



wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 7, 2023 – 11:29 PM EDT

PDB ID : 4QDH
Title : Crystal Structure of the C-terminal Domain of Mouse TLR9
Authors : Collins, B.C.; Wilson, I.A.
Deposited on : 2014-05-13
Resolution : 2.40 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.35.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35.1

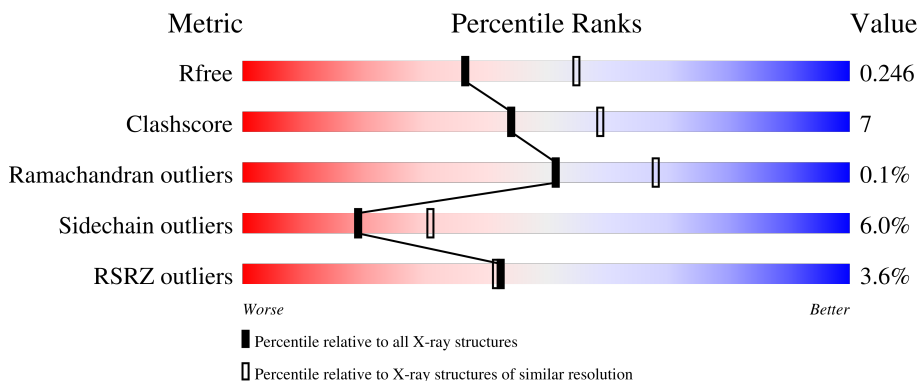
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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}	130704	3907 (2.40-2.40)
Clashscore	141614	4398 (2.40-2.40)
Ramachandran outliers	138981	4318 (2.40-2.40)
Sidechain outliers	138945	4319 (2.40-2.40)
RSRZ outliers	127900	3811 (2.40-2.40)

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	438	 3% 74% 16% • 8%
1	B	438	 3% 73% 15% • 10%

2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 6532 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 Variable lymphocyte receptor B, Toll-like receptor 9 chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	402	3155	2001	553	587	14	0	0	0
1	B	393	3077	1950	537	577	13	0	0	0

There are 56 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-6	ALA	-	expression tag	UNP Q4G1L2
A	-5	ASP	-	expression tag	UNP Q4G1L2
A	-4	PRO	-	expression tag	UNP Q4G1L2
A	-3	GLY	-	expression tag	UNP Q4G1L2
A	408	ALA	-	expression tag	UNP Q4G1L2
A	409	SER	-	expression tag	UNP Q4G1L2
A	410	LEU	-	expression tag	UNP Q4G1L2
A	411	VAL	-	expression tag	UNP Q4G1L2
A	412	PRO	-	expression tag	UNP Q4G1L2
A	413	ARG	-	expression tag	UNP Q4G1L2
A	414	GLY	-	expression tag	UNP Q4G1L2
A	415	SER	-	expression tag	UNP Q4G1L2
A	416	TRP	-	expression tag	UNP Q4G1L2
A	417	SER	-	expression tag	UNP Q4G1L2
A	418	HIS	-	expression tag	UNP Q4G1L2
A	419	PRO	-	expression tag	UNP Q4G1L2
A	420	GLN	-	expression tag	UNP Q4G1L2
A	421	PHE	-	expression tag	UNP Q4G1L2
A	422	GLU	-	expression tag	UNP Q4G1L2
A	423	LYS	-	expression tag	UNP Q4G1L2
A	424	GLY	-	expression tag	UNP Q4G1L2
A	425	SER	-	expression tag	UNP Q4G1L2
A	426	HIS	-	expression tag	UNP Q4G1L2
A	427	HIS	-	expression tag	UNP Q4G1L2
A	428	HIS	-	expression tag	UNP Q4G1L2

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Chain	Residue	Modelled	Actual	Comment	Reference
A	429	HIS	-	expression tag	UNP Q4G1L2
A	430	HIS	-	expression tag	UNP Q4G1L2
A	431	HIS	-	expression tag	UNP Q4G1L2
B	-6	ALA	-	expression tag	UNP Q4G1L2
B	-5	ASP	-	expression tag	UNP Q4G1L2
B	-4	PRO	-	expression tag	UNP Q4G1L2
B	-3	GLY	-	expression tag	UNP Q4G1L2
B	408	ALA	-	expression tag	UNP Q4G1L2
B	409	SER	-	expression tag	UNP Q4G1L2
B	410	LEU	-	expression tag	UNP Q4G1L2
B	411	VAL	-	expression tag	UNP Q4G1L2
B	412	PRO	-	expression tag	UNP Q4G1L2
B	413	ARG	-	expression tag	UNP Q4G1L2
B	414	GLY	-	expression tag	UNP Q4G1L2
B	415	SER	-	expression tag	UNP Q4G1L2
B	416	TRP	-	expression tag	UNP Q4G1L2
B	417	SER	-	expression tag	UNP Q4G1L2
B	418	HIS	-	expression tag	UNP Q4G1L2
B	419	PRO	-	expression tag	UNP Q4G1L2
B	420	GLN	-	expression tag	UNP Q4G1L2
B	421	PHE	-	expression tag	UNP Q4G1L2
B	422	GLU	-	expression tag	UNP Q4G1L2
B	423	LYS	-	expression tag	UNP Q4G1L2
B	424	GLY	-	expression tag	UNP Q4G1L2
B	425	SER	-	expression tag	UNP Q4G1L2
B	426	HIS	-	expression tag	UNP Q4G1L2
B	427	HIS	-	expression tag	UNP Q4G1L2
B	428	HIS	-	expression tag	UNP Q4G1L2
B	429	HIS	-	expression tag	UNP Q4G1L2
B	430	HIS	-	expression tag	UNP Q4G1L2
B	431	HIS	-	expression tag	UNP Q4G1L2

- Molecule 2 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C₈H₁₅NO₆).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
			Total	C	N	O		
2	A	1	14	8	1	5	0	0
2	A	1	14	8	1	5	0	0
2	A	1	14	8	1	5	0	0
2	A	1	14	8	1	5	0	0
2	A	1	14	8	1	5	0	0
2	B	1	14	8	1	5	0	0
2	B	1	14	8	1	5	0	0
2	B	1	14	8	1	5	0	0
2	B	1	14	8	1	5	0	0
2	B	1	14	8	1	5	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	A	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	57	Total O 57 57	0	0
4	B	63	Total O 63 63	0	0

4 Data and refinement statistics i

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	106.03Å 106.03Å 221.55Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	47.82 – 2.40 47.82 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.6 (47.82-2.40) 99.6 (47.82-2.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.13	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.86 (at 2.39Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.1_1168)	Depositor
R, R_{free}	0.214 , 0.247 0.216 , 0.246	Depositor DCC
R_{free} test set	2888 reflections (5.06%)	wwPDB-VP
Wilson B-factor (Å ²)	37.7	Xtrriage
Anisotropy	0.423	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 37.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	0.027 for -h,-k,l	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6532	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.88% 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: NAG, SO4

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	0.46	0/3222	0.71	4/4371 (0.1%)
1	B	0.44	0/3140	0.65	2/4258 (0.0%)
All	All	0.45	0/6362	0.68	6/8629 (0.1%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	303	LEU	CA-CB-CG	10.07	138.45	115.30
1	B	303	LEU	CA-CB-CG	7.88	133.43	115.30
1	A	340	ASN	N-CA-C	5.48	125.80	111.00
1	A	326	GLY	C-N-CD	-5.38	108.77	120.60
1	A	370	CYS	CA-CB-SG	-5.14	104.74	114.00

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	3155	0	3170	46	0
1	B	3077	0	3079	38	0
2	A	70	0	65	0	0
2	B	70	0	65	1	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	A	20	0	0	0	0
3	B	20	0	0	0	0
4	A	57	0	0	2	0
4	B	63	0	0	2	0
All	All	6532	0	6379	84	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 7.

The worst 5 of 84 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:368:CYS:HA	1:A:373:ILE:HG12	1.46	0.97
1:B:368:CYS:HA	1:B:373:ILE:HG12	1.55	0.89
1:A:88:ILE:HG13	1:A:113:LEU:HD21	1.59	0.85
1:A:401:ARG:NH1	4:A:605:HOH:O	2.14	0.81
1:A:69:PRO:HG3	1:A:95:SER:O	1.91	0.71

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	398/438 (91%)	372 (94%)	25 (6%)	1 (0%)	41	55
1	B	385/438 (88%)	359 (93%)	26 (7%)	0	100	100
All	All	783/876 (89%)	731 (93%)	51 (6%)	1 (0%)	51	68

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	327	PRO

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	369/397 (93%)	346 (94%)	23 (6%)	18	29
1	B	360/397 (91%)	339 (94%)	21 (6%)	20	32
All	All	729/794 (92%)	685 (94%)	44 (6%)	19	31

5 of 44 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	151	VAL
1	B	294	VAL
1	B	152	THR
1	B	228	LEU
1	B	337	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 monosaccharides in this entry.

5.6 Ligand geometry

18 ligands 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	SO4	A	507	-	4,4,4	0.19	0	6,6,6	0.21	0
3	SO4	A	509	-	4,4,4	0.14	0	6,6,6	0.08	0
3	SO4	B	509	-	4,4,4	0.14	0	6,6,6	0.09	0
2	NAG	B	503	1	14,14,15	0.46	0	17,19,21	1.74	2 (11%)
2	NAG	A	502	1	14,14,15	0.57	0	17,19,21	1.01	1 (5%)
3	SO4	A	506	-	4,4,4	0.15	0	6,6,6	0.35	0
3	SO4	B	508	-	4,4,4	0.18	0	6,6,6	0.11	0
2	NAG	A	503	1	14,14,15	0.60	0	17,19,21	0.88	1 (5%)
2	NAG	B	502	1	14,14,15	0.51	0	17,19,21	1.35	2 (11%)
2	NAG	B	504	1	14,14,15	0.47	0	17,19,21	1.86	3 (17%)
2	NAG	B	505	1	14,14,15	0.53	0	17,19,21	1.25	3 (17%)
2	NAG	A	501	1	14,14,15	0.64	0	17,19,21	1.20	2 (11%)
3	SO4	A	508	-	4,4,4	0.14	0	6,6,6	0.11	0
3	SO4	B	507	-	4,4,4	0.19	0	6,6,6	0.46	0
3	SO4	B	506	-	4,4,4	0.18	0	6,6,6	0.12	0
2	NAG	A	505	1	14,14,15	0.59	0	17,19,21	2.21	4 (23%)
2	NAG	B	501	1	14,14,15	0.57	0	17,19,21	1.08	1 (5%)
2	NAG	A	504	1	14,14,15	0.43	0	17,19,21	1.78	2 (11%)

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	NAG	B	503	1	-	0/6/23/26	0/1/1/1
2	NAG	A	502	1	-	0/6/23/26	0/1/1/1
2	NAG	A	503	1	-	0/6/23/26	0/1/1/1
2	NAG	B	502	1	-	2/6/23/26	0/1/1/1

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	B	504	1	-	0/6/23/26	0/1/1/1
2	NAG	B	505	1	-	2/6/23/26	0/1/1/1
2	NAG	A	501	1	-	2/6/23/26	0/1/1/1
2	NAG	A	505	1	-	1/6/23/26	0/1/1/1
2	NAG	B	501	1	-	2/6/23/26	0/1/1/1
2	NAG	A	504	1	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

The worst 5 of 21 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	505	NAG	C1-O5-C5	6.30	120.73	112.19
2	B	503	NAG	C1-O5-C5	6.08	120.43	112.19
2	A	504	NAG	C1-O5-C5	5.76	119.99	112.19
2	B	504	NAG	C1-O5-C5	5.56	119.73	112.19
2	B	502	NAG	C2-N2-C7	-4.06	117.12	122.90

There are no chirality outliers.

5 of 9 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	501	NAG	C8-C7-N2-C2
2	B	501	NAG	O7-C7-N2-C2
2	B	505	NAG	O5-C5-C6-O6
2	B	505	NAG	C4-C5-C6-O6
2	A	501	NAG	C8-C7-N2-C2

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	504	NAG	1	0

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 [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	402/438 (91%)	0.16	15 (3%) 41 41	18, 33, 70, 111	0
1	B	393/438 (89%)	0.25	14 (3%) 42 42	18, 40, 78, 120	0
All	All	795/876 (90%)	0.21	29 (3%) 42 42	18, 35, 74, 120	0

The worst 5 of 29 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	397	GLY	4.9
1	A	3	SER	4.7
1	B	3	SER	4.6
1	A	6	SER	4.2
1	A	4	ARG	3.8

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 monosaccharides 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(\AA^2)	Q<0.9
3	SO4	B	506	5/5	0.76	0.29	107,108,110,111	0
2	NAG	A	504	14/15	0.81	0.32	70,80,89,90	0
2	NAG	B	505	14/15	0.86	0.19	52,63,70,70	0
2	NAG	A	505	14/15	0.87	0.21	42,53,64,68	0
2	NAG	B	504	14/15	0.87	0.22	57,72,80,82	0
3	SO4	B	509	5/5	0.89	0.21	89,92,94,97	0
2	NAG	B	503	14/15	0.90	0.23	62,70,77,78	0
3	SO4	A	509	5/5	0.91	0.20	115,115,116,118	0
2	NAG	A	502	14/15	0.92	0.13	35,43,45,50	0
3	SO4	A	508	5/5	0.93	0.17	88,92,94,95	0
2	NAG	A	503	14/15	0.93	0.21	58,70,75,76	0
2	NAG	A	501	14/15	0.94	0.13	27,44,49,51	0
3	SO4	A	506	5/5	0.94	0.14	63,68,70,70	0
2	NAG	B	502	14/15	0.94	0.11	37,47,56,56	0
2	NAG	B	501	14/15	0.95	0.13	39,55,62,63	0
3	SO4	B	508	5/5	0.97	0.18	75,77,82,82	0
3	SO4	A	507	5/5	0.98	0.15	46,46,49,57	0
3	SO4	B	507	5/5	0.99	0.14	35,41,45,48	0

6.5 Other polymers [i](#)

There are no such residues in this entry.