



# Full wwPDB X-ray Structure Validation Report ⓘ

Apr 29, 2025 – 09:00 AM EDT

PDB ID : 4LAW / pdb\_00004law  
Title : Crystal Structure Analysis of FKBP52, Crystal Form III  
Authors : Bracher, A.; Kozany, C.; Haehle, A.; Wild, P.; Zacharias, M.; Hausch, F.  
Deposited on : 2013-06-20  
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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0rc1  
Mogul : 2022.3.0, CSD as543be (2022)  
Xtriage (Phenix) : 2.0rc1  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.006 (Gargrove)  
Density-Fitness : 1.0.12  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.43.1

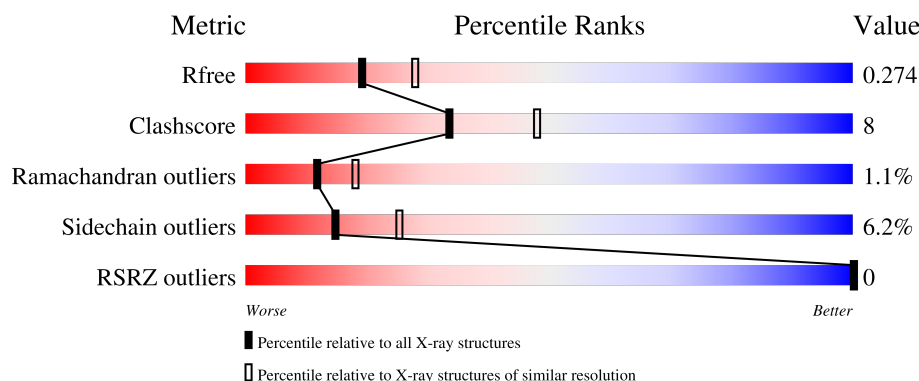
# 1 Overall quality at a glance

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))
$R_{free}$	164625	4642 (2.40-2.40)
Clashscore	180529	5218 (2.40-2.40)
Ramachandran outliers	177936	5158 (2.40-2.40)
Sidechain outliers	177891	5159 (2.40-2.40)
RSRZ outliers	164620	4642 (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  $\geq 3$ , 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	246	 77% 14% • •
1	B	246	 78% 14% • 5%

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 criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
2	DMS	B	301	-	-	X	-

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 3795 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.

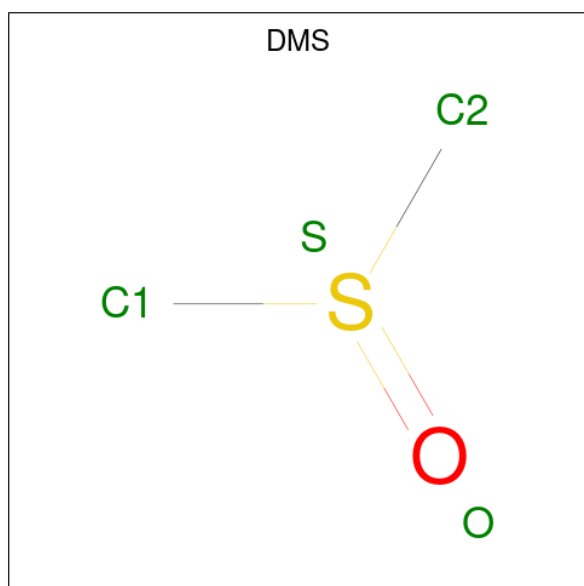
- Molecule 1 is a protein called Peptidyl-prolyl cis-trans isomerase FKBP4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	235	Total	C	N	O	S	0	0	0
			1856	1188	305	357	6			
1	B	234	Total	C	N	O	S	0	0	0
			1829	1173	303	347	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	15	GLY	-	cloning artifact	UNP Q02790
B	15	GLY	-	cloning artifact	UNP Q02790

- Molecule 2 is DIMETHYL SULFOXIDE (CCD ID: DMS) (formula: C<sub>2</sub>H<sub>6</sub>OS).



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

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

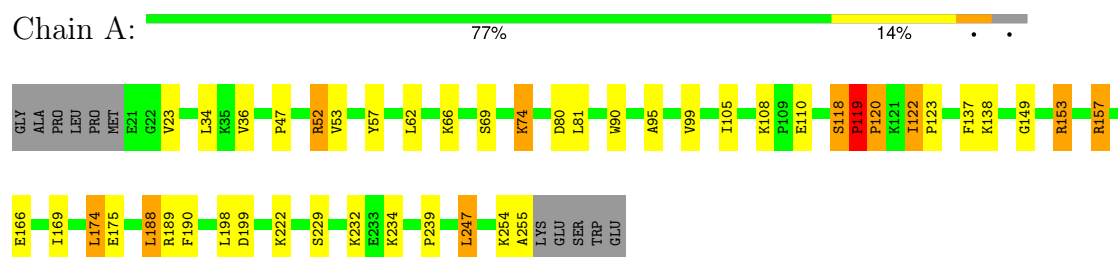
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	39	Total 39	O 39	0	0
3	B	35	Total 35	O 35	0	0

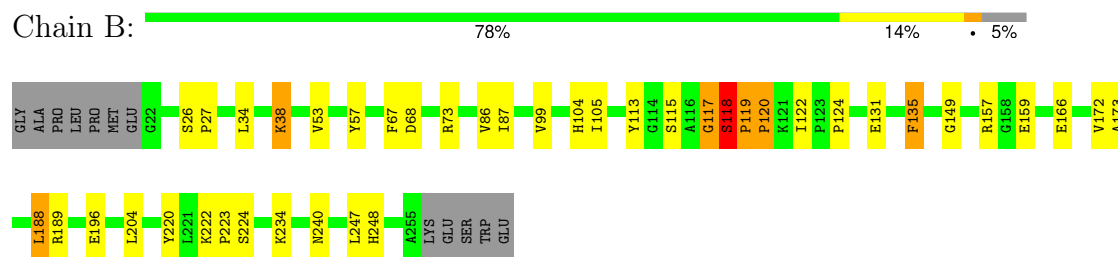
### 3 Residue-property plots

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 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: Peptidyl-prolyl cis-trans isomerase FKBP4



- Molecule 1: Peptidyl-prolyl cis-trans isomerase FKBP4



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	47.66Å 42.70Å 116.88Å 90.00° 92.41° 90.00°	Depositor
Resolution (Å)	20.00 – 2.40 20.00 – 2.40	Depositor EDS
% Data completeness (in resolution range)	95.7 (20.00-2.40) 95.6 (20.00-2.40)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.40 (at 2.41Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.215 , 0.282 0.217 , 0.274	Depositor DCC
$R_{free}$ test set	893 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	34.2	Xtriage
Anisotropy	0.149	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 19.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.44$ , $\langle L^2 \rangle = 0.27$	Xtriage
Estimated twinning fraction	0.099 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	3795	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.09% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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

Bond lengths and bond angles in the following residue types are not validated in this section: DMS

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	0.63	0/1897	0.93	8/2554 (0.3%)
1	B	0.64	0/1870	0.90	3/2520 (0.1%)
All	All	0.64	0/3767	0.92	11/5074 (0.2%)

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	B	0	1

There are no bond length outliers.

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	B	117	GLY	N-CA-C	8.62	118.06	110.21
1	A	118	SER	CA-C-N	6.72	127.31	120.38
1	A	118	SER	C-N-CA	6.72	127.31	120.38
1	A	122	ILE	N-CA-C	6.38	113.87	107.55
1	B	118	SER	N-CA-C	6.20	123.51	109.81
1	A	119	PRO	N-CA-C	6.06	118.09	110.70
1	A	247	LEU	N-CA-C	5.78	118.19	109.23
1	B	135	PHE	N-CA-C	5.32	119.11	111.02
1	A	123	PRO	CA-C-N	5.14	125.08	119.78
1	A	123	PRO	C-N-CA	5.14	125.08	119.78
1	A	174	LEU	N-CA-C	5.14	117.62	109.50

There are no chirality outliers.

All (1) planarity outliers are listed below:



Mol	Chain	Res	Type	Group
1	B	118	SER	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	1856	0	1823	22	0
1	B	1829	0	1789	34	0
2	A	20	0	30	3	0
2	B	16	0	24	10	0
3	A	39	0	0	0	0
3	B	35	0	0	0	0
All	All	3795	0	3666	56	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 8.

All (56) 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:99:VAL:HG13	1:B:135:PHE:O	1.76	0.86
1:B:119:PRO:HB2	1:B:120:PRO:CD	2.06	0.85
1:A:137:PHE:HE1	1:A:153:ARG:NH2	1.77	0.81
1:B:119:PRO:HB2	1:B:120:PRO:HD3	1.62	0.81
1:B:115:SER:O	1:B:124:PRO:HB3	1.86	0.75
1:B:119:PRO:HD2	1:B:122:ILE:HD12	1.69	0.74
1:A:110:GLU:HG3	2:A:301:DMS:O	1.89	0.73
1:B:119:PRO:CB	1:B:120:PRO:HD3	2.19	0.72
1:A:119:PRO:HB2	1:A:120:PRO:HD3	1.70	0.72
1:B:113:TYR:HB3	1:B:117:GLY:HA2	1.70	0.72
1:B:113:TYR:HB3	1:B:117:GLY:CA	2.20	0.70
1:B:68:ASP:OD1	1:B:73:ARG:NH2	2.27	0.67
1:B:220:TYR:CD2	2:B:301:DMS:H23	2.31	0.65
1:B:86:VAL:HG12	2:B:302:DMS:H11	1.80	0.64
1:A:118:SER:HB3	1:A:122:ILE:HB	1.84	0.59
1:B:149:GLY:HA2	1:B:222:LYS:HG3	1.84	0.58
1:A:169:ILE:HG21	1:A:189:ARG:HE	1.70	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:190:PHE:HA	2:B:304:DMS:H12	1.87	0.56
1:B:118:SER:HA	1:B:122:ILE:HB	1.86	0.56
1:B:189:ARG:HH11	1:B:189:ARG:HG2	1.71	0.55
1:B:87:ILE:HG23	2:B:302:DMS:H22	1.88	0.54
1:B:247:LEU:N	1:B:247:LEU:HD23	2.23	0.53
1:A:199:ASP:OD1	1:A:232:LYS:NZ	2.36	0.52
1:A:229:SER:O	1:A:239:PRO:HB3	2.10	0.51
1:B:86:VAL:HA	2:B:302:DMS:H21	1.93	0.51
1:A:34:LEU:O	1:A:105:ILE:HA	2.11	0.51
1:A:137:PHE:CE1	1:A:153:ARG:NH2	2.69	0.51
1:B:173:ALA:HB3	1:B:248:HIS:HB2	1.93	0.51
1:A:74:LYS:HE2	1:A:74:LYS:H	1.75	0.50
1:B:67:PHE:CE2	1:B:122:ILE:HD11	2.47	0.50
1:B:220:TYR:CE2	2:B:301:DMS:H23	2.47	0.50
1:A:188:LEU:CD2	1:A:188:LEU:N	2.76	0.49
1:B:166:GLU:HG3	2:B:303:DMS:O	2.13	0.48
1:A:66:LYS:HE3	1:A:69:SER:HB2	1.96	0.47
1:B:166:GLU:CG	2:B:303:DMS:O	2.62	0.47
1:B:223:PRO:HB3	1:B:240:ASN:HA	1.97	0.47
1:A:157:ARG:HD3	2:A:302:DMS:H23	1.96	0.46
1:A:254:LYS:O	1:A:255:ALA:C	2.58	0.46
1:B:220:TYR:HB3	2:B:301:DMS:H12	1.97	0.46
1:A:174:LEU:HD23	1:A:188:LEU:HD21	1.99	0.45
1:A:47:PRO:HB2	1:A:81:LEU:HD22	1.98	0.45
1:B:34:LEU:O	1:B:105:ILE:HA	2.18	0.44
1:B:204:LEU:HD11	1:B:247:LEU:HD13	1.98	0.44
1:A:149:GLY:HA2	1:A:222:LYS:HG3	2.00	0.44
1:B:220:TYR:CB	2:B:301:DMS:H12	2.48	0.43
1:B:38:LYS:HD3	1:B:104:HIS:ND1	2.34	0.43
1:B:172:VAL:HG23	1:B:188:LEU:HD23	2.00	0.43
1:A:166:GLU:OE2	2:A:303:DMS:H22	2.19	0.42
1:B:172:VAL:HG23	1:B:188:LEU:CD2	2.49	0.42
1:B:26:SER:HA	1:B:27:PRO:HD3	1.86	0.42
1:A:52:ARG:NH1	1:A:80:ASP:OD2	2.45	0.42
1:B:57:TYR:HA	1:B:131:GLU:O	2.21	0.41
1:A:57:TYR:CD2	1:A:90:TRP:HH2	2.38	0.41
1:B:118:SER:HB2	1:B:122:ILE:O	2.20	0.41
1:A:81:LEU:HD21	1:A:95:ALA:HB2	2.03	0.40
1:B:172:VAL:CG2	1:B:188:LEU:HD23	2.52	0.40

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	A	233/246 (95%)	227 (97%)	4 (2%)	2 (1%)	14	22
1	B	232/246 (94%)	223 (96%)	6 (3%)	3 (1%)	10	15
All	All	465/492 (94%)	450 (97%)	10 (2%)	5 (1%)	12	18

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	119	PRO
1	B	119	PRO
1	A	120	PRO
1	B	120	PRO
1	B	118	SER

### 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	195/206 (95%)	179 (92%)	16 (8%)	9	15
1	B	189/206 (92%)	181 (96%)	8 (4%)	25	43
All	All	384/412 (93%)	360 (94%)	24 (6%)	15	25

All (24) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	23	VAL

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Mol	Chain	Res	Type
1	A	36	VAL
1	A	52	ARG
1	A	53	VAL
1	A	62	LEU
1	A	74	LYS
1	A	99	VAL
1	A	108	LYS
1	A	138	LYS
1	A	153	ARG
1	A	157	ARG
1	A	175	GLU
1	A	188	LEU
1	A	198	LEU
1	A	234	LYS
1	A	247	LEU
1	B	38	LYS
1	B	53	VAL
1	B	157	ARG
1	B	159	GLU
1	B	188	LEU
1	B	196	GLU
1	B	224	SER
1	B	234	LYS

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

Mol	Chain	Res	Type
1	A	125	ASN
1	A	185	GLN
1	A	197	ASN
1	A	209	GLN
1	A	240	ASN
1	B	185	GLN
1	B	248	HIS

### 5.3.3 RNA ⓘ

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](#)

9 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	DMS	B	304	-	3,3,3	2.78	1 (33%)	3,3,3	0.63	0
2	DMS	B	303	-	3,3,3	2.65	1 (33%)	3,3,3	0.59	0
2	DMS	A	304	-	3,3,3	2.72	1 (33%)	3,3,3	0.45	0
2	DMS	A	303	-	3,3,3	2.69	1 (33%)	3,3,3	0.92	0
2	DMS	B	301	-	3,3,3	2.83	1 (33%)	3,3,3	0.76	0
2	DMS	A	302	-	3,3,3	2.72	1 (33%)	3,3,3	0.45	0
2	DMS	A	301	-	3,3,3	2.77	1 (33%)	3,3,3	0.54	0
2	DMS	A	305	-	3,3,3	2.76	1 (33%)	3,3,3	0.70	0
2	DMS	B	302	-	3,3,3	2.64	1 (33%)	3,3,3	0.39	0

All (9) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	301	DMS	O-S	4.76	1.81	1.50
2	B	304	DMS	O-S	4.66	1.80	1.50
2	A	301	DMS	O-S	4.63	1.80	1.50
2	A	305	DMS	O-S	4.61	1.80	1.50
2	A	302	DMS	O-S	4.57	1.80	1.50
2	A	304	DMS	O-S	4.57	1.80	1.50
2	A	303	DMS	O-S	4.47	1.79	1.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	303	DMS	O-S	4.47	1.79	1.50
2	B	302	DMS	O-S	4.44	1.79	1.50

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

7 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	304	DMS	1	0
2	B	303	DMS	2	0
2	A	303	DMS	1	0
2	B	301	DMS	4	0
2	A	302	DMS	1	0
2	A	301	DMS	1	0
2	B	302	DMS	3	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](#)

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	235/246 (95%)	-1.85	0 100 100	11, 31, 56, 104	0
1	B	234/246 (95%)	-1.87	0 100 100	16, 30, 51, 64	0
All	All	469/492 (95%)	-1.86	0 100 100	11, 31, 53, 104	0

There are no RSRZ outliers to report.

### 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 monosaccharides 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, 95<sup>th</sup> 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(Å <sup>2</sup> )	Q<0.9
2	DMS	A	301	4/4	0.98	0.07	50,50,50,50	0
2	DMS	A	302	4/4	0.99	0.04	51,51,51,52	0
2	DMS	A	303	4/4	0.99	0.03	32,33,33,35	0
2	DMS	B	304	4/4	0.99	0.04	63,63,63,64	0
2	DMS	A	305	4/4	1.00	0.03	55,55,55,55	0
2	DMS	B	301	4/4	1.00	0.02	34,34,34,35	0
2	DMS	B	302	4/4	1.00	0.02	39,39,39,39	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
2	DMS	B	303	4/4	1.00	0.03	42,42,42,42	0
2	DMS	A	304	4/4	1.00	0.02	42,43,43,43	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.