



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 01:11 PM UTC

PDB ID : 1SQM / pdb_00001sqm
Title : STRUCTURE OF [R563A] LEUKOTRIENE A4 HYDROLASE
Authors : Tholander, F.O.T.; Rudberg, P.C.; Thunnissen, M.M.G.M.; Haeggstrom, J.Z.
Deposited on : 2004-03-19
Resolution : 2.30 Å(reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

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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)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

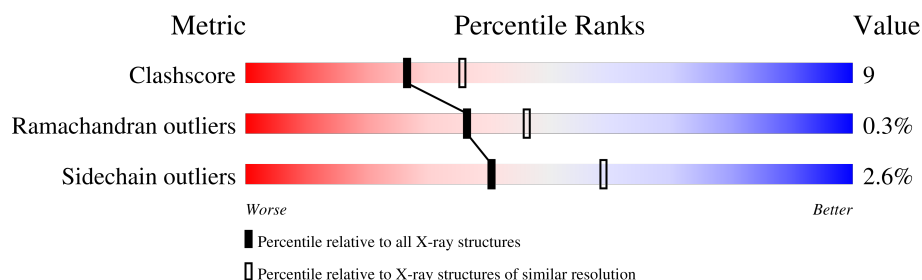
1 Overall quality at a glance

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))
Clashscore	190562	6919 (2.30-2.30)
Ramachandran outliers	187476	6854 (2.30-2.30)
Sidechain outliers	187428	6854 (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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	610	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 5480 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 LEUKOTRIENE A-4 HYDROLASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	610	Total	C	N	O	S	0	0	0
			4871	3127	808	915	21			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	563	ALA	ARG	engineered mutation	UNP P09960

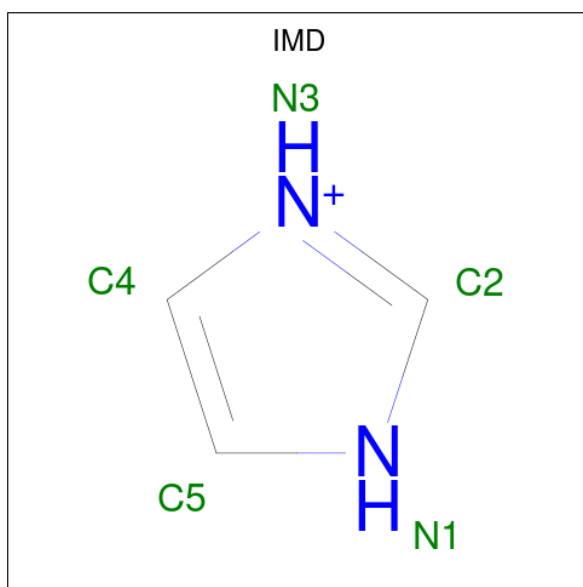
- Molecule 2 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Zn	0	0
			1	1		

- Molecule 3 is YTTERBIUM (III) ION (CCD ID: YB) (formula: Yb).

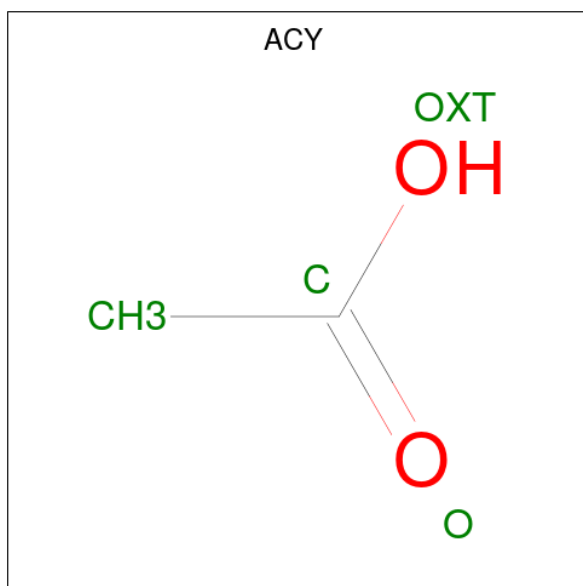
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Yb	0	0
			1	1		

- Molecule 4 is IMIDAZOLE (CCD ID: IMD) (formula: C₃H₅N₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
4	A	1	Total	C	N	0	0
			5	3	2		

- Molecule 5 is ACETIC ACID (CCD ID: ACY) (formula: $C_2H_4O_2$).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	A	1	Total	C	O	0	0
			4	2	2		

- Molecule 6 is water.

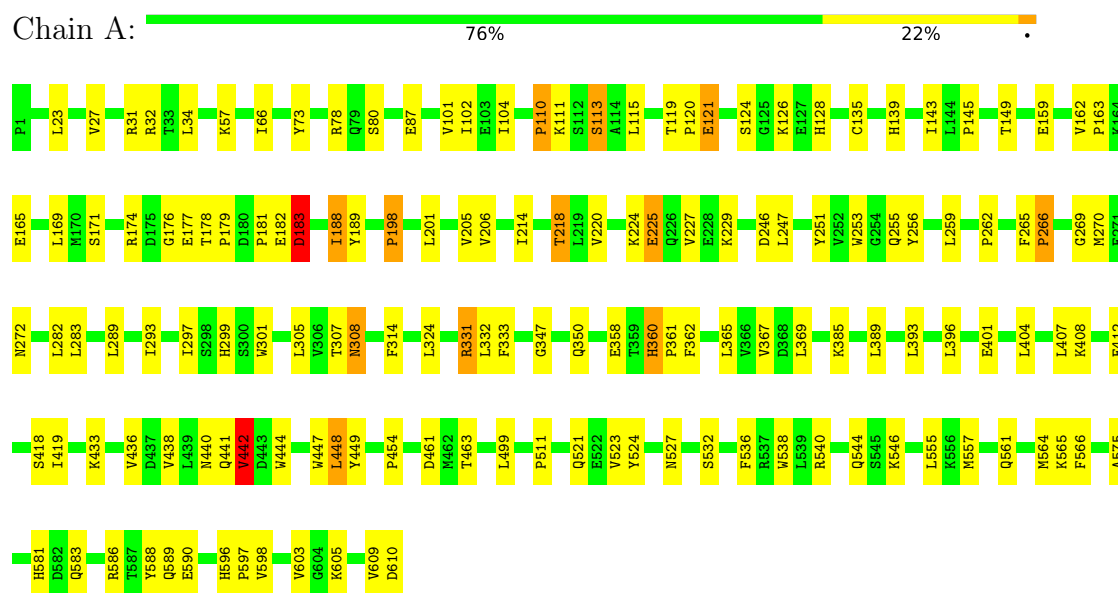
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	598	Total 598	O 598	0	0

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. 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. 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: LEUKOTRIENE A-4 HYDROLASE



4 Data and refinement statistics

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

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	78.00Å 86.85Å 98.95Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	16.48 – 2.30	Depositor
% Data completeness (in resolution range)	(Not available) (16.48-2.30)	Depositor
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.190 , 0.230	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	5480	wwPDB-VP
Average B, all atoms (Å ²)	26.0	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: ACY, YB, ZN, IMD

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	0.66	2/4996 (0.0%)	1.06	31/6791 (0.5%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	442	VAL	CA-CB	5.23	1.61	1.54
1	A	557	MET	SD-CE	5.20	1.92	1.79

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	115	LEU	N-CA-C	6.68	120.42	109.72
1	A	198	PRO	N-CA-C	-6.62	100.86	111.38
1	A	463	THR	N-CA-C	6.43	118.83	111.11
1	A	358	GLU	N-CA-C	6.35	120.63	113.01
1	A	183	ASP	CA-C-N	6.22	127.61	119.84
1	A	183	ASP	C-N-CA	6.22	127.61	119.84
1	A	266	PRO	N-CA-C	6.16	121.84	113.84
1	A	227	VAL	N-CA-C	6.11	116.58	110.23
1	A	251	TYR	N-CA-C	-5.99	99.43	108.96
1	A	419	ILE	N-CA-C	5.99	117.54	108.80
1	A	218	THR	N-CA-C	5.77	118.90	108.69
1	A	603	VAL	N-CA-C	-5.74	104.92	110.72
1	A	360	HIS	CA-C-N	5.66	125.77	119.32
1	A	360	HIS	C-N-CA	5.66	125.77	119.32
1	A	561	GLN	N-CA-C	-5.64	100.72	109.24
1	A	448	LEU	N-CA-C	5.63	118.62	111.69
1	A	253	TRP	N-CA-C	5.58	120.08	113.16
1	A	110	PRO	N-CA-C	-5.52	107.24	114.03
1	A	135	CYS	N-CA-C	5.50	119.71	112.89

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	34	LEU	N-CA-C	-5.43	100.33	109.07
1	A	532	SER	N-CA-C	5.42	117.88	111.33
1	A	546	LYS	N-CA-C	5.40	119.15	111.92
1	A	385	LYS	N-CA-C	-5.28	105.61	111.36
1	A	333	PHE	N-CA-C	5.25	121.48	113.61
1	A	461	ASP	N-CA-C	-5.23	102.65	110.23
1	A	143	ILE	CB-CA-C	-5.21	106.30	111.30
1	A	262	PRO	N-CA-C	-5.18	104.38	110.70
1	A	265	PHE	CA-C-N	5.15	124.82	119.56
1	A	265	PHE	C-N-CA	5.15	124.82	119.56
1	A	176	GLY	N-CA-C	5.15	117.29	112.04
1	A	449	TYR	N-CA-C	5.03	121.15	113.61

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	4871	0	4829	90	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
4	A	5	0	5	0	0
5	A	4	0	3	1	0
6	A	598	0	0	10	0
All	All	5480	0	4837	90	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 9.

All (90) 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:360:HIS:HD2	1:A:362:PHE:H	1.08	0.92
1:A:527:ASN:ND2	1:A:538:TRP:HE1	1.71	0.87

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:360:HIS:CD2	1:A:362:PHE:H	1.97	0.80
1:A:527:ASN:HD22	1:A:538:TRP:HE1	1.28	0.76
1:A:159:GLU:HB3	1:A:188:ILE:HD11	1.68	0.74
1:A:521:GLN:HE22	1:A:527:ASN:H	1.37	0.72
1:A:174:ARG:HD2	6:A:3051:HOH:O	1.90	0.71
1:A:324:LEU:HG	1:A:407:LEU:HD21	1.74	0.68
1:A:270:MET:HA	1:A:270:MET:HE2	1.78	0.66
1:A:111:LYS:HG2	1:A:111:LYS:O	1.97	0.64
1:A:360:HIS:HD2	1:A:362:PHE:N	1.90	0.64
1:A:347:GLY:HA2	1:A:350:GLN:HE21	1.65	0.62
1:A:396:LEU:HG	1:A:438:VAL:CG1	2.31	0.60
1:A:269:GLY:O	5:A:3001:ACY:H1	2.01	0.60
1:A:78:ARG:NH2	6:A:3210:HOH:O	2.36	0.59
1:A:293:ILE:HG22	1:A:297:ILE:HD12	1.87	0.56
1:A:588:TYR:CE2	1:A:609:VAL:HG21	2.40	0.56
1:A:555:LEU:HD11	1:A:583:GLN:HG2	1.88	0.55
1:A:225:GLU:H	1:A:225:GLU:CD	2.15	0.55
1:A:178:THR:O	1:A:188:ILE:HG22	2.07	0.55
1:A:182:GLU:O	1:A:183:ASP:HB2	2.07	0.54
1:A:401:GLU:HG3	6:A:3204:HOH:O	2.07	0.54
1:A:27:VAL:HG21	1:A:206:VAL:HG21	1.90	0.53
1:A:282:LEU:HA	1:A:289:LEU:HD12	1.91	0.52
1:A:586:ARG:O	1:A:590:GLU:HG3	2.10	0.52
1:A:32:ARG:HB2	1:A:110:PRO:HB3	1.90	0.52
1:A:31:ARG:HG2	1:A:31:ARG:HH21	1.75	0.51
1:A:266:PRO:HB2	1:A:564:MET:HE2	1.92	0.51
1:A:565:LYS:HE3	1:A:566:PHE:CZ	2.46	0.51
1:A:433:LYS:O	1:A:436:VAL:HG13	2.11	0.51
1:A:605:LYS:NZ	1:A:605:LYS:HB3	2.26	0.51
1:A:159:GLU:CB	1:A:188:ILE:HD11	2.40	0.51
1:A:229:LYS:HG3	6:A:3087:HOH:O	2.11	0.50
1:A:596:HIS:HE1	6:A:3002:HOH:O	1.94	0.50
1:A:179:PRO:O	1:A:181:PRO:HD3	2.11	0.50
1:A:57:LYS:NZ	1:A:78:ARG:HH22	2.10	0.50
1:A:120:PRO:O	1:A:126:LYS:HA	2.12	0.50
1:A:523:VAL:HG23	1:A:524:TYR:CD1	2.46	0.49
1:A:307:THR:O	1:A:418:SER:HA	2.12	0.49
1:A:104:ILE:HG21	1:A:145:PRO:HG2	1.95	0.49
1:A:293:ILE:HG22	1:A:297:ILE:CD1	2.42	0.49
1:A:609:VAL:O	1:A:610:ASP:HB2	2.13	0.49
1:A:121:GLU:H	1:A:121:GLU:CD	2.21	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:111:LYS:O	1:A:111:LYS:CG	2.62	0.47
1:A:169:LEU:HB2	1:A:205:VAL:CG1	2.44	0.47
1:A:229:LYS:HE2	1:A:283:LEU:HB3	1.96	0.47
1:A:586:ARG:NH1	1:A:590:GLU:OE2	2.47	0.47
1:A:246:ASP:OD2	1:A:331:ARG:NH2	2.47	0.47
1:A:367:VAL:HG23	1:A:369:LEU:HG	1.97	0.46
1:A:128:HIS:CE1	1:A:165:GLU:HG3	2.50	0.46
1:A:442:VAL:HG22	1:A:444:TRP:CE2	2.50	0.46
1:A:447:TRP:CZ3	1:A:454:PRO:HB3	2.51	0.46
1:A:499:LEU:HD22	6:A:3500:HOH:O	2.16	0.46
1:A:57:LYS:HZ3	1:A:78:ARG:NH2	2.14	0.45
1:A:171:SER:HB3	1:A:272:ASN:HB3	1.96	0.45
1:A:139:HIS:HA	6:A:3477:HOH:O	2.16	0.45
1:A:218:THR:HG23	1:A:256:TYR:O	2.17	0.45
1:A:57:LYS:HE3	1:A:113:SER:OG	2.16	0.45
1:A:174:ARG:CD	6:A:3051:HOH:O	2.58	0.45
1:A:596:HIS:CD2	1:A:598:VAL:H	2.35	0.45
1:A:360:HIS:CD2	1:A:361:PRO:HD2	2.52	0.45
1:A:124:SER:HB3	1:A:225:GLU:CG	2.47	0.44
1:A:305:LEU:HD23	1:A:305:LEU:HA	1.87	0.44
1:A:586:ARG:NH1	6:A:3556:HOH:O	2.50	0.44
1:A:255:GLN:HG3	1:A:256:TYR:N	2.32	0.44
1:A:119:THR:OG1	1:A:121:GLU:HG2	2.18	0.44
1:A:214:ILE:HD13	1:A:220:VAL:CG2	2.48	0.44
1:A:408:LYS:O	1:A:412:GLU:HG3	2.18	0.43
1:A:511:PRO:HB3	1:A:544:GLN:O	2.18	0.43
1:A:360:HIS:HA	1:A:361:PRO:HD3	1.88	0.43
1:A:389:LEU:O	1:A:393:LEU:HG	2.19	0.43
1:A:596:HIS:CG	1:A:597:PRO:HD2	2.53	0.43
1:A:447:TRP:CH2	1:A:454:PRO:HB3	2.54	0.43
1:A:162:VAL:O	1:A:163:PRO:C	2.61	0.42
1:A:589:GLN:OE1	1:A:589:GLN:HA	2.18	0.42
1:A:365:LEU:HD23	1:A:448:LEU:HD23	2.02	0.42
1:A:121:GLU:HA	1:A:126:LYS:HD2	2.01	0.42
1:A:308:ASN:OD1	1:A:314:PHE:HA	2.18	0.42
1:A:536:PHE:CZ	1:A:540:ARG:HD2	2.55	0.42
1:A:188:ILE:HD12	1:A:189:TYR:N	2.35	0.41
1:A:544:GLN:NE2	6:A:3136:HOH:O	2.52	0.41
1:A:73:TYR:HA	1:A:87:GLU:O	2.20	0.41
1:A:177:GLU:O	1:A:178:THR:CG2	2.69	0.41
1:A:198:PRO:HD2	1:A:201:LEU:HD12	2.03	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:404:LEU:HD23	1:A:404:LEU:HA	1.87	0.40
1:A:575:ALA:O	1:A:581:HIS:HD2	2.04	0.40
1:A:440:ASN:HD22	1:A:440:ASN:HA	1.73	0.40
1:A:66:ILE:CD1	1:A:102:ILE:HG12	2.52	0.40
1:A:205:VAL:HG11	1:A:259:LEU:HD22	2.03	0.40
1:A:299:HIS:C	1:A:301:TRP:N	2.78	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	608/610 (100%)	584 (96%)	22 (4%)	2 (0%)	36	46

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	80	SER
1	A	183	ASP

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	541/541 (100%)	527 (97%)	14 (3%)	40	59

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	LEU
1	A	101	VAL
1	A	113	SER
1	A	121	GLU
1	A	149	THR
1	A	188	ILE
1	A	224	LYS
1	A	225	GLU
1	A	247	LEU
1	A	308	ASN
1	A	331	ARG
1	A	332	LEU
1	A	441	GLN
1	A	442	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (17) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	43	GLN
1	A	45	GLN
1	A	69	GLN
1	A	213	GLN
1	A	341	ASN
1	A	350	GLN
1	A	360	HIS
1	A	440	ASN
1	A	466	ASN
1	A	505	GLN
1	A	508	GLN
1	A	521	GLN
1	A	525	ASN
1	A	527	ASN
1	A	544	GLN
1	A	581	HIS
1	A	596	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 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	$\# Z > 2$
4	IMD	A	2002	-	5,5,5	0.95	0	5,5,5	0.20	0
5	ACY	A	3001	2	3,3,3	1.15	0	3,3,3	1.63	1 (33%)

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
4	IMD	A	2002	-	-	-	0/1/1/1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	A	3001	ACY	O-C-CH3	-2.25	113.32	122.53

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	A	3001	ACY	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.