



## Full wwPDB EM Validation Report ⓘ

Jul 16, 2025 – 01:43 AM JST

PDB ID : 8Z9Q / pdb\_00008z9q  
EMDB ID : EMD-39867  
Title : Cryo-EM structure of Thogoto virus polymerase in a replication reception conformation  
Authors : Xue, L.; Chang, T.; Li, Z.; Zhao, H.; Li, M.; He, J.; Chen, X.; Xiong, X.  
Deposited on : 2024-04-23  
Resolution : 2.33 Å (reported)

This is a Full wwPDB EM Validation Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

A user guide is available at

<https://www.wwpdb.org/validation/2017/EMValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

EMDB validation analysis : **FAILED**  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
MolProbity : 4-5-2 with Phenix2.0rc1  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
MapQ : **FAILED**  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.44

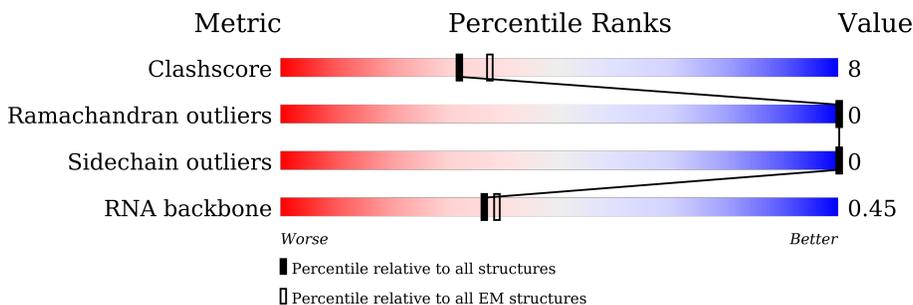
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*ELECTRON MICROSCOPY*

The reported resolution of this entry is 2.33 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



| Metric                | Whole archive (#Entries) | EM structures (#Entries) |
|-----------------------|--------------------------|--------------------------|
| Clashscore            | 210492                   | 15764                    |
| Ramachandran outliers | 207382                   | 16835                    |
| Sidechain outliers    | 206894                   | 16415                    |
| RNA backbone          | 6643                     | 2191                     |

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions  $\leq 5\%$ .

| Mol | Chain | Length | Quality of chain                   |
|-----|-------|--------|------------------------------------|
| 1   | A     | 622    | 81% (Green) 19% (Yellow)           |
| 2   | B     | 710    | 69% (Green) 22% (Yellow) 9% (Grey) |
| 3   | C     | 827    | 22% (Green) 7% (Yellow) 71% (Grey) |
| 4   | D     | 10     | 60% (Green) 40% (Yellow)           |

## 2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 12362 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Polymerase acidic protein.

| Mol | Chain | Residues | Atoms |      |     |     |    | AltConf | Trace |
|-----|-------|----------|-------|------|-----|-----|----|---------|-------|
|     |       |          | Total | C    | N   | O   | S  |         |       |
| 1   | A     | 621      | 5020  | 3172 | 874 | 946 | 28 | 0       | 0     |

There is a discrepancy between the modelled and reference sequences:

| Chain | Residue | Modelled | Actual | Comment  | Reference  |
|-------|---------|----------|--------|----------|------------|
| A     | 471     | GLU      | GLY    | conflict | UNP P27194 |

- Molecule 2 is a protein called RNA-directed RNA polymerase catalytic subunit.

| Mol | Chain | Residues | Atoms |      |     |     |    | AltConf | Trace |
|-----|-------|----------|-------|------|-----|-----|----|---------|-------|
|     |       |          | Total | C    | N   | O   | S  |         |       |
| 2   | B     | 647      | 5190  | 3305 | 896 | 956 | 33 | 0       | 0     |

There are 2 discrepancies between the modelled and reference sequences:

| Chain | Residue | Modelled | Actual | Comment  | Reference  |
|-------|---------|----------|--------|----------|------------|
| B     | 7       | LEU      | ARG    | conflict | UNP O41353 |
| B     | 230     | TRP      | CYS    | conflict | UNP O41353 |

- Molecule 3 is a protein called Polymerase basic protein 2.

| Mol | Chain | Residues | Atoms |      |     |     |    | AltConf | Trace |
|-----|-------|----------|-------|------|-----|-----|----|---------|-------|
|     |       |          | Total | C    | N   | O   | S  |         |       |
| 3   | C     | 237      | 1926  | 1228 | 337 | 348 | 13 | 0       | 0     |

There are 58 discrepancies between the modelled and reference sequences:

| Chain | Residue | Modelled | Actual | Comment        | Reference  |
|-------|---------|----------|--------|----------------|------------|
| C     | 770     | LEU      | -      | expression tag | UNP Q9YNA4 |
| C     | 771     | GLU      | -      | expression tag | UNP Q9YNA4 |
| C     | 772     | VAL      | -      | expression tag | UNP Q9YNA4 |

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| Chain | Residue | Modelled | Actual | Comment        | Reference  |
|-------|---------|----------|--------|----------------|------------|
| C     | 773     | LEU      | -      | expression tag | UNP Q9YNA4 |
| C     | 774     | PHE      | -      | expression tag | UNP Q9YNA4 |
| C     | 775     | GLN      | -      | expression tag | UNP Q9YNA4 |
| C     | 776     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 777     | PRO      | -      | expression tag | UNP Q9YNA4 |
| C     | 778     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 779     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 780     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 781     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 782     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 783     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 784     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 785     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 786     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 787     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 788     | ALA      | -      | expression tag | UNP Q9YNA4 |
| C     | 789     | ASP      | -      | expression tag | UNP Q9YNA4 |
| C     | 790     | TYR      | -      | expression tag | UNP Q9YNA4 |
| C     | 791     | LYS      | -      | expression tag | UNP Q9YNA4 |
| C     | 792     | ASP      | -      | expression tag | UNP Q9YNA4 |
| C     | 793     | ASP      | -      | expression tag | UNP Q9YNA4 |
| C     | 794     | ASP      | -      | expression tag | UNP Q9YNA4 |
| C     | 795     | ASP      | -      | expression tag | UNP Q9YNA4 |
| C     | 796     | LYS      | -      | expression tag | UNP Q9YNA4 |
| C     | 797     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 798     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 799     | TRP      | -      | expression tag | UNP Q9YNA4 |
| C     | 800     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 801     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 802     | PRO      | -      | expression tag | UNP Q9YNA4 |
| C     | 803     | GLN      | -      | expression tag | UNP Q9YNA4 |
| C     | 804     | PHE      | -      | expression tag | UNP Q9YNA4 |
| C     | 805     | GLU      | -      | expression tag | UNP Q9YNA4 |
| C     | 806     | LYS      | -      | expression tag | UNP Q9YNA4 |
| C     | 807     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 808     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 809     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 810     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 811     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 812     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 813     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 814     | GLY      | -      | expression tag | UNP Q9YNA4 |

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| Chain | Residue | Modelled | Actual | Comment        | Reference  |
|-------|---------|----------|--------|----------------|------------|
| C     | 815     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 816     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 817     | GLY      | -      | expression tag | UNP Q9YNA4 |
| C     | 818     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 819     | ALA      | -      | expression tag | UNP Q9YNA4 |
| C     | 820     | TRP      | -      | expression tag | UNP Q9YNA4 |
| C     | 821     | SER      | -      | expression tag | UNP Q9YNA4 |
| C     | 822     | HIS      | -      | expression tag | UNP Q9YNA4 |
| C     | 823     | PRO      | -      | expression tag | UNP Q9YNA4 |
| C     | 824     | GLN      | -      | expression tag | UNP Q9YNA4 |
| C     | 825     | PHE      | -      | expression tag | UNP Q9YNA4 |
| C     | 826     | GLU      | -      | expression tag | UNP Q9YNA4 |
| C     | 827     | LYS      | -      | expression tag | UNP Q9YNA4 |

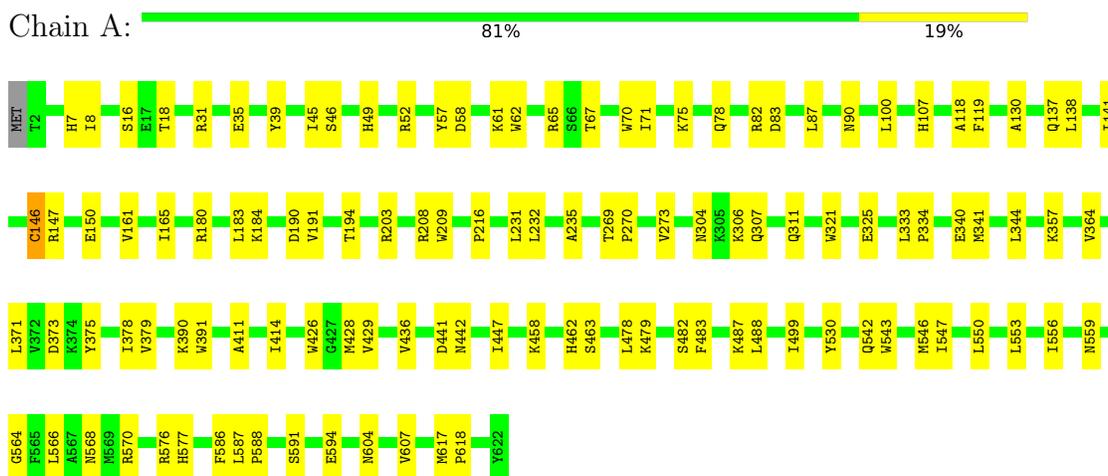
- Molecule 4 is a RNA chain called RNA (5'-D\*(ATP))-R(P\*GP\*CP\*AP\*AP\*AP\*AP\*AP\*CP\*A)-3').

| Mol | Chain | Residues | Atoms |    |    |    | AltConf | Trace |   |
|-----|-------|----------|-------|----|----|----|---------|-------|---|
|     |       |          | Total | C  | N  | O  |         |       | P |
| 4   | D     | 10       | 226   | 98 | 46 | 70 | 12      | 0     | 0 |

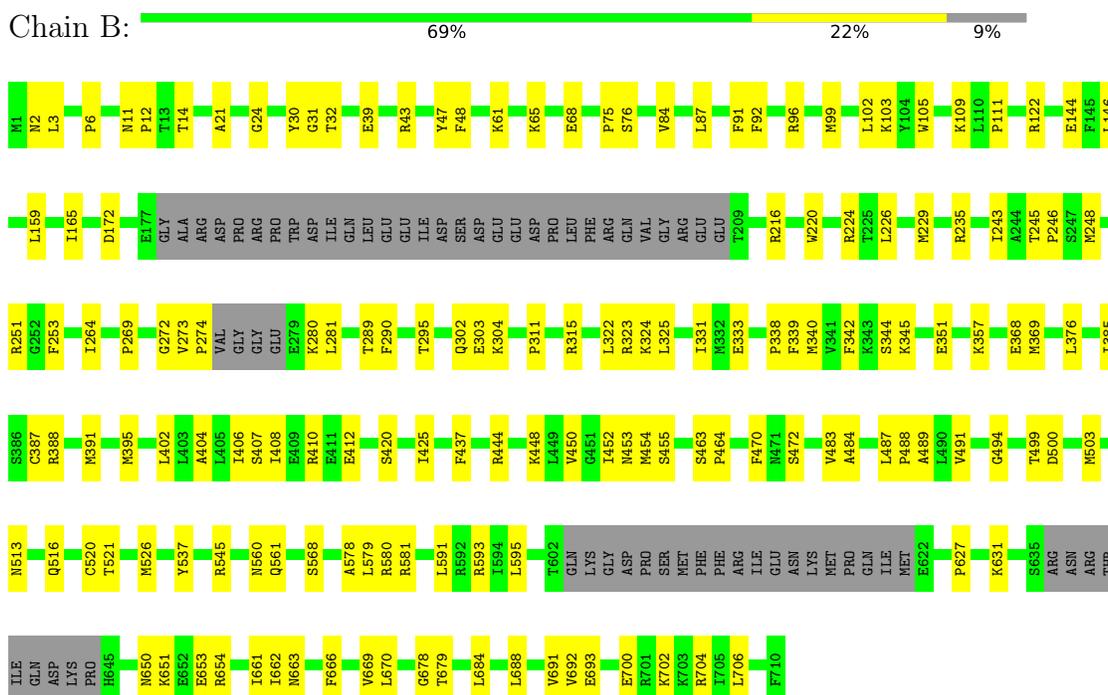
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: Polymerase acidic protein



- Molecule 2: RNA-directed RNA polymerase catalytic subunit



• Molecule 3: Polymerase basic protein 2



• Molecule 4: RNA (5'-D\*(ATP))-R(P\*GP\*CP\*AP\*AP\*AP\*AP\*AP\*CP\*A)-3')



## 4 Experimental information

| Property                             | Value                                   | Source    |
|--------------------------------------|-----------------------------------------|-----------|
| EM reconstruction method             | SINGLE PARTICLE                         | Depositor |
| Imposed symmetry                     | POINT, Not provided                     |           |
| Number of particles used             | 592143                                  | Depositor |
| Resolution determination method      | FSC 0.143 CUT-OFF                       | Depositor |
| CTF correction method                | PHASE FLIPPING AND AMPLITUDE CORRECTION | Depositor |
| Microscope                           | TFS KRIOS                               | Depositor |
| Voltage (kV)                         | 300                                     | Depositor |
| Electron dose ( $e^-/\text{\AA}^2$ ) | 50                                      | Depositor |
| Minimum defocus (nm)                 | 600                                     | Depositor |
| Maximum defocus (nm)                 | 2400                                    | Depositor |
| Magnification                        | Not provided                            |           |
| Image detector                       | TFS FALCON 4i (4k x 4k)                 | Depositor |

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: ATP

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with  $|Z| > 5$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

| Mol | Chain | Bond lengths |             | Bond angles |                |
|-----|-------|--------------|-------------|-------------|----------------|
|     |       | RMSZ         | # $ Z  > 5$ | RMSZ        | # $ Z  > 5$    |
| 1   | A     | 0.11         | 0/5135      | 0.29        | 2/6967 (0.0%)  |
| 2   | B     | 0.13         | 0/5294      | 0.30        | 0/7150         |
| 3   | C     | 0.10         | 0/1975      | 0.28        | 0/2676         |
| 4   | D     | 0.09         | 0/219       | 0.18        | 0/339          |
| All | All   | 0.12         | 0/12623     | 0.29        | 2/17132 (0.0%) |

There are no bond length outliers.

All (2) bond angle outliers are listed below:

| Mol | Chain | Res | Type | Atoms  | Z    | Observed(°) | Ideal(°) |
|-----|-------|-----|------|--------|------|-------------|----------|
| 1   | A     | 146 | CYS  | CA-C-N | 5.97 | 132.95      | 121.54   |
| 1   | A     | 146 | CYS  | C-N-CA | 5.97 | 132.95      | 121.54   |

There are no chirality outliers.

There are no planarity outliers.

### 5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

| Mol | Chain | Non-H | H(model) | H(added) | Clashes | Symm-Clashes |
|-----|-------|-------|----------|----------|---------|--------------|
| 1   | A     | 5020  | 0        | 4960     | 82      | 0            |
| 2   | B     | 5190  | 0        | 5257     | 117     | 0            |
| 3   | C     | 1926  | 0        | 1938     | 41      | 0            |
| 4   | D     | 226   | 0        | 111      | 3       | 0            |
| All | All   | 12362 | 0        | 12266    | 206     | 0            |

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 8.

All (206) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 2:B:302:GLN:HE21 | 2:B:452:ILE:HG22 | 1.45                     | 0.80              |
| 2:B:253:PHE:HB3  | 2:B:338:PRO:HG3  | 1.62                     | 0.80              |
| 2:B:302:GLN:NE2  | 2:B:452:ILE:HG22 | 2.01                     | 0.74              |
| 1:A:183:LEU:HB3  | 2:B:340:MET:HE2  | 1.70                     | 0.73              |
| 1:A:321:TRP:HB2  | 2:B:369:MET:HE1  | 1.71                     | 0.71              |
| 1:A:208:ARG:HE   | 1:A:209:TRP:H    | 1.39                     | 0.70              |
| 2:B:593:ARG:HD3  | 3:C:111:GLY:H    | 1.56                     | 0.69              |
| 2:B:246:PRO:HB3  | 2:B:395:MET:HE1  | 1.74                     | 0.69              |
| 2:B:472:SER:OG   | 2:B:483:VAL:O    | 2.12                     | 0.68              |
| 2:B:273:VAL:O    | 2:B:280:LYS:NZ   | 2.27                     | 0.68              |
| 1:A:304:ASN:HB3  | 1:A:307:GLN:HE21 | 1.60                     | 0.67              |
| 2:B:76:SER:O     | 2:B:453:ASN:ND2  | 2.27                     | 0.67              |
| 2:B:87:LEU:HD13  | 2:B:407:SER:HA   | 1.75                     | 0.66              |
| 3:C:229:THR:HG22 | 3:C:233:HIS:HD2  | 1.60                     | 0.66              |
| 2:B:500:ASP:OD2  | 2:B:537:TYR:OH   | 2.13                     | 0.66              |
| 1:A:604:ASN:HB3  | 1:A:607:VAL:HB   | 1.78                     | 0.66              |
| 1:A:576:ARG:NH1  | 1:A:617:MET:SD   | 2.71                     | 0.64              |
| 2:B:172:ASP:OD1  | 2:B:216:ARG:NH2  | 2.24                     | 0.64              |
| 1:A:340:GLU:OE1  | 1:A:458:LYS:NZ   | 2.26                     | 0.63              |
| 1:A:559:ASN:HD21 | 1:A:604:ASN:HD22 | 1.45                     | 0.62              |
| 2:B:670:LEU:O    | 3:C:217:ARG:NH2  | 2.33                     | 0.62              |
| 2:B:487:LEU:HD12 | 2:B:488:PRO:HD2  | 1.83                     | 0.61              |
| 2:B:303:GLU:HB3  | 2:B:455:SER:HB2  | 1.83                     | 0.61              |
| 2:B:144:GLU:OE1  | 3:C:33:LYS:NZ    | 2.35                     | 0.59              |
| 2:B:220:TRP:O    | 2:B:224:ARG:HG3  | 2.03                     | 0.58              |
| 1:A:235:ALA:HB2  | 1:A:344:LEU:HG   | 1.85                     | 0.58              |
| 1:A:208:ARG:NH2  | 2:B:437:PHE:HB3  | 2.18                     | 0.58              |
| 2:B:376:LEU:HB3  | 2:B:385:ILE:HD11 | 1.86                     | 0.58              |
| 2:B:224:ARG:HD2  | 2:B:344:SER:O    | 2.04                     | 0.58              |
| 1:A:378:ILE:HG13 | 1:A:379:VAL:HG13 | 1.84                     | 0.58              |
| 2:B:581:ARG:HB2  | 2:B:591:LEU:HD11 | 1.85                     | 0.58              |
| 2:B:595:LEU:HD12 | 3:C:119:VAL:HG13 | 1.85                     | 0.58              |
| 1:A:216:PRO:HB3  | 1:A:594:GLU:HB3  | 1.85                     | 0.58              |
| 1:A:45:ILE:O     | 1:A:137:GLN:NE2  | 2.37                     | 0.57              |
| 3:C:163:ASN:O    | 3:C:166:SER:OG   | 2.21                     | 0.57              |
| 3:C:183:ASP:OD1  | 3:C:186:ARG:NH1  | 2.37                     | 0.57              |
| 1:A:184:LYS:HE3  | 1:A:190:ASP:HA   | 1.85                     | 0.57              |

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| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 2:B:463:SER:HB3  | 2:B:464:PRO:HD3  | 1.86                     | 0.57              |
| 1:A:586:PHE:HE2  | 2:B:463:SER:HB2  | 1.69                     | 0.56              |
| 2:B:105:TRP:HD1  | 2:B:109:LYS:HE3  | 1.70                     | 0.56              |
| 2:B:650:ASN:O    | 2:B:654:ARG:HG3  | 2.06                     | 0.56              |
| 2:B:494:GLY:HA2  | 3:C:57:LEU:HD13  | 1.88                     | 0.56              |
| 2:B:102:LEU:HD22 | 2:B:264:ILE:HD11 | 1.88                     | 0.56              |
| 2:B:684:LEU:HD12 | 3:C:31:MET:HE1   | 1.88                     | 0.56              |
| 2:B:342:PHE:CE1  | 2:B:395:MET:HG2  | 2.41                     | 0.56              |
| 2:B:21:ALA:O     | 2:B:235:ARG:NH2  | 2.39                     | 0.56              |
| 1:A:146:CYS:O    | 1:A:147:ARG:HG2  | 2.05                     | 0.55              |
| 1:A:390:LYS:HD3  | 1:A:426:TRP:CE3  | 2.42                     | 0.55              |
| 2:B:39:GLU:O     | 2:B:43:ARG:HG3   | 2.07                     | 0.55              |
| 3:C:173:GLN:HG3  | 3:C:190:MET:HE1  | 1.89                     | 0.55              |
| 2:B:315:ARG:HD3  | 2:B:340:MET:HG3  | 1.89                     | 0.54              |
| 3:C:171:LEU:HD11 | 3:C:217:ARG:HG2  | 1.90                     | 0.54              |
| 2:B:499:THR:O    | 2:B:503:MET:HG2  | 2.07                     | 0.54              |
| 1:A:483:PHE:HD2  | 1:A:488:LEU:HG   | 1.72                     | 0.54              |
| 1:A:31:ARG:O     | 1:A:35:GLU:HG2   | 2.07                     | 0.54              |
| 3:C:180:THR:OG1  | 3:C:184:SER:OG   | 2.24                     | 0.54              |
| 1:A:530:TYR:O    | 2:B:2:ASN:ND2    | 2.35                     | 0.53              |
| 3:C:86:ASP:OD2   | 3:C:98:ARG:NH2   | 2.41                     | 0.53              |
| 2:B:248:MET:HA   | 2:B:251:ARG:HD2  | 1.89                     | 0.53              |
| 1:A:58:ASP:OD2   | 1:A:75:LYS:NZ    | 2.42                     | 0.53              |
| 1:A:273:VAL:HG23 | 1:A:478:LEU:HD13 | 1.91                     | 0.52              |
| 1:A:46:SER:O     | 1:A:49:HIS:ND1   | 2.40                     | 0.52              |
| 1:A:499:ILE:HG23 | 2:B:521:THR:HG23 | 1.91                     | 0.52              |
| 2:B:322:LEU:HD13 | 2:B:331:ILE:HG22 | 1.90                     | 0.52              |
| 1:A:390:LYS:HG3  | 1:A:414:ILE:HG21 | 1.91                     | 0.52              |
| 1:A:130:ALA:HA   | 1:A:138:LEU:HD11 | 1.92                     | 0.52              |
| 2:B:402:LEU:O    | 2:B:406:ILE:HG23 | 2.10                     | 0.52              |
| 3:C:99:ALA:HB1   | 3:C:103:VAL:HG21 | 1.92                     | 0.51              |
| 1:A:442:ASN:HB3  | 1:A:482:SER:HB3  | 1.91                     | 0.51              |
| 2:B:693:GLU:O    | 2:B:702:LYS:NZ   | 2.30                     | 0.51              |
| 2:B:105:TRP:CD1  | 2:B:109:LYS:HE3  | 2.46                     | 0.51              |
| 1:A:147:ARG:HA   | 1:A:150:GLU:HG2  | 1.94                     | 0.50              |
| 2:B:650:ASN:OD1  | 2:B:651:LYS:N    | 2.44                     | 0.50              |
| 1:A:70:TRP:NE1   | 2:B:693:GLU:OE1  | 2.44                     | 0.50              |
| 2:B:43:ARG:HD3   | 2:B:304:LYS:HD3  | 1.93                     | 0.50              |
| 2:B:425:ILE:HB   | 2:B:470:PHE:HB2  | 1.92                     | 0.50              |
| 1:A:364:VAL:HG11 | 3:C:243:PHE:HB2  | 1.94                     | 0.50              |
| 1:A:462:HIS:NE2  | 1:A:479:LYS:HD2  | 2.26                     | 0.50              |

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| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 1:A:39:TYR:HD1   | 1:A:61:LYS:HD3   | 1.76                     | 0.49              |
| 2:B:666:PHE:HE1  | 2:B:684:LEU:HD23 | 1.77                     | 0.49              |
| 3:C:100:ASN:OD1  | 3:C:101:ILE:N    | 2.45                     | 0.49              |
| 2:B:688:LEU:HD21 | 3:C:17:VAL:HG22  | 1.95                     | 0.49              |
| 1:A:436:VAL:HG13 | 1:A:441:ASP:HB2  | 1.94                     | 0.49              |
| 2:B:61:LYS:HA    | 2:B:388:ARG:HD2  | 1.93                     | 0.49              |
| 2:B:289:THR:OG1  | 2:B:290:PHE:N    | 2.46                     | 0.49              |
| 2:B:311:PRO:HG3  | 2:B:391:MET:HE3  | 1.94                     | 0.49              |
| 1:A:82:ARG:NH1   | 1:A:83:ASP:OD2   | 2.46                     | 0.49              |
| 2:B:545:ARG:NH1  | 2:B:560:ASN:O    | 2.43                     | 0.49              |
| 2:B:545:ARG:HH12 | 2:B:561:GLN:HA   | 1.78                     | 0.49              |
| 3:C:229:THR:HG22 | 3:C:233:HIS:CD2  | 2.44                     | 0.49              |
| 2:B:410:ARG:NH1  | 2:B:412:GLU:OE1  | 2.45                     | 0.48              |
| 3:C:66:PRO:HG2   | 3:C:101:ILE:HB   | 1.95                     | 0.48              |
| 1:A:65:ARG:HD2   | 3:C:181:THR:HG22 | 1.95                     | 0.48              |
| 2:B:226:LEU:HD11 | 2:B:342:PHE:CE1  | 2.49                     | 0.48              |
| 2:B:661:ILE:HD13 | 3:C:19:GLU:HG2   | 1.95                     | 0.48              |
| 1:A:180:ARG:NH2  | 2:B:333:GLU:OE2  | 2.43                     | 0.48              |
| 1:A:232:LEU:HB2  | 1:A:391:TRP:CE2  | 2.48                     | 0.48              |
| 2:B:578:ALA:HB1  | 3:C:130:VAL:HG21 | 1.94                     | 0.48              |
| 1:A:553:LEU:HD23 | 1:A:556:ILE:HD11 | 1.94                     | 0.48              |
| 2:B:11:ASN:OD1   | 2:B:14:THR:HG23  | 2.14                     | 0.47              |
| 2:B:679:THR:HA   | 3:C:34:GLN:HA    | 1.97                     | 0.47              |
| 1:A:543:TRP:CE2  | 1:A:547:ILE:HD11 | 2.49                     | 0.47              |
| 1:A:16:SER:HB3   | 1:A:62:TRP:CH2   | 2.49                     | 0.47              |
| 1:A:57:TYR:HB3   | 1:A:87:LEU:HD22  | 1.96                     | 0.47              |
| 2:B:269:PRO:HA   | 2:B:280:LYS:HE2  | 1.96                     | 0.47              |
| 1:A:577:HIS:ND1  | 2:B:12:PRO:HD2   | 2.30                     | 0.47              |
| 2:B:146:LEU:HD21 | 2:B:165:ILE:HD13 | 1.96                     | 0.47              |
| 2:B:404:ALA:O    | 2:B:408:ILE:HG12 | 2.14                     | 0.47              |
| 1:A:269:THR:O    | 1:A:463:SER:OG   | 2.24                     | 0.47              |
| 2:B:666:PHE:O    | 2:B:669:VAL:HG22 | 2.15                     | 0.47              |
| 2:B:111:PRO:HA   | 2:B:159:LEU:HD12 | 1.97                     | 0.46              |
| 1:A:75:LYS:NZ    | 1:A:90:ASN:HD21  | 2.13                     | 0.46              |
| 2:B:31:GLY:HA3   | 4:D:7:A:H4'      | 1.98                     | 0.46              |
| 2:B:281:LEU:HD22 | 2:B:470:PHE:HB3  | 1.97                     | 0.46              |
| 2:B:32:THR:HG22  | 2:B:351:GLU:HB2  | 1.97                     | 0.46              |
| 2:B:662:ILE:HG22 | 2:B:663:ASN:H    | 1.81                     | 0.46              |
| 2:B:315:ARG:HG2  | 2:B:339:PHE:HB2  | 1.96                     | 0.46              |
| 2:B:700:GLU:OE2  | 2:B:704:ARG:NH2  | 2.49                     | 0.46              |
| 1:A:542:GLN:O    | 1:A:546:MET:HG3  | 2.16                     | 0.45              |

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| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 2:B:92:PHE:CD2   | 2:B:99:MET:HE3   | 2.51                     | 0.45              |
| 1:A:7:HIS:CD2    | 1:A:8:ILE:HG13   | 2.51                     | 0.45              |
| 1:A:100:LEU:HD23 | 1:A:119:PHE:HB2  | 1.97                     | 0.45              |
| 2:B:68:GLU:H     | 2:B:68:GLU:CD    | 2.25                     | 0.45              |
| 2:B:472:SER:OG   | 2:B:472:SER:O    | 2.33                     | 0.45              |
| 1:A:321:TRP:CE2  | 2:B:357:LYS:HD2  | 2.52                     | 0.45              |
| 3:C:60:SER:HA    | 3:C:63:LYS:HE2   | 1.98                     | 0.45              |
| 3:C:151:LYS:HG2  | 3:C:229:THR:HG21 | 1.99                     | 0.45              |
| 3:C:244:LEU:HD13 | 3:C:251:VAL:HB   | 1.97                     | 0.45              |
| 1:A:306:LYS:NZ   | 4:D:10:A:OP2     | 2.32                     | 0.44              |
| 3:C:25:LYS:NZ    | 3:C:26:GLU:OE2   | 2.50                     | 0.44              |
| 1:A:429:VAL:HG23 | 1:A:447:ILE:HG12 | 2.00                     | 0.44              |
| 2:B:513:ASN:O    | 3:C:228:PRO:HG3  | 2.17                     | 0.44              |
| 2:B:578:ALA:C    | 2:B:580:ARG:H    | 2.25                     | 0.44              |
| 1:A:411:ALA:HB1  | 1:A:428:MET:SD   | 2.58                     | 0.44              |
| 2:B:444:ARG:HB2  | 2:B:454:MET:HE2  | 1.99                     | 0.44              |
| 3:C:161:GLU:O    | 3:C:161:GLU:HG2  | 2.18                     | 0.44              |
| 3:C:125:ALA:HB2  | 3:C:219:LEU:HG   | 2.00                     | 0.44              |
| 1:A:194:THR:HG22 | 2:B:323:ARG:HH12 | 1.82                     | 0.44              |
| 1:A:576:ARG:NH2  | 1:A:618:PRO:O    | 2.51                     | 0.44              |
| 1:A:231:LEU:HD13 | 1:A:483:PHE:CD1  | 2.53                     | 0.43              |
| 1:A:357:LYS:NZ   | 1:A:373:ASP:OD1  | 2.51                     | 0.43              |
| 1:A:499:ILE:HD12 | 2:B:487:LEU:HD21 | 1.99                     | 0.43              |
| 2:B:448:LYS:NZ   | 2:B:453:ASN:OD1  | 2.43                     | 0.43              |
| 2:B:650:ASN:O    | 2:B:653:GLU:HG3  | 2.18                     | 0.43              |
| 2:B:324:LYS:HB3  | 2:B:324:LYS:HE3  | 1.73                     | 0.43              |
| 2:B:272:GLY:HA3  | 2:B:420:SER:OG   | 2.19                     | 0.43              |
| 2:B:545:ARG:NH2  | 2:B:560:ASN:OD1  | 2.52                     | 0.43              |
| 3:C:41:PHE:HA    | 3:C:44:TYR:HB2   | 2.00                     | 0.43              |
| 3:C:59:TYR:O     | 3:C:63:LYS:HG3   | 2.19                     | 0.43              |
| 3:C:240:MET:O    | 3:C:244:LEU:HD23 | 2.18                     | 0.43              |
| 1:A:203:ARG:HA   | 1:A:203:ARG:HD3  | 1.69                     | 0.43              |
| 1:A:550:LEU:HD11 | 2:B:3:LEU:HD12   | 2.01                     | 0.43              |
| 1:A:161:VAL:O    | 1:A:165:ILE:HG12 | 2.18                     | 0.43              |
| 1:A:325:GLU:O    | 1:A:325:GLU:HG2  | 2.19                     | 0.43              |
| 1:A:483:PHE:CE2  | 1:A:487:LYS:HB3  | 2.53                     | 0.43              |
| 1:A:566:LEU:O    | 1:A:570:ARG:HG3  | 2.18                     | 0.43              |
| 2:B:489:ALA:HB1  | 2:B:491:VAL:HG12 | 2.01                     | 0.43              |
| 2:B:103:LYS:HB2  | 2:B:325:LEU:HD22 | 2.00                     | 0.43              |
| 2:B:253:PHE:CB   | 2:B:338:PRO:HG3  | 2.41                     | 0.43              |
| 2:B:229:MET:HE3  | 2:B:243:ILE:HD11 | 2.00                     | 0.43              |

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| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 2:B:368:GLU:HG2  | 2:B:369:MET:HG3  | 2.01                     | 0.43              |
| 2:B:688:LEU:HA   | 2:B:691:VAL:HG12 | 2.00                     | 0.43              |
| 2:B:47:TYR:CD2   | 2:B:75:PRO:HB2   | 2.54                     | 0.42              |
| 2:B:692:VAL:HG22 | 3:C:13:LEU:HD23  | 2.01                     | 0.42              |
| 1:A:209:TRP:CH2  | 1:A:588:PRO:HG3  | 2.54                     | 0.42              |
| 2:B:48:PHE:O     | 2:B:65:LYS:NZ    | 2.44                     | 0.42              |
| 2:B:96:ARG:HD3   | 2:B:96:ARG:HA    | 1.85                     | 0.42              |
| 1:A:307:GLN:O    | 1:A:311:GLN:HG3  | 2.20                     | 0.42              |
| 2:B:578:ALA:O    | 2:B:579:LEU:HB3  | 2.20                     | 0.42              |
| 3:C:69:MET:HG3   | 3:C:97:THR:HG23  | 2.00                     | 0.42              |
| 1:A:52:ARG:HA    | 1:A:52:ARG:HH11  | 1.85                     | 0.42              |
| 1:A:191:VAL:HG22 | 2:B:340:MET:HE1  | 2.01                     | 0.42              |
| 2:B:484:ALA:HB2  | 2:B:516:GLN:CD   | 2.45                     | 0.42              |
| 2:B:663:ASN:HB3  | 2:B:670:LEU:HD11 | 2.01                     | 0.42              |
| 1:A:107:HIS:CE1  | 1:A:118:ALA:HB2  | 2.55                     | 0.42              |
| 2:B:30:TYR:HB3   | 4:D:8:A:H1'      | 2.01                     | 0.42              |
| 2:B:345:LYS:HE2  | 2:B:387:CYS:SG   | 2.60                     | 0.42              |
| 2:B:526:MET:HE1  | 2:B:568:SER:O    | 2.20                     | 0.41              |
| 3:C:140:GLU:OE2  | 3:C:140:GLU:N    | 2.52                     | 0.41              |
| 1:A:333:LEU:HD12 | 1:A:334:PRO:HD2  | 2.02                     | 0.41              |
| 1:A:375:TYR:O    | 1:A:379:VAL:HG22 | 2.19                     | 0.41              |
| 2:B:303:GLU:HG2  | 2:B:453:ASN:O    | 2.20                     | 0.41              |
| 1:A:341:MET:HE3  | 1:A:341:MET:HB3  | 1.72                     | 0.41              |
| 2:B:24:GLY:O     | 2:B:235:ARG:NH2  | 2.37                     | 0.41              |
| 2:B:702:LYS:O    | 2:B:706:LEU:HG   | 2.20                     | 0.41              |
| 1:A:18:THR:HG21  | 2:B:678:GLY:H    | 1.85                     | 0.41              |
| 1:A:78:GLN:HG3   | 3:C:182:LEU:HD22 | 2.02                     | 0.41              |
| 1:A:559:ASN:HD21 | 1:A:604:ASN:ND2  | 2.16                     | 0.41              |
| 2:B:627:PRO:HA   | 2:B:631:LYS:HD3  | 2.01                     | 0.41              |
| 1:A:564:GLY:O    | 1:A:568:ASN:ND2  | 2.54                     | 0.41              |
| 2:B:289:THR:OG1  | 2:B:295:THR:HG21 | 2.20                     | 0.41              |
| 1:A:67:THR:O     | 1:A:71:ILE:HG13  | 2.20                     | 0.41              |
| 1:A:119:PHE:CE1  | 1:A:141:ILE:HG21 | 2.56                     | 0.41              |
| 2:B:122:ARG:HH12 | 2:B:245:THR:HG22 | 1.86                     | 0.41              |
| 3:C:191:GLY:O    | 3:C:195:LYS:HG3  | 2.20                     | 0.41              |
| 2:B:84:VAL:HG22  | 2:B:450:VAL:HG12 | 2.02                     | 0.41              |
| 3:C:151:LYS:HG3  | 3:C:153:VAL:HG13 | 2.03                     | 0.41              |
| 1:A:270:PRO:O    | 1:A:273:VAL:HG22 | 2.22                     | 0.40              |
| 1:A:371:LEU:HB3  | 2:B:520:CYS:HB2  | 2.04                     | 0.40              |
| 1:A:587:LEU:HB3  | 1:A:591:SER:HB3  | 2.03                     | 0.40              |
| 1:A:543:TRP:CZ2  | 2:B:6:PRO:HG3    | 2.56                     | 0.40              |

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| Atom-1           | Atom-2           | Interatomic distance (Å) | Clash overlap (Å) |
|------------------|------------------|--------------------------|-------------------|
| 2:B:274:PRO:HB2  | 3:C:226:TRP:CZ2  | 2.56                     | 0.40              |
| 1:A:191:VAL:HG11 | 2:B:333:GLU:HG2  | 2.04                     | 0.40              |
| 1:A:375:TYR:HA   | 1:A:378:ILE:HG12 | 2.03                     | 0.40              |
| 2:B:91:PHE:CG    | 2:B:406:ILE:HG22 | 2.57                     | 0.40              |
| 3:C:42:LYS:HE2   | 3:C:42:LYS:HB3   | 1.82                     | 0.40              |

There are no symmetry-related clashes.

### 5.3 Torsion angles [i](#)

#### 5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

| Mol | Chain | Analysed        | Favoured   | Allowed | Outliers | Percentiles |     |
|-----|-------|-----------------|------------|---------|----------|-------------|-----|
| 1   | A     | 619/622 (100%)  | 599 (97%)  | 20 (3%) | 0        | 100         | 100 |
| 2   | B     | 637/710 (90%)   | 611 (96%)  | 26 (4%) | 0        | 100         | 100 |
| 3   | C     | 233/827 (28%)   | 227 (97%)  | 6 (3%)  | 0        | 100         | 100 |
| All | All   | 1489/2159 (69%) | 1437 (96%) | 52 (4%) | 0        | 100         | 100 |

There are no Ramachandran outliers to report.

#### 5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

| Mol | Chain | Analysed       | Rotameric  | Outliers | Percentiles |     |
|-----|-------|----------------|------------|----------|-------------|-----|
| 1   | A     | 560/561 (100%) | 560 (100%) | 0        | 100         | 100 |
| 2   | B     | 576/633 (91%)  | 576 (100%) | 0        | 100         | 100 |

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| Mol | Chain | Analysed        | Rotameric   | Outliers | Percentiles |     |
|-----|-------|-----------------|-------------|----------|-------------|-----|
| 3   | C     | 216/736 (29%)   | 216 (100%)  | 0        | 100         | 100 |
| All | All   | 1352/1930 (70%) | 1352 (100%) | 0        | 100         | 100 |

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 1   | A     | 90  | ASN  |
| 1   | A     | 107 | HIS  |
| 1   | A     | 307 | GLN  |
| 1   | A     | 351 | ASN  |
| 1   | A     | 559 | ASN  |
| 2   | B     | 129 | HIS  |
| 2   | B     | 267 | ASN  |
| 2   | B     | 306 | ASN  |
| 2   | B     | 336 | ASN  |
| 2   | B     | 383 | ASN  |
| 2   | B     | 513 | ASN  |
| 3   | C     | 51  | HIS  |
| 3   | C     | 189 | HIS  |

### 5.3.3 RNA [i](#)

| Mol | Chain | Analysed   | Backbone Outliers | Pucker Outliers |
|-----|-------|------------|-------------------|-----------------|
| 4   | D     | 8/10 (80%) | 1 (12%)           | 0               |

All (1) RNA backbone outliers are listed below:

| Mol | Chain | Res | Type |
|-----|-------|-----|------|
| 4   | D     | 6   | A    |

There are no RNA pucker outliers to report.

## 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

There are no ligands in this entry.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.