# Full wwPDB X-ray Structure Validation Report ⓘ

Dec 2, 2021 – 03:11 pm GMT

| | | |
|---|---|---|
| PDB ID | : | 7BNY |
| Title | : | Structure of 2A protein from encephalomyocarditis virus (EMCV) |
| Authors | : | Hill, C.H.; Napthine, S.; Pekarek, L.; Kibe, A.; Firth, A.E.; Graham, S.C.; Caliskan, N.; Brierley, I. |
| Deposited on | : | 2021-01-22 |
| Resolution | : | 2.62 Å(reported) |

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at *validation@mail.wwpdb.org*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the ⓘ symbol.

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

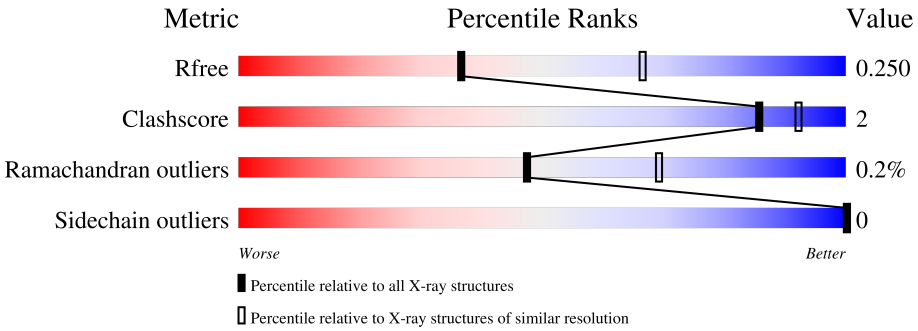
| | | |
|---|---|---|
| MolProbity | : | 4.02b-467 |
| Mogul | : | 1.8.4 (270009), CSD as541be (2020) |
| Xtriage (Phenix) | : | 1.13 |
| EDS | : | 2.23.2 |
| Percentile statistics | : | 20191225.v01 (using entries in the PDB archive December 25th 2019) |
| Refmac | : | 5.8.0267 |
| CCP4 | : | 7.1.010 (Gargrove) |
| Ideal geometry (proteins) | : | Engh & Huber (2001) |
| Ideal geometry (DNA, RNA) | : | Parkinson et al. (1996) |
| Validation Pipeline (wwPDB-VP) | : | 2.23.2 |

# 1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.62 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) | Similar resolution (#Entries, resolution range(Å)) |
|---|---|---|
| $R_{free}$ | 130704 | 3797 (2.64-2.60) |
| Clashscore | 141614 | 4168 (2.64-2.60) |
| Ramachandran outliers | 138981 | 4093 (2.64-2.60) |
| Sidechain outliers | 138945 | 4093 (2.64-2.60) |

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for >=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 <=5%

| Mol | Chain | Length | Quality of chain |
|---|---|---|---|
| 1 | A | 152 | 86% · 13% |
| 1 | B | 152 | 89% · 8% |
| 1 | C | 152 | 73% 10% 17% |
| 1 | D | 152 | 75% 8% 17% |

## 2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 4596 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, 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 Genome polyprotein.

| Mol | Chain | Residues | Atoms | | | | | ZeroOcc | AltConf | Trace |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 132 | Total | C | N | O | S | 0 | 0 | 0 |
| | | | 1106 | 712 | 198 | 193 | 3 | | | |
| 1 | B | 140 | Total | C | N | O | S | 0 | 1 | 0 |
| | | | 1175 | 755 | 209 | 208 | 3 | | | |
| 1 | C | 126 | Total | C | N | O | S | 0 | 0 | 0 |
| | | | 1056 | 681 | 191 | 181 | 3 | | | |
| 1 | D | 126 | Total | C | N | O | S | 0 | 1 | 0 |
| | | | 1067 | 687 | 195 | 182 | 3 | | | |

There are 36 discrepancies between the modelled and reference sequences:

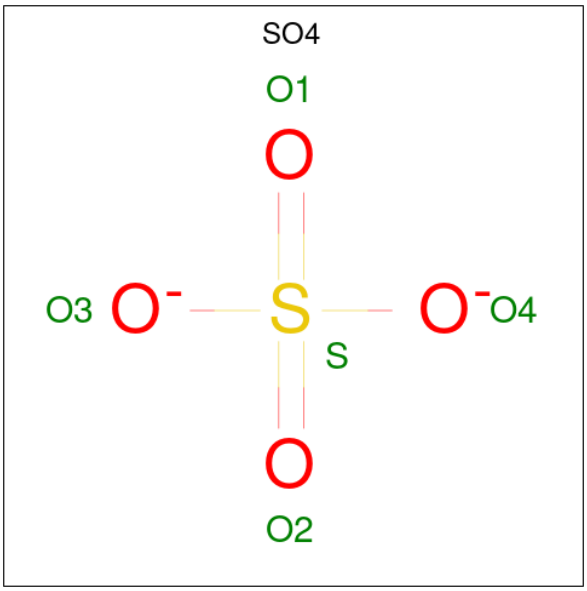
| Chain | Residue | Modelled | Actual | Comment | Reference |
|---|---|---|---|---|---|
| A | 144 | GLY | - | expression tag | UNP P12296 |
| A | 145 | SER | - | expression tag | UNP P12296 |
| A | 146 | LYS | - | expression tag | UNP P12296 |
| A | 147 | HIS | - | expression tag | UNP P12296 |
| A | 148 | HIS | - | expression tag | UNP P12296 |
| A | 149 | HIS | - | expression tag | UNP P12296 |
| A | 150 | HIS | - | expression tag | UNP P12296 |
| A | 151 | HIS | - | expression tag | UNP P12296 |
| A | 152 | HIS | - | expression tag | UNP P12296 |
| B | 144 | GLY | - | expression tag | UNP P12296 |
| B | 145 | SER | - | expression tag | UNP P12296 |
| B | 146 | LYS | - | expression tag | UNP P12296 |
| B | 147 | HIS | - | expression tag | UNP P12296 |
| B | 148 | HIS | - | expression tag | UNP P12296 |
| B | 149 | HIS | - | expression tag | UNP P12296 |
| B | 150 | HIS | - | expression tag | UNP P12296 |
| B | 151 | HIS | - | expression tag | UNP P12296 |
| B | 152 | HIS | - | expression tag | UNP P12296 |
| C | 144 | GLY | - | expression tag | UNP P12296 |
| C | 145 | SER | - | expression tag | UNP P12296 |
| C | 146 | LYS | - | expression tag | UNP P12296 |

*Continued on next page...*

*Continued from previous page...*

| Chain | Residue | Modelled | Actual | Comment | Reference |
|---|---|---|---|---|---|
| C | 147 | HIS | - | expression tag | UNP P12296 |
| C | 148 | HIS | - | expression tag | UNP P12296 |
| C | 149 | HIS | - | expression tag | UNP P12296 |
| C | 150 | HIS | - | expression tag | UNP P12296 |
| C | 151 | HIS | - | expression tag | UNP P12296 |
| C | 152 | HIS | - | expression tag | UNP P12296 |
| D | 144 | GLY | - | expression tag | UNP P12296 |
| D | 145 | SER | - | expression tag | UNP P12296 |
| D | 146 | LYS | - | expression tag | UNP P12296 |
| D | 147 | HIS | - | expression tag | UNP P12296 |
| D | 148 | HIS | - | expression tag | UNP P12296 |
| D | 149 | HIS | - | expression tag | UNP P12296 |
| D | 150 | HIS | - | expression tag | UNP P12296 |
| D | 151 | HIS | - | expression tag | UNP P12296 |
| D | 152 | HIS | - | expression tag | UNP P12296 |

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: $O_4S$).




| Mol | Chain | Residues | Atoms | ZeroOcc | AltConf |
|---|---|---|---|---|---|
| 2 | A | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | A | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | A | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | B | 1 | Total O S<br>5 4 1 | 0 | 0 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Residues | Atoms | ZeroOcc | AltConf |
|---|---|---|---|---|---|
| 2 | B | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | B | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | C | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | D | 1 | Total O S<br>5 4 1 | 0 | 0 |
| 2 | D | 1 | Total O S<br>5 4 1 | 0 | 0 |

- Molecule 3 is water.

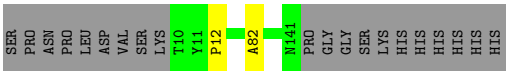
| Mol | Chain | Residues | Atoms | ZeroOcc | AltConf |
|---|---|---|---|---|---|
| 3 | A | 56 | Total O<br>56 56 | 0 | 0 |
| 3 | B | 45 | Total O<br>45 45 | 0 | 0 |
| 3 | C | 26 | Total O<br>26 26 | 0 | 0 |
| 3 | D | 20 | Total O<br>20 20 | 0 | 0 |

# 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.

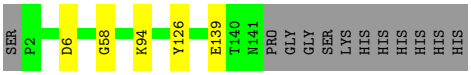
• Molecule 1: Genome polyprotein

Chain A:

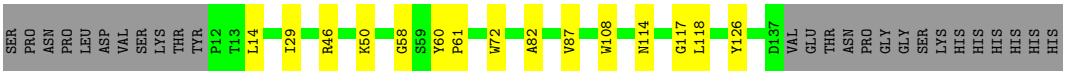

• Molecule 1: Genome polyprotein

Chain B:


• Molecule 1: Genome polyprotein

Chain C:


• Molecule 1: Genome polyprotein

Chain D:


# 4 Data and refinement statistics (i)

| Property | Value | Source |
|---|---|---|
| Space group | P 62 2 2 | Depositor |
| Cell constants<br>a, b, c, $\alpha$, $\beta$, $\gamma$ | 91.56Å 91.56Å 316.39Å<br>90.00° 90.00° 120.00° | Depositor |
| Resolution (Å) | 43.91 – 2.62<br>43.91 – 2.62 | Depositor<br>EDS |
| % Data completeness<br>(in resolution range) | 99.7 (43.91-2.62)<br>99.7 (43.91-2.62) | Depositor<br>EDS |
| $R_{merge}$ | 0.23 | Depositor |
| $R_{sym}$ | (Not available) | Depositor |
| $< I/\sigma(I) >$ [1] | 1.43 (at 2.61Å) | Xtriage |
| Refinement program | PHENIX 1.18.1_3865 | Depositor |
| R, $R_{free}$ | 0.225 , 0.251<br>0.225 , 0.250 | Depositor<br>DCC |
| $R_{free}$ test set | 1207 reflections (4.91%) | wwPDB-VP |
| Wilson B-factor (Å$^2$) | 61.9 | Xtriage |
| Anisotropy | 0.574 | Xtriage |
| Bulk solvent $k_{sol}$(e/Å$^3$), $B_{sol}$(Å$^2$) | (Not available) , (Not available) | EDS |
| L-test for twinning[2] | $< \|L\| > = 0.49$, $< L^2 > = 0.32$ | Xtriage |
| Estimated twinning fraction | No twinning to report. | Xtriage |
| $F_o$,$F_c$ correlation | 0.91 | EDS |
| Total number of atoms | 4596 | wwPDB-VP |
| Average B, all atoms (Å$^2$) | 75.0 | wwPDB-VP |

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.35% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

# 5 Model quality

## 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SO4

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 | 0.25 | 0/1141 | 0.50 | 0/1552 |
| 1 | B | 0.25 | 0/1212 | 0.49 | 0/1649 |
| 1 | C | 0.27 | 0/1090 | 0.49 | 0/1480 |
| 1 | D | 0.25 | 0/1101 | 0.51 | 0/1494 |
| All | All | 0.26 | 0/4544 | 0.50 | 0/6175 |

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

## 5.2 Too-close contacts

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 | 1106 | 0 | 1076 | 1 | 0 |
| 1 | B | 1175 | 0 | 1144 | 1 | 1 |
| 1 | C | 1056 | 0 | 1033 | 8 | 0 |
| 1 | D | 1067 | 0 | 1045 | 9 | 0 |
| 2 | A | 15 | 0 | 0 | 0 | 0 |
| 2 | B | 15 | 0 | 0 | 0 | 0 |
| 2 | C | 5 | 0 | 0 | 0 | 0 |
| 2 | D | 10 | 0 | 0 | 0 | 0 |
| 3 | A | 56 | 0 | 0 | 0 | 0 |

*Continued on next page...*

*Continued from previous page...*

| Mol | Chain | Non-H | H(model) | H(added) | Clashes | Symm-Clashes |
|---|---|---|---|---|---|---|
| 3 | B | 45 | 0 | 0 | 0 | 0 |
| 3 | C | 26 | 0 | 0 | 0 | 0 |
| 3 | D | 20 | 0 | 0 | 0 | 0 |
| All | All | 4596 | 0 | 4298 | 19 | 1 |

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 2.

All (19) 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) |
|---|---|---|---|
| 1:D:83:GLU:HB3 | 1:D:84:PRO:HD2 | 1.84 | 0.58 |
| 1:C:14:LEU:HD11 | 1:C:29:ILE:HD13 | 1.87 | 0.55 |
| 1:D:95:ARG:NH2 | 1:D:97:ARG:HE | 2.05 | 0.55 |
| 1:C:82:ALA:HB2 | 1:C:118:LEU:HD21 | 1.90 | 0.53 |
| 1:D:83:GLU:HB3 | 1:D:84:PRO:CD | 2.39 | 0.52 |
| 1:D:87:VAL:HG13 | 1:D:108:TRP:HE3 | 1.75 | 0.52 |
| 1:D:13:THR:HG22 | 1:D:81[B]:ARG:HG2 | 1.93 | 0.51 |
| 1:D:83:GLU:OE2 | 1:D:86:ARG:NE | 2.32 | 0.50 |
| 1:C:50:LYS:HG2 | 1:C:60:TYR:CZ | 2.48 | 0.49 |
| 1:C:87:VAL:HG13 | 1:C:108:TRP:HE3 | 1.79 | 0.48 |
| 1:D:97:ARG:HD3 | 1:D:97:ARG:HA | 1.53 | 0.47 |
| 1:D:82:ALA:HB2 | 1:D:118:LEU:HD21 | 1.97 | 0.47 |
| 1:C:114:ASN:OD1 | 1:C:117:GLY:N | 2.47 | 0.46 |
| 1:D:97:ARG:HD2 | 1:D:98:PRO:HD2 | 1.97 | 0.45 |
| 1:C:58:GLY:HA2 | 1:C:126:TYR:CD1 | 2.51 | 0.45 |
| 1:C:60:TYR:CG | 1:C:61:PRO:HD2 | 2.52 | 0.44 |
| 1:C:46:ARG:HG3 | 1:C:72:TRP:CD2 | 2.53 | 0.43 |
| 1:A:12:PRO:HD2 | 1:A:82:ALA:HB3 | 2.02 | 0.41 |
| 1:B:58:GLY:HA2 | 1:B:126:TYR:CD1 | 2.55 | 0.40 |

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

| Atom-1 | Atom-2 | Interatomic distance (Å) | Clash overlap (Å) |
|---|---|---|---|
| 1:B:6:ASP:OD1 | 1:B:139:GLU:OE2[8_555] | 2.17 | 0.03 |

## 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 X-ray entries followed by that with respect to entries of similar resolution.

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 | 130/152 (86%) | 124 (95%) | 6 (5%) | 0 | 100 100 |
| 1 | B | 139/152 (91%) | 134 (96%) | 4 (3%) | 1 (1%) | 22 41 |
| 1 | C | 124/152 (82%) | 118 (95%) | 6 (5%) | 0 | 100 100 |
| 1 | D | 125/152 (82%) | 121 (97%) | 4 (3%) | 0 | 100 100 |
| All | All | 518/608 (85%) | 497 (96%) | 20 (4%) | 1 (0%) | 47 69 |

All (1) Ramachandran outliers are listed below:

| Mol | Chain | Res | Type |
|---|---|---|---|
| 1 | B | 94 | LYS |

### 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 X-ray entries followed by that with respect to entries of similar resolution.

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 | 120/138 (87%) | 120 (100%) | 0 | 100 100 |
| 1 | B | 129/138 (94%) | 129 (100%) | 0 | 100 100 |
| 1 | C | 114/138 (83%) | 114 (100%) | 0 | 100 100 |
| 1 | D | 115/138 (83%) | 115 (100%) | 0 | 100 100 |
| All | All | 478/552 (87%) | 478 (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 (1) such sidechains are listed below:

| Mol | Chain | Res | Type |
|---|---|---|---|
| 1 | B | 40 | HIS |

#### 5.3.3 RNA

There are no RNA molecules in this entry.

### 5.4 Non-standard residues in protein, DNA, RNA chains

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

### 5.5 Carbohydrates

There are no monosaccharides in this entry.

### 5.6 Ligand geometry

9 ligands are modelled in this entry.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

### 5.7 Other polymers

There are no such residues in this entry.

### 5.8 Polymer linkage issues

There are no chain breaks in this entry.

# 6 Fit of model and data

## 6.1 Protein, DNA and RNA chains

Unable to reproduce the depositors R factor - this section is therefore empty.

## 6.2 Non-standard residues in protein, DNA, RNA chains

Unable to reproduce the depositors R factor - this section is therefore empty.

## 6.3 Carbohydrates

Unable to reproduce the depositors R factor - this section is therefore empty.

## 6.4 Ligands

Unable to reproduce the depositors R factor - this section is therefore empty.

## 6.5 Other polymers

Unable to reproduce the depositors R factor - this section is therefore empty.