Full wwPDB X-ray Structure Validation Report (i)

Feb 1, 2016 – 05:15 PM GMT

PDB ID	:	4HQO
Title	:	Crystal structure of Plasmodium vivax TRAP protein
Authors	:	Song, G.; Koksal, A.C.; Lu, C.; Springer, T.A.
Deposited on	:	2012-10-25
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
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

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

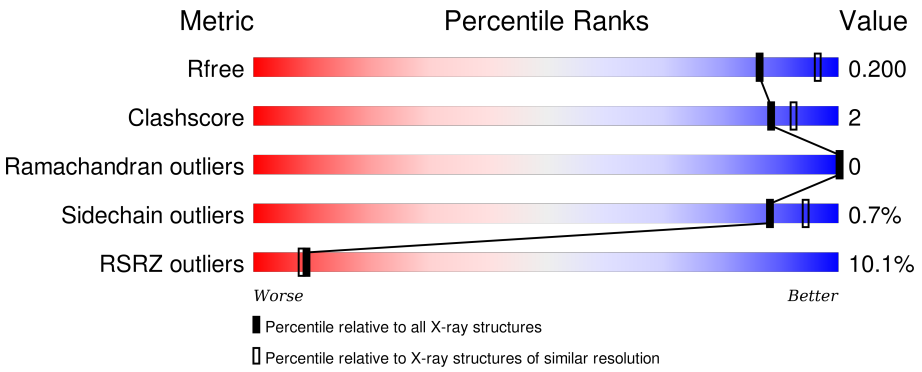
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

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}	91344	3774 (2.20-2.20)
Clashscore	102246	4477 (2.20-2.20)
Ramachandran outliers	100387	4404 (2.20-2.20)
Sidechain outliers	100360	4405 (2.20-2.20)
RSRZ outliers	91569	3781 (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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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	266	13% 91% 6% •
1	B	266	7% 91% 7% •

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	MG	A	301	-	-	-	X

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 4759 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 Sporozoite surface protein 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	257	2023	1263	363	382	15	0	0	0
1	B	260	2043	1276	363	389	15	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	42	GLN	SER	ENGINEERED MUTATION	UNP Q9TVF0
A	91	SER	ASN	ENGINEERED MUTATION	UNP Q9TVF0
A	128	SER	ASN	ENGINEERED MUTATION	UNP Q9TVF0
A	180	ARG	SER	ENGINEERED MUTATION	UNP Q9TVF0
A	284	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	285	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	286	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	287	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	288	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	289	HIS	-	EXPRESSION TAG	UNP Q9TVF0
A	290	ALA	-	EXPRESSION TAG	UNP Q9TVF0
B	42	GLN	SER	ENGINEERED MUTATION	UNP Q9TVF0
B	91	SER	ASN	ENGINEERED MUTATION	UNP Q9TVF0
B	128	SER	ASN	ENGINEERED MUTATION	UNP Q9TVF0
B	180	ARG	SER	ENGINEERED MUTATION	UNP Q9TVF0
B	284	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	285	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	286	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	287	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	288	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	289	HIS	-	EXPRESSION TAG	UNP Q9TVF0
B	290	ALA	-	EXPRESSION TAG	UNP Q9TVF0

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Mg 1 1	0	0

- Molecule 3 is a polymer of unknown type called SUGAR (2-MER).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total C O 21 12 9	0	0
3	B	2	Total C O 21 12 9	0	0

- Molecule 4 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	B	1	Total Cl 1 1	0	0
4	A	1	Total Cl 1 1	0	0

- Molecule 5 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total Na 1 1	0	0

- Molecule 6 is water.

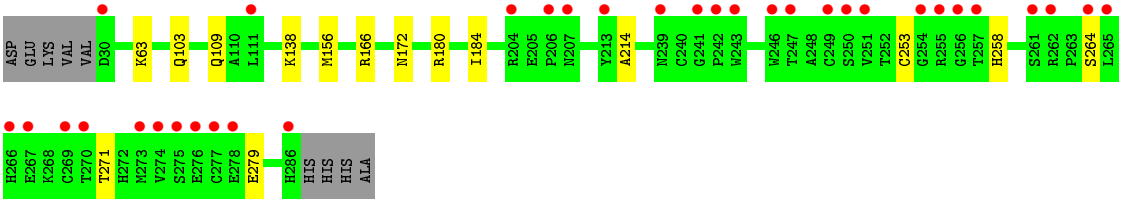
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
6	A	346	Total O 346 346	0	0
6	B	301	Total O 301 301	0	0

3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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.

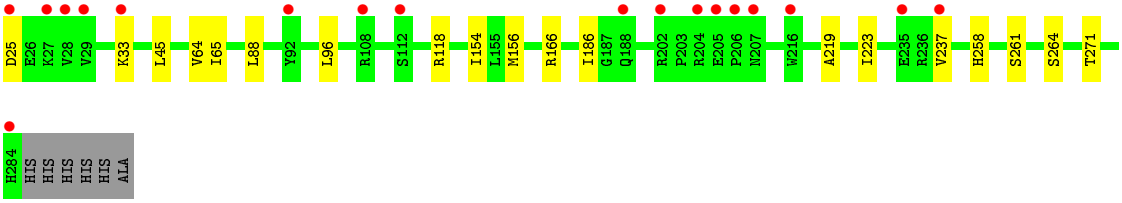
- Molecule 1: Sporozoite surface protein 2

Chain A:



- Molecule 1: Sporozoite surface protein 2

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	56.29Å 100.47Å 158.55Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	42.43 – 2.19 42.43 – 2.19	Depositor EDS
% Data completeness (in resolution range)	98.3 (42.43-2.19) 98.3 (42.43-2.19)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$< I/\sigma(I) >$ [1]	4.05 (at 2.20Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, R_{free}	0.159 , 0.200 0.163 , 0.200	Depositor DCC
R_{free} test set	2321 reflections (5.30%)	DCC
Wilson B-factor (Å^2)	37.2	Xtriage
Anisotropy	0.656	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 61.2	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Outliers	0 of 46091 reflections	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	4759	wwPDB-VP
Average B, all atoms (Å^2)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.21% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: NA, MG, BGC, FUC, CL

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	0.32	0/2063	0.49	0/2796
1	B	0.28	0/2081	0.48	0/2820
All	All	0.30	0/4144	0.49	0/5616

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	2023	0	1995	11	0
1	B	2043	0	2026	9	2
2	A	1	0	0	0	0
3	A	21	0	19	0	0
3	B	21	0	19	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	1	0	0	0	0
6	A	346	0	0	5	4
6	B	301	0	0	1	3
All	All	4759	0	4059	20	5

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 2.

All (20) 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:172:ASN:HB3	6:A:732:HOH:O	2.00	0.61
1:B:264:SER:HB3	1:B:271:THR:HG21	1.90	0.53
1:B:156:MET:HG2	1:B:186:ILE:HG13	1.90	0.52
1:B:65:ILE:HG21	1:B:118:ARG:HG3	1.94	0.49
1:B:166:ARG:NH2	6:B:464:HOH:O	2.42	0.47
1:B:64:VAL:HG22	1:B:186:ILE:HG21	1.96	0.47
1:A:103:GLN:HG2	1:A:109:GLN:HB3	1.97	0.45
1:A:103:GLN:OE1	6:A:733:HOH:O	2.21	0.45
1:A:180:ARG:NE	6:A:578:HOH:O	2.40	0.44
1:A:166:ARG:NH2	6:A:587:HOH:O	2.50	0.44
1:A:253:CYS:HA	1:A:279:GLU:O	2.18	0.44
1:B:33:LYS:HG2	1:B:237:VAL:HG22	2.00	0.43
1:A:264:SER:HB2	1:A:271:THR:HG21	2.00	0.43
1:A:63:LYS:NZ	1:A:214:ALA:O	2.53	0.41
1:A:138:LYS:HE3	1:A:138:LYS:HB2	1.83	0.41
1:A:63:LYS:HD2	6:A:510:HOH:O	2.20	0.41
1:B:45:LEU:HD21	1:B:154:ILE:HD12	2.02	0.41
1:B:88:LEU:HB2	1:B:96:LEU:HD11	2.03	0.41
1:A:156:MET:HG2	1:A:184:ILE:HB	2.03	0.40
1:B:219:ALA:O	1:B:223:ILE:HG12	2.22	0.40

All (5) 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)
6:A:459:HOH:O	6:B:562:HOH:O[4_545]	2.12	0.08
1:B:25:ASP:OD1	6:A:502:HOH:O[4_445]	2.15	0.05
6:A:608:HOH:O	6:B:527:HOH:O[4_545]	2.17	0.03
6:A:532:HOH:O	6:A:541:HOH:O[4_545]	2.18	0.02
1:B:25:ASP:N	6:B:559:HOH:O[3_544]	2.18	0.02

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	255/266 (96%)	245 (96%)	10 (4%)	0	100	100
1	B	258/266 (97%)	250 (97%)	8 (3%)	0	100	100
All	All	513/532 (96%)	495 (96%)	18 (4%)	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	226/234 (97%)	225 (100%)	1 (0%)	93	97
1	B	229/234 (98%)	227 (99%)	2 (1%)	84	92
All	All	455/468 (97%)	452 (99%)	3 (1%)	88	94

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	258	HIS
1	B	258	HIS
1	B	261	SER

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

Mol	Chain	Res	Type
1	A	103	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)

4 carbohydrates 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	FUC	A	302	1,3	10,10,11	0.80	0	14,14,16	1.07	1 (7%)
3	BGC	A	303	3	11,11,12	0.56	0	14,15,17	0.65	0
3	FUC	B	301	1,3	10,10,11	0.86	0	14,14,16	1.01	1 (7%)
3	BGC	B	302	3	11,11,12	0.68	0	14,15,17	0.58	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	FUC	A	302	1,3	-	0/0/17/20	0/1/1/1
3	BGC	A	303	3	-	0/2/19/22	0/1/1/1
3	FUC	B	301	1,3	-	0/0/17/20	0/1/1/1
3	BGC	B	302	3	-	0/2/19/22	0/1/1/1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	B	301	FUC	C1-O5-C5	2.34	115.99	112.38
3	A	302	FUC	C1-O5-C5	2.65	116.47	112.38

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.6 Ligand geometry (i)

Of 4 ligands modelled in this entry, 4 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 (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	257/266 (96%)	0.50	34 (13%)	4	4	25, 41, 105, 149	0
1	B	260/266 (97%)	0.09	18 (6%)	20	19	26, 53, 94, 132	0
All	All	517/532 (97%)	0.29	52 (10%)	9	8	25, 49, 98, 149	0

All (52) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	28	VAL	7.2
1	A	265	LEU	6.9
1	A	286	HIS	5.2
1	A	239	ASN	4.5
1	B	25	ASP	4.3
1	A	204	ARG	4.2
1	A	246	TRP	3.9
1	B	27	LYS	3.8
1	A	30	ASP	3.7
1	A	243	TRP	3.7
1	B	207	ASN	3.6
1	A	242	PRO	3.6
1	A	241	GLY	3.5
1	A	264	SER	3.5
1	B	206	PRO	3.3
1	B	29	VAL	3.2
1	A	206	PRO	3.1
1	A	266	HIS	3.0
1	A	276	GLU	3.0
1	A	213	TYR	2.9
1	A	261	SER	2.9
1	B	108	ARG	2.9
1	A	257	THR	2.8
1	A	251	VAL	2.7

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Mol	Chain	Res	Type	RSRZ
1	B	216	TRP	2.7
1	B	205	GLU	2.6
1	A	256	GLY	2.6
1	A	267	GLU	2.5
1	B	235	GLU	2.5
1	A	255	ARG	2.5
1	B	92	TYR	2.5
1	A	270	THR	2.4
1	B	284	HIS	2.3
1	B	204	ARG	2.3
1	B	33	LYS	2.3
1	A	250	SER	2.3
1	B	237	VAL	2.3
1	B	188	GLN	2.2
1	B	202	ARG	2.2
1	A	254	GLY	2.2
1	A	249	CYS	2.2
1	A	269	CYS	2.2
1	A	275	SER	2.2
1	A	274	VAL	2.1
1	A	278	GLU	2.1
1	A	207	ASN	2.1
1	B	112	SER	2.1
1	A	111	LEU	2.1
1	A	262	ARG	2.0
1	A	247	THR	2.0
1	A	277	CYS	2.0
1	A	273	MET	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)

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å^2)	Q<0.9
3	FUC	B	301	10/11	0.97	0.09	-0.72	36,39,45,46	0
3	BGC	B	302	11/12	0.98	0.07	-0.81	34,41,46,46	0
3	BGC	A	303	11/12	0.95	0.08	-1.10	54,56,60,60	0
3	FUC	A	302	10/11	0.97	0.09	-2.32	40,45,50,52	0

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å^2)	Q<0.9
2	MG	A	301	1/1	0.89	0.17	3.03	56,56,56,56	0
5	NA	A	305	1/1	0.96	0.14	-0.16	53,53,53,53	0
4	CL	B	303	1/1	0.99	0.10	-0.18	40,40,40,40	0
4	CL	A	304	1/1	1.00	0.11	-2.11	33,33,33,33	0

6.5 Other polymers (i)

There are no such residues in this entry.