



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:48 PM UTC

PDB ID : 4MSN / pdb_00004msn
Title : Crystal structure of PDE10A2 with fragment ZT0451 (8-nitroquinoline)
Authors : Sridhar, V.; Badger, J.; Logan, C.; Chie-Leon, B.; Nienaber, V.
Deposited on : 2013-09-18
Resolution : 2.30 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

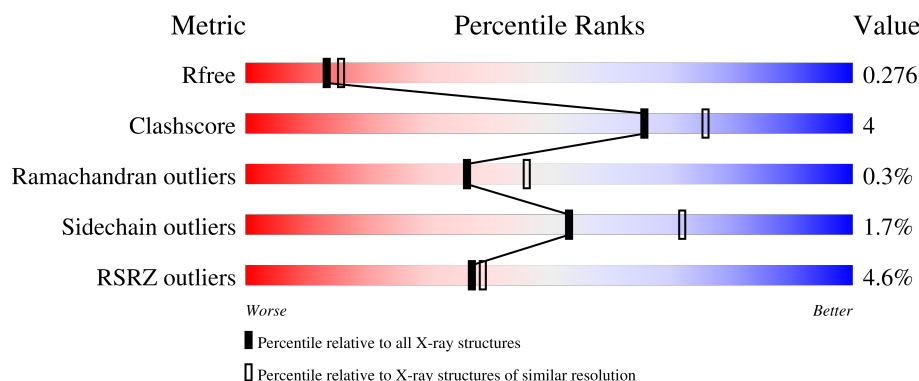
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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	6319 (2.30-2.30)
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (2.30-2.30)
RSRZ outliers	180081	6325 (2.30-2.30)

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 ≥ 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	345	3% 86% 9% ••
1	B	345	5% 82% 12% 6%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5390 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.

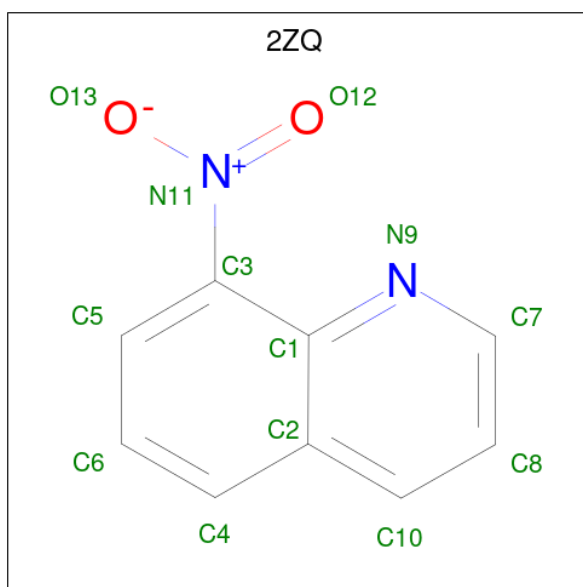
- Molecule 1 is a protein called cAMP and cAMP-inhibited cGMP 3',5'-cyclic phosphodiesterase 10A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	330	Total	C	N	O	S	0	11	0
			2683	1718	453	488	24			
1	B	325	Total	C	N	O	S	0	10	0
			2643	1687	451	479	26			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	445	GLY	-	expression tag	UNP Q9Y233
A	446	ALA	-	expression tag	UNP Q9Y233
A	447	GLY	-	expression tag	UNP Q9Y233
A	448	THR	-	expression tag	UNP Q9Y233
B	445	GLY	-	expression tag	UNP Q9Y233
B	446	ALA	-	expression tag	UNP Q9Y233
B	447	GLY	-	expression tag	UNP Q9Y233
B	448	THR	-	expression tag	UNP Q9Y233

- Molecule 2 is 8-nitroquinoline (CCD ID: 2ZQ) (formula: C₉H₆N₂O₂).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			13	9	2	2		

- Molecule 3 is NICKEL (II) ION (CCD ID: NI) (formula: Ni).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	2	Total	Ni	0	0
			2	2		
3	B	2	Total	Ni	0	0
			2	2		

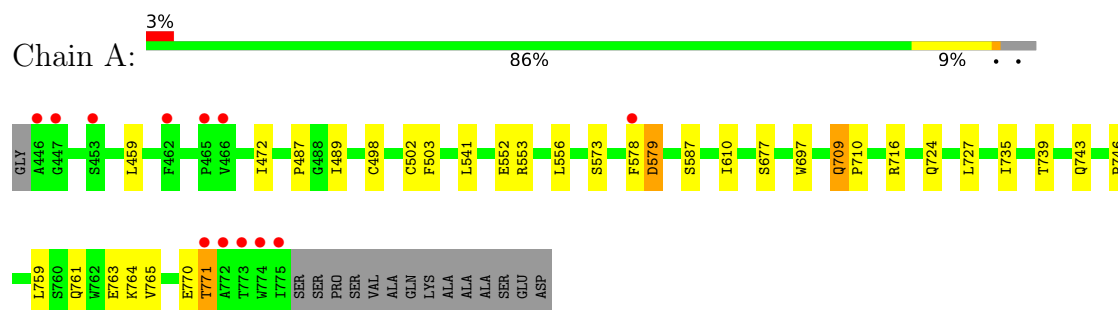
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	27	Total	O	0	0
			27	27		
4	B	20	Total	O	0	0
			20	20		

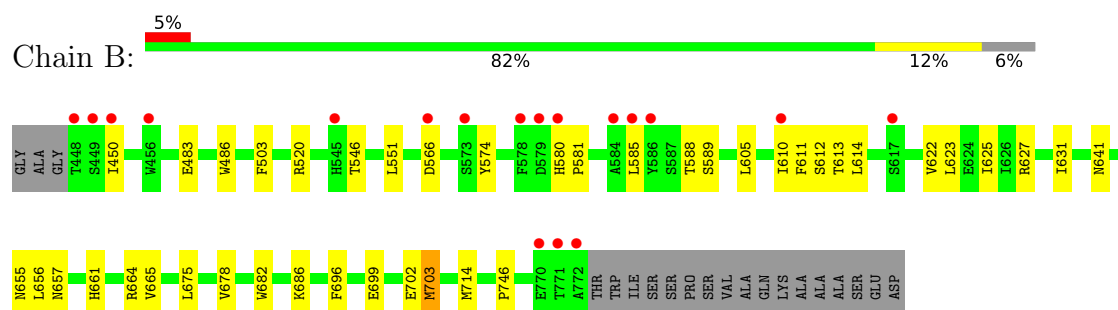
3 Residue-property plots [i](#)

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: cAMP and cAMP-inhibited cGMP 3',5'-cyclic phosphodiesterase 10A



- Molecule 1: cAMP and cAMP-inhibited cGMP 3',5'-cyclic phosphodiesterase 10A



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	49.86Å 82.16Å 156.13Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.73 – 2.30 39.73 – 2.30	Depositor EDS
% Data completeness (in resolution range)	(Not available) (39.73-2.30) 95.4 (39.73-2.30)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.29 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.5.0072	Depositor
R, R_{free}	0.231 , 0.287 0.223 , 0.276	Depositor DCC
R_{free} test set	1405 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å ²)	29.4	Xtriage
Anisotropy	0.951	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 35.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	5390	wwPDB-VP
Average B, all atoms (Å ²)	31.0	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.*

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: 2ZQ, NI

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	0.55	1/2804 (0.0%)	0.89	1/3800 (0.0%)
1	B	0.51	0/2757	0.85	1/3734 (0.0%)
All	All	0.53	1/5561 (0.0%)	0.87	2/7534 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	735	ILE	CA-CB	6.40	1.57	1.54

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	746	PRO	N-CA-C	5.96	117.97	110.70
1	A	746	PRO	N-CA-C	5.40	117.28	110.70

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	2683	0	2650	17	0
1	B	2643	0	2609	23	0
2	A	13	0	6	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	27	0	0	0	0
4	B	20	0	0	0	0
All	All	5390	0	5265	40	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 4.

All (40) 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:655:ASN:H	1:B:661:HIS:HD2	1.28	0.78
1:B:656:LEU:HD21	1:B:665:VAL:HG21	1.71	0.71
1:A:739:THR:HG22	1:A:743:GLN:NE2	2.06	0.70
1:B:574:TYR:HD2	1:B:699:GLU:HG3	1.56	0.68
1:A:552:GLU:O	1:A:556:LEU:HG	1.99	0.63
1:B:450:ILE:HG22	1:B:605:LEU:HD13	1.86	0.57
1:B:641:ASN:HD22	1:B:664:ARG:HH11	1.54	0.56
1:B:682:TRP:O	1:B:686:LYS:HB2	2.10	0.52
1:B:611:PHE:HB3	1:B:614:LEU:HD12	1.93	0.50
1:A:697:TRP:HB3	1:A:716:ARG:HB3	1.94	0.49
1:A:739:THR:HG22	1:A:743:GLN:HE21	1.76	0.49
1:B:622:VAL:HA	1:B:625:ILE:HD12	1.94	0.49
1:B:696:PHE:O	1:B:714[B]:MET:HG3	2.14	0.48
1:A:541:LEU:HD22	1:A:553:ARG:HG2	1.97	0.47
1:A:472[A]:ILE:HD11	1:A:489:ILE:HG23	1.97	0.46
1:B:574:TYR:OH	1:B:702:GLU:HG3	2.16	0.46
1:A:724:GLN:HE22	1:A:727[A]:LEU:HD23	1.82	0.45
1:B:574:TYR:CD2	1:B:699:GLU:HG3	2.44	0.45
1:A:761[A]:GLN:NE2	1:A:764:LYS:HD3	2.30	0.45
1:A:503:PHE:CD1	1:A:610:ILE:HB	2.52	0.45
1:B:612:SER:C	1:B:614:LEU:H	2.23	0.45
1:B:503:PHE:CD1	1:B:610:ILE:HB	2.52	0.45
1:B:551:LEU:HD22	1:B:622:VAL:HB	1.99	0.44
1:B:520:ARG:NE	1:B:566:ASP:OD1	2.46	0.44
1:B:580:HIS:CG	1:B:581:PRO:HD2	2.53	0.44
1:A:578:PHE:O	1:A:579:ASP:C	2.61	0.43
1:B:655:ASN:C	1:B:657:ASN:H	2.27	0.42
1:A:727[B]:LEU:HD21	1:A:763:GLU:HG3	2.00	0.42
1:A:459:LEU:HD13	1:A:487:PRO:HB2	2.02	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:770:GLU:HG2	1:A:771:THR:N	2.35	0.42
1:B:627:ARG:O	1:B:631:ILE:HG12	2.21	0.41
1:B:588:THR:O	1:B:589:SER:C	2.64	0.41
1:B:675:LEU:O	1:B:678:VAL:HG22	2.21	0.41
1:A:709:GLN:HG2	1:A:710:PRO:HD2	2.03	0.41
1:B:483:GLU:HA	1:B:486:TRP:CE2	2.56	0.40
1:A:498:CYS:O	1:A:502:CYS:HB2	2.21	0.40
1:A:709:GLN:HE21	1:A:709:GLN:HB3	1.69	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	339/345 (98%)	325 (96%)	13 (4%)	1 (0%)	36	46
1	B	333/345 (96%)	325 (98%)	7 (2%)	1 (0%)	36	46
All	All	672/690 (97%)	650 (97%)	20 (3%)	2 (0%)	36	46

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	579	ASP
1	B	613	THR

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	301/306 (98%)	295 (98%)	6 (2%)	48	67
1	B	297/306 (97%)	292 (98%)	5 (2%)	53	72
All	All	598/612 (98%)	587 (98%)	11 (2%)	53	70

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	573	SER
1	A	587	SER
1	A	677	SER
1	A	709	GLN
1	A	759	LEU
1	A	771	THR
1	B	546	THR
1	B	585	LEU
1	B	623	LEU
1	B	703[A]	MET
1	B	703[B]	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	621	GLN
1	A	641	ASN
1	A	644	GLN
1	A	709	GLN
1	A	724	GLN
1	A	726	GLN
1	A	743	GLN
1	B	495	HIS
1	B	572	ASN
1	B	580	HIS
1	B	594	HIS
1	B	641	ASN
1	B	655	ASN
1	B	661	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

Of 5 ligands modelled in this entry, 4 are 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	2ZQ	A	900	-	13,14,14	2.00	1 (7%)	16,19,19	1.84	5 (31%)

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	2ZQ	A	900	-	-	2/2/4/4	0/2/2/2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	900	2ZQ	C3-N11	-5.81	1.35	1.45

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	A	900	2ZQ	C5-C3-N11	3.39	120.10	116.47
2	A	900	2ZQ	C7-N9-C1	3.36	121.27	117.31
2	A	900	2ZQ	C3-C1-C2	2.77	119.88	117.30
2	A	900	2ZQ	C2-C1-N9	-2.52	119.97	122.63
2	A	900	2ZQ	C8-C7-N9	-2.26	120.65	123.97

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	900	2ZQ	C1-C3-N11-O12
2	A	900	2ZQ	C5-C3-N11-O12

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, 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	330/345 (95%)	0.04	12 (3%) 46 48	12, 25, 53, 68	11 (3%)
1	B	325/345 (94%)	0.32	18 (5%) 30 32	16, 32, 58, 73	10 (3%)
All	All	655/690 (94%)	0.18	30 (4%) 37 39	12, 28, 56, 73	21 (3%)

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	771	THR	4.7
1	A	775	ILE	4.5
1	A	773	THR	3.9
1	B	617	SER	3.7
1	A	771	THR	3.7
1	B	772	ALA	3.6
1	B	579	ASP	3.5
1	A	446	ALA	3.5
1	A	774	TRP	3.5
1	B	585	LEU	3.2
1	B	449	SER	3.1
1	B	584	ALA	3.0
1	B	545	HIS	2.8
1	B	580	HIS	2.8
1	B	448	THR	2.7
1	B	586	TYR	2.7
1	B	573	SER	2.5
1	A	578	PHE	2.4
1	A	453	SER	2.3
1	B	456	TRP	2.3
1	B	566	ASP	2.2
1	A	447	GLY	2.2
1	A	462	PHE	2.2
1	A	465	PRO	2.1

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Mol	Chain	Res	Type	RSRZ
1	B	450	ILE	2.1
1	A	466	VAL	2.1
1	B	610	ILE	2.1
1	B	578	PHE	2.1
1	A	772	ALA	2.1
1	B	770	GLU	2.1

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
3	NI	B	902	1/1	0.92	0.07	63,63,63,63	0
3	NI	A	902	1/1	0.93	0.06	48,48,48,48	0
2	2ZQ	A	900	13/13	0.95	0.06	31,32,33,34	0
3	NI	A	901	1/1	0.97	0.09	24,24,24,24	0
3	NI	B	901	1/1	0.98	0.03	31,31,31,31	0

6.5 Other polymers [i](#)

There are no such residues in this entry.