



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 03:31 PM GMT

PDB ID : 4CI1  
Title : Structure of the DDB1-CRBN E3 ubiquitin ligase bound to thalidomide  
Authors : Fischer, E.S.; Boehm, K.; Thoma, N.H.  
Deposited on : 2013-12-05  
Resolution : 2.98 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

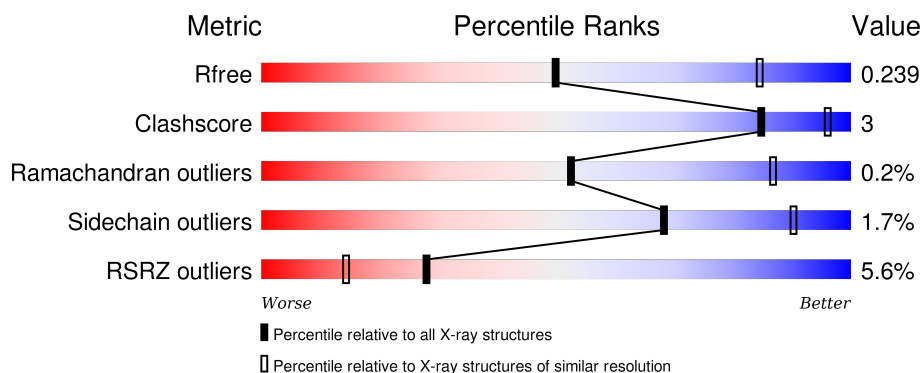
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.98 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))
$R_{free}$	91344	1992 (3.00-2.96)
Clashscore	102246	2349 (3.00-2.96)
Ramachandran outliers	100387	2274 (3.00-2.96)
Sidechain outliers	100360	2277 (3.00-2.96)
RSRZ outliers	91569	2007 (3.00-2.96)

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  $\geq 3$ , 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.

Mol	Chain	Length	Quality of chain
1	A	1158	<div> <div>6%</div> <div> <div></div> <div>86%</div> <div>8%</div> <div>6%</div> </div> </div>
2	B	469	<div> <div>3%</div> <div> <div></div> <div>69%</div> <div>9%</div> <div>21%</div> </div> </div>

## 2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 11460 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 DNA DAMAGE-BINDING PROTEIN 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	1091	Total	As	C	N	O	S	0	0	0
			8420	2	5352	1412	1609	45			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-17	MET	-	EXPRESSION TAG	UNP Q16531
A	-16	HIS	-	EXPRESSION TAG	UNP Q16531
A	-15	HIS	-	EXPRESSION TAG	UNP Q16531
A	-14	HIS	-	EXPRESSION TAG	UNP Q16531
A	-13	HIS	-	EXPRESSION TAG	UNP Q16531
A	-12	HIS	-	EXPRESSION TAG	UNP Q16531
A	-11	HIS	-	EXPRESSION TAG	UNP Q16531
A	-10	ARG	-	EXPRESSION TAG	UNP Q16531
A	-9	ARG	-	EXPRESSION TAG	UNP Q16531
A	-8	LEU	-	EXPRESSION TAG	UNP Q16531
A	-7	VAL	-	EXPRESSION TAG	UNP Q16531
A	-6	PRO	-	EXPRESSION TAG	UNP Q16531
A	-5	ARG	-	EXPRESSION TAG	UNP Q16531
A	-4	GLY	-	EXPRESSION TAG	UNP Q16531
A	-3	SER	-	EXPRESSION TAG	UNP Q16531
A	-2	GLY	-	EXPRESSION TAG	UNP Q16531
A	-1	GLY	-	EXPRESSION TAG	UNP Q16531
A	0	ARG	-	EXPRESSION TAG	UNP Q16531

- Molecule 2 is a protein called PROTEIN CEREBLON.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	370	Total	As	C	N	O	S	0	0	0
			2985	2	1895	522	544	22			

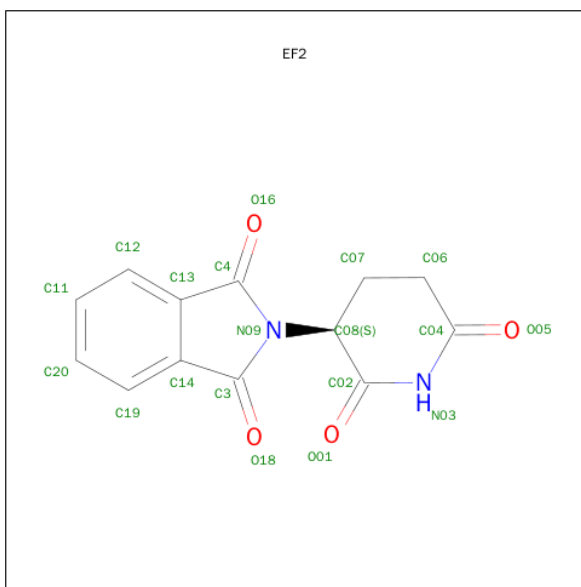
There are 24 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-23	MET	-	EXPRESSION TAG	UNP P0CF65
B	-22	ASP	-	EXPRESSION TAG	UNP P0CF65
B	-21	TRP	-	EXPRESSION TAG	UNP P0CF65
B	-20	SER	-	EXPRESSION TAG	UNP P0CF65
B	-19	HIS	-	EXPRESSION TAG	UNP P0CF65
B	-18	PRO	-	EXPRESSION TAG	UNP P0CF65
B	-17	GLN	-	EXPRESSION TAG	UNP P0CF65
B	-16	PHE	-	EXPRESSION TAG	UNP P0CF65
B	-15	GLU	-	EXPRESSION TAG	UNP P0CF65
B	-14	LYS	-	EXPRESSION TAG	UNP P0CF65
B	-13	SER	-	EXPRESSION TAG	UNP P0CF65
B	-12	ALA	-	EXPRESSION TAG	UNP P0CF65
B	-11	VAL	-	EXPRESSION TAG	UNP P0CF65
B	-10	ASP	-	EXPRESSION TAG	UNP P0CF65
B	-9	GLU	-	EXPRESSION TAG	UNP P0CF65
B	-8	ASN	-	EXPRESSION TAG	UNP P0CF65
B	-7	LEU	-	EXPRESSION TAG	UNP P0CF65
B	-6	TYR	-	EXPRESSION TAG	UNP P0CF65
B	-5	PHE	-	EXPRESSION TAG	UNP P0CF65
B	-4	GLN	-	EXPRESSION TAG	UNP P0CF65
B	-3	GLY	-	EXPRESSION TAG	UNP P0CF65
B	-2	GLY	-	EXPRESSION TAG	UNP P0CF65
B	-1	GLY	-	EXPRESSION TAG	UNP P0CF65
B	0	ARG	-	EXPRESSION TAG	UNP P0CF65

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	1	Total 1	Zn 1	0	0

- Molecule 4 is S-THALIDOMIDE (three-letter code: EF2) (formula: C<sub>13</sub>H<sub>10</sub>N<sub>2</sub>O<sub>4</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
4	B	1	Total	C	N	O	0	0
			19	13	2	4		

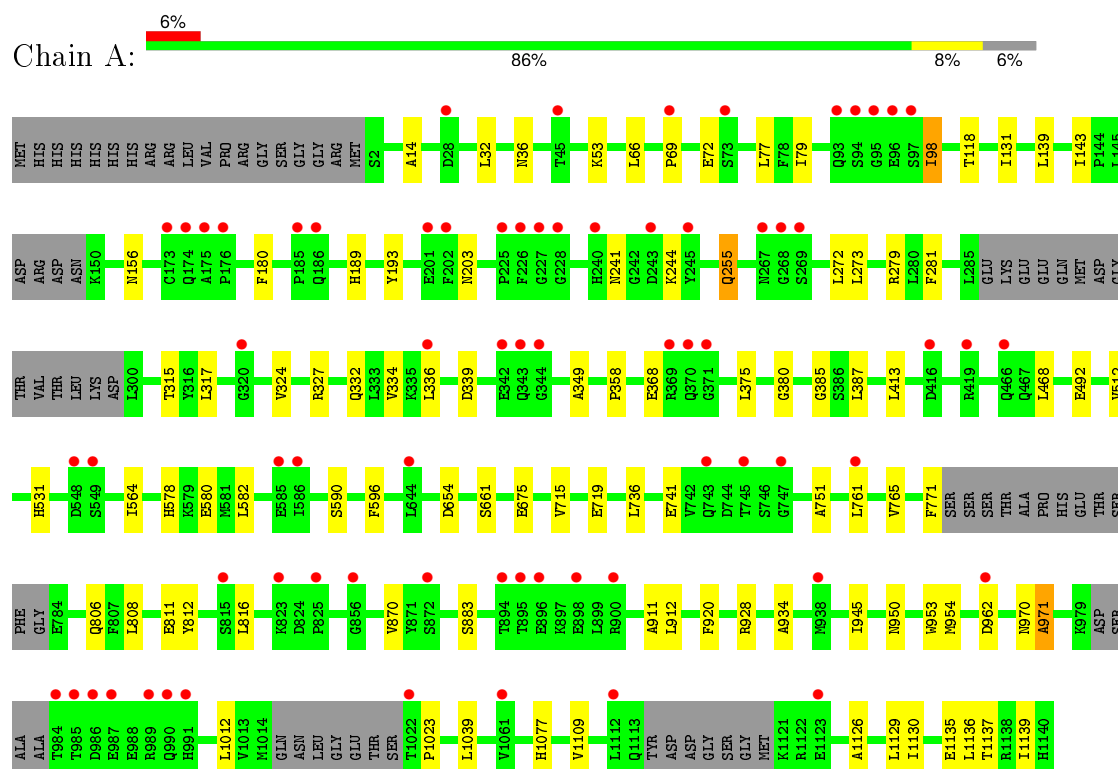
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	22	Total	O	0	0
			22	22		
5	B	13	Total	O	0	0
			13	13		

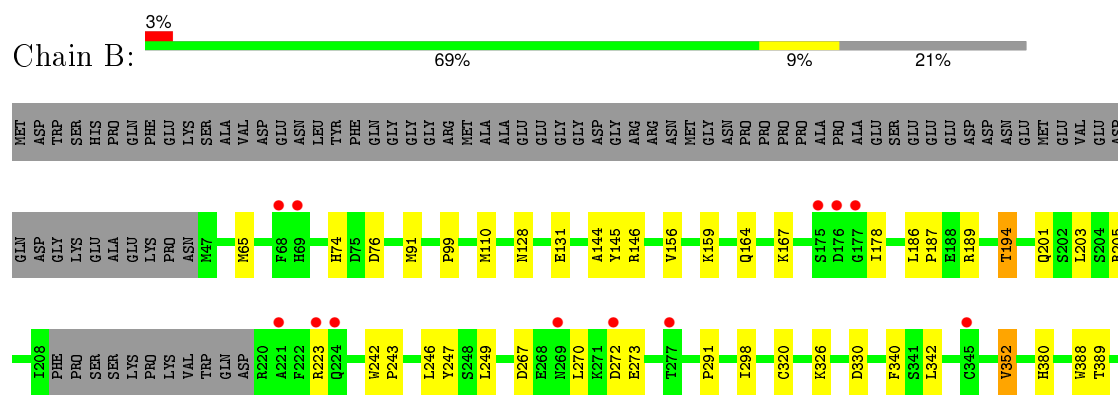
### 3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: DNA DAMAGE-BINDING PROTEIN 1



#### • Molecule 2: PROTEIN CEREBLON



P404	
I425	
P426	
R427	
ILE	
PRO	
GLU	
ALA	
GLU	
ASP	
GLU	
LEU	
GLY	
HIS	
ASP	
ARG	
SER	
PRO	
LEU	
CYS	
LEU	

## 4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	172.18Å 172.18Å 140.09Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	29.82 – 2.98 29.82 – 2.98	Depositor EDS
% Data completeness (in resolution range)	100.0 (29.82-2.98) 100.0 (29.82-2.98)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.43 (at 3.00Å)	Xtriage
Refinement program	BUSTER 2.11.4	Depositor
R, $R_{free}$	0.197 , 0.233 0.205 , 0.239	Depositor DCC
$R_{free}$ test set	2461 reflections (5.27%)	DCC
Wilson B-factor (Å <sup>2</sup> )	78.9	Xtriage
Anisotropy	0.085	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 69.4	EDS
Estimated twinning fraction	0.020 for -h,-k,l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	1 of 49202 reflections (0.002%)	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	11460	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	87.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.62% 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, 0.375 respectively for untwinned datasets, and 0.333, 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: ZN, EF2, CAF

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	0.41	0/8553	0.67	0/11605
2	B	0.42	0/3037	0.67	0/4119
All	All	0.41	0/11590	0.67	0/15724

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 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	8420	0	8287	44	0
2	B	2985	0	2916	25	0
3	B	1	0	0	0	0
4	B	19	0	10	1	0
5	A	22	0	0	0	0
5	B	13	0	0	1	0
All	All	11460	0	11213	66	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 3.

The worst 5 of 66 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:255:GLN:HB2	1:A:279:ARG:HH22	1.57	0.69
1:A:596:PHE:HB3	1:A:661:SER:HB2	1.79	0.63
2:B:110:MET:HG3	2:B:178:ILE:HG21	1.80	0.63
1:A:953:TRP:HB2	1:A:970:ASN:HB2	1.80	0.62
1:A:358:PRO:HD2	1:A:380:GLY:HA2	1.85	0.58

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	1075/1158 (93%)	1011 (94%)	61 (6%)	3 (0%)	46	82
2	B	364/469 (78%)	348 (96%)	16 (4%)	0	100	100
All	All	1439/1627 (88%)	1359 (94%)	77 (5%)	3 (0%)	52	87

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	36	ASN
1	A	368	GLU
1	A	971	ALA

### 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	921/1012 (91%)	907 (98%)	14 (2%)	72	91
2	B	324/414 (78%)	317 (98%)	7 (2%)	60	87
All	All	1245/1426 (87%)	1224 (98%)	21 (2%)	68	90

5 of 21 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	761	LEU
1	A	920	PHE
2	B	273	GLU
1	A	590	SER
2	B	330	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	201	GLN
2	B	299	GLN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

4 non-standard protein/DNA/RNA residues 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	$\# Z  > 2$
1	CAF	A	87	1	3,9,10	0.61	0	1,12,14	1.94	0
1	CAF	A	977	1	3,9,10	0.59	0	1,12,14	2.18	1 (100%)
2	CAF	B	312	2	3,9,10	0.52	0	1,12,14	2.48	1 (100%)
2	CAF	B	320	2	3,9,10	0.67	0	1,12,14	1.85	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
1	CAF	A	87	1	-	0/0/8/10	0/0/0/0
1	CAF	A	977	1	-	0/0/8/10	0/0/0/0
2	CAF	B	312	2	-	0/0/8/10	0/0/0/0
2	CAF	B	320	2	-	0/0/8/10	0/0/0/0

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	312	CAF	O-C-CA	-2.48	119.04	125.49
1	A	977	CAF	O-C-CA	-2.18	119.81	125.49

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
2	B	320	CAF	1	0

## 5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 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	EF2	B	1429	-	21,21,21	1.18	2 (9%)	29,31,31	2.09	10 (34%)

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	EF2	B	1429	-	-	0/4/33/33	0/3/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	B	1429	EF2	C3-N09	-2.62	1.36	1.40
4	B	1429	EF2	C13-C4	2.12	1.52	1.48

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	B	1429	EF2	C13-C14-C3	-3.48	105.31	108.27
4	B	1429	EF2	O16-C4-C13	-2.92	122.87	128.68
4	B	1429	EF2	O18-C3-C14	-2.87	122.96	128.68
4	B	1429	EF2	C14-C13-C4	-2.52	106.13	108.27
4	B	1429	EF2	C07-C06-C04	-2.51	109.54	114.24

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
4	B	1429	EF2	1	0

## 5.7 Other polymers ⓘ

There are no such residues in this entry.

## 5.8 Polymer linkage issues ⓘ

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	1089/1158 (94%)	0.27	70 (6%)	23 11	48, 91, 131, 156	0
2	B	368/469 (78%)	0.06	12 (3%)	50 29	40, 65, 111, 140	0
All	All	1457/1627 (89%)	0.22	82 (5%)	28 14	40, 86, 128, 156	0

The worst 5 of 82 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	370	GLN	4.9
1	A	268	GLY	4.4
1	A	225	PRO	4.3
1	A	872	SER	4.2
1	A	990	GLN	3.9

### 6.2 Non-standard residues in protein, DNA, RNA chains [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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	CAF	B	312	10/11	0.98	0.14	-	55,62,67,68	4
2	CAF	B	320	10/11	0.97	0.20	-	65,66,69,69	4
1	CAF	A	87	10/11	0.96	0.18	-	81,84,86,87	4
1	CAF	A	977	10/11	0.97	0.17	-	74,82,86,88	4

### 6.3 Carbohydrates [i](#)

There are no carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors( $\text{\AA}^2$ )	Q<0.9
4	EF2	B	1429	19/19	0.97	0.17	-0.20	45,52,60,63	0
3	ZN	B	1428	1/1	1.00	0.14	-0.66	52,52,52,52	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.