

**PROPOSAL Prokaryotes SC**  
**New Genus 'N4-like viruses'**

- 2002.144B.02** to establish a new Genus, within the Family *Podoviridae*, Order *Caudovirales*  
**2002.145B.02** to provisionally call this new genus 'N4-like viruses'  
**2002.146B.02** to designate *Escherichia coli* bacteriophage *N4* (*N4*) as the Type Species of the new Genus.

**Rationale**

Bacteriophage N4 is a well studied lytic virus with several properties that distinguish it from phages of established Genera. Virions carry a phage-encoded RNA polymerase which, upon infection, is injected into the host cell along with the phage genome. Other examples of phage-carried RNA polymerases are known only in the lipid-containing *Cystoviridae* family. Recent determination of the genome sequence has solidified our understanding of its life style and shown clearly that it is not closely related to any of the existing Genera.

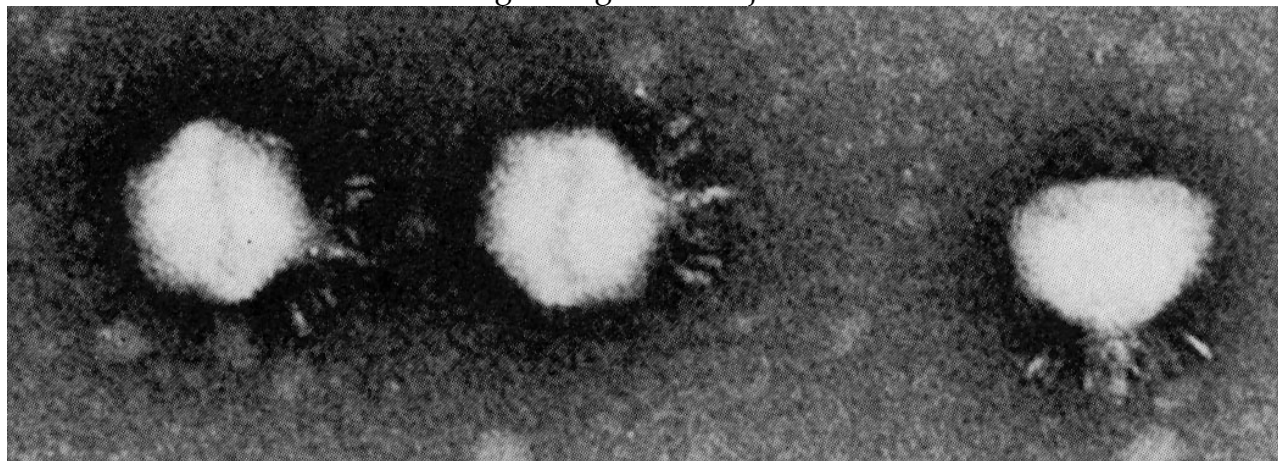
**Distinguishing Properties**

Virions contain a phage-encoded RNA polymerase and inject it into the host. The transcriptional program during lytic growth (described below) is unique among characterized phages.

**Virion Properties**

**Morphology**

Particles have icosahedral heads of about 70 nm in diameter and short tails 10 nm in length, with several short tail fibers originating from the junction between the head and tail.



**Physicochemical and chemical properties**

Particle weight is about  $84 \times 10^6$ . Buoyant density in CsCl is 1.500 g/ml. Lipids have not been detected.

**Nucleic acid**

Virions contain a single molecule of double-stranded DNA of 70,153 bp of unique sequence plus an additional 390-440 bp (variable lengths within the population) at the right end

duplicating DNA sequence at the left end to give direct terminal repeats. There are short 3' ssDNA extensions at both ends. G+C content is 41.3%. The genome sequence is known.

#### Proteins

Particles contain at least 10 structural proteins. The major capsid protein (approx. 500 molecules per phage) has a subunit mass of 44.0 kD.

#### Lipids and carbohydrates

Lipids (2.4%) have been reported in possible member phage sd. Carbohydrates have not been reported.

### Genome organization and replication

The physical map is linear; a genetic linkage map has not been determined for technical reasons. There are 72 protein-coding genes identified which occupy 94% of the DNA sequence. Transcription of N4 DNA is carried out by sequential activity of three different RNA polymerases. Early transcription is done by the virion RNA polymerase, a large (3500 amino acid) single subunit enzyme that is present in 1-2 copies in the virion and injected with the DNA during infection. Early proteins include a two-subunit RNA polymerase responsible for middle transcription. Middle proteins include a 98 kD DNA polymerase and other DNA replication functions that replicate the phage DNA in cooperation with some host functions. Late transcription is carried out by the host (*E. coli*) RNA polymerase. Early and middle genes occupy a contiguous block in the left half of the genome and are transcribed rightwards. Late genes occupy the right half of the genome and are transcribed leftwards. Other noteworthy genes include three tRNA genes (Asn, Thr, Pro), a gene encoding a dCTP deaminase, homologs of the *rIIA* and *rIIB* genes originally studied in phage T4, and a homolog of gene 17 of temperate phage P22. Assembling particles form intracellular crystal-like arrays of phage heads.

### Biological properties

Phages are virulent. Infection is lytic. Host range is restricted to enterobacteria (*E. coli*).

Possible members: Coliphage sd and about 25 poorly known enterobacterial phages (*Escherichia*, *Klebsiella*, *Salmonella*) with spike-like tail appendages, most of which are temperate, show converting ability or are capsule-specific.

### References

- Giraldi, M., Toni, M., Schito, G.C. 1973. Structural proteins of coliphage N4. *Virology*, 55, 476-482.
- Kiino, D.R., Rothman-Denes, L.B. 1988. Bacteriophage N4. In: *The Bacteriophages*, vol. 1, R. Calendar, ed., Plenum Press, New York, 475-494.
- Rothman-Denes, L.B. 1995. DNA supercoiling, DNA hairpins and single-stranded DNA binding proteins in bacteriophage N4 transcription regulation. *Sem. Virol.*, 6, 15-23.