



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 15, 2026 – 01:15 PM UTC

PDB ID : 4EZO / pdb_00004ezo
Title : Crystal structure of the substrate binding domain of E.coli DnaK in complex with PR-39 (residues 1 to 15)
Authors : Zahn, M.; Straeter, N.
Deposited on : 2012-05-03
Resolution : 1.90 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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

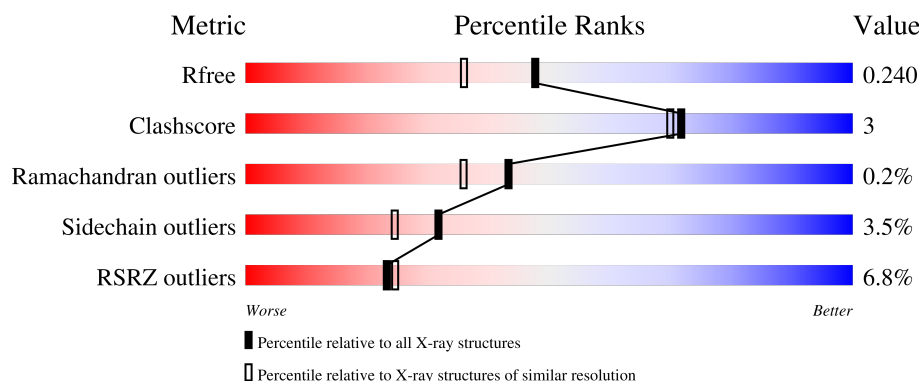
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.90 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	7789 (1.90-1.90)
Clashscore	190562	8410 (1.90-1.90)
Ramachandran outliers	187476	8333 (1.90-1.90)
Sidechain outliers	187428	8333 (1.90-1.90)
RSRZ outliers	180081	7790 (1.90-1.90)

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 $\leq 5\%$. 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	219	7% 83% 11% • •
1	B	219	4% 88% 10% •
2	C	15	33% 33% 13% 7% 47%
2	D	15	47% 7% 47%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3684 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.

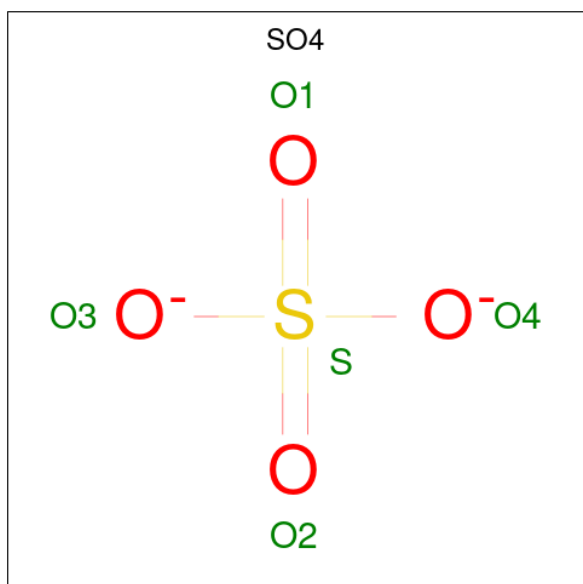
- Molecule 1 is a protein called Chaperone protein DnaK.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	211	Total	C	N	O	S	0	2	0
			1614	993	285	330	6			
1	B	215	Total	C	N	O	S	0	3	0
			1650	1016	289	338	7			

- Molecule 2 is a protein called Antibacterial protein PR-39.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	8	Total	C	N	O	0	0	0
			70	47	14	9			
2	D	8	Total	C	N	O	0	0	0
			70	47	14	9			

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0

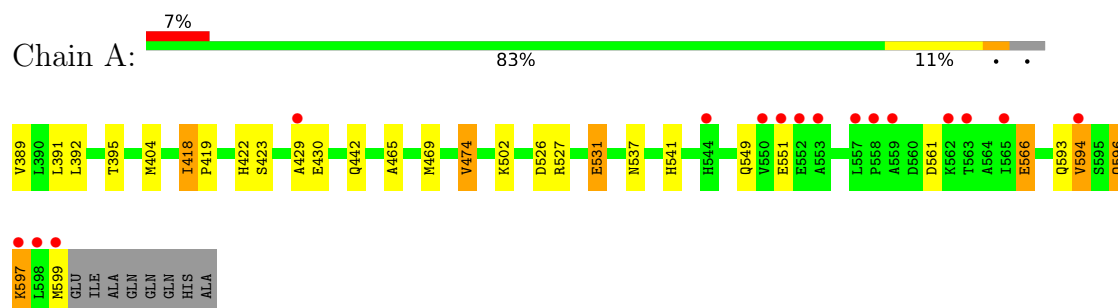
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	128	Total O 128 128	0	0
4	B	116	Total O 116 116	0	0
4	C	4	Total O 4 4	0	0
4	D	2	Total O 2 2	0	0

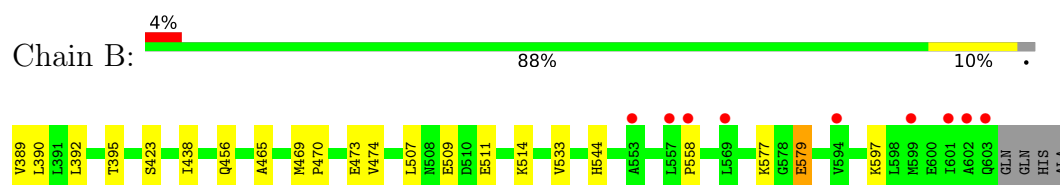
3 Residue-property plots [i](#)

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.

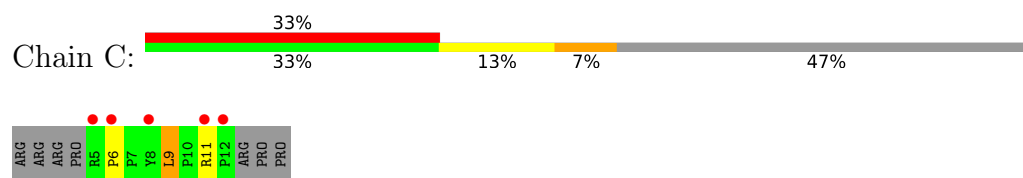
- Molecule 1: Chaperone protein DnaK



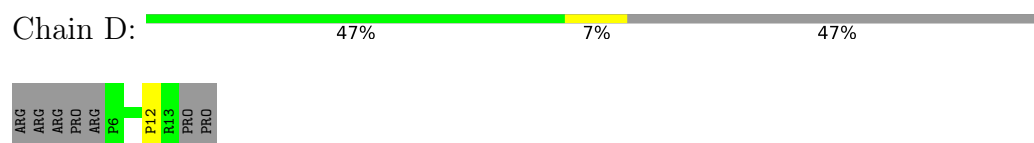
- Molecule 1: Chaperone protein DnaK



- Molecule 2: Antibacterial protein PR-39



- Molecule 2: Antibacterial protein PR-39



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	77.63Å 161.27Å 44.69Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.80 – 1.90 24.80 – 1.90	Depositor EDS
% Data completeness (in resolution range)	99.7 (24.80-1.90) 99.7 (24.80-1.90)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.97 (at 1.90Å)	Xtriage
Refinement program	REFMAC with PDBID 3DPO	Depositor
R, R_{free}	0.204 , 0.240 0.208 , 0.240	Depositor DCC
R_{free} test set	1405 reflections (3.11%)	wwPDB-VP
Wilson B-factor (Å ²)	29.8	Xtriage
Anisotropy	0.732	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 36.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	3684	wwPDB-VP
Average B, all atoms (Å ²)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.48% 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

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	1.35	5/1635 (0.3%)	1.22	4/2203 (0.2%)
1	B	1.25	2/1674 (0.1%)	1.26	7/2256 (0.3%)
2	C	1.20	0/74	1.85	4/102 (3.9%)
2	D	0.73	0/74	1.00	0/101
All	All	1.29	7/3457 (0.2%)	1.25	15/4662 (0.3%)

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	422	HIS	CG-CD2	6.31	1.42	1.35
1	A	442	GLN	C-O	5.99	1.30	1.24
1	B	579	GLU	CA-CB	5.73	1.61	1.53
1	A	541	HIS	CG-CD2	5.34	1.41	1.35
1	A	474	VAL	N-CA	5.26	1.52	1.46
1	A	465	ALA	C-O	5.05	1.29	1.24
1	B	544	HIS	CG-CD2	5.01	1.41	1.35

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	395	THR	CB-CA-C	9.11	124.16	109.41
2	C	9	LEU	CA-C-N	-8.18	111.35	119.78
2	C	9	LEU	C-N-CA	-8.18	111.35	119.78
1	B	390	LEU	N-CA-C	-7.27	103.55	113.30
2	C	6	PRO	CA-C-N	-6.99	112.28	120.11
2	C	6	PRO	C-N-CA	-6.99	112.28	120.11
1	B	509	GLU	N-CA-C	6.41	119.09	111.33
1	B	395	THR	N-CA-C	-6.08	101.99	109.65
1	B	533	VAL	N-CA-C	6.04	116.78	110.62
1	A	526	ASP	N-CA-C	-5.84	104.99	111.36

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	594	VAL	CB-CA-C	5.35	117.83	111.20
1	B	465	ALA	CA-C-N	-5.28	114.27	119.92
1	B	465	ALA	C-N-CA	-5.28	114.27	119.92
1	A	537	ASN	N-CA-C	-5.08	105.82	111.36
1	A	395	THR	N-CA-C	-5.07	103.38	109.72

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	1614	0	1633	16	0
1	B	1650	0	1670	6	0
2	C	70	0	73	4	0
2	D	70	0	74	1	0
3	A	10	0	0	0	0
3	B	20	0	0	0	0
4	A	128	0	0	0	0
4	B	116	0	0	1	0
4	C	4	0	0	0	0
4	D	2	0	0	0	0
All	All	3684	0	3450	23	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 3.

All (23) 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:A:566:GLU:HA	1:A:566:GLU:OE2	1.79	0.80
1:A:389:VAL:HG22	1:A:391:LEU:H	1.57	0.69
1:A:404:MET:HE3	2:C:11:ARG:HD2	1.73	0.69
1:A:561:ASP:OD2	1:A:597:LYS:HD2	1.96	0.64
1:B:389:VAL:HG21	1:B:392:LEU:HD13	1.87	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:593:GLN:O	1:A:596:GLN:NE2	2.42	0.53
1:A:429:ALA:HB2	2:C:9:LEU:O	2.09	0.52
1:B:507:LEU:HB3	1:B:511:GLU:HB2	1.95	0.47
1:A:392:LEU:C	1:A:392:LEU:HD12	2.41	0.46
1:A:389:VAL:HG22	1:A:391:LEU:O	2.16	0.45
4:B:884:HOH:O	2:D:12:PRO:HA	2.16	0.45
1:B:469[B]:MET:HB3	1:B:470:PRO:HD3	1.99	0.44
1:A:389:VAL:CG2	1:A:391:LEU:O	2.65	0.44
1:B:438:ILE:O	1:B:456:GLN:HA	2.17	0.44
1:B:558:PRO:HG2	1:B:597:LYS:HE3	1.99	0.44
1:A:418:ILE:HA	1:A:419:PRO:C	2.43	0.43
1:A:502:LYS:HE2	1:A:502:LYS:HB2	1.75	0.43
1:A:527:ARG:O	1:A:531:GLU:HG2	2.19	0.43
1:A:430:GLU:HG2	2:C:11:ARG:HG2	2.00	0.43
1:B:423:SER:HA	1:B:474:VAL:O	2.18	0.43
1:A:418:ILE:HB	1:A:419:PRO:HA	2.02	0.42
1:A:423:SER:HA	1:A:474:VAL:O	2.21	0.40
1:A:429:ALA:HB1	2:C:11:ARG:HG3	2.03	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	211/219 (96%)	207 (98%)	3 (1%)	1 (0%)	24	16
1	B	216/219 (99%)	213 (99%)	3 (1%)	0	100	100
2	C	6/15 (40%)	6 (100%)	0	0	100	100
2	D	6/15 (40%)	6 (100%)	0	0	100	100
All	All	439/468 (94%)	432 (98%)	6 (1%)	1 (0%)	43	36

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	596	GLN

5.3.2 Protein sidechains ⓘ

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	177/181 (98%)	168 (95%)	9 (5%)	21	13
1	B	181/181 (100%)	177 (98%)	4 (2%)	45	42
2	C	8/15 (53%)	8 (100%)	0	100	100
2	D	8/15 (53%)	8 (100%)	0	100	100
All	All	374/392 (95%)	361 (96%)	13 (4%)	32	24

All (13) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	418	ILE
1	A	469	MET
1	A	531	GLU
1	A	549	GLN
1	A	551	GLU
1	A	566	GLU
1	A	594	VAL
1	A	597	LYS
1	A	599	MET
1	B	473	GLU
1	B	514	LYS
1	B	577	LYS
1	B	579	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	513	GLN
1	B	432	ASN
1	B	497	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

6 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	$\# Z > 2$
3	SO4	B	704	-	4,4,4	0.41	0	6,6,6	0.42	0
3	SO4	B	703	-	4,4,4	0.54	0	6,6,6	0.30	0
3	SO4	B	702	-	4,4,4	0.46	0	6,6,6	0.75	0
3	SO4	A	702	-	4,4,4	0.47	0	6,6,6	0.09	0
3	SO4	A	701	-	4,4,4	0.51	0	6,6,6	0.36	0
3	SO4	B	701	-	4,4,4	0.55	0	6,6,6	0.61	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.

No monomer is involved in short contacts.

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	211/219 (96%)	0.16	16 (7%) 20 21	15, 31, 84, 105	2 (0%)
1	B	215/219 (98%)	0.13	9 (4%) 40 43	17, 34, 81, 92	3 (1%)
2	C	8/15 (53%)	1.88	5 (62%) 0 0	40, 54, 73, 90	0
2	D	8/15 (53%)	0.45	0 100 100	34, 45, 57, 72	0
All	All	442/468 (94%)	0.18	30 (6%) 23 24	15, 33, 83, 105	5 (1%)

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	599	MET	5.6
1	A	552	GLU	5.5
1	A	598	LEU	5.1
1	A	551	GLU	5.0
1	A	550	VAL	3.8
1	A	557	LEU	3.2
1	A	553	ALA	3.1
1	B	603	GLN	2.8
2	C	5	ARG	2.7
1	B	553	ALA	2.6
1	B	602	ALA	2.6
1	A	544	HIS	2.5
1	A	565	ILE	2.5
2	C	6	PRO	2.5
1	B	569	LEU	2.3
1	B	558	PRO	2.3
1	B	599	MET	2.3
1	A	429	ALA	2.3
1	A	597	LYS	2.2
1	B	601	ILE	2.2
1	A	558	PRO	2.2

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Mol	Chain	Res	Type	RSRZ
2	C	11	ARG	2.2
1	A	594	VAL	2.2
2	C	12	PRO	2.2
1	A	562	LYS	2.1
1	B	594	VAL	2.1
2	C	8	TYR	2.0
1	A	563	THR	2.0
1	B	557	LEU	2.0
1	A	559	ALA	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 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, 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
3	SO4	B	703	5/5	0.74	0.11	78,79,86,93	0
3	SO4	A	702	5/5	0.84	0.09	71,83,85,86	0
3	SO4	B	701	5/5	0.86	0.09	56,61,65,76	0
3	SO4	B	704	5/5	0.90	0.07	54,60,67,73	0
3	SO4	B	702	5/5	0.93	0.08	37,49,67,74	0
3	SO4	A	701	5/5	0.95	0.07	47,52,58,65	0

6.5 Other polymers [i](#)

There are no such residues in this entry.