



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 05:32 PM UTC

PDB ID : 3PB9 / pdb_00003pb9
Title : Crystal structure of the catalytic domain of human Golgi-resident glutaminyl cyclase in complex with 1-benzylimidazole
Authors : Huang, K.F.; Liaw, S.S.; Huang, W.L.; Chia, C.Y.; Lo, Y.C.; Chen, Y.L.; Wang, A.H.J.
Deposited on : 2010-10-20
Resolution : 1.12 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
Mogul : 2022.3.0, CSD as543be (2022)
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

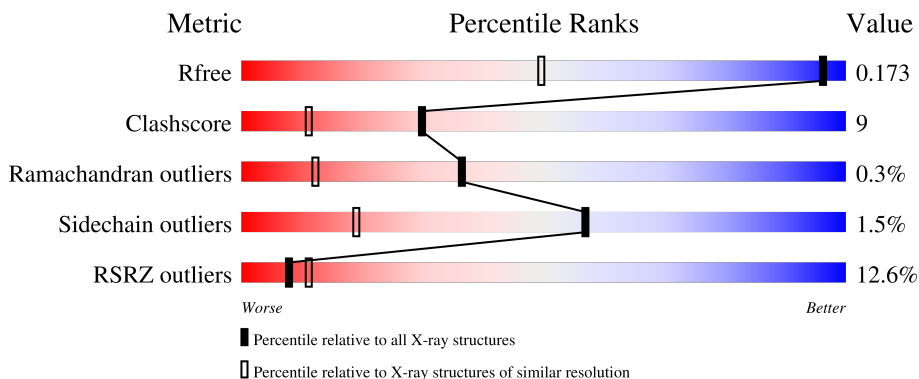
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.12 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	1985 (1.14-1.10)
Clashscore	190562	2021 (1.14-1.10)
Ramachandran outliers	187476	1978 (1.14-1.10)
Sidechain outliers	187428	1974 (1.14-1.10)
RSRZ outliers	180081	1984 (1.14-1.10)

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	X	330	12% 83% 6% •• 6%

2 Entry composition [i](#)

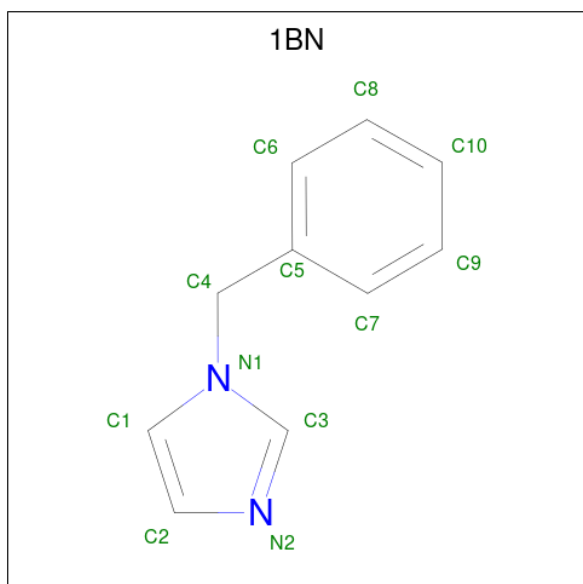
There are 4 unique types of molecules in this entry. The entry contains 2920 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Glutaminyl-peptide cyclotransferase-like protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	X	309	Total	C	N	O	S	0	0	0
			2444	1579	432	427	6			

- Molecule 2 is 1-BENZYL-1H-IMIDAZOLE (CCD ID: 1BN) (formula: C₁₀H₁₀N₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	X	1	Total	C	N	0	0
			12	10	2		

- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	X	1	Total	Zn	0	0
			1	1		

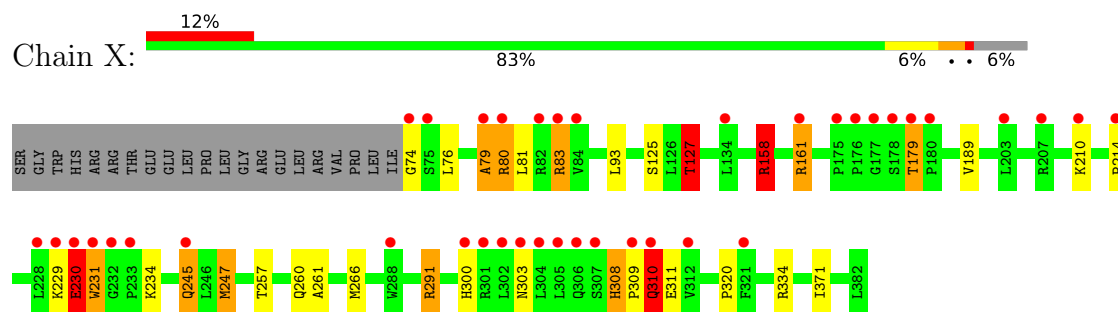
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	X	463	Total 463	O 463	0	0

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: Glutaminyl-peptide cyclotransferase-like protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	53.56Å 69.20Å 77.40Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 1.12 30.00 – 1.12	Depositor EDS
% Data completeness (in resolution range)	96.8 (30.00-1.12) 91.2 (30.00-1.12)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.50 (at 1.12Å)	Xtriage
Refinement program	REFMAC 5.5.0102	Depositor
R, R_{free}	0.150 , 0.181 0.174 , 0.173	Depositor DCC
R_{free} test set	5412 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å ²)	9.7	Xtriage
Anisotropy	0.332	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 40.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	2920	wwPDB-VP
Average B, all atoms (Å ²)	15.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.14% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 1BN, ZN

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	X	1.48	20/2519 (0.8%)	1.28	17/3444 (0.5%)

All (20) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	X	266	MET	SD-CE	-17.90	1.34	1.79
1	X	230	GLU	N-CA	11.40	1.60	1.46
1	X	230	GLU	CA-C	9.70	1.65	1.52
1	X	80	ARG	CA-C	8.67	1.64	1.52
1	X	247	MET	SD-CE	-8.13	1.59	1.79
1	X	229	LYS	C-N	7.22	1.43	1.33
1	X	230	GLU	CB-CG	-6.71	1.32	1.52
1	X	245	GLN	CG-CD	6.36	1.68	1.52
1	X	291	ARG	CZ-NH2	6.32	1.41	1.33
1	X	231	TRP	CE3-CZ3	6.22	1.57	1.38
1	X	79	ALA	N-CA	6.03	1.53	1.46
1	X	79	ALA	C-O	5.76	1.30	1.24
1	X	93	LEU	CG-CD1	-5.75	1.33	1.52
1	X	310	GLN	CA-C	5.72	1.59	1.52
1	X	371	ILE	CA-CB	-5.60	1.47	1.54
1	X	231	TRP	CE2-CZ2	5.37	1.51	1.39
1	X	125	SER	CB-OG	5.33	1.52	1.42
1	X	214	PRO	CA-C	5.30	1.60	1.52
1	X	189	VAL	CA-CB	-5.26	1.51	1.54
1	X	80	ARG	N-CA	-5.23	1.40	1.46

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	158	ARG	CA-CB-CG	13.61	141.31	114.10

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	161	ARG	CD-NE-CZ	9.17	137.23	124.40
1	X	229	LYS	CA-C-N	8.85	138.44	121.54
1	X	229	LYS	C-N-CA	8.85	138.44	121.54
1	X	127	THR	OG1-CB-CG2	8.53	126.37	109.30
1	X	266	MET	CG-SD-CE	-8.42	82.37	100.90
1	X	80	ARG	N-CA-C	-8.28	102.25	111.28
1	X	229	LYS	CA-C-O	-7.74	110.01	118.52
1	X	308	HIS	CA-C-N	-7.17	112.30	120.04
1	X	308	HIS	C-N-CA	-7.17	112.30	120.04
1	X	234	LYS	N-CA-C	6.92	122.01	113.50
1	X	161	ARG	NE-CZ-NH1	6.44	127.94	121.50
1	X	79	ALA	O-C-N	-6.21	115.44	122.08
1	X	179	THR	CB-CA-C	-5.72	100.48	109.52
1	X	230	GLU	N-CA-CB	5.44	119.68	110.49
1	X	158	ARG	CG-CD-NE	-5.42	100.08	112.00
1	X	158	ARG	CB-CA-C	5.20	120.87	109.99

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	X	2444	0	2461	42	1
2	X	12	0	10	2	0
3	X	1	0	0	0	0
4	X	463	0	0	25	5
All	All	2920	0	2471	42	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 9.

All (42) 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:X:179:THR:HG21	4:X:839:HOH:O	1.26	1.33
1:X:80:ARG:HD3	4:X:831:HOH:O	1.34	1.26
1:X:79:ALA:O	4:X:849:HOH:O	1.59	1.19
1:X:179:THR:CG2	4:X:839:HOH:O	1.81	1.17
1:X:247:MET:HE3	4:X:859:HOH:O	1.77	0.83
1:X:161:ARG:NH1	4:X:834:HOH:O	2.15	0.80
1:X:291:ARG:HD2	4:X:538:HOH:O	1.86	0.75
1:X:210:LYS:HE3	4:X:607:HOH:O	1.91	0.70
1:X:158:ARG:HG3	4:X:809:HOH:O	1.93	0.69
1:X:161:ARG:HD2	1:X:261:ALA:HA	1.77	0.67
1:X:80:ARG:CD	4:X:831:HOH:O	2.11	0.67
1:X:79:ALA:HA	4:X:849:HOH:O	2.02	0.58
1:X:127:THR:HG23	4:X:536:HOH:O	2.03	0.58
1:X:303:ASN:HB3	4:X:648:HOH:O	2.03	0.58
1:X:79:ALA:C	4:X:849:HOH:O	2.28	0.58
1:X:231:TRP:CE2	2:X:390:1BN:H7	2.38	0.58
1:X:257:THR:H	1:X:260:GLN:HE21	1.52	0.58
1:X:80:ARG:HG3	1:X:83:ARG:NH1	2.18	0.57
1:X:291:ARG:NE	4:X:820:HOH:O	2.38	0.56
1:X:320:PRO:HB3	4:X:687:HOH:O	2.07	0.56
1:X:79:ALA:CA	4:X:849:HOH:O	2.55	0.54
1:X:300:HIS:HD2	1:X:308:HIS:ND1	2.06	0.54
1:X:179:THR:HG22	4:X:839:HOH:O	1.75	0.54
1:X:76:LEU:HD22	1:X:80:ARG:HD2	1.90	0.54
1:X:158:ARG:HG2	4:X:722:HOH:O	2.08	0.53
1:X:245:GLN:HE21	1:X:334:ARG:HH21	1.55	0.52
1:X:257:THR:H	1:X:260:GLN:NE2	2.08	0.52
1:X:231:TRP:CZ2	2:X:390:1BN:H7	2.44	0.52
1:X:303:ASN:ND2	4:X:648:HOH:O	2.43	0.50
1:X:80:ARG:CG	1:X:83:ARG:NH1	2.76	0.49
1:X:74:GLY:N	4:X:787:HOH:O	2.45	0.48
1:X:80:ARG:CG	4:X:831:HOH:O	2.53	0.48
1:X:300:HIS:CG	1:X:311:GLU:HA	2.49	0.48
1:X:303:ASN:CB	4:X:648:HOH:O	2.61	0.46
1:X:79:ALA:O	1:X:80:ARG:C	2.58	0.45
1:X:309:PRO:HG2	1:X:310:GLN:HE21	1.82	0.45
1:X:81:LEU:C	1:X:81:LEU:HD23	2.41	0.45
1:X:245:GLN:NE2	1:X:334:ARG:HH21	2.15	0.44
1:X:247:MET:CE	4:X:859:HOH:O	2.51	0.42
1:X:83:ARG:HG3	4:X:699:HOH:O	2.20	0.41
1:X:300:HIS:CD2	1:X:308:HIS:ND1	2.87	0.41
1:X:80:ARG:CG	1:X:83:ARG:HH12	2.33	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)
4:X:614:HOH:O	4:X:763:HOH:O[3_654]	1.76	0.44
4:X:856:HOH:O	4:X:860:HOH:O[3_544]	1.79	0.41
4:X:777:HOH:O	4:X:863:HOH:O[3_554]	2.02	0.18
4:X:777:HOH:O	4:X:862:HOH:O[3_554]	2.03	0.17
1:X:230:GLU:OE1	4:X:851:HOH:O[3_554]	2.06	0.14

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	X	307/330 (93%)	298 (97%)	8 (3%)	1 (0%)	36 12

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	X	230	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	X	267/286 (93%)	263 (98%)	4 (2%)	57 19

All (4) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	83	ARG
1	X	127	THR
1	X	158	ARG
1	X	310	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	X	245	GLN
1	X	260	GLN
1	X	300	HIS
1	X	303	ASN
1	X	310	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](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 for Mogul analysis.

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	$\# Z > 2$
2	1BN	X	390	3	13,13,13	1.16	1 (7%)	16,16,16	1.74	4 (25%)

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
2	1BN	X	390	3	-	1/4/4/4	0/2/2/2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	X	390	1BN	C4-C5	-2.45	1.47	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	X	390	1BN	C10-C8-C6	-3.46	115.98	120.24
2	X	390	1BN	C9-C10-C8	3.13	124.16	119.87
2	X	390	1BN	C10-C9-C7	-2.74	116.86	120.24
2	X	390	1BN	C4-C5-C7	-2.73	115.72	120.75

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	X	390	1BN	C5-C4-N1-C1

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	X	390	1BN	2	0

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, 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	X	309/330 (93%)	0.78	39 (12%) 8 11	7, 11, 24, 34	0

All (39) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	X	232	GLY	7.0
1	X	231	TRP	6.6
1	X	233	PRO	6.1
1	X	309	PRO	5.3
1	X	230	GLU	4.7
1	X	74	GLY	4.3
1	X	79	ALA	4.2
1	X	177	GLY	3.8
1	X	80	ARG	3.8
1	X	312	VAL	3.8
1	X	307	SER	3.2
1	X	310	GLN	3.1
1	X	303	ASN	3.1
1	X	83	ARG	2.9
1	X	229	LYS	2.8
1	X	203	LEU	2.8
1	X	175	PRO	2.7
1	X	134	LEU	2.6
1	X	321	PHE	2.6
1	X	84	VAL	2.6
1	X	306	GLN	2.5
1	X	161	ARG	2.5
1	X	75	SER	2.5
1	X	228	LEU	2.5
1	X	302	LEU	2.5
1	X	304	LEU	2.3
1	X	210	LYS	2.3

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Mol	Chain	Res	Type	RSRZ
1	X	245	GLN	2.3
1	X	214	PRO	2.3
1	X	179	THR	2.3
1	X	207	ARG	2.2
1	X	178	SER	2.2
1	X	300	HIS	2.2
1	X	176	PRO	2.2
1	X	82	ARG	2.2
1	X	305	LEU	2.2
1	X	288	TRP	2.2
1	X	301	ARG	2.1
1	X	180	PRO	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(Å ²)	Q<0.9
2	1BN	X	390	12/12	0.97	0.05	7,10,16,17	0
3	ZN	X	400	1/1	1.00	0.01	6,6,6,6	0

6.5 Other polymers [i](#)

There are no such residues in this entry.