Supplemental Material

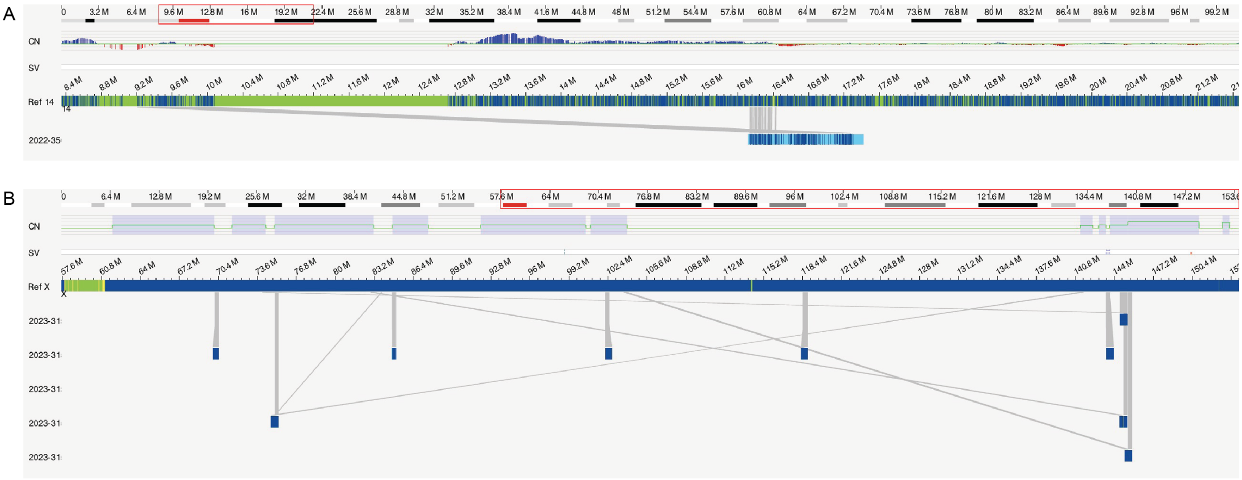
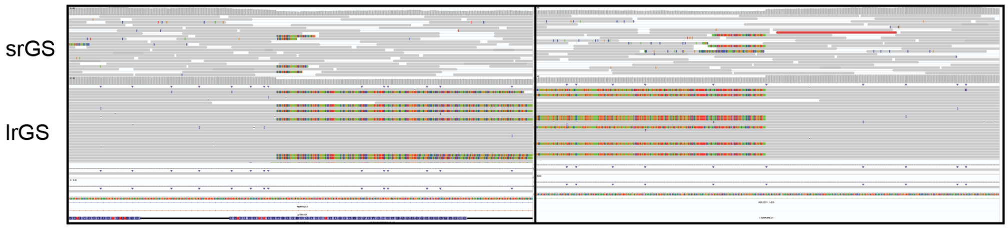


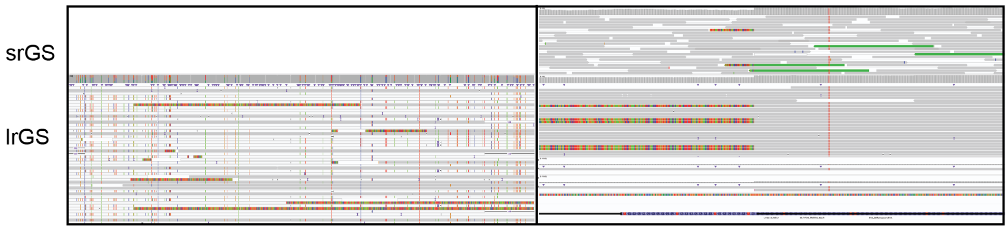
Figure S1: Optical genome mapping of two small supernumerary marker chromosomes (sSMCs) A) r(14) carried by RD_P550 and **B)** der(X) carried by RD_P586. On top, a schematic of the respective chromosomes are shown with a red frame around the zoomed in region. Below, a copy number track (CN) illustrates the gains across the chromosomes. At the bottom, a zoom in of the region from 8.4 Mbp to 21.6 Mbp for Chromosome 14 and 58 Mbp to 154 Mbp for chromosome X, respectively. Maps are shown in blue and grey lines indicate alignments to different parts of the chromosome according to genome build T2T-CHM13v2.0.

Junction 1



```
Chr 5:(+) 37676103   TTCTATGTAACAAACCACCTTAAACTTAGTGATTTAAAAGAATAGCCAGTATAATTTTTCTCATGACTATA
                     ||||||||||||||||||||||||||||||||||||||||||
                     TTCTATGTAACAAACCACCTTAAACTTAGTGATTTAAAAGAAACGACCAGTACTGCCACGGAAAAGAATCC
                                                            ||||||||||||||||||||||||||||||||
Chr 5:(+) 43290183   CCAGCCGGCACAGTGCGAGTGAGAAACCGGCCACTCCATGAAACGACCAGTACTGCCACGGAAAAGAATCC
```

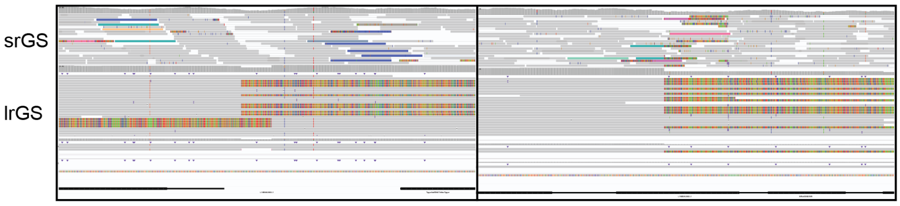
Junction 2



```
Chr 5:(+) 49497791   GTGGATATTCAGACCTCTTTGAGGCCTTCGTTGGAAACGGGTTTTTTTCATATAAGGCTAGACAGAAGAATTCCCAGTAAC
                     ||||||||||||||||||||||||||||||||||||||||||
                     GTGGATATTCAGACCTCTTTGAGGCCTTCGTTGGAAACGGGTGTGGGGCTGTAGACCAGGTTTCTGGCTCACTGTTCAAAT
                                                            ||||||||||||||||||||||||||||||||||||||||||
Chr 5:(+) 32320809   TCTGGCTCCAGATCTCTTACAAAACGGCAGTCAAGGTTTGGTGTGGGGCTGTAGACCAGGTTTCTGGCTCACTGTTCAAAT
```

Figure S2: Breakpoint junction sequences of r(5) (RD_P276): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

Junction 1

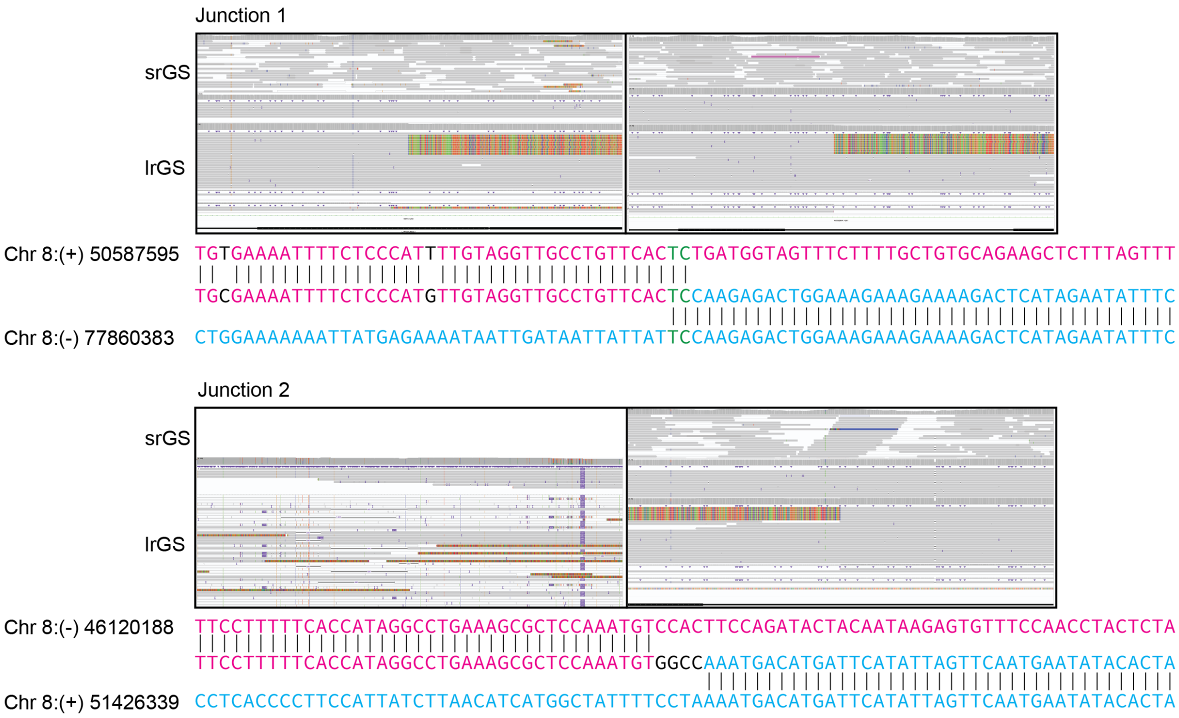


```
Chr 7:(-) 59987274  TGGTATATGGATCACTTGTTTCTGTTGAGTTA....................CAGATTCAGCTGGCTATTTCTCCCAATGTTAG
                                                                    ||||||||||||||||||||||||||||||||
                    GTTCAACATAGTGAAACCCCGTCTCTACTAAATCTTAGCAACCTCAAATAGCCAGATTCAGCTGGCTATTTCTCCCAATGTTAG
                    ||||||||||||||||||||||||||||||||
Chr 7:(+) 72094570  GTTCAACATAGTGAAACCCCGTCTCTACTAAA....................AATACAAAACTCAGCCGGGAGTGGTGGCGGGC
```

Junction 2

```
Chr 7:(+) 59978281  TGTAGACGGTACGCCTACAGTGGCTCATGGCAATGGTTGAGGTTGCTAAGATTTGGTGGAAGAAGGCAAAATGAAATGGCC
                    ||||||||||| ||||||||||||||||||||||||||||||||
                    TGTAGACGGTAGGCCTACAGTGGCTCATGGCAATGGTTGAGGTTAGCTAATTAAGAAATATTATTGTAATAGACATTAAAA
                                                             ||||||||||||||||||||||||||||||||||||||||
Chr 7:(-) 59987351  TAGTAAGTGCATATAAATAAATGTCTTAAAACTTCTCTTATGTTAGCTAATTAAGAAATATTATTGTAATAGACATTAAAA
```

Figure S3: Breakpoint junction sequences of r(7) (RD_P278): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

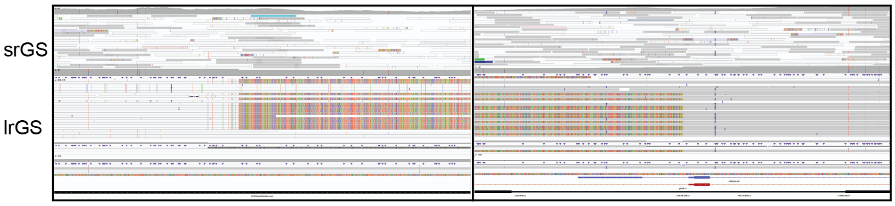


```
Chr 8:(+) 50587595  TGTGAAAATTTTCTCCCATTTTGTAGGTTGCCTGTTCACTCTGATGGTAGTTTCTTTTGCTGTGCAGAAGCTCTTTAGTTT
                    || |||||||||||||||| |||||||||||||||||||||
                    TGCGAAAATTTTCTCCCATGTTGTAGGTTGCCTGTTCACTCCAAGAGACTGGAAAGAAAGAAAAGACTCATAGAATATTTC
                                                           ||||||||||||||||||||||||||||||||||||||||||
Chr 8:(-) 77860383  CTGGAAAAAAATTATGAGAAAATAATTGATAATTATTATTCCAAGAGACTGGAAAGAAAGAAAAGACTCATAGAATATTTC
```

```
Chr 8:(-) 46120188  TTCCTTTTTCACCATAGGCCTGAAAGCGCTCCAAATGTCCACTTCCAGATACTACAATAAGAGTGTTTCCAACCTACTCTA
                    ||||||||||||||||||||||||||||||||||||||
                    TTCCTTTTTCACCATAGGCCTGAAAGCGCTCCAAATGTGGCCAAATGACATGATTCATATTAGTTCAATGAATATACACTA
                                                              |||||||||||||||||||||||||||||||||||||||
Chr 8:(+) 51426339  CCTCACCCCTTCCATTATCTTAACATCATGGCTATTTTCCTAAAATGACATGATTCATATTAGTTCAATGAATATACACTA
```

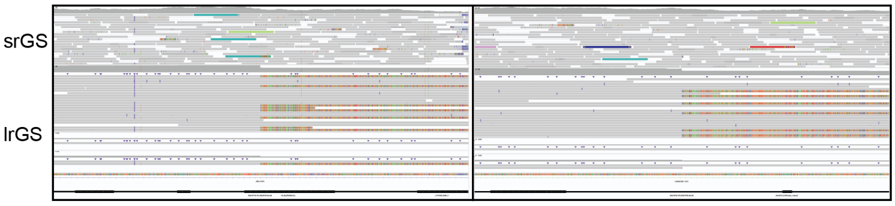
Figure S4: Breakpoint junction sequences of r(8) (RD_P273): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

Junction 1



```
Chr 13:(+) 11452840  GCTTCTGTCTAATTTTTATGTGAAGATATTTCCTTTTCCACCGTAGTCCTCAAAGCACTCCAATTGTACACTTGTAGAATCT
                     | |||||||||||| ||| ||||||||| ||||||||
                     GTTTCTGTCTAGTTCTTAAGTGAAGATACTTCCTTTT...42...TCTTGTTTTTCTCCCCAGCCCCTCCCGCCGATTGCTA
                                                                  ||||||||||||||||||||||||||||||||||||
Chr 13:(+) 56358138  TCCCCCTGCCTTGTCACCTCTGTCTTCCTAAATCCGTTCTTGCTCTCTTGTTTTTCTCCCCAGCCCCTCCCGCCGATTGCTC
```

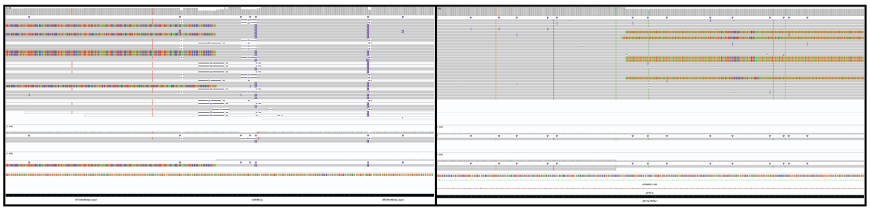
Junction 2



```
Chr 13:(-) 29045867  GATGGAGGTTGCAGTGAGTTGAGATCACACCATTGCACTCCAGCCTGGGCAACAGGAGCGAACTCCTTCTCAAAGAAAA
                                                            ||||||||||||||||||||||||||||||||||||||||
                     CATTTTTGTCTTTTATTACAACTTAAAACTTCCACTTGCCCAGCCTGGGCAACAGGAGCGAACTCCTTCTCAAAGAAAA
                     |||||||||||||||||||||||||||||||||||||||
Chr 13:(+) 84773620  CATTTTTGTCTTTTATTACAACTTAAAACTTCCACTTGCTATATTGAGATCAACTTGCTTCAAAATAGGAAGCTGGCAT
```

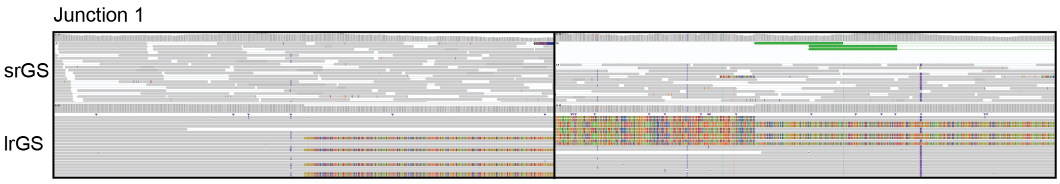
Figure S5: Breakpoint junction sequences of r(13) (RD_P166): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

Junction 1

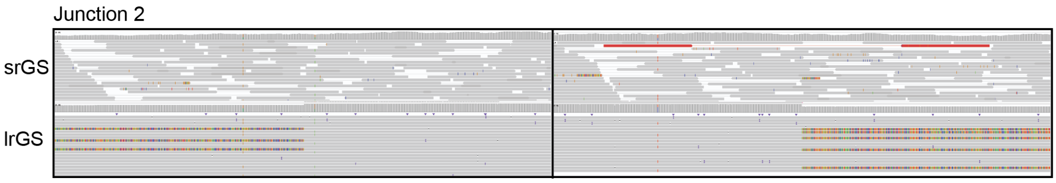


```
Chr 14:(+) 9208604  AATGGAATGGAATGGAATGGAATGGAATGGAAAGGAAATGAATGGAATGGAATGGAATGGAATGGAATGGAATGGAATG
                                                          |||||||||||||||||||||||||||||||||||||||||
                    GCCACCATCTTGGAAGTGGCCTGCCACCACTTTG.AAGTGAATGGAATGGAATGGAATGGAATGGAATGGAATGGAATG
                    ||||||||||||||||||||||||| |||||||| |||||
Chr 14:(+) 16434843 GCCACCATCTTGGAAGTGGCCTGCCGCCACTTTGGAAGTGGCCCACCACCATCTTGGGAGCTCTAGAAGCAAGGACCCC
```

Figure S6: Breakpoint junction sequences of r(14) (RD_P550): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.



```
Chr 20: (+) 4979434   ATCCATTAATACCCCCCC.AACAGGTCAGAGGAGCTTGCTAAAAAATCCTCTAGAAGAATAAGCAAGGGCCAGGCATGG
                      |||||||||||||||||| ||||||||||||||||
                      ATCCATTAATACCCCCCCCAACAGGTCAGAGGAGC..(205)..CAGGAGTTCAGTGTTCTGATCCTGGGGGCAATAGG
                                                                  |||||||||||||||||||||||||||||||||||
Chr 20:(+) 59369410   AAGAGCGGTCGGAGGGCCGGGTCTGGCTAACTGAGGGCTGAGTTCAGGAGTTCAGTGTTCTGATCCTGGGGGCAATAGG
```



```
Chr 20:(+) 24892355   AGGGAGGAGCAGGGCAACAGCCTGGCACAGCGAACCTCCAGCAGACTGAGGGGCACACGCTGTGGGGTGGCTGGGAGGA
                                                              |||||||||||||||||||||||||||||||||||||||
                      ACGGCCACGGCCCCAAAGGCGCCGCGCAGGGCCCGGCTAGGCAGACTGAGGGGCACACGCTGTGGGGTGGCTGGGAGGA
                      ||||||||||||||||||||||||||||||||||||||
Chr 20:(+) 65776662   ACGGCCACGGCCCCAAAGGCGCCGCGCAGGGCCCGGCTCCCAGAGGGGCCACTCGGGGTGACGAACCGGGGTGGGGGCG
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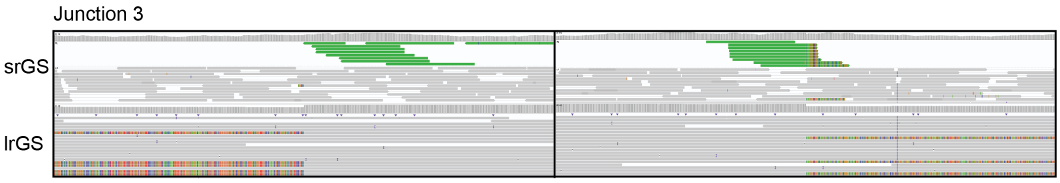
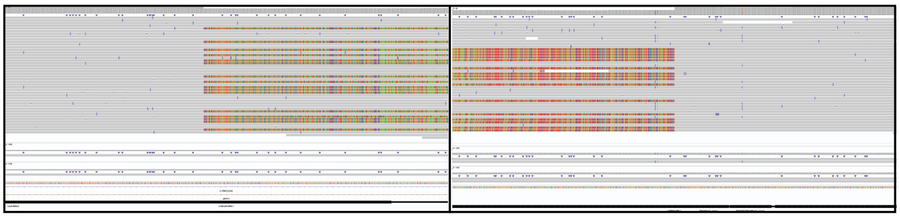


```
Chr 20:(+) 3306020    TGGAAAGCTTGATGCCAGAATCCCATGCCCTGGTGCAGCCACAGAAAGTAGGGCCTCTGGAAACTGAGTAAGGCAAAGT
                                                           ||||||||||||||||||||||||||||||||||||||||||
                      ATGGTCAACGCAATATCAGGTTTTCCCCTGTGTCCATGCCACAGAAAGTAGGGCCTCTGGAAACTGAGTAAGGCAAAGT
                      |||||||||||||||||||||||||||||||||||||||||
Chr 20:(+) 42368945   ATGGTCAACGCAATATCAGGTTTTCCCCTGTGTCCATGCCAGGATCCTGCTCCTCTGTGCCCCCAACAAAGGGGTCATC
```

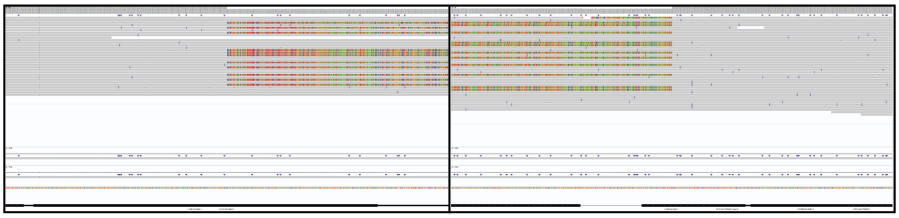
Figure S7: Breakpoint junction sequences of r(20) (RD_P275): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

Junction 1



```
Chr X:(+) 103977823   TCTAGTTAGTAAAGCTGTTAGATTTTCTTACTCACCTTGTGTCCAAGATGATCACTTCCACTGACAACACGGTTGGCATG
                      |||||||||||||||||||||||||||||||||||||||||
                      TCTAGTTAGTAAAGCTGTTAGATTTTCTTACTCACCTTGTGACTTCATCAGTACCAGACCTGTTGCACAGGTATTTATATA
                                                              |||||||||||||||||||||||||||||||||||||||||
Chr X:(+) 145148123   GACGGAGAAATAAAGACTTTCCCAGAAAAACAAAAGCTGAGACTTCATCAGTACCAGACCTGTTGCACAGGTATTTATATA
```

Junction 2



```
Chr X:(+) 89566572    CAATCAGAGAATAGGAAAGAATATGTGATATATCAATACCATATATTACTATGCAGAAAAAATGAAAATGTAGATACATA
                      |||||||||||||||||||||||||||||||||||||||
                      CAATCAGAGAATAGGAAAGAATATGTGATATATCAATACTCACAGTTCTGGGGGCTGGAAGTCCAAGATCAAGATGTCAG
                                                             |||||||||||||||||||||||||||||||||||||||||
Chr X:(+) 89651697    AAGACACGCTGTGTGGCTTCAACAATGGACATTTATTTTCTCACAGTTCTGGGGGCTGGAAGTCCAAGATCAAGATGTCAG
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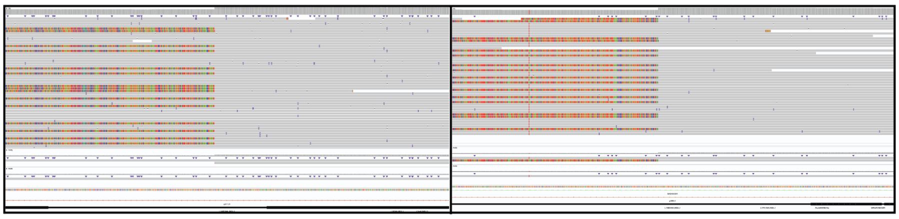
Junction 3



```
Chr X:(+) 66181028    TACCTTTTCCATATGCAGTGAAGCAGTACAAGTTAGTGCACCGCTTTGACAGAGGTGGCATCAGCAGGGCCCAGTGACAAT
                                                              |||||||||||||||||||||||||||||||||||||||||
                      TAGGACCTATTAACAAATAAAACCCCTTTAAGAATAATTTCCGCTTTGACAGAGGTGGCATCAGCAGGGCCCAGTGACAAT
                      ||||||||||||||||||||||||||||||||||||||||||
Chr X:(-) 84675390    TAGGACCTATTAACAAATAAAACCCCTTTAAGAATAATTTCCACATCTTAATGCAAAATAGTCAGTTATTAAAATGTATTA
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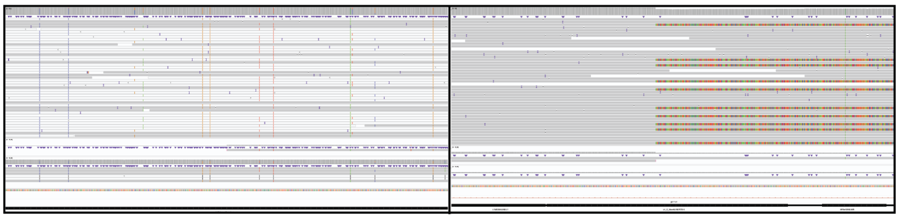
Junction 4



```
Chr X:(+) 58080098    AAGGCTTTCAGGCCTTTTCCACCACAGGCCTGAAAGCGCTCCAAATGTCCACTTGCAGATTCTGCCAAAAGAATATTTCAA
                                                              |||||||||||||||||||||||||||||||||||||||||
                      TCAACCCAGAATGTCTGATTACTCTCTCTACCTCTCTTCACCAAATGTCCACTTGCAGATTCTGCCAAAAGAATATTTCAA
                      ||||||||||||||||||||||||||||||||||||||||||
Chr X:(+) 66184481    TCAACCCAGAATGTCTGATTACTCTCTCTACCTCTCTTCACCTATAGATTTCAACTAAAATCTCCAGGAGTTTATCAAATC
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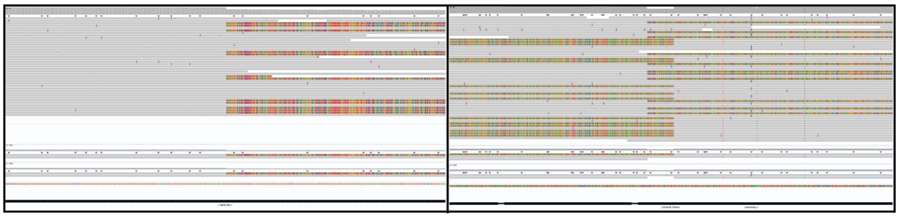
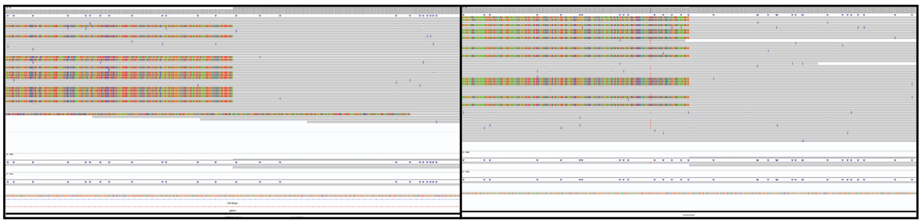
Junction 5



```
Chr X:(+) 74310915    CTGTGAAGAAAGTCAATGGTAGCTCAATGGGAATAGCATTGGATCTATAAATTGCTTTGGGCAGTATGGCCATTTTCACAA
                      ||||||||||||||||||||||||||||||||||||||||
                      CTGTGAAGAAAGTCAATGGTAGCTCAATGGGAATAGCATTTAACTATGACAGGTGGTGTGAGGGGCTGAGCTATCTGCTGA
                                                                |||||||||||||||||||||||||||||||||||||||
Chr X:(-) 144762602   CATATGGCCATAGGTGTGCAATAAATGTGGAAACCTGAAACAACTATGACAGGTGGTGTGAGGGGCTGAGCTATCTGCTGA
```

Image continues on next page.

Junction 6



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Chr X:(+) 83792179  GGTATGATTTCAGTTCTCTTGCAGTTCCTGAAGATTGTTTTATATCTGATTGTTTGGTGGATTTTAGAGTATGTGCTACG
                                                                 |||||||||||||||||||||||||||||||||||
                    CTAAGAAATAAGATTATTTTGATGGTGACATTCAA...(37)...CTGATTGTTTGGTGGATTTTAGAGTATGTGCTACG
                    |||||||||||||||||||||||||||||||||||
Chr X:(-) 141163862 CTAAGAAATAAGATTATTTTGATGGTGACATTCAAAATAATGCAGGTTATTTTAAAATCGAATAATGCAAAAAGGTGCTG
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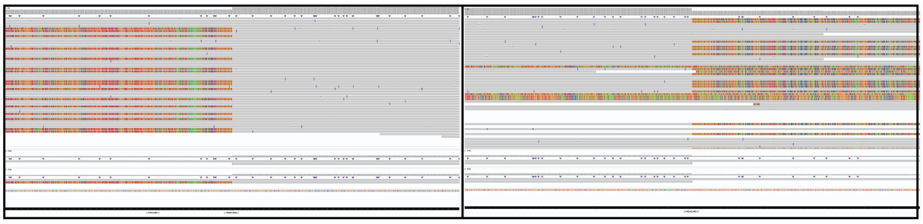
Junction 7



```
Chr X:(+) 75059486  AAGTTGTGTGGACTGAAAGCCATGCTTGCTTTCTCAACAGGGAAGAATATGGCT.GGGGTCAGATCTGAGTTCTCTGCAC
                                                                 ||||||||| |||||||||||||||||||||||||
                    TCTACACCTTAACTTCATCCCCTTGCTTTTTAACT...(29)...AATATGGCTGGGGGTCAGATCTGAGTTCTCTGCAC
                    |||||||||||||||||||||||||||||||||||
Chr X:(+) 83829717  TCTACACCTTAACTTCATCCCCTTGCTTTTTAACTTTTTGTTGTCTCTATTTCTATCTTATTGTATGGATTATGTCTTGA
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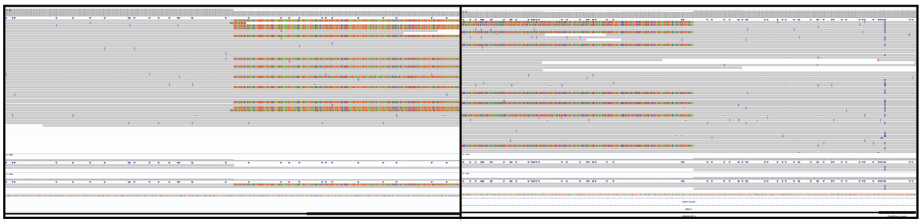
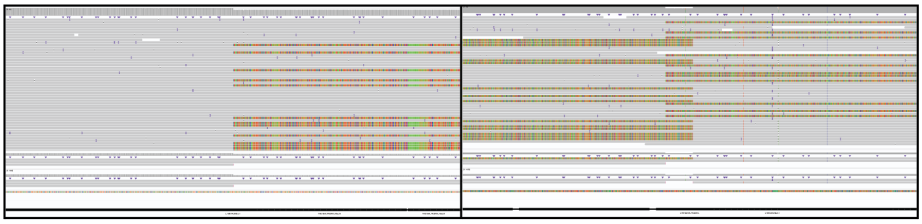
Junction 8



```
Chr X:(+) 83190233  TTGGTAGAAATTATACAATTTTTAATGACCACAAATTTGGTGCTCACTTCAAAGTCTCTGCTGACTGCATGGACTCTGCT
                    |||||||||||||||||||||||||||||||||||
                    TTGGTAGAAATTATACAATTTTTAATGACCACAAA...(41)...ATTCACAGAGTAGTTTGCTACTGTGTGAGAGGCTA
                                                                 |||||||||||||||||||||||||||||||||||
Chr X:(+) 91038187  CTATATGACTGCATCACAATTTTCCTAGGGAAGAATTACTGTGATATTCACAGAGTAGTTTGCTACTGTGTGAGAGGCTA
```

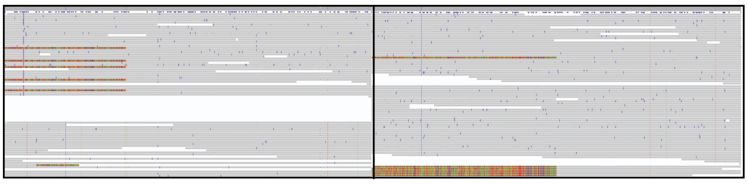
Junction 9



```
Chr X:(+) 91089607  ACAACACACACTAGGGCCTATCAAAAAGTGGAGGTTGGGAAGAGGGAGAAGATCAGGAAAAATAATAATTAATGGTGATA
                    |||||||||||||||||||||||||||||||||||
                    ACAACACACACTAGGGCCTATCAAAAAGTGGAGGT...(33)...AAGCCCAAAGGTGATGGTGGTTGCATTACAGCCAC
                                                                 |||||||||||||||||||||||||||||||||||
Chr X:(+) 144762724 AAGCCCAAGCCGTGTTACAAATGTATCAGCTTAGTTTTTGGGTGCAAGCCCAAAGGTGATGGTGGTTGCATTACAGCCAC
```

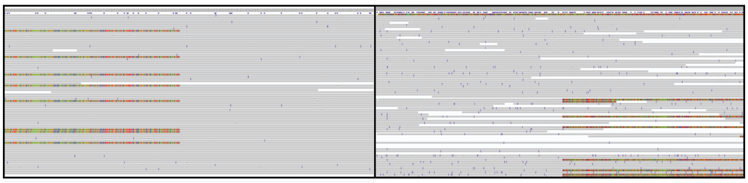
Figure S8: Breakpoint junction sequences of der(X) (RD_P586): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

Junction 1



```
Chr 9:(+) 30592557 TGTCTTTCCAGAATAAAAACACCCTGCAATTAAAGCATAGGAATGTAGTATATTATATAGAGTTTCATAATGATATTTTA
                                                                ||||||||||| |||||||||||||||||||||||
                   TCTCTGAAAGATTTTTTCCCCTACTTTTTTGCTTA...(28)...TAGTATATTATGTAGAGTTTCATAATGATATTTTA
                   |||||||||||||||||||||||||||||||||||
Chr 9:(-) 31050290 TCTCTGAAAGATTTTTTCCCCTACTTTTTTGCTTAGTTACCACTGTGTTTTACCTTGCTGTATCTCTTGTATTCCTTAAT
```

Junction 2



```
Chr 9:(+) 28144043 TTTGGGATCCTATTAGACATTCATGTAGAGCTGTCAATTAGAAGGATGATATATGAGCTCTGGAAAAAAGTCTGGACTAG
                                                                |||||||||||||||||||||||||||||||||||
                   AAATCTAGAAGAAATGGATAAATTCCTTGACACA...(224)...ATGATATATGAGCTCTGGAAAAAAGTCTGGACTAG
                   ||||||||||||||||||||||||||||||||||
Chr 9:(+) 31568556 AAATCTAGAAGAAATGGATAAATTCCTTGACACATACACTCTCCCAAGACTAAACCAGAAAGAAGTTGAATCTCTGAATA
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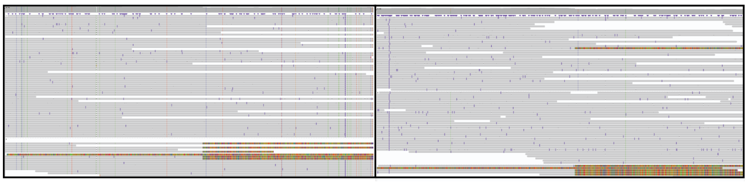
Junction 3



```
Chr 9:(+) 29574388 GTCTCCAGGGTTCAAACAATTCTCCTTCCTCAGCCTCCCAAGTAGCTGAGATTGCAGGGGCCCACCACCATGCCTGGC
                   ||||||||||||||||||||||||||||||||||||||||
                   GTCTCCAGGGTTCAAACAATTCTCCTTCCTCAGCCTCCCATAAAACCTGTAAGCCAAAAATAAAATTTGAAGACACCC
                                                        |||||||||||||||||||||||||||||||||||||||||
Chr 9:(-) 91194419 AAGGGTGTGACCAGGATGTGAGGTAGGATCCATGAAACCATAAAACCTGTAAGCCAAAAATAAAATTTGAAGACACCC
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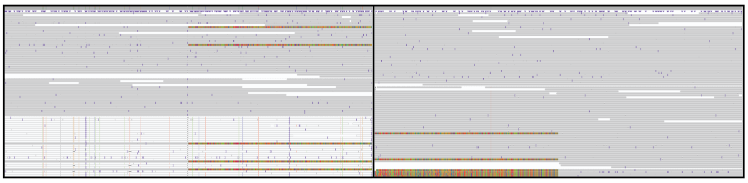
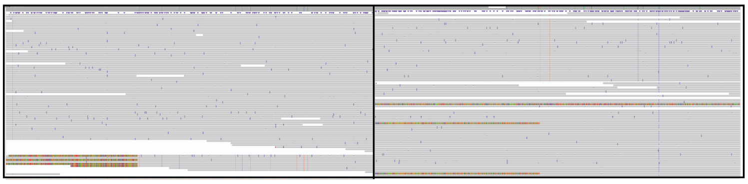
Junction 4



```
Chr 9:(+) 39306747 CAGCCTGGGTGAAAGAGCAAGACTCTGTCTCAAAAAAAAAAAAAAAAAAAAAAAAAAGAAAGAAACAAAGAAAGCATT
                   ||||||||||||||||||||||||||||||||||||||
                   CAGCCTGGGTGAAAGAGCAAGACTCTGTCTCAAAAAAATAGACTGCTGTATGCCTTAGTTTTCTATTTTGTTGAACTG
                                                         ||||||||||||||||||||||||||||||||||||||||
Chr 9:(+) 91060755 TCTGCTGCTCATAATTCCTGTGACTCTAGACAATTCATTAGACTGCTGTATGCCTTAGTTTTCTATTTTGTTGAACTG
```

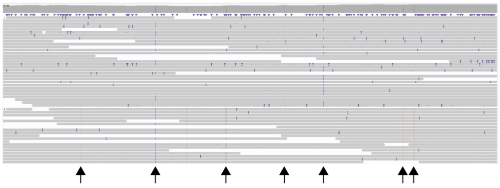
Junction 5



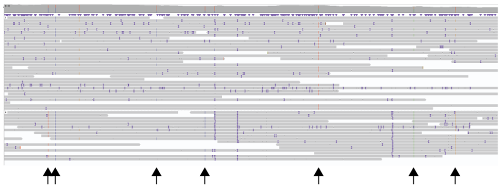
```
Chr 9:(+) 32076512 GTGAGCCACCGCGCCCGGCCTTTTTTTTTATTTCAATAGCTTTGGGAGTACAAGTGGTTTTGGTTACATGGATTTAAGTT
                                                                |||||||||||||||||||||| ||||||||||||
                   GTTAGAGCTCCTTGATCCACTCATGCAAGGCGGT...(100)...GAGTACAAGTGGTTTTGGTTACTTGGATTTAAGTT
                   ||||||||||||||||||||||||||||||||||
Chr 9:(-) 44432381 GTTAGAGCTCCTTGATCCACTCATGCAAGGCGGTCCATAAAACACATAAAATAAACCATGTCGAATAAGCTTCCGATATC
```

Figure S9: Breakpoint junction sequences of r(9) (RD_P272): Integrative Genomics Viewer images of short read genome sequencing (srGS) and long read genome sequencing (lrGS) data for the two breakpoint junctions. Breakpoint sequences with the chimeric sequence in the center aligned to the reference sequences shown in pink and blue. Microhomology is indicated in green. Coordinates according to genome build T2T-CHM13v2.0.

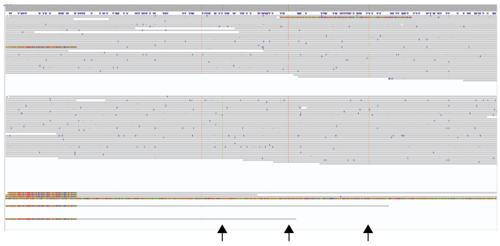
RD_P166
Chr 13
Segment B



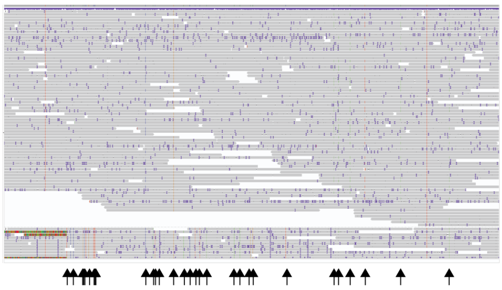
Segment C



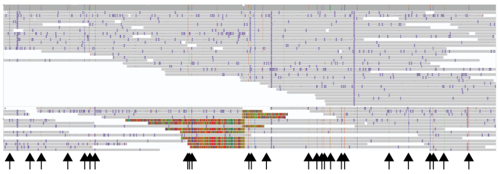
RD_P272
Chr 9
Segment C



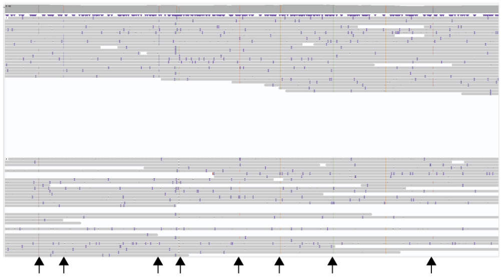
Segment D



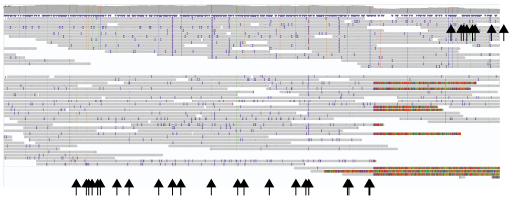
RD_P586
Chr X
Segment H-I



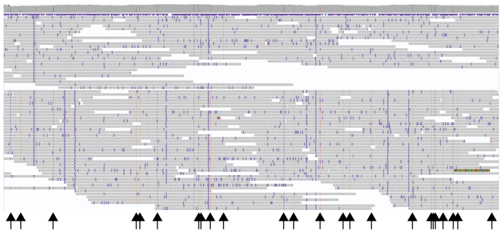
Segment J



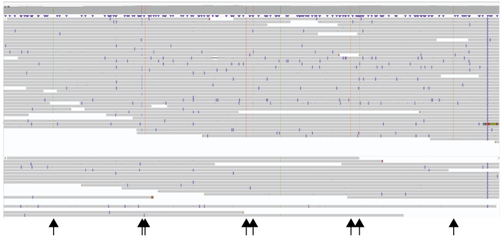
RD_P328
Chr 7
Segment B



Chr 5
Segment A



Chr X
Segment C



Chr X
Segment C Chr X

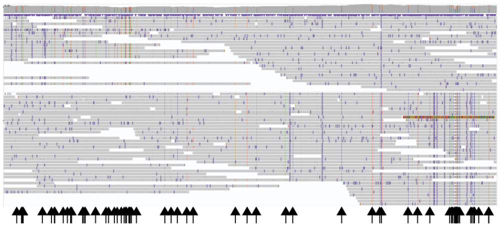


Figure S10: Triallelic sites discovered through haplotype analysis. The phased long read genome sequencing data is shown in the Integrative Genomics Viewer with informative single nucleotide variants indicated by arrows.