

Lyme, Informatics, & Evolution

[Qiu Lab @Belfer](#)

Department of Biological Sciences
Hunter College, City University of New York

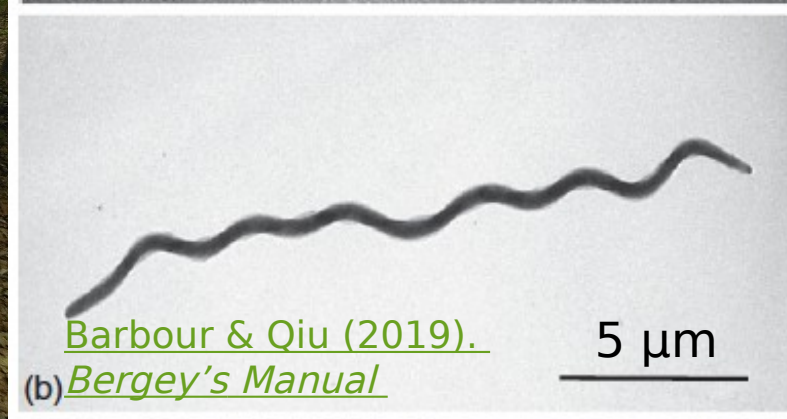
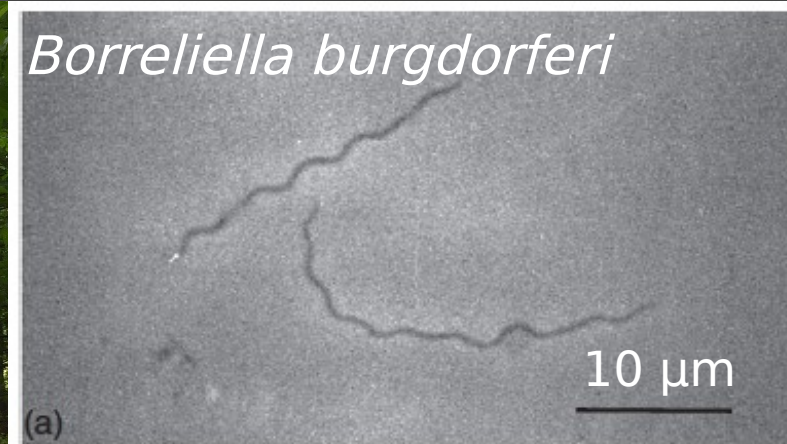
Ixodes scapularis



© Dr. Weigang Qiu Lab
Photo-credit: Pedro Peg



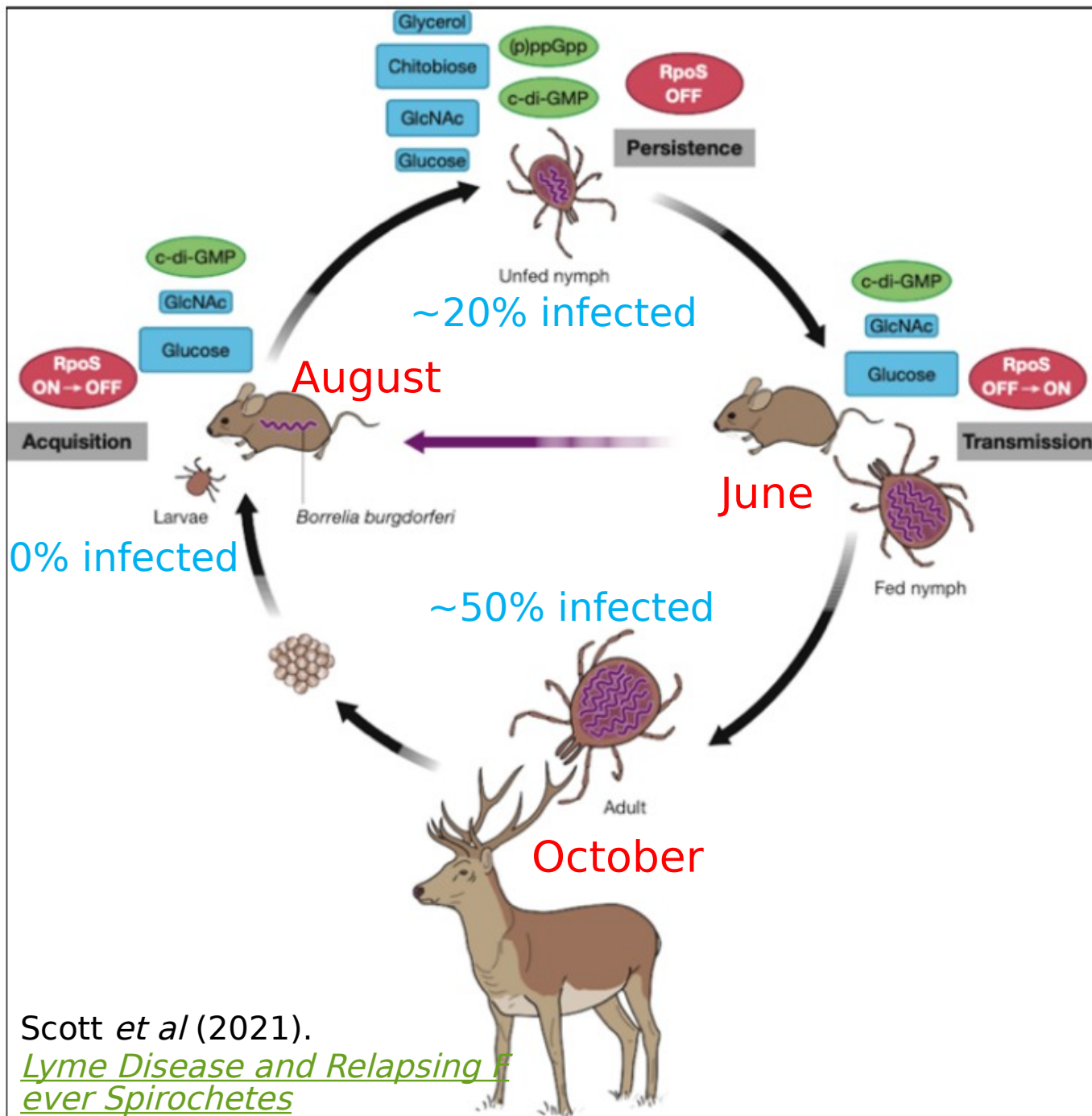
Borrelia burgdorferi



[Barbour & Qiu \(2019\).](#)

(b) [Bergey's Manual](#)

Lyme Disease



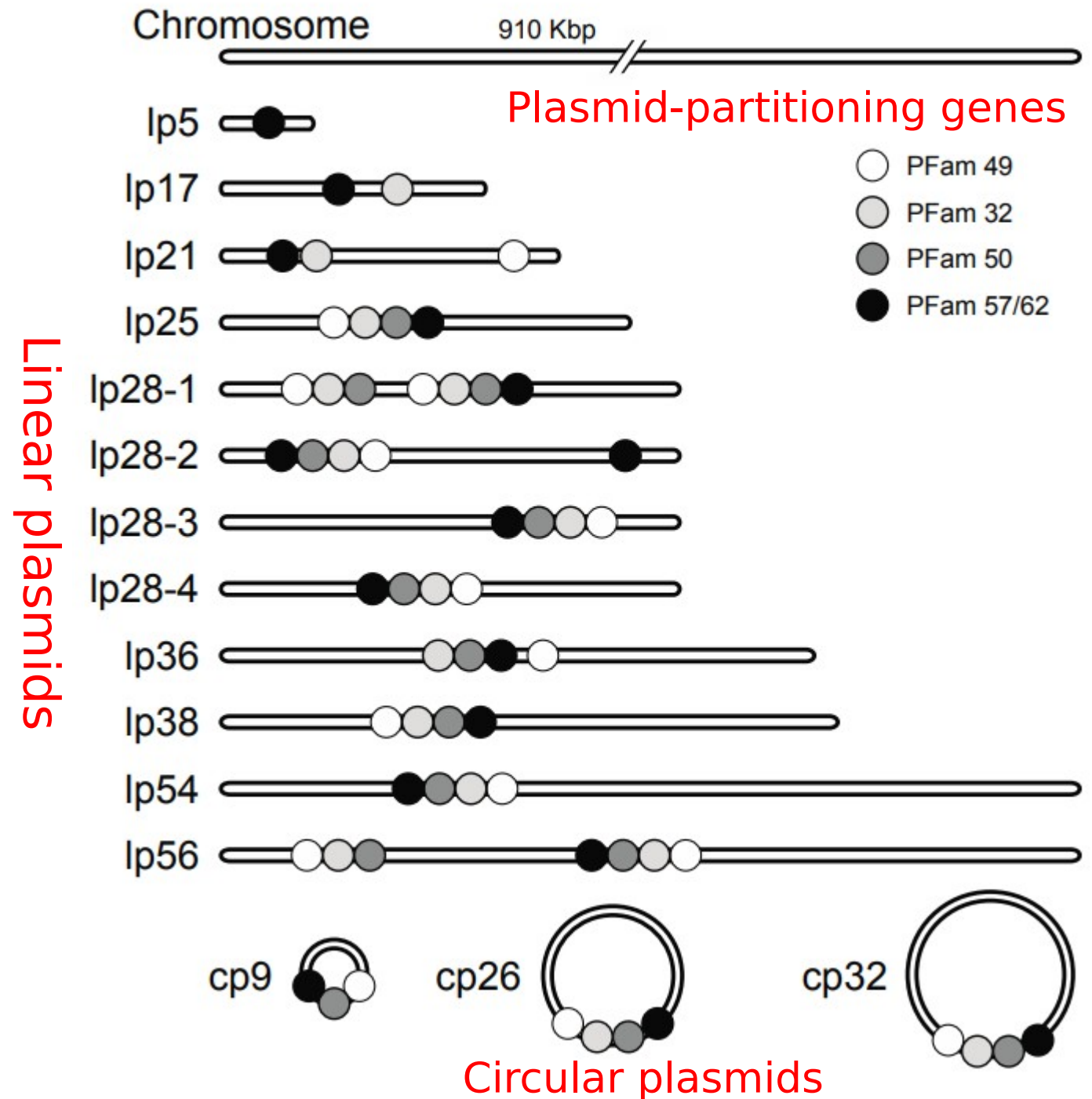
- Symptoms
 - Stage I. Skin infections
 - Stage II. Arthritis
 - Stage III. Chronic infections
- Most common vector-borne disease in US and Europe; 300,000 annual cases in the US (Northeast & Midwest)
- Poor/Controversial diagnostics
- No human-use vaccine
- No targeted antibiotics

Borrelia Genomics

- **Multipartite**
Genomes
- **Bi-phasal** (tick & mammalian)
switching

Schwartz *et al* (2021).

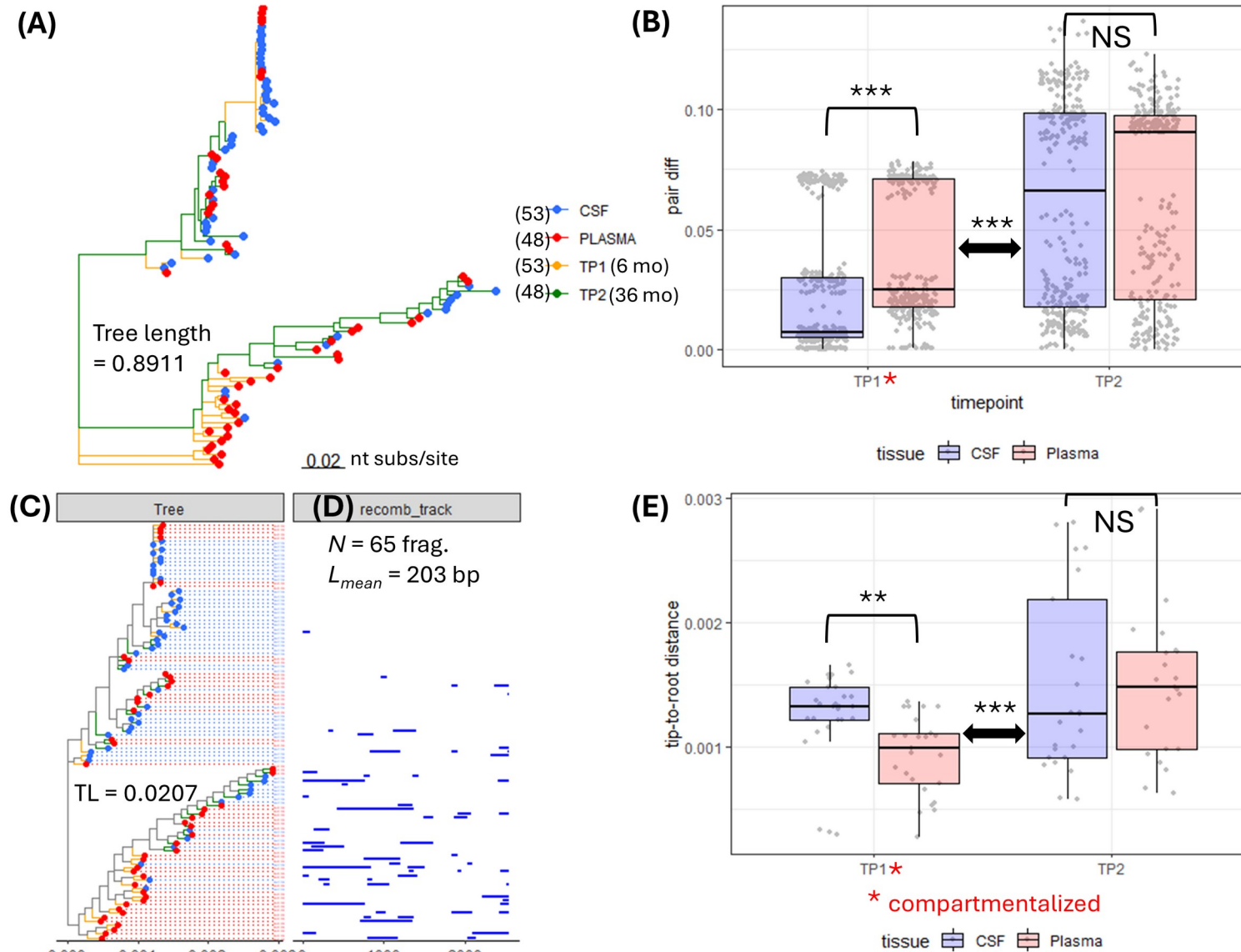
Lyme Disease and Relapsing Fever Spirochetes



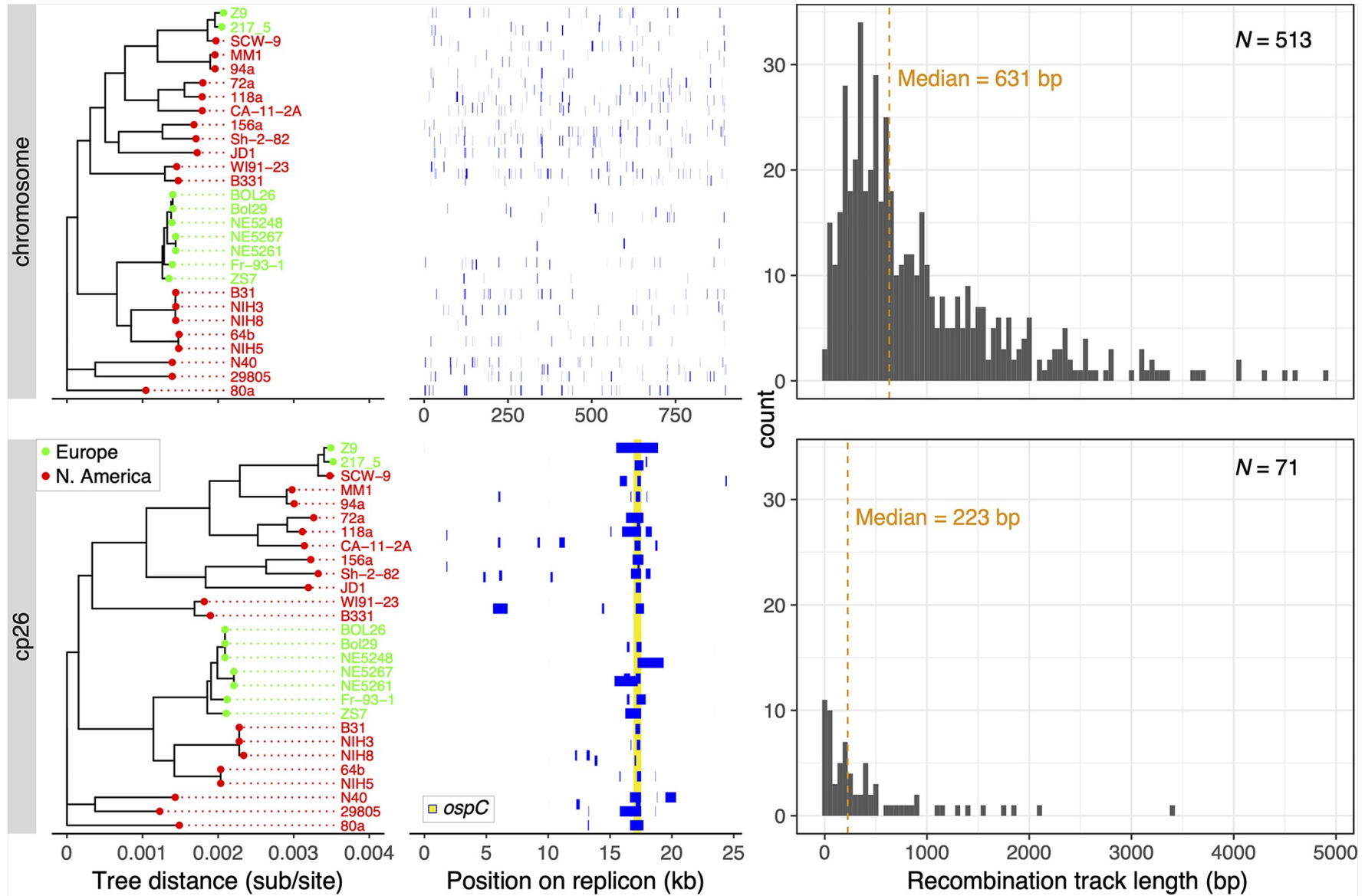
Microbes Recombine (not clonal)

Pathogenicity & Virulence

HIV evolution within a single host



Borrelia diversification



Evolutionary History & Mechanisms



8 | Editor's Pick | Genomics and Proteomics | AAM Contribution-Research Article

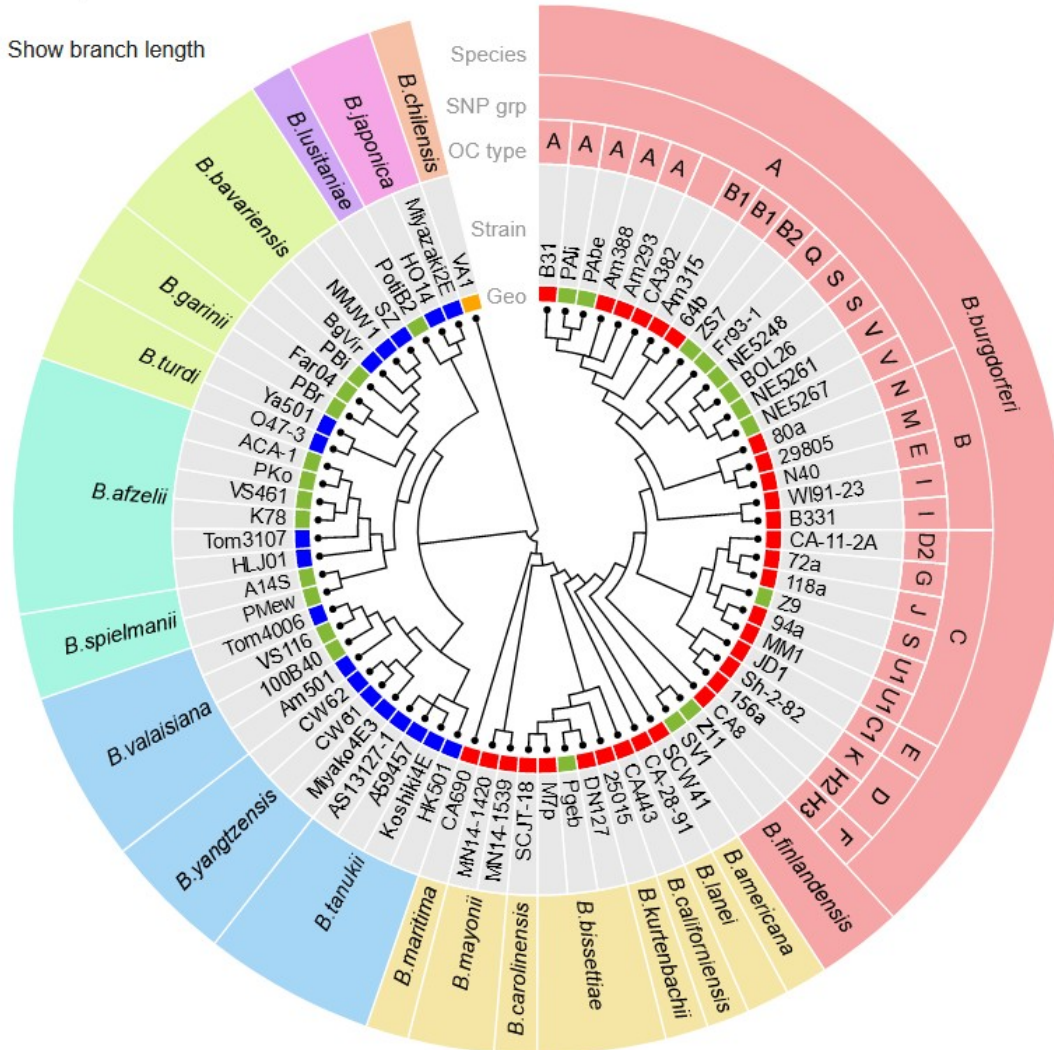
Natural selection and recombination at host-interacting lipoprotein loci drive genome diversification of Lyme disease and related bacteria

Saymon Akther,¹ Emmanuel F. Mongodin,² Richard G. Morgan,³ Lia Di,¹ Xiaohua Yang,⁴ Maryna Golovchenko,⁵ Natalie Rudenko,⁵ Gabriele Margos,⁶ Sabrina Hepner,⁶ Volker Fingerle,⁶ Hiroki Kawabata,⁷ Ana Cláudia Norte,⁸ Isabel Lopes de Carvalho,⁹ Maria Sofia Nuncio,⁹ Adriana Marques,¹⁰ Steven E. Schutzer,¹¹ Claire M. Fraser,² Benjamin J. Luft,⁴ Sherwood R. Casjens,¹² Weigang Qiu^{1,13}

- Phylogenetic coverage: 47 new genomes, all 23 species, 15 major US pathogen strains
- Leading institutions: U. Maryland, U. Utah, Stony Brook U, NJ Medical School, Hunter/CUNY
- Participants: Japan, Germany, Portugal, Czech Republic

Strains Replicons Genes BLAST Transcriptomes *ospC* DB

Show branch length



Continent

- North America
- South America
- Europe
- Asia
- Africa
- unknown

Species Group

- *B. burgdorferi* & *B. finlandensis* (N. America & Europe)
- N. American outgroups
- *B. garinii*-like (Eurasia)
- *B. afzelii*-like (Eurasia)
- *B. valaisiana*-like (Eurasia)
- *B. lusitanae* (Europe, basal)
- *B. japonica* (Asia, basal)
- *B. chilensis* (S. America; outgroup for all)

BpWrapper: a Command-Line Utilities

```
>seq_1
atcttaacg
>seq_2
agtaggatggaaa
>seq_3
agggcctgaaa
>seq_4
aggcctgga
```

