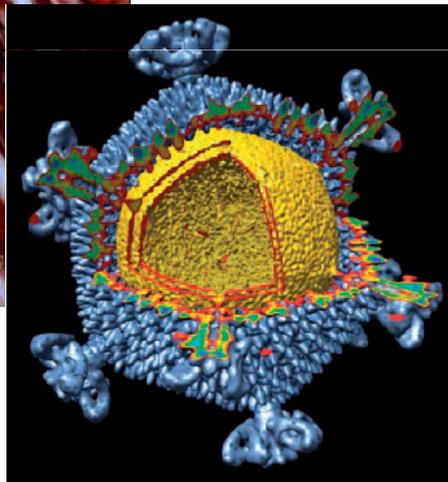




Vírus de Archaea



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Laboratório de Vírus Entéricos Humanos e Animais



Torsvik & Dundas (1974) – primo-isolamento fago-like de *Halobacterium salinarium*

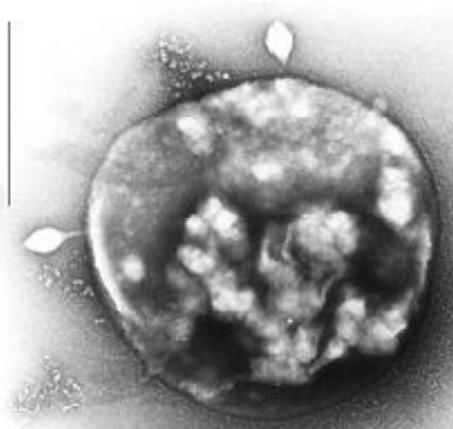
Atualmente 42 espécies conhecidas

Isolados preferencialmente de ambientes:

- acidófilos pH1,5 a 4
- termófilos - temperaturas de 45 a 80°C
- halofílicos (NaCl 0,3 a 3,4 M)



Fonte termal
[Grand Prismatic Spring](#)
[Yellowstone National Park.](#)



[Sulfolobus](#) infectada por
DNA virus STSV1 .

Vírus de Archaea



Rio Tinto, Espanha



Lago Hillier - Austrália

Vírus de Archaea ou fagos de Archaea?

Hindawi Publishing Corporation
Archaea
Volume 2013, Article ID 251245, 10 pages
<http://dx.doi.org/10.1155/2013/251245>



Review Article

Archaeal Viruses, Not Archaeal Phages: An Archaeological Dig

Stephen T. Abedon and Kelly L. Murray

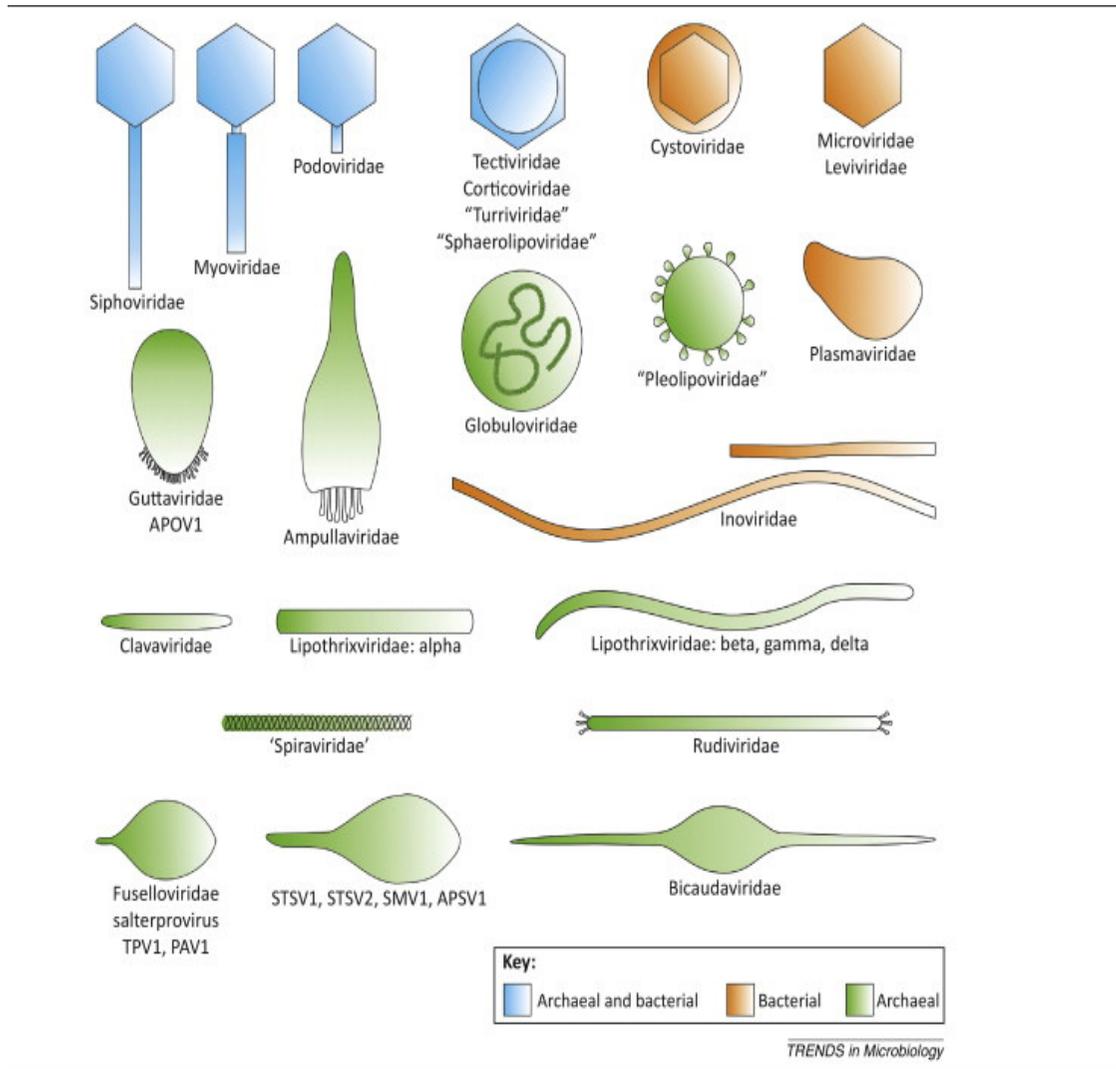
Department of Microbiology, The Ohio State University, 1680 University Drive, Mansfield, OH 44906, USA

“...the use of “Phage” should be limited in favor of “Archaeal virus” for viruses of domain *Archaea* and “Bacterial virus” for viruses of domain *Bacteria*,...”

Vírus de Archaea

Morfologia

Formas não convencionais:



Estrutura

Genoma

DNA ds ou DNA ss

Tamanho de 14 a 50kb

Linear ou circular

Envoltório

Presente em algumas espécies

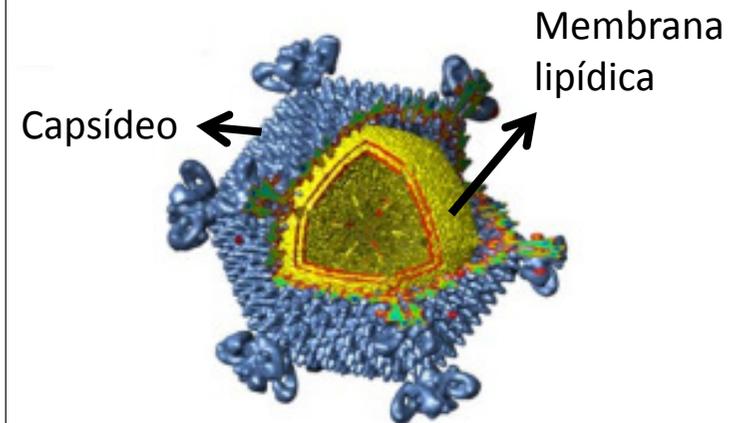


FIGURE 1. Morphological diversity in crenarchaeal viruses.

Table 1 General properties of archaeal viruses

Viral family	Morphotype	Genome (ds DNA)	Size range (kb)	Member
Crenarchaea				
<i>Rudiviridae</i>	Rod	Linear	24.6–35.4	SIRV1, SIRV2, ARV1, SRV1
<i>Lipothrixviridae</i>	Filamentous	Linear	21–42	TTV1, SIFV, AFV1, 2, 3, 6, 7, 8, 9
<i>Fuselloviridae</i>	Spindle	Circular	14.7–24.1	SSV1, 2, 4, 5, 6, 7, SSVk1, SSVrh
<i>Bicaudaviridae</i>	Spindle, bipolar tails	Circular	63	ATV
<i>Ampullaviridae</i>	Bottle	linear	23.9	ABV
<i>Globuloviridae</i>	Spherical	linear	21–28.3	PSV, TTSV1
<i>Guttaviridae</i>	Droplet, bearded	Circular, modified	20	SNDV
Unclassified	Icosahedral	Circular	16.6–17.6	STIV, STIV2
Unclassified	Tailed-fusiform	Circular	75	STSV1
Euryarchaea				
Salterprovirus	Spindle-shaped	Linear	14.5–16.1	His1, His2
Unclassified (haloarchaea)	Spherical	Linear	30.9	SH1
Unclassified (<i>Pyrococcus</i>)	Filamentous	Circular	18	PAV1
<i>Mycoviridae</i> (haloarchaea)	Head-tail	Linear	59–78	HF1, HF2, ØH1, ØCh1, Hs1
<i>Siphoviridae</i> (<i>Methanogens</i> , haloarchaea)	Head-tail	Linear	28.7–80	ψM1, ψM2, ψM100, ØF1, ØF3, BJ1

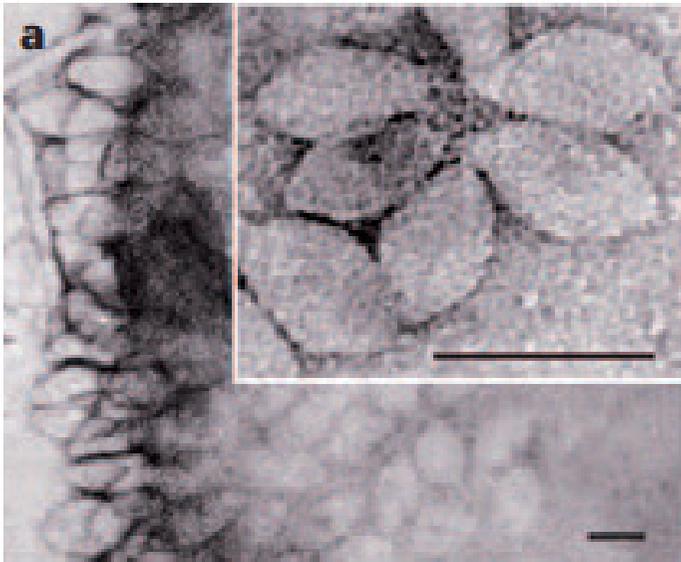
Vírus fusiformes

Família Fuselloviridae

Sulfolobus spindle-shaped virus 1
(SSV1)

Infecta a Archaea hipertermofílica
Sulfolobus (Chrenarcheota)

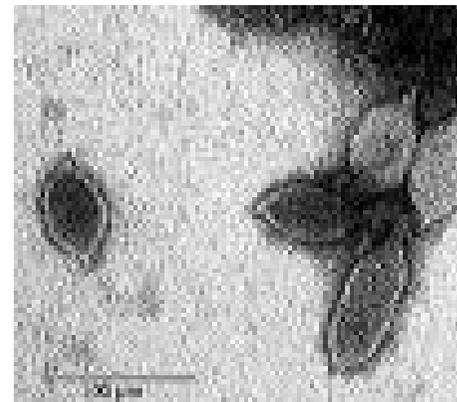
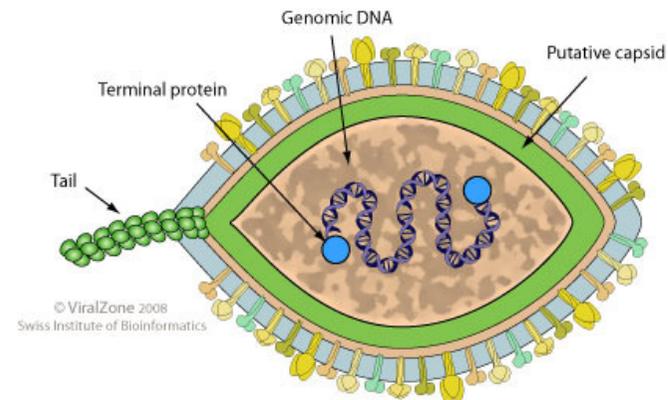
DNA fita dupla circular
Não lítico



Gênero Salterprovirus

Halovirus His1
Halovirus His2

Infecta Archaea halofílica
Haloarcula hispanica (Euryarchaeota)



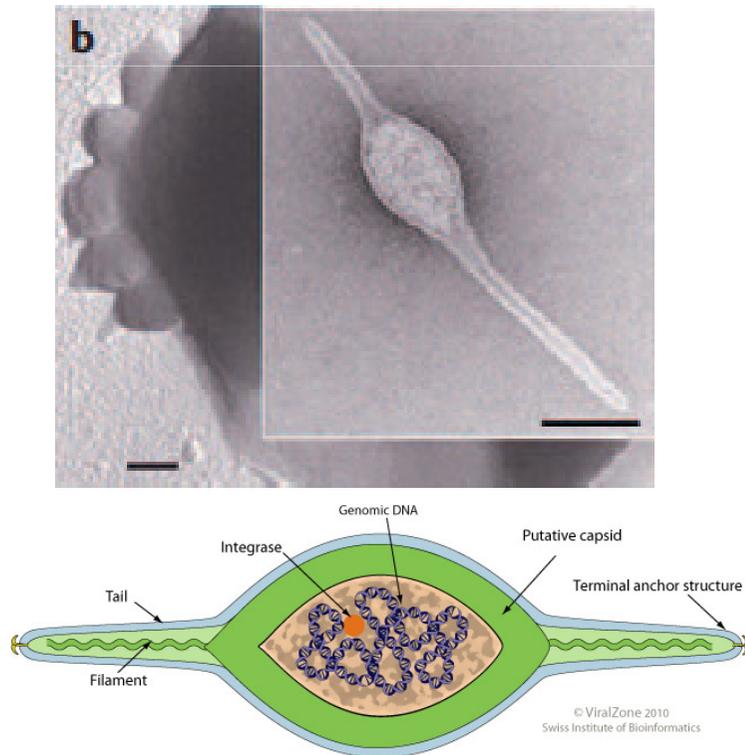
DNA fd linear
líticos/crônicos?

Bicaudaviridae

Acidianus two-tailed virus (ATV)

Infecta Archaea acidofílica e hipertermofílica
(*Sulfolobus*, *Acidianus*,
Thermoproteus and *Pyrobaculum*)

DNA fita dupla circular
lítico



Liberado da célula hospedeira sem
cauda e só então desenvolve longa
cauda (acima de 75°C)

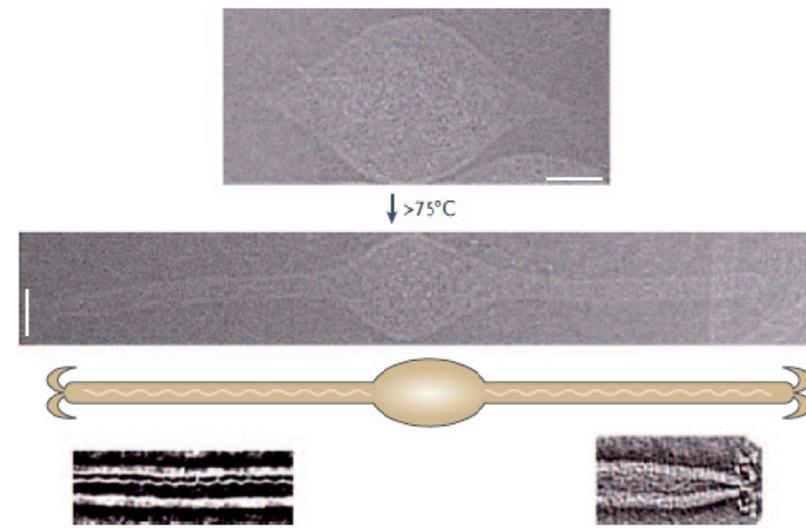
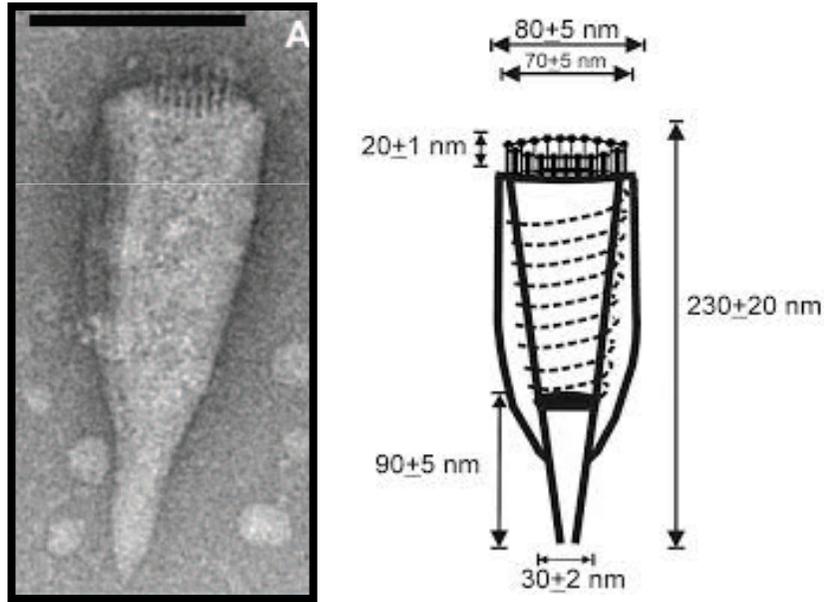


Figure 2 | Extracellular tail development of *Acidianus* two-tailed virus (ATV).

Vírus em formato de garrafa e de gota

Ampullaviridae

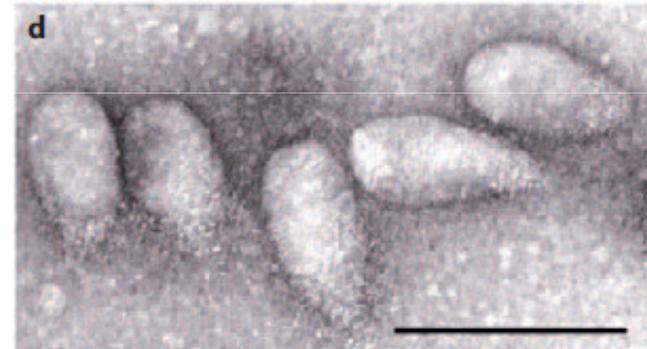
Acidianus bottle-shaped virus (ABV)



Infecta Archaea hipertermofílica do gênero *Acidianus*

Guttaviridae

Sulfolobus neozealandicus droplet-shaped virus (SNDV),



Infecta Archaea hipertermofílica do gênero *Sulfolobus*

Vírus lineares ou filamentosos

Predominam em ambientes terrestres com temperaturas acima de 80°C

Rudiviridae

Sulfolobus islandicus rod-shaped virus 1 (SIRV-1)
Sulfolobus islandicus rod-shaped virus 2 (SIRV-2)

DNA dupla fita linear
Sem envoltório

Isolados de fumarolas sulfurosas na Islandia

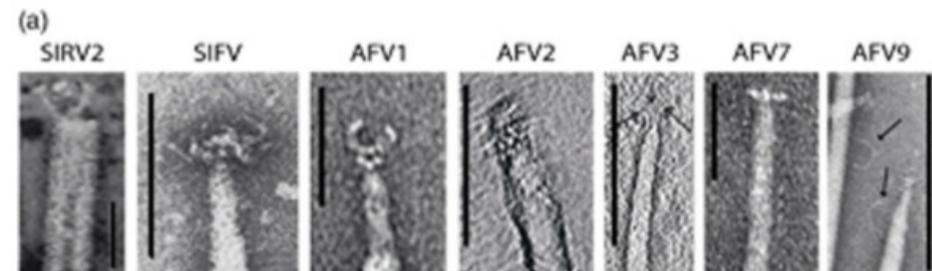
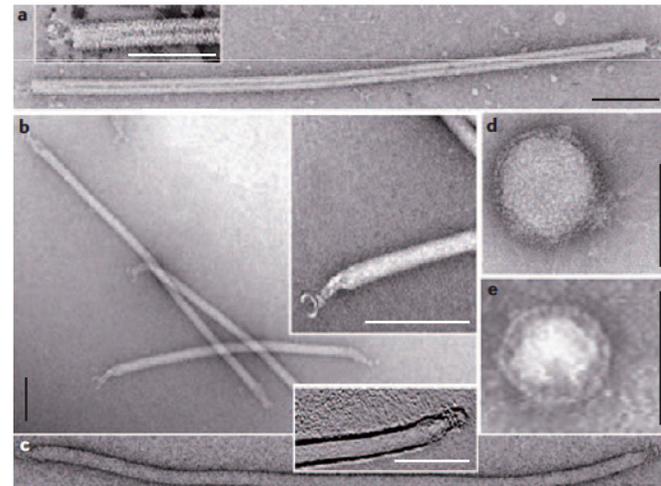


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Lipothrixviridae

Acidianus filamentous virus (AF1)

DNA fita dupla linear
Com envoltório com ganchos terminais



Vírus Esféricos

Globuloviridae

Pyrobaculum spherical virus 1 (PSV-1)

Thermoproteus tenax spherical vírus-1 (TTSV1)

DNA fita dupla linear
Com envoltório

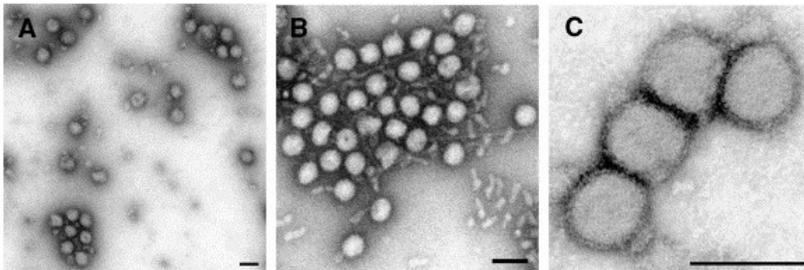


Fig. 4

Infectam arqueias hipertermofílicas dos gêneros *Pyrobaculum* e *Thermoproteus*

Não classificados

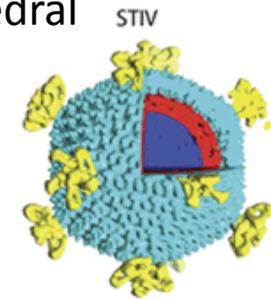
Infectam arqueias hipertermofílicas do gênero *Sulfolobus*

vírus temperados ou lisogênicos permanentes (sem lise hosp.)

Sulfolobus turreted icosahedral virus (STIV-1)

DNA fita dupla circular com envoltório interno

Sulfolobus solfataricus (Solfataria, Itália)

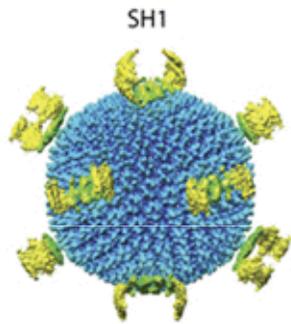


Vírus Esféricos

Não classificados

Spherical halovirus 1

Infectam haloarchaea



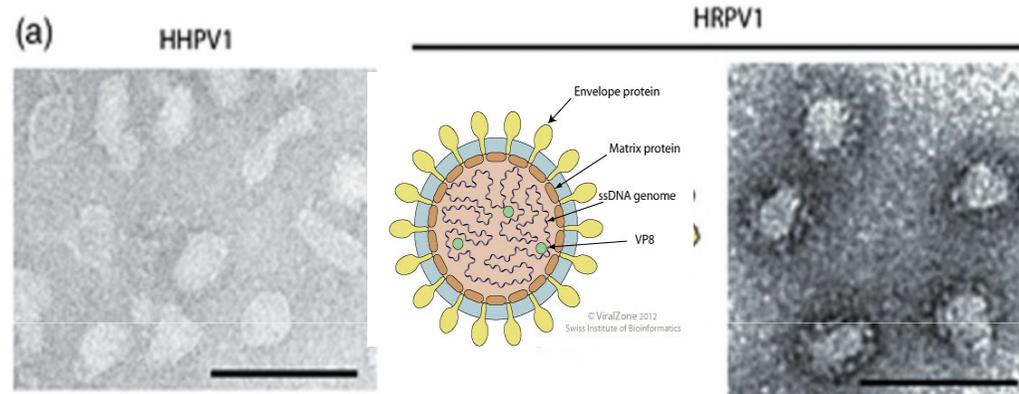
DNA fita dupla linear
sem envoltório



Lagos salinos australianos

Virus pleomorfos

Infectam arqueias hiperhalofílicas
do gênero Halorubrum



Haloarcola hispanica pleomorphic virus 1
(HHPV-1)

DNA fita dupla

Halorubrum pleomorphic virus 1
(HRPV-1)

DNA fita simples
Com envoltório

“Head-tail viruses”

Fagos associados ao Phylum *Euryarchaeota*

Halofitas extremos ou metanogênicos

Semelhantes a fagos *Myoviridae* e *Siphoviridae*

Familia Siphoviridae

Gênero Psimunalikevirus

Espécie Methanobacterium phage psiM1

DNA fita dupla

Sem envoltório

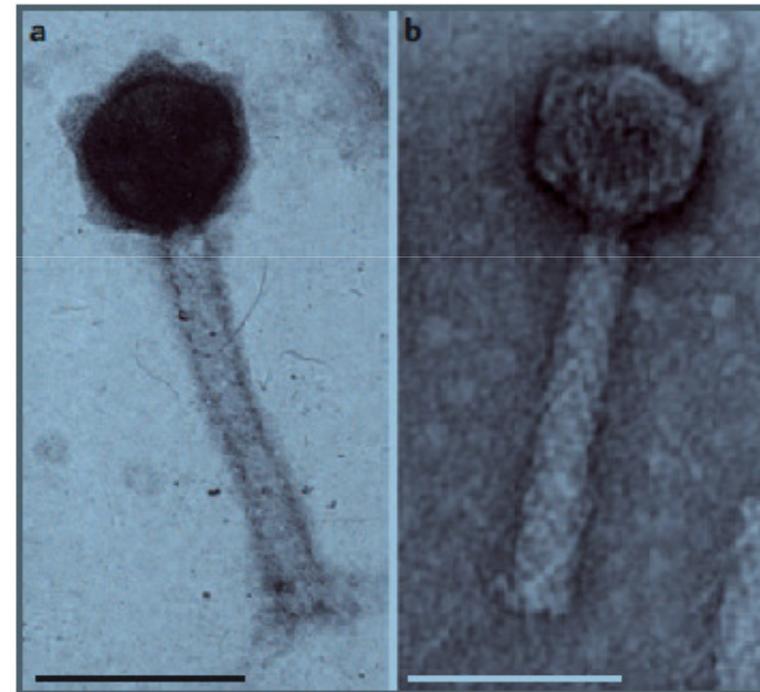


Figure 4 | Electron micrographs of head-tail viruses of archaea and bacteria. **a** | The haloarchaeal virus ϕ H1. **b** | The bacteriophage P2. Both are negatively stained with uranyl acetate. Scale bars represent 100 nm. Part **a** is courtesy of W. Zillig. Part **b** is reproduced with permission from <http://www.biochem.wisc.edu/inman/empics>.

Interação parasita-hospedeiro

Phylum Crenarchaeota maioria estabelece relação estável (portador crônico) com seus hospedeiros, sendo poucos líticos, em alguns casos lisogênicos

Família Sulfolobaceae

Gênero Sulfolobus – acidófilos (pH 2-3) e termófilos (75°C a 80°C),
Gênero Acidianus

Família Thermoproteaceae

Gênero Thermoproteus – termófilos, dependentes de enxofre
Gênero Pirobaculum – termófilo, fumarolas marinhas e termas vulcânicas

Família Desulfurococcaceae

Gênero Aeropyrum – termofílico obrigatório, termais Japão

Phylum Euryarchaeota

maioria líticos

Hipertermófilos - gênero *Thermococcus*

Hiperhalófilos – classe *Halobacteria*

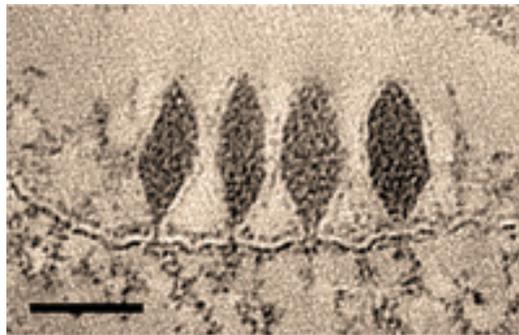
Metanogênicas – classe *Methanobacteria*

Interação parasita-hospedeiro

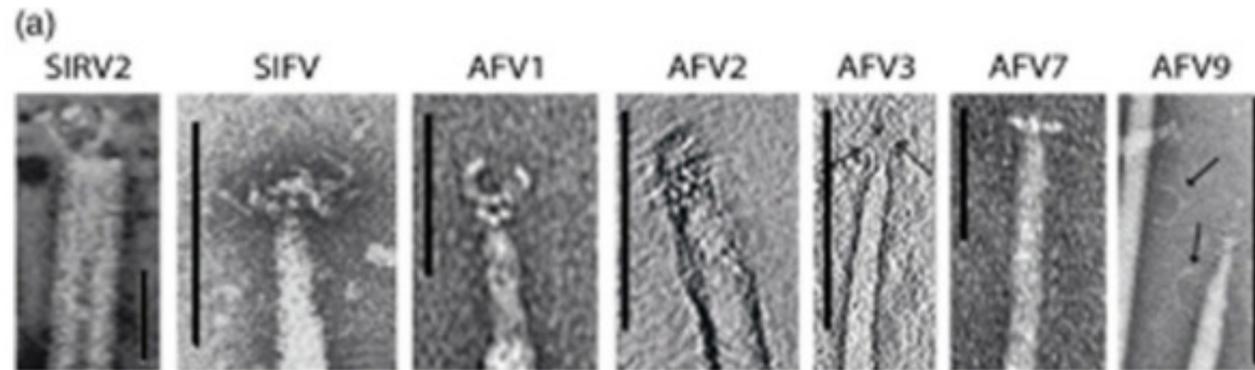
1. Mecanismos de adsorção e penetração

- Uso de ganchos para interação direta com membrana celular ou com pili;
- Fusão do envoltório com MC
- Injeção do genoma

Lipothrixviridae

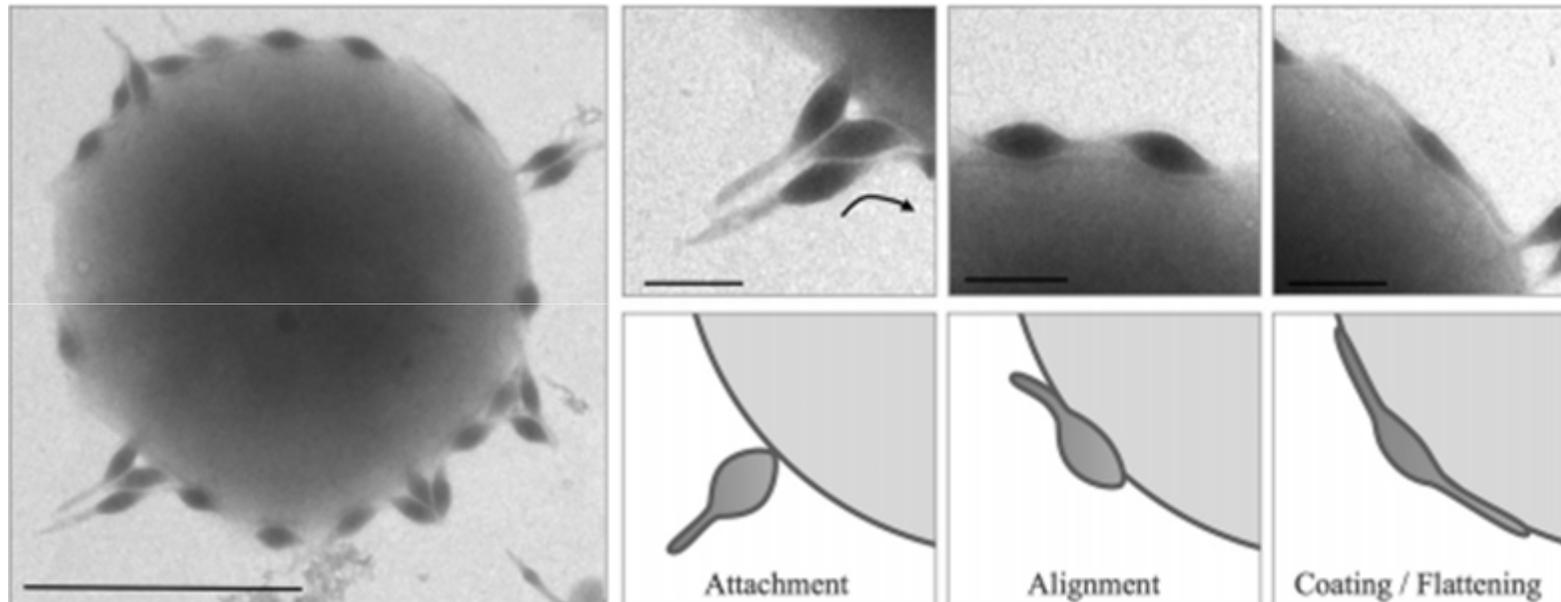


SSV1 virions attached to the cell surface (bar, 50 nm).
Image courtesy of P. Chlanda, NIH, Maryland, USA.



Interação parasita-hospedeiro

Sulfolobus monocaudavirus 1 (SMV1)* cultivado em *Sulfolobus islandicus* cepa Δ C1C2



Uldahl KB et al., 2016. Life cycle characterization of *Sulfolobus monocaudavirus 1*, an extremophilic spindle-shaped virus with extracellular tail development. *J Virol* 90:5693–5699.

* Yellowstone National Park

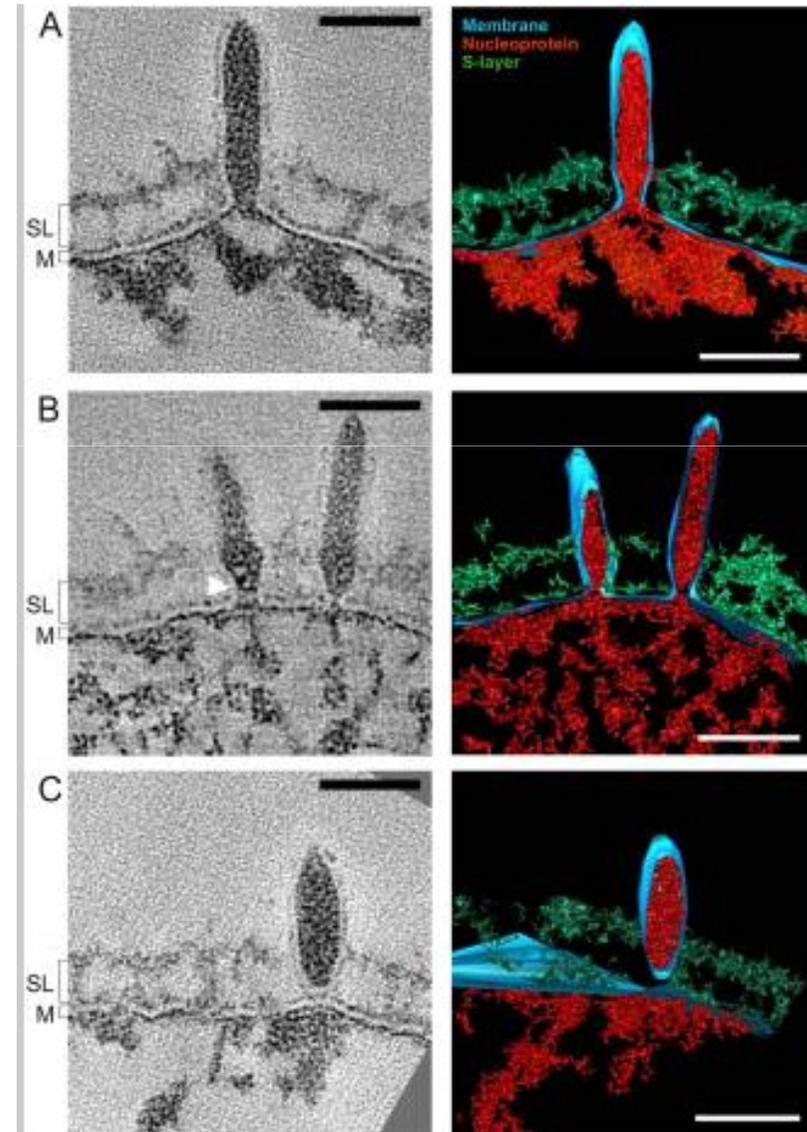
Interação parasita-hospedeiro

2. Mecanismo de liberação

Alguns líticos

Alguns saem por brotamento (pleomorfos que infectam Euryarchaea)

Alguns formam VAPs



Video S1

Budding of a rod-shaped SSV1 virus. The video of a tomogram and rendering corresponds to that in [Fig. 1A](#). Scale bar, 50 nm. Download [Video S1, AVI file, 6.4 MB](#)^(6.5M, avi)

Virus-associated pyramids (VAPs)



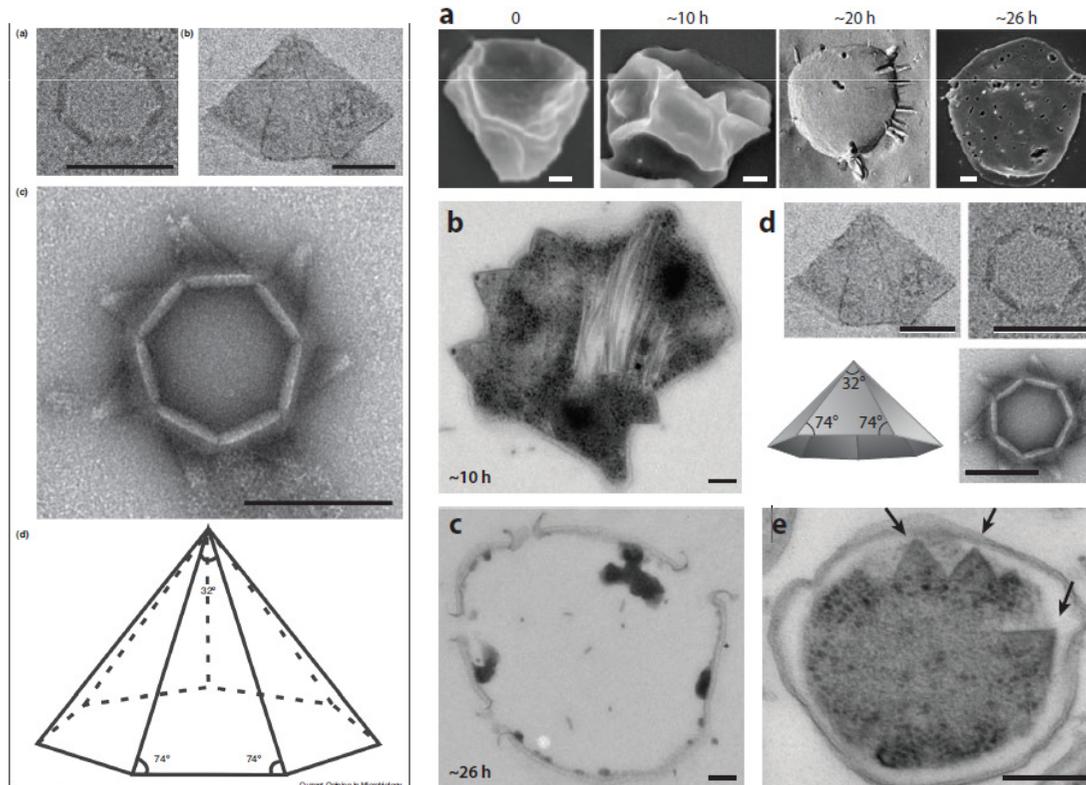
Available online at www.sciencedirect.com



Exceptional virion release mechanism: one more surprise from archaeal viruses

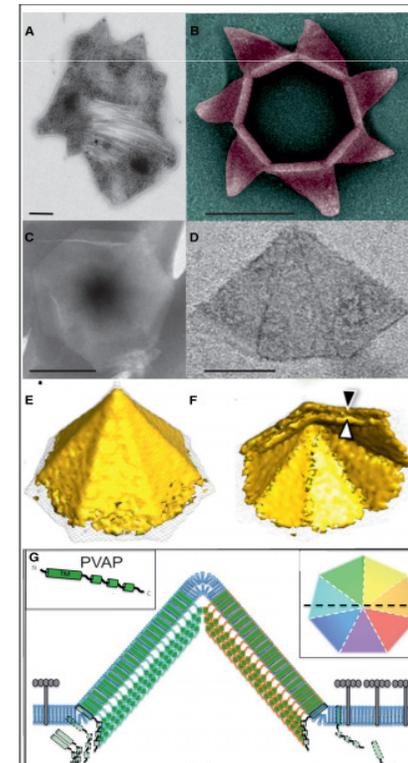
David Prangishvili and Tessa EF Quax

Current Opinion in Microbiology 2011, 14:315–320



Sulfolobus islandicus rod-shaped virus 2 (SIRV-2)

Sulfolobus turreted icosahedral virus (STIV-1)



Peng X, *et al.* *Sci China Life Sci* May (2012) Vol.55 No.5

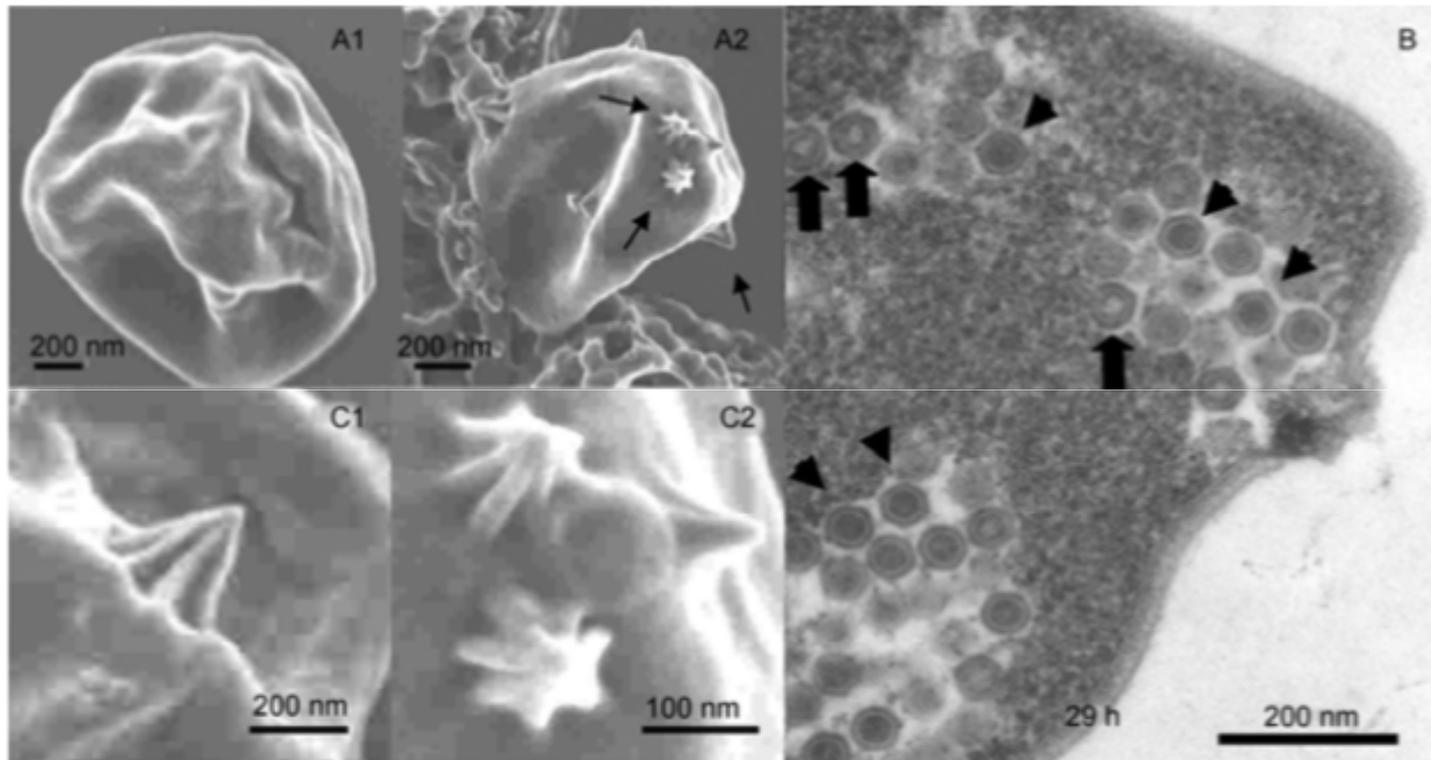


Figure 6 Electron micrographs of *S. solfataricus* cells at different stages of infection with STIV1. (adapted from Brumfield *et al.* [42]).