



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 09:46 AM UTC

PDB ID : 4Z31 / pdb_00004z31
Title : Crystal structure of the RC3H2 ROQ domain in complex with stem-loop and double-stranded forms of RNA
Authors : DONG, A.; ZHANG, Q.; TEMPEL, W.; Bountra, C.; Arrowsmith, C.H.; Edwards, A.M.; TONG, Y.; Structural Genomics Consortium (SGC)
Deposited on : 2015-03-30
Resolution : 2.50 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

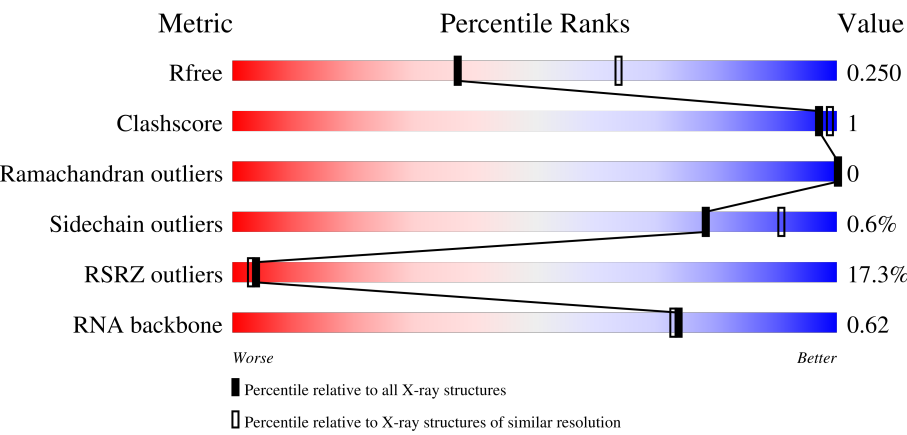
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.50 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	5829 (2.50-2.50)
Clashscore	190562	6492 (2.50-2.50)
Ramachandran outliers	187476	6378 (2.50-2.50)
Sidechain outliers	187428	6380 (2.50-2.50)
RSRZ outliers	180081	5833 (2.50-2.50)
RNA backbone	3983	1003 (2.78-2.22)

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	319	15% 91% 8%
1	B	319	19% 89% 8%
2	C	15	7% 80% 13% 7%
2	D	15	13% 67% 20% 7% 7%

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Mol	Chain	Length	Quality of chain
2	E	15	7% 93% 7%
2	F	15	93% 7%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5806 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 Roquin-2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	293	Total	C	N	O	S	0	1	0
			2286	1446	413	416	11			
1	B	295	Total	C	N	O	S	0	0	0
			2256	1424	407	414	11			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	86	GLY	-	expression tag	UNP Q9HBD1
B	86	GLY	-	expression tag	UNP Q9HBD1

- Molecule 2 is a RNA chain called RNA (5'-R(*A)-D(P*UP*GP*UP*UP*CP*UP*GP*UP*GP*AP*AP*CP*AP*C)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	14	Total	C	N	O	P	0	0	0
			295	132	49	100	14			
2	D	14	Total	C	N	O	P	0	0	0
			294	133	51	97	13			
2	E	15	Total	C	N	O	P	0	0	0
			318	142	54	107	15			
2	F	15	Total	C	N	O	P	0	0	0
			314	142	54	104	14			

- Molecule 3 is UNKNOWN ATOM OR ION (CCD ID: UNX) (formula: X).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	X	0	0
			2	2		

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

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

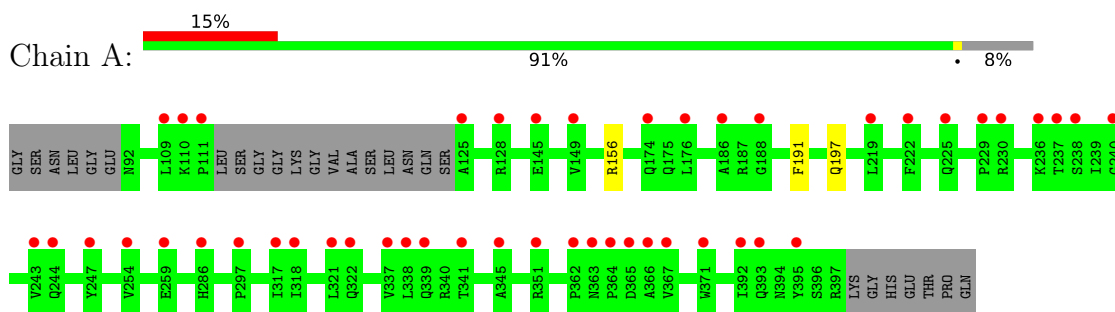
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	28	Total	O	0	0
			28	28		
5	B	6	Total	O	0	0
			6	6		
5	D	2	Total	O	0	0
			2	2		
5	E	1	Total	O	0	0
			1	1		
5	F	3	Total	O	0	0
			3	3		

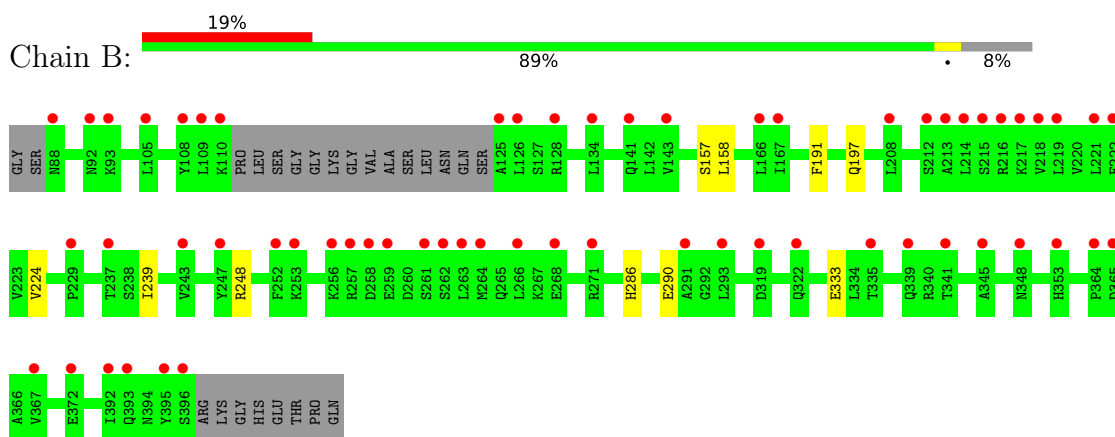
3 Residue-property plots [i](#)

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.

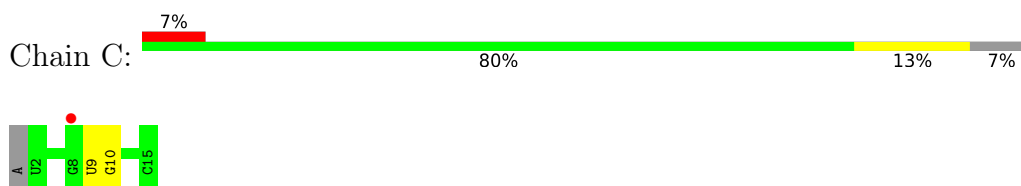
- Molecule 1: Roquin-2



- Molecule 1: Roquin-2

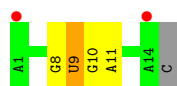


- Molecule 2: RNA (5'-R(*A)-D(P*UP*GP*UP*UP*CP*UP*GP*UP*GP*AP*AP*CP*AP*C)-3')

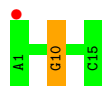


- Molecule 2: RNA (5'-R(*A)-D(P*UP*GP*UP*UP*CP*UP*GP*UP*GP*AP*AP*CP*AP*C)-3')





- Molecule 2: RNA (5'-R(*A)-D(P*UP*GP*UP*UP*CP*UP*GP*UP*GP*AP*AP*CP*AP*C)-3')



- Molecule 2: RNA (5'-R(*A)-D(P*UP*GP*UP*UP*CP*UP*GP*UP*GP*AP*AP*CP*AP*C)-3')



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	60.30Å 174.73Å 61.29Å 90.00° 114.12° 90.00°	Depositor
Resolution (Å)	50.00 – 2.50 50.00 – 2.50	Depositor EDS
% Data completeness (in resolution range)	98.9 (50.00-2.50) 98.9 (50.00-2.50)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.09 (at 2.48Å)	Xtriage
Refinement program	REFMAC 5.8.0107	Depositor
R, R_{free}	0.245 , 0.259 0.246 , 0.250	Depositor DCC
R_{free} test set	824 reflections (1.89%)	wwPDB-VP
Wilson B-factor (Å ²)	57.8	Xtriage
Anisotropy	0.095	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 36.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.020 for l,-k,h	Xtriage
F_o, F_c correlation	0.92	EDS
Total number of atoms	5806	wwPDB-VP
Average B, all atoms (Å ²)	65.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.65% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: UNX, 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	0.56	0/2328	0.87	0/3156
1	B	0.56	0/2294	0.86	0/3115
2	C	0.41	0/328	0.79	0/508
2	D	0.36	0/328	0.77	0/509
2	E	0.35	0/354	0.71	0/547
2	F	0.37	0/350	0.71	0/543
All	All	0.53	0/5982	0.84	0/8378

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	2286	0	2293	2	0
1	B	2256	0	2214	5	0
2	C	295	0	150	2	0
2	D	294	0	151	3	0
2	E	318	0	161	1	0
2	F	314	0	162	0	0
3	A	2	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	1	0	0	0	0
5	A	28	0	0	1	0
5	B	6	0	0	0	0
5	D	2	0	0	0	0
5	E	1	0	0	0	0
5	F	3	0	0	0	0
All	All	5806	0	5131	10	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 1.

All (10) 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:248:ARG:NH2	2:E:10:G:OP2	2.23	0.69
1:B:157:SER:OG	2:D:11:A:OP1	2.16	0.63
1:B:248:ARG:NH1	1:B:290:GLU:OE1	2.40	0.53
2:C:9:U:H2'	2:C:10:G:O4'	2.09	0.53
1:A:191:PHE:CD1	1:A:197:GLN:HG3	2.46	0.50
1:B:191:PHE:CD1	1:B:197:GLN:HG3	2.47	0.49
2:D:9:U:H2'	2:D:10:G:O4'	2.14	0.47
2:C:9:U:C6	2:D:8:G:N2	2.85	0.45
1:A:156[A]:ARG:NH2	5:A:1101:HOH:O	2.52	0.43
1:B:224:VAL:HG22	1:B:239:ILE:HG13	2.03	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	290/319 (91%)	286 (99%)	4 (1%)	0	100 100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	291/319 (91%)	288 (99%)	3 (1%)	0	100	100
All	All	581/638 (91%)	574 (99%)	7 (1%)	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	242/275 (88%)	242 (100%)	0	100	100
1	B	231/275 (84%)	228 (99%)	3 (1%)	61	82
All	All	473/550 (86%)	470 (99%)	3 (1%)	78	91

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

Mol	Chain	Res	Type
1	B	158	LEU
1	B	286	HIS
1	B	333	GLU

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	353	HIS

5.3.3 RNA ⓘ

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
2	C	13/15 (86%)	0	0
2	D	13/15 (86%)	1 (7%)	0
2	E	14/15 (93%)	1 (7%)	0
2	F	14/15 (93%)	1 (7%)	0

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Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
All	All	54/60 (90%)	3 (5%)	0

All (3) RNA backbone outliers are listed below:

Mol	Chain	Res	Type
2	D	9	U
2	E	10	G
2	F	10	G

There are no RNA pucker outliers to report.

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](#)

Of 3 ligands modelled in this entry, 2 are unknown and 1 is 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 ⓘ

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	293/319 (91%)	1.08	47 (16%)	5	4	31, 57, 78, 108	1 (0%)
1	B	295/319 (92%)	1.28	61 (20%)	2	2	48, 64, 92, 105	0
2	C	14/15 (93%)	0.84	1 (7%)	22	19	63, 76, 98, 112	0
2	D	14/15 (93%)	0.50	2 (14%)	6	5	59, 75, 107, 115	0
2	E	15/15 (100%)	0.36	1 (6%)	24	21	64, 69, 81, 82	0
2	F	15/15 (100%)	0.27	0	100	100	52, 65, 75, 86	0
All	All	646/698 (92%)	1.11	112 (17%)	4	3	31, 62, 89, 115	1 (0%)

All (112) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	319	ASP	5.1
1	A	364	PRO	4.9
1	B	125	ALA	4.8
1	B	264	MET	4.6
1	B	258	ASP	4.6
1	B	215	SER	4.4
1	B	213	ALA	4.4
1	B	392	ILE	4.3
1	A	351	ARG	4.2
1	B	126	LEU	4.1
1	B	110	LYS	4.0
1	A	111	PRO	4.0
1	B	214	LEU	4.0
1	A	128	ARG	3.8
1	A	365	ASP	3.8
1	B	339	GLN	3.8
1	A	125	ALA	3.8
1	B	108	TYR	3.7
1	B	219	LEU	3.7

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Mol	Chain	Res	Type	RSRZ
1	B	396	SER	3.7
1	B	216	ARG	3.6
1	A	174	GLN	3.6
1	B	261	SER	3.5
1	A	321	LEU	3.4
1	A	338	LEU	3.3
1	A	322	GLN	3.3
1	A	339	GLN	3.3
1	B	218	VAL	3.3
1	B	105	LEU	3.2
1	B	268	GLU	3.2
1	B	93	LYS	3.2
1	A	236	LYS	3.1
1	A	363	ASN	3.1
1	A	247	TYR	3.0
1	B	263	LEU	3.0
1	A	243	VAL	3.0
1	A	109	LEU	3.0
1	B	367	VAL	3.0
1	B	322	GLN	3.0
1	B	128	ARG	2.9
1	B	257	ARG	2.9
1	A	341	THR	2.9
1	B	237	THR	2.9
1	A	367	VAL	2.8
1	A	238	SER	2.8
1	A	237	THR	2.8
1	B	109	LEU	2.8
1	A	254	VAL	2.8
1	A	244	GLN	2.8
2	E	1	A	2.7
1	A	222	PHE	2.7
1	B	252	PHE	2.7
1	A	337	VAL	2.7
1	A	219	LEU	2.7
1	B	221	LEU	2.7
1	A	225	GLN	2.7
1	A	286	HIS	2.7
1	A	318	ILE	2.7
1	B	259	GLU	2.7
2	D	1	A	2.6
1	B	341	THR	2.6

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Mol	Chain	Res	Type	RSRZ
1	B	364	PRO	2.6
1	B	134	LEU	2.5
1	A	366	ALA	2.5
1	B	256	LYS	2.5
1	A	149	VAL	2.5
1	B	262	SER	2.5
1	B	167	ILE	2.5
1	B	365	ASP	2.5
1	B	229	PRO	2.4
1	B	166	LEU	2.4
1	A	362	PRO	2.4
1	B	92	ASN	2.4
1	A	110	LYS	2.4
1	A	392	ILE	2.4
1	B	208	LEU	2.3
1	B	217	LYS	2.3
1	A	186	ALA	2.3
1	A	371	TRP	2.3
1	A	188	GLY	2.3
1	B	266	LEU	2.3
1	B	291	ALA	2.3
1	A	393	GLN	2.3
1	B	243	VAL	2.3
1	A	317	ILE	2.2
1	B	271	ARG	2.2
1	A	345	ALA	2.2
1	B	393	GLN	2.2
1	B	253	LYS	2.2
1	A	259	GLU	2.2
1	B	247	TYR	2.2
1	A	229	PRO	2.2
1	A	240	GLY	2.2
1	A	395	TYR	2.2
1	A	145	GLU	2.2
1	B	222	PHE	2.2
1	B	88	ASN	2.1
1	A	176	LEU	2.1
1	B	395	TYR	2.1
2	C	8	G	2.1
1	A	297	PRO	2.1
1	B	141	GLN	2.1
1	B	143	VAL	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	230	ARG	2.1
1	B	293	LEU	2.1
1	B	348	ASN	2.1
1	B	335	THR	2.1
1	B	212	SER	2.1
1	B	372	GLU	2.0
2	D	14	A	2.0
1	B	345	ALA	2.0
1	B	353	HIS	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($\text{\AA}^2$)	Q<0.9
3	UNX	A	1001	1/1	0.86	0.15	30,30,30,30	0
4	CL	B	501	1/1	0.86	0.21	94,94,94,94	0
3	UNX	A	1000	1/1	0.88	0.08	30,30,30,30	0

6.5 Other polymers [i](#)

There are no such residues in this entry.