



Full wwPDB X-ray Structure Validation Report ⓘ

Jul 16, 2026 – 04:06 PM EDT

PDB ID : 9Z6E / pdb_00009z6e
Title : Crystal structure of apo LIMK1 mutant D460N
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Deposited on : 2025-11-14
Resolution : 2.26 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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

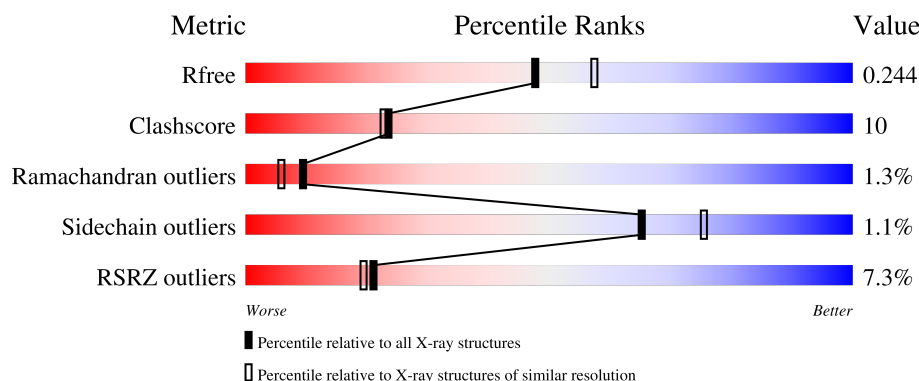
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.26 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	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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	313	5% 73% 18% • 8%
1	B	313	8% 66% 19% • 14%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4475 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 LIM domain kinase 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	288	Total	C	N	O	S	3	1	0
			2270	1456	391	404	19			
1	B	270	Total	C	N	O	S	0	2	0
			2122	1364	366	374	18			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	328	GLY	-	expression tag	UNP P53667
A	460	ASN	ASP	engineered mutation	UNP P53667
B	328	GLY	-	expression tag	UNP P53667
B	460	ASN	ASP	engineered mutation	UNP P53667

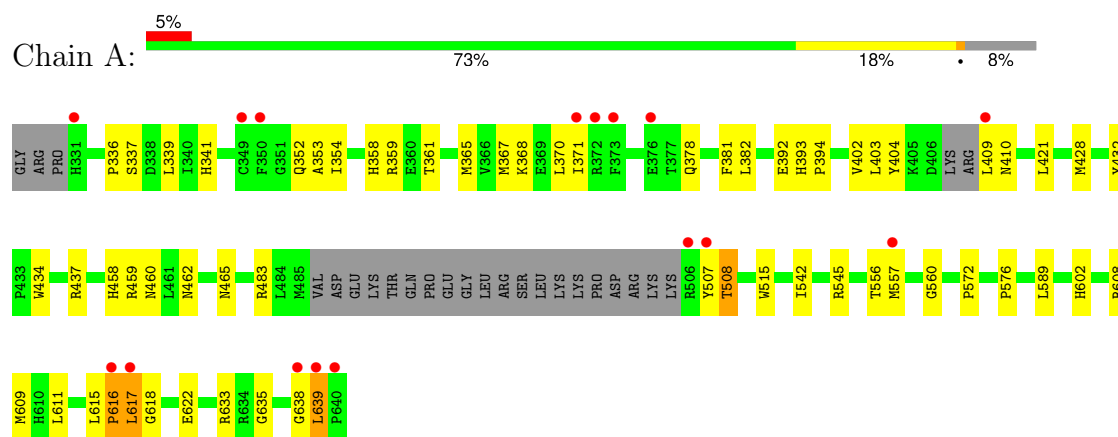
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	35	Total	O	0	0
			35	35		
2	B	48	Total	O	0	0
			48	48		

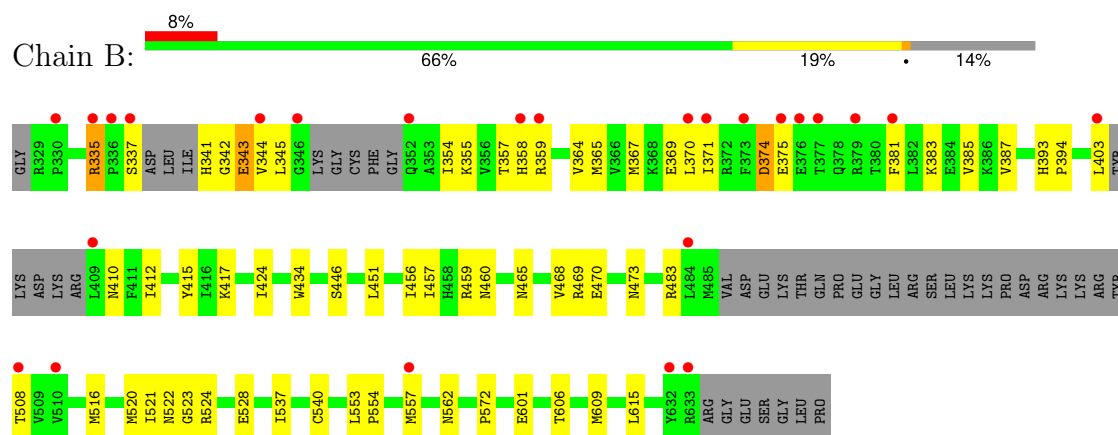
3 Residue-property plots

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: LIM domain kinase 1



• Molecule 1: LIM domain kinase 1



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	54.38Å 59.49Å 103.03Å 90.00° 102.66° 90.00°	Depositor
Resolution (Å)	51.84 – 2.26 51.84 – 2.26	Depositor EDS
% Data completeness (in resolution range)	66.7 (51.84-2.26) 66.7 (51.84-2.26)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.42 (at 2.27Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.192 , 0.245 0.192 , 0.244	Depositor DCC
R_{free} test set	1015 reflections (3.35%)	wwPDB-VP
Wilson B-factor (Å ²)	40.0	Xtriage
Anisotropy	0.010	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 50.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	0.007 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4475	wwPDB-VP
Average B, all atoms (Å ²)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.16% 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

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	0.44	1/2330 (0.0%)	0.75	3/3158 (0.1%)
1	B	0.42	0/2179	0.69	0/2954
All	All	0.43	1/4509 (0.0%)	0.72	3/6112 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	617	LEU	CG-CD1	5.38	1.70	1.52

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	617	LEU	CB-CG-CD2	-16.35	61.64	110.70
1	A	617	LEU	CB-CG-CD1	12.92	149.45	110.70
1	A	617	LEU	CD1-CG-CD2	-6.97	95.47	110.80

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	616	PRO	Peptide

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	A	2270	0	2205	41	0
1	B	2122	0	2066	48	0
2	A	35	0	0	1	0
2	B	48	0	0	0	0
All	All	4475	0	4271	88	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 10.

All (88) 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:403:LEU:HB3	1:B:410:ASN:HD21	1.30	0.97
1:B:460:ASN:O	1:B:465:ASN:ND2	2.11	0.83
1:A:635:GLY:HA2	1:A:639:LEU:HB3	1.66	0.77
1:A:368:LYS:HD3	1:A:381:PHE:HE1	1.51	0.76
1:A:428:MET:HE2	1:A:545:ARG:HG2	1.67	0.76
1:B:516:MET:HE2	1:B:521:ILE:HG13	1.71	0.70
1:B:403:LEU:HB3	1:B:410:ASN:ND2	2.07	0.69
1:B:457:ILE:HG22	1:B:459:ARG:HG3	1.75	0.68
1:A:460:ASN:O	1:A:465:ASN:ND2	2.27	0.67
1:B:516:MET:HE3	1:B:520:MET:HE2	1.79	0.65
1:B:341:HIS:O	1:B:341:HIS:ND1	2.29	0.65
1:B:459:ARG:HH11	1:B:483:ARG:HB3	1.63	0.64
1:A:378:GLN:O	1:A:382:LEU:HD12	1.98	0.63
1:A:392:GLU:OE1	2:A:701:HOH:O	2.15	0.63
1:B:554:PRO:HB2	1:B:562:ASN:HB3	1.79	0.63
1:A:434:TRP:HZ2	1:A:572:PRO:HG2	1.63	0.63
1:B:381:PHE:O	1:B:385:VAL:HG23	2.00	0.62
1:A:358:HIS:ND1	1:A:361:THR:HG23	2.14	0.62
1:B:335:ARG:H	1:B:337:SER:HB3	1.65	0.62
1:A:633:ARG:HD2	1:A:639:LEU:HB2	1.82	0.61
1:B:354:ILE:HD11	1:B:367:MET:HE2	1.82	0.61
1:B:367:MET:HE3	1:B:369:GLU:HB3	1.80	0.61
1:B:365:MET:HE3	1:B:412:ILE:HG21	1.83	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:415:TYR:CD1	1:B:417:LYS:HE3	2.36	0.61
1:A:483:ARG:HH11	1:A:483:ARG:HG2	1.68	0.59
1:A:370:LEU:HD12	1:A:409:LEU:HD13	1.86	0.58
1:B:415:TYR:CE1	1:B:417:LYS:HE3	2.41	0.56
1:B:457:ILE:HG12	1:B:528:GLU:HA	1.88	0.56
1:A:428:MET:HG2	1:A:432:TYR:CG	2.42	0.55
1:A:428:MET:CE	1:A:545:ARG:HG2	2.39	0.53
1:B:424:ILE:HG13	1:B:468:VAL:HG21	1.89	0.52
1:A:402:VAL:HG13	1:A:410:ASN:O	2.10	0.52
1:B:446[B]:SER:OG	1:B:601:GLU:OE2	2.23	0.52
1:B:343:GLU:HB2	1:B:355:LYS:HB3	1.92	0.50
1:A:557:MET:SD	1:A:557:MET:N	2.79	0.50
1:B:522:ASN:HB3	1:B:524:ARG:HD3	1.93	0.50
1:A:339:LEU:HD12	1:A:403:LEU:HD22	1.92	0.49
1:A:576:PRO:HB3	1:A:611:LEU:HD21	1.93	0.49
1:B:343:GLU:OE1	1:B:355:LYS:HD2	2.12	0.49
1:A:393:HIS:CG	1:A:394:PRO:HD2	2.47	0.49
1:B:557:MET:HE3	1:B:557:MET:HA	1.93	0.49
1:A:483:ARG:HG2	1:A:483:ARG:NH1	2.28	0.48
1:B:365:MET:CE	1:B:412:ILE:HG21	2.44	0.48
1:B:469:ARG:N	1:B:473:ASN:O	2.40	0.47
1:B:434:TRP:HZ2	1:B:572:PRO:HG2	1.79	0.47
1:B:609:MET:HG2	1:B:615:LEU:HD22	1.97	0.47
1:A:462:ASN:HB2	1:A:515:TRP:CE2	2.50	0.47
1:A:560:GLY:HA3	1:A:589:LEU:HD21	1.96	0.46
1:B:364:VAL:C	1:B:365:MET:HG3	2.41	0.46
1:A:616:PRO:HB2	1:A:618:GLY:N	2.31	0.46
1:B:451:LEU:HG	1:B:456:ILE:HB	1.97	0.46
1:B:345:LEU:HD11	1:B:355:LYS:HB2	1.98	0.46
1:B:367:MET:HB2	1:B:412:ILE:HG13	1.98	0.46
1:B:434:TRP:CZ2	1:B:572:PRO:HG2	2.51	0.46
1:B:344:VAL:HG22	1:B:354:ILE:HG22	1.97	0.45
1:B:403:LEU:CB	1:B:410:ASN:HD21	2.14	0.45
1:B:374:ASP:OD1	1:B:375:GLU:N	2.50	0.45
1:A:337:SER:O	1:A:359:ARG:HD2	2.17	0.44
1:B:383:LYS:O	1:B:387:VAL:HG23	2.16	0.44
1:A:635:GLY:CA	1:A:639:LEU:HB3	2.43	0.44
1:B:459:ARG:NH1	1:B:483:ARG:HB3	2.28	0.44
1:A:602:HIS:CE1	1:B:606:THR:HG23	2.54	0.43
1:B:457:ILE:CG2	1:B:459:ARG:HG3	2.48	0.43
1:A:483:ARG:CD	1:A:507:TYR:HE1	2.31	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:615:LEU:HB3	1:A:616:PRO:CD	2.49	0.43
1:A:638:GLY:O	1:A:639:LEU:HG	2.19	0.43
1:A:421:LEU:HD21	1:A:542:ILE:HD11	2.00	0.43
1:A:483:ARG:HD2	1:A:507:TYR:HE1	1.84	0.43
1:B:335:ARG:C	1:B:337:SER:N	2.76	0.42
1:B:370:LEU:HD23	1:B:370:LEU:HA	1.75	0.42
1:B:521:ILE:C	1:B:523:GLY:H	2.27	0.42
1:B:553:LEU:HA	1:B:554:PRO:HD3	1.93	0.42
1:A:556:THR:HG22	1:A:557:MET:N	2.35	0.42
1:B:342:GLY:O	1:B:343:GLU:HB2	2.19	0.42
1:A:368:LYS:HD3	1:A:381:PHE:CE1	2.42	0.42
1:B:365:MET:HE3	1:B:412:ILE:CG2	2.50	0.42
1:A:617:LEU:HB3	1:A:622:GLU:HG3	2.02	0.42
1:A:336:PRO:HD3	1:A:404:TYR:O	2.20	0.41
1:A:428:MET:HE1	1:A:437:ARG:HD3	2.02	0.41
1:A:608:ARG:NH2	1:A:609:MET:HE3	2.35	0.41
1:A:353:ALA:HA	1:A:367:MET:O	2.20	0.41
1:A:365:MET:HE3	1:A:365:MET:HB2	1.95	0.41
1:B:344:VAL:HA	1:B:354:ILE:HG22	2.03	0.41
1:B:393:HIS:CG	1:B:394:PRO:HD2	2.55	0.41
1:A:341:HIS:CD2	1:A:354:ILE:HD11	2.56	0.40
1:B:537:ILE:O	1:B:540:CYS:HB2	2.21	0.40
1:A:352:GLN:HG2	1:A:371:ILE:HD11	2.02	0.40
1:A:458:HIS:O	1:A:459:ARG:HB2	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	283/313 (90%)	272 (96%)	10 (4%)	1 (0%)	30 31

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	262/313 (84%)	245 (94%)	11 (4%)	6 (2%)	5	2
All	All	545/626 (87%)	517 (95%)	21 (4%)	7 (1%)	9	6

All (7) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	374	ASP
1	B	335	ARG
1	B	359	ARG
1	B	343	GLU
1	B	358	HIS
1	B	371	ILE
1	A	508	THR

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	244/280 (87%)	242 (99%)	2 (1%)	73	80
1	B	228/280 (81%)	225 (99%)	3 (1%)	61	72
All	All	472/560 (84%)	467 (99%)	5 (1%)	65	75

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	508	THR
1	A	639	LEU
1	B	357	THR
1	B	470	GLU
1	B	508	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	341	HIS
1	A	436	GLN
1	B	331	HIS
1	B	410	ASN

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, 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	288/313 (92%)	0.13	16 (5%) 30 28	24, 45, 80, 121	1 (0%)
1	B	270/313 (86%)	0.22	25 (9%) 14 13	21, 44, 87, 142	2 (0%)
All	All	558/626 (89%)	0.17	41 (7%) 21 19	21, 44, 87, 142	3 (0%)

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	350	PHE	5.0
1	A	616	PRO	4.6
1	A	638	GLY	4.3
1	A	507	TYR	3.6
1	A	373	PHE	3.6
1	A	640	PRO	3.5
1	B	371	ILE	3.4
1	B	510	VAL	3.2
1	A	639	LEU	3.2
1	A	409	LEU	3.1
1	B	359	ARG	3.0
1	B	358	HIS	2.9
1	A	349	CYS	2.9
1	B	337	SER	2.9
1	B	335	ARG	2.8
1	A	506	ARG	2.7
1	B	376	GLU	2.6
1	A	371	ILE	2.6
1	A	372	ARG	2.6
1	B	484	LEU	2.6
1	B	373	PHE	2.6
1	B	352	GLN	2.6
1	B	403	LEU	2.5
1	B	344	VAL	2.5

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Mol	Chain	Res	Type	RSRZ
1	B	409	LEU	2.5
1	B	632	TYR	2.5
1	B	557	MET	2.5
1	B	346	GLY	2.4
1	A	617	LEU	2.4
1	B	377	THR	2.4
1	B	330	PRO	2.3
1	B	381	PHE	2.3
1	B	633	ARG	2.3
1	B	336	PRO	2.2
1	B	375	GLU	2.2
1	B	370	LEU	2.2
1	A	557	MET	2.2
1	A	376	GLU	2.1
1	B	379	ARG	2.1
1	A	331	HIS	2.0
1	B	508	THR	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.