



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 05:19 PM UTC

PDB ID : 7KP5 / pdb_00007kp5
Title : Energetic and structural effects of the Tanford transition on the ligand recognition of bovine Beta-lactoglobulin
Authors : Rodriguez-Hernandez, A.; Rodriguez-Romero, A.
Deposited on : 2020-11-10
Resolution : 2.40 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
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

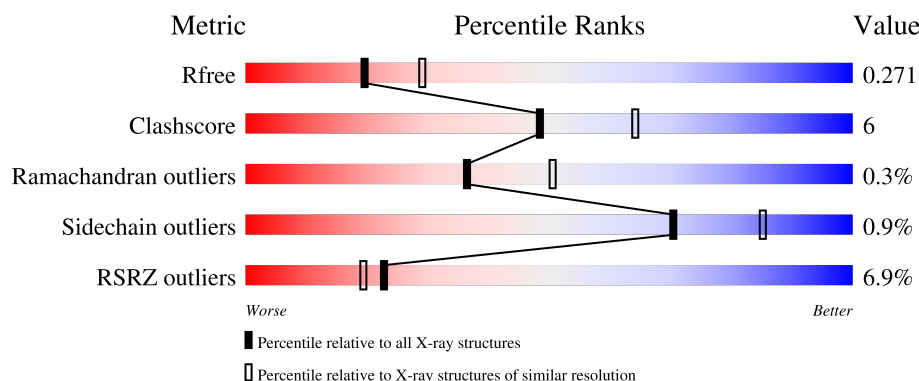
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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}	180053	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (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	AA1	162	 5% 86% 12% .
1	BA1	162	 9% 82% 14% .

2 Entry composition [i](#)

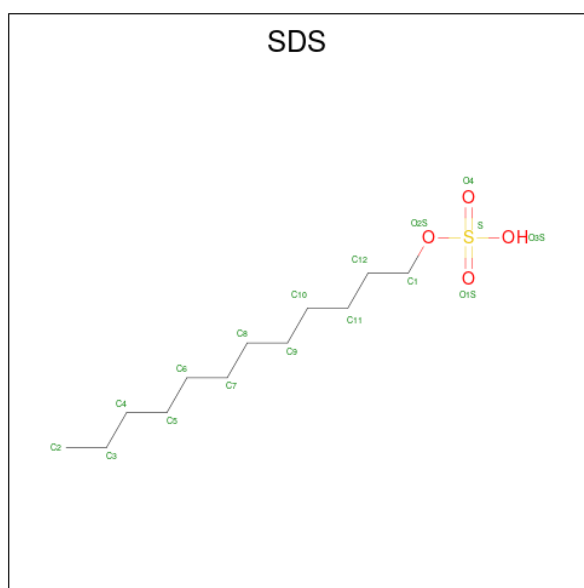
There are 3 unique types of molecules in this entry. The entry contains 2385 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 Beta-lactoglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	AA1	162	Total	C	N	O	S	0	0	0
			1191	756	192	235	8			
1	BA1	155	Total	C	N	O	S	0	0	0
			1108	710	180	209	9			

- Molecule 2 is DODECYL SULFATE (CCD ID: SDS) (formula: $C_{12}H_{26}O_4S$) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	AA1	1	Total	C	O	S	0	0
			17	12	4	1		
2	BA1	1	Total	C	O	S	0	0
			17	12	4	1		
2	BA1	1	Total	C	O	S	0	0
			17	12	4	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	AA1	23	Total 23	O 23	0	0
3	BA1	12	Total 12	O 12	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 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.

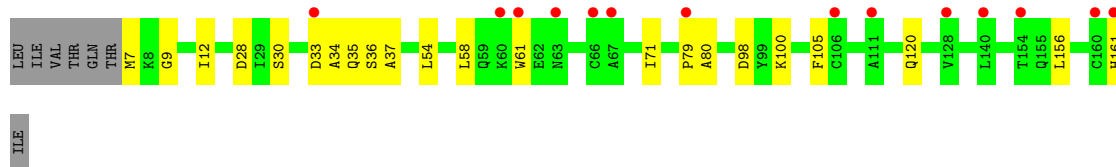
- Molecule 1: Beta-lactoglobulin

Chain AA1: 



- Molecule 1: Beta-lactoglobulin

Chain BA1: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 2 21 21	Depositor
Cell constants a, b, c, α , β , γ	35.75Å 69.79Å 140.33Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.86 – 2.40 38.86 – 2.40	Depositor EDS
% Data completeness (in resolution range)	99.4 (38.86-2.40) 99.6 (38.86-2.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.21 (at 2.39Å)	Xtriage
Refinement program	PHENIX 1.16_3549	Depositor
R, R_{free}	0.235 , 0.269 0.236 , 0.271	Depositor DCC
R_{free} test set	1000 reflections (6.90%)	wwPDB-VP
Wilson B-factor (Å ²)	49.5	Xtriage
Anisotropy	0.511	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 56.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	2385	wwPDB-VP
Average B, all atoms (Å ²)	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.45% 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: SDS

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	AA1	0.24	0/1212	0.52	3/1661 (0.2%)
1	BA1	0.14	0/1129	0.33	0/1547
All	All	0.20	0/2341	0.44	3/3208 (0.1%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	AA1	160	CYS	CA-CB-SG	-8.82	94.11	114.40
1	AA1	65	GLU	CA-C-N	-5.64	112.48	122.74
1	AA1	65	GLU	C-N-CA	-5.64	112.48	122.74

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	AA1	1191	0	1107	12	0
1	BA1	1108	0	1016	13	0
2	AA1	17	0	25	1	0
2	BA1	34	0	50	2	0
3	AA1	23	0	0	1	0
3	BA1	12	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	2385	0	2198	25	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 6.

All (25) 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:BA1:30:SER:HA	1:BA1:33:ASP:HB2	1.65	0.79
1:AA1:31:LEU:HB3	1:AA1:39:LEU:HD12	1.78	0.64
1:BA1:156:LEU:HD23	1:BA1:161:HIS:CE1	2.36	0.60
1:BA1:105:PHE:CE1	1:BA1:120:GLN:HB2	2.38	0.58
1:AA1:56:ILE:HD13	1:AA1:71:ILE:HD11	1.87	0.57
1:BA1:28:ASP:OD2	1:BA1:30:SER:OG	2.22	0.56
1:BA1:34:ALA:H	1:BA1:37:ALA:HB2	1.72	0.54
1:BA1:12:ILE:HG23	1:BA1:54:LEU:HD22	1.92	0.52
1:BA1:36:SER:HB3	1:BA1:61:TRP:HD1	1.76	0.51
1:AA1:159:GLN:C	1:AA1:160:CYS:SG	2.87	0.51
1:AA1:40:ARG:NH2	3:AA1:301:HOH:O	2.44	0.50
1:AA1:105:PHE:CE1	1:AA1:120:GLN:HB2	2.47	0.49
1:BA1:58:LEU:HD21	1:BA1:71:ILE:HD12	1.93	0.49
1:BA1:35:GLN:NE2	2:BA1:202:SDS:H122	2.28	0.49
1:BA1:9:GLY:HA2	1:BA1:79:PRO:HB2	1.94	0.49
1:AA1:88:ASN:O	1:AA1:109:ASN:HB2	2.14	0.48
1:AA1:33:ASP:O	1:AA1:40:ARG:NH1	2.49	0.45
1:AA1:46:LEU:HD21	2:AA1:201:SDS:H2C2	1.99	0.44
1:BA1:7:MET:O	1:BA1:80:ALA:HB2	2.17	0.44
1:BA1:98:ASP:C	1:BA1:100:LYS:H	2.26	0.44
1:AA1:12:ILE:O	1:AA1:15:VAL:HG22	2.19	0.43
1:AA1:140:LEU:HD22	1:AA1:145:MET:HG3	2.00	0.43
1:BA1:105:PHE:CZ	2:BA1:201:SDS:H7C1	2.54	0.42
1:AA1:24:MET:HB3	1:AA1:120:GLN:HG2	2.00	0.42
1:AA1:136:PHE:O	1:AA1:140:LEU:HG	2.20	0.41

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	AA1	160/162 (99%)	157 (98%)	2 (1%)	1 (1%)	21	32
1	BA1	153/162 (94%)	151 (99%)	2 (1%)	0	100	100
All	All	313/324 (97%)	308 (98%)	4 (1%)	1 (0%)	36	50

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	AA1	33	ASP

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	AA1	120/143 (84%)	118 (98%)	2 (2%)	53	74
1	BA1	105/143 (73%)	105 (100%)	0	100	100
All	All	225/286 (79%)	223 (99%)	2 (1%)	70	85

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	AA1	115	GLN
1	AA1	130	ASP

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

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 ⓘ

3 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
2	SDS	BA1	201	-	16,16,16	1.17	1 (6%)	17,18,18	0.76	0
2	SDS	BA1	202	-	16,16,16	1.16	1 (6%)	17,18,18	0.71	0
2	SDS	AA1	201	-	16,16,16	1.17	1 (6%)	17,18,18	0.80	0

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	SDS	BA1	201	-	-	7/14/14/14	-
2	SDS	BA1	202	-	-	7/14/14/14	-
2	SDS	AA1	201	-	-	6/14/14/14	-

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	AA1	201	SDS	O1S-S	4.29	1.63	1.45
2	BA1	202	SDS	O4-S	4.28	1.63	1.45
2	BA1	201	SDS	O4-S	4.27	1.63	1.45

There are no bond angle outliers.

There are no chirality outliers.

All (20) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	AA1	201	SDS	O2S-C1-C12-C11
2	BA1	202	SDS	O2S-C1-C12-C11
2	AA1	201	SDS	C1-O2S-S-O3S
2	BA1	201	SDS	C5-C6-C7-C8
2	BA1	202	SDS	C7-C8-C9-C10
2	AA1	201	SDS	C1-O2S-S-O1S
2	AA1	201	SDS	C1-O2S-S-O4
2	BA1	201	SDS	C3-C4-C5-C6
2	BA1	202	SDS	C10-C11-C12-C1
2	BA1	201	SDS	O2S-C1-C12-C11
2	BA1	201	SDS	C7-C8-C9-C10
2	BA1	201	SDS	C6-C7-C8-C9
2	BA1	202	SDS	C1-O2S-S-O1S
2	AA1	201	SDS	C10-C11-C12-C1
2	BA1	201	SDS	C2-C3-C4-C5
2	AA1	201	SDS	C7-C8-C9-C10
2	BA1	202	SDS	C1-O2S-S-O4
2	BA1	202	SDS	C5-C6-C7-C8
2	BA1	202	SDS	C11-C10-C9-C8
2	BA1	201	SDS	C4-C5-C6-C7

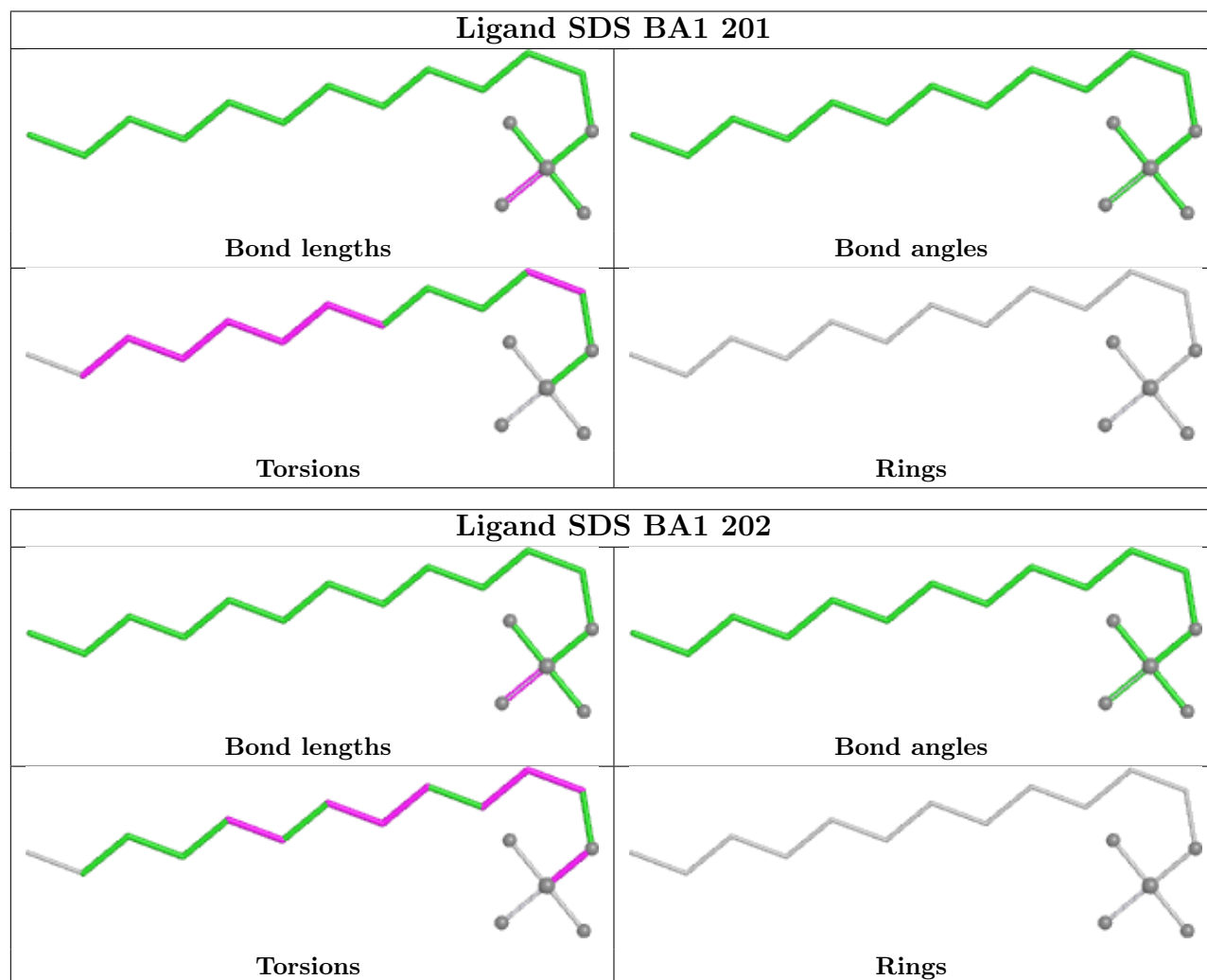
There are no ring outliers.

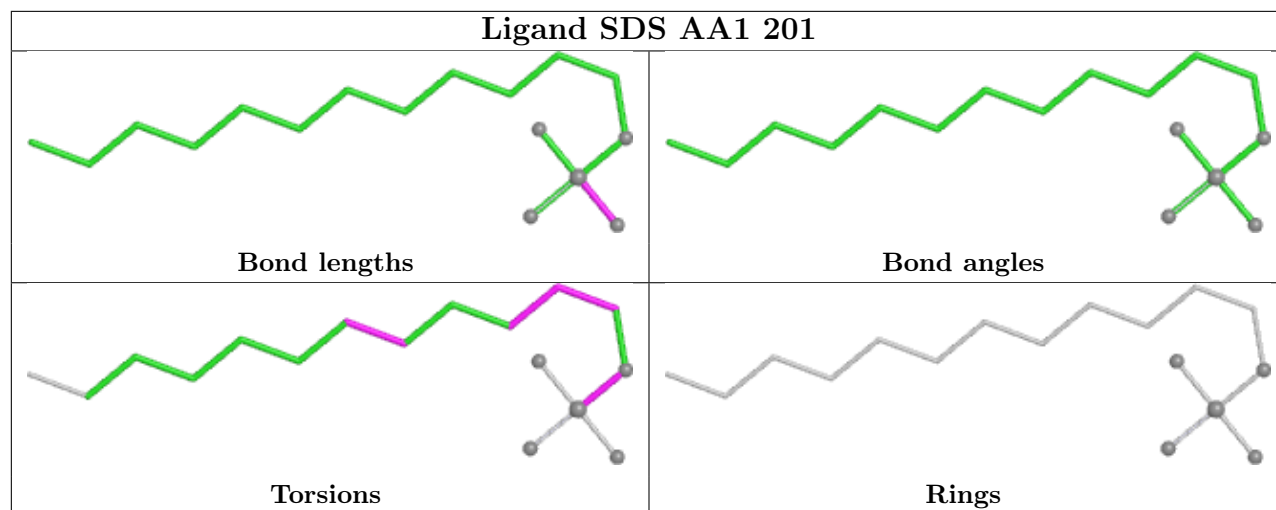
3 monomers are involved in 3 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	BA1	201	SDS	1	0
2	BA1	202	SDS	1	0
2	AA1	201	SDS	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is

within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.





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	AA1	162/162 (100%)	0.51	8 (4%) 35 31	35, 51, 67, 77	0
1	BA1	155/162 (95%)	0.80	14 (9%) 15 12	35, 55, 78, 92	0
All	All	317/324 (97%)	0.65	22 (6%) 23 19	35, 53, 76, 92	0

All (22) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	BA1	66	CYS	3.8
1	BA1	63	ASN	3.2
1	BA1	128	VAL	3.2
1	AA1	12	ILE	3.2
1	BA1	106	CYS	2.9
1	BA1	160	CYS	2.8
1	BA1	161	HIS	2.6
1	BA1	61	TRP	2.6
1	AA1	162	ILE	2.5
1	BA1	111	ALA	2.5
1	BA1	67	ALA	2.5
1	BA1	79	PRO	2.4
1	AA1	130	ASP	2.4
1	AA1	128	VAL	2.4
1	BA1	140	LEU	2.4
1	AA1	137	ASP	2.3
1	BA1	33	ASP	2.2
1	BA1	154	THR	2.1
1	AA1	160	CYS	2.1
1	AA1	106	CYS	2.1
1	AA1	66	CYS	2.1
1	BA1	60	LYS	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](#)

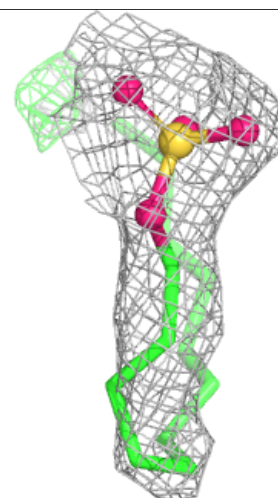
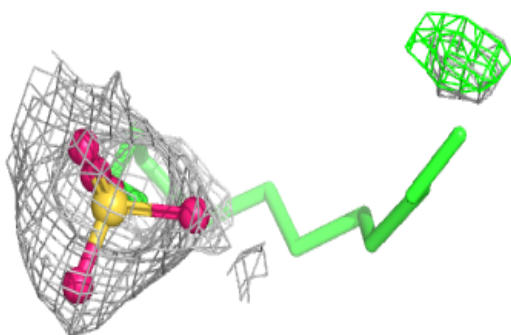
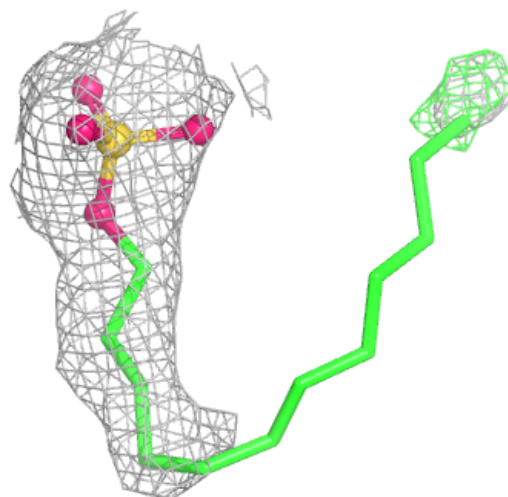
In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	SDS	BA1	202	17/17	0.68	0.21	69,83,94,115	0
2	SDS	AA1	201	17/17	0.89	0.13	39,50,74,84	0
2	SDS	BA1	201	17/17	0.93	0.12	44,51,70,72	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

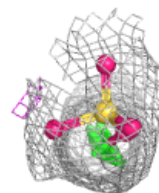
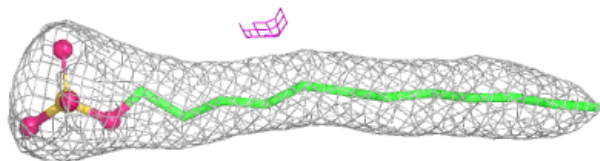
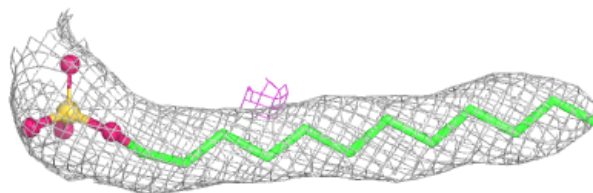
Electron density around SDS BA1 202:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

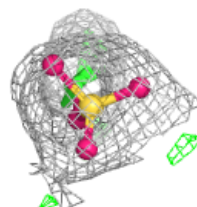
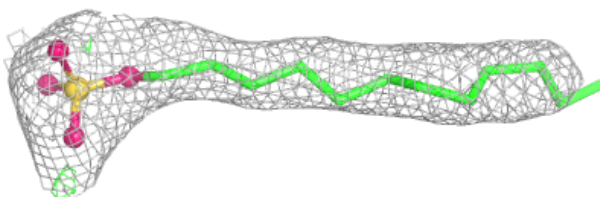
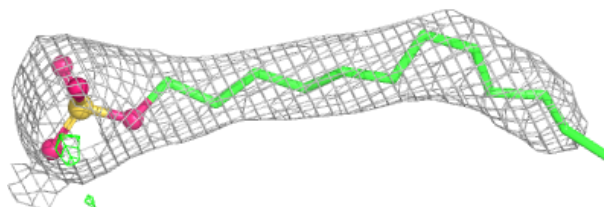


Electron density around SDS AA1 201:

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

**Electron density around SDS BA1 201:**

$2mF_o-DF_c$ (at 0.7 rmsd) in gray
 mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)



6.5 Other polymers [i](#)

There are no such residues in this entry.