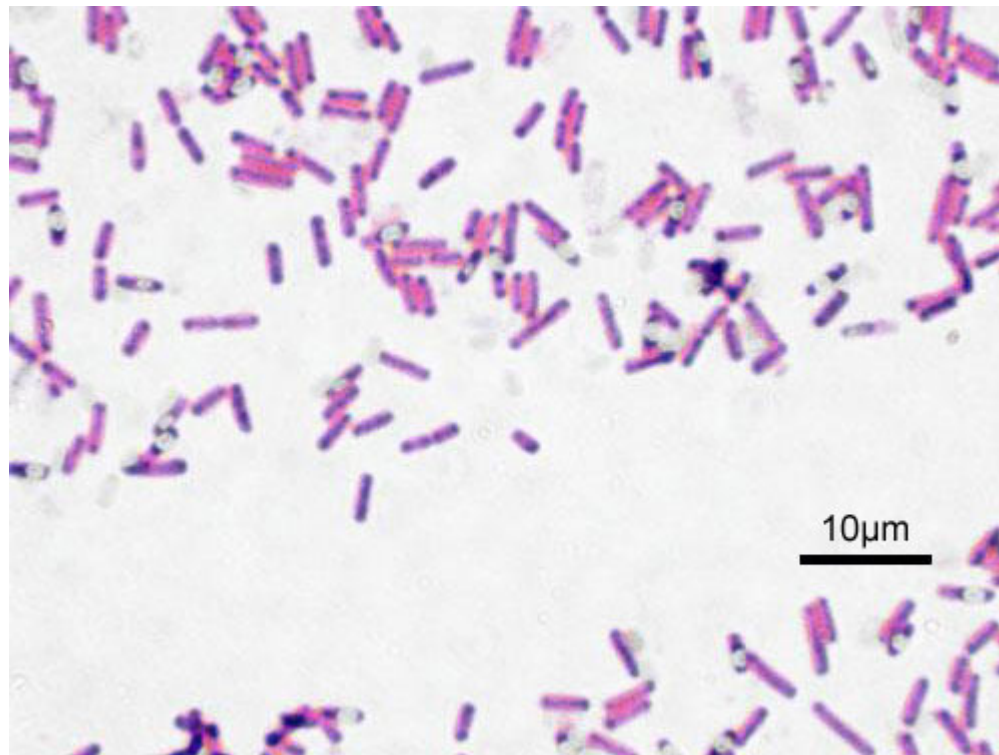
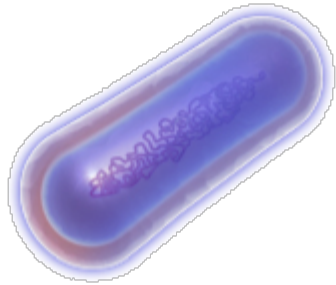


# Comparative genomics between Bacillus and Lactobacillus

# Firmicutes

- Gram-positive bacteria
- round cells or rod-shaped forms.





# Bacillus

- includes both free-living and pathogenic species.
- Bacillus anthracis
- Bacillus cereus
- Bacillus clausii
- Bacillus cytotoxicus

# Lactobacillus

- major part of the lactic acid bacteria group
- commonly found in the oral, vaginal, and intestinal regions of many animals
- used in the production of yogurt, cheese and other fermented foods.

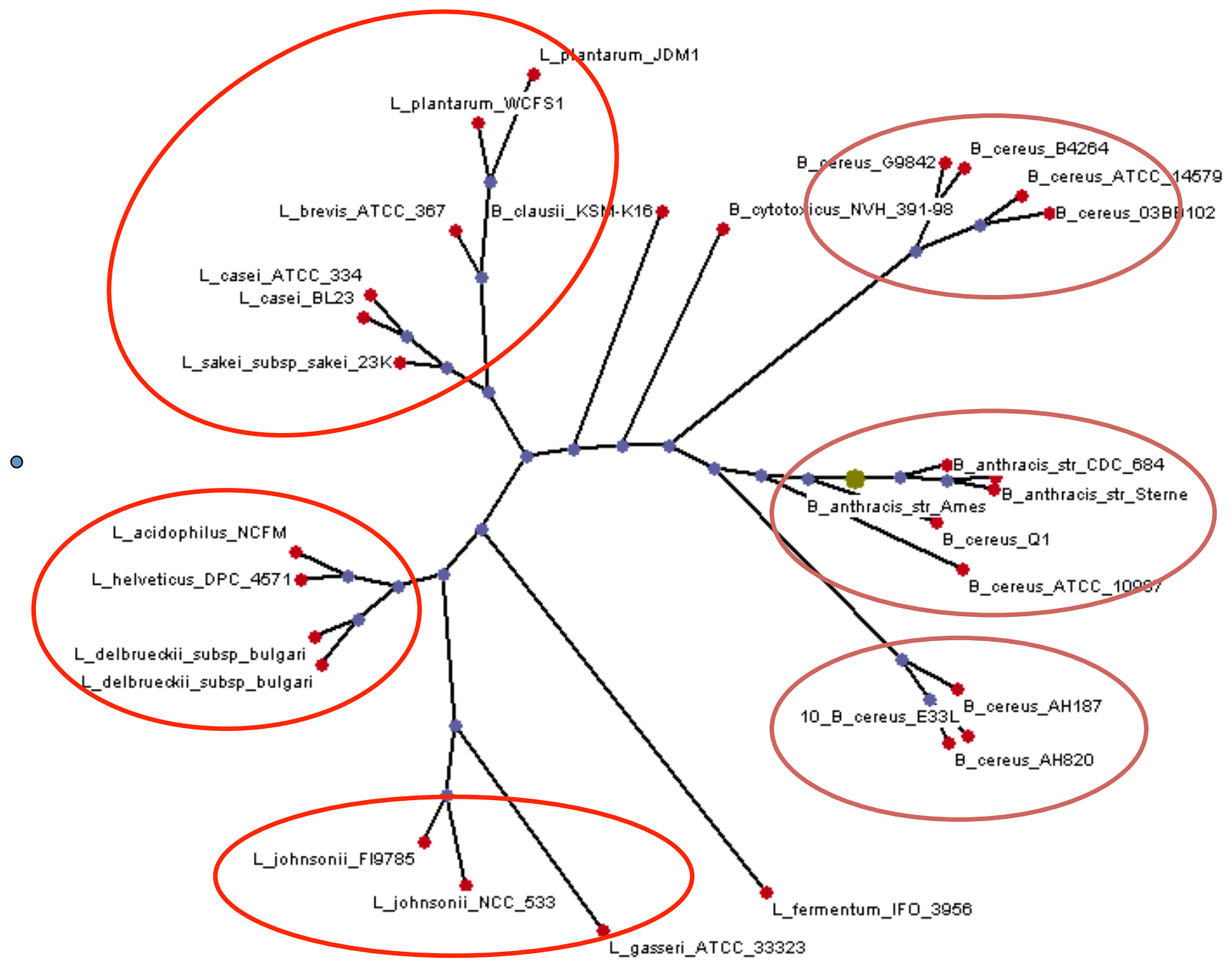
# Related information

24 genomes: 14 Bacillus, 14 Lactobacillus

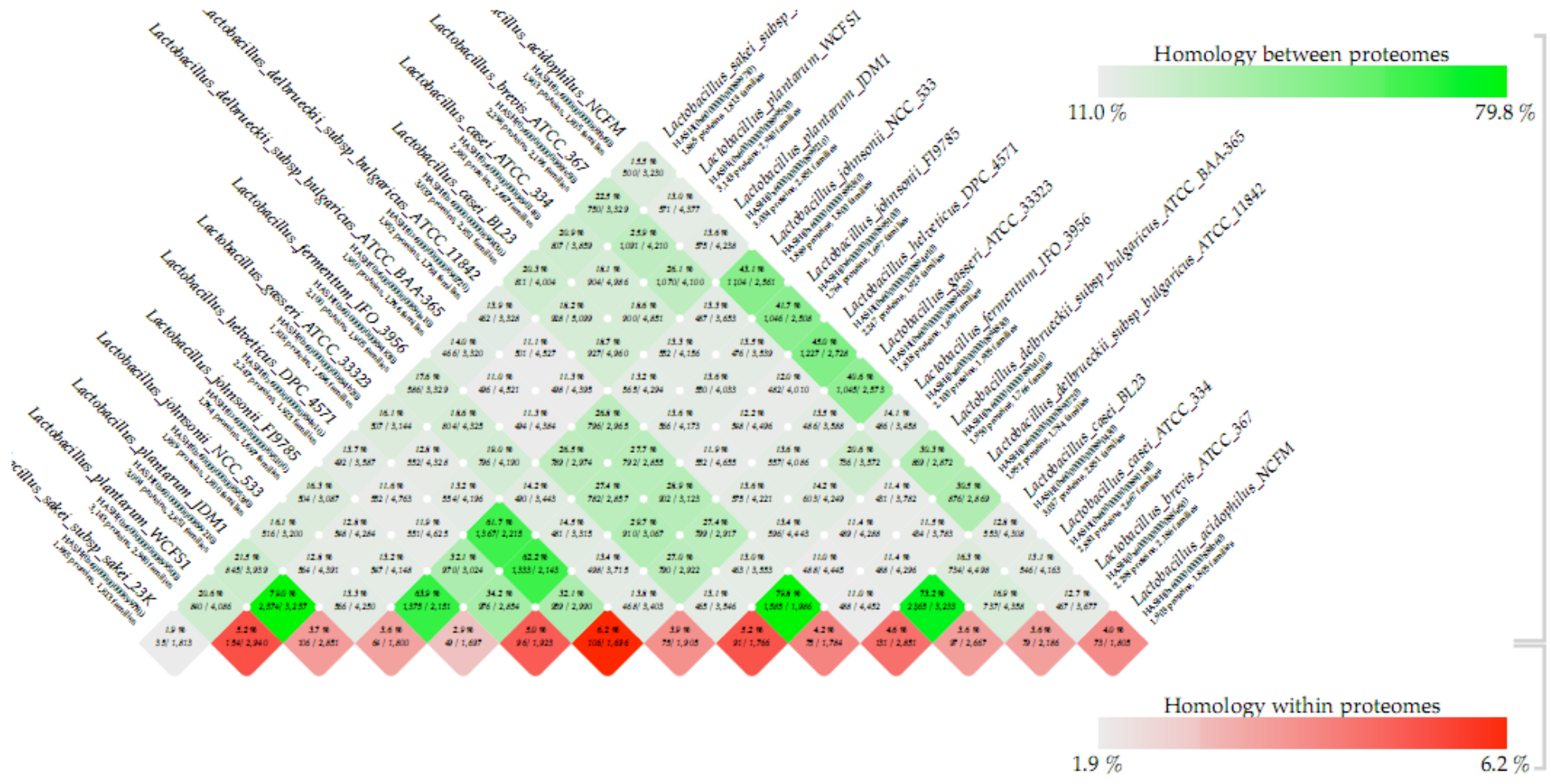
Genome Project ID	Organism	Size	#genes (from GenBank files)	#genes (from RefSeq files)	# predicted proteins	Mean (predicted prot.)	STD (predicted prot.)	Min - Max Length (predicted prot.)	# 16S rRNA
309	Bacillus anthracis str. Ames	5.2	5330	5328	5492	326	159.46	91 - 602	11
31329	Bacillus anthracis str. CDC 684	5.5	5896	5902	5791	196	181.25	55 - 542	11
10878	Bacillus anthracis str. Sterne	5.23	5287	5287	5492	226	142.38	67 - 542	11
31307	Bacillus cereus	5.44	5606	5606	5527	275	98.22	144 - 415	14
17715	Bacillus cereus	5.6	5783	5783	5693	271	143.7	97 - 527	14
17711	Bacillus cereus	5.59	5810	5810	5699	203	137.39	59 - 463	12
74	Bacillus cereus	5.43	5844	5843	5516	204	119.82	30 - 429	12
384	Bacillus cereus	5.42	5255	5255	5570	278	116.42	62 - 446	13
17731	Bacillus cereus	5.4	5398	5398	5371	269	119.44	110 - 533	14
12468	Bacillus cereus	5.85	5641	5641	5886	303	139.97	144 - 610	13
17733	Bacillus cereus	5.75	5857	5857	5760	320	316.03	48 - 1171	13
16220	Bacillus cereus Q1	5.49	5502	5488	5568	228	150.11	62 - 511	13
13291	Bacillus clausii KSM-K16	4.3	4108	4096	4338	188	66.44	82 - 274	7
13624	Bacillus cytotoxicus NVH 391-98	4.11	3844	3844	4120	182	107.08	58 - 414	13
82	Lactobacillus acidophilus NCFM	2	1862	1862	1903	223	148.28	60 - 494	4
404	Lactobacillus brevis ATCC 367	2.35	2218	2218	2298	326	142.74	92 - 513	5
402	Lactobacillus casei ATCC 334	2.93	2771	2768	2881	412	325.12	137 - 1111	5
30359	Lactobacillus casei BL23	3.1	3044	3022	3037	283	133.65	87 - 547	5
16871	Lactobacillus delbrueckii subsp. bulgaricus ATCC 11842	1.9	2096	1529	1952	315	262.57	61 - 793	9
403	Lactobacillus delbrueckii subsp. bulgaricus ATCC 11842	1.9	1721	1715	1950	394	303.6	78 - 1063	9
18979	Lactobacillus fermentum IFO 3956	2.1	1843	1843	2100	286	136.57	129 - 526	5
84	Lactobacillus gasseri ATCC 33323	1.9	1755	1755	1818	251	130.25	76 - 460	6
17811	Lactobacillus helveticus DPC 4571	2.1	1610	1610	2247	286	251.14	31 - 879	4
36575	Lactobacillus johnsonii FI9785	1.83	1737	-	1764	308	165.87	140 - 641	4
9638	Lactobacillus johnsonii NCC 533	2	1821	1821	1889	269	181	61 - 606	6
32969	Lactobacillus plantarum JDM1	3.2	2948	2948	3004	408	641.87	103 - 2219	5
356	Lactobacillus plantarum WCFS1	3.34	3101	3057	3143	350	196.28	106 - 748	5
13435	Lactobacillus sakei subsp. sakei 23K	1.9	1885	1879	1865	414	262.27	174 - 1056	7

Bacillus:  
Bigger genome  
More protein  
More 16S rRNA

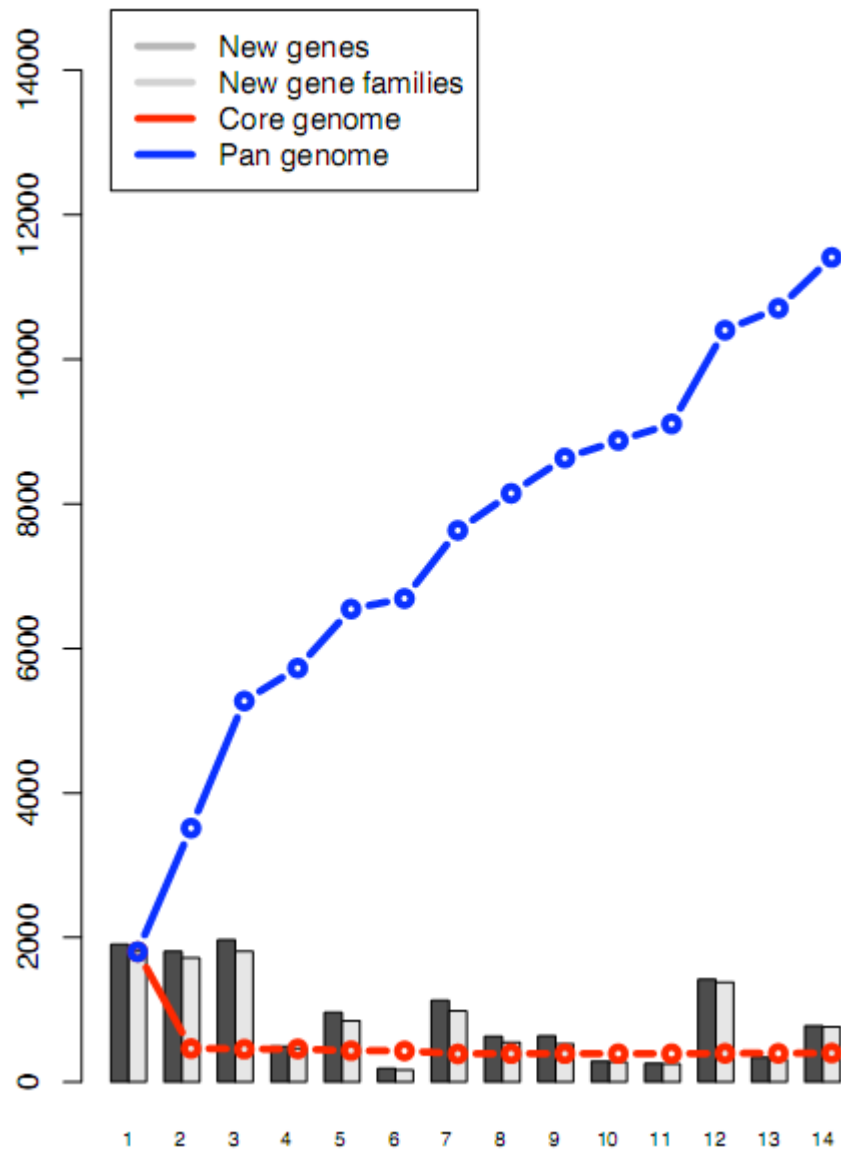




# Blast matrix : Lactobacillus

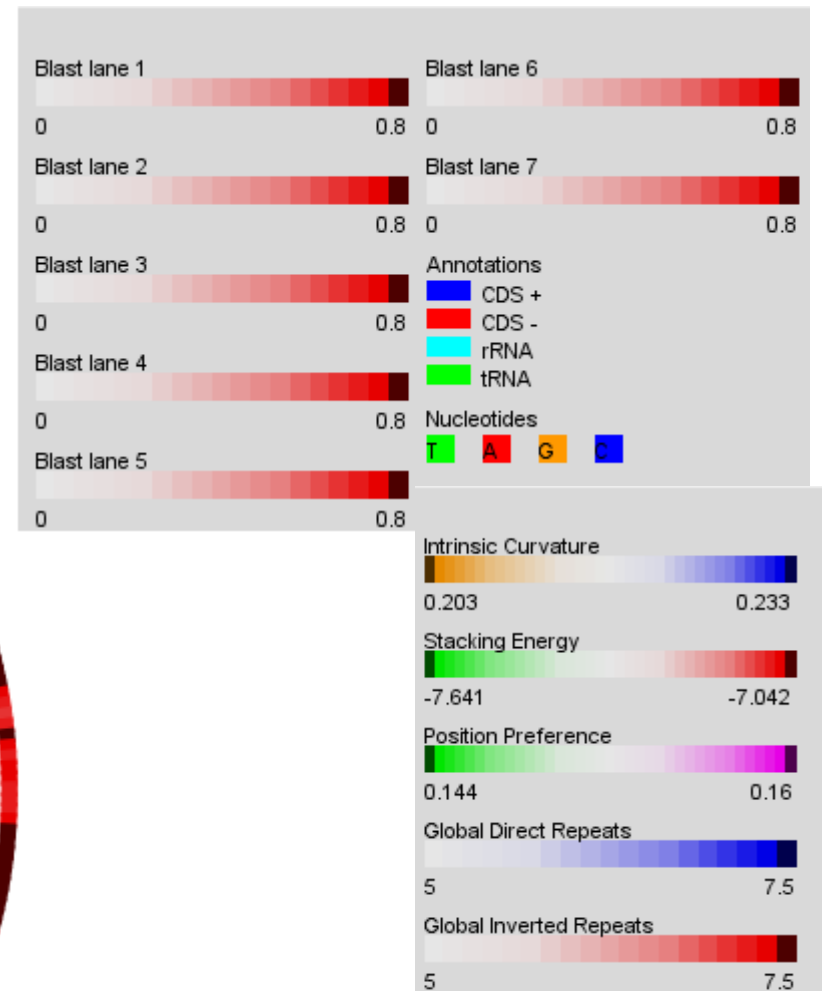
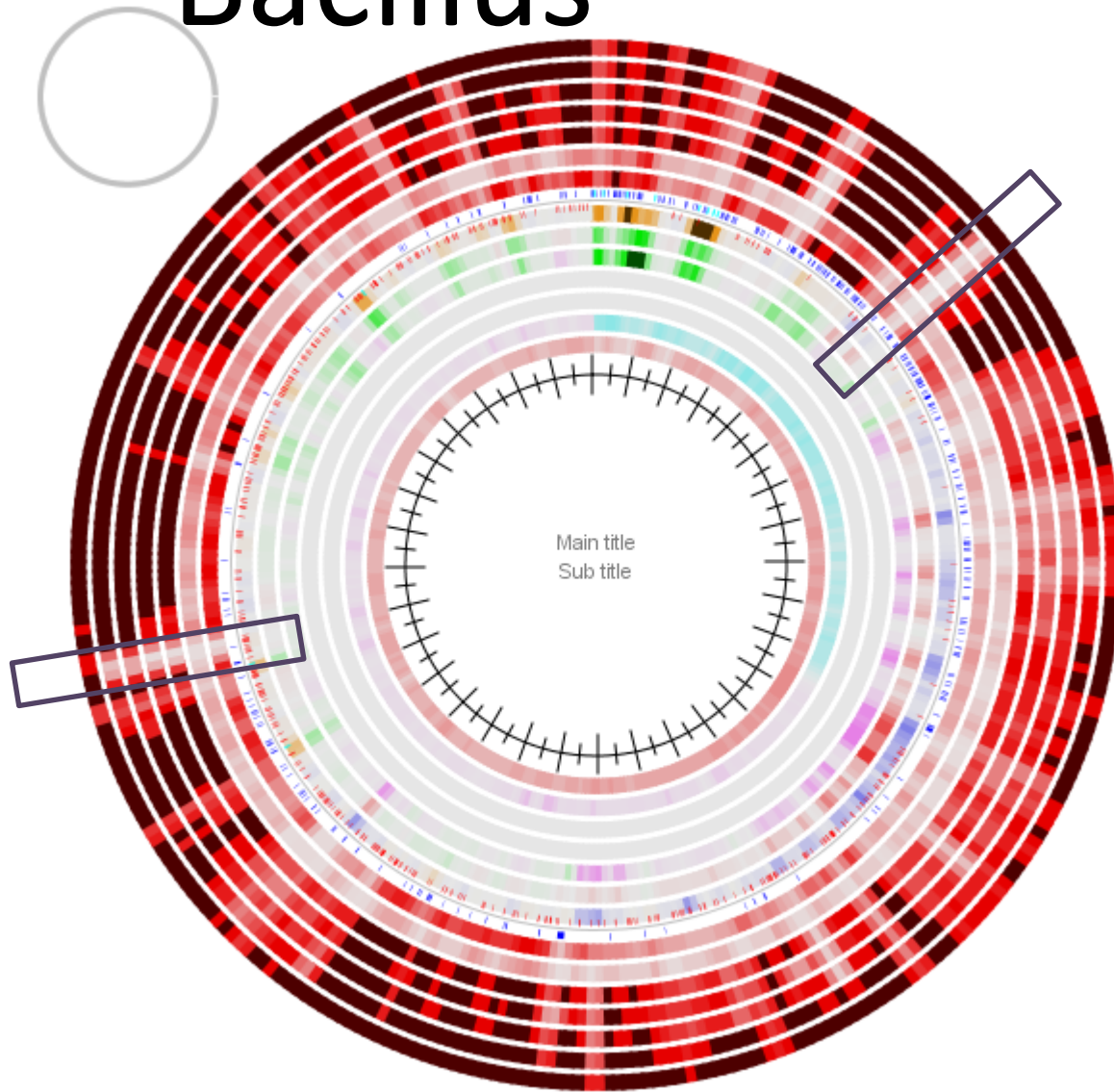


# Pan core genome : Lactobacillus



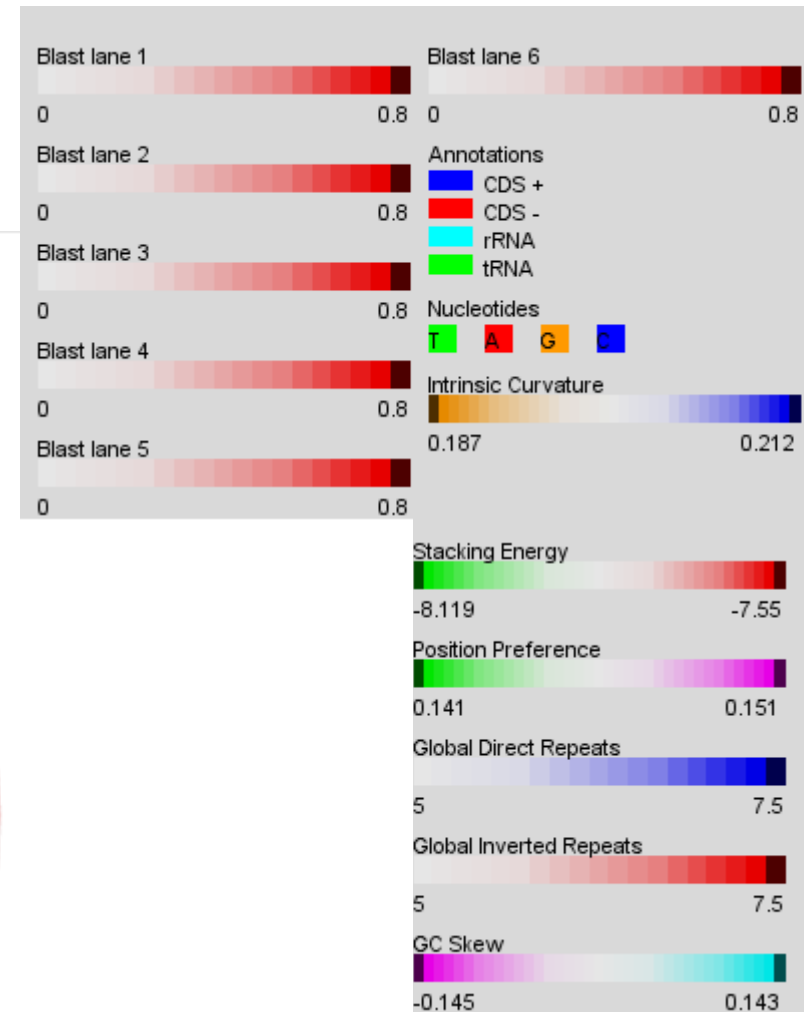
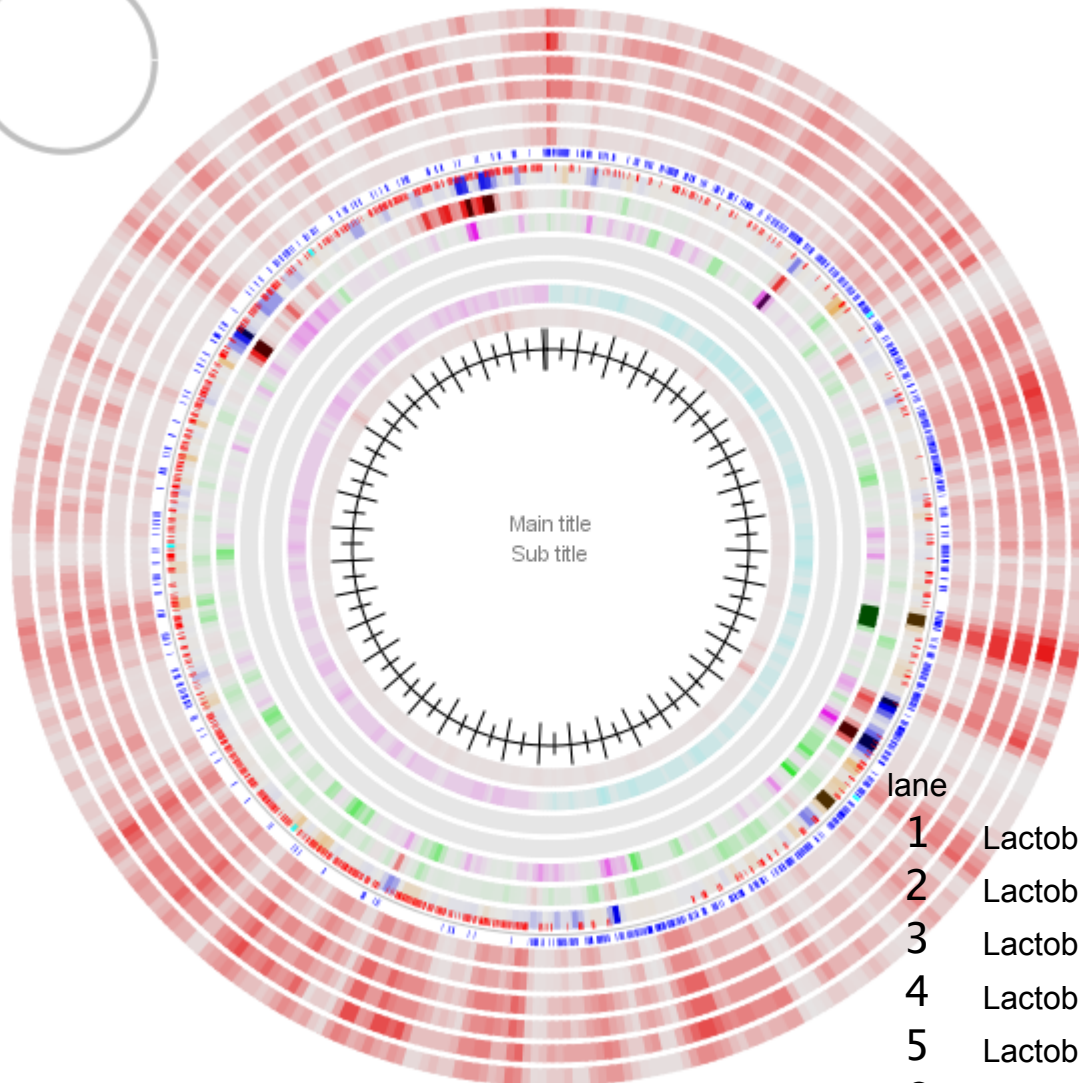
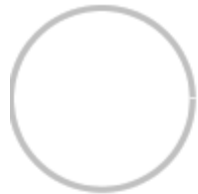
- 1 : *Lactobacillus\_acidophilus*\_NCFM
- 2 : *Lactobacillus\_brevis*\_ATCC\_367
- 3 : *Lactobacillus\_casei*\_ATCC\_334
- 4 : *Lactobacillus\_casei*\_BL23
- 5 : *Lactobacillus\_delbrueckii*\_subsp\_bulgaricus\_ATCC\_11842
- 6 : *Lactobacillus\_delbrueckii*\_subsp\_bulgaricus\_ATCC\_BAA-365
- 7 : *Lactobacillus\_fermentum*\_IFO\_3956
- 8 : *Lactobacillus\_gasseri*\_ATCC\_33323
- 9 : *Lactobacillus\_helveticus*\_DPC\_4571
- 10 : *Lactobacillus\_johnsonii*\_FI9785
- 11 : *Lactobacillus\_johnsonii*\_NCC\_533
- 12 : *Lactobacillus\_plantarum*\_JDM1
- 13 : *Lactobacillus\_plantarum*\_WCFS1
- 14 : *Lactobacillus\_sakei*\_subsp\_sakei\_23K

# Bacillus



- 1 Bacillus anthracis str. Sterne
- 2 Bacillus cereus 03BB102
- 3 Bacillus cereus AH187
- 4 Bacillus cereus ATCC 10987
- 5 Bacillus cereus Q1
- 6 Bacillus clausii KSM-K16
- 7 Bacillus cytotoxicus NVH 391-98
- \_ Bacillus anthracis str. CDC 684

# Lactobacillus



lane

- 1 Lactobacillus acidophilus NCFM
- 2 Lactobacillus brevis ATCC 367
- 3 Lactobacillus casei ATCC 334
- 4 Lactobacillus casei BL23
- 5 Lactobacillus delbrueckii subsp. bulgaricus ATCC 11842
- 6 Lactobacillus delbrueckii subsp. bulgaricus ATCC BAA-365
- Lactobacillus plantarum JDM1

# Summary

- Bacillus having more proteins and more 16s rRNA than Lactobacillus
- Bacillus might be able to adapt in more environments
- Clearly separated groups between Bacillus and Lactobacillus that one is pathogen and another one is probiotic.
- Prospective:
  - We can study further in the suspicious genes in Bacillus that may involve in disease course to get more detail