Full wwPDB X-ray Structure Validation Report (i)

Jun 12, 2024 – 07:24 PM EDT

PDB ID	:	3TS3
Title	:	Crystal structure of the projection domain of the turkey astrovirus capsid protein at 1.5 angstrom resolution
Authors	:	DuBois, R.M.; Schultz-Cherry, S.; White, S.W.
Deposited on	:	2011-09-12
Resolution	:	1.49 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 (i)) were used in the production of this report:

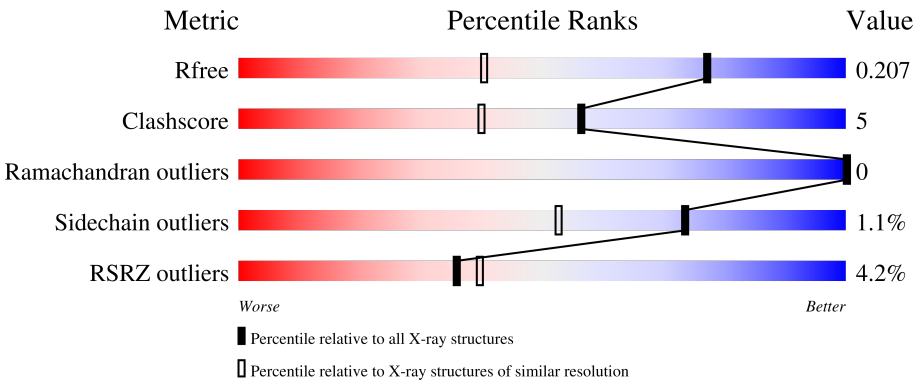
MolProbity	:	4.02b-467
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.20.1
EDS	:	2.36.2
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

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 1.49 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	2936 (1.50-1.50)
Clashscore	141614	3144 (1.50-1.50)
Ramachandran outliers	138981	3066 (1.50-1.50)
Sidechain outliers	138945	3064 (1.50-1.50)
RSRZ outliers	127900	2884 (1.50-1.50)

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	208	4% 88% 9% • •
1	B	208	5% 88% 10% •
1	C	208	2% 90% 7% •
1	D	208	5% 88% 9% • •

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 7519 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.

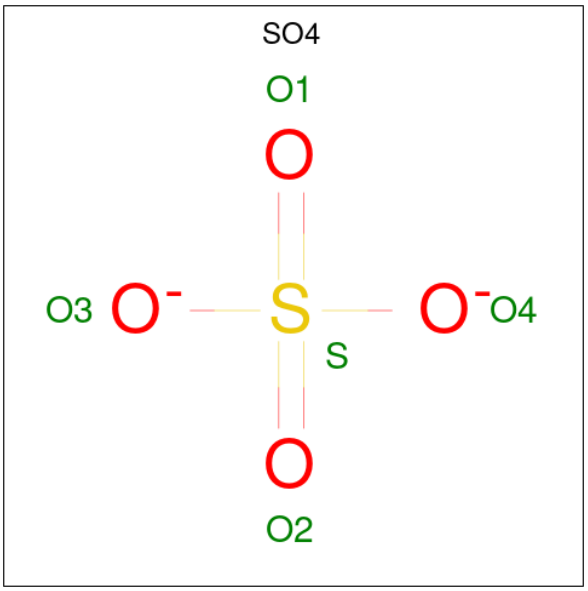
- Molecule 1 is a protein called Capsid polyprotein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	203	1673	1081	271	314	7	0	6	0
1	B	205	1692	1094	273	318	7	0	6	0
1	C	203	1676	1083	271	315	7	0	6	0
1	D	203	1673	1081	271	314	7	0	6	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	476	ILE	THR	SEE REMARK 999	UNP Q9Q3G5
A	490	LEU	SER	SEE REMARK 999	UNP Q9Q3G5
B	476	ILE	THR	SEE REMARK 999	UNP Q9Q3G5
B	490	LEU	SER	SEE REMARK 999	UNP Q9Q3G5
C	476	ILE	THR	SEE REMARK 999	UNP Q9Q3G5
C	490	LEU	SER	SEE REMARK 999	UNP Q9Q3G5
D	476	ILE	THR	SEE REMARK 999	UNP Q9Q3G5
D	490	LEU	SER	SEE REMARK 999	UNP Q9Q3G5

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



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	O	S		
2	B	1	5	4	1	0	0
			Total	O	S		
2	B	1	5	4	1	0	0
			Total	O	S		
2	B	1	5	4	1	0	0
			Total	O	S		
2	B	1	5	4	1	0	0
			Total	O	S		
2	C	1	5	4	1	0	0
			Total	O	S		
2	D	1	5	4	1	0	0
			Total	O	S		
2	D	1	5	4	1	0	0

- Molecule 3 is water.

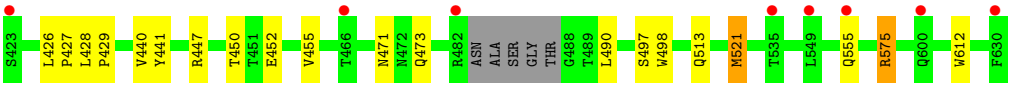
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	207	207	207	0	0
			Total	O		
3	B	194	194	194	0	0
			Total	O		
3	C	189	189	189	0	0
			Total	O		
3	D	180	180	180	0	0

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.

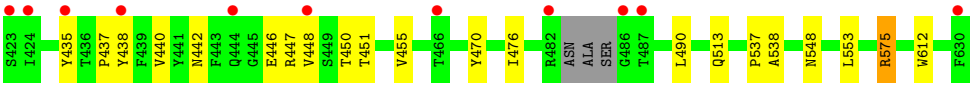
- Molecule 1: Capsid polyprotein

Chain A:



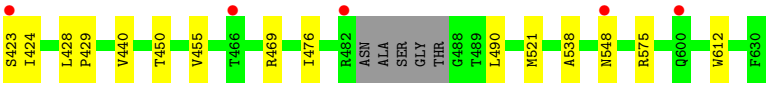
- Molecule 1: Capsid polyprotein

Chain B:



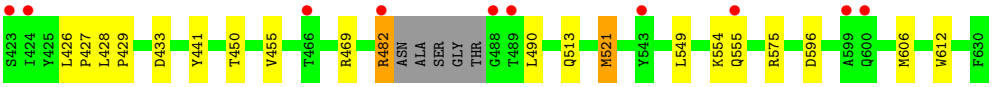
- Molecule 1: Capsid polyprotein

Chain C:



- Molecule 1: Capsid polyprotein

Chain D:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	44.49Å 127.88Å 71.01Å 90.00° 104.49° 90.00°	Depositor
Resolution (Å)	50.00 – 1.49 46.82 – 1.49	Depositor EDS
% Data completeness (in resolution range)	99.8 (50.00-1.49) 99.8 (46.82-1.49)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.21 (at 1.49Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.176 , 0.205 0.181 , 0.207	Depositor DCC
R_{free} test set	6265 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	11.7	Xtriage
Anisotropy	0.051	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.43 , 48.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	7519	wwPDB-VP
Average B, all atoms (Å^2)	13.0	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 52.62 % 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 4.7359e-05. 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)

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	0.50	0/1734	0.66	0/2360
1	B	0.48	0/1754	0.66	0/2387
1	C	0.50	0/1737	0.66	0/2364
1	D	0.49	0/1734	0.64	0/2360
All	All	0.49	0/6959	0.65	0/9471

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	1673	0	1643	15	0
1	B	1692	0	1656	28	0
1	C	1676	0	1644	14	0
1	D	1673	0	1643	15	0
2	B	20	0	0	0	0
2	C	5	0	0	0	0
2	D	10	0	0	1	0
3	A	207	0	0	2	0
3	B	194	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	189	0	0	2	0
3	D	180	0	0	1	0
All	All	7519	0	6586	67	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 5.

All (67) 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:482:ARG:HH11	1:D:482:ARG:HG2	0.96	1.10
1:D:482:ARG:HG2	1:D:482:ARG:NH1	1.75	0.90
1:B:442:ASN:HD21	1:B:446[B]:GLU:CG	1.85	0.89
1:D:482:ARG:HH11	1:D:482:ARG:CG	1.86	0.88
1:B:442:ASN:ND2	1:B:446[B]:GLU:CG	2.44	0.80
1:B:442:ASN:HD21	1:B:446[B]:GLU:CD	1.92	0.72
1:B:442:ASN:ND2	1:B:446[B]:GLU:HG2	2.08	0.68
1:D:469:ARG:NH1	1:D:596:ASP:OD1	2.29	0.65
1:B:442:ASN:HD21	1:B:446[B]:GLU:HG2	1.61	0.65
1:B:442:ASN:OD1	1:B:446[B]:GLU:HG2	1.97	0.64
1:A:450:THR:HA	1:A:455[B]:VAL:HG21	1.79	0.64
1:D:450:THR:HA	1:D:455[B]:VAL:HG21	1.80	0.64
1:B:435[B]:TYR:CZ	1:B:437:PRO:HA	2.34	0.61
1:D:433:ASP:HB2	2:D:2:SO4:O1	2.03	0.59
1:B:435[B]:TYR:OH	1:B:437:PRO:HA	2.03	0.58
1:A:440:VAL:HG13	1:A:521[B]:MET:HE1	1.83	0.58
1:A:575:ARG:HD2	1:A:612:TRP:CE3	2.39	0.57
1:C:490:LEU:C	1:C:490:LEU:HD12	2.24	0.57
1:B:442:ASN:CG	1:B:446[B]:GLU:HG2	2.25	0.57
1:A:440:VAL:HG13	1:A:521[B]:MET:CE	2.36	0.56
1:D:482:ARG:NH1	1:D:482:ARG:CG	2.53	0.55
1:B:450:THR:HA	1:B:455[B]:VAL:HG21	1.89	0.55
1:A:441:TYR:CZ	1:A:521[A]:MET:HB2	2.43	0.54
1:B:438:TYR:OH	1:C:548:ASN:OD1	2.21	0.54
1:B:447:ARG:HD3	1:C:476:ILE:CD1	2.39	0.52
1:B:437:PRO:HB2	1:B:438:TYR:CD1	2.45	0.52
1:D:441:TYR:CZ	1:D:521[A]:MET:HB2	2.45	0.51
1:A:575:ARG:HD2	1:A:612:TRP:CD2	2.46	0.51
1:A:473:GLN:OE1	1:A:497[A]:SER:OG	2.29	0.50
1:B:442:ASN:ND2	1:B:446[B]:GLU:HG3	2.28	0.49
1:D:549:LEU:O	1:D:554:LYS:HE3	2.13	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:447:ARG:CD	1:C:476:ILE:HD13	2.44	0.48
1:C:440:VAL:HG11	1:C:455[A]:VAL:HG12	1.96	0.47
1:C:575:ARG:HD2	1:C:612:TRP:CE3	2.49	0.47
1:A:490:LEU:HD12	1:A:490:LEU:C	2.35	0.47
1:B:575:ARG:HD2	1:B:612:TRP:CD2	2.50	0.47
1:C:575:ARG:HD2	1:C:612:TRP:CD2	2.50	0.46
1:C:450:THR:HA	1:C:455[B]:VAL:HG21	1.98	0.46
1:B:440:VAL:HG11	1:B:455[A]:VAL:HG12	1.99	0.45
1:A:513:GLN:NE2	3:A:680:HOH:O	2.45	0.45
1:B:451:THR:OG1	1:B:537:PRO:HG2	2.17	0.45
1:B:470:TYR:CD2	1:B:553:LEU:HG	2.52	0.45
1:A:428:LEU:N	1:A:429:PRO:CD	2.80	0.44
1:B:447:ARG:HG2	1:B:448:VAL:N	2.32	0.44
1:C:450:THR:HB	1:C:538:ALA:HB2	1.99	0.44
1:A:426:LEU:HA	1:A:427:PRO:C	2.37	0.44
1:B:438:TYR:CG	1:B:447:ARG:HB2	2.53	0.44
1:D:490:LEU:HD12	1:D:490:LEU:C	2.38	0.44
1:B:447:ARG:CD	1:C:476:ILE:CD1	2.96	0.43
1:A:447:ARG:CZ	1:B:476:ILE:HD12	2.49	0.43
1:D:575:ARG:HD2	1:D:612:TRP:CE3	2.54	0.43
1:C:469:ARG:HG3	3:C:665:HOH:O	2.19	0.42
1:D:513:GLN:NE2	3:D:654:HOH:O	2.51	0.42
1:C:428:LEU:N	1:C:429:PRO:CD	2.82	0.42
3:A:312:HOH:O	1:B:548:ASN:HB2	2.19	0.42
1:C:548:ASN:ND2	3:C:340:HOH:O	2.32	0.42
1:A:452:GLU:O	1:A:455[A]:VAL:HG23	2.20	0.41
1:C:423:SER:OG	1:C:424:ILE:N	2.52	0.41
1:B:490:LEU:C	1:B:490:LEU:HD12	2.40	0.41
1:D:606:MET:HB3	1:D:606:MET:HE3	1.96	0.41
1:B:450:THR:HB	1:B:538:ALA:HB2	2.01	0.41
1:D:426:LEU:HA	1:D:427:PRO:C	2.40	0.41
1:D:428:LEU:N	1:D:429:PRO:CD	2.83	0.41
1:A:440:VAL:HG13	1:A:521[B]:MET:SD	2.61	0.40
1:A:471:ASN:HB2	1:A:498:TRP:CZ3	2.57	0.40
1:B:455[B]:VAL:HA	1:B:513:GLN:HB2	2.03	0.40
1:B:575:ARG:HD2	1:B:612:TRP:CE3	2.57	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	205/208 (99%)	205 (100%)	0	0	100	100
1	B	207/208 (100%)	207 (100%)	0	0	100	100
1	C	205/208 (99%)	205 (100%)	0	0	100	100
1	D	205/208 (99%)	205 (100%)	0	0	100	100
All	All	822/832 (99%)	822 (100%)	0	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	184/181 (102%)	180 (98%)	4 (2%)	52	22
1	B	185/181 (102%)	184 (100%)	1 (0%)	88	78
1	C	184/181 (102%)	182 (99%)	2 (1%)	73	53
1	D	184/181 (102%)	180 (98%)	4 (2%)	52	22
All	All	737/724 (102%)	726 (98%)	11 (2%)	73	39

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	521[A]	MET
1	A	521[B]	MET

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Mol	Chain	Res	Type
1	A	555	GLN
1	A	575	ARG
1	B	575	ARG
1	C	521[A]	MET
1	C	521[B]	MET
1	D	482	ARG
1	D	521[A]	MET
1	D	521[B]	MET
1	D	555	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	555	GLN
1	D	513	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)

7 ligands 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	$\#\|Z\| > 2$
2	SO4	D	4	-	4,4,4	0.18	0	6,6,6	0.17	0
2	SO4	B	3	-	4,4,4	0.24	0	6,6,6	0.25	0
2	SO4	B	7	-	4,4,4	0.27	0	6,6,6	0.21	0
2	SO4	B	1	-	4,4,4	0.21	0	6,6,6	0.27	0
2	SO4	D	2	-	4,4,4	0.26	0	6,6,6	0.30	0
2	SO4	B	6	-	4,4,4	0.28	0	6,6,6	0.11	0
2	SO4	C	5	-	4,4,4	0.24	0	6,6,6	0.12	0

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.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	D	2	SO4	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 (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	203/208 (97%)	0.15	8 (3%)	39	44	6, 11, 18, 25	0
1	B	205/208 (98%)	0.30	11 (5%)	25	28	6, 11, 18, 26	0
1	C	203/208 (97%)	0.11	5 (2%)	57	62	6, 10, 17, 27	0
1	D	203/208 (97%)	0.29	10 (4%)	29	32	6, 12, 22, 28	0
All	All	814/832 (97%)	0.21	34 (4%)	36	40	6, 11, 19, 28	0

All (34) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	423	SER	5.8
1	B	487	THR	4.9
1	B	438	TYR	4.2
1	B	435[A]	TYR	4.0
1	D	423	SER	3.9
1	A	423	SER	3.8
1	B	423	SER	3.7
1	D	543	TYR	3.7
1	B	444	GLN	3.7
1	A	466	THR	3.5
1	D	600	GLN	3.3
1	C	482	ARG	3.2
1	D	488	GLY	3.2
1	D	482	ARG	3.0
1	A	600	GLN	3.0
1	D	599	ALA	2.9
1	A	549	LEU	2.8
1	D	555	GLN	2.7
1	B	486	GLY	2.5
1	B	482	ARG	2.5
1	D	466	THR	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	424	ILE	2.4
1	A	482	ARG	2.3
1	A	555	GLN	2.3
1	A	535	THR	2.2
1	C	548	ASN	2.2
1	C	466	THR	2.1
1	C	600	GLN	2.1
1	B	630	PHE	2.1
1	D	489	THR	2.1
1	D	424	ILE	2.1
1	B	448	VAL	2.1
1	B	466	THR	2.1
1	A	630	PHE	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)

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, 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	B-factors(Å^2)	Q<0.9
2	SO4	B	6	5/5	0.87	0.26	31,31,31,32	0
2	SO4	D	2	5/5	0.90	0.19	23,24,25,25	0
2	SO4	B	7	5/5	0.94	0.12	28,29,29,30	0
2	SO4	C	5	5/5	0.97	0.11	26,27,28,28	0
2	SO4	B	1	5/5	0.98	0.09	16,16,19,19	0
2	SO4	D	4	5/5	0.98	0.10	14,15,17,17	0
2	SO4	B	3	5/5	0.99	0.06	11,13,13,13	0

6.5 Other polymers (i)

There are no such residues in this entry.