



Full wwPDB X-ray Structure Validation Report ⓘ

Jan 10, 2017 – 08:56 PM EST

PDB ID : 5HK4
Title : Structure function studies of R. palustris RubisCO (A47V-M331A mutant)
Authors : Arbing, M.A.; Shin, A.; Cascio, D.; Satagopan, S.; North, J.A.; Tabita, F.R.
Deposited on : 2016-01-13
Resolution : 2.15 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

<http://wwpdb.org/validation/2016/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 : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20028442
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : rb-20028442

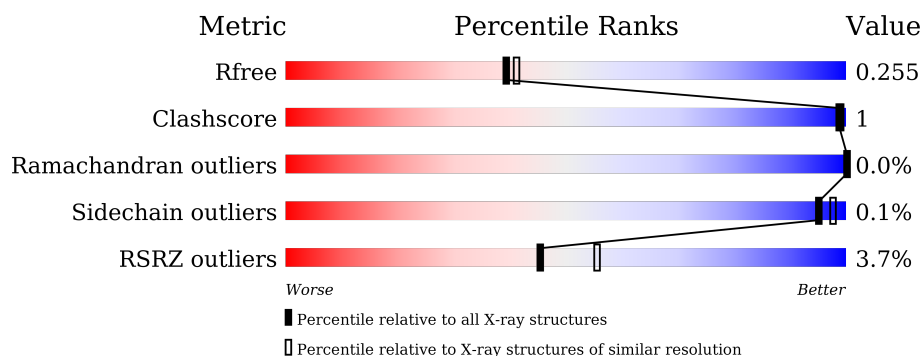
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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}	91344	1045 (2.16-2.16)
Clashscore	102246	1152 (2.16-2.16)
Ramachandran outliers	100387	1131 (2.16-2.16)
Sidechain outliers	100360	1131 (2.16-2.16)
RSRZ outliers	91569	1050 (2.16-2.16)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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	A	481	<div> <div>3%</div> <div>94%</div> <div>5%</div> </div>
1	B	481	<div> <div>2%</div> <div>93%</div> <div>5%</div> </div>
1	C	481	<div> <div>3%</div> <div>93%</div> <div>5%</div> </div>
1	D	481	<div> <div>4%</div> <div>92%</div> <div>5%</div> </div>
1	E	481	<div> <div>2%</div> <div>93%</div> <div>5%</div> </div>
1	F	481	<div> <div>6%</div> <div>91%</div> <div>5%</div> </div>

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 42492 atoms, of which 20284 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 Ribulose biphosphate carboxylase.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	457	Total	C	H	N	O	S	0	0	0
			6925	2245	3393	612	657	18			
1	B	455	Total	C	H	N	O	S	0	0	0
			6884	2233	3369	609	655	18			
1	C	455	Total	C	H	N	O	S	0	0	0
			6877	2233	3362	609	655	18			
1	D	456	Total	C	H	N	O	S	0	0	0
			6890	2239	3367	610	656	18			
1	E	455	Total	C	H	N	O	S	0	0	0
			6884	2233	3369	609	655	18			
1	F	455	Total	C	H	N	O	S	0	0	0
			6885	2233	3370	609	655	18			

There are 132 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-19	MET	-	initiating methionine	UNP Q6N0W9
A	-18	GLY	-	expression tag	UNP Q6N0W9
A	-17	SER	-	expression tag	UNP Q6N0W9
A	-16	SER	-	expression tag	UNP Q6N0W9
A	-15	HIS	-	expression tag	UNP Q6N0W9
A	-14	HIS	-	expression tag	UNP Q6N0W9
A	-13	HIS	-	expression tag	UNP Q6N0W9
A	-12	HIS	-	expression tag	UNP Q6N0W9
A	-11	HIS	-	expression tag	UNP Q6N0W9
A	-10	HIS	-	expression tag	UNP Q6N0W9
A	-9	SER	-	expression tag	UNP Q6N0W9
A	-8	SER	-	expression tag	UNP Q6N0W9
A	-7	GLY	-	expression tag	UNP Q6N0W9
A	-6	LEU	-	expression tag	UNP Q6N0W9
A	-5	VAL	-	expression tag	UNP Q6N0W9
A	-4	PRO	-	expression tag	UNP Q6N0W9
A	-3	ARG	-	expression tag	UNP Q6N0W9

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Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP Q6N0W9
A	-1	SER	-	expression tag	UNP Q6N0W9
A	0	HIS	-	expression tag	UNP Q6N0W9
A	47	VAL	ALA	engineered mutation	UNP Q6N0W9
A	331	ALA	MET	engineered mutation	UNP Q6N0W9
B	-19	MET	-	initiating methionine	UNP Q6N0W9
B	-18	GLY	-	expression tag	UNP Q6N0W9
B	-17	SER	-	expression tag	UNP Q6N0W9
B	-16	SER	-	expression tag	UNP Q6N0W9
B	-15	HIS	-	expression tag	UNP Q6N0W9
B	-14	HIS	-	expression tag	UNP Q6N0W9
B	-13	HIS	-	expression tag	UNP Q6N0W9
B	-12	HIS	-	expression tag	UNP Q6N0W9
B	-11	HIS	-	expression tag	UNP Q6N0W9
B	-10	HIS	-	expression tag	UNP Q6N0W9
B	-9	SER	-	expression tag	UNP Q6N0W9
B	-8	SER	-	expression tag	UNP Q6N0W9
B	-7	GLY	-	expression tag	UNP Q6N0W9
B	-6	LEU	-	expression tag	UNP Q6N0W9
B	-5	VAL	-	expression tag	UNP Q6N0W9
B	-4	PRO	-	expression tag	UNP Q6N0W9
B	-3	ARG	-	expression tag	UNP Q6N0W9
B	-2	GLY	-	expression tag	UNP Q6N0W9
B	-1	SER	-	expression tag	UNP Q6N0W9
B	0	HIS	-	expression tag	UNP Q6N0W9
B	47	VAL	ALA	engineered mutation	UNP Q6N0W9
B	331	ALA	MET	engineered mutation	UNP Q6N0W9
C	-19	MET	-	initiating methionine	UNP Q6N0W9
C	-18	GLY	-	expression tag	UNP Q6N0W9
C	-17	SER	-	expression tag	UNP Q6N0W9
C	-16	SER	-	expression tag	UNP Q6N0W9
C	-15	HIS	-	expression tag	UNP Q6N0W9
C	-14	HIS	-	expression tag	UNP Q6N0W9
C	-13	HIS	-	expression tag	UNP Q6N0W9
C	-12	HIS	-	expression tag	UNP Q6N0W9
C	-11	HIS	-	expression tag	UNP Q6N0W9
C	-10	HIS	-	expression tag	UNP Q6N0W9
C	-9	SER	-	expression tag	UNP Q6N0W9
C	-8	SER	-	expression tag	UNP Q6N0W9
C	-7	GLY	-	expression tag	UNP Q6N0W9
C	-6	LEU	-	expression tag	UNP Q6N0W9
C	-5	VAL	-	expression tag	UNP Q6N0W9

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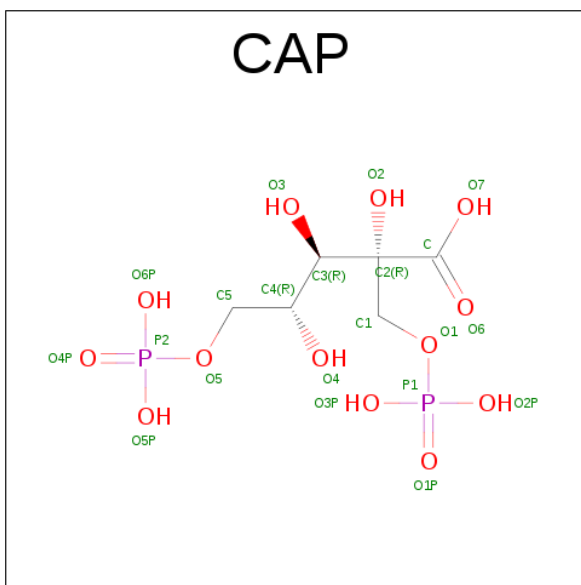
Chain	Residue	Modelled	Actual	Comment	Reference
C	-4	PRO	-	expression tag	UNP Q6N0W9
C	-3	ARG	-	expression tag	UNP Q6N0W9
C	-2	GLY	-	expression tag	UNP Q6N0W9
C	-1	SER	-	expression tag	UNP Q6N0W9
C	0	HIS	-	expression tag	UNP Q6N0W9
C	47	VAL	ALA	engineered mutation	UNP Q6N0W9
C	331	ALA	MET	engineered mutation	UNP Q6N0W9
D	-19	MET	-	initiating methionine	UNP Q6N0W9
D	-18	GLY	-	expression tag	UNP Q6N0W9
D	-17	SER	-	expression tag	UNP Q6N0W9
D	-16	SER	-	expression tag	UNP Q6N0W9
D	-15	HIS	-	expression tag	UNP Q6N0W9
D	-14	HIS	-	expression tag	UNP Q6N0W9
D	-13	HIS	-	expression tag	UNP Q6N0W9
D	-12	HIS	-	expression tag	UNP Q6N0W9
D	-11	HIS	-	expression tag	UNP Q6N0W9
D	-10	HIS	-	expression tag	UNP Q6N0W9
D	-9	SER	-	expression tag	UNP Q6N0W9
D	-8	SER	-	expression tag	UNP Q6N0W9
D	-7	GLY	-	expression tag	UNP Q6N0W9
D	-6	LEU	-	expression tag	UNP Q6N0W9
D	-5	VAL	-	expression tag	UNP Q6N0W9
D	-4	PRO	-	expression tag	UNP Q6N0W9
D	-3	ARG	-	expression tag	UNP Q6N0W9
D	-2	GLY	-	expression tag	UNP Q6N0W9
D	-1	SER	-	expression tag	UNP Q6N0W9
D	0	HIS	-	expression tag	UNP Q6N0W9
D	47	VAL	ALA	engineered mutation	UNP Q6N0W9
D	331	ALA	MET	engineered mutation	UNP Q6N0W9
E	-19	MET	-	initiating methionine	UNP Q6N0W9
E	-18	GLY	-	expression tag	UNP Q6N0W9
E	-17	SER	-	expression tag	UNP Q6N0W9
E	-16	SER	-	expression tag	UNP Q6N0W9
E	-15	HIS	-	expression tag	UNP Q6N0W9
E	-14	HIS	-	expression tag	UNP Q6N0W9
E	-13	HIS	-	expression tag	UNP Q6N0W9
E	-12	HIS	-	expression tag	UNP Q6N0W9
E	-11	HIS	-	expression tag	UNP Q6N0W9
E	-10	HIS	-	expression tag	UNP Q6N0W9
E	-9	SER	-	expression tag	UNP Q6N0W9
E	-8	SER	-	expression tag	UNP Q6N0W9
E	-7	GLY	-	expression tag	UNP Q6N0W9

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Chain	Residue	Modelled	Actual	Comment	Reference
E	-6	LEU	-	expression tag	UNP Q6N0W9
E	-5	VAL	-	expression tag	UNP Q6N0W9
E	-4	PRO	-	expression tag	UNP Q6N0W9
E	-3	ARG	-	expression tag	UNP Q6N0W9
E	-2	GLY	-	expression tag	UNP Q6N0W9
E	-1	SER	-	expression tag	UNP Q6N0W9
E	0	HIS	-	expression tag	UNP Q6N0W9
E	47	VAL	ALA	engineered mutation	UNP Q6N0W9
E	331	ALA	MET	engineered mutation	UNP Q6N0W9
F	-19	MET	-	initiating methionine	UNP Q6N0W9
F	-18	GLY	-	expression tag	UNP Q6N0W9
F	-17	SER	-	expression tag	UNP Q6N0W9
F	-16	SER	-	expression tag	UNP Q6N0W9
F	-15	HIS	-	expression tag	UNP Q6N0W9
F	-14	HIS	-	expression tag	UNP Q6N0W9
F	-13	HIS	-	expression tag	UNP Q6N0W9
F	-12	HIS	-	expression tag	UNP Q6N0W9
F	-11	HIS	-	expression tag	UNP Q6N0W9
F	-10	HIS	-	expression tag	UNP Q6N0W9
F	-9	SER	-	expression tag	UNP Q6N0W9
F	-8	SER	-	expression tag	UNP Q6N0W9
F	-7	GLY	-	expression tag	UNP Q6N0W9
F	-6	LEU	-	expression tag	UNP Q6N0W9
F	-5	VAL	-	expression tag	UNP Q6N0W9
F	-4	PRO	-	expression tag	UNP Q6N0W9
F	-3	ARG	-	expression tag	UNP Q6N0W9
F	-2	GLY	-	expression tag	UNP Q6N0W9
F	-1	SER	-	expression tag	UNP Q6N0W9
F	0	HIS	-	expression tag	UNP Q6N0W9
F	47	VAL	ALA	engineered mutation	UNP Q6N0W9
F	331	ALA	MET	engineered mutation	UNP Q6N0W9

- Molecule 2 is 2-CARBOXYARABINITOL-1,5-DIPHOSPHATE (three-letter code: CAP) (formula: C₆H₁₄O₁₃P₂).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	H	O	P	0	0
			30	6	9	13	2		
2	B	1	Total	C	H	O	P	0	0
			30	6	9	13	2		
2	C	1	Total	C	H	O	P	0	0
			30	6	9	13	2		
2	D	1	Total	C	H	O	P	0	0
			30	6	9	13	2		
2	E	1	Total	C	H	O	P	0	0
			30	6	9	13	2		
2	F	1	Total	C	H	O	P	0	0
			30	6	9	13	2		

- Molecule 3 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	D	1	Total	Mg	0	0
			1	1		
3	E	1	Total	Mg	0	0
			1	1		
3	B	1	Total	Mg	0	0
			1	1		
3	C	1	Total	Mg	0	0
			1	1		
3	A	1	Total	Mg	0	0
			1	1		
3	F	1	Total	Mg	0	0
			1	1		

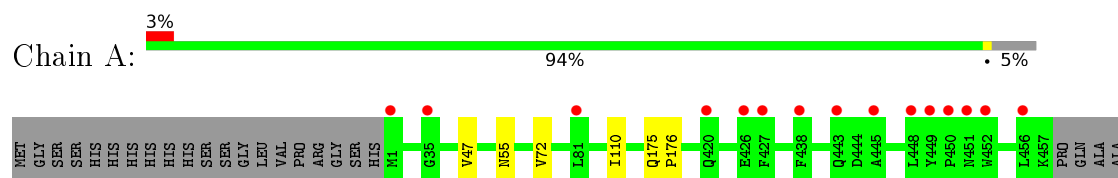
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	147	Total 147	O 147	0	0
4	B	173	Total 173	O 173	0	0
4	C	171	Total 171	O 171	0	0
4	D	176	Total 176	O 176	0	0
4	E	146	Total 146	O 146	0	0
4	F	148	Total 148	O 148	0	0

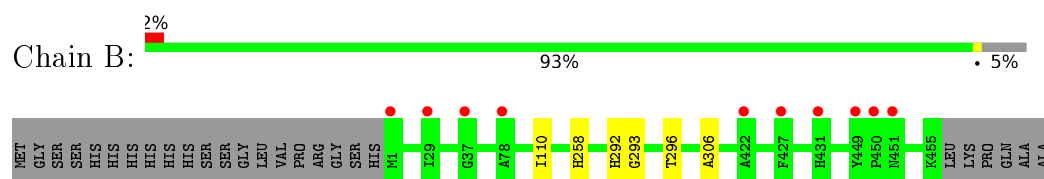
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

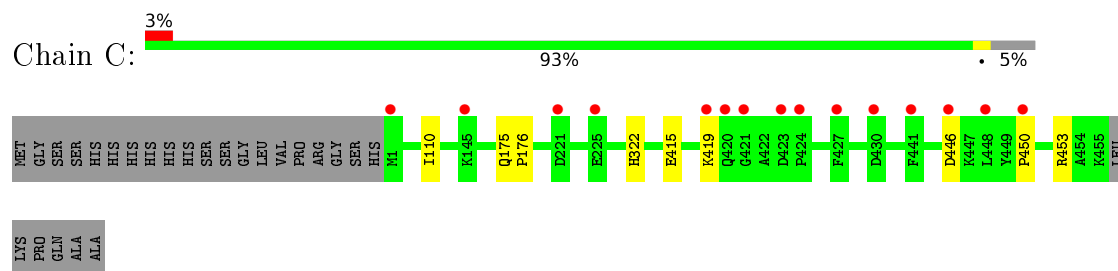
- Molecule 1: Ribulose biphosphate carboxylase



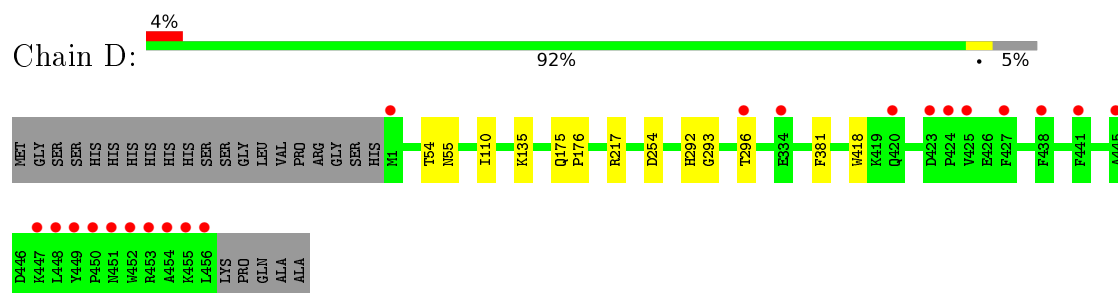
- Molecule 1: Ribulose biphosphate carboxylase



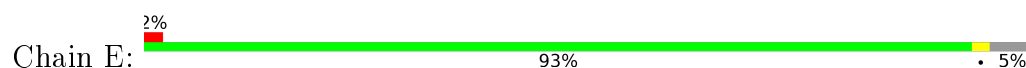
- Molecule 1: Ribulose biphosphate carboxylase

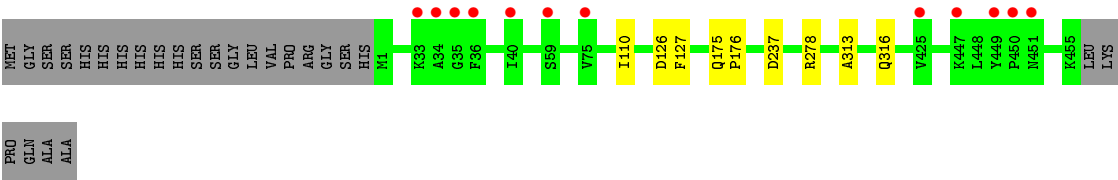


- Molecule 1: Ribulose biphosphate carboxylase

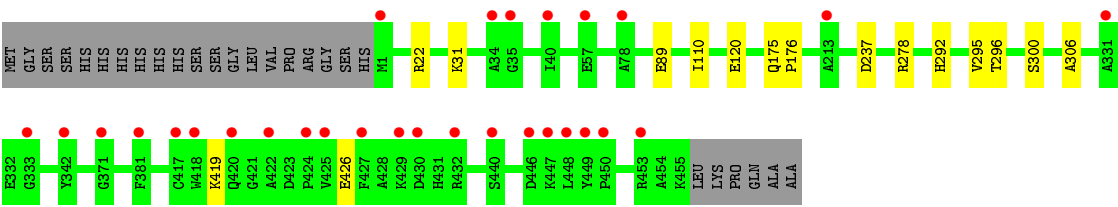
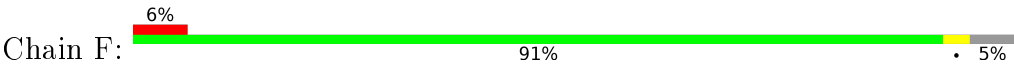


- Molecule 1: Ribulose biphosphate carboxylase





● Molecule 1: Ribulose biphosphate carboxylase



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	76.09Å 100.41Å 100.32Å 113.06° 88.86° 108.01°	Depositor
Resolution (Å)	81.96 – 2.15 81.96 – 2.15	Depositor EDS
% Data completeness (in resolution range)	95.3 (81.96-2.15) 82.1 (81.96-2.15)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.39 (at 2.14Å)	Xtriage
Refinement program	PHENIX 1.9_1692	Depositor
R, R_{free}	0.225 , 0.255 0.223 , 0.255	Depositor DCC
R_{free} test set	13380 reflections (10.00%)	DCC
Wilson B-factor (Å ²)	35.3	Xtriage
Anisotropy	0.246	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 43.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	42492	wwPDB-VP
Average B, all atoms (Å ²)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.41% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: MG, CAP, KCX

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	0.24	0/3608	0.41	0/4883
1	B	0.24	0/3591	0.40	0/4861
1	C	0.24	0/3591	0.41	0/4861
1	D	0.23	0/3599	0.40	0/4872
1	E	0.23	0/3591	0.40	0/4861
1	F	0.24	0/3591	0.41	0/4861
All	All	0.24	0/21571	0.40	0/29199

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 [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	3532	3393	3405	4	0
1	B	3515	3369	3381	4	0
1	C	3515	3362	3381	5	0
1	D	3523	3367	3392	8	0
1	E	3515	3369	3381	6	0
1	F	3515	3370	3381	9	0
2	A	21	9	7	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	B	21	9	7	0	0
2	C	21	9	7	1	0
2	D	21	9	7	0	0
2	E	21	9	7	0	0
2	F	21	9	7	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	E	1	0	0	0	0
3	F	1	0	0	0	0
4	A	147	0	0	1	0
4	B	173	0	0	0	0
4	C	171	0	0	0	0
4	D	176	0	0	1	0
4	E	146	0	0	0	0
4	F	148	0	0	0	0
All	All	22208	20284	20363	34	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 1.

All (34) 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:F:296:THR:OG1	1:F:306:ALA:N	2.37	0.57
1:B:292:HIS:ND1	1:B:296:THR:HG21	2.23	0.53
1:F:292:HIS:ND1	1:F:296:THR:HG21	2.27	0.50
1:C:446:ASP:OD1	1:C:453:ARG:NH2	2.45	0.50
1:D:217:ARG:NH2	1:D:254:ASP:OD1	2.32	0.49
1:E:237:ASP:OD2	1:F:278:ARG:NH1	2.45	0.49
1:F:31:LYS:NZ	1:F:120:GLU:OE1	2.40	0.48
1:E:313:ALA:HA	1:E:316:GLN:HE21	1.77	0.48
1:E:278:ARG:NH1	1:F:237:ASP:OD2	2.47	0.48
1:F:110:ILE:HG23	1:F:110:ILE:O	2.14	0.47
1:C:415:GLU:OE2	1:C:419:LYS:NZ	2.47	0.46
1:E:110:ILE:HG23	1:E:110:ILE:O	2.15	0.46
1:B:293:GLY:HA2	1:B:296:THR:HG22	1.99	0.46
1:D:292:HIS:ND1	1:D:296:THR:HG21	2.31	0.45
1:B:296:THR:OG1	1:B:306:ALA:N	2.50	0.45
1:F:295:VAL:O	1:F:300:SER:OG	2.35	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:C:110:ILE:O	1:C:110:ILE:HG23	2.16	0.44
1:A:110:ILE:O	1:A:110:ILE:HG23	2.16	0.44
1:B:110:ILE:HG23	1:B:110:ILE:O	2.17	0.44
1:D:293:GLY:HA2	1:D:296:THR:HG22	1.99	0.44
1:E:126:ASP:OD1	1:E:127:PHE:N	2.51	0.44
1:D:135:LYS:NZ	4:D:631:HOH:O	2.52	0.42
1:F:22:ARG:NH2	1:F:89:GLU:OE2	2.53	0.42
1:D:110:ILE:HG23	1:D:110:ILE:O	2.19	0.42
1:C:175:GLN:HB3	1:C:176:PRO:HD3	2.02	0.41
1:C:322:HIS:ND1	2:C:500:CAP:O5P	2.48	0.41
1:A:175:GLN:HB3	1:A:176:PRO:HD3	2.03	0.41
1:A:47:VAL:HG21	1:A:72:VAL:HG23	2.02	0.41
1:D:175:GLN:HB3	1:D:176:PRO:HD3	2.02	0.41
1:F:175:GLN:HB3	1:F:176:PRO:HD3	2.01	0.41
1:E:175:GLN:HB3	1:E:176:PRO:HD3	2.03	0.41
1:D:54:THR:OG1	1:D:55:ASN:N	2.52	0.41
1:D:381:PHE:HB3	1:D:418:TRP:CE2	2.56	0.41
1:A:55:ASN:ND2	4:A:621:HOH:O	2.49	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 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	454/481 (94%)	440 (97%)	14 (3%)	0	100	100
1	B	452/481 (94%)	438 (97%)	14 (3%)	0	100	100
1	C	452/481 (94%)	436 (96%)	15 (3%)	1 (0%)	52	51
1	D	453/481 (94%)	440 (97%)	13 (3%)	0	100	100
1	E	452/481 (94%)	438 (97%)	14 (3%)	0	100	100
1	F	452/481 (94%)	436 (96%)	16 (4%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	2715/2886 (94%)	2628 (97%)	86 (3%)	1 (0%)	100	100

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	450	PRO

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	352/372 (95%)	352 (100%)	0	100	100
1	B	350/372 (94%)	349 (100%)	1 (0%)	94	97
1	C	350/372 (94%)	350 (100%)	0	100	100
1	D	351/372 (94%)	351 (100%)	0	100	100
1	E	350/372 (94%)	350 (100%)	0	100	100
1	F	350/372 (94%)	348 (99%)	2 (1%)	90	94
All	All	2103/2232 (94%)	2100 (100%)	3 (0%)	95	98

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	258	HIS
1	F	419	LYS
1	F	426	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

6 non-standard protein/DNA/RNA residues are modelled in this entry.

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
1	KCX	A	192	1,3	6,11,12	0.60	0	7,12,14	1.34	2 (28%)
1	KCX	B	192	1,3	6,11,12	0.56	0	7,12,14	1.11	1 (14%)
1	KCX	C	192	1,3	6,11,12	0.58	0	7,12,14	1.13	0
1	KCX	D	192	1,3	6,11,12	0.62	0	7,12,14	1.39	2 (28%)
1	KCX	E	192	1,3	6,11,12	0.59	0	7,12,14	0.98	1 (14%)
1	KCX	F	192	1,3	6,11,12	0.57	0	7,12,14	1.01	1 (14%)

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
1	KCX	A	192	1,3	-	0/6/10/12	0/0/0/0
1	KCX	B	192	1,3	-	0/6/10/12	0/0/0/0
1	KCX	C	192	1,3	-	0/6/10/12	0/0/0/0
1	KCX	D	192	1,3	-	0/6/10/12	0/0/0/0
1	KCX	E	192	1,3	-	0/6/10/12	0/0/0/0
1	KCX	F	192	1,3	-	0/6/10/12	0/0/0/0

There are no bond length outliers.

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	192	KCX	CE-NZ-CX	-2.89	120.49	123.53
1	A	192	KCX	CE-NZ-CX	-2.40	121.01	123.53
1	A	192	KCX	O-C-CA	-2.38	119.33	125.72
1	B	192	KCX	O-C-CA	-2.12	120.04	125.72
1	F	192	KCX	O-C-CA	-2.11	120.05	125.72
1	D	192	KCX	O-C-CA	-2.09	120.11	125.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	192	KCX	O-C-CA	-2.07	120.18	125.72

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 12 ligands modelled in this entry, 6 are monoatomic - leaving 6 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	$\# Z > 2$
2	CAP	A	500	3	14,20,20	0.78	0	16,31,31	0.91	1 (6%)
2	CAP	B	500	3	14,20,20	0.81	0	16,31,31	0.87	1 (6%)
2	CAP	C	500	3	14,20,20	0.78	0	16,31,31	0.87	1 (6%)
2	CAP	D	500	3	14,20,20	0.80	0	16,31,31	0.93	1 (6%)
2	CAP	E	500	3	14,20,20	0.83	0	16,31,31	0.89	1 (6%)
2	CAP	F	500	3	14,20,20	0.79	0	16,31,31	0.89	1 (6%)

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
2	CAP	A	500	3	-	0/23/29/29	0/0/0/0

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	CAP	B	500	3	-	0/23/29/29	0/0/0/0
2	CAP	C	500	3	-	0/23/29/29	0/0/0/0
2	CAP	D	500	3	-	0/23/29/29	0/0/0/0
2	CAP	E	500	3	-	0/23/29/29	0/0/0/0
2	CAP	F	500	3	-	0/23/29/29	0/0/0/0

There are no bond length outliers.

All (6) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	500	CAP	O3-C3-C4	2.04	113.21	109.07
2	F	500	CAP	O3-C3-C4	2.25	113.63	109.07
2	C	500	CAP	O3-C3-C4	2.30	113.73	109.07
2	E	500	CAP	O3-C3-C4	2.32	113.78	109.07
2	D	500	CAP	O3-C3-C4	2.44	114.03	109.07
2	A	500	CAP	O3-C3-C4	2.52	114.18	109.07

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	500	CAP	1	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, 95th 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 ²)	Q<0.9
1	A	456/481 (94%)	0.40	15 (3%)	50	60	22, 43, 66, 86	0
1	B	454/481 (94%)	0.32	10 (2%)	65	73	22, 41, 64, 77	0
1	C	454/481 (94%)	0.32	15 (3%)	50	60	24, 43, 71, 97	0
1	D	455/481 (94%)	0.39	21 (4%)	36	47	23, 45, 71, 95	0
1	E	454/481 (94%)	0.46	12 (2%)	59	68	23, 47, 71, 87	0
1	F	454/481 (94%)	0.53	29 (6%)	23	32	24, 47, 76, 102	0
All	All	2727/2886 (94%)	0.40	102 (3%)	45	55	22, 44, 70, 102	0

All (102) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	449	TYR	7.8
1	D	449	TYR	5.8
1	A	451	ASN	5.1
1	F	35	GLY	5.0
1	F	448	LEU	4.5
1	D	451	ASN	4.4
1	A	449	TYR	4.3
1	C	427	PHE	4.2
1	D	445	ALA	4.2
1	C	1	MET	4.0
1	F	450	PRO	4.0
1	A	438	PHE	3.9
1	F	333	GLY	3.8
1	B	1	MET	3.8
1	D	450	PRO	3.7
1	F	34	ALA	3.7
1	C	441	PHE	3.7
1	A	1	MET	3.6
1	E	35	GLY	3.6

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Mol	Chain	Res	Type	RSRZ
1	A	445	ALA	3.5
1	A	450	PRO	3.5
1	A	420	GLN	3.5
1	D	456	LEU	3.5
1	D	455	LYS	3.5
1	E	449	TYR	3.5
1	D	448	LEU	3.3
1	F	420	GLN	3.3
1	B	427	PHE	3.3
1	D	452	TRP	3.3
1	A	452	TRP	3.3
1	F	447	LYS	3.2
1	B	450	PRO	3.2
1	D	420	GLN	3.2
1	C	424	PRO	3.2
1	B	449	TYR	3.2
1	C	448	LEU	3.2
1	C	419	LYS	3.2
1	C	221	ASP	3.1
1	E	447	LYS	3.1
1	C	420	GLN	3.1
1	F	78	ALA	3.1
1	A	427	PHE	3.0
1	F	424	PRO	3.0
1	F	430	ASP	3.0
1	F	427	PHE	2.9
1	B	78	ALA	2.9
1	A	456	LEU	2.9
1	F	453	ARG	2.8
1	B	422	ALA	2.8
1	B	451	ASN	2.8
1	E	40	ILE	2.8
1	D	425	VAL	2.7
1	D	441	PHE	2.7
1	F	40	ILE	2.7
1	D	424	PRO	2.6
1	F	446	ASP	2.6
1	C	450	PRO	2.6
1	A	81	LEU	2.6
1	F	371	GLY	2.6
1	E	450	PRO	2.5
1	E	36	PHE	2.5

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Mol	Chain	Res	Type	RSRZ
1	F	417	CYS	2.5
1	C	225	GLU	2.5
1	F	1	MET	2.4
1	D	427	PHE	2.4
1	E	59	SER	2.4
1	F	429	LYS	2.4
1	F	342	TYR	2.4
1	B	37	GLY	2.4
1	C	423	ASP	2.4
1	D	438	PHE	2.4
1	F	440	SER	2.4
1	C	145	LYS	2.3
1	F	422	ALA	2.3
1	C	446	ASP	2.3
1	D	334	GLU	2.3
1	E	34	ALA	2.3
1	D	453	ARG	2.3
1	C	421	GLY	2.2
1	A	426	GLU	2.2
1	E	451	ASN	2.2
1	E	33	LYS	2.1
1	A	35	GLY	2.1
1	D	454	ALA	2.1
1	D	423	ASP	2.1
1	E	425	VAL	2.1
1	F	381	PHE	2.1
1	D	447	LYS	2.1
1	C	430	ASP	2.1
1	A	443	GLN	2.1
1	A	448	LEU	2.1
1	F	425	VAL	2.1
1	D	296	THR	2.1
1	F	57	GLU	2.1
1	F	213	ALA	2.1
1	B	431	HIS	2.1
1	F	418	TRP	2.1
1	B	29	ILE	2.0
1	D	1	MET	2.0
1	F	331	ALA	2.0
1	E	75	VAL	2.0
1	F	432	ARG	2.0

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

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	LLDF	B-factors(Å ²)	Q<0.9
1	KCX	A	192	12/13	0.91	0.13	-	32,36,39,40	0
1	KCX	C	192	12/13	0.95	0.12	-	34,43,50,51	0
1	KCX	E	192	12/13	0.93	0.14	-	32,38,43,43	0
1	KCX	B	192	12/13	0.94	0.14	-	29,36,42,42	0
1	KCX	F	192	12/13	0.89	0.14	-	37,44,47,47	0
1	KCX	D	192	12/13	0.94	0.12	-	34,38,43,44	0

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	LLDF	B-factors(Å ²)	Q<0.9
2	CAP	D	500	21/21	0.96	0.14	0.40	38,43,52,54	0
2	CAP	A	500	21/21	0.96	0.14	-0.09	34,42,49,50	0
2	CAP	F	500	21/21	0.96	0.14	-0.20	40,48,58,60	0
2	CAP	E	500	21/21	0.95	0.14	-0.23	37,42,50,51	0
2	CAP	B	500	21/21	0.97	0.13	-0.25	35,38,48,50	0
2	CAP	C	500	21/21	0.97	0.12	-0.36	37,43,52,53	0
3	MG	D	501	1/1	0.96	0.06	-2.76	38,38,38,38	0
3	MG	B	501	1/1	0.98	0.07	-3.36	34,34,34,34	0
3	MG	C	501	1/1	0.89	0.06	-3.55	44,44,44,44	0
3	MG	A	501	1/1	0.89	0.06	-4.19	32,32,32,32	0
3	MG	E	501	1/1	0.94	0.05	-4.70	37,37,37,37	0
3	MG	F	501	1/1	0.92	0.05	-5.39	37,37,37,37	0

6.5 Other polymers [i](#)

There are no such residues in this entry.