



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 03:59 AM UTC

PDB ID : 1PQ3 / pdb_00001pq3
Title : Human Arginase II: Crystal Structure and Physiological Role in Male and Female Sexual Arousal
Authors : Cama, E.; Colleluori, D.M.; Emig, F.A.; Shin, H.; Kim, S.W.; Kim, N.N.; Traish, A.M.; Ash, D.E.; Christianson, D.W.
Deposited on : 2003-06-17
Resolution : 2.70 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 : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtrriage (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

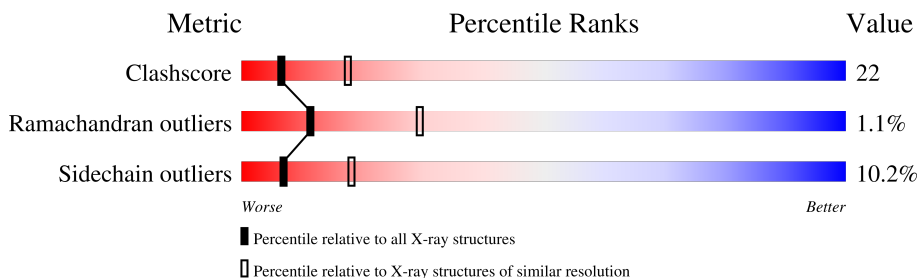
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)

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	306	
1	B	306	
1	C	306	
1	D	306	
1	E	306	
1	F	306	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit crite-

ria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	SO4	F	3074	-	-	X	-

2 Entry composition [i](#)

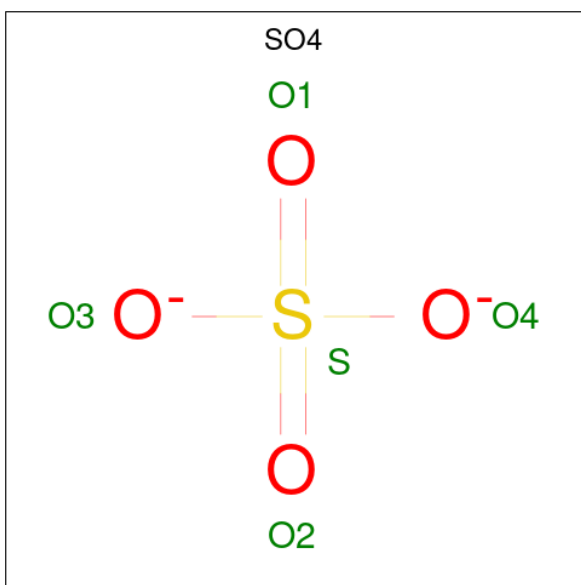
There are 6 unique types of molecules in this entry. The entry contains 14599 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Arginase II, mitochondrial precursor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0
1	B	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0
1	C	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0
1	D	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0
1	E	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0
1	F	306	Total 2337	C 1474	N 407	O 447	S 9	0	0	0

- Molecule 2 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	A	1	Total O S 5 4 1	0	0
2	B	1	Total O S 5 4 1	0	0
2	C	1	Total O S 5 4 1	0	0
2	C	1	Total O S 5 4 1	0	0
2	D	1	Total O S 5 4 1	0	0
2	D	1	Total O S 5 4 1	0	0
2	D	1	Total O S 5 4 1	0	0
2	D	1	Total O S 5 4 1	0	0
2	F	1	Total O S 5 4 1	0	0
2	F	1	Total O S 5 4 1	0	0
2	F	1	Total O S 5 4 1	0	0
2	F	1	Total O S 5 4 1	0	0

- Molecule 3 is MANGANESE (II) ION (CCD ID: MN) (formula: Mn).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	2	Total Mn 2 2	0	0
3	B	2	Total Mn 2 2	0	0
3	C	2	Total Mn 2 2	0	0
3	D	2	Total Mn 2 2	0	0
3	E	2	Total Mn 2 2	0	0

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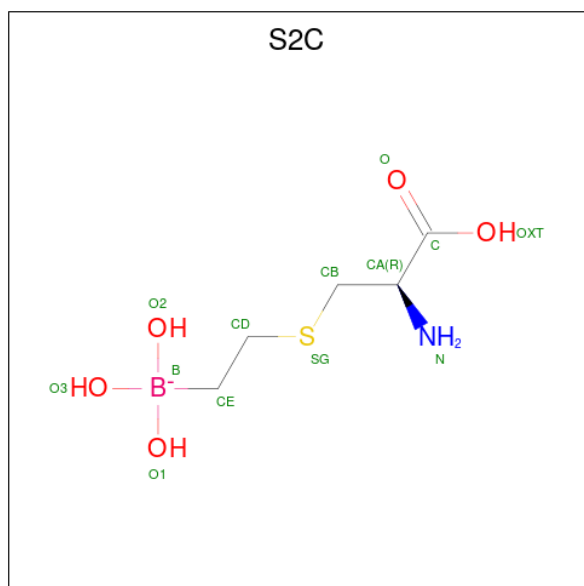
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	F	2	Total	Mn	0	0
			2	2		

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Cl	0	0
			1	1		
4	C	1	Total	Cl	0	0
			1	1		
4	D	1	Total	Cl	0	0
			1	1		
4	E	1	Total	Cl	0	0
			1	1		
4	F	1	Total	Cl	0	0
			1	1		

- Molecule 5 is S-2-(BORONOETHYL)-L-CYSTEINE (CCD ID: S2C) (formula: C₅H₁₃BNO₅S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
5	A	1	Total	B	C	N	O	S	0	0
			13	1	5	1	5	1		
5	B	1	Total	B	C	N	O	S	0	0
			13	1	5	1	5	1		
5	C	1	Total	B	C	N	O	S	0	0
			13	1	5	1	5	1		

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
			Total	B	C	N	O			S
5	D	1	Total 13	B 1	C 5	N 1	O 5	S 1	0	0
5	E	1	Total 13	B 1	C 5	N 1	O 5	S 1	0	0
5	F	1	Total 13	B 1	C 5	N 1	O 5	S 1	0	0

- Molecule 6 is water.

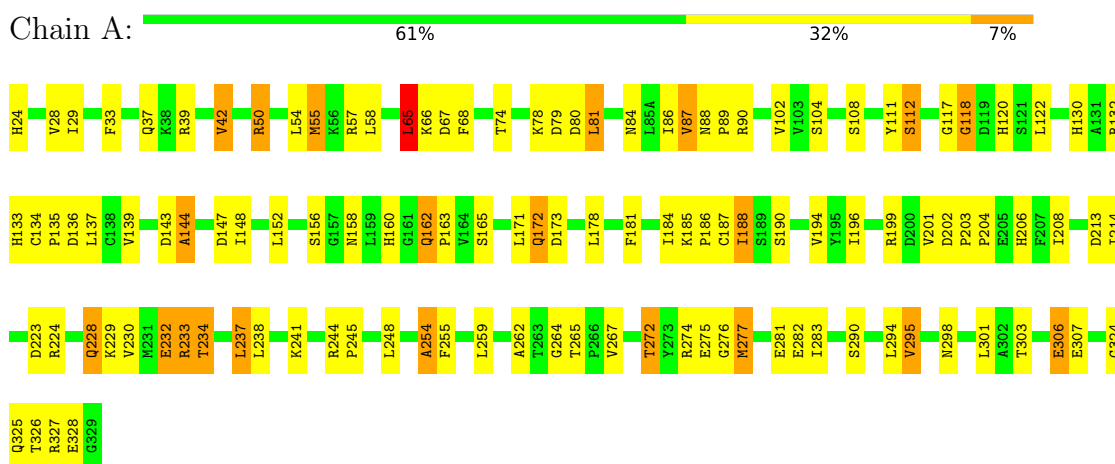
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	69	Total 69	O 69	0	0
6	B	75	Total 75	O 75	0	0
6	C	63	Total 63	O 63	0	0
6	D	74	Total 74	O 74	0	0
6	E	67	Total 67	O 67	0	0
6	F	59	Total 59	O 59	0	0

3 Residue-property plots [i](#)

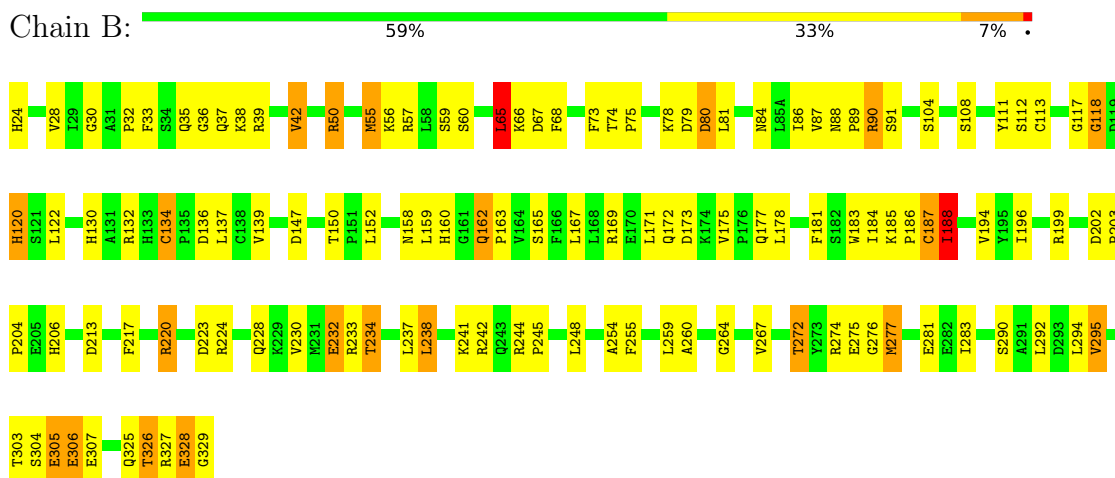
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded 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: Arginase II, mitochondrial precursor

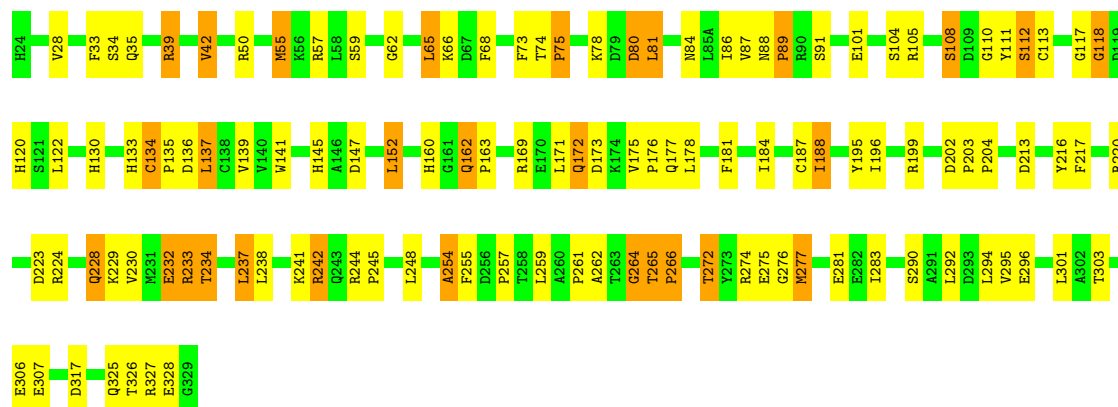


- Molecule 1: Arginase II, mitochondrial precursor



- Molecule 1: Arginase II, mitochondrial precursor





4 Data and refinement statistics

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

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	142.99Å 142.99Å 127.33Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	30.00 – 2.70	Depositor
% Data completeness (in resolution range)	(Not available) (30.00-2.70)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS 1.0	Depositor
R, R_{free}	0.227 , 0.247	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	14599	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

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: SO4, CL, S2C, MN

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	0.51	0/2387	1.06	14/3245 (0.4%)
1	B	0.47	0/2387	1.02	19/3245 (0.6%)
1	C	0.46	0/2387	1.04	15/3245 (0.5%)
1	D	0.53	0/2387	1.07	13/3245 (0.4%)
1	E	0.49	0/2387	1.02	20/3245 (0.6%)
1	F	0.50	0/2387	1.04	16/3245 (0.5%)
All	All	0.49	0/14322	1.04	97/19470 (0.5%)

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
1	B	0	1
1	C	0	1
1	D	0	1
1	E	0	1
1	F	0	1
All	All	0	6

There are no bond length outliers.

The worst 5 of 97 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	238	LEU	N-CA-C	9.16	121.03	111.14
1	D	238	LEU	N-CA-C	9.12	120.99	111.14
1	C	55	MET	N-CA-C	7.55	119.15	111.07
1	F	55	MET	N-CA-C	7.55	119.14	111.07

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	265	THR	CA-C-N	7.42	127.40	119.76

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	117	GLY	Peptide
1	B	117	GLY	Peptide
1	C	117	GLY	Peptide
1	D	117	GLY	Peptide
1	E	117	GLY	Peptide

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	2337	0	2318	102	0
1	B	2337	0	2318	114	0
1	C	2337	0	2318	110	0
1	D	2337	0	2318	110	0
1	E	2337	0	2318	113	0
1	F	2337	0	2318	122	0
2	A	20	0	0	1	0
2	B	5	0	0	0	0
2	C	10	0	0	0	0
2	D	20	0	0	1	0
2	F	20	0	0	4	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
3	D	2	0	0	0	0
3	E	2	0	0	0	0
3	F	2	0	0	0	0
4	A	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
4	E	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	F	1	0	0	0	0
5	A	13	0	12	1	0
5	B	13	0	12	2	0
5	C	13	0	11	2	0
5	D	13	0	12	1	0
5	E	13	0	12	2	0
5	F	13	0	12	2	0
6	A	69	0	0	7	0
6	B	75	0	0	4	0
6	C	63	0	0	3	0
6	D	74	0	0	10	0
6	E	67	0	0	7	0
6	F	59	0	0	8	0
All	All	14599	0	13979	612	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 22.

The worst 5 of 612 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:C:326:THR:HG22	1:C:328:GLU:H	1.07	1.13
1:F:326:THR:HG22	1:F:328:GLU:H	1.07	1.11
1:F:81:LEU:HD12	1:F:81:LEU:H	1.13	1.08
1:A:326:THR:HG22	1:A:328:GLU:H	1.17	1.08
1:D:326:THR:HG22	1:D:328:GLU:H	1.16	1.07

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	304/306 (99%)	285 (94%)	16 (5%)	3 (1%)	12	32
1	B	304/306 (99%)	285 (94%)	17 (6%)	2 (1%)	18	41
1	C	304/306 (99%)	287 (94%)	12 (4%)	5 (2%)	7	20
1	D	304/306 (99%)	284 (93%)	17 (6%)	3 (1%)	12	32
1	E	304/306 (99%)	285 (94%)	17 (6%)	2 (1%)	18	41
1	F	304/306 (99%)	285 (94%)	14 (5%)	5 (2%)	7	20
All	All	1824/1836 (99%)	1711 (94%)	93 (5%)	20 (1%)	11	29

5 of 20 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	118	GLY
1	A	172	GLN
1	B	118	GLY
1	C	118	GLY
1	D	118	GLY

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	257/257 (100%)	234 (91%)	23 (9%)	9	23
1	B	257/257 (100%)	229 (89%)	28 (11%)	6	16
1	C	257/257 (100%)	230 (90%)	27 (10%)	6	17
1	D	257/257 (100%)	233 (91%)	24 (9%)	8	21
1	E	257/257 (100%)	228 (89%)	29 (11%)	5	14
1	F	257/257 (100%)	231 (90%)	26 (10%)	7	18
All	All	1542/1542 (100%)	1385 (90%)	157 (10%)	7	18

5 of 157 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	187	CYS

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Mol	Chain	Res	Type
1	F	187	CYS
1	E	228	GLN
1	E	328	GLU
1	F	242	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 39 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	206	HIS
1	F	211	ASN
1	E	211	ASN
1	F	97	GLN
1	F	284	HIS

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](#)

Of 38 ligands modelled in this entry, 17 are monoatomic - leaving 21 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	SO4	A	3073	-	4,4,4	0.18	0	6,6,6	1.15	0
5	S2C	D	554	3	11,12,12	1.14	0	9,16,16	0.98	1 (11%)
2	SO4	F	3074	-	4,4,4	0.29	0	6,6,6	1.15	0
2	SO4	F	3084	-	4,4,4	0.42	0	6,6,6	1.20	0
2	SO4	C	3075	-	4,4,4	0.35	0	6,6,6	1.22	0
2	SO4	A	3082	-	4,4,4	0.40	0	6,6,6	1.16	0
2	SO4	C	3078	-	4,4,4	0.40	0	6,6,6	1.12	0
2	SO4	D	3079	-	4,4,4	0.39	0	6,6,6	1.17	0
5	S2C	A	551	3	11,12,12	1.15	0	9,16,16	0.97	1 (11%)
2	SO4	D	3072	-	4,4,4	0.18	0	6,6,6	1.20	0
2	SO4	A	3070	-	4,4,4	0.22	0	6,6,6	1.13	0
5	S2C	B	552	3	11,12,12	1.14	0	9,16,16	0.97	1 (11%)
2	SO4	D	3083	-	4,4,4	0.26	0	6,6,6	1.21	0
5	S2C	E	555	3	11,12,12	1.16	0	9,16,16	0.97	1 (11%)
2	SO4	A	3081	-	4,4,4	0.35	0	6,6,6	1.16	0
5	S2C	C	553	3	11,12,12	1.15	0	9,16,16	0.97	1 (11%)
2	SO4	D	3080	-	4,4,4	0.35	0	6,6,6	1.18	0
2	SO4	F	3071	-	4,4,4	0.24	0	6,6,6	1.15	0
2	SO4	B	3085	-	4,4,4	0.37	0	6,6,6	1.17	0
2	SO4	F	3077	-	4,4,4	0.39	0	6,6,6	1.11	0
5	S2C	F	556	3	11,12,12	1.16	0	9,16,16	0.97	1 (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
5	S2C	D	554	3	-	4/8/12/12	-
5	S2C	C	553	3	-	4/8/12/12	-
5	S2C	B	552	3	-	4/8/12/12	-
5	S2C	F	556	3	-	4/8/12/12	-
5	S2C	A	551	3	-	4/8/12/12	-
5	S2C	E	555	3	-	4/8/12/12	-

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(°)
5	D	554	S2C	CB-SG-CD	-2.46	94.96	102.26
5	C	553	S2C	CB-SG-CD	-2.45	94.99	102.26
5	A	551	S2C	CB-SG-CD	-2.45	95.00	102.26
5	E	555	S2C	CB-SG-CD	-2.45	95.00	102.26
5	B	552	S2C	CB-SG-CD	-2.44	95.01	102.26

There are no chirality outliers.

5 of 24 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	A	551	S2C	N-CA-CB-SG
5	B	552	S2C	N-CA-CB-SG
5	C	553	S2C	N-CA-CB-SG
5	D	554	S2C	N-CA-CB-SG
5	E	555	S2C	N-CA-CB-SG

There are no ring outliers.

10 monomers are involved in 16 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	3073	SO4	1	0
5	D	554	S2C	1	0
2	F	3074	SO4	3	0
2	F	3084	SO4	1	0
5	A	551	S2C	1	0
5	B	552	S2C	2	0
2	D	3083	SO4	1	0
5	E	555	S2C	2	0
5	C	553	S2C	2	0
5	F	556	S2C	2	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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.