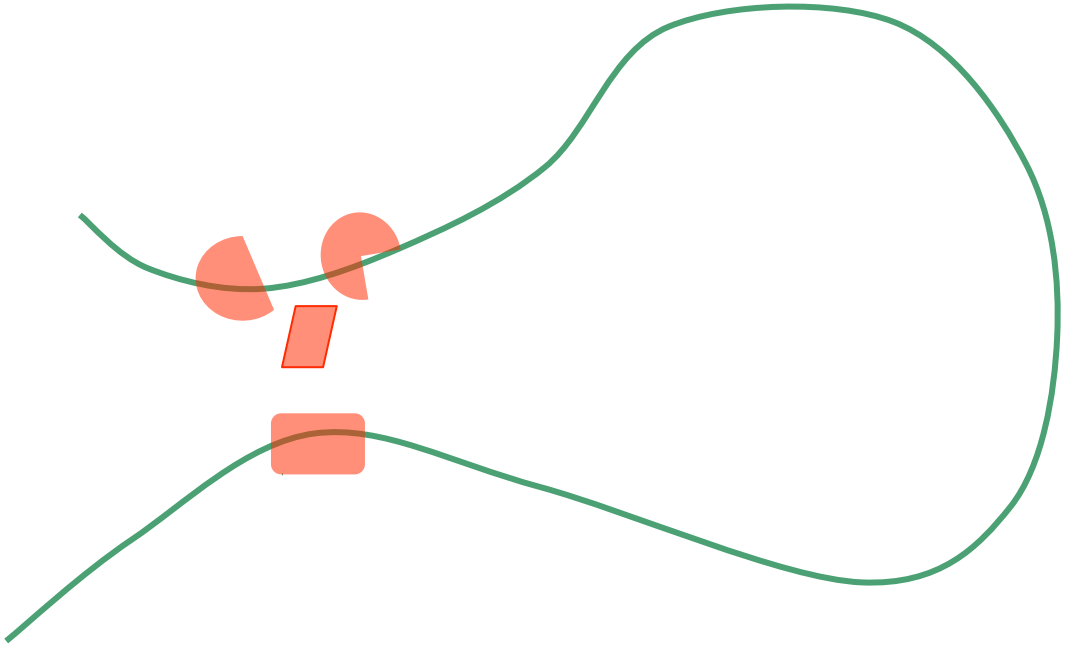
Functional aspect



Rao *et al*/*Cell* 2014

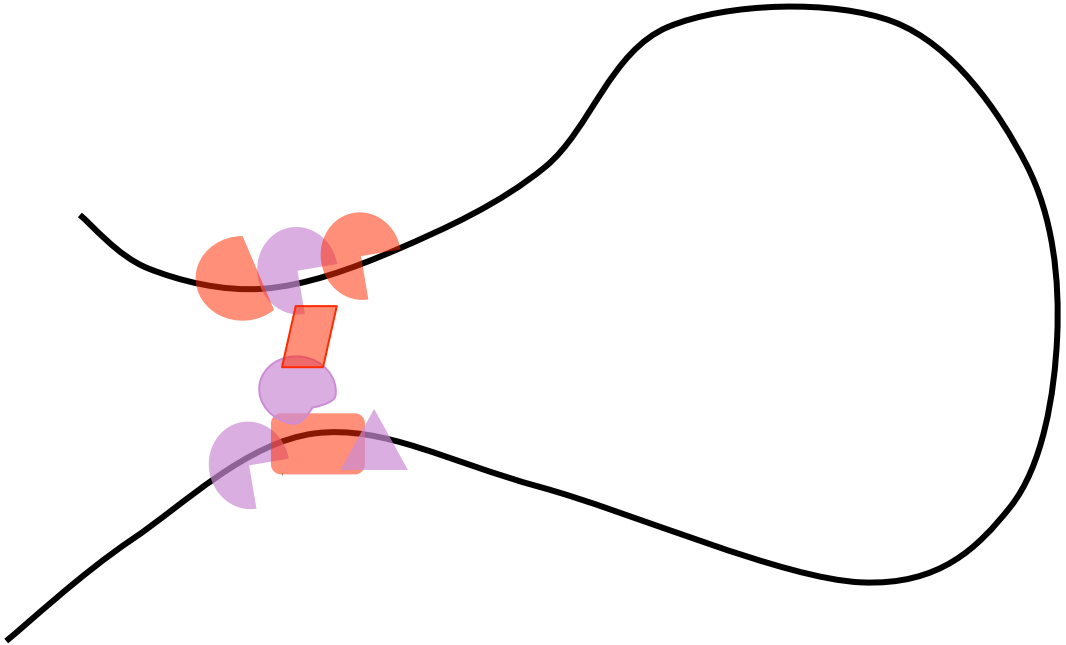
Binding factors at boundaries

- Architectural Proteins

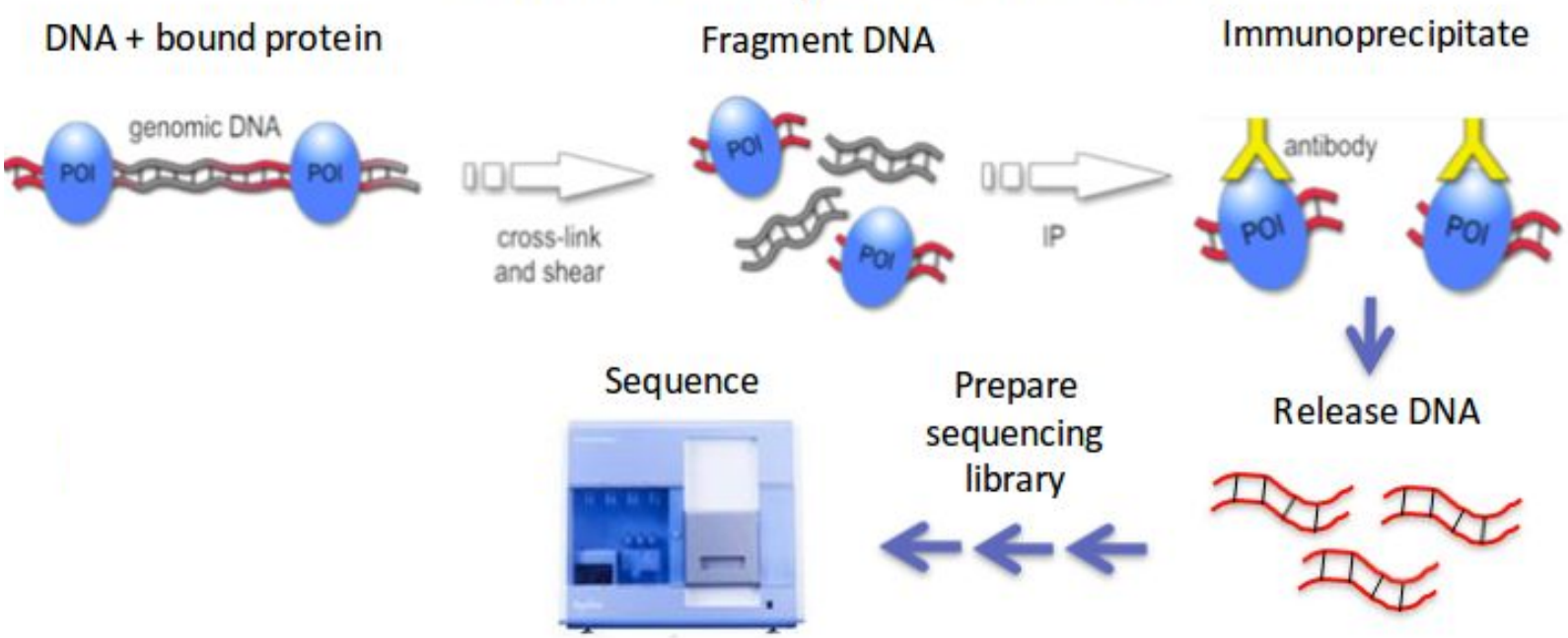


Binding factors at boundaries

- Architectural Proteins
- Transcription Factors

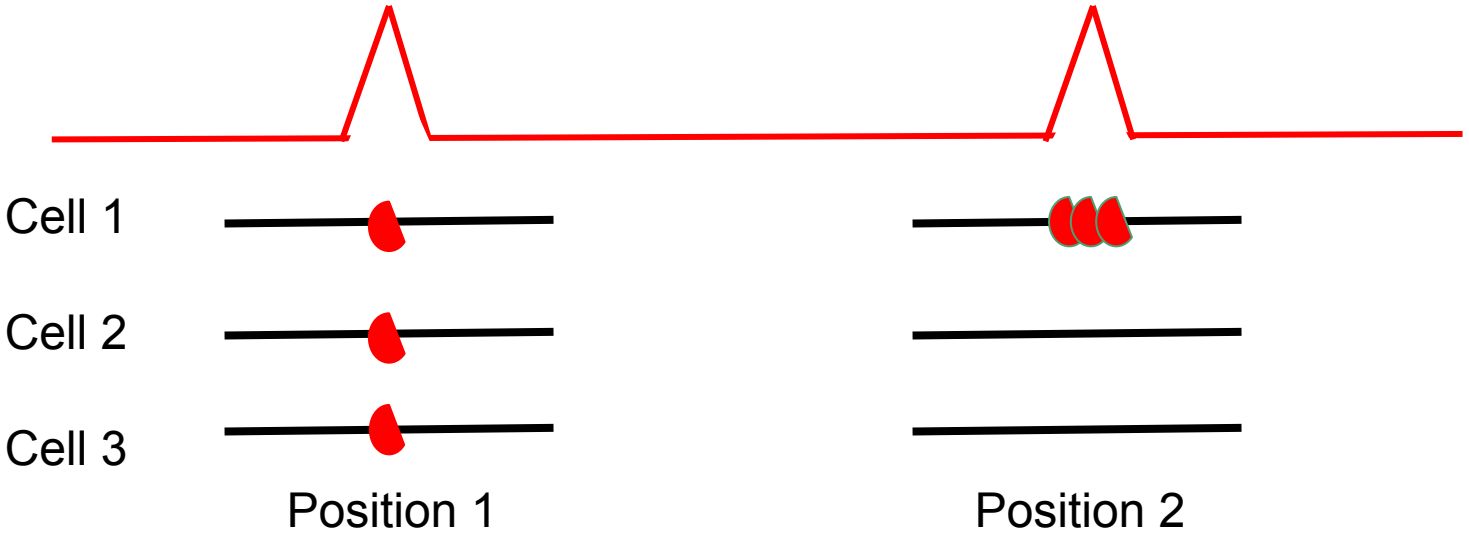


Chromatin Immunoprecipitation Seq (ChIP-seq)



http://slideplayer.com/slide/3385783/

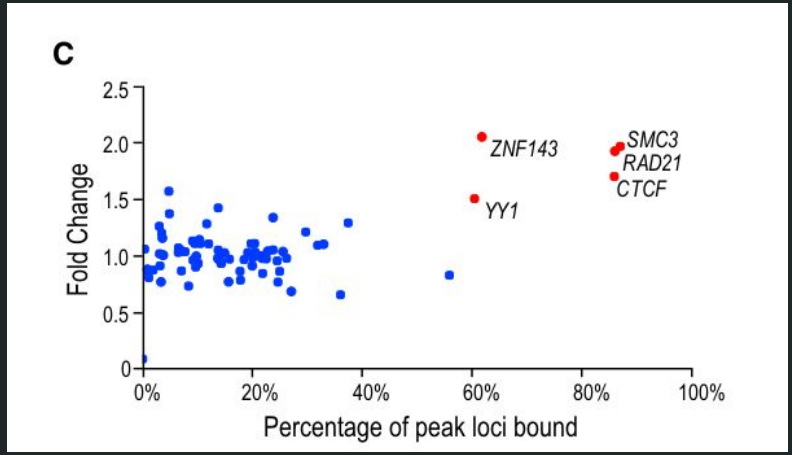
Chromatin Immunoprecipitation Seq (ChIP-seq)



Methods and Results

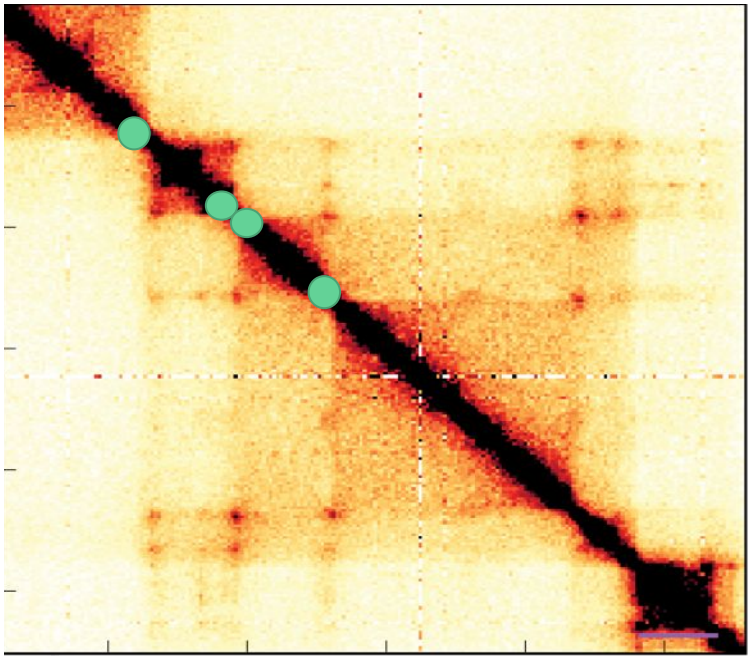
Protein Enrichment

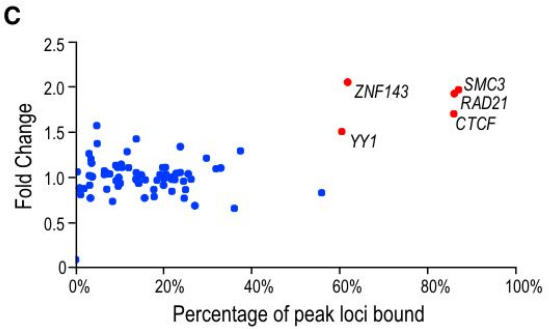
Peak enrichment vs percentage states occupied



Rao et. al. 2014

Percentage of loop or domain boundaries with protein

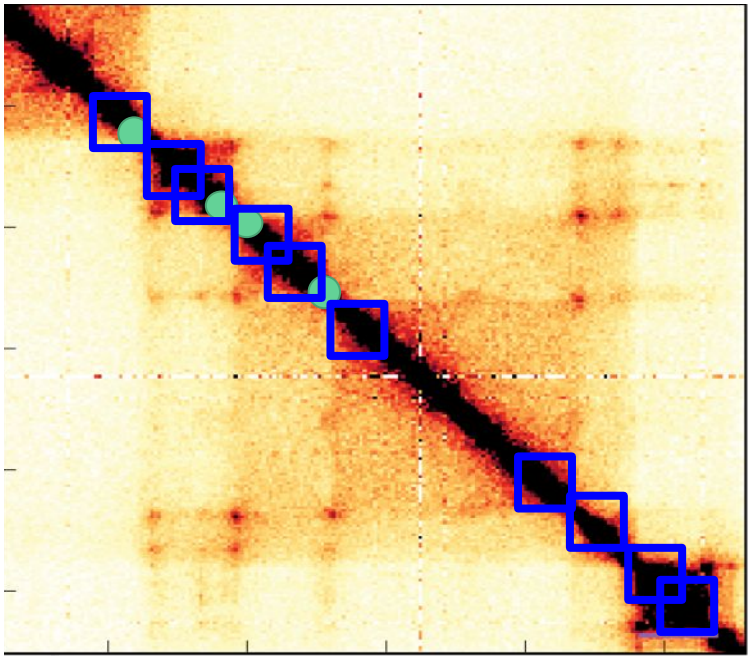


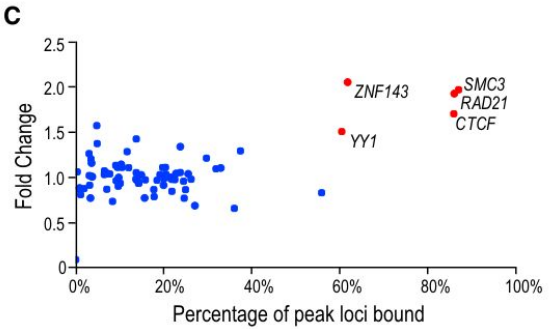


Percentage of loop or domain boundaries with protein

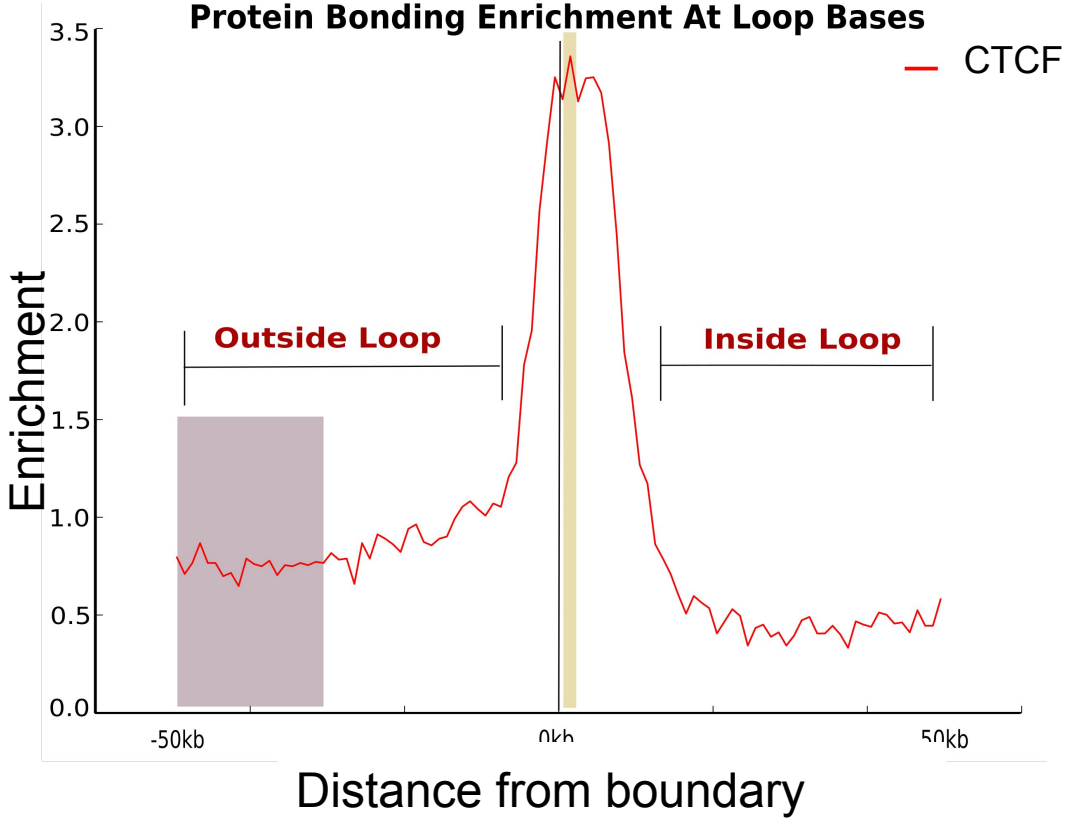
Example:

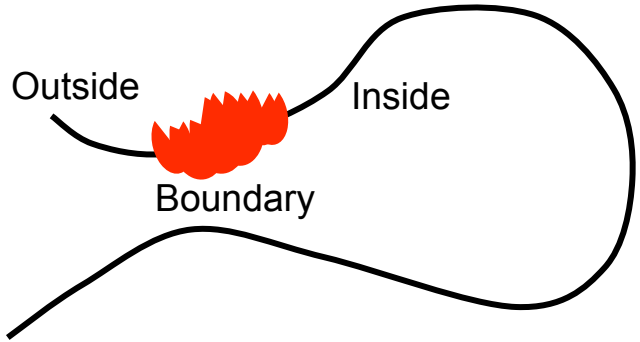
- 10 total boundaries
- 4 with green protein
- 4/10 = 40% green protein



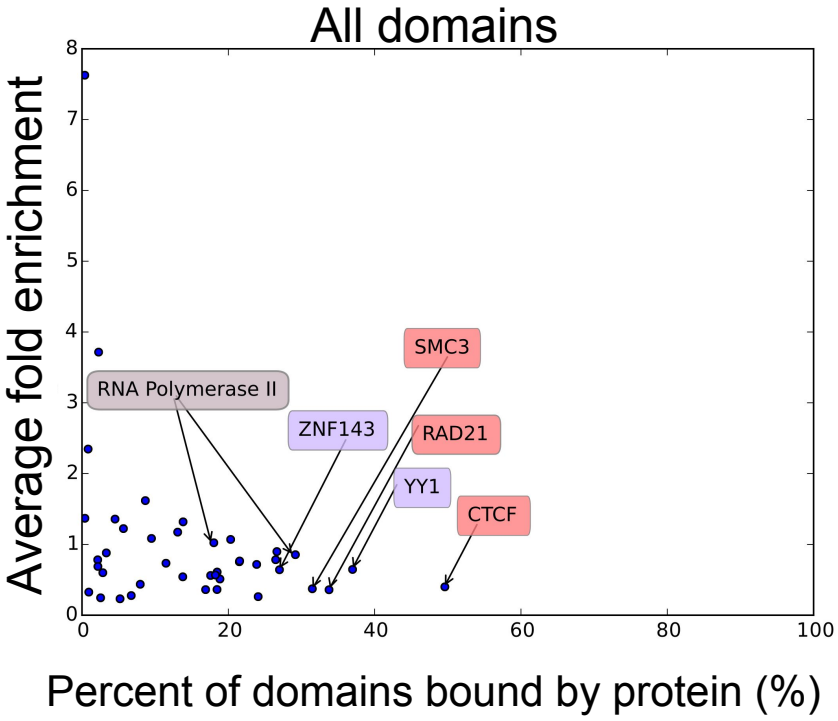


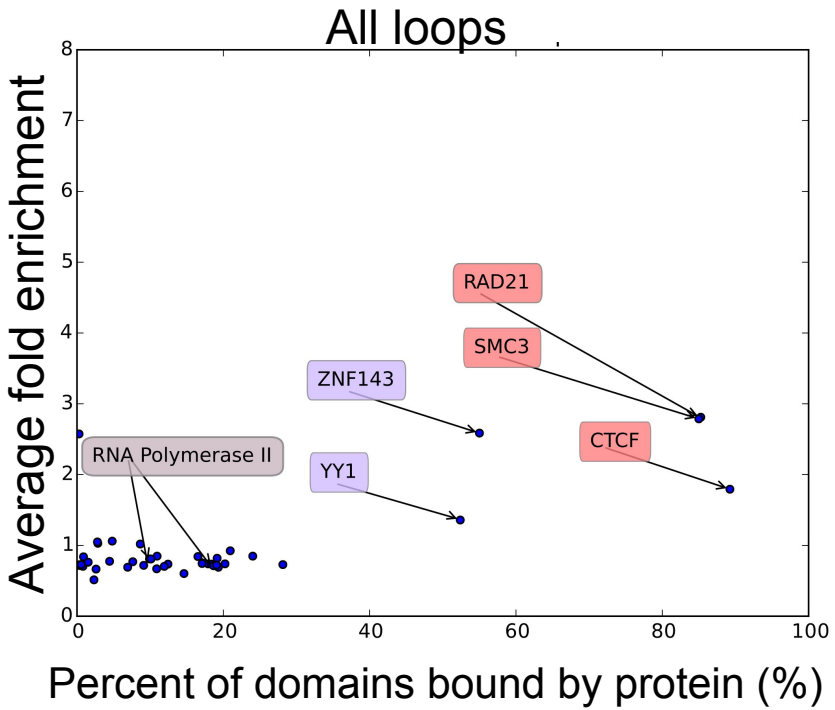
Enrichment of proteins at loop and domain boundaries





Architectural and transcription proteins are enriched at loop boundaries



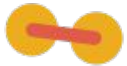


Architectural proteins enriched at loop boundaries

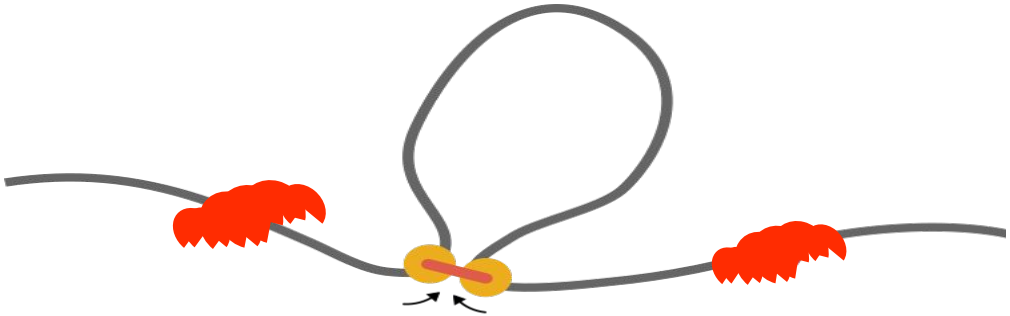
CTCF

- Known to be related to 3D genome structure and loop formation

Cohesin

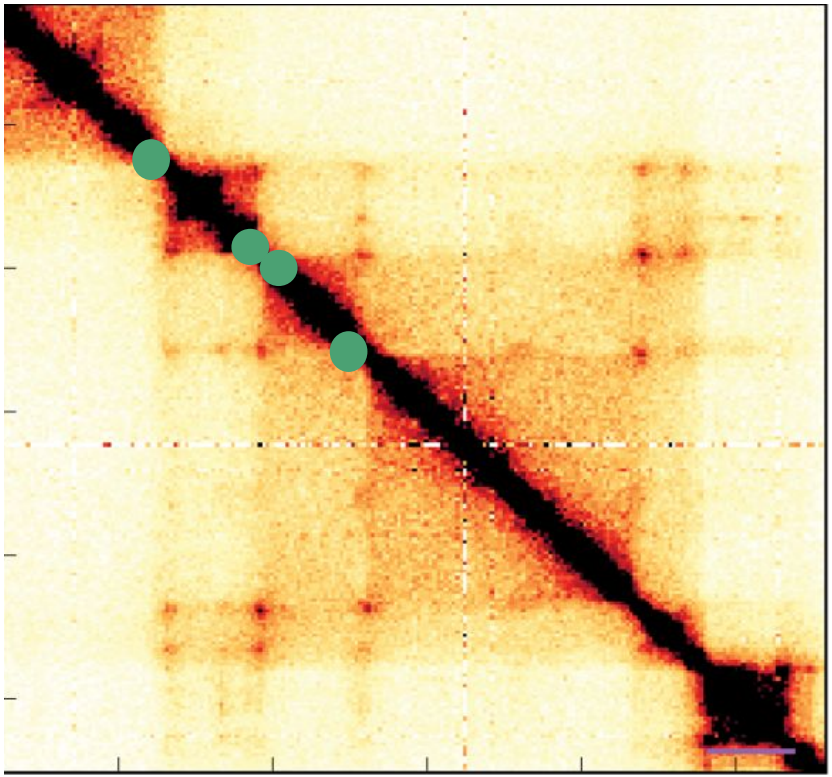


- RAD21 and SMC3 subunits
- Forms chromatin loops in Interphase



Considering boundaries with a particular protein

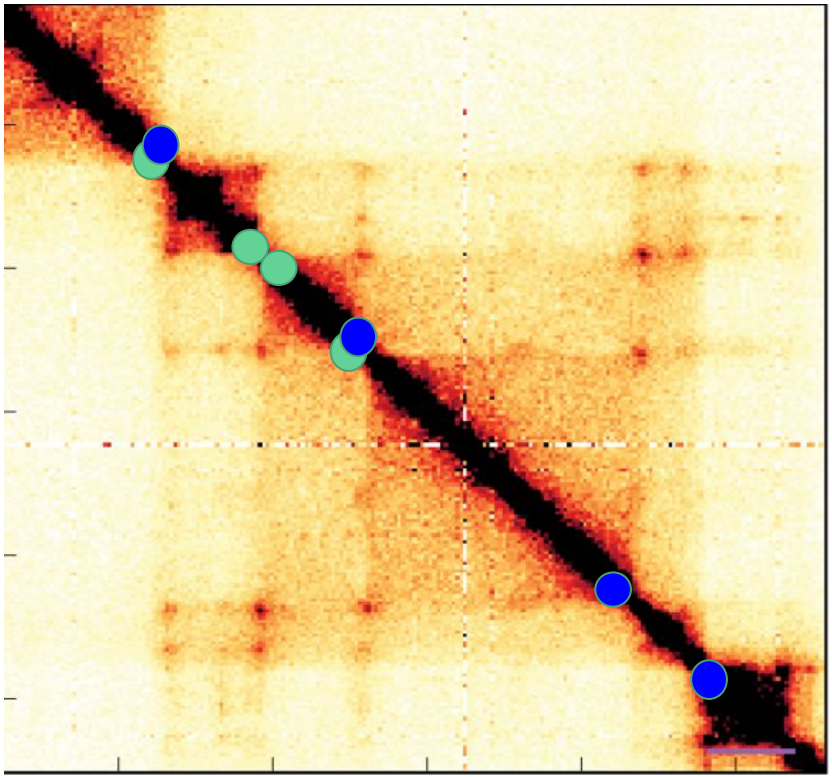
- Only interested in boundaries with a particular protein (green)



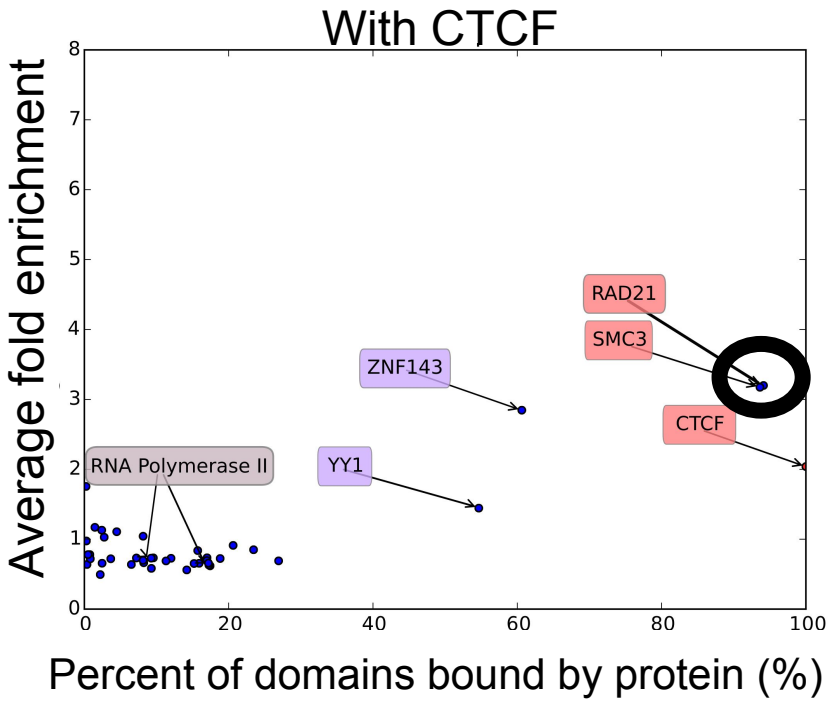
Considering boundaries with a particular protein

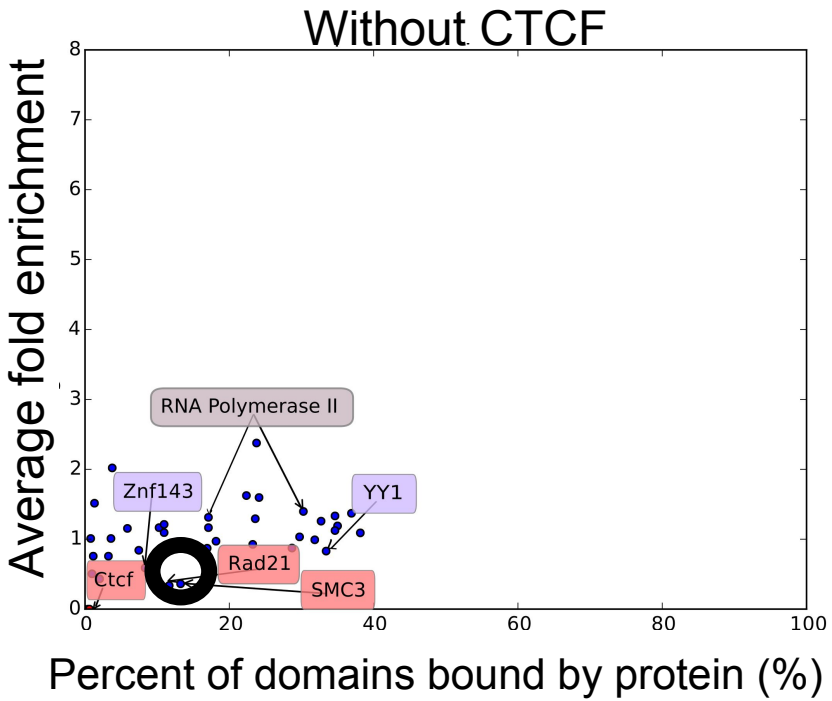
- Only interested in boundaries with a particular protein (green)

- 2 boundaries with both CTCF and the blue protein/ 4 boundaries with CTCF

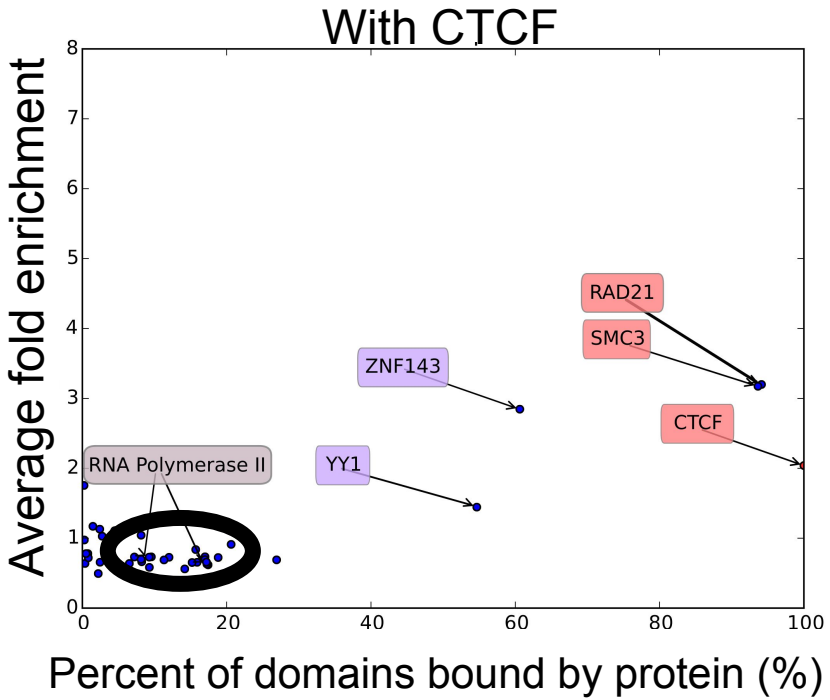


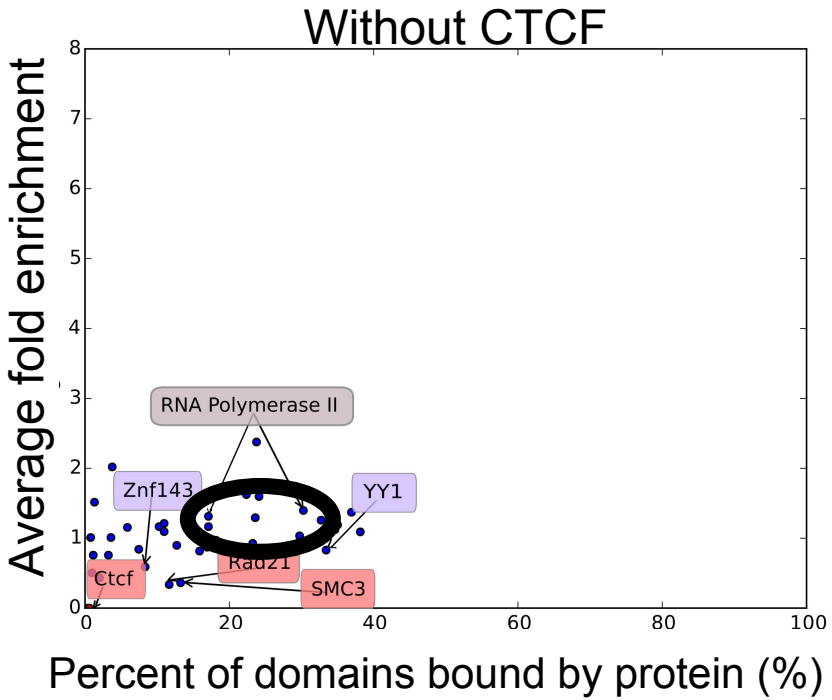
Architectural proteins CTCF, SMC3, RAD21 are co-enriched at loop boundaries



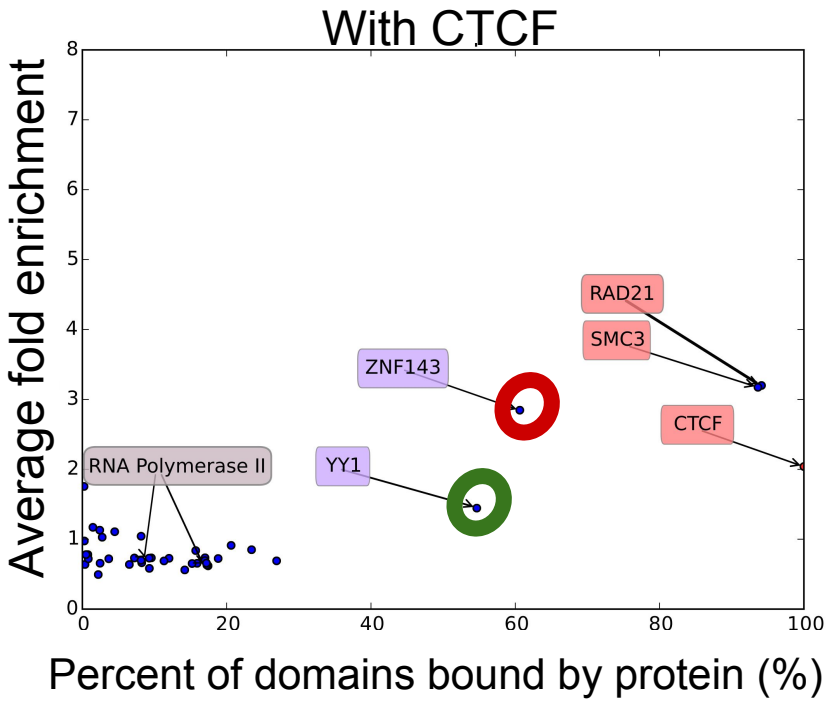


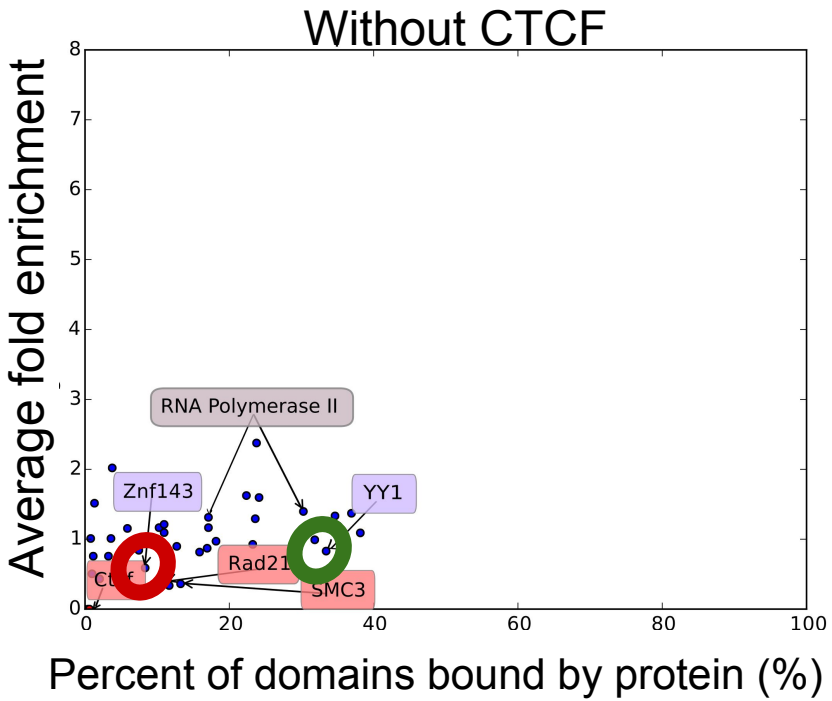
RNA Polymerase II is more common on boundaries without CTCF than with CTCF



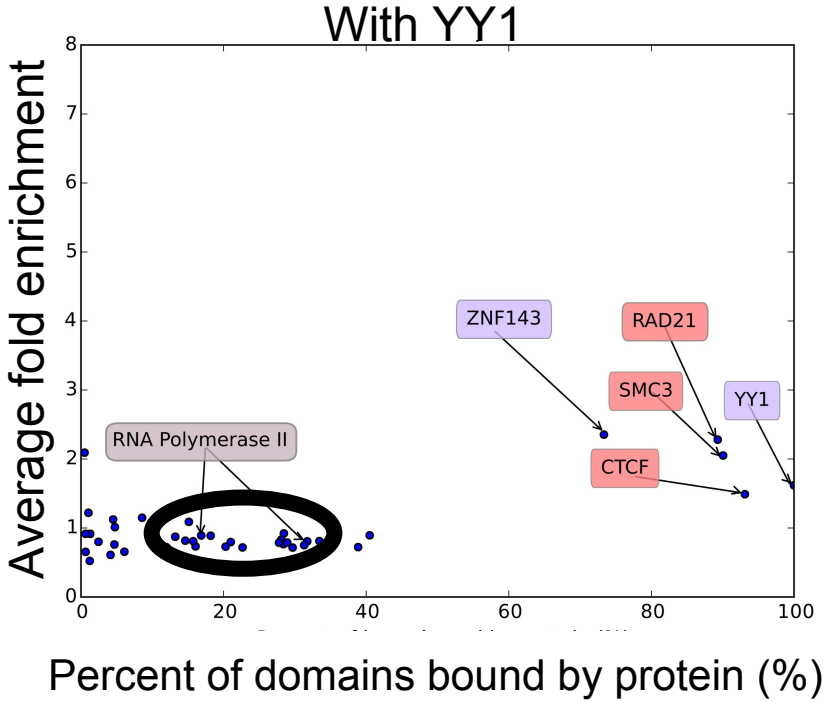


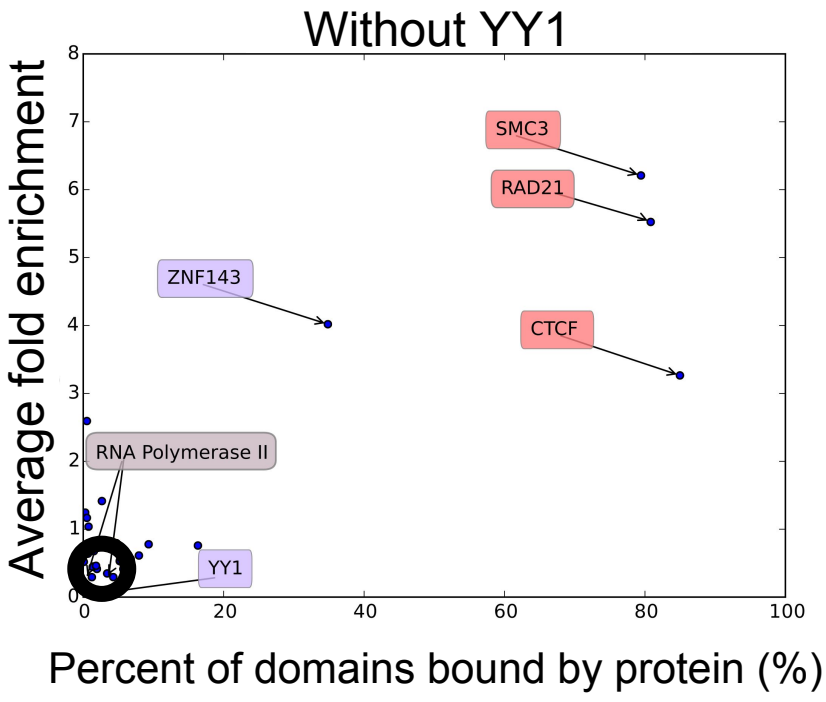
ZNF143 is more co-enriched with CTCF than YY1



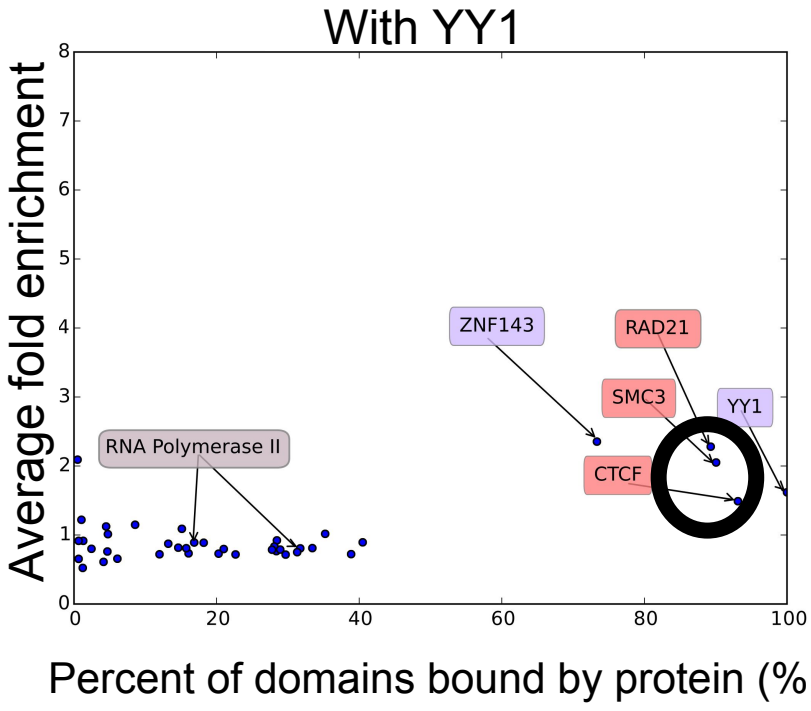


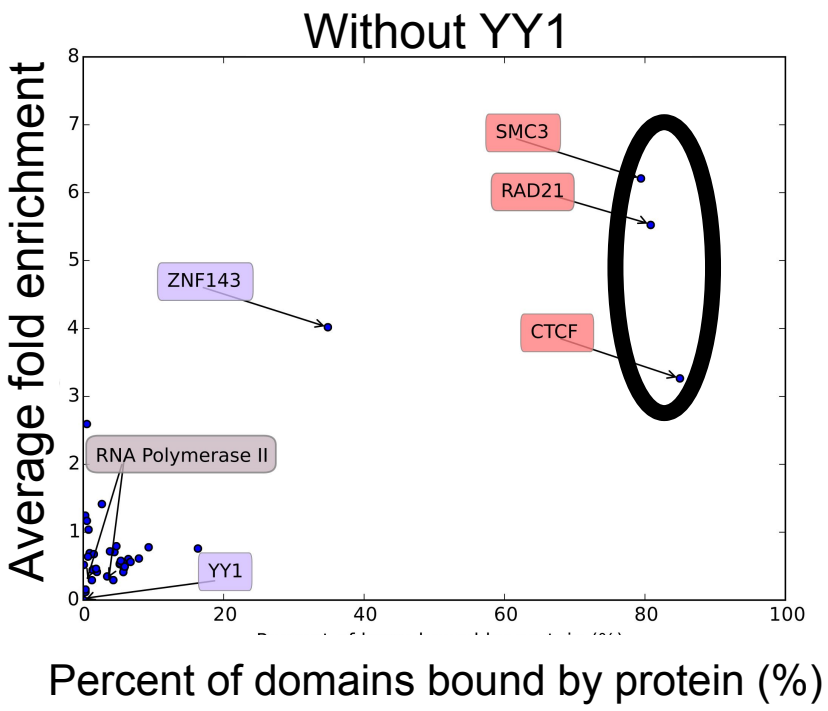
YY1 and RNA Polymerase II are correlated



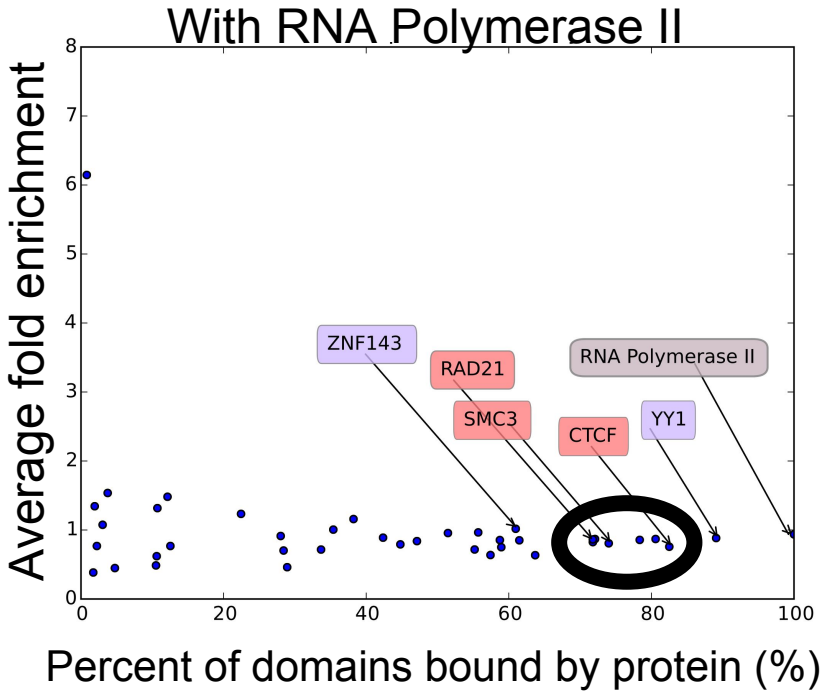


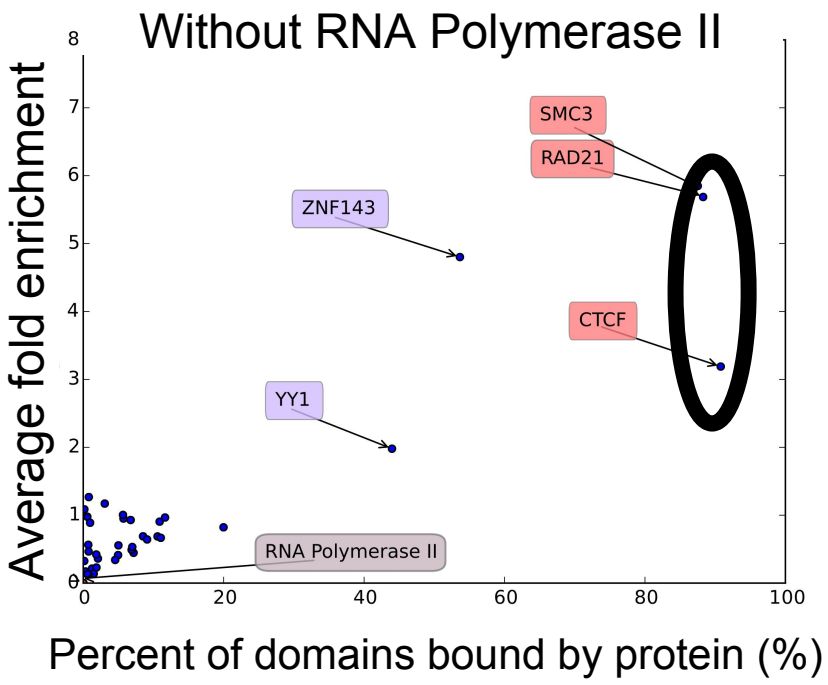
YY1 bound loci are bound by CTCF with a similar frequency but less enrichment



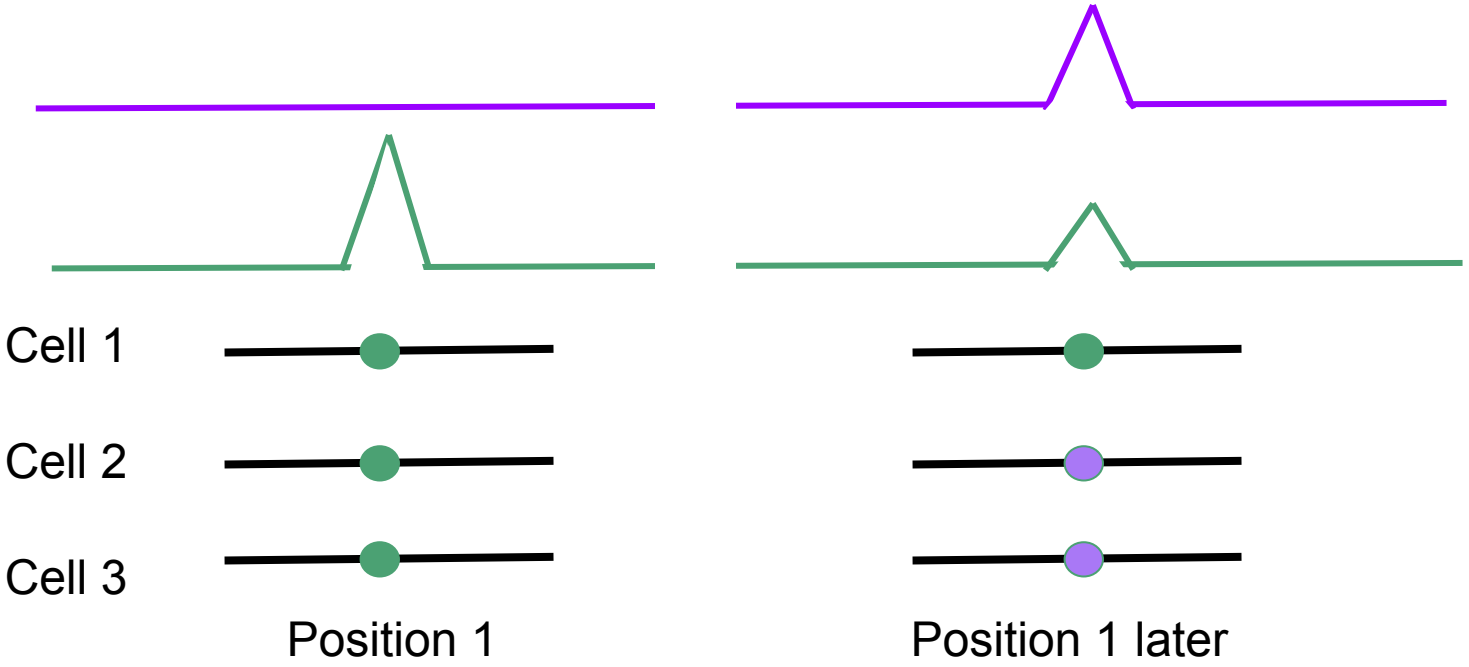


RNA Polymerase II bound loci are bound by CTCF with a similar frequency but less enrichment

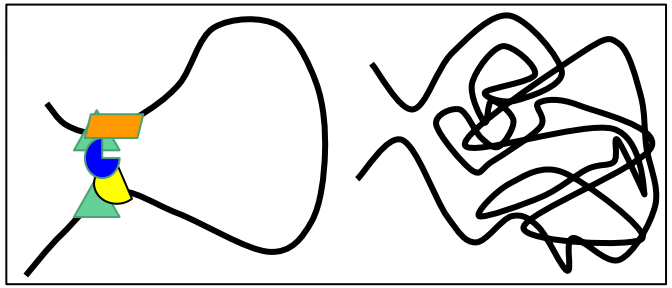


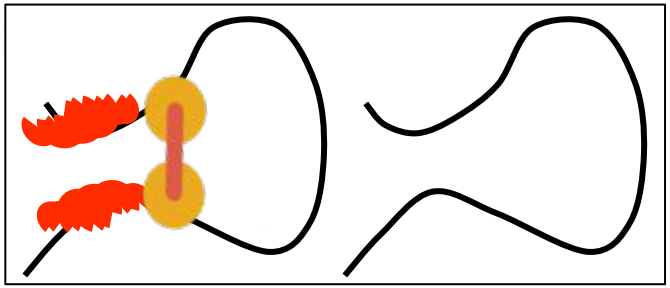


Testable hypotheses: CTCF could be replaced with RNA Polymerase II after loops are created



Conclusion





- Hypothesized classifications:
  - ZNF143 = Architectural protein
  - YY1 = Transcription / RNA Polymerase II associated boundary factor
- Enrichment of RNA Polymerase II is anticorrelated with CTCF
- Testable hypothesis: RNA Polymerase II replaces CTCF at boundaries?

Acknowledgements

Mirny lab:

Prof. Leonid Mirny
Nezar Abdennur
Boryana Doyle
Dr. Geoff Fudenberg
Dr. Maxim Imakaev
Anton Goloborodko
The Espresso Machine

Dr. Slava Gerovitch and Dr. Pavel Etingof for dealing with our poor adherence to deadlines

And my parents for supporting me through this journey