Full wwPDB X-ray Structure Validation Report ⓘ

Sep 11, 2023 – 09:47 PM EDT

PDB ID	:	4M5X
Title	:	Crystal structure of the USP7/HAUSP catalytic domain
Authors	:	Mesecar, A.D.; Molland, K.L.; Zhou, Q.
Deposited on	:	2013-08-08
Resolution	:	2.19 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:

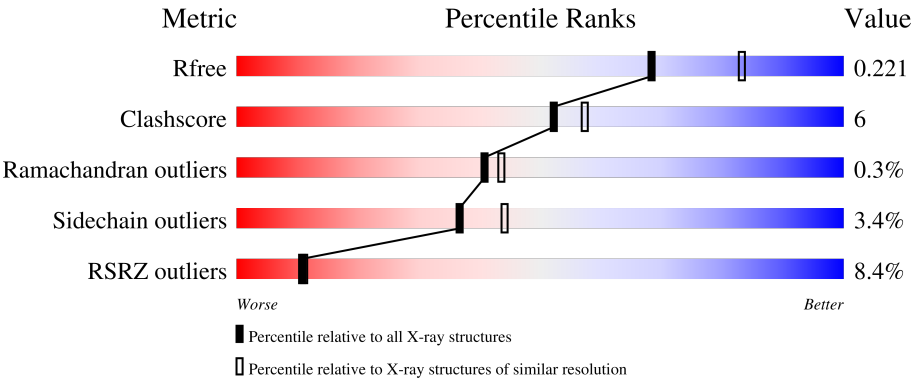
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

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 2.19 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	6864 (2.20-2.16)
Clashscore	141614	7689 (2.20-2.16)
Ramachandran outliers	138981	7564 (2.20-2.16)
Sidechain outliers	138945	7564 (2.20-2.16)
RSRZ outliers	127900	6738 (2.20-2.16)

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 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	355	9% 81% 12% •• 5%
1	B	355	7% 84% 10% • 5%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 5746 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 Ubiquitin carboxyl-terminal hydrolase 7.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	339	Total	C	N	O	S	0	0	0
			2755	1743	470	526	16			
1	B	337	Total	C	N	O	S	0	0	0
			2741	1735	468	522	16			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	206	GLY	-	expression tag	UNP Q93009
B	206	GLY	-	expression tag	UNP Q93009

- Molecule 2 is BROMIDE ION (three-letter code: BR) (formula: Br).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	2	Total	Br	0	0
			2	2		
2	B	1	Total	Br	0	0
			1	1		

- Molecule 3 is water.

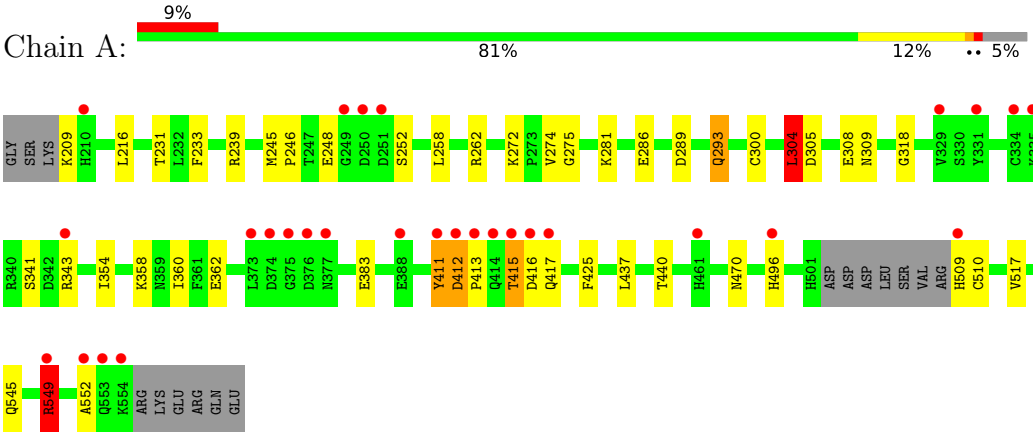
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	102	Total	O	0	0
			102	102		
3	B	145	Total	O	0	0
			145	145		

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.

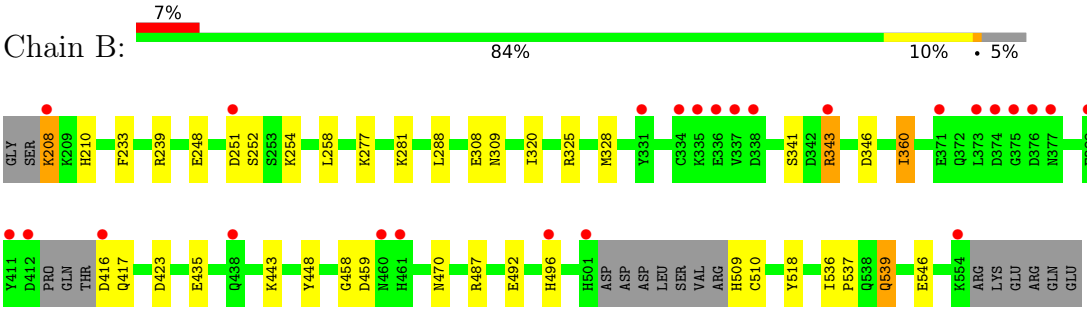
• Molecule 1: Ubiquitin carboxyl-terminal hydrolase 7

Chain A:



• Molecule 1: Ubiquitin carboxyl-terminal hydrolase 7

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	74.95Å 67.58Å 76.81Å 90.00° 96.21° 90.00°	Depositor
Resolution (Å)	38.18 – 2.19 43.33 – 2.19	Depositor EDS
% Data completeness (in resolution range)	98.2 (38.18-2.19) 98.2 (43.33-2.19)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	1.85 (at 2.18Å)	Xtriage
Refinement program	PHENIX 1.8.1_1168	Depositor
R, R_{free}	0.180 , 0.221 0.181 , 0.221	Depositor DCC
R_{free} test set	1958 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	32.6	Xtriage
Anisotropy	0.131	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.38 , 61.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.51$, $< L^2 > = 0.34$	Xtriage
Estimated twinning fraction	0.006 for l,-k,h	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	5746	wwPDB-VP
Average B, all atoms (Å^2)	37.0	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 56.30 % 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 2.7926e-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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: BR

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	0.39	0/2814	0.60	2/3795 (0.1%)
1	B	0.41	0/2798	0.57	0/3769
All	All	0.40	0/5612	0.58	2/7564 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	549	ARG	NE-CZ-NH2	-8.13	116.23	120.30
1	A	304	LEU	CA-CB-CG	6.17	129.48	115.30

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	2755	0	2690	32	1
1	B	2741	0	2680	27	1
2	A	2	0	0	2	0
2	B	1	0	0	1	0
3	A	102	0	0	3	0
3	B	145	0	0	8	0
All	All	5746	0	5370	60	2

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 6.

All (60) 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:308:GLU:OE1	3:B:732:HOH:O	1.93	0.86
1:A:358:LYS:N	1:A:362:GLU:OE1	2.07	0.86
1:A:411:TYR:HB3	1:A:413:PRO:HD3	1.63	0.79
2:A:601:BR:BR	3:A:798:HOH:O	2.59	0.75
1:B:341:SER:OG	1:B:343:ARG:NH2	2.24	0.70
1:B:308:GLU:OE2	3:B:824:HOH:O	2.10	0.68
1:A:415:THR:HG23	1:A:417:GLN:H	1.57	0.67
1:B:309:ASN:OD1	3:B:808:HOH:O	2.12	0.67
1:A:252:SER:HA	1:A:258:LEU:HD23	1.75	0.66
1:B:492:GLU:HA	1:B:496:HIS:CD2	2.30	0.66
1:B:539:GLN:OE1	3:B:782:HOH:O	2.12	0.66
1:A:318:GLY:N	3:A:748:HOH:O	2.29	0.65
1:A:300:CYS:O	1:A:304:LEU:HD22	1.99	0.61
1:A:549:ARG:CZ	1:A:549:ARG:HA	2.33	0.59
1:A:233:PHE:CD1	1:A:239:ARG:HD2	2.40	0.57
1:A:341:SER:OG	1:A:343:ARG:NH1	2.39	0.55
1:A:412:ASP:HB3	1:A:416:ASP:HA	1.88	0.55
1:B:423:ASP:OD1	3:B:834:HOH:O	2.18	0.54
1:A:545:GLN:O	1:A:549:ARG:HG2	2.08	0.54
1:A:411:TYR:HB3	1:A:413:PRO:CD	2.37	0.54
1:B:210:HIS:HE2	1:B:487:ARG:H	1.58	0.52
1:B:448:TYR:HB3	1:B:518:TYR:HB3	1.92	0.51
1:A:509:HIS:CG	1:A:510:CYS:H	2.29	0.50
1:A:252:SER:OG	1:A:262:ARG:NH2	2.45	0.50
1:A:308:GLU:OE1	3:A:748:HOH:O	2.20	0.49
1:A:509:HIS:CG	1:A:510:CYS:N	2.81	0.48
1:B:248:GLU:H	1:B:248:GLU:CD	2.17	0.48
1:B:509:HIS:CG	1:B:510:CYS:H	2.32	0.48
1:B:509:HIS:CG	1:B:510:CYS:N	2.81	0.47
1:B:509:HIS:HB3	3:B:712:HOH:O	2.13	0.47
1:B:309:ASN:ND2	3:B:808:HOH:O	2.49	0.46
1:B:416:ASP:N	1:B:417:GLN:HB3	2.31	0.46
1:B:360:ILE:HG22	3:B:799:HOH:O	2.15	0.46
1:A:248:GLU:HG2	1:A:539:GLN:NE2	2.31	0.45
1:A:216:LEU:HD23	1:A:274:VAL:HB	1.98	0.45
1:A:281:LYS:HE3	1:A:286:GLU:OE1	2.17	0.45
1:B:492:GLU:HA	1:B:496:HIS:CG	2.52	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:289:ASP:O	1:A:293:GLN:HG2	2.17	0.45
1:B:325:ARG:HD2	1:B:346:ASP:OD2	2.18	0.44
1:B:277:LYS:HB2	2:B:601:BR:BR	2.72	0.44
1:A:275:GLY:HA3	2:A:602:BR:BR	2.73	0.44
1:B:233:PHE:CD1	1:B:239:ARG:HD2	2.52	0.44
1:B:458:GLY:O	1:B:510:CYS:HB3	2.17	0.44
1:B:328:MET:HE2	1:B:328:MET:HB2	1.94	0.43
1:A:354:ILE:HG22	1:A:425:PHE:CE1	2.53	0.43
1:A:231:THR:HG21	1:A:517:VAL:HG21	2.01	0.43
1:A:245:MET:HA	1:A:246:PRO:HD3	1.84	0.43
1:B:343:ARG:HA	1:B:343:ARG:HD3	1.84	0.43
1:B:251:ASP:CG	1:B:254:LYS:HE3	2.39	0.43
1:A:412:ASP:OD1	1:A:412:ASP:N	2.52	0.42
1:A:411:TYR:CB	1:A:413:PRO:HD3	2.44	0.42
1:A:305:ASP:O	1:A:309:ASN:HB2	2.20	0.42
1:B:252:SER:HA	1:B:258:LEU:HD23	2.02	0.42
1:A:209:LYS:HE3	1:A:209:LYS:HB2	1.84	0.41
1:A:412:ASP:HA	1:A:417:GLN:O	2.19	0.41
1:A:549:ARG:HA	1:A:549:ARG:NE	2.34	0.41
1:B:308:GLU:OE1	1:B:320:ILE:HB	2.19	0.41
1:B:536:ILE:HA	1:B:537:PRO:HD2	1.89	0.41
1:A:248:GLU:H	1:A:248:GLU:CD	2.25	0.40
1:A:549:ARG:NH2	1:A:552:ALA:HB3	2.36	0.40

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:383:GLU:O	1:A:549:ARG:NE[1_655]	2.10	0.10
1:B:208:LYS:NZ	1:B:546:GLU:OE1[2_655]	2.16	0.04

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	335/355 (94%)	312 (93%)	22 (7%)	1 (0%)	41	43
1	B	331/355 (93%)	317 (96%)	13 (4%)	1 (0%)	41	43
All	All	666/710 (94%)	629 (94%)	35 (5%)	2 (0%)	41	43

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	415	THR
1	B	435	GLU

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	306/321 (95%)	294 (96%)	12 (4%)	32	38
1	B	304/321 (95%)	295 (97%)	9 (3%)	41	49
All	All	610/642 (95%)	589 (97%)	21 (3%)	37	44

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	272	LYS
1	A	293	GLN
1	A	304	LEU
1	A	360	ILE
1	A	411	TYR
1	A	412	ASP
1	A	437	LEU
1	A	440	THR
1	A	470	ASN
1	A	496	HIS
1	A	542	GLU
1	A	549	ARG

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Mol	Chain	Res	Type
1	B	208	LYS
1	B	281	LYS
1	B	288	LEU
1	B	343	ARG
1	B	360	ILE
1	B	443	LYS
1	B	459	ASP
1	B	470	ASN
1	B	539	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	496	HIS

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)

Of 3 ligands modelled in this entry, 3 are monoatomic - leaving 0 for Mogul analysis.

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, 95^{th} 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	339/355 (95%)	0.53	32 (9%)	8	8	18, 36, 75, 106	0
1	B	337/355 (94%)	0.40	25 (7%)	14	15	15, 31, 66, 90	0
All	All	676/710 (95%)	0.46	57 (8%)	11	11	15, 33, 71, 106	0

All (57) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	249	GLY	8.0
1	A	411	TYR	6.7
1	B	208	LYS	6.3
1	A	412	ASP	5.6
1	A	374	ASP	5.2
1	B	411	TYR	5.1
1	A	413	PRO	5.1
1	A	549	ARG	4.7
1	A	416	ASP	4.5
1	A	417	GLN	4.5
1	B	416	ASP	4.5
1	A	415	THR	4.1
1	B	376	ASP	4.1
1	B	460	ASN	4.0
1	A	375	GLY	3.9
1	A	388	GLU	3.9
1	A	414	GLN	3.8
1	B	377	ASN	3.8
1	B	373	LEU	3.8
1	A	251	ASP	3.7
1	A	331	TYR	3.7
1	A	554	LYS	3.7
1	A	552	ALA	3.6
1	B	374	ASP	3.5

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Mol	Chain	Res	Type	RSRZ
1	B	336	GLU	3.5
1	A	336	GLU	3.3
1	A	461	HIS	3.3
1	B	388	GLU	3.2
1	A	343	ARG	3.1
1	B	335	LYS	2.9
1	A	509	HIS	2.9
1	B	343	ARG	2.9
1	A	250	ASP	2.8
1	B	337	VAL	2.8
1	B	496	HIS	2.8
1	A	339	TYR	2.8
1	B	554	LYS	2.7
1	A	335	LYS	2.7
1	A	377	ASN	2.7
1	A	373	LEU	2.7
1	A	210	HIS	2.6
1	A	376	ASP	2.6
1	A	553	GLN	2.5
1	B	461	HIS	2.5
1	B	334	CYS	2.4
1	B	412	ASP	2.4
1	B	338	ASP	2.4
1	B	438	GLN	2.3
1	B	251	ASP	2.3
1	B	331	TYR	2.2
1	A	334	CYS	2.2
1	B	371	GLU	2.2
1	A	338	ASP	2.2
1	A	329	VAL	2.1
1	A	496	HIS	2.0
1	B	501	HIS	2.0
1	B	375	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 monosaccharides 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. The B-factors column lists the minimum, median, 95^{th} 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	BR	A	601	1/1	0.97	0.07	72,72,72,72	0
2	BR	A	602	1/1	0.99	0.04	56,56,56,56	0
2	BR	B	601	1/1	1.00	0.05	45,45,45,45	0

6.5 Other polymers

There are no such residues in this entry.