



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 08:22 PM UTC

PDB ID : 7RK1 / pdb_00007rk1
Title : Crystal structure of the human astrovirus serotype 8 capsid spike in complex with scFv 3E8, an astrovirus-neutralizing antibody, at 2.05-Å resolution
Authors : Meyer, L.; DuBois, R.M.
Deposited on : 2021-07-21
Resolution : 2.05 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
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

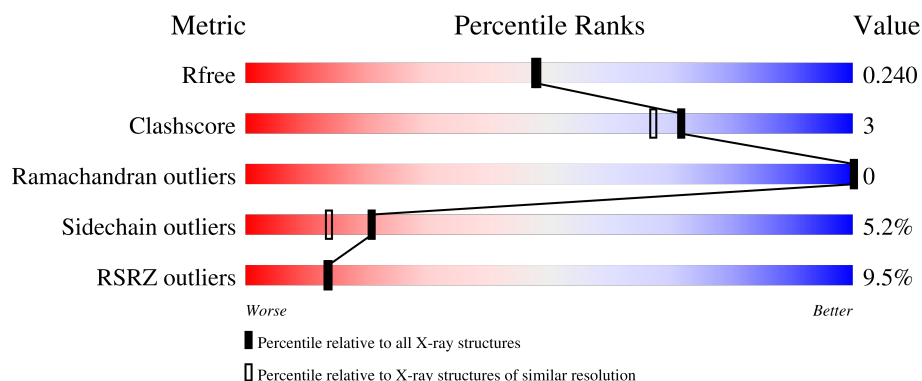
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.05 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	2260 (2.04-2.04)
Clashscore	190562	2333 (2.04-2.04)
Ramachandran outliers	187476	2318 (2.04-2.04)
Sidechain outliers	187428	2318 (2.04-2.04)
RSRZ outliers	180081	2260 (2.04-2.04)

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	230	7% 87% 8% 5%
1	B	230	7% 84% 11% 5%
2	C	248	5% 72% 18% • 9%
2	D	248	16% 77% 11% • 11%

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7378 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 polypeptide VP70.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	218	Total	C	N	O	S	0	1	0
			1756	1122	297	331	6			
1	B	218	Total	C	N	O	S	0	2	0
			1761	1125	299	331	6			

There are 22 discrepancies between the modelled and reference sequences:

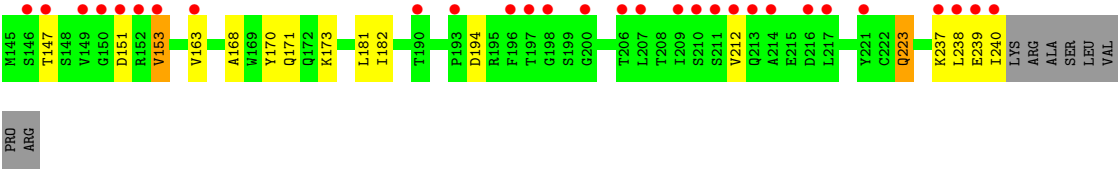
Chain	Residue	Modelled	Actual	Comment	Reference
A	427	MET	-	initiating methionine	UNP Q9IFX1
A	428	GLY	-	expression tag	UNP Q9IFX1
A	648	ALA	-	expression tag	UNP Q9IFX1
A	649	ALA	-	expression tag	UNP Q9IFX1
A	650	GLU	-	expression tag	UNP Q9IFX1
A	651	LEU	-	expression tag	UNP Q9IFX1
A	652	ALA	-	expression tag	UNP Q9IFX1
A	653	LEU	-	expression tag	UNP Q9IFX1
A	654	VAL	-	expression tag	UNP Q9IFX1
A	655	PRO	-	expression tag	UNP Q9IFX1
A	656	ARG	-	expression tag	UNP Q9IFX1
B	427	MET	-	initiating methionine	UNP Q9IFX1
B	428	GLY	-	expression tag	UNP Q9IFX1
B	648	ALA	-	expression tag	UNP Q9IFX1
B	649	ALA	-	expression tag	UNP Q9IFX1
B	650	GLU	-	expression tag	UNP Q9IFX1
B	651	LEU	-	expression tag	UNP Q9IFX1
B	652	ALA	-	expression tag	UNP Q9IFX1
B	653	LEU	-	expression tag	UNP Q9IFX1
B	654	VAL	-	expression tag	UNP Q9IFX1
B	655	PRO	-	expression tag	UNP Q9IFX1
B	656	ARG	-	expression tag	UNP Q9IFX1

- Molecule 2 is a protein called scFv 3E8.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	225	Total 1783	C 1128	N 295	O 353	S 7	0	1	0
2	D	221	Total 1743	C 1105	N 283	O 348	S 7	0	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	101	Total 101	O 101	0	0
3	C	98	Total 98	O 98	0	0
3	B	77	Total 77	O 77	0	0
3	D	59	Total 59	O 59	0	0



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	48.83Å 80.43Å 117.21Å 90.00° 90.67° 90.00°	Depositor
Resolution (Å)	66.32 – 2.05 66.32 – 2.05	Depositor EDS
% Data completeness (in resolution range)	97.6 (66.32-2.05) 97.6 (66.32-2.05)	Depositor EDS
R_{merge}	0.18	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.21 (at 2.05Å)	Xtriage
Refinement program	PHENIX 1.19_4092	Depositor
R, R_{free}	0.223 , 0.238 0.223 , 0.240	Depositor DCC
R_{free} test set	1996 reflections (3.50%)	wwPDB-VP
Wilson B-factor (Å ²)	25.3	Xtriage
Anisotropy	1.076	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 36.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.053 for h,-k,-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	7378	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.34% 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](#)

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	0.84	0/1809	1.15	0/2478
1	B	0.88	1/1814 (0.1%)	1.15	3/2485 (0.1%)
2	C	0.88	0/1829	1.29	7/2487 (0.3%)
2	D	0.87	0/1789	1.24	5/2436 (0.2%)
All	All	0.87	1/7241 (0.0%)	1.21	15/9886 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	547	PHE	C-N	7.53	1.44	1.33

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	9	PRO	N-CA-C	8.68	124.71	113.86
2	C	163	VAL	CB-CA-C	6.92	119.78	111.20
2	C	111	THR	CB-CA-C	5.66	119.33	109.65
2	D	102	GLY	CA-C-O	-5.44	118.47	122.23
2	C	163	VAL	N-CA-C	-5.43	107.69	112.90
2	D	79	PHE	CA-CB-CG	5.39	119.19	113.80
1	B	642	THR	N-CA-C	-5.38	106.48	113.16
2	C	102	GLY	CA-C-O	-5.35	118.74	122.22
1	B	603	GLY	CA-C-O	-5.35	117.65	122.57
2	D	42	PRO	N-CA-C	-5.18	103.06	111.14
1	B	457	ILE	N-CA-C	-5.16	105.81	113.39
2	C	32	GLY	CA-C-O	-5.10	116.55	121.75
2	C	42	PRO	N-CA-CB	5.09	107.38	103.30
2	D	32	GLY	CA-C-O	-5.01	116.71	121.83
2	D	173	LYS	CB-CA-C	5.01	116.63	109.11

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	1756	0	1697	10	0
1	B	1761	0	1703	8	0
2	C	1783	0	1697	16	0
2	D	1743	0	1651	12	0
3	A	101	0	0	2	0
3	B	77	0	0	0	0
3	C	98	0	0	0	0
3	D	59	0	0	0	0
All	All	7378	0	6748	45	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 (45) 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)
2:C:170:TYR:HE1	2:C:223:GLN:HG2	1.58	0.69
1:B:442:MET:HG3	1:B:483:PRO:HG3	1.76	0.67
2:D:170:TYR:HE1	2:D:223:GLN:HG2	1.61	0.66
2:D:147:THR:HG21	2:D:153:VAL:CG2	2.27	0.65
1:A:442:MET:HG3	1:A:483:PRO:HG3	1.80	0.64
1:A:624:MET:HB3	1:B:624:MET:HB3	1.83	0.61
2:C:152[A]:ARG:HG3	2:C:210:SER:HA	1.83	0.60
2:C:20:LEU:HD12	2:C:81:LEU:HD23	1.87	0.56
2:C:18:LEU:HD22	2:C:112:LEU:HD22	1.87	0.56
2:D:147:THR:HG21	2:D:153:VAL:HG23	1.87	0.55
1:B:444:PRO:HG3	1:B:578:THR:HG21	1.89	0.53
2:C:2:VAL:HG22	2:C:27:TYR:HB2	1.91	0.53
2:D:20:LEU:HD12	2:D:81:LEU:HD23	1.91	0.52
1:A:574:GLN:HG2	3:A:788:HOH:O	2.11	0.50
1:B:525:LYS:HG2	1:B:535:ILE:HG23	1.97	0.47
2:D:171:GLN:HB2	2:D:181:LEU:HD11	1.96	0.47
1:A:508:ALA:HB3	1:A:516:ALA:HB3	1.97	0.46
2:C:171:GLN:HB2	2:C:181:LEU:HD11	1.97	0.46
1:B:516:ALA:HB2	1:B:543:VAL:HA	1.97	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:C:91:THR:HG23	2:C:113:THR:HA	1.96	0.46
2:C:98:THR:O	2:C:103:TYR:HA	2.16	0.46
2:D:153:VAL:HG21	2:D:238:LEU:HD21	1.97	0.46
1:A:518:VAL:HG22	1:A:541:VAL:HG12	1.98	0.46
2:C:8:GLY:HA3	2:C:20:LEU:CD2	2.46	0.45
2:D:147:THR:HG21	2:D:153:VAL:HG22	1.98	0.45
2:C:29:ILE:HA	2:C:35:TRP:CZ2	2.51	0.45
1:A:625:TYR:CE1	1:A:638:PHE:HZ	2.35	0.45
2:C:64:LEU:O	2:C:68:ILE:HG22	2.17	0.45
2:C:8:GLY:HA3	2:C:20:LEU:HD23	1.99	0.44
1:A:548:GLN:NE2	3:A:701:HOH:O	2.49	0.44
2:D:3:GLN:HE21	2:D:3:GLN:HB2	1.54	0.43
1:B:570:LYS:HE3	1:B:614:ASN:HA	1.99	0.43
2:C:86:VAL:HG13	2:C:90:ASP:HB2	2.01	0.43
2:D:168:ALA:HB3	2:D:223:GLN:HG2	2.00	0.43
2:C:79:PHE:CZ	2:C:96:CYS:HB2	2.53	0.42
1:A:589:LEU:HD23	1:A:589:LEU:HA	1.89	0.42
1:B:528:HIS:NE2	1:B:618[B]:ARG:HD3	2.36	0.41
1:A:568:ASN:HB2	1:A:570:LYS:HE2	2.02	0.41
1:B:440:PRO:O	1:B:483:PRO:HG2	2.20	0.41
2:C:51:TYR:CD1	2:C:51:TYR:C	2.99	0.41
2:D:51:TYR:CD1	2:D:51:TYR:C	2.98	0.41
2:D:151:ASP:O	2:D:212:VAL:HG23	2.20	0.41
2:C:48:TRP:CZ2	2:C:50:GLY:HA2	2.56	0.40
2:D:143:LYS:HD2	2:D:143:LYS:H	1.86	0.40
1:A:646:GLN:H	1:A:646:GLN:HG2	1.43	0.40

There are no symmetry-related clashes.

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	A	217/230 (94%)	213 (98%)	4 (2%)	0	100	100
1	B	218/230 (95%)	215 (99%)	3 (1%)	0	100	100
2	C	222/248 (90%)	216 (97%)	6 (3%)	0	100	100
2	D	217/248 (88%)	208 (96%)	9 (4%)	0	100	100
All	All	874/956 (91%)	852 (98%)	22 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	198/204 (97%)	193 (98%)	5 (2%)	42	39
1	B	198/204 (97%)	191 (96%)	7 (4%)	32	27
2	C	199/207 (96%)	184 (92%)	15 (8%)	12	6
2	D	195/207 (94%)	181 (93%)	14 (7%)	13	7
All	All	790/822 (96%)	749 (95%)	41 (5%)	21	14

All (41) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	486	SER
1	A	600	THR
1	A	601	SER
1	A	644	LEU
1	A	646	GLN
2	C	3	GLN
2	C	68	ILE
2	C	115	SER
2	C	134	SER
2	C	153	VAL
2	C	164	SER
2	C	197	THR
2	C	217	LEU

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Mol	Chain	Res	Type
2	C	219	LEU
2	C	223	GLN
2	C	237	LYS
2	C	239	GLU
2	C	240	ILE
2	C	242	ARG
2	C	244	SER
1	B	472	LEU
1	B	486	SER
1	B	514	LYS
1	B	530	ASN
1	B	600	THR
1	B	601	SER
1	B	646	GLN
2	D	1	ASP
2	D	3	GLN
2	D	65	LYS
2	D	82	LYS
2	D	83	LEU
2	D	88	THR
2	D	153	VAL
2	D	163	VAL
2	D	182	ILE
2	D	194	ASP
2	D	223	GLN
2	D	237	LYS
2	D	239	GLU
2	D	240	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (18) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	462	ASN
1	A	551	ASN
2	C	3	GLN
2	C	40	GLN
2	C	78	GLN
2	C	142	HIS
2	C	172	GLN
2	C	223	GLN
1	B	548	GLN
1	B	551	ASN

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Mol	Chain	Res	Type
1	B	568	ASN
1	B	574	GLN
1	B	584	GLN
2	D	3	GLN
2	D	40	GLN
2	D	59	ASN
2	D	172	GLN
2	D	213	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](#)

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	218/230 (94%)	0.45	15 (6%)	23 23	17, 26, 47, 67	1 (0%)
1	B	218/230 (94%)	0.79	17 (7%)	19 19	16, 31, 52, 68	2 (0%)
2	C	225/248 (90%)	0.62	12 (5%)	32 32	20, 29, 41, 51	1 (0%)
2	D	221/248 (89%)	1.18	40 (18%)	3 3	22, 35, 60, 67	0
All	All	882/956 (92%)	0.76	84 (9%)	14 13	16, 30, 54, 68	4 (0%)

All (84) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	600	THR	5.9
1	B	647	ALA	5.4
2	D	210	SER	5.2
2	D	153	VAL	5.1
2	D	214	ALA	4.6
2	D	1	ASP	4.5
2	D	149	VAL	4.3
2	D	211	SER	4.3
2	D	150	GLY	4.2
1	B	601	SER	4.1
1	A	599	PRO	3.8
1	A	601	SER	3.7
1	B	472	LEU	3.7
2	D	240	ILE	3.7
2	D	147	THR	3.6
1	B	600	THR	3.5
2	D	151	ASP	3.5
1	B	618[A]	ARG	3.4
2	D	144	PHE	3.4
2	C	242	ARG	3.3
1	A	647	ALA	3.3

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Mol	Chain	Res	Type	RSRZ
2	D	239	GLU	3.3
1	A	646	GLN	3.2
2	D	213	GLN	3.2
1	B	495	GLN	3.1
1	B	646	GLN	3.1
1	B	648	ALA	3.1
2	D	212	VAL	3.1
1	A	602	SER	3.0
2	D	206	THR	3.0
2	C	244	SER	2.9
2	C	2	VAL	2.9
2	D	209	ILE	2.9
2	D	196	PHE	2.8
1	B	599	PRO	2.8
1	B	498	ASP	2.7
1	B	643	VAL	2.7
1	B	529	THR	2.7
1	B	598	GLY	2.6
2	D	163	VAL	2.6
1	A	492	ALA	2.5
2	D	217	LEU	2.5
2	C	152[A]	ARG	2.5
2	D	216	ASP	2.5
1	B	531	ASN	2.5
2	D	54	TYR	2.4
1	A	529	THR	2.4
2	D	15	SER	2.4
2	C	65	LYS	2.4
2	C	179	LYS	2.4
2	D	238	LEU	2.4
2	C	191	GLY	2.4
2	D	146	SER	2.4
2	D	190	THR	2.4
2	D	142	HIS	2.4
2	D	66	ASN	2.4
2	D	65	LYS	2.4
1	A	614	ASN	2.3
1	A	598	GLY	2.3
2	D	152	ARG	2.3
1	A	526	SER	2.3
1	A	498	ASP	2.3
1	B	526	SER	2.3

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Mol	Chain	Res	Type	RSRZ
2	C	3	GLN	2.2
1	B	597	ASP	2.2
2	D	69	SER	2.2
2	D	237	LYS	2.2
1	A	472	LEU	2.1
2	D	221	TYR	2.1
2	D	193	PRO	2.1
2	D	200	GLY	2.1
2	C	75	SER	2.1
2	C	115	SER	2.1
2	D	207	LEU	2.1
2	D	197	THR	2.1
2	C	43	GLY	2.1
2	D	137	VAL	2.1
2	D	75	SER	2.1
2	D	82	LYS	2.1
2	C	66	ASN	2.0
1	B	519	TYR	2.0
1	A	527	SER	2.0
1	A	597	ASP	2.0
2	D	198	GLY	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](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.