



Full wwPDB X-ray Structure Validation Report ⓘ

Feb 21, 2018 – 11:56 am GMT

PDB ID : 1RDW
Title : Actin Crystal Dynamics: Structural Implications for F-actin Nucleation, Polymerization and Branching Mediated by the Anti-parallel Dimer
Authors : Reutzell, R.; Yoshioka, C.; Govindasamy, L.; Yarmola, E.G.; Agbandje-Mckenna, M.; Bubb, M.R.; McKenna, R.
Deposited on : 2003-11-06
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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.7.3 (157068), CSD as539be (2018)
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20171227.v01 (using entries in the PDB archive December 27th 2017)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk30686

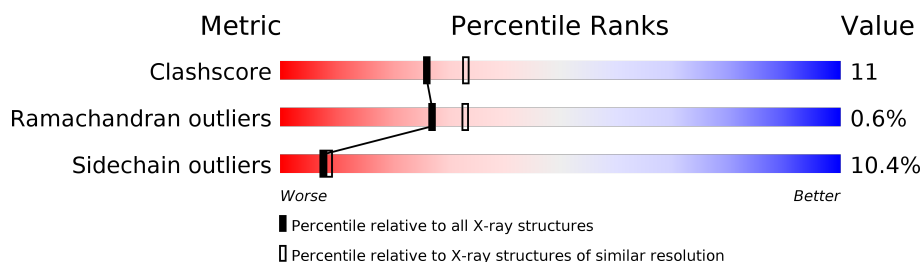
1 Overall quality at a glance

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))
Clashscore	122078	5071 (2.30-2.30)
Ramachandran outliers	120005	5021 (2.30-2.30)
Sidechain outliers	119972	5020 (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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	X	375	 66% 23% 6% • •

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 3004 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 Actin, alpha skeletal muscle.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	X	361	Total	C	N	O	S	0	0	0
			2829	1794	476	540	19			

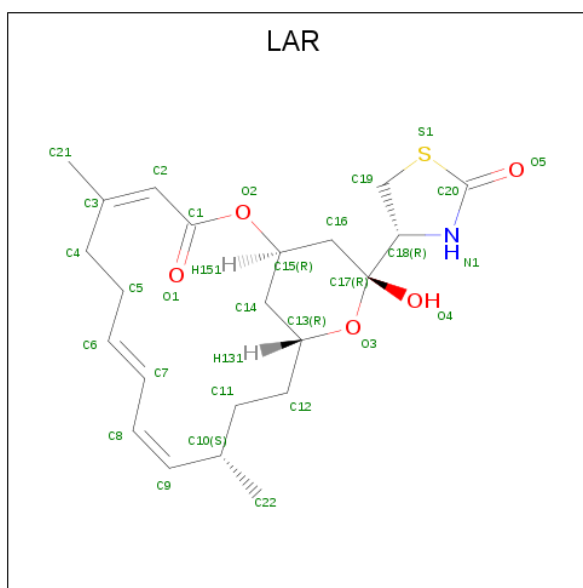
- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	X	2	Total	Mg	0	0
			2	2		

- Molecule 3 is ADENOSINE-5'-TRIPHOSPHATE (three-letter code: ATP) (formula: $C_{10}H_{16}N_5O_{13}P_3$).



- Molecule 4 is LATRUNCULIN A (three-letter code: LAR) (formula: $C_{22}H_{31}NO_5S$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	X	1	Total	C	N	O	S	0
			29	22	1	5	1	

- Molecule 5 is water.

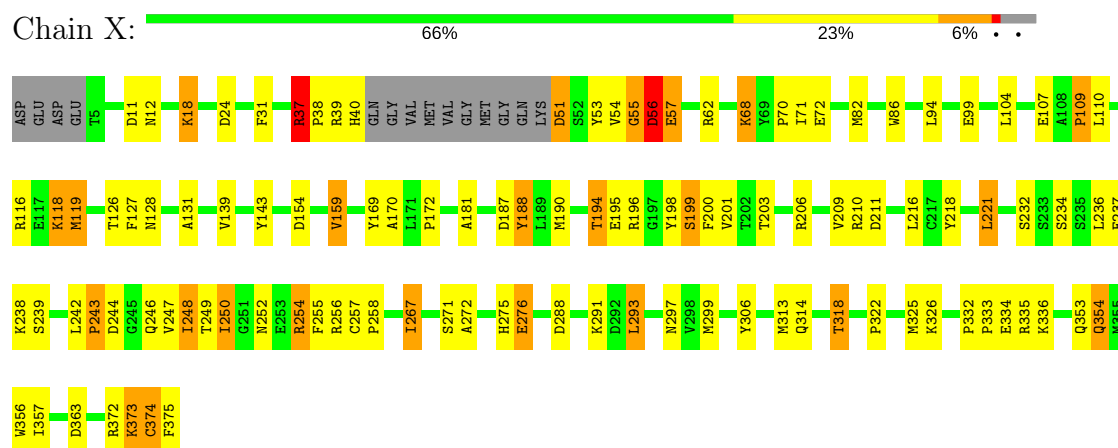
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	X	113	Total	O	0	0
			113	113		

3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

Note EDS was not executed.

- Molecule 1: Actin, alpha skeletal muscle



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α , β , γ	100.92Å 100.92Å 103.87Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 2.30	Depositor
% Data completeness (in resolution range)	(Not available) (20.00-2.30)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.09	Depositor
Refinement program	REFMAC 5.0	Depositor
R, R_{free}	0.162 , 0.224	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	3004	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG, ATP, LAR

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	1.45	17/2891 (0.6%)	1.34	28/3919 (0.7%)

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	X	0	3

All (17) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	X	57	GLU	CD-OE2	8.40	1.34	1.25
1	X	276	GLU	CD-OE2	7.92	1.34	1.25
1	X	72	GLU	CD-OE1	7.44	1.33	1.25
1	X	68	LYS	CD-CE	6.76	1.68	1.51
1	X	53	TYR	CD1-CE1	6.45	1.49	1.39
1	X	118	LYS	CD-CE	6.18	1.66	1.51
1	X	119	MET	CG-SD	6.11	1.97	1.81
1	X	139	VAL	CB-CG2	5.86	1.65	1.52
1	X	373	LYS	CD-CE	5.80	1.65	1.51
1	X	143	TYR	CB-CG	-5.66	1.43	1.51
1	X	188	TYR	CD1-CE1	5.62	1.47	1.39
1	X	169	TYR	CD2-CE2	5.61	1.47	1.39
1	X	127	PHE	CE2-CZ	5.47	1.47	1.37
1	X	31	PHE	CD1-CE1	5.19	1.49	1.39
1	X	374	CYS	CB-SG	-5.19	1.73	1.81
1	X	72	GLU	CD-OE2	5.18	1.31	1.25
1	X	354	GLN	CB-CG	5.10	1.66	1.52

All (28) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	X	56	ASP	CB-CG-OD2	11.40	128.56	118.30
1	X	210	ARG	NE-CZ-NH2	-8.22	116.19	120.30
1	X	24	ASP	CB-CG-OD2	7.88	125.39	118.30
1	X	159	VAL	CG1-CB-CG2	7.77	123.34	110.90
1	X	210	ARG	NE-CZ-NH1	7.54	124.07	120.30
1	X	299	MET	CG-SD-CE	-7.38	88.39	100.20
1	X	159	VAL	CB-CA-C	-7.37	97.40	111.40
1	X	37	ARG	NE-CZ-NH1	-7.21	116.69	120.30
1	X	288	ASP	CB-CG-OD2	7.11	124.70	118.30
1	X	187	ASP	CB-CG-OD1	6.70	124.33	118.30
1	X	154	ASP	CB-CG-OD2	6.67	124.30	118.30
1	X	56	ASP	CB-CG-OD1	-6.55	112.40	118.30
1	X	11	ASP	CB-CG-OD2	6.39	124.05	118.30
1	X	99	GLU	CB-CA-C	-6.16	98.09	110.40
1	X	250	ILE	CG1-CB-CG2	-5.79	98.66	111.40
1	X	51	ASP	CB-CG-OD2	5.62	123.35	118.30
1	X	363	ASP	CB-CG-OD2	5.58	123.33	118.30
1	X	313	MET	CG-SD-CE	-5.51	91.38	100.20
1	X	254	ARG	NE-CZ-NH2	-5.43	117.59	120.30
1	X	244	ASP	CB-CG-OD2	5.33	123.10	118.30
1	X	211	ASP	CB-CG-OD2	5.22	123.00	118.30
1	X	293	LEU	CB-CG-CD1	5.21	119.86	111.00
1	X	375	PHE	CB-CG-CD1	5.19	124.43	120.80
1	X	236	LEU	CB-CG-CD2	5.12	119.71	111.00
1	X	56	ASP	N-CA-C	-5.10	97.22	111.00
1	X	243	PRO	N-CD-CG	-5.07	95.59	103.20
1	X	55	GLY	N-CA-C	-5.04	100.51	113.10
1	X	221	LEU	CB-CG-CD1	5.00	119.51	111.00

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	X	199	SER	Peptide
1	X	55	GLY	Peptide
1	X	56	ASP	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	X	2829	0	2796	63	0
2	X	2	0	0	0	0
3	X	31	0	12	1	0
4	X	29	0	27	1	0
5	X	113	0	0	14	0
All	All	3004	0	2835	64	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 (64) 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:188:TYR:HB2	1:X:267:ILE:HD11	1.24	1.14
1:X:190:MET:HE2	1:X:206:ARG:HG3	1.37	1.01
1:X:190:MET:CE	1:X:206:ARG:HG3	1.91	1.00
1:X:373:LYS:HD3	5:X:513:HOH:O	1.64	0.97
1:X:373:LYS:HE2	5:X:492:HOH:O	1.68	0.91
1:X:195:GLU:N	5:X:501:HOH:O	2.04	0.88
1:X:194:THR:C	5:X:501:HOH:O	2.11	0.88
1:X:354:GLN:HG2	5:X:507:HOH:O	1.76	0.85
1:X:188:TYR:HB2	1:X:267:ILE:CD1	2.08	0.80
1:X:336:LYS:HE2	5:X:473:HOH:O	1.80	0.79
1:X:188:TYR:CB	1:X:267:ILE:HD11	2.10	0.77
1:X:71:ILE:HG13	1:X:82:MET:HE1	1.73	0.71
1:X:257:CYS:HB3	1:X:258:PRO:HD3	1.75	0.67
1:X:71:ILE:HG13	1:X:82:MET:CE	2.23	0.67
1:X:190:MET:HE2	1:X:206:ARG:CG	2.20	0.66
1:X:40:HIS:ND1	5:X:483:HOH:O	2.30	0.65
1:X:314:GLN:O	1:X:318:THR:HG23	1.96	0.65
1:X:12:ASN:ND2	5:X:421:HOH:O	2.04	0.62
1:X:190:MET:CE	1:X:206:ARG:CG	2.76	0.61
1:X:297:ASN:HB3	5:X:455:HOH:O	2.01	0.60
1:X:12:ASN:HD21	1:X:86:TRP:HE1	1.49	0.59
1:X:190:MET:O	1:X:194:THR:HG23	2.04	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:X:250:ILE:HG22	1:X:254:ARG:HG3	1.86	0.58
1:X:332:PRO:O	1:X:335:ARG:HD3	2.04	0.57
4:X:391:LAR:H42	4:X:391:LAR:O2	2.04	0.57
1:X:104:LEU:C	1:X:104:LEU:HD23	2.26	0.56
1:X:190:MET:HE1	1:X:206:ARG:HG3	1.86	0.56
1:X:275:HIS:H	1:X:275:HIS:CD2	2.25	0.55
1:X:200:PHE:CD1	1:X:200:PHE:N	2.74	0.55
1:X:252:ASN:OD1	1:X:256:ARG:HD3	2.09	0.53
1:X:71:ILE:CG1	1:X:82:MET:CE	2.86	0.53
1:X:71:ILE:CG1	1:X:82:MET:HE3	2.39	0.52
1:X:322:PRO:HD2	1:X:325:MET:HE3	1.92	0.52
1:X:70:PRO:HB2	1:X:82:MET:HE2	1.93	0.51
1:X:353:GLN:NE2	1:X:356:TRP:HE1	2.09	0.50
1:X:198:TYR:CZ	1:X:248:ILE:HG12	2.47	0.49
1:X:272:ALA:HB1	1:X:276:GLU:HB2	1.94	0.49
1:X:218:TYR:O	1:X:255:PHE:HA	2.13	0.48
1:X:306:TYR:CZ	3:X:390:ATP:H2	2.33	0.47
1:X:107:GLU:OE1	1:X:116:ARG:HD3	2.14	0.47
1:X:18:LYS:HD3	1:X:18:LYS:N	2.29	0.47
1:X:242:LEU:HD11	1:X:248:ILE:HD12	1.96	0.47
1:X:56:ASP:HB2	5:X:408:HOH:O	2.15	0.47
1:X:37:ARG:HG3	1:X:38:PRO:HD2	1.98	0.46
1:X:12:ASN:ND2	1:X:86:TRP:HE1	2.13	0.45
1:X:12:ASN:CB	5:X:421:HOH:O	2.64	0.45
1:X:188:TYR:CG	1:X:267:ILE:CD1	3.00	0.45
1:X:190:MET:HE1	1:X:206:ARG:HB2	1.98	0.44
1:X:109:PRO:O	1:X:110:LEU:HB2	2.19	0.43
1:X:116:ARG:HA	1:X:119:MET:HE3	2.00	0.43
1:X:373:LYS:O	1:X:374:CYS:HB2	2.17	0.43
1:X:242:LEU:HD11	1:X:248:ILE:CD1	2.49	0.43
1:X:332:PRO:HA	1:X:333:PRO:HD3	1.89	0.43
1:X:196:ARG:HD2	1:X:249:THR:O	2.18	0.43
1:X:181:ALA:HB3	5:X:476:HOH:O	2.18	0.42
1:X:131:ALA:HA	1:X:357:ILE:O	2.19	0.42
1:X:334:GLU:OE2	1:X:334:GLU:N	2.50	0.42
1:X:242:LEU:HB3	1:X:243:PRO:CD	2.48	0.42
1:X:170:ALA:O	1:X:172:PRO:HD3	2.20	0.42
1:X:195:GLU:CA	5:X:501:HOH:O	2.61	0.42
1:X:190:MET:HG2	1:X:209:VAL:HG21	2.02	0.42
1:X:372:ARG:HG2	1:X:372:ARG:O	2.20	0.41
1:X:128:ASN:HB2	5:X:431:HOH:O	2.19	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:X:188:TYR:CG	1:X:267:ILE:HD12	2.57	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	X	357/375 (95%)	338 (95%)	17 (5%)	2 (1%)	27 33

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	X	57	GLU
1	X	232	SER

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	307/318 (96%)	275 (90%)	32 (10%)	8 9

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	18	LYS

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Mol	Chain	Res	Type
1	X	37	ARG
1	X	39	ARG
1	X	51	ASP
1	X	54	VAL
1	X	56	ASP
1	X	62	ARG
1	X	68	LYS
1	X	94	LEU
1	X	109	PRO
1	X	118	LYS
1	X	126	THR
1	X	159	VAL
1	X	194	THR
1	X	199	SER
1	X	201	VAL
1	X	203	THR
1	X	216	LEU
1	X	221	LEU
1	X	234	SER
1	X	237	GLU
1	X	238	LYS
1	X	239	SER
1	X	246	GLN
1	X	247	VAL
1	X	248	ILE
1	X	267	ILE
1	X	271	SER
1	X	291	LYS
1	X	293	LEU
1	X	318	THR
1	X	326	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	X	12	ASN
1	X	59	GLN
1	X	92	ASN
1	X	246	GLN
1	X	275	HIS
1	X	280	ASN
1	X	353	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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	$\# Z > 2$
3	ATP	X	390	2	27,33,33	1.27	3 (11%)	27,52,52	2.48	2 (7%)
4	LAR	X	391	-	30,31,31	2.54	11 (36%)	36,43,43	4.30	22 (61%)

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
3	ATP	X	390	2	-	0/18/38/38	0/3/3/3
4	LAR	X	391	-	-	0/23/51/51	0/2/3/3

All (14) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	X	391	LAR	C8-C7	-6.27	1.26	1.44

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	X	391	LAR	C7-C6	-4.42	1.19	1.33
4	X	391	LAR	C20-S1	-4.38	1.67	1.78
4	X	391	LAR	C5-C6	-4.32	1.27	1.50
4	X	391	LAR	C20-N1	-3.06	1.32	1.36
4	X	391	LAR	C18-N1	-2.57	1.43	1.46
4	X	391	LAR	C19-S1	-2.51	1.76	1.81
3	X	390	ATP	O2'-C2'	-2.21	1.37	1.43
4	X	391	LAR	C8-C9	-2.07	1.24	1.33
4	X	391	LAR	C2-C3	2.25	1.38	1.33
3	X	390	ATP	C8-N9	2.89	1.40	1.36
3	X	390	ATP	C2-N3	3.31	1.37	1.32
4	X	391	LAR	O4-C17	4.57	1.48	1.40
4	X	391	LAR	O2-C1	5.27	1.45	1.34

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	X	390	ATP	N3-C2-N1	-11.72	118.84	128.86
4	X	391	LAR	O4-C17-O3	-9.33	93.27	110.06
4	X	391	LAR	O2-C1-O1	-6.14	112.82	123.31
4	X	391	LAR	O2-C15-C14	-5.21	95.44	107.77
4	X	391	LAR	O5-C20-N1	-2.72	123.09	125.82
4	X	391	LAR	O1-C1-C2	-2.45	119.88	126.20
4	X	391	LAR	O4-C17-C16	-2.13	102.92	109.80
4	X	391	LAR	C14-C13-C12	2.01	117.20	113.18
4	X	391	LAR	C15-O2-C1	2.01	122.89	117.31
3	X	390	ATP	O3G-PG-O2G	2.19	116.24	107.59
4	X	391	LAR	C18-N1-C20	2.25	116.56	113.20
4	X	391	LAR	C19-C18-N1	2.59	107.31	100.92
4	X	391	LAR	C7-C8-C9	2.85	145.43	124.53
4	X	391	LAR	C19-S1-C20	2.99	93.60	92.00
4	X	391	LAR	C5-C4-C3	3.61	124.78	112.85
4	X	391	LAR	C14-C15-C16	3.76	119.57	111.09
4	X	391	LAR	S1-C20-N1	3.96	114.60	111.20
4	X	391	LAR	C21-C3-C4	4.09	122.35	115.29
4	X	391	LAR	C12-C11-C10	4.23	121.04	113.90
4	X	391	LAR	O3-C13-C14	4.90	118.11	108.85
4	X	391	LAR	O3-C17-C18	6.29	112.31	104.25
4	X	391	LAR	O2-C1-C2	7.00	127.30	111.25
4	X	391	LAR	C5-C6-C7	9.87	174.38	126.08
4	X	391	LAR	C8-C7-C6	12.38	174.18	124.64

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	X	390	ATP	1	0
4	X	391	LAR	1	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

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.