



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 10, 2026 – 06:06 pm GMT

PDB ID : 9SOI / pdb\_00009soi  
Title : CTLH-CRA domains of Maea-Twa1 mutant (A125G, Q126R, T127del, Q128E, A130Q, M143L, E144Q, L147F, A148S, F152Y and F160V) complex  
Authors : van gen Hassend, P.M.; Schindelin, H.  
Deposited on : 2025-09-12  
Resolution : 3.31 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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (Phenix) : 2.0  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.48

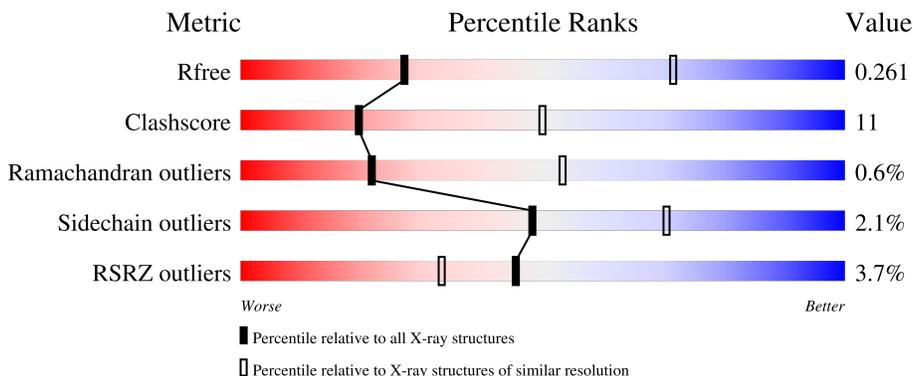
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.31 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))
$R_{free}$	164625	1066 (3.34-3.30)
Clashscore	180529	1111 (3.34-3.30)
Ramachandran outliers	177936	1109 (3.34-3.30)
Sidechain outliers	177891	1108 (3.34-3.30)
RSRZ outliers	164620	1066 (3.34-3.30)

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  $\geq 3$ , 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	133	 3% 64% 32% 5%
1	C	133	 2% 67% 32% ..
2	B	126	 6% 68% 30% .
2	D	126	 3% 77% 21% .

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4253 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 Glucose-induced degradation protein 8 homolog.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	127	1055	658	185	208	4	0	0	0
1	C	132	1093	681	190	218	4	0	0	0

There are 22 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	69	GLY	ALA	engineered mutation	UNP Q9D7M1
A	70	ARG	GLN	engineered mutation	UNP Q9D7M1
A	?	-	THR	deletion	UNP Q9D7M1
A	71	GLU	GLN	engineered mutation	UNP Q9D7M1
A	73	GLN	ALA	engineered mutation	UNP Q9D7M1
A	86	LEU	MET	engineered mutation	UNP Q9D7M1
A	87	GLN	GLU	engineered mutation	UNP Q9D7M1
A	90	PHE	LEU	engineered mutation	UNP Q9D7M1
A	91	SER	ALA	engineered mutation	UNP Q9D7M1
A	95	TYR	PHE	engineered mutation	UNP Q9D7M1
A	103	VAL	PHE	engineered mutation	UNP Q9D7M1
C	69	GLY	ALA	engineered mutation	UNP Q9D7M1
C	70	ARG	GLN	engineered mutation	UNP Q9D7M1
C	?	-	THR	deletion	UNP Q9D7M1
C	71	GLU	GLN	engineered mutation	UNP Q9D7M1
C	73	GLN	ALA	engineered mutation	UNP Q9D7M1
C	86	LEU	MET	engineered mutation	UNP Q9D7M1
C	87	GLN	GLU	engineered mutation	UNP Q9D7M1
C	90	PHE	LEU	engineered mutation	UNP Q9D7M1
C	91	SER	ALA	engineered mutation	UNP Q9D7M1
C	95	TYR	PHE	engineered mutation	UNP Q9D7M1
C	103	VAL	PHE	engineered mutation	UNP Q9D7M1

- Molecule 2 is a protein called E3 ubiquitin-protein transferase MAEA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	124	1047	656	197	186	8	0	0	0
2	D	126	1058	663	199	188	8	0	0	0

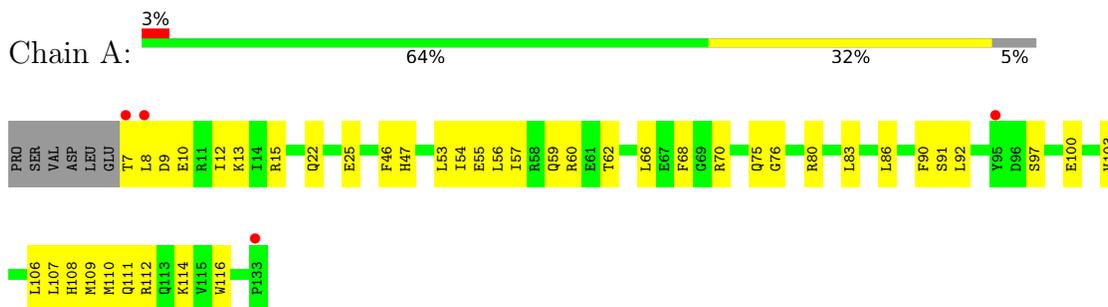
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-1	GLY	-	expression tag	UNP Q4VC33
B	0	PRO	-	expression tag	UNP Q4VC33
D	-1	GLY	-	expression tag	UNP Q4VC33
D	0	PRO	-	expression tag	UNP Q4VC33

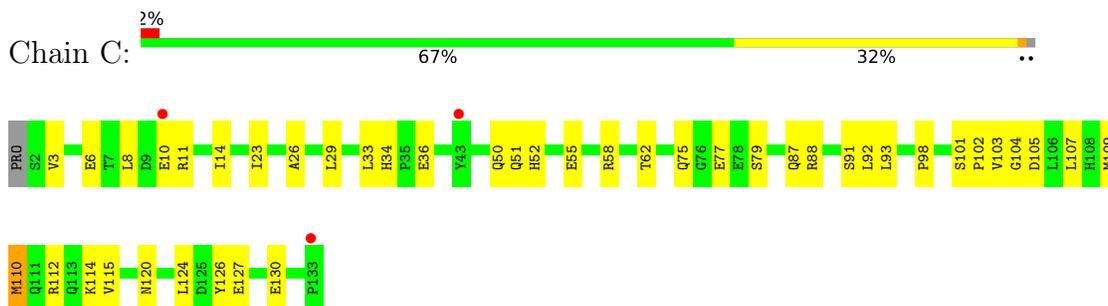
### 3 Residue-property plots [i](#)

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.

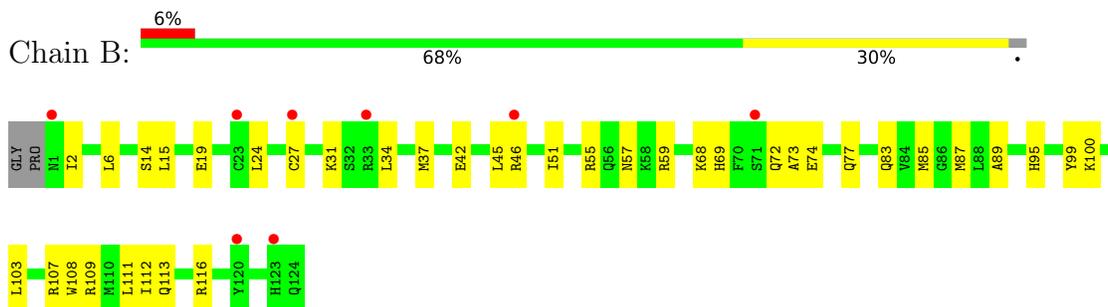
- Molecule 1: Glucose-induced degradation protein 8 homolog



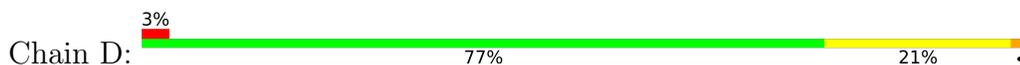
- Molecule 1: Glucose-induced degradation protein 8 homolog



- Molecule 2: E3 ubiquitin-protein transferase MAEA



- Molecule 2: E3 ubiquitin-protein transferase MAEA





## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	142.35Å 142.35Å 213.23Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	48.93 – 3.31 48.93 – 3.31	Depositor EDS
% Data completeness (in resolution range)	46.1 (48.93-3.31) 47.3 (48.93-3.31)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.22 (at 3.33Å)	Xtrriage
Refinement program	PHENIX 1.21.2_5419	Depositor
R, $R_{free}$	0.229 , 0.263 0.228 , 0.261	Depositor DCC
$R_{free}$ test set	843 reflections (1.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	180.7	Xtrriage
Anisotropy	0.043	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 173.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.44$ , $\langle L^2 \rangle = 0.27$	Xtrriage
Estimated twinning fraction	0.089 for -h,-k,l	Xtrriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	4253	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	156.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.84% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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	0.15	0/1071	0.37	0/1445
1	C	0.14	0/1109	0.38	0/1497
2	B	0.14	0/1068	0.41	0/1433
2	D	0.13	0/1080	0.35	0/1450
All	All	0.14	0/4328	0.38	0/5825

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	1055	0	1035	35	0
1	C	1093	0	1070	29	0
2	B	1047	0	1044	23	0
2	D	1058	0	1054	21	0
All	All	4253	0	4203	96	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 11.

All (96) 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:D:55:ARG:HH11	2:D:92:PRO:HB2	1.47	0.77
1:A:108:HIS:HA	1:A:111:GLN:HB2	1.73	0.69
1:C:34:HIS:CE1	1:C:36:GLU:HB2	2.29	0.67
1:C:6:GLU:O	1:C:10:GLU:N	2.29	0.65
2:B:15:LEU:HD13	2:B:112:ILE:HG12	1.78	0.63
1:A:108:HIS:CD2	1:A:112:ARG:HG3	2.33	0.63
2:D:2:ILE:HD12	2:D:3:GLU:HG3	1.80	0.63
1:C:58:ARG:NH2	1:C:107:LEU:O	2.34	0.60
1:A:91:SER:HA	2:B:85:MET:HG3	1.84	0.59
1:A:54:ILE:HA	1:A:57:ILE:HD12	1.85	0.59
1:C:62:THR:HG22	1:C:93:LEU:HD11	1.86	0.57
1:C:93:LEU:O	2:D:67:ARG:NH1	2.32	0.57
2:B:57:ASN:HA	2:B:59:ARG:HE	1.70	0.57
1:A:92:LEU:HD21	1:A:106:LEU:HD11	1.86	0.56
1:A:59:GLN:O	1:A:60:ARG:HG2	2.06	0.55
1:C:77:GLU:HG2	2:D:96:ILE:HG12	1.89	0.55
2:B:34:LEU:HA	2:B:37:MET:HG2	1.89	0.55
1:A:108:HIS:HB3	1:A:112:ARG:HD2	1.89	0.54
2:B:27:CYS:O	2:B:31:LYS:HG3	2.09	0.53
2:D:37:MET:HB3	2:D:121:ARG:CZ	2.39	0.53
1:C:51:GLN:HG3	1:C:115:VAL:HG21	1.91	0.53
1:A:100:GLU:N	1:A:100:GLU:OE1	2.42	0.52
2:D:47:ILE:HD12	2:D:84:VAL:HG11	1.91	0.52
2:B:27:CYS:SG	2:B:42:GLU:HG2	2.50	0.51
1:A:46:PHE:CD1	1:A:75:GLN:HB2	2.47	0.50
2:B:24:LEU:HD23	2:B:45:LEU:HD13	1.93	0.50
1:A:92:LEU:HD13	1:A:103:VAL:HB	1.93	0.49
2:D:41:LEU:HD12	2:D:44:SER:HB3	1.93	0.49
2:B:74:GLU:HG2	2:B:77:GLN:HB2	1.94	0.49
1:C:55:GLU:OE1	1:C:112:ARG:NH2	2.46	0.48
1:C:14:ILE:HG23	1:C:26:ALA:HB1	1.95	0.48
2:B:108:TRP:O	2:B:112:ILE:HG13	2.14	0.48
2:D:2:ILE:H	2:D:2:ILE:HG13	1.45	0.48
1:A:111:GLN:HE21	1:C:110:MET:HE3	1.79	0.48
1:C:120:ASN:O	1:C:124:LEU:HG	2.14	0.48
1:A:66:LEU:HD13	2:B:59:ARG:HB2	1.95	0.47
1:C:92:LEU:HD21	1:C:104:GLY:HA2	1.95	0.47
1:A:110:MET:SD	1:C:103:VAL:HA	2.54	0.47
2:D:1:ASN:HA	2:D:4:MET:HG2	1.96	0.47
2:B:51:ILE:HG12	2:B:87:MET:HE1	1.95	0.47
1:A:53:LEU:HD13	1:A:68:PHE:HD2	1.80	0.47
2:D:84:VAL:O	2:D:87:MET:HG2	2.15	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:2:ILE:O	2:B:6:LEU:HD13	2.14	0.47
1:A:110:MET:HE3	1:A:114:LYS:HA	1.96	0.46
1:C:88:ARG:O	1:C:103:VAL:HG21	2.15	0.46
1:C:126:TYR:O	1:C:130:GLU:N	2.48	0.46
1:A:9:ASP:O	1:A:10:GLU:HB2	2.14	0.46
1:A:12:ILE:HG12	1:A:15:ARG:NH2	2.30	0.46
2:B:83:GLN:HB3	2:B:99:TYR:HE1	1.82	0.45
1:A:46:PHE:CE1	1:A:75:GLN:HB2	2.52	0.45
1:A:107:LEU:HB3	1:C:105:ASP:CG	2.42	0.45
1:C:98:PRO:O	1:C:104:GLY:HA3	2.15	0.45
2:D:34:LEU:HA	2:D:37:MET:HG2	1.98	0.45
2:B:55:ARG:NH2	2:B:103:LEU:O	2.49	0.45
1:C:34:HIS:CE1	1:C:126:TYR:CZ	3.05	0.45
1:A:7:THR:OG1	1:A:8:LEU:N	2.50	0.45
1:A:55:GLU:OE2	1:A:112:ARG:NH2	2.47	0.45
1:C:75:GLN:O	1:C:79:SER:N	2.50	0.44
1:A:70:ARG:HH21	2:B:59:ARG:HG3	1.83	0.44
2:D:81:VAL:HA	2:D:84:VAL:HG22	2.00	0.44
1:A:109:MET:HE3	1:C:102:PRO:HA	1.99	0.44
1:A:22:GLN:HB3	1:A:25:GLU:HB2	2.00	0.43
1:A:10:GLU:HA	1:A:13:LYS:HD3	2.00	0.43
2:B:68:LYS:HB2	2:B:68:LYS:HE3	1.77	0.43
1:C:14:ILE:HG13	1:C:29:LEU:HD23	1.99	0.43
1:C:87:GLN:O	1:C:91:SER:OG	2.27	0.43
1:C:8:LEU:HD23	1:C:11:ARG:NH2	2.34	0.43
1:C:23:ILE:HG21	1:C:52:HIS:HB2	2.00	0.43
2:D:110:MET:O	2:D:114:GLN:HG3	2.19	0.43
2:B:109:ARG:O	2:B:113:GLN:HG2	2.19	0.43
1:A:97:SER:HB2	1:A:100:GLU:CD	2.43	0.42
2:D:74:GLU:HA	2:D:78:LEU:HG	2.02	0.42
1:A:90:PHE:CZ	2:B:89:ALA:HB2	2.54	0.42
2:B:46:ARG:NH1	2:B:69:HIS:HB3	2.34	0.42
2:D:81:VAL:O	2:D:85:MET:HG2	2.20	0.42
2:D:84:VAL:HG23	2:D:85:MET:HE2	2.02	0.42
1:A:62:THR:O	1:A:66:LEU:HG	2.20	0.42
2:B:14:SER:HB2	2:B:19:GLU:HB2	2.01	0.42
1:C:91:SER:HA	2:D:85:MET:HG3	2.02	0.42
1:C:127:GLU:HA	1:C:130:GLU:HG3	2.01	0.42
2:D:9:LYS:HD3	2:D:9:LYS:HA	1.74	0.41
1:A:15:ARG:HB2	1:A:116:TRP:CE2	2.55	0.41
1:A:76:GLY:O	1:A:83:LEU:HG	2.19	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:80:ARG:O	1:A:83:LEU:HB2	2.20	0.41
1:A:83:LEU:HD23	1:A:86:LEU:HD12	2.02	0.41
1:C:8:LEU:N	1:C:11:ARG:HH21	2.18	0.41
2:D:107:ARG:O	2:D:111:LEU:HG	2.20	0.41
2:D:58:LYS:NZ	2:D:61:ASP:OD1	2.41	0.41
2:B:107:ARG:O	2:B:111:LEU:HG	2.20	0.41
2:D:118:ASP:OD1	2:D:121:ARG:NH2	2.21	0.41
1:A:15:ARG:HG3	1:A:116:TRP:CE3	2.56	0.41
1:C:110:MET:HG3	1:C:114:LYS:HZ1	1.84	0.41
1:A:110:MET:HB2	1:C:102:PRO:O	2.21	0.41
1:A:53:LEU:O	1:A:56:LEU:HB2	2.21	0.40
2:B:95:HIS:ND1	2:B:100:LYS:HD3	2.35	0.40
2:B:112:ILE:O	2:B:116:ARG:HG3	2.21	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	125/133 (94%)	119 (95%)	6 (5%)	0	100	100
1	C	130/133 (98%)	123 (95%)	7 (5%)	0	100	100
2	B	122/126 (97%)	119 (98%)	1 (1%)	2 (2%)	8	33
2	D	124/126 (98%)	123 (99%)	0	1 (1%)	16	47
All	All	501/518 (97%)	484 (97%)	14 (3%)	3 (1%)	22	53

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	73	ALA
2	D	41	LEU

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Mol	Chain	Res	Type
2	B	72	GLN

### 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	117/123 (95%)	116 (99%)	1 (1%)	75	85
1	C	122/123 (99%)	116 (95%)	6 (5%)	21	49
2	B	114/115 (99%)	114 (100%)	0	100	100
2	D	115/115 (100%)	112 (97%)	3 (3%)	41	66
All	All	468/476 (98%)	458 (98%)	10 (2%)	48	70

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	47	HIS
1	C	3	VAL
1	C	33	LEU
1	C	50	GLN
1	C	101	SER
1	C	109	MET
1	C	110	MET
2	D	2	ILE
2	D	58	LYS
2	D	103	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	47	HIS
2	D	48	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

### 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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	127/133 (95%)	0.13	4 (3%) 51 38	89, 158, 213, 308	0
1	C	132/133 (99%)	0.01	3 (2%) 61 45	94, 155, 218, 270	0
2	B	124/126 (98%)	0.20	8 (6%) 26 21	78, 149, 194, 234	0
2	D	126/126 (100%)	-0.00	4 (3%) 50 36	101, 145, 192, 238	0
All	All	509/518 (98%)	0.08	19 (3%) 45 33	78, 151, 208, 308	0

All (19) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	39	SER	4.3
2	B	23	CYS	4.0
1	A	8	LEU	3.6
2	B	27	CYS	3.4
2	B	33	ARG	2.9
1	A	95	TYR	2.8
1	C	43	TYR	2.7
2	D	123	HIS	2.6
1	A	7	THR	2.5
2	B	120	TYR	2.5
2	B	46	ARG	2.4
1	C	133	PRO	2.4
2	D	38	LYS	2.4
1	C	10	GLU	2.4
2	D	87	MET	2.3
2	B	123	HIS	2.2
1	A	133	PRO	2.2
2	B	1	ASN	2.1
2	B	71	SER	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.