

Template for Taxonomic Proposal to the ICTV Executive Committee To create a new Genus in an existing Family

Code[†] To create a new genus in the family*

Code[†] To name the new genus*

Code[†] To remove from the list of unassigned viruses in family *Siphoviridae*
——— ~~*Bacillus phage SPbeta*~~

Code[†] To create as type species in the new genus the species named*

Code[†] To designate the following as species of the new genus*:

Code[†] To designate the following as tentative species in the new genus*:

[†] Assigned by ICTV officers

* repeat these lines and the corresponding arguments for each genus created in the family

Author(s) with email address(es) of the Taxonomic Proposal

Ackermann, Hans-W., MD
Department of Medical Biology, Faculty of Medicine, Laval University, Quebec, QC, G1K 7P4,
Canada
ackermann@mcb.ulaval.ca

Old Taxonomic Order

Order
Family
Genus
Type Species
Species in the Genus
Tentative Species in the Genus
Unassigned Species in the family

New Taxonomic Order

Order
Family
Genus
Type Species
Species in the Genus
Tentative Species in the Genus
Unassigned Species in the family

ICTV-EC comments and response of the SG

Accepted. Move to 02. Before next consideration need to amend proposal to create and name SPbeta as a species in the newly created genus. Also need to change all instances of “β” to “beta” as ICTV no longer recognizes Greek characters (rationales include that Genbank does not recognize Greek characters, and ascii characters for Greek characters not always fully compatible with different computer platforms/software). **Done. Hans-W. Ackermann**

EC40: Approved, move to -04 with following changes.

SPR and H2 are deleted, pending more specific lines for species demarcation

May 30, 2009 Done. Hans-W. Ackermann

Argumentation to choose the type species in the genus

SPbeta is the ~~best known~~ **only** species of the genus.

Species demarcation criteria in the genus

Restriction endonuclease digestion patterns, presence or absence of a gene coding for thymidylate synthetase

List of Species in the created genus

Bacillus phage SPbeta
Bacillus phage SPR
Bacillus phage H2

List of Tentative Species in the created genus

None

Argumentation to create a new genus:

Virions have large heads of 80 nm in diameter, large genomes of approximately 134 kb in size coding for 187 ORFs, and very long, tails (355 nm). They are among the largest siphoviruses known [and the largest siphoviruses with a fully sequenced genome](#).

Origin of the proposed genus name

Name of type species

References

- Dean DH, Orrego JC, Hutchison KW, Halvorson HO. 1976. New temperate bacteriophage for *Bacillus subtilis*, ρ11. *J Virol* 20:509-519
- Lazar3ic V, Düsterhöft A, Soldo B, Hilbert H, Mauël C, Karamata D. 1999. Nucleotide sequence of the *Bacillus subtilis* temperate bacteriophage SPβc2. *Microbiology (UK)* 145:1055–1067
- Spancake DA, Daignault SD, Hemphill HE. 1987. Genome homology and divergence in the SPβ-related bacteriophages of *Bacillus subtilis*. *Can J Microbiol* 33:249-255
- Weiner MP, Zahler SA. 1988. Genome homology and host range of some SPβ-related bacteriophages of *Bacillus subtilis* and *Bacillus amyloliquefaciens*. *J Gen Virol* 69:1307-135

Annexes:

SPbeta (original name SP β)

Background

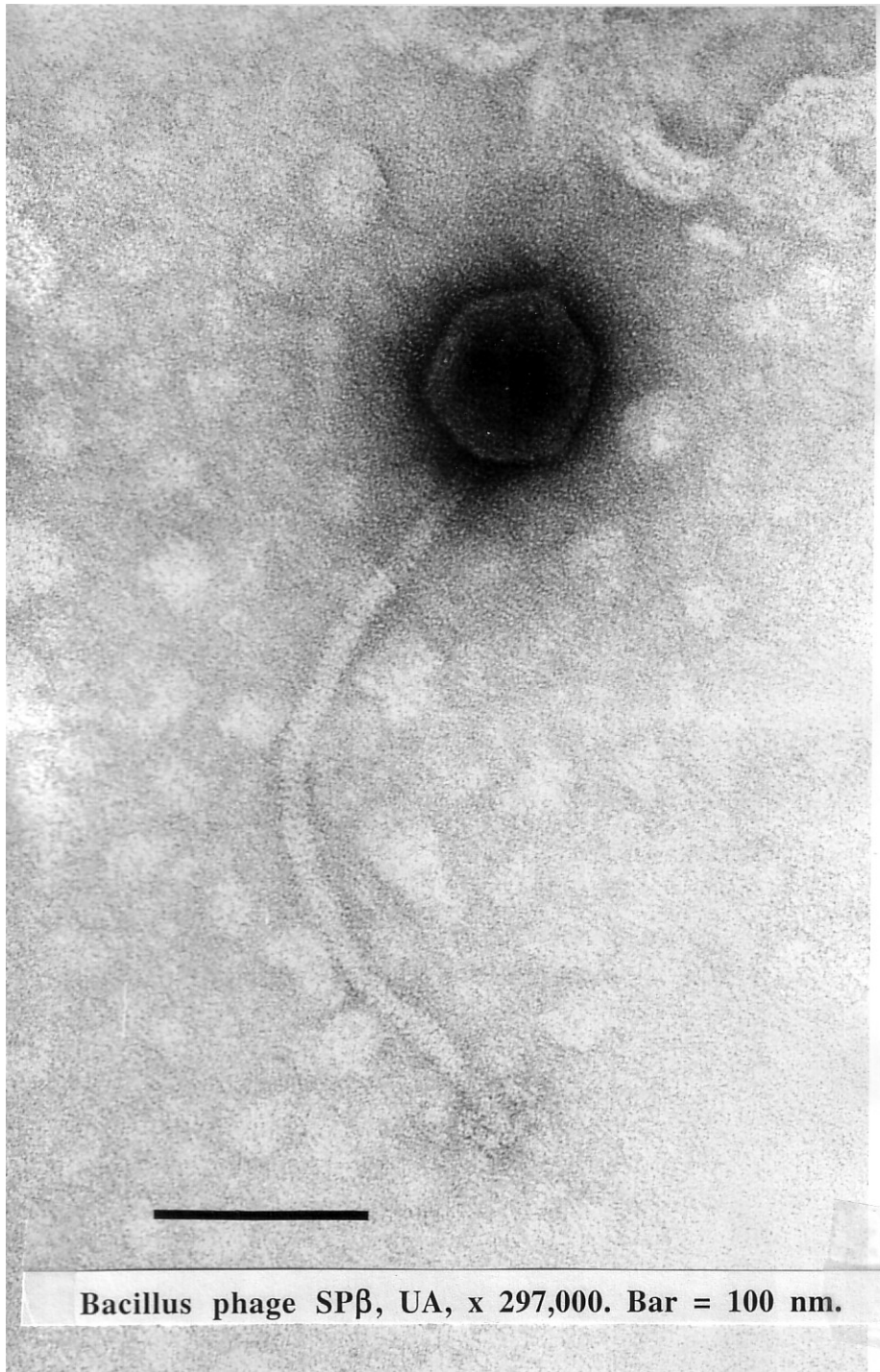
The present *Siphoviridae* family of tailed phages includes 6 genera named after their type species: lambda, T1, T5 (enterics), L5 (*Mycobacterium*), phiC31 (*Streptomyces*), and c2 (*Lactococcus*). These few phage groups comprise a small part of siphoviruses only, of which over 3000 representatives are known, and many more siphoviruses remain to be classified. *Bacillus* phage SP β and its possible relatives do not resemble these phages and constitute a distinct group. Most data are from SPbeta2c, a clear-plaque mutant of SPbeta.

History

Phage SPbeta was first described in 1963 by Eiserling (1963). SPbeta is temperate and inducible from *B. subtilis* 168 (Warner et al., 1977). A similar phage, named S-a, had been incompletely characterized (Cr shadowing) in 1960 by Fukuda (1960). More SPbeta-like phages were isolated in the USA and Portugal. Investigators in Germany, the USA, and Portugal found that these phages were related by serology, host range, DNA-DNA hybridization, presence of methyltransferase genes, and structural proteins, but could be differentiated by RE digestion patterns (see Zahler 1988 and 1993; more reviews in the literature).

Proposals

1. To establish a new genus within the family *Siphoviridae*.
2. To name this genus "SP β -like viruses."
3. To designate *Bacillus* phage SPbeta as the type species of this genus.
4. To designate *Bacillus* phage SPbeta as the type virus of this species.
- ~~5. To establish two more species, named SPR and H2, within the genus.~~
- ~~6. To designate *Bacillus* phages SPR and H2 as type viruses of these species.~~



Bacillus phage SP β , UA, x 297,000. Bar = 100 nm.

Genus "SPbeta-LIKE VIRUSES"

Type Species Bacillus phage SPbeta

Distinguishing Features

Virions have very large heads and very long tails. They are among the largest siphoviruses known.

Virion Properties

Morphology

Heads are icosahedra of 81 nm in diameter. Tails measure 355 x 10 nm, are relatively rigid, have no collar, and possess 6 club-shaped terminal spikes.

Physicochemical and Physical Properties

Virion buoyant density in CsCl is 1.52 g/ml.

Nucleic Acid

The genome of SPbeta is 134.416 kb in size, consists of 187 ORFs, and has a G+C content of 34-35%. It thymidylate synthetase genes are absent in SPβ present in other members of the group (φ3T, ρ11).

Proteins Virions have 6-7 major proteins.

Lipids None known.

Carbohydrates None known.

Genome Organization and Replication

The genetic map is linear. Based on the origin of transcription, the genome is divided into three main clusters, the second of which may correspond to late genes. The genome is mosaic and contains bacterial elements, especially in *B. subtilis*, and elements of 8 morphologically unrelated phages or prophages. Only 25% of ORFs have significant homology to known sequences.

Antigenic Properties **No group antigens are reported.**

Biological Properties **Phages are temperate.**

List of Species Demarkation Criteria in the Genus

Restriction endonuclease digestion patterns, gene coding for thymidylate synthetase.

List of Species in the Genus

Official virus species names are in italics. Tentative virus species names, alternative names (), strains, or serotypes are not italicized. Virus names, genome sequence accession numbers [], and assigned abbreviations are:

SPECIES IN THE GENUS

<i>Bacillus phage SPbeta</i>		
Bacillus phage SPβ	[AF020713]	(SPbeta)
Bacillus phage 3T		(phi3T)
Bacillus phage 11		(rho11)
Bacillus phage IG1		(IG1)
Bacillus phage IG3		(IG3)
Bacillus phage Z		(Z)
<i>Bacillus phage SPR</i>		
Bacillus phage SPR		(SPR)
<i>Bacillus phage H2</i>		
Bacillus phage H2		(H2)

Phages SPR and H2 may also be considered as subspecies.

Similarity to Other Taxa Not known.

References

- Dean DH, Orrego JC, Hutchison KW, Halvorson HO. 1976. New temperate bacteriophage for *Bacillus subtilis*, ρ11. J Virol 20:509-519
- Lazarevic V, Düsterhöft A, Soldo B, Hilbert H, Mauël C, Karamata D. 1999. Nucleotide sequence of the *Bacillus subtilis* temperate bacteriophage SPβc2. Microbiology (UK) 145:1055–1067
- Spancake DA, Daignault SD, Hemphill HE. 1987. Genome homology and divergence in the SPβ-related bacteriophages of *Bacillus subtilis*. Can J Microbiol 33:249-255
- Weiner MP, Zahler SA. 1988. Genome homology and host range of some SPβ-related bacteriophages of *Bacillus subtilis* and *Bacillus amyloliquefaciens*. J Gen Virol 69:1307-135

Contributed by
Ackermann, H.-W.

SUPPORTING MATERIAL

Members and Relatives

The group of SP \square eta-like *Bacillus* phages comprises 10 isolates, namely SP \square eta, phi3T, \square ho11, H2, IG1, IG3, IG4, SPR, Z and E (Zahler, 1988, 1993; others). Seven of the phages were divided into three subgroups, represented by phages SPbeta, SPR, and H2, respectively (Weiner and Zahler, 1988).

Possible relatives of SPbeta occur in *B. thuringiensis*, *B. cereus*, *B. sphaericus*, *B. stearothermophilus*, and various Gram-positive bacteria (*Clostridium*, *Enterococcus*, *Lactococcus*, *Nocardia*, *Streptomyces*). They vary considerably in their dimensions. The best candidates for inclusion into the SP β group are the *Streptomyces* and *Nocardia* phages (Anné et al. 1984; Bradley and Ritzi, 1967; Diaz et al., 1989). However, none of these phages can be attributed with certainty to the SPbeta group and they should remain unclassified at this time.

Dimensions

Phage	Host	Head, nm	Tail, nm	References
SPbeta	<i>B. subtilis</i>	82	358 x 12	Warner 77
		88	320	Eiserling 63
		81	355	Ackermann et al. 95
H2	<i>B. sub. var. amylo.</i>	85	434	Zahler et al. 1987
S-a	<i>B. sub. var. amylo.</i>	96	380	Fukuda 60
phi3T	<i>B. subtilis</i>	79	358	Dean 76
rho1	<i>B. subtilis</i>	100	378	Dean 76
?				
phiA1	<i>Sm. antibioticus</i>	79	327	Diaz et al. 89
CPC	<i>Sm. cattleya</i>	104	330	Anné et al. 84
MNP8	<i>Nocardia corallina</i>	85-88	364	Bradley and Ritzi 67

As usual for large phages investigated in many different laboratories, there is considerable variation in reported sizes. I measured or reexamined SPbeta, H2, S-a, and phi3T after calibration with catalase crystals and found 81 nm for the head and 355 x 10 nm for the tail.

Additional References

Ackermann H-W, Azizbekyan RR, Bernier RL, de Barjac H, Saindoux S, Valéro J-R, Yu M-X. 1995.

Phage typing of *Bacillus subtilis* and *B. thuringiensis*. Res Microbiol 146:643-657

Anné J, Wohlleben W, Burkardt HJ, Springer R, Pühler A. 1984.

Morphological and molecular characterization of several actinophages isolated from soil which lyse *Streptomyces cattleya* or *S. venezuelae*. J Gen Microbiol 130:2639-2649

Bradley SG, Ritzi D. 1967.

Structure of actinophages for *Streptomyces* and *Nocardia*. Devel Ind Microbiol 8:206-213

Cregg JM, Ito J. 1979.

A physical map of the genome of temperate phage phi3T. Gene 6:199-219

Diaz LA, Hardisson C, Rodicio MR. 1989.

Isolation and characterization of actinophages infecting *Streptomyces* species and their interaction with host restriction-modification systems. J Gen Microbiol 135:1847-1856

Eiserling FA. 1963.

Bacillus subtilis bacteriophages: structure, intracellular development, and conditions of lysogeny. PhD thesis, University of California at Los Angeles, Los Angeles, CA, 127 p

Fukuda S. 1960.

Isolation of a bacteriophage specifically attacking amylase-producing forms of *Bacillus subtilis*. J Gen Appl Microbiol 6:90-100

Warner FD, Kitos GA, Romano MP, Hemphill HE. 1977.

Characterization of SP β : a temperate bacteriophage from *Bacillus subtilis* 168M. Can J Microbiol 23:45-51

Zahler SA. 1988. Temperate bacteriophages of *Bacillus subtilis*. In: The Bacteriophages, Vol. 1, 559-592, ed. R. Calendar. Plenum Press, New York, NY

Zahler SA. 1993. Temperate bacteriophages. In: *Bacillus subtilis* and Other Gram-Positive Bacteria, 831-842, eds. A Sonenshein, JA Hoch, R Losick. ASM Press, Washington, DC

Zahler SA, Korman RZ, Thomas C, Fink PS, Weiner MP, Odebralski JM. 1987.

H2, a temperate bacteriophage isolated from *Bacillus amyloliquefaciens* strain H. J Gen Microbiol 133:2937-2944