

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- | | | |
|-------------------------------------|-------------------------------------|--|
| ☒ | ☒ | The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement |
| ☒ | ☐ | A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly |
| ☒ | ☐ | The statistical test(s) used AND whether they are one- or two-sided
<i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i> |
| ☒ | ☐ | A description of all covariates tested |
| ☒ | ☐ | A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons |
| ☒ | ☐ | A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals) |
| ☒ | ☐ | For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
<i>Give P values as exact values whenever suitable.</i> |
| ☒ | ☐ | For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings |
| ☒ | ☐ | For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes |
| ☒ | ☐ | Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated |

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection EPU version 2.5

Data analysis MotionCor2; CTFFIND-4.1.13; cryoSPARC v4.5.1; Chimera v1.16; Molprobity, Phenix-1.16; Coot-0.8.9; UCSF ChimeraX 1.7; ModelAngelo, trRosetta, Multalin web server (<http://multalin.toulouse.inra.fr/multalin/>), ESPript 3.0 web server (<https://esprict.ibcp.fr/ESPript/ESPript/index.php>), TM-align algorithm web server (<https://www.rcsb.org/alignment>), PISA and PDBSum web servers (http://www.ebi.ac.uk/pdbe/prot_int/pistart.html and <https://www.ebi.ac.uk/thornton-srv/databases/pdbsum/>).

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

The atomic coordinate of NiV L-P complex has been deposited in PDB with accession number 9CGI [<http://doi.org/10.2210/pdb9CGI/pdb>]. The cryo-EM density map has been deposited in the Electron Microscopy Data Bank with accession number EMD-45580 [<https://www.ebi.ac.uk/pdbe/entry/emdb/EMD-45580>]. The

coordinates we used for structural comparison and analysis include PDBs: 6EB8 [http://doi.org/10.2210/pdb6EB8/pdb], 6PZK [http://doi.org/10.2210/pdb6PZK/pdb], 6QCT [http://doi.org/10.2210/pdb6QCT/pdb], 6U1X [http://doi.org/10.2210/pdb6U1X/pdb], 6U5O [http://doi.org/10.2210/pdb6U5O/pdb], 6UEB [http://doi.org/10.2210/pdb6UEB/pdb], 6UEN [http://doi.org/10.2210/pdb6UEN/pdb], 6V85 [http://doi.org/10.2210/pdb6V85/pdb], 7YER [http://doi.org/10.2210/pdb7YER/pdb], 7YET [http://doi.org/10.2210/pdb7YET/pdb], 7YOV [http://doi.org/10.2210/pdb7YOV/pdb], 8FPJ [http://doi.org/10.2210/pdb8FPJ/pdb], 8FU3 [http://doi.org/10.2210/pdb8FU3/pdb], 8IZM [http://doi.org/10.2210/pdb8IZM/pdb], 8KDC [http://doi.org/10.2210/pdb8KDC/pdb], 8SNX [http://doi.org/10.2210/pdb8SNX/pdb].

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	N/A
Reporting on race, ethnicity, or other socially relevant groupings	N/A
Population characteristics	N/A
Recruitment	N/A
Ethics oversight	N/A

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	No statistical methods were used to predetermine sample size. Sufficient cryo-EM data were collected to achieve adequate map resolutions for model building.
Data exclusions	No data were excluded from analyses.
Replication	Sample preparation-related experiments including protein purification and enzymatic assays were reproduced at least twice independently. All attempts at replication were successful.
Randomization	Randomization was not relevant to our study because our study did not involve the allocation of samples/organisms/participants into experimental groups.
Blinding	Investigators were not blinded to group allocation because group allocation was not involved in our study. Investigators were not blinded during data collection because the data being collected were quantitative in nature and were not prone to subjective interpretation.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☐	☒ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	Mouse anti-6X His-tag monoclonal mouse antibody(Invitrogen, clone GT359, SAB2702219, 1:3000 dilution), rabbit anti-strep-tag polyclonal antibody(Genscript, A00875, 1:3000 dilution), goat anti-rabbit HRP-conjugated secondary antibody(Cell Signaling Technology, 7074S, 1:5000 dilution) and rabbit anti-mouse HRP-conjugated secondary antibody(Cell Signaling Technology, 58802S, 1:5000 dilution).
Validation	All antibodies used in this study were validated by the manufacturer. Mouse anti-6X His-tag monoclonal mouse antibody https://www.sigmaaldrich.com/US/en/product/sigma/sab2702219 Rabbit anti-strep-tag polyclonal antibody https://www.genscript.com/antibody/A00875-NWSHPQFEK_Antibody_HRP_pAb_Rabbit.html?page_no=1&position_no=1&sensors=googlesearch&_gl=1*7lev4a*_up*MQ..&gclid=Cj0KCQjw-uK0BhC0ARIsANQtgGOuRjYetmY9oGcBBHLUHBi9JgqnXCzj-BloNJRgQoN__AerSYZYLxcaAuxdEALw_wcB Goat anti-rabbit HRP-conjugated secondary antibody https://www.cellsignal.com/products/secondary-antibodies/anti-rabbit-igg-hrp-linked-antibody/7074 Rabbit anti-mouse HRP-conjugated secondary antibody https://www.cellsignal.com/products/secondary-antibodies/rabbit-anti-mouse-igg-light-chain-specific-d3v2a-mab-hrp-conjugate/58802

Eukaryotic cell lines

Policy information about [cell lines and Sex and Gender in Research](#)

Cell line source(s)	Spodoptera frugiperda(sf9) cells(ThermoFisher), Trichoplusia ni(Tni) cells(Expression Systems), HECK293T cells(ATCC)
Authentication	The cell line was purchased from ThermoFisher, Expression Systems and ATCC was not authenticated
Mycoplasma contamination	Mycoplasma testing revealed no contamination.
Commonly misidentified lines (See ICLAC register)	No commonly misidentified cell lines were used

Plants

Seed stocks	N/A
Novel plant genotypes	N/A
Authentication	N/A