



# Full wwPDB X-ray Structure Validation Report ⓘ

Apr 26, 2026 – 06:50 AM EDT

PDB ID : 7Q8P / pdb\_00007q8p  
Title : Peptide LLKVAL in complex with human cathepsin V C25S mutant  
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Deposited on : 2021-11-11  
Resolution : 1.71 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](mailto: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 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:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

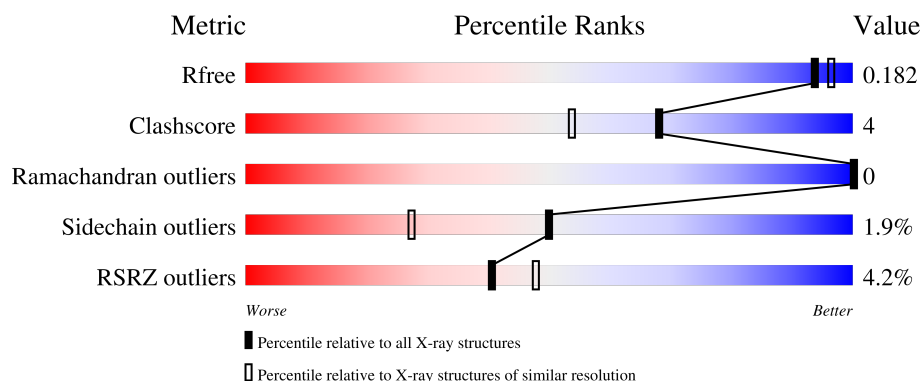
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.71 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))
$R_{free}$	180053	1039 (1.72-1.72)
Clashscore	190562	1049 (1.72-1.72)
Ramachandran outliers	187476	1041 (1.72-1.72)
Sidechain outliers	187428	1041 (1.72-1.72)
RSRZ outliers	180081	1039 (1.72-1.72)

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  $\geq 3$ , 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	AA	222	<div> <div>3%</div> <div> <div></div> <div>91%</div> <div>9%</div> </div> </div>
1	BA	222	<div> <div>4%</div> <div> <div></div> <div>90%</div> <div>9%</div> </div> </div>
2	PA	6	<div> <div>33%</div> <div> <div>33%</div> <div>17%</div> <div>17%</div> <div>33%</div> </div> </div>
3	PB	3	<div> <div>67%</div> <div> <div></div> <div>100%</div> </div> </div>

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 7876 atoms, of which 4020 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 Cathepsin L2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	AA	222	Total	C	H	N	O	S	1630	0	0
			3325	1069	1627	291	328	10			
1	BA	221	Total	C	H	N	O	S	1627	0	0
			3313	1065	1623	290	325	10			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
AA	26	SER	CYS	engineered mutation	UNP O60911
AA	109	GLN	ASN	engineered mutation	UNP O60911
AA	180	GLN	ASN	engineered mutation	UNP O60911
BA	247	SER	CYS	engineered mutation	UNP O60911
BA	330	GLN	ASN	engineered mutation	UNP O60911
BA	401	GLN	ASN	engineered mutation	UNP O60911

- Molecule 2 is a protein called LLKVAL Peptide.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	PA	4	Total	C	H	N	O	44	0	0
			76	23	44	5	4			

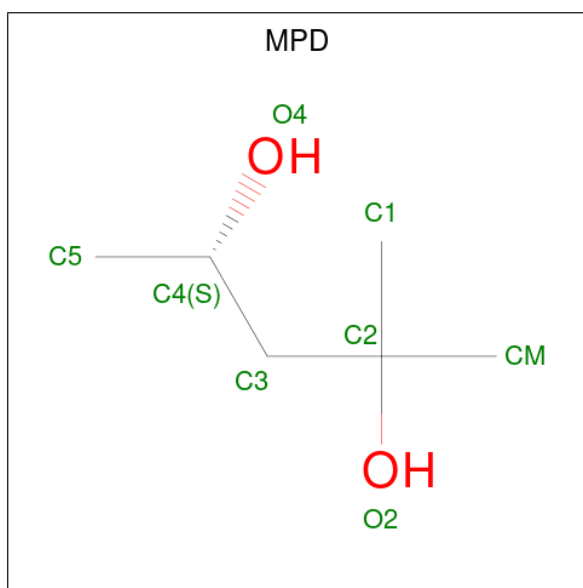
- Molecule 3 is a protein called EYS Peptide.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	PB	3	Total	C	H	N	O	20	0	0
			48	17	20	3	8			

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	AA	1	Total	Cl	0	0
			1	1		

- Molecule 5 is (4S)-2-METHYL-2,4-PENTANEDIOL (CCD ID: MPD) (formula:  $C_6H_{14}O_2$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	AA	1	Total	C	O	0	0
			8	6	2		
5	AA	1	Total	C	O	0	0
			8	6	2		
5	BA	1	Total	C	O	0	0
			8	6	2		
5	BA	1	Total	C	O	0	0
			8	6	2		
5	BA	1	Total	C	O	0	0
			8	6	2		
5	BA	1	Total	C	O	0	0
			8	6	2		

- Molecule 6 is GLYCEROL (CCD ID: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	AA	1	Total	C	O	0	0
			6	3	3		

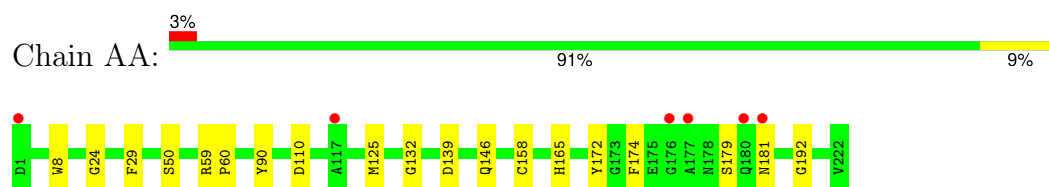
- Molecule 7 is water.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
7	AA	184	Total	H	O	368	0
			552	368	184		
7	BA	166	Total	H	O	332	0
			498	332	166		
7	PA	2	Total	H	O	4	0
			6	4	2		
7	PB	1	Total	H	O	2	0
			3	2	1		

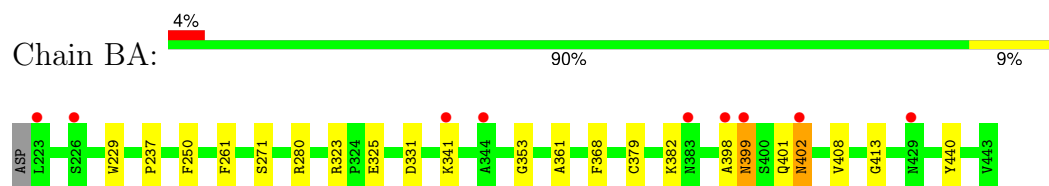
### 3 Residue-property plots [i](#)

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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.

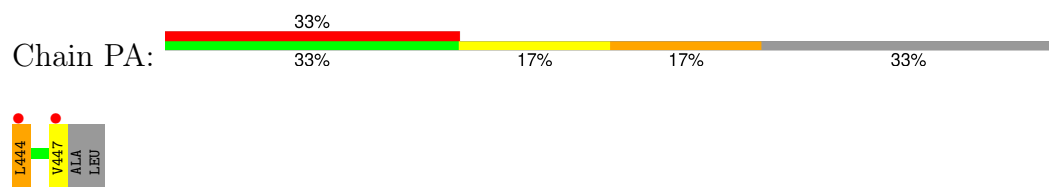
- Molecule 1: Cathepsin L2



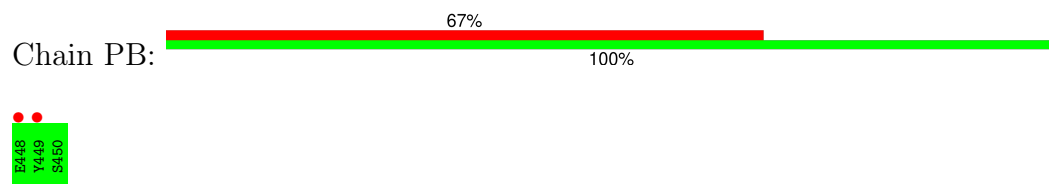
- Molecule 1: Cathepsin L2



- Molecule 2: LLKVAL Peptide



- Molecule 3: EYS Peptide



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	94.20Å 94.20Å 126.18Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.10 – 1.71 47.10 – 1.71	Depositor EDS
% Data completeness (in resolution range)	100.0 (47.10-1.71) 100.0 (47.10-1.71)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.72 (at 1.71Å)	Xtriage
Refinement program	MAIN	Depositor
R, $R_{free}$	0.176 , 0.199 0.174 , 0.182	Depositor DCC
$R_{free}$ test set	2101 reflections (3.39%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	22.1	Xtriage
Anisotropy	0.020	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 47.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	7876	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.44% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  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: MPD, GOL, CL

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	AA	0.86	0/1740	1.15	7/2351 (0.3%)
1	BA	0.80	0/1732	1.21	13/2340 (0.6%)
2	PA	1.08	0/31	1.22	0/40
3	PB	0.78	0/28	0.95	0/35
All	All	0.83	0/3531	1.18	20/4766 (0.4%)

There are no bond length outliers.

All (20) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	BA	413	GLY	CA-C-N	7.79	127.85	119.28
1	BA	413	GLY	C-N-CA	7.79	127.85	119.28
1	AA	90	TYR	CA-C-N	7.09	127.08	119.78
1	AA	90	TYR	C-N-CA	7.09	127.08	119.78
1	AA	192	GLY	CA-C-N	6.99	126.97	119.28
1	AA	192	GLY	C-N-CA	6.99	126.97	119.28
1	AA	50	SER	N-CA-C	6.32	118.58	108.41
1	BA	401	GLN	CA-C-N	-6.31	112.91	122.81
1	BA	401	GLN	C-N-CA	-6.31	112.91	122.81
1	BA	331	ASP	CA-CB-CG	6.26	118.86	112.60
1	BA	250	PHE	CA-CB-CG	-5.99	107.81	113.80
1	BA	398	ALA	CA-C-N	-5.93	114.33	122.93
1	BA	398	ALA	C-N-CA	-5.93	114.33	122.93
1	AA	110	ASP	CA-CB-CG	5.49	118.08	112.60
1	BA	440	TYR	CA-C-N	5.29	125.20	119.85
1	BA	440	TYR	C-N-CA	5.29	125.20	119.85
1	BA	368	PHE	CA-CB-CG	-5.22	108.58	113.80
1	BA	408	VAL	N-CA-C	5.16	115.33	108.11
1	AA	29	PHE	CA-CB-CG	-5.14	108.66	113.80
1	BA	271	SER	N-CA-C	5.14	117.04	107.99



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	AA	1698	1627	1632	7	1
1	BA	1690	1623	1621	8	1
2	PA	32	44	43	2	0
3	PB	28	20	19	0	0
4	AA	1	0	0	1	0
5	AA	16	0	28	4	0
5	BA	32	0	56	1	0
6	AA	6	0	8	3	0
7	AA	184	368	0	2	0
7	BA	166	332	0	2	0
7	PA	2	4	0	0	0
7	PB	1	2	0	0	0
All	All	3856	4020	3407	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 4.

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)
6:AA:304:GOL:H12	7:AA:526:HOH:O	1.71	0.88
6:AA:304:GOL:H32	7:BA:626:HOH:O	1.76	0.84
5:AA:302:MPD:HM1	5:AA:302:MPD:H52	1.64	0.78
5:AA:302:MPD:H11	7:AA:498:HOH:O	1.97	0.64
1:AA:165:HIS:HD1	2:PA:444:LEU:N	2.02	0.56
6:AA:304:GOL:H31	1:BA:237:PRO:HB3	1.90	0.54
1:BA:229:TRP:CE2	1:BA:353:GLY:HA2	2.43	0.53
1:AA:8:TRP:CE2	1:AA:132:GLY:HA2	2.45	0.51
1:AA:146:GLN:OE1	2:PA:447:VAL:HG12	2.10	0.50
5:AA:302:MPD:H53	1:BA:261:PHE:CZ	2.48	0.49
1:AA:59:ARG:N	1:AA:60:PRO:CD	2.77	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:AA:24:GLY:HA2	4:AA:301:CL:CL	2.52	0.46
1:BA:399:ASN:ND2	1:BA:402:ASN:OD1	2.48	0.46
1:BA:361:ALA:O	5:BA:502:MPD:H53	2.19	0.43
1:BA:280:ARG:HB2	7:BA:653:HOH:O	2.19	0.43
5:AA:302:MPD:H53	1:BA:261:PHE:HZ	1.84	0.42
1:AA:125:MET:HE3	1:AA:172:TYR:CE1	2.55	0.42
1:BA:323:ARG:HD2	1:BA:325:GLU:OE2	2.20	0.41
1:AA:174:PHE:CG	1:AA:179:SER:HA	2.57	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:AA:139:ASP:OD2	1:BA:382:LYS:HZ2[4_445]	1.57	0.03

## 5.3 Torsion angles ⓘ

### 5.3.1 Protein backbone ⓘ

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	AA	220/222 (99%)	214 (97%)	6 (3%)	0	100	100
1	BA	219/222 (99%)	212 (97%)	7 (3%)	0	100	100
2	PA	2/6 (33%)	2 (100%)	0	0	100	100
3	PB	1/3 (33%)	1 (100%)	0	0	100	100
All	All	442/453 (98%)	429 (97%)	13 (3%)	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 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	AA	180/180 (100%)	178 (99%)	2 (1%)	65	50
1	BA	179/180 (99%)	175 (98%)	4 (2%)	45	23
2	PA	4/5 (80%)	3 (75%)	1 (25%)	0	0
3	PB	3/3 (100%)	3 (100%)	0	100	100
All	All	366/368 (100%)	359 (98%)	7 (2%)	50	27

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	AA	158	CYS
1	AA	181	ASN
1	BA	341	LYS
1	BA	379	CYS
1	BA	399	ASN
1	BA	402	ASN
2	PA	444	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	AA	81	ASN
1	AA	181	ASN
1	AA	221	ASN
1	BA	241	GLN
1	BA	259	GLN
1	BA	401	GLN
1	BA	442	ASN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

## 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](#)

Of 8 ligands modelled in this entry, 1 is monoatomic - leaving 7 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z  > 2$	Counts	RMSZ	$\# Z  > 2$
5	MPD	BA	501	-	7,7,7	0.23	0	9,10,10	0.36	0
6	GOL	AA	304	-	5,5,5	0.54	0	5,5,5	0.32	0
5	MPD	BA	502	-	7,7,7	0.24	0	9,10,10	0.32	0
5	MPD	BA	503	-	7,7,7	0.24	0	9,10,10	0.32	0
5	MPD	BA	504	-	7,7,7	0.26	0	9,10,10	0.41	0
5	MPD	AA	303	-	7,7,7	0.25	0	9,10,10	0.36	0
5	MPD	AA	302	-	7,7,7	0.19	0	9,10,10	0.41	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	MPD	BA	501	-	-	1/5/5/5	-
6	GOL	AA	304	-	-	2/4/4/4	-
5	MPD	BA	502	-	-	1/5/5/5	-
5	MPD	BA	503	-	-	3/5/5/5	-
5	MPD	BA	504	-	-	0/5/5/5	-
5	MPD	AA	303	-	-	2/5/5/5	-
5	MPD	AA	302	-	-	2/5/5/5	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (11) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	AA	303	MPD	C2-C3-C4-O4
5	AA	303	MPD	C2-C3-C4-C5
6	AA	304	GOL	O1-C1-C2-C3
6	AA	304	GOL	O1-C1-C2-O2
5	BA	501	MPD	O2-C2-C3-C4
5	AA	302	MPD	CM-C2-C3-C4
5	BA	503	MPD	C1-C2-C3-C4
5	BA	503	MPD	CM-C2-C3-C4
5	BA	503	MPD	O2-C2-C3-C4
5	BA	502	MPD	C2-C3-C4-O4
5	AA	302	MPD	C1-C2-C3-C4

There are no ring outliers.

3 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
6	AA	304	GOL	3	0
5	BA	502	MPD	1	0
5	AA	302	MPD	4	0

## 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.

## 6 Fit of model and data ⓘ

### 6.1 Protein, DNA and RNA chains ⓘ

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2			OWAB(Å <sup>2</sup> )	Q<0.9
1	AA	222/222 (100%)	-0.12	6 (2%)	56	64	6, 12, 23, 55	1 (0%)
1	BA	221/222 (99%)	0.14	9 (4%)	41	49	7, 14, 29, 61	1 (0%)
2	PA	4/6 (66%)	3.08	2 (50%)	0	0	17, 17, 21, 43	0
3	PB	3/3 (100%)	2.57	2 (66%)	0	0	25, 25, 27, 54	0
All	All	450/453 (99%)	0.05	19 (4%)	40	48	6, 13, 27, 61	2 (0%)

All (19) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	PA	447	VAL	6.1
1	AA	181	ASN	5.0
3	PB	448	GLU	3.8
1	AA	177	ALA	3.4
1	BA	398	ALA	3.3
1	AA	1	ASP	3.2
1	AA	176	GLY	2.7
1	BA	223	LEU	2.6
1	BA	383	ASN	2.4
2	PA	444	LEU	2.4
1	BA	226	SER	2.4
1	BA	399	ASN	2.4
1	AA	117	ALA	2.4
1	BA	429	ASN	2.3
1	BA	402	ASN	2.2
1	BA	344	ALA	2.2
1	AA	180	GLN	2.1
1	BA	341	LYS	2.1
3	PB	449	TYR	2.1

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

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

## 6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
5	MPD	AA	303	8/8	0.75	0.26	48,48,54,59	0
5	MPD	BA	504	8/8	0.76	0.29	71,78,105,122	0
5	MPD	BA	503	8/8	0.78	0.25	53,65,104,108	0
5	MPD	BA	501	8/8	0.80	0.23	57,58,64,66	0
5	MPD	BA	502	8/8	0.80	0.22	48,54,56,58	0
5	MPD	AA	302	8/8	0.86	0.25	46,60,103,110	0
4	CL	AA	301	1/1	0.89	0.14	31,31,31,31	0
6	GOL	AA	304	6/6	0.93	0.15	18,50,54,57	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.