

Exchange Among Sex Chromosomes and Autosomes

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9/3/2013

Outline

- Exchange between X, Y and autosomes
Export and import, respectively
 - Triangle plots of total pseudogenes:
 - 6 species
 - Update: + 2 species: macaque, chicken
 - New comparison: PSSD vs. DUP:
 - Human, chimp & mouse
 - Triangle plots of export/import flow
 - Co-residence tests
 - Linear Regression



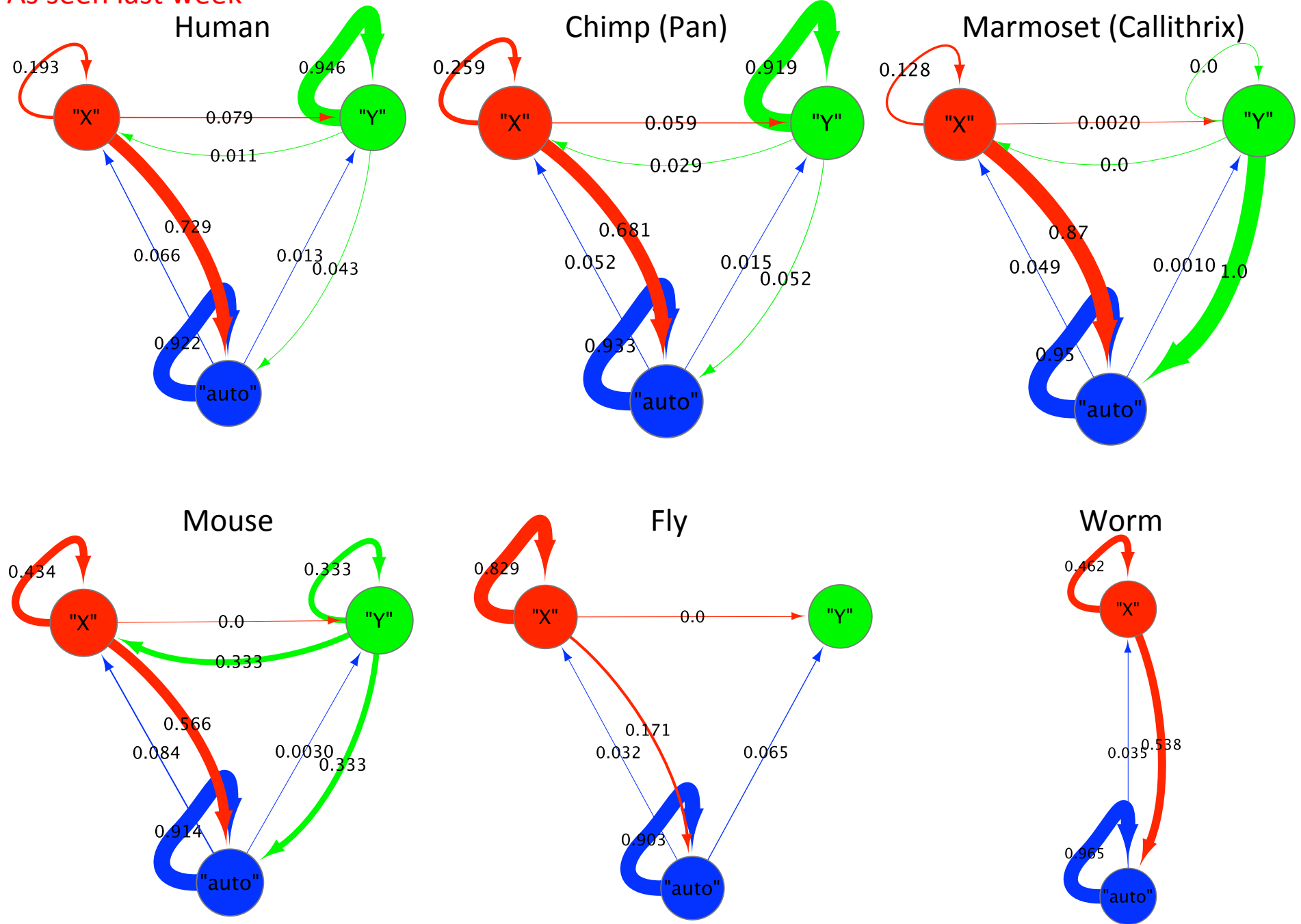
Triangle Plots of Total Pseudogenes

- Export of DNA
- Import of DNA

Export of DNA

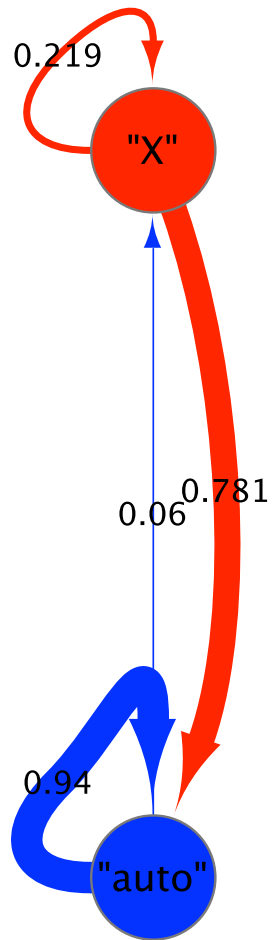
(Total Pseudogenes)

As seen last week

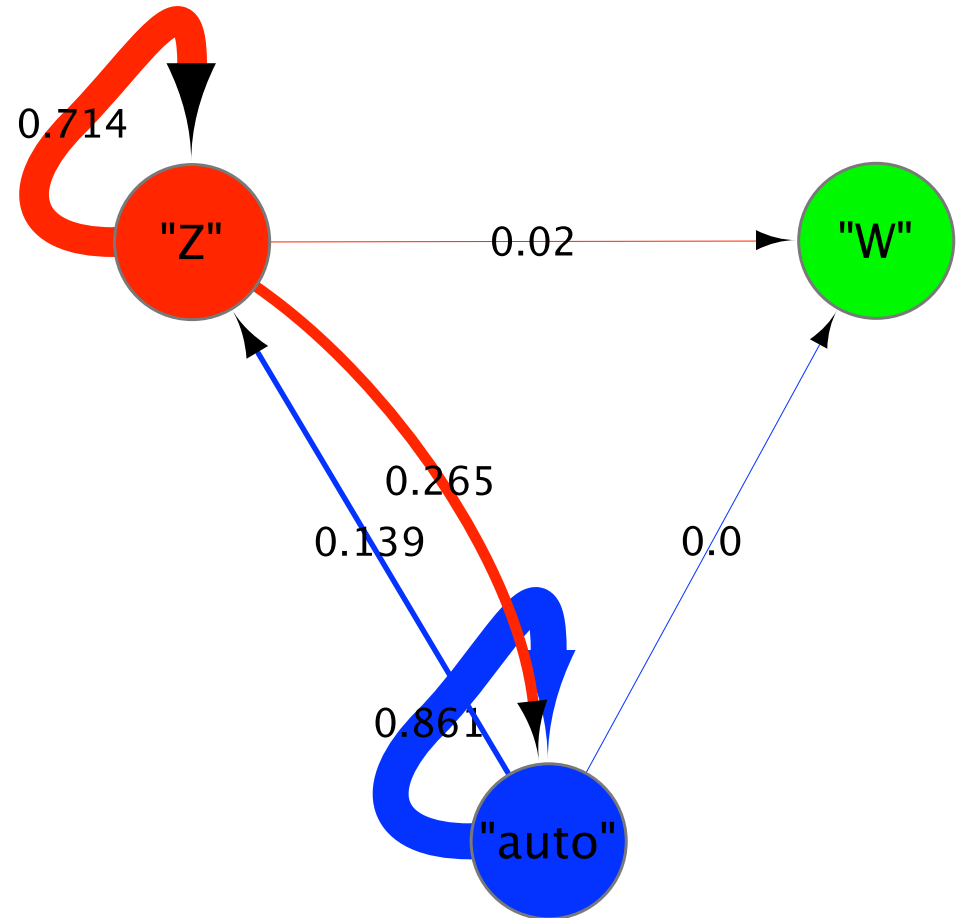


Newly added this week

Macaque



Chicken



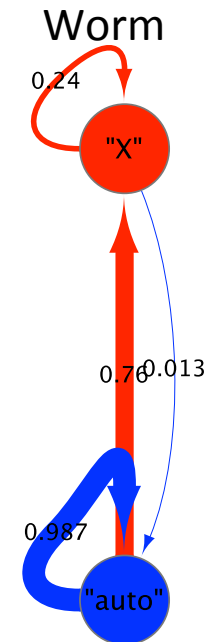
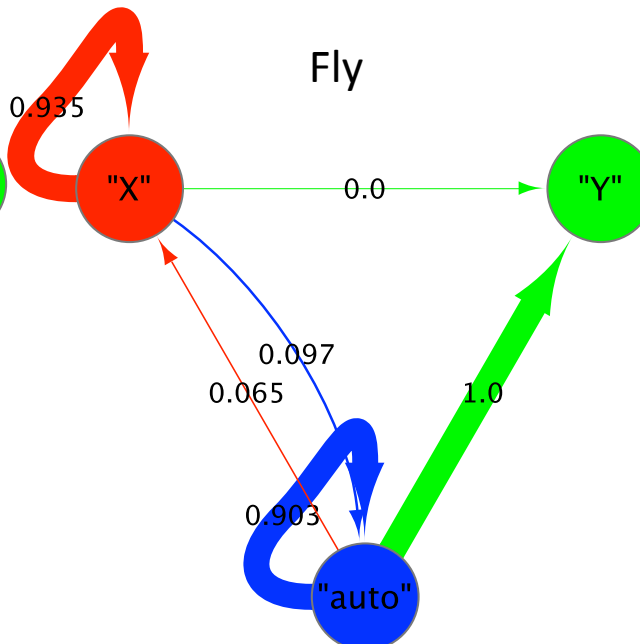
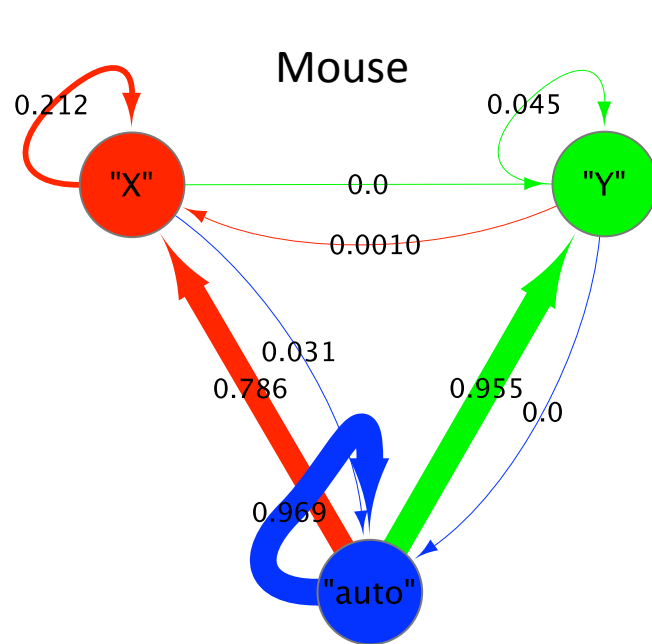
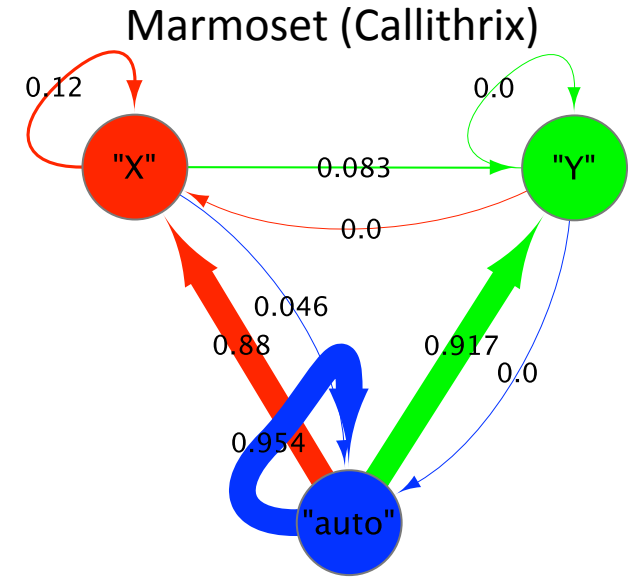
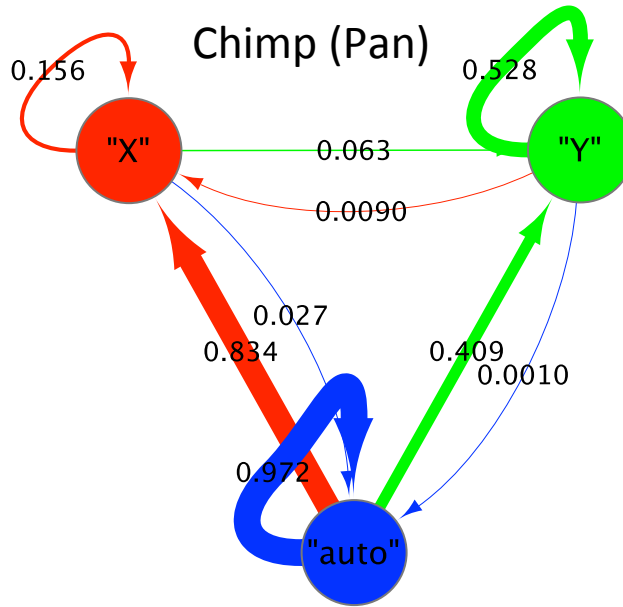
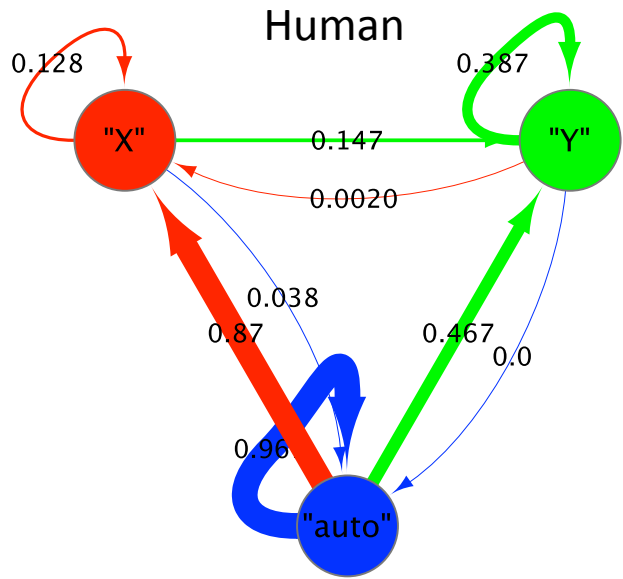
Observations

- In term of export flow (percentage in export)
 - In primates, X is an exporter.
 - In human and chimp, Y mainly contributes to pseudogenes on itself.
 - In human and chimp, Y is not an exporter.
 - In fly, X mainly contributes to pseudogenes on itself.

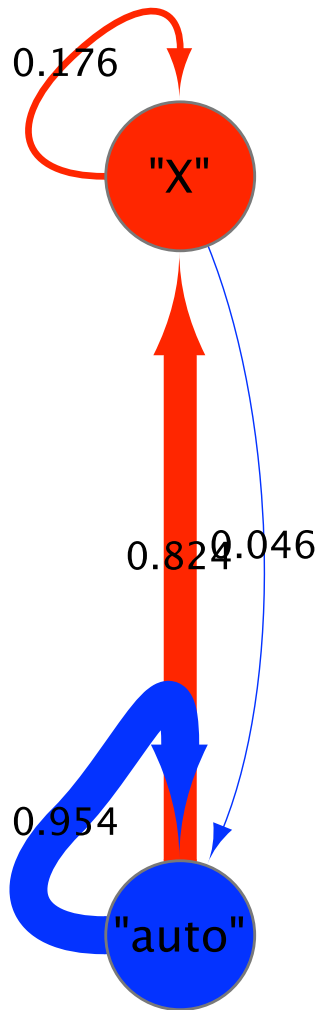
Import of DNA

(Total Pseudogenes)

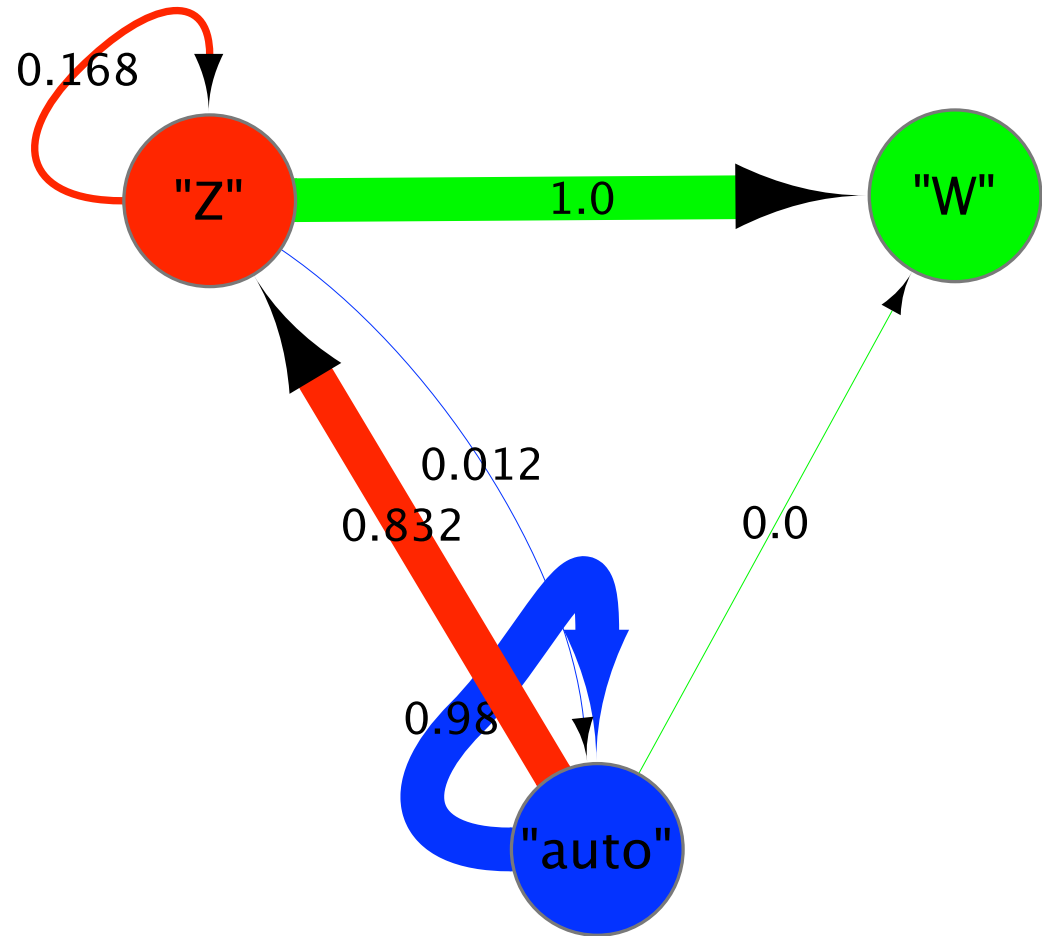
As seen last week



Newly added this week
Macaque



Chicken



Observation

- In term of import flow (percentage in import)
 - In all except fly, large fractions of pseudogenes on X came from parents on autosomes.
 - Recognizable fractions of pseudogenes on Y came from parents on autosomes too.

Observations

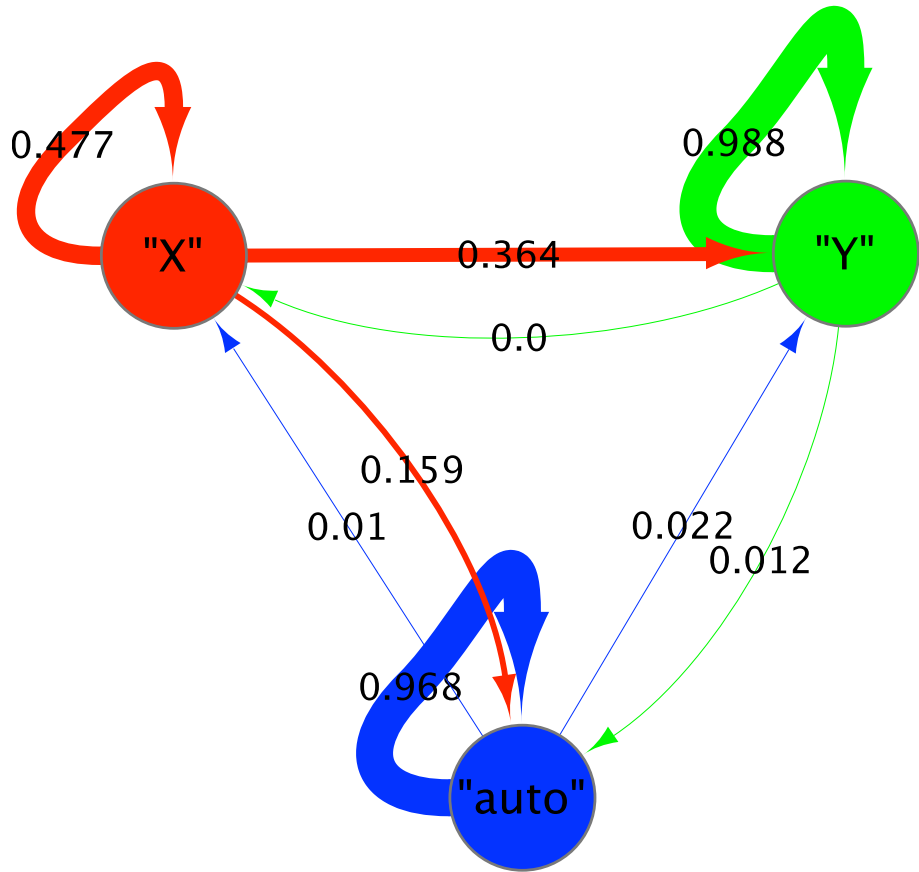
- The flow between X and autosomes in Macaque is like that of other primates.

2. Triangle Plots and Co-residence Tests of DUP and PSSD

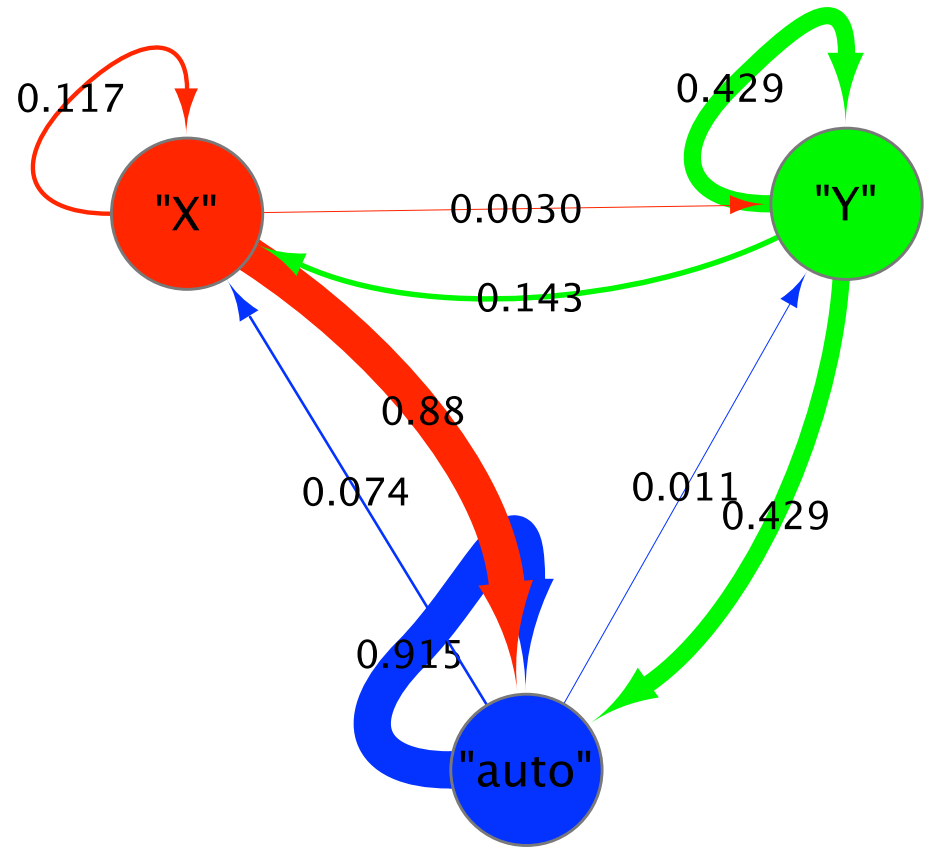
Human

DUP vs. PSSD

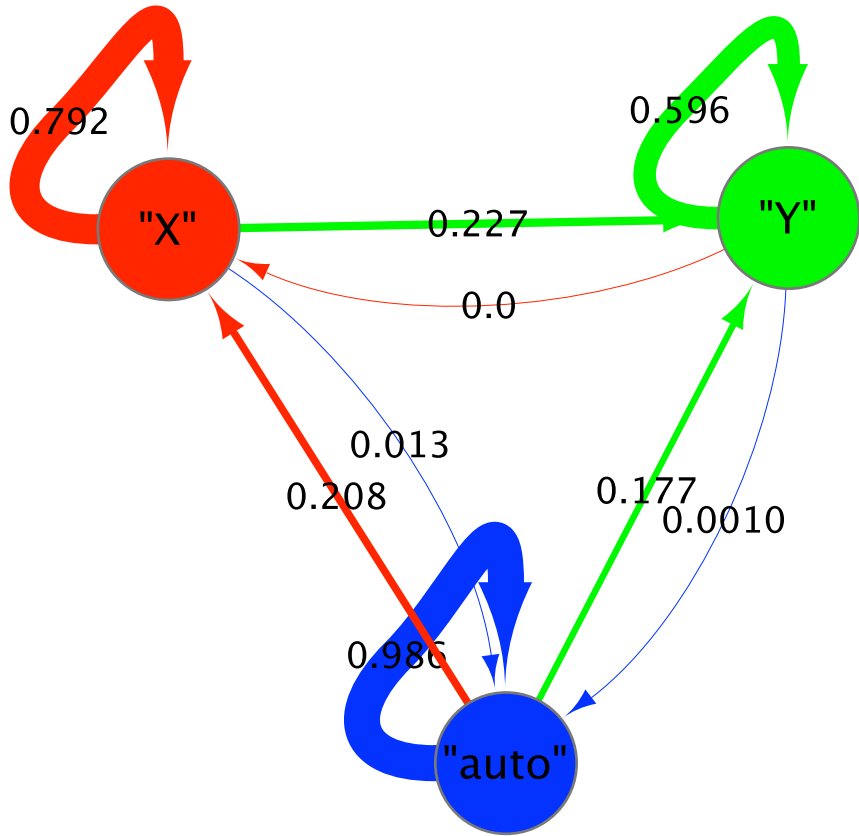
Human, DUP, export



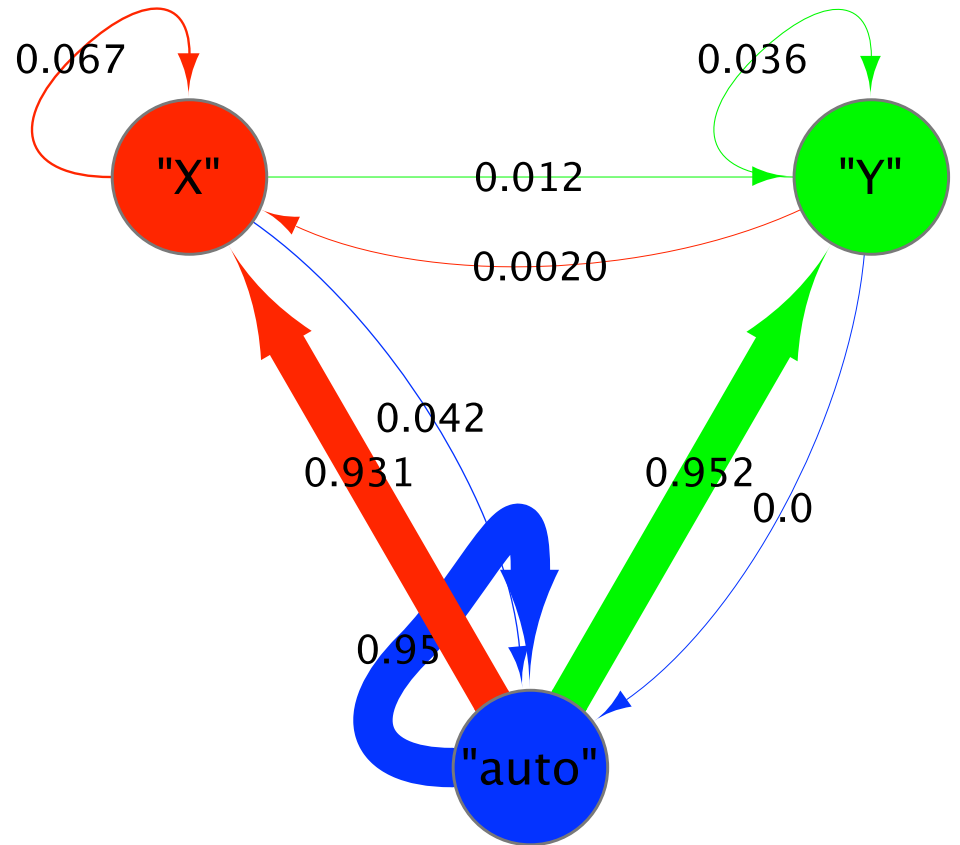
Human, PSSD, export



Human, DUP, import

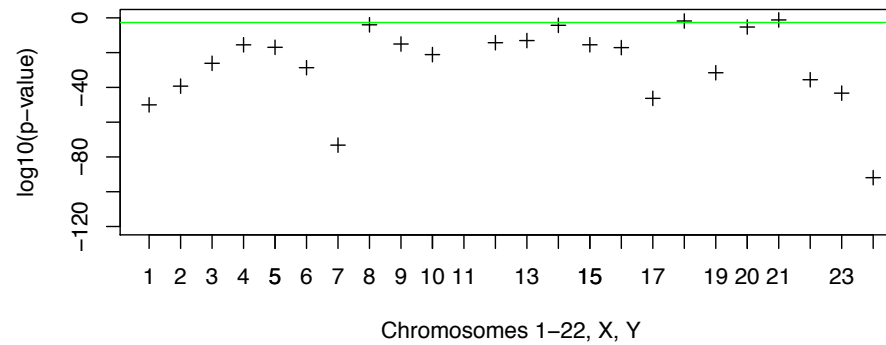
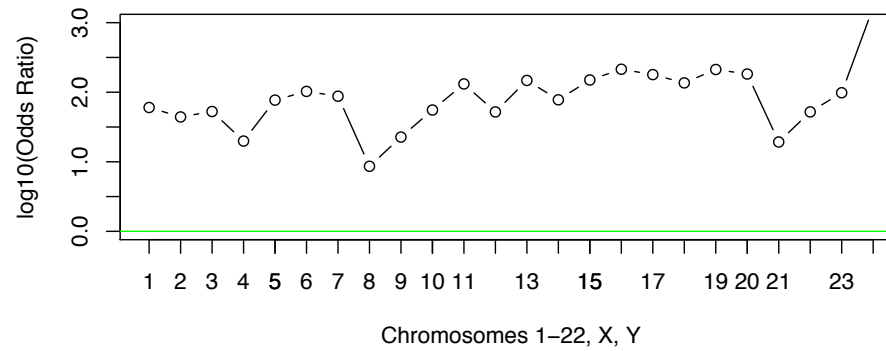


Human, PSSD, import



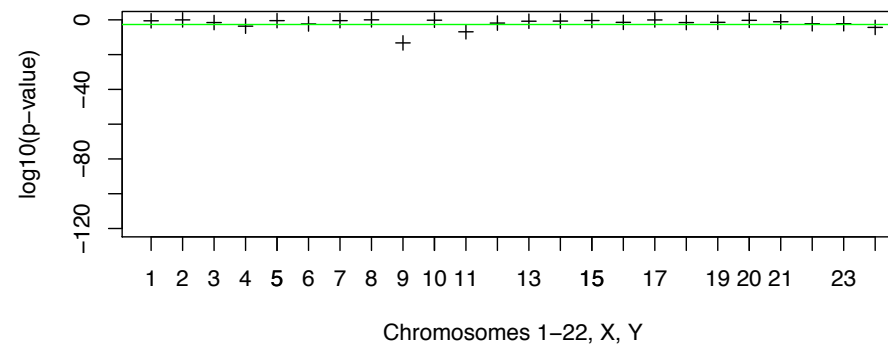
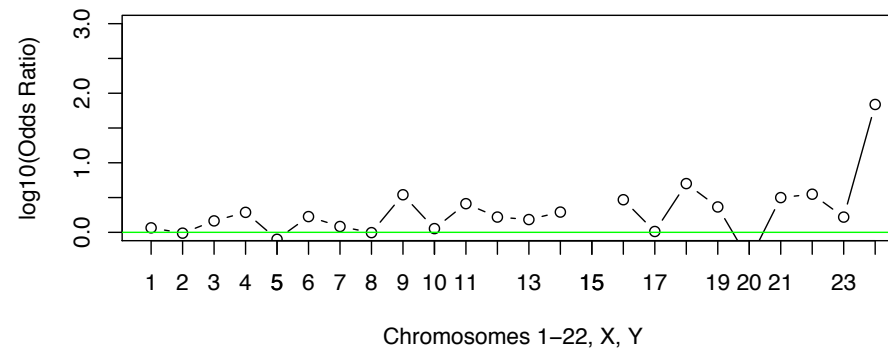
Human, DUP

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosom



Human, PSSD

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosom



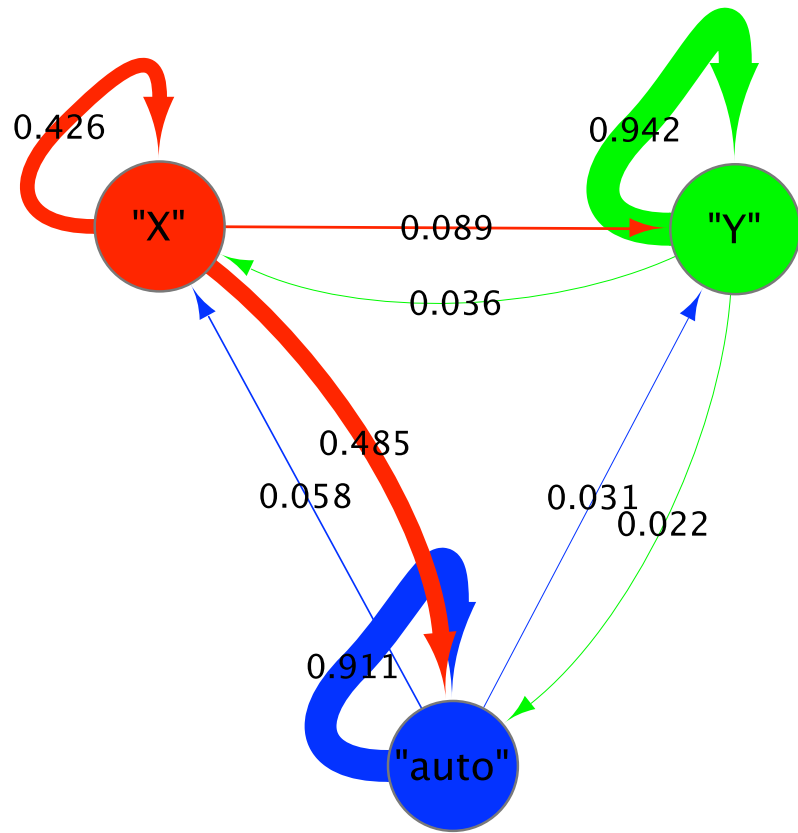
Observations from Human

- Results from triangle plots and co-residence tests are quite consistent:
 - DUP: Significant co-residence
 - PSSD: No co-residence
 - In terms of percentage in flow, X is a strong importer as well as a strong exporter

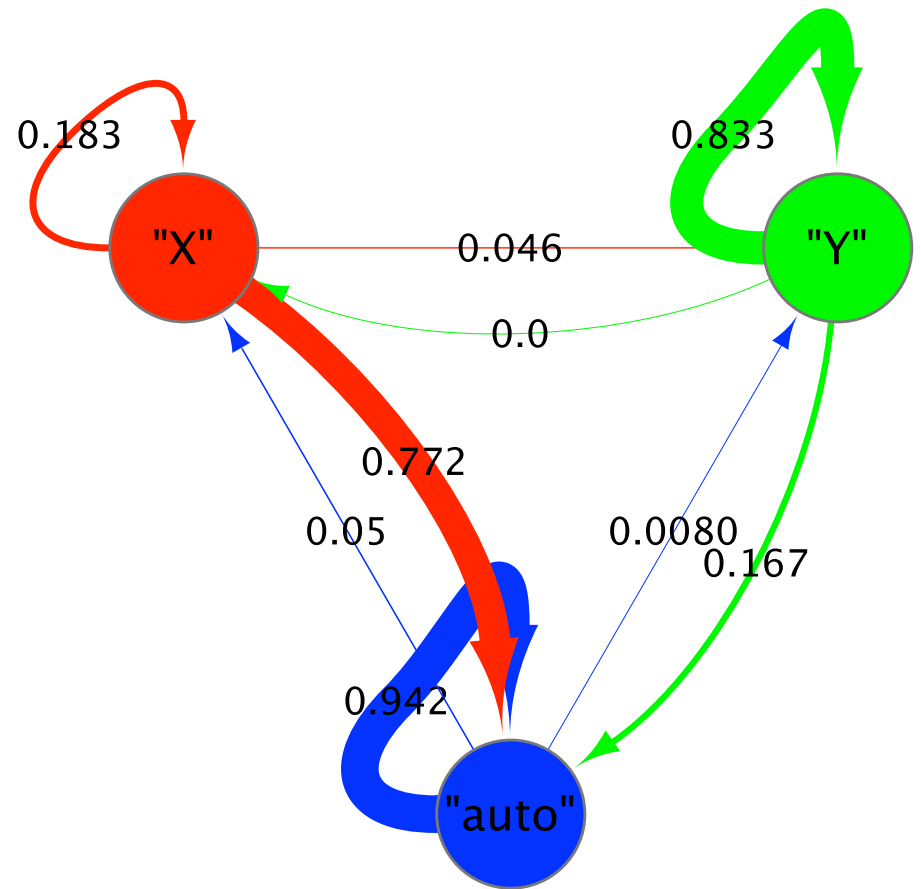
Chimp

DUP vs. PSSD

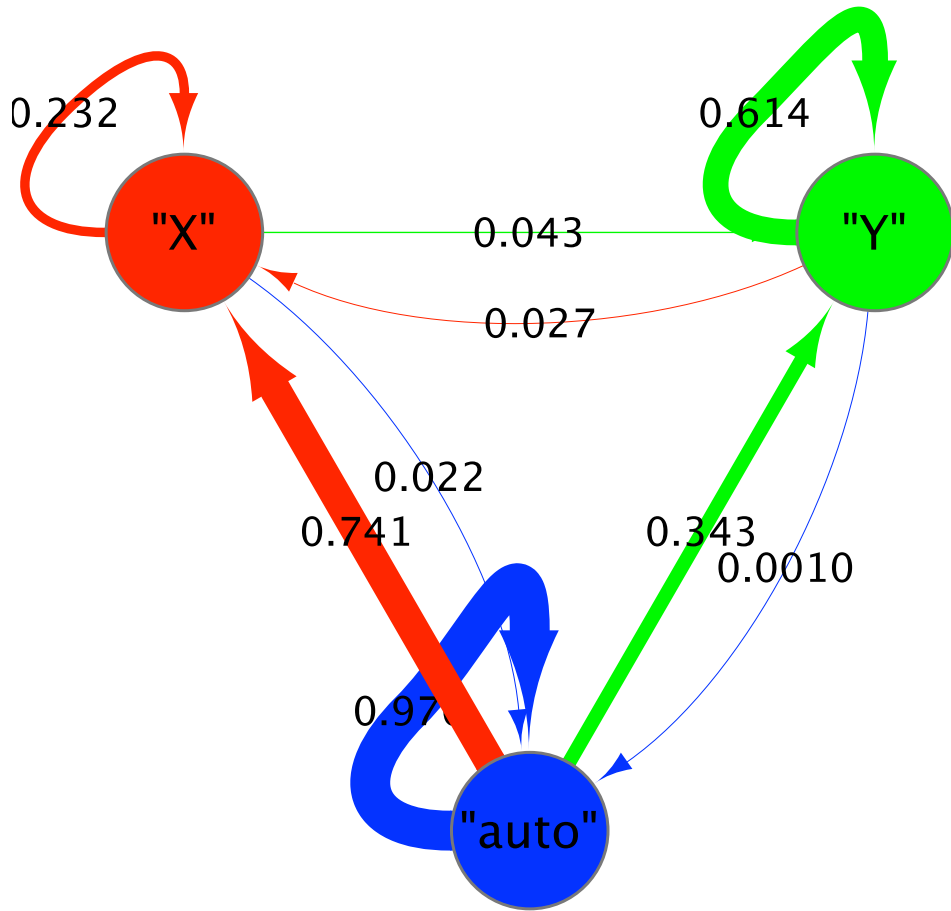
Chimp, DUP, export



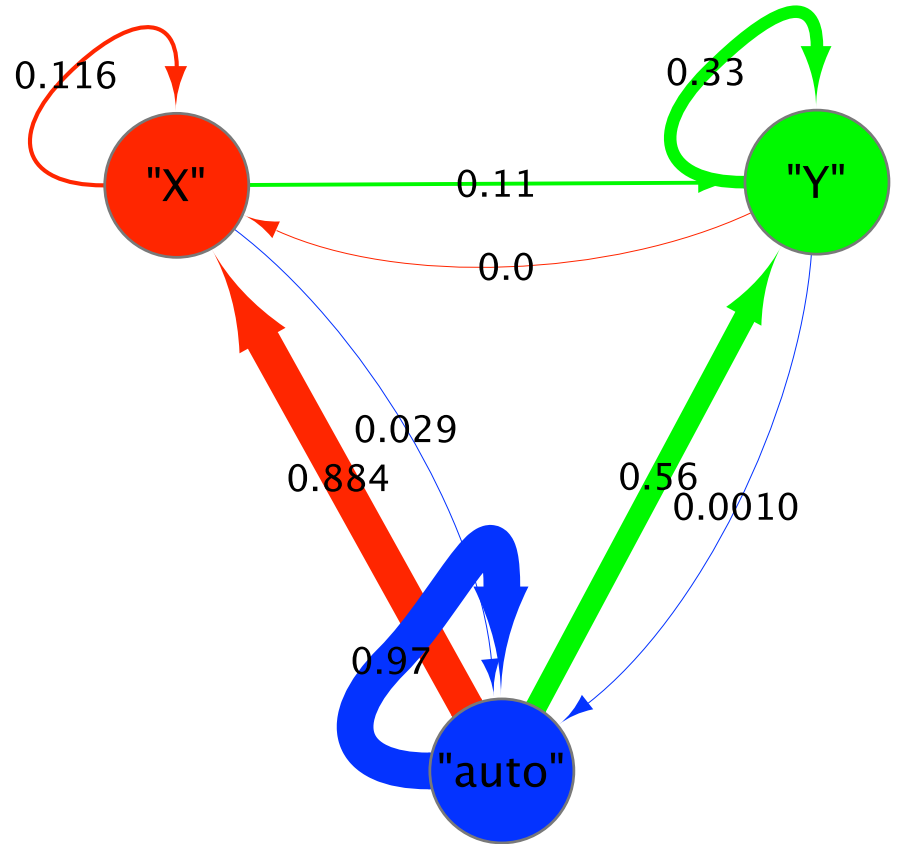
Chimp, PSSD, export



Chimp, DUP, import

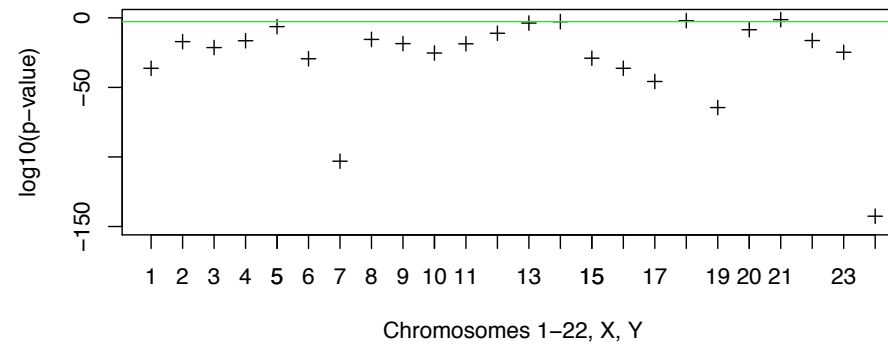
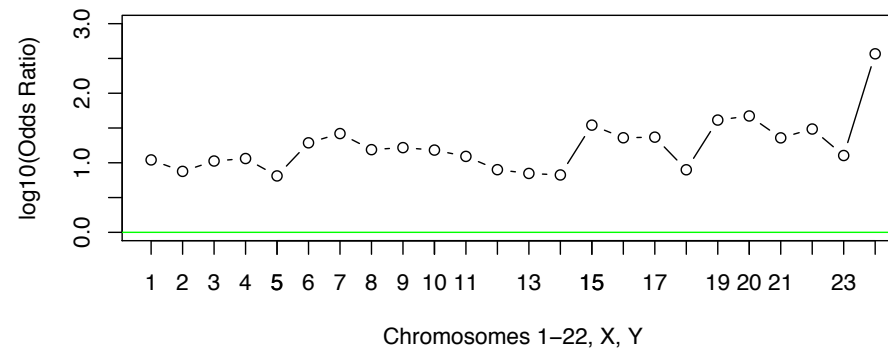


Chimp, PSSD, import



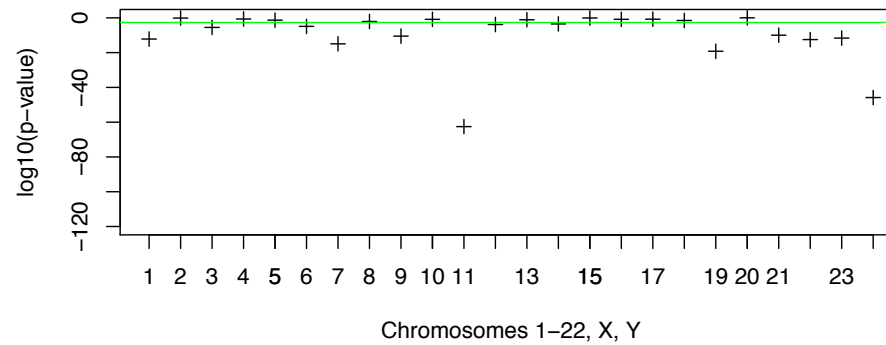
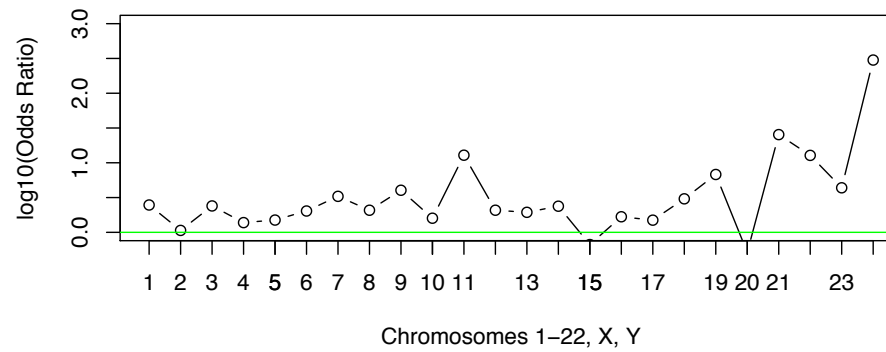
Chimp, DUP

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosom



Chimp, PSSD

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosom



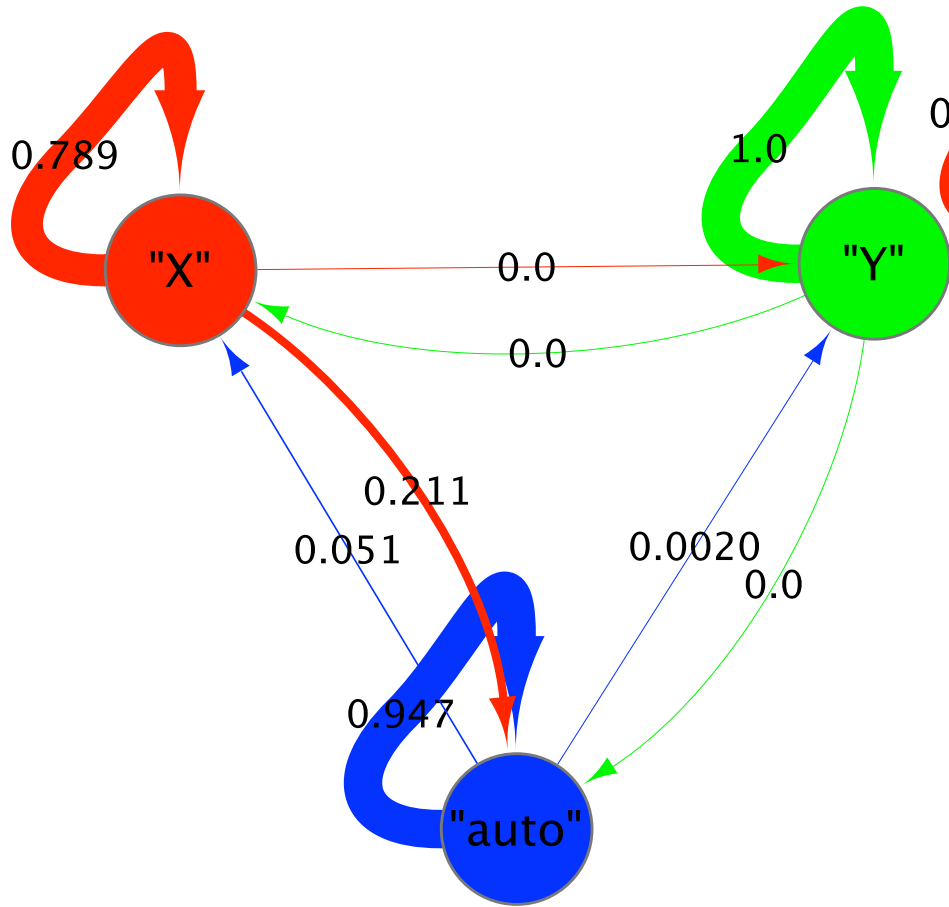
Observations from Chimp

- For most autosomes,
 - DUP: Significant co-residence
 - PSSD: No co-residence
- For sex chromosomes,
 - DUP: Significant co-residence
 - PSSD: Weaker co-residence, but still significant (see the loops from/to the same node)
 - We observe X as importer and exporter in both DUP and PSSD. Although in DUP the flow is smaller.

Mouse

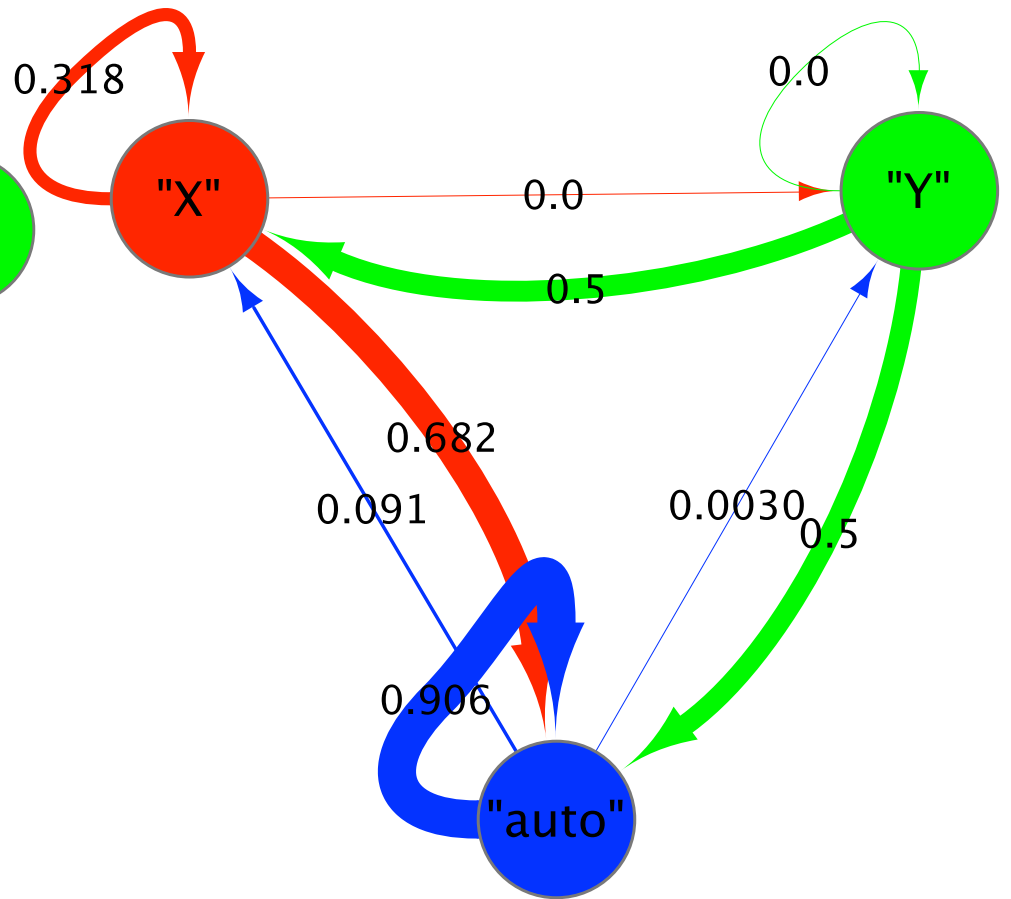
DUP vs. PSSD

Mouse, DUP, export



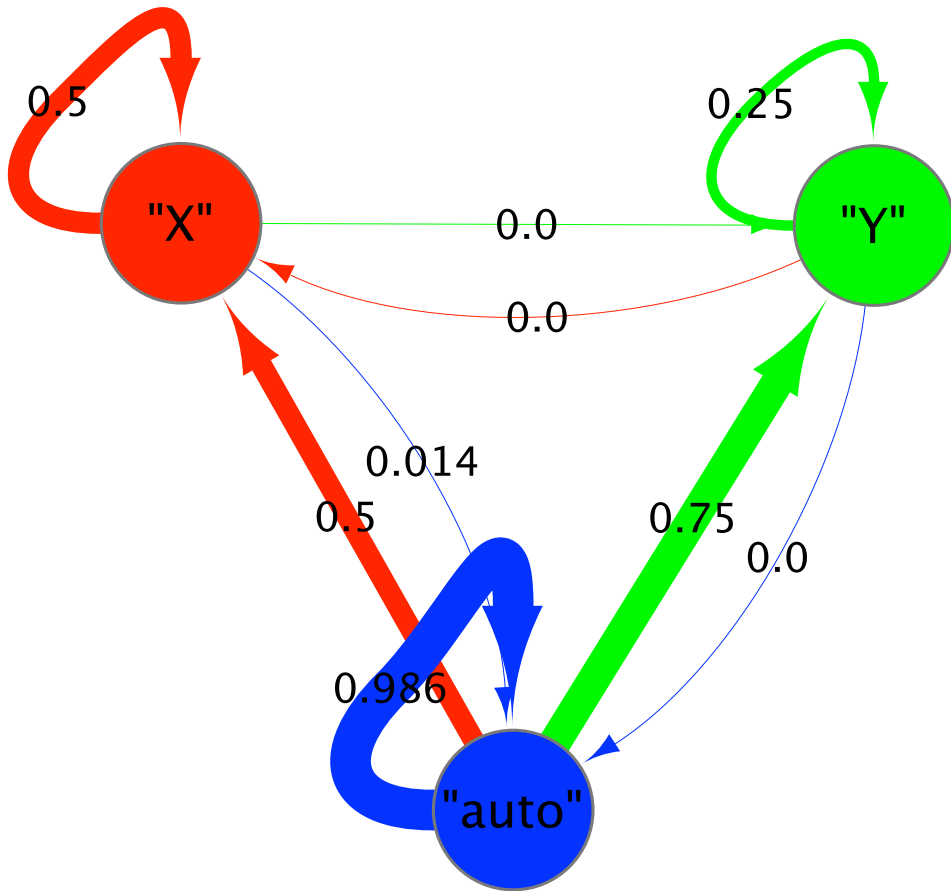
DUP: Strong co-residence

Mouse, PSSD, export

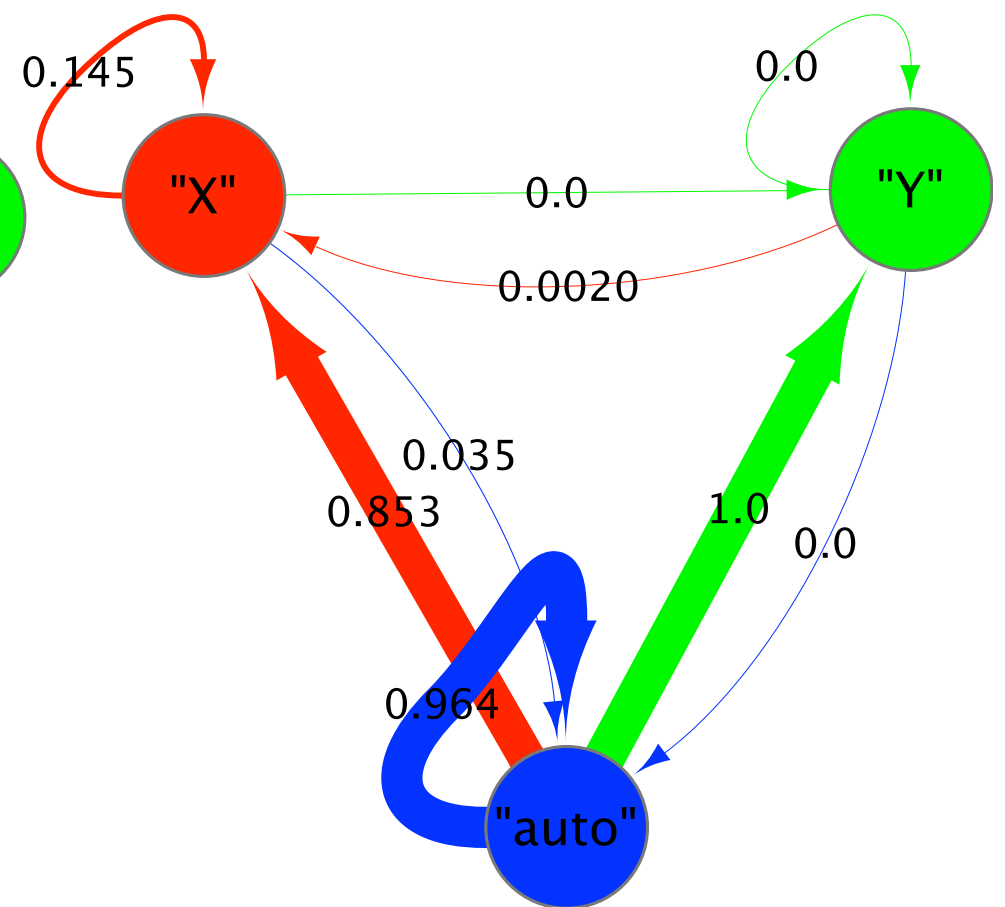


PSSD: X and Y weaker co-residence

Mouse, DUP, import

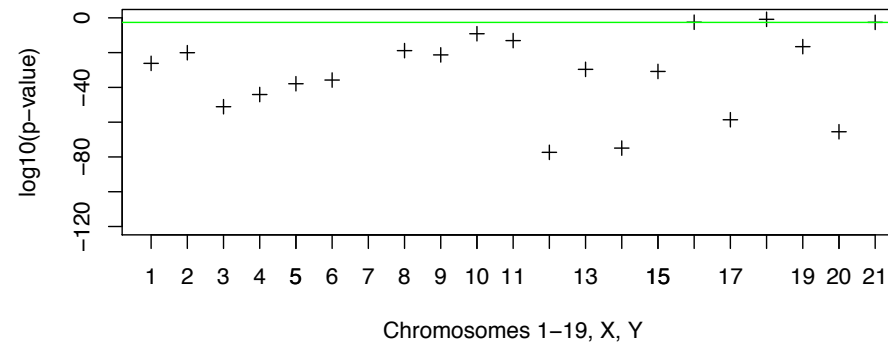
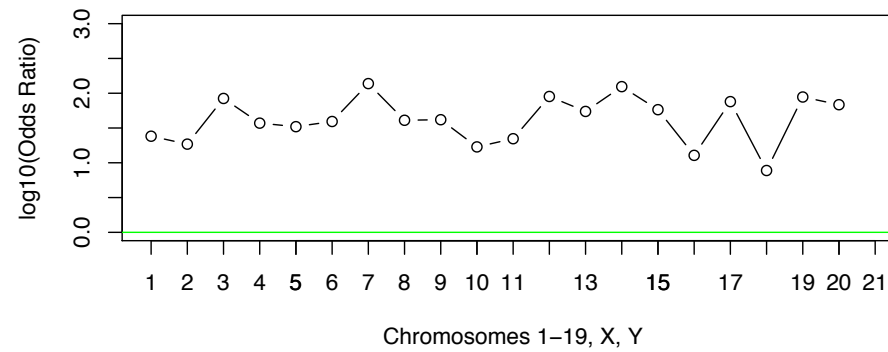


Mouse, PSSD, import



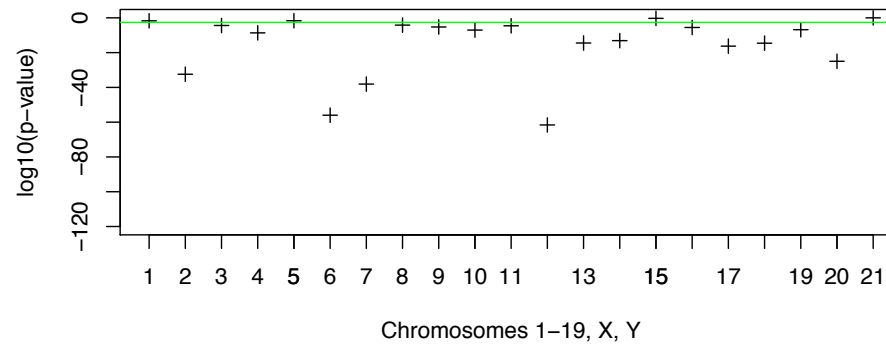
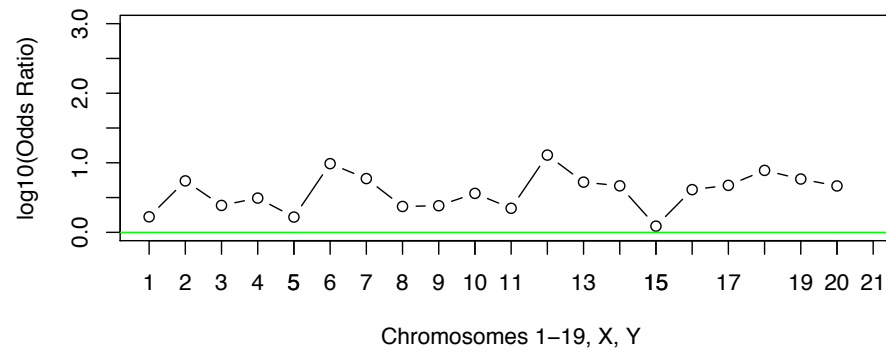
Mouse, DUP

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosom



Mouse, PSSD

Fisher's Exact Test: Co-residence is Random or Not for Each Chromosome



3. Excluding co-residing pgene-parent pairs, Linear regression results

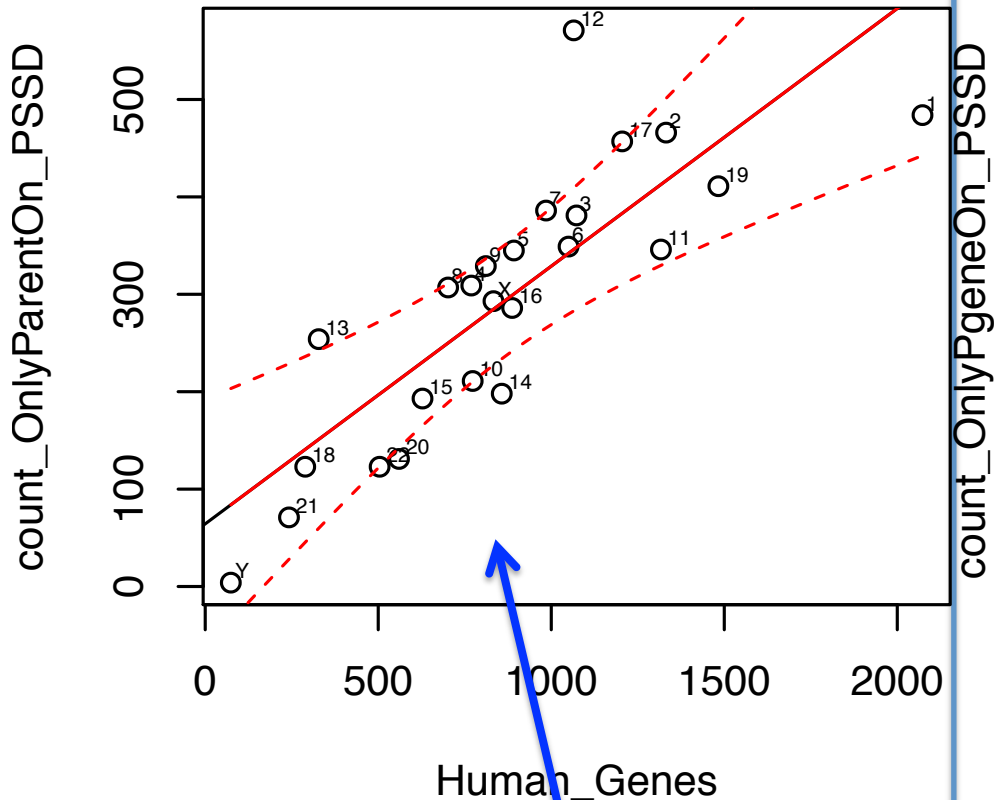
Human vs. Chimp vs. Mouse

Human

Update w/ latest genomedata from ensembl

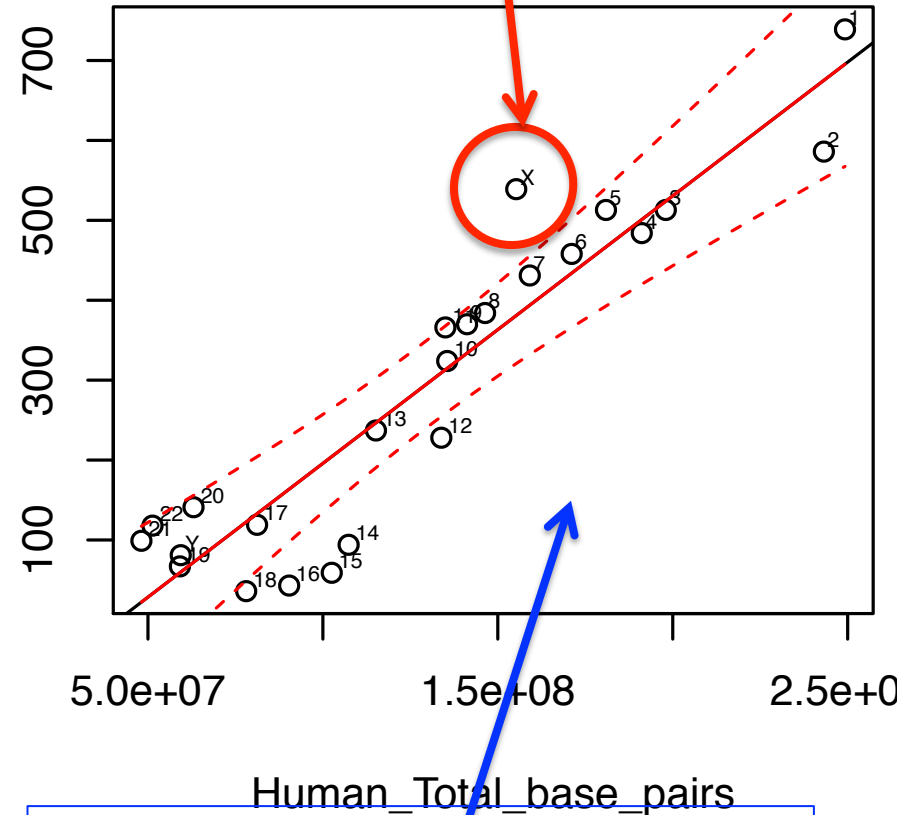
Human (PSSD)

X is not a significant exporter (not the same as in terms of flow percentage)



Generalization of retroposition from a parent gene is random (except Chr 12, 14, 20).

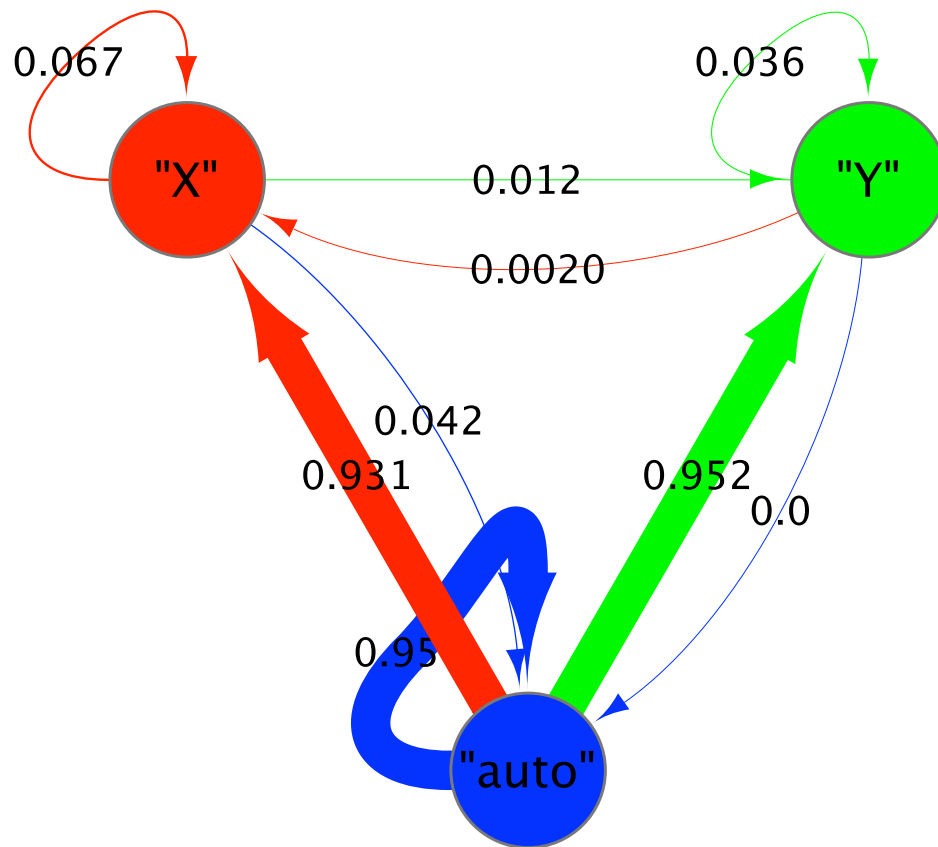
X is an importer for PSSD



Retroposition into X tends to be fixed.

Human (PSSD) explanation

Human, PSSD, import

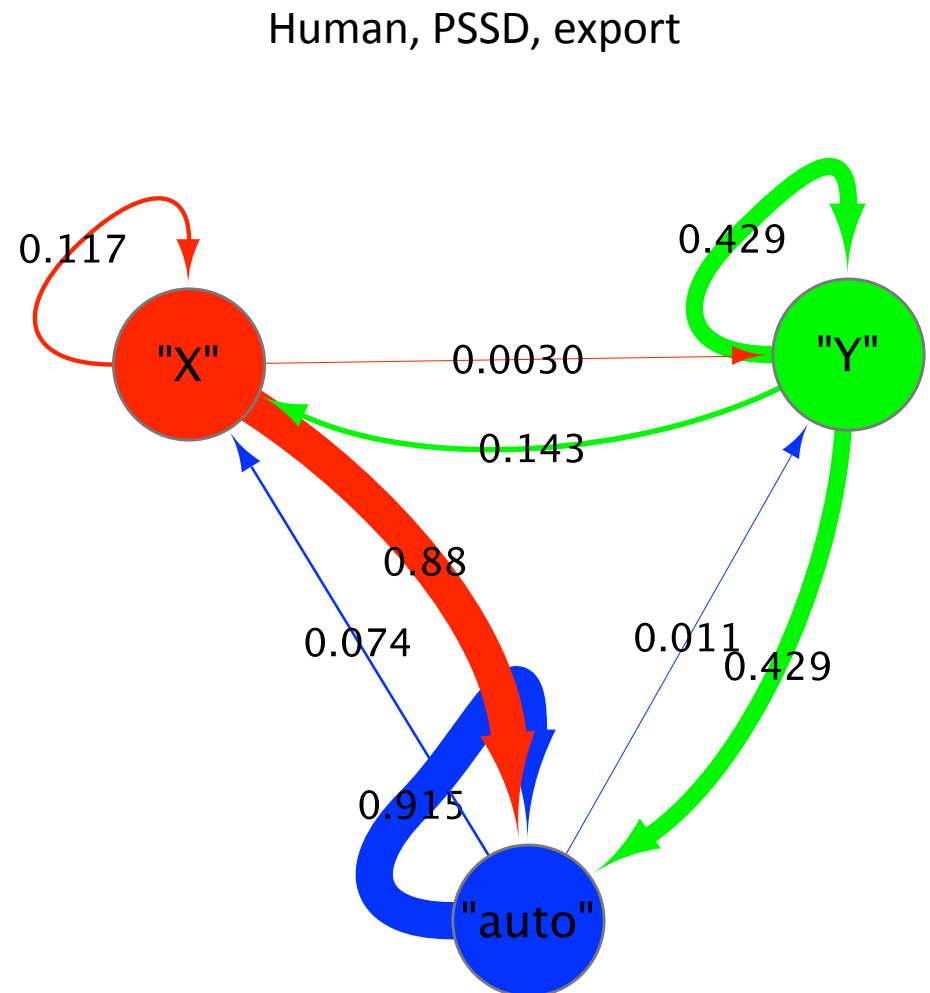


- PSSDs do not have significant co-residence tendency.
- Y has a large import flow from autosomes, so as X.

Human (PSSD) explanation

- X is not an significant exporter (not the same as in terms of flow percentage).

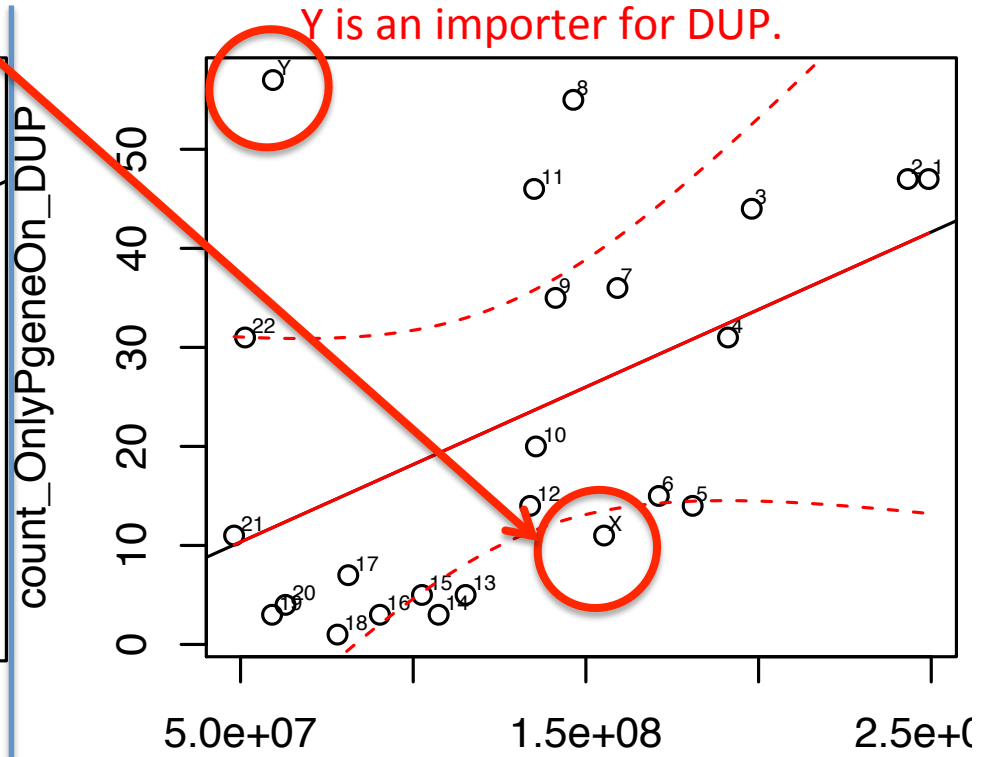
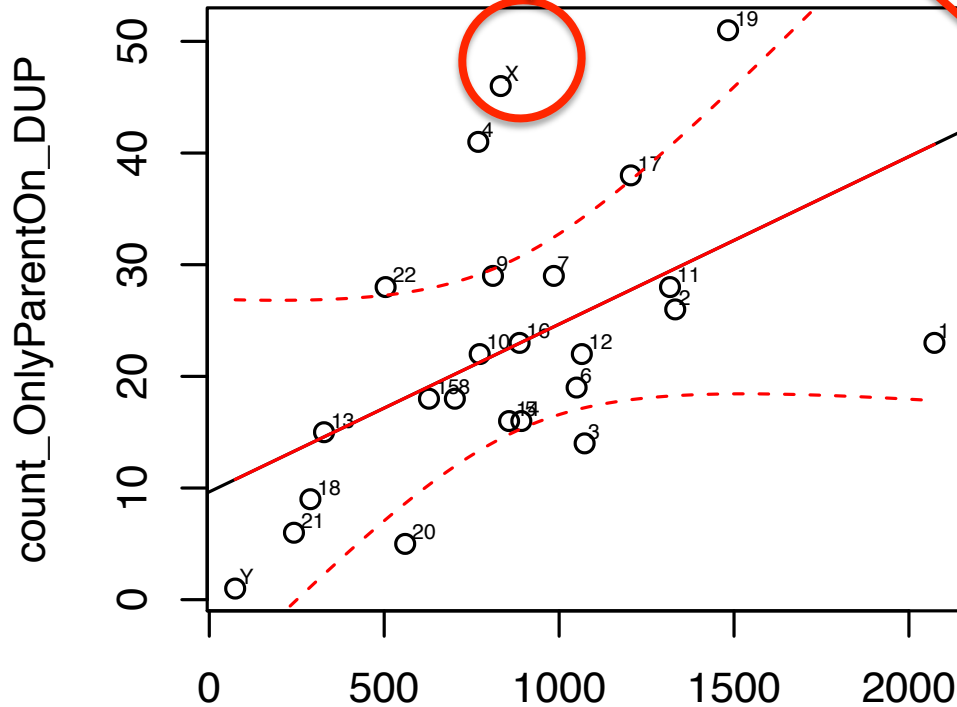
- The reason might be:
Other chromosomes export large flows as well. (The flow from Y to autosomes is not too small. It is about the same as “Y’s self-contribution”.)



Update w/ latest genomedata from ensembl

Human (DUP)

For DUP, X is an exporter, but not an importer.

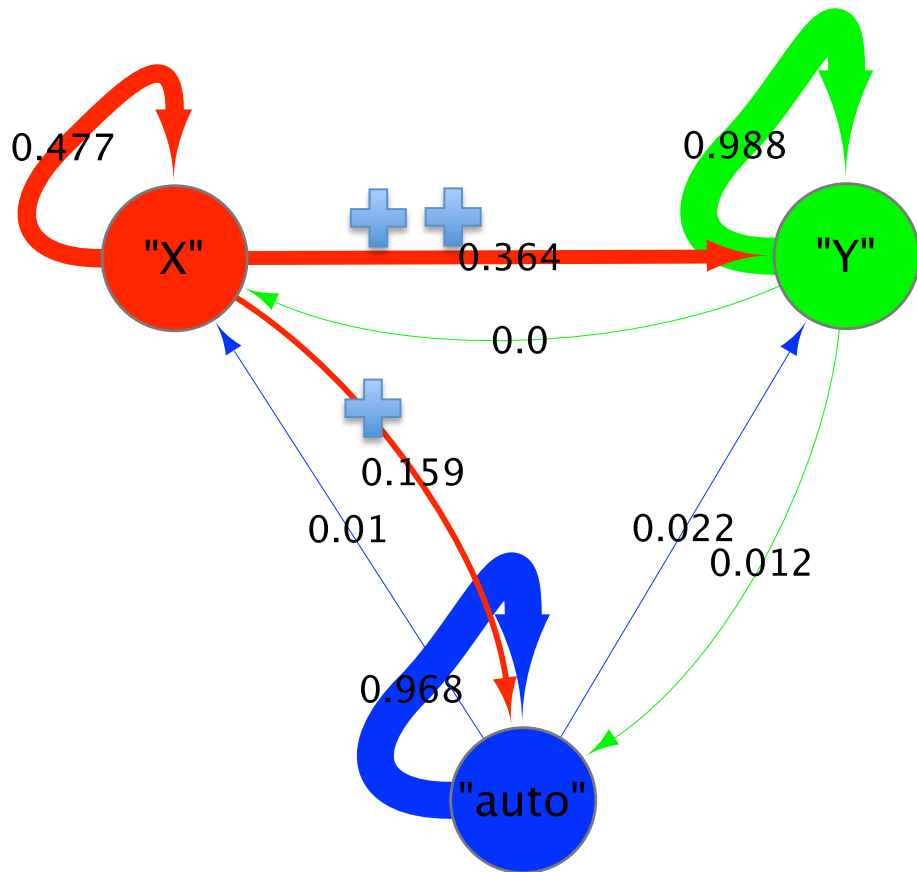


My explanation:

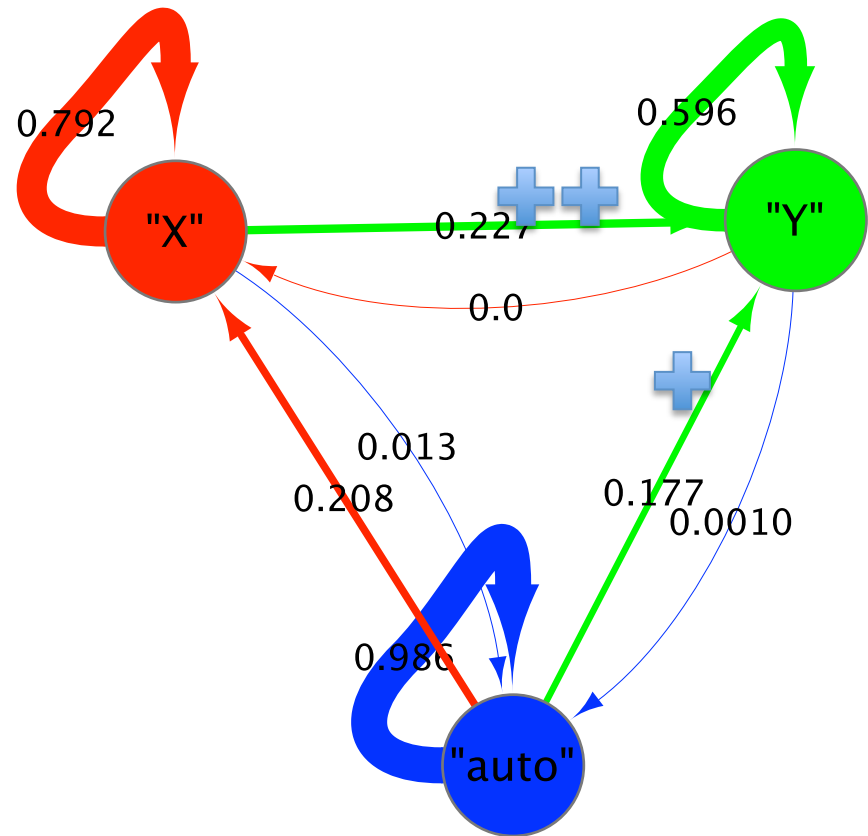
- X exports a large flow to Y, and Y imports a large flow from X. These flows are larger than the flows with all autosomes. (see triangle plots)
- These DUPs on Y might come from recombination between X pairs, and the degradation from X to Y fixed the DUPs on Y. (Age of the DUPs older than Y?) They might also comes from recombination between X and Y, after DUPs appeared X. (Age of DUPs can be younger than Y)

Human (DUP) explanation

Human, DUP, export



Human, DUP, import



Human (DUP) explanation



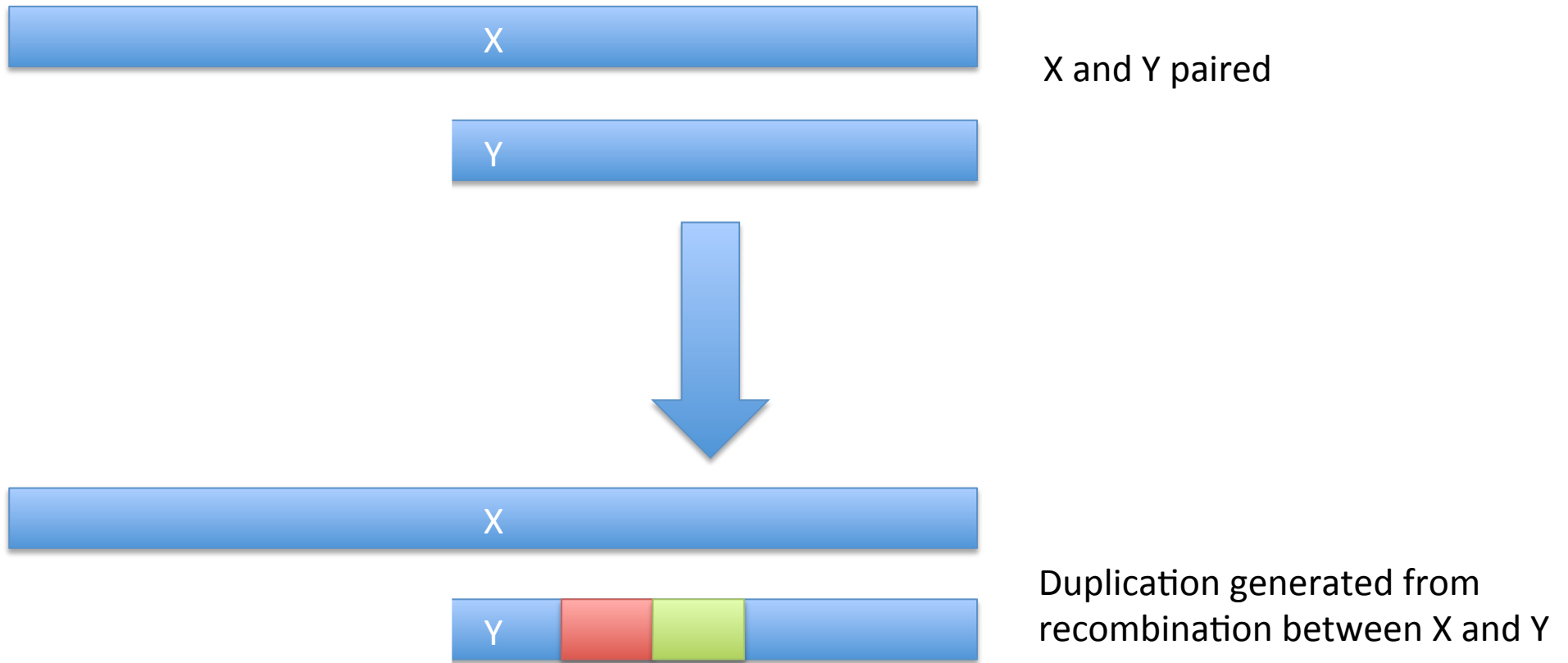
Duplication generated from
Recombination between X pairs



X lost DNA,
turned into Y

Age of the DUPs older than Y

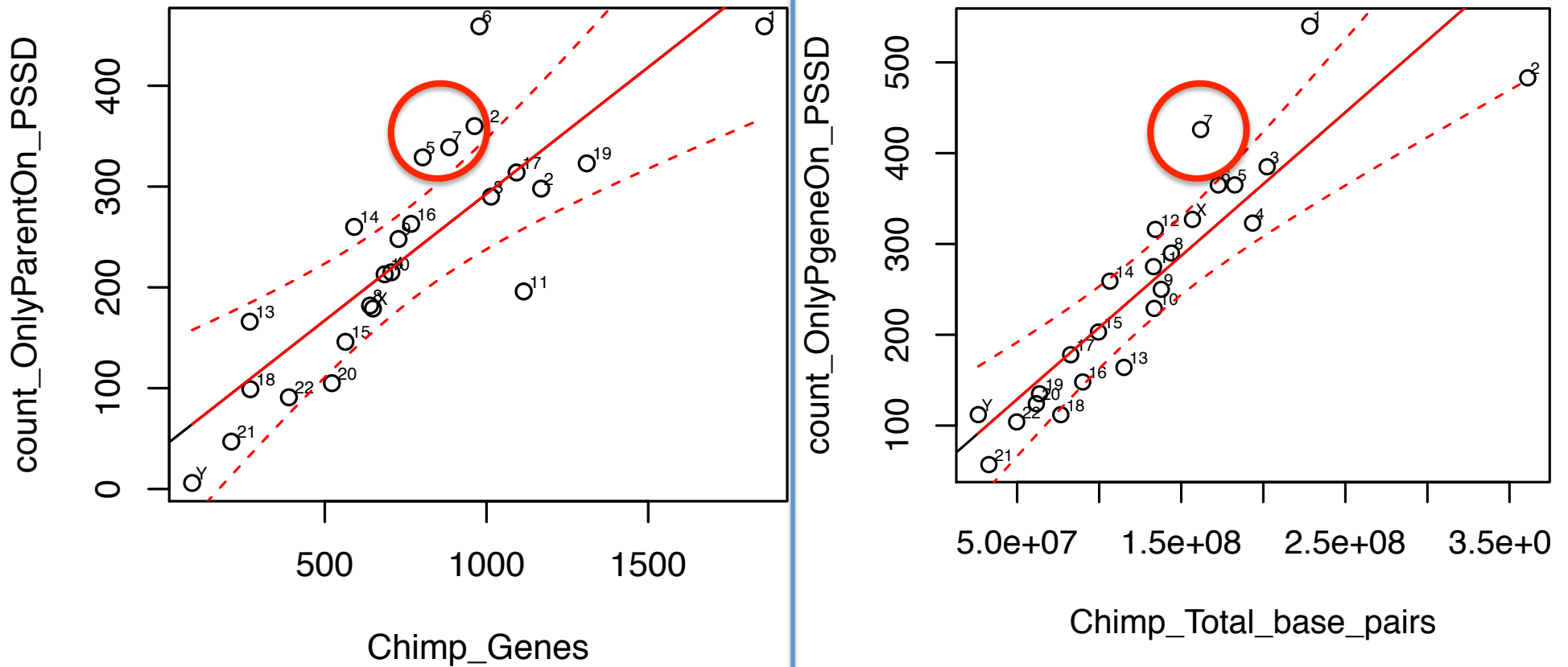
Human (DUP) explanation



Age of DUPs can be younger than Y, or older than Y (a whole DUP section from X).
Specific region on Y that can pair with X?

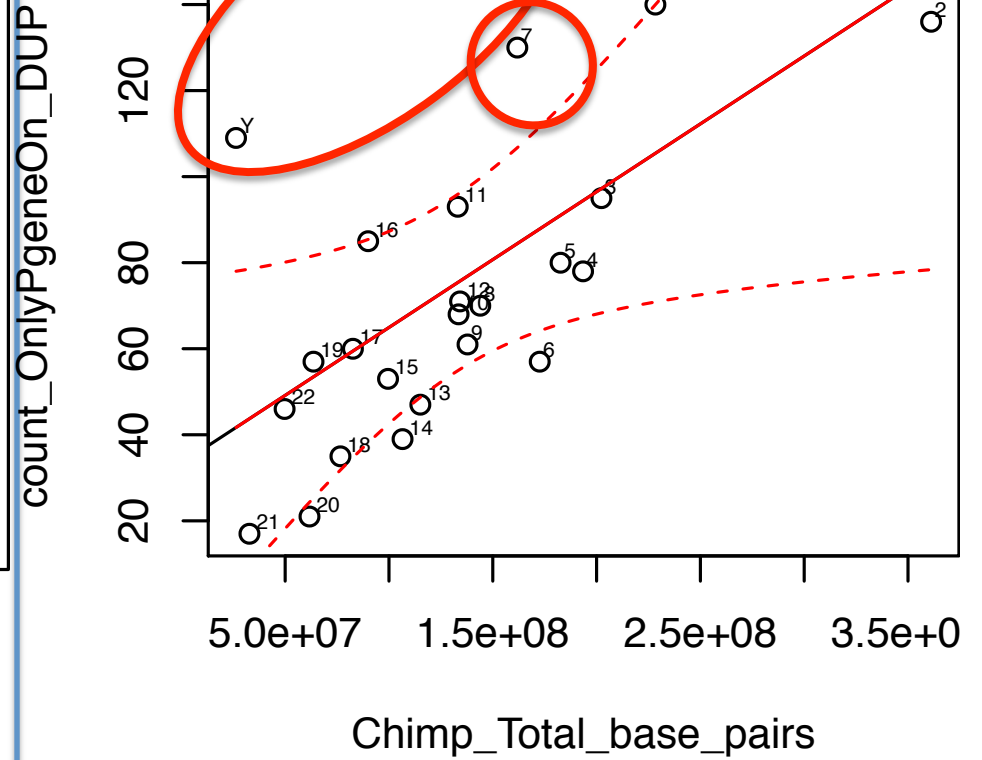
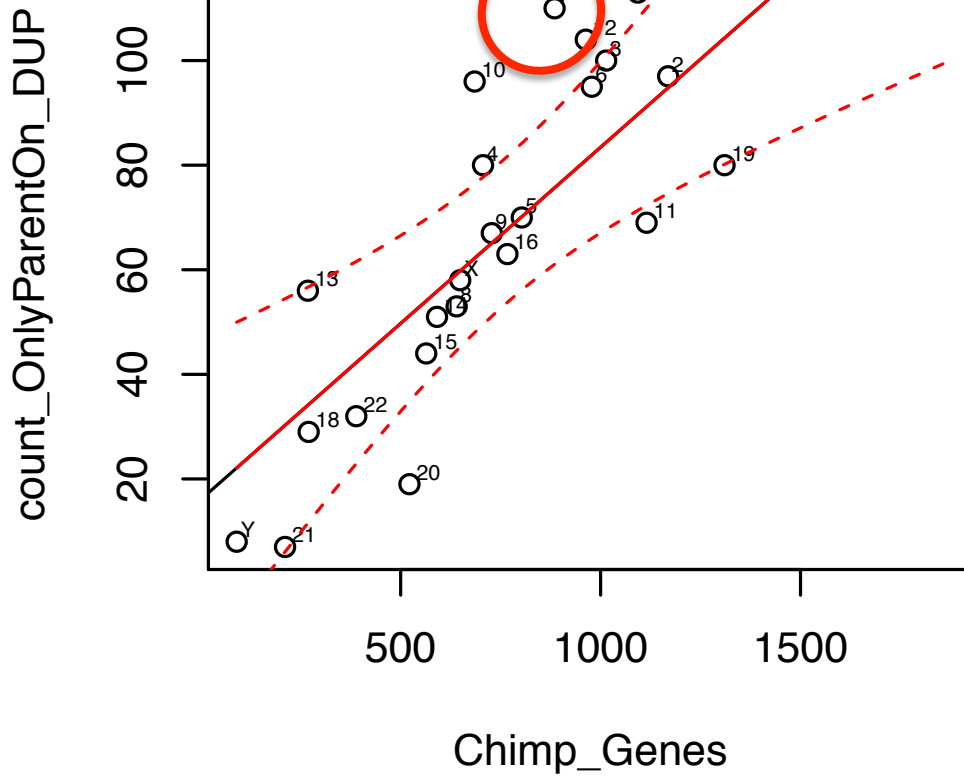
Chimp

Chimp (PSSD)



Chr 7 is a strong importer and exporter for both PSSD and DUP.

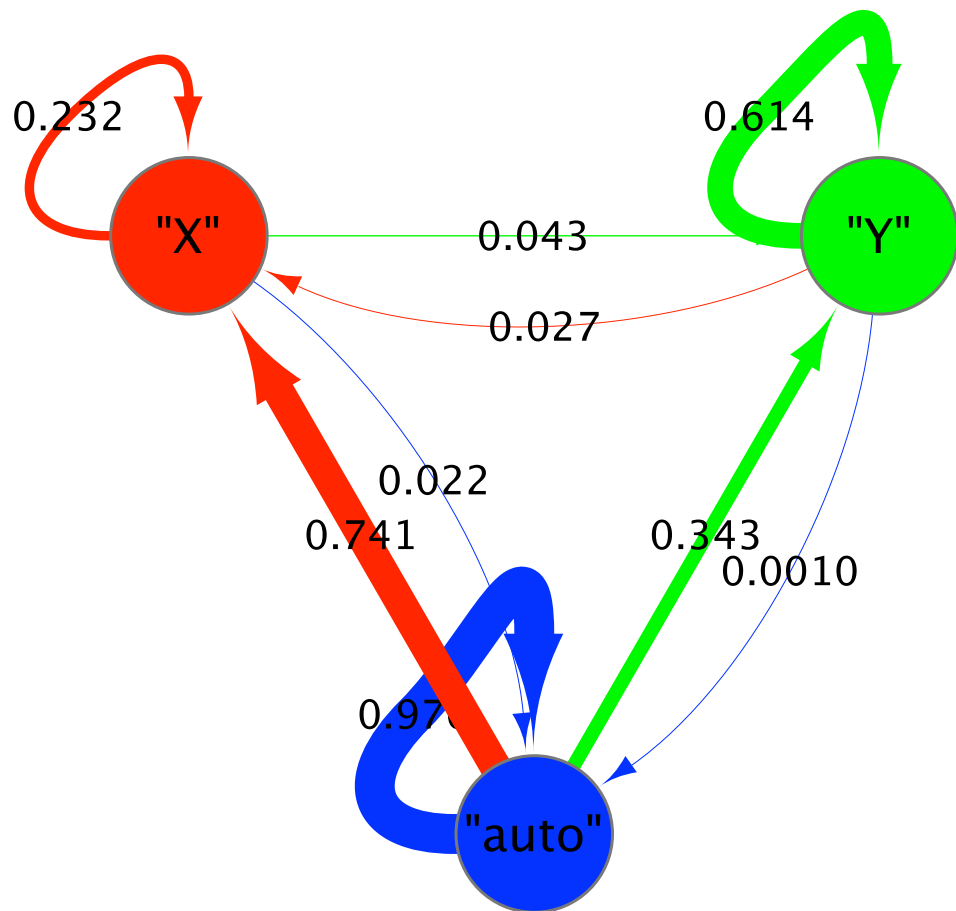
Chimp (DUP)



X, Y are both importers of DUP

Chimp (DUP) explanation

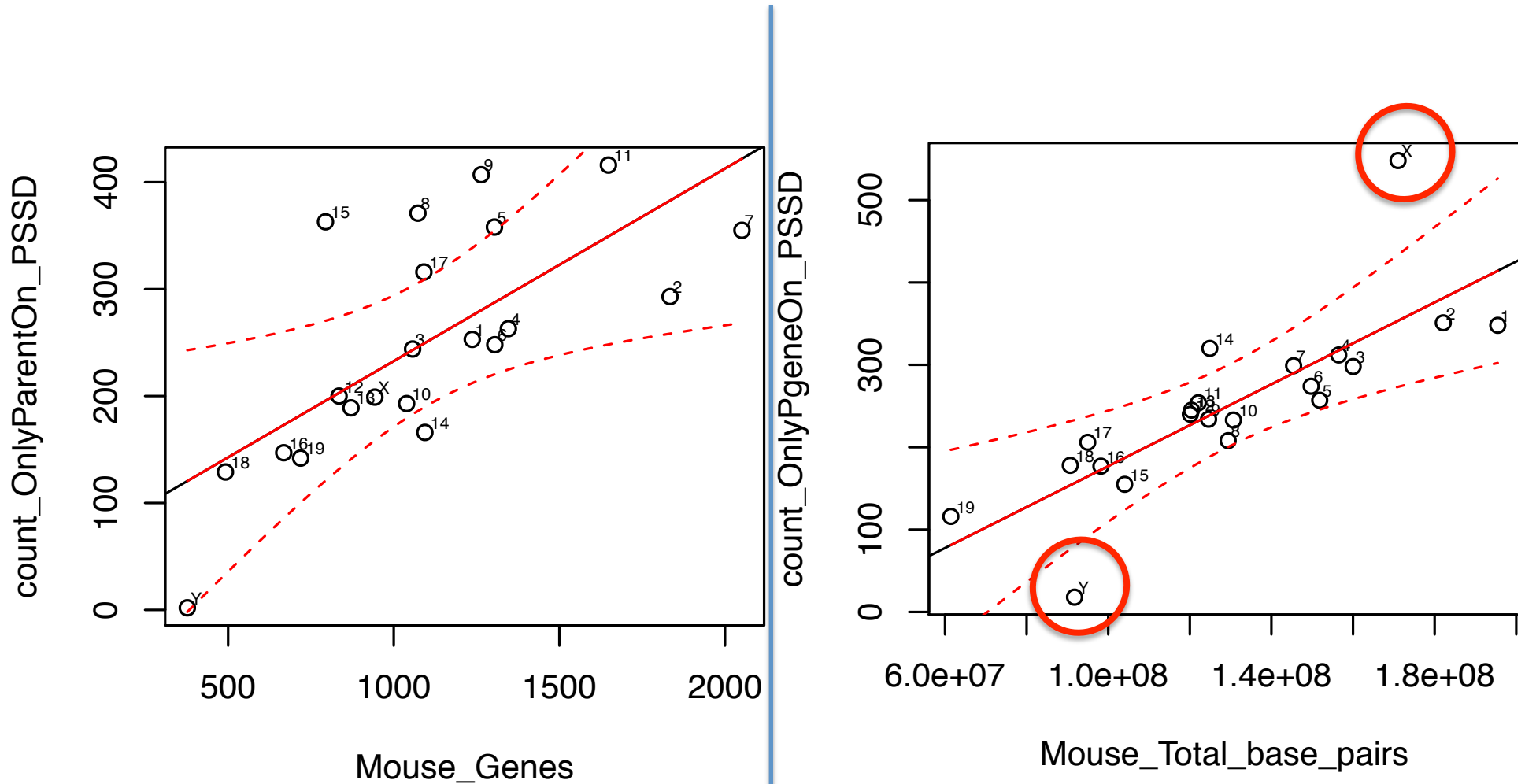
Chimp, DUP, import



- Unlike human, a lot of DUPs on Chimp X and Y came from autosomes.

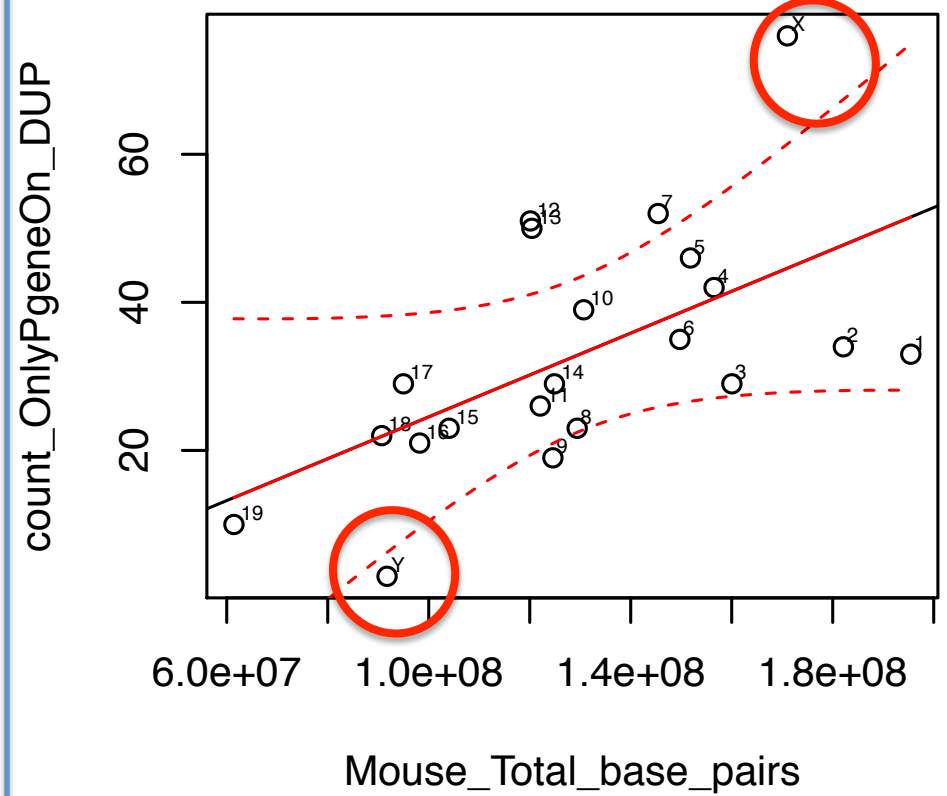
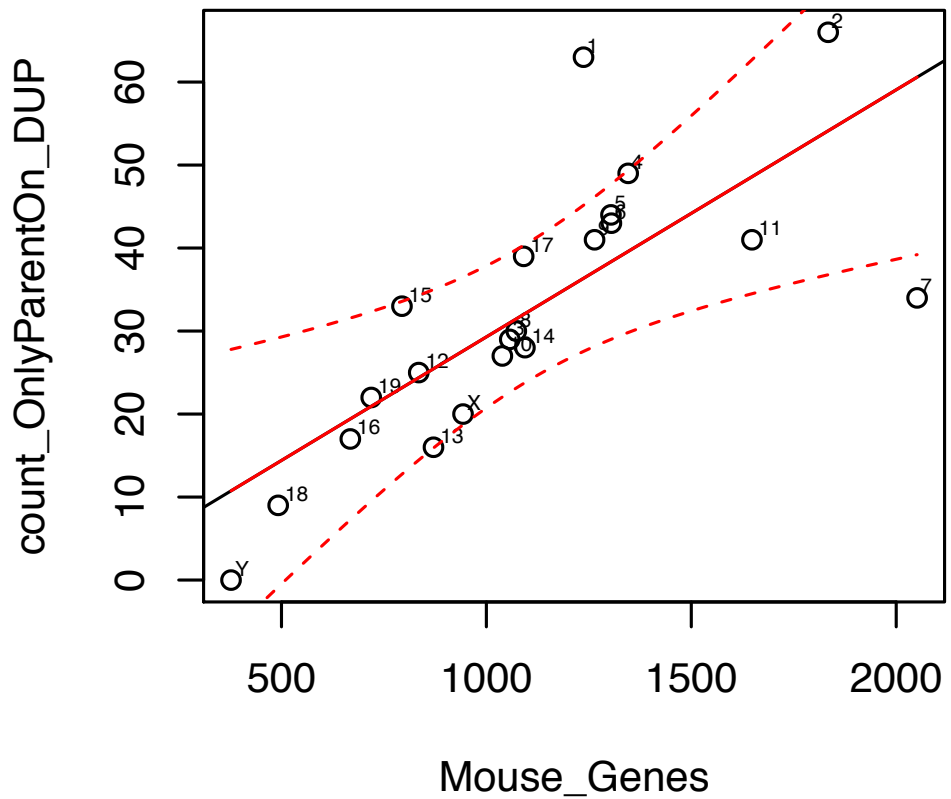
Mouse

Mouse (PSSD)



X is a strong importer; Y is a weak importer.

Mouse (DUP)



X is a strong importer; Y is a weak importer.