Full wwPDB X-ray Structure Validation Report (i)

Dec 16, 2023 – 09:05 pm GMT

PDB ID	:	4C5Q
Title	:	measles virus phosphoprotein tetramerization domain
Authors	:	Blocquel, D.; Habchi, J.; Durand, E.; Sevajol, M.; Ferron, F.; Papageorgiou, N.; Longhi, S.
Deposited on	:	2013-09-14
Resolution	:	2.20 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 (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

The following versions of software and data (see references (1)) were used in the production of this report:

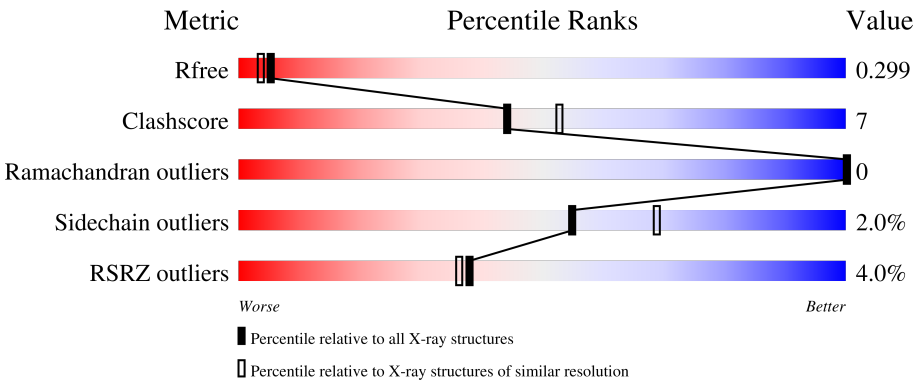
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

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 2.20 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	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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% 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	79	58% 13% 29%
1	B	79	5% 61% 8% • 30%
1	C	79	5% 59% •• 38%
1	D	79	3% 51% 13% • 35%
1	E	79	3% 49% 19% • 29%

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Mol	Chain	Length	Quality of chain
1	F	79	3% 53% 15% • 30%
1	G	79	3% 49% 10% 41%
1	H	79	% 61% • 35%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 3667 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 PHOSPHOPROTEIN.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
1	A	56	453	285	77	91	0	0	0
1	B	55	447	282	76	89	0	0	0
1	C	49	395	248	68	79	0	0	0
1	D	51	415	261	70	84	0	0	0
1	E	56	453	285	77	91	0	0	0
1	F	55	447	282	76	89	0	0	0
1	G	47	378	239	66	73	0	0	0
1	H	51	415	261	70	84	0	0	0

There are 64 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	303	MET	-	expression tag	UNP P35974
A	376	HIS	-	expression tag	UNP P35974
A	377	HIS	-	expression tag	UNP P35974
A	378	HIS	-	expression tag	UNP P35974
A	379	HIS	-	expression tag	UNP P35974
A	380	HIS	-	expression tag	UNP P35974
A	381	HIS	-	expression tag	UNP P35974
A	306	HIS	TYR	engineered mutation	UNP P35974
B	303	MET	-	expression tag	UNP P35974
B	376	HIS	-	expression tag	UNP P35974
B	377	HIS	-	expression tag	UNP P35974
B	378	HIS	-	expression tag	UNP P35974
B	379	HIS	-	expression tag	UNP P35974

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Chain	Residue	Modelled	Actual	Comment	Reference
B	380	HIS	-	expression tag	UNP P35974
B	381	HIS	-	expression tag	UNP P35974
B	306	HIS	TYR	engineered mutation	UNP P35974
C	303	MET	-	expression tag	UNP P35974
C	376	HIS	-	expression tag	UNP P35974
C	377	HIS	-	expression tag	UNP P35974
C	378	HIS	-	expression tag	UNP P35974
C	379	HIS	-	expression tag	UNP P35974
C	380	HIS	-	expression tag	UNP P35974
C	381	HIS	-	expression tag	UNP P35974
C	306	HIS	TYR	engineered mutation	UNP P35974
D	303	MET	-	expression tag	UNP P35974
D	376	HIS	-	expression tag	UNP P35974
D	377	HIS	-	expression tag	UNP P35974
D	378	HIS	-	expression tag	UNP P35974
D	379	HIS	-	expression tag	UNP P35974
D	380	HIS	-	expression tag	UNP P35974
D	381	HIS	-	expression tag	UNP P35974
D	306	HIS	TYR	engineered mutation	UNP P35974
E	303	MET	-	expression tag	UNP P35974
E	376	HIS	-	expression tag	UNP P35974
E	377	HIS	-	expression tag	UNP P35974
E	378	HIS	-	expression tag	UNP P35974
E	379	HIS	-	expression tag	UNP P35974
E	380	HIS	-	expression tag	UNP P35974
E	381	HIS	-	expression tag	UNP P35974
E	306	HIS	TYR	engineered mutation	UNP P35974
F	303	MET	-	expression tag	UNP P35974
F	376	HIS	-	expression tag	UNP P35974
F	377	HIS	-	expression tag	UNP P35974
F	378	HIS	-	expression tag	UNP P35974
F	379	HIS	-	expression tag	UNP P35974
F	380	HIS	-	expression tag	UNP P35974
F	381	HIS	-	expression tag	UNP P35974
F	306	HIS	TYR	engineered mutation	UNP P35974
G	303	MET	-	expression tag	UNP P35974
G	376	HIS	-	expression tag	UNP P35974
G	377	HIS	-	expression tag	UNP P35974
G	378	HIS	-	expression tag	UNP P35974
G	379	HIS	-	expression tag	UNP P35974
G	380	HIS	-	expression tag	UNP P35974
G	381	HIS	-	expression tag	UNP P35974

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Chain	Residue	Modelled	Actual	Comment	Reference
G	306	HIS	TYR	engineered mutation	UNP P35974
H	303	MET	-	expression tag	UNP P35974
H	376	HIS	-	expression tag	UNP P35974
H	377	HIS	-	expression tag	UNP P35974
H	378	HIS	-	expression tag	UNP P35974
H	379	HIS	-	expression tag	UNP P35974
H	380	HIS	-	expression tag	UNP P35974
H	381	HIS	-	expression tag	UNP P35974
H	306	HIS	TYR	engineered mutation	UNP P35974

- Molecule 2 is water.

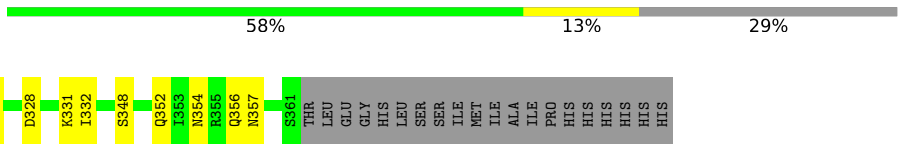
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	33	Total O 33 33	0	0
2	B	35	Total O 35 35	0	0
2	C	32	Total O 32 32	0	0
2	D	33	Total O 33 33	0	0
2	E	35	Total O 35 35	0	0
2	F	38	Total O 38 38	0	0
2	G	29	Total O 29 29	0	0
2	H	29	Total O 29 29	0	0

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 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.

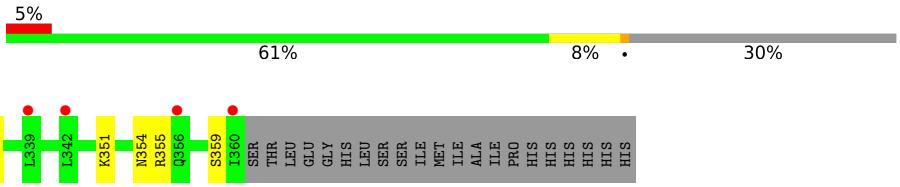
• Molecule 1: PHOSPHOPROTEIN

Chain A:



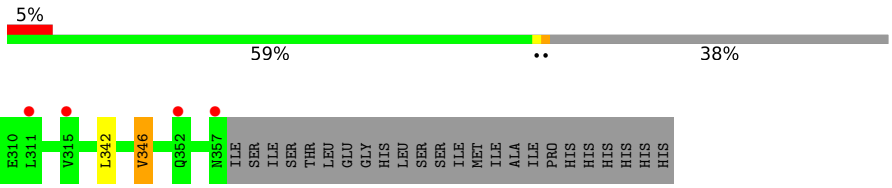
• Molecule 1: PHOSPHOPROTEIN

Chain B:



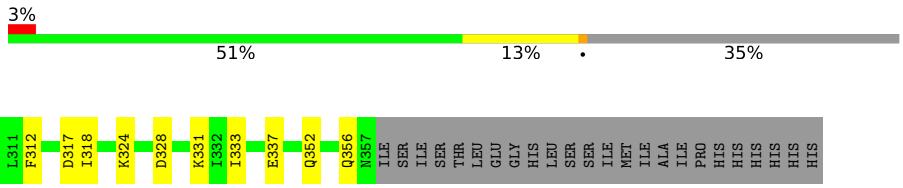
• Molecule 1: PHOSPHOPROTEIN

Chain C:



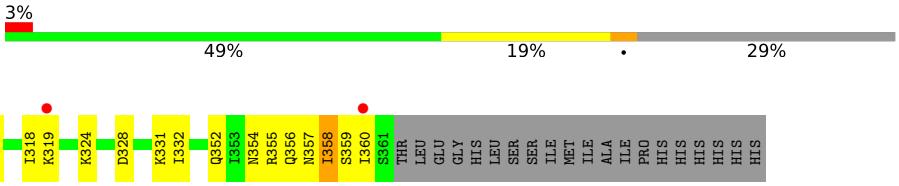
• Molecule 1: PHOSPHOPROTEIN

Chain D:



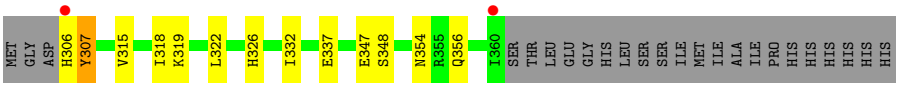
• Molecule 1: PHOSPHOPROTEIN

Chain E:



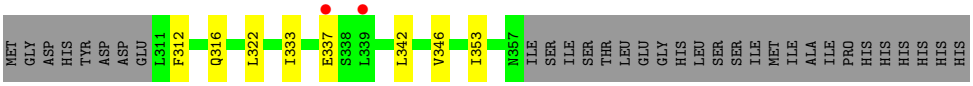
• Molecule 1: PHOSPHOPROTEIN

Chain F:



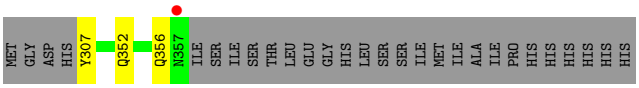
• Molecule 1: PHOSPHOPROTEIN

Chain G:



• Molecule 1: PHOSPHOPROTEIN

Chain H:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α, β, γ	34.34Å 34.39Å 139.69Å 97.04° 96.90° 90.12°	Depositor
Resolution (Å)	34.12 – 2.20 45.87 – 2.15	Depositor EDS
% Data completeness (in resolution range)	97.3 (34.12-2.20) 89.3 (45.87-2.15)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.64 (at 2.16Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.250 , 0.295 0.256 , 0.299	Depositor DCC
R_{free} test set	1642 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å^2)	26.8	Xtriage
Anisotropy	0.081	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 2.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.53$, $< L^2 > = 0.37$	Xtriage
Estimated twinning fraction	0.437 for k,-h,h+l 0.437 for -k,h,k+l 0.437 for h,-k,-h-l 0.458 for -h,k,-k-l 0.449 for k,h,-h-k-l 0.438 for -k,-h,-l 0.437 for -h,-k,h+k+l	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	3667	wwPDB-VP
Average B, all atoms (Å^2)	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 20.09 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 9.3711e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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 (i)

5.1 Standard geometry (i)

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	0.36	0/456	0.54	0/610
1	B	0.37	0/450	0.51	0/602
1	C	0.35	0/396	0.48	0/528
1	D	0.34	0/417	0.46	0/557
1	E	0.36	0/456	0.50	0/610
1	F	0.38	0/450	0.52	0/602
1	G	0.39	0/379	0.49	0/505
1	H	0.36	0/417	0.46	0/557
All	All	0.36	0/3421	0.50	0/4571

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	453	0	468	10	0
1	B	447	0	463	6	0
1	C	395	0	416	1	0
1	D	415	0	429	12	0
1	E	453	0	468	16	0
1	F	447	0	463	12	0
1	G	378	0	406	6	0
1	H	415	0	429	3	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	A	33	0	0	3	0
2	B	35	0	0	1	0
2	C	32	0	0	0	0
2	D	33	0	0	2	0
2	E	35	0	0	2	0
2	F	38	0	0	0	0
2	G	29	0	0	0	0
2	H	29	0	0	0	0
All	All	3667	0	3542	46	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 7.

All (46) 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:B:351:LYS:HG2	1:B:355:ARG:HH12	1.54	0.71
1:E:354:ASN:OD1	1:H:352:GLN:NE2	2.24	0.70
1:E:352:GLN:OE1	1:F:354:ASN:ND2	2.24	0.69
1:A:356:GLN:NE2	1:D:356:GLN:OE1	2.27	0.67
2:A:2033:HOH:O	1:E:306:HIS:NE2	2.27	0.65
1:E:356:GLN:NE2	1:H:356:GLN:OE1	2.30	0.65
1:D:307:TYR:N	2:D:2001:HOH:O	2.33	0.62
1:E:360:ILE:HG13	1:E:360:ILE:O	2.00	0.61
1:A:357:ASN:OD1	1:D:356:GLN:NE2	2.19	0.61
1:B:306:HIS:CG	1:B:307:TYR:H	2.20	0.60
1:D:312:PHE:HE2	1:F:348:SER:HG	1.50	0.60
1:E:355:ARG:O	1:E:358:ILE:HG13	2.03	0.58
1:A:348:SER:HG	1:E:312:PHE:HE2	1.54	0.55
1:A:352:GLN:NE2	1:B:354:ASN:OD1	2.42	0.53
1:F:306:HIS:CG	1:F:307:TYR:H	2.24	0.53
1:A:352:GLN:HE22	1:B:354:ASN:CG	2.13	0.52
1:D:312:PHE:HZ	1:F:347:GLU:HB3	1.75	0.52
1:E:328:ASP:O	1:E:332:ILE:HG12	2.10	0.51
1:B:359:SER:HA	2:B:2035:HOH:O	2.11	0.51
1:A:322:LEU:HD11	1:D:318:ILE:HG23	1.92	0.51
1:E:332:ILE:HD12	1:F:332:ILE:HG22	1.94	0.50
1:D:333:ILE:O	1:D:337:GLU:HG2	2.12	0.48
1:F:315:VAL:O	1:F:319:LYS:HG3	2.12	0.48
1:G:342:LEU:O	1:G:346:VAL:HG13	2.13	0.48
1:F:318:ILE:HG23	1:G:322:LEU:HD11	1.95	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:354:ASN:ND2	1:D:352:GLN:OE1	2.42	0.47
1:G:312:PHE:O	1:G:316:GLN:HG2	2.15	0.46
1:D:331:LYS:HE3	1:E:331:LYS:HD2	1.98	0.46
2:A:2017:HOH:O	1:D:328:ASP:OD2	2.20	0.45
1:C:342:LEU:O	1:C:346:VAL:HG13	2.17	0.45
1:E:319:LYS:HG3	2:E:2007:HOH:O	2.16	0.45
1:E:318:ILE:HG23	1:F:322:LEU:HD11	1.98	0.45
1:D:317:ASP:OD1	2:D:2004:HOH:O	2.21	0.44
1:G:333:ILE:O	1:G:337:GLU:HG2	2.17	0.44
2:A:2024:HOH:O	1:E:324:LYS:HE3	2.16	0.44
1:A:328:ASP:O	1:A:332:ILE:HG12	2.18	0.44
1:F:356:GLN:NE2	1:G:353:ILE:HG23	2.33	0.43
1:D:324:LYS:HE3	1:F:337:GLU:OE1	2.19	0.43
1:E:357:ASN:OD1	1:H:356:GLN:NE2	2.25	0.42
1:A:331:LYS:HB3	1:A:331:LYS:HE3	1.82	0.42
1:E:356:GLN:O	1:E:359:SER:HB3	2.21	0.41
1:F:306:HIS:CG	1:F:307:TYR:N	2.89	0.41
2:E:2012:HOH:O	1:F:326:HIS:HB2	2.21	0.41
1:G:353:ILE:HA	1:G:353:ILE:HD13	1.85	0.41
1:A:332:ILE:HD12	1:B:336:LEU:HD12	2.03	0.40
1:E:306:HIS:HD2	1:E:307:TYR:C	2.25	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	54/79 (68%)	52 (96%)	2 (4%)	0	100	100
1	B	53/79 (67%)	52 (98%)	1 (2%)	0	100	100
1	C	47/79 (60%)	47 (100%)	0	0	100	100
1	D	49/79 (62%)	49 (100%)	0	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	E	54/79 (68%)	52 (96%)	2 (4%)	0	100	100
1	F	53/79 (67%)	52 (98%)	1 (2%)	0	100	100
1	G	45/79 (57%)	45 (100%)	0	0	100	100
1	H	49/79 (62%)	49 (100%)	0	0	100	100
All	All	404/632 (64%)	398 (98%)	6 (2%)	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	A	53/73 (73%)	52 (98%)	1 (2%)	57	71
1	B	52/73 (71%)	51 (98%)	1 (2%)	57	71
1	C	46/73 (63%)	45 (98%)	1 (2%)	52	65
1	D	48/73 (66%)	47 (98%)	1 (2%)	53	67
1	E	53/73 (73%)	51 (96%)	2 (4%)	33	42
1	F	52/73 (71%)	51 (98%)	1 (2%)	57	71
1	G	44/73 (60%)	44 (100%)	0	100	100
1	H	48/73 (66%)	47 (98%)	1 (2%)	53	67
All	All	396/584 (68%)	388 (98%)	8 (2%)	55	69

All (8) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	307	TYR
1	B	307	TYR
1	C	346	VAL
1	D	307	TYR
1	E	307	TYR
1	E	358	ILE

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Mol	Chain	Res	Type
1	F	307	TYR
1	H	307	TYR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	352	GLN
1	B	316	GLN
1	F	330	GLN
1	H	352	GLN

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 monosaccharides 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.

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

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	56/79 (70%)	0.21	0	100	100	10, 18, 45, 49	0
1	B	55/79 (69%)	0.36	4 (7%)	15	14	10, 17, 41, 60	0
1	C	49/79 (62%)	0.64	4 (8%)	11	10	10, 16, 32, 39	0
1	D	51/79 (64%)	0.27	2 (3%)	39	37	10, 16, 34, 43	0
1	E	56/79 (70%)	0.44	2 (3%)	42	41	10, 18, 45, 60	0
1	F	55/79 (69%)	0.22	2 (3%)	42	41	9, 18, 44, 60	0
1	G	47/79 (59%)	0.22	2 (4%)	35	33	11, 15, 32, 39	0
1	H	51/79 (64%)	0.30	1 (1%)	65	63	10, 16, 34, 42	0
All	All	420/632 (66%)	0.33	17 (4%)	38	36	9, 17, 41, 60	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	H	357	ASN	3.7
1	C	311	LEU	3.2
1	B	339	LEU	3.1
1	F	306	HIS	2.9
1	B	360	ILE	2.8
1	D	307	TYR	2.6
1	C	352	GLN	2.5
1	D	310	GLU	2.4
1	G	337	GLU	2.3
1	B	356	GLN	2.3
1	E	360	ILE	2.2
1	F	360	ILE	2.2
1	B	342	LEU	2.2
1	C	357	ASN	2.1
1	C	315	VAL	2.1
1	G	339	LEU	2.1

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Mol	Chain	Res	Type	RSRZ
1	E	319	LYS	2.0

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 monosaccharides in this entry.

6.4 Ligands (i)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.