



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 01:04 PM UTC

PDB ID : 5O76 / pdb\_00005o76  
Title : Structure of phosphoY371 c-CBL in complex with ZAP70-peptide and UbV.pCBL ubiquitin variant  
Authors : Gabrielsen, M.; Buetow, L.; Huang, D.T.  
Deposited on : 2017-06-08  
Resolution : 2.47 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

<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 Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
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

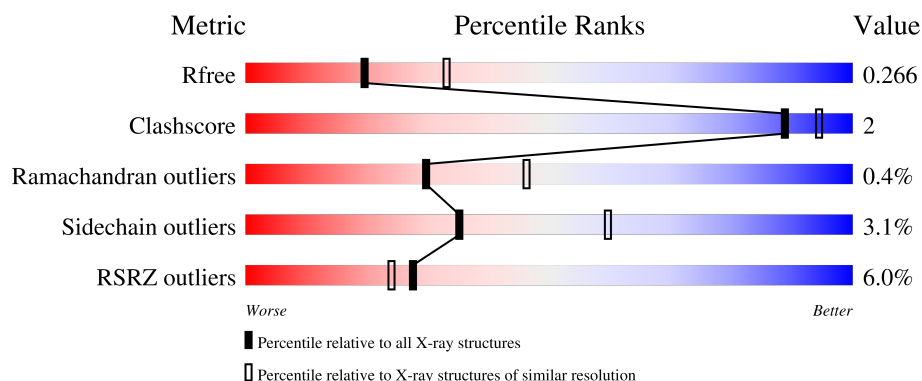
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.47 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	7589 (2.50-2.46)
Clashscore	190562	8295 (2.50-2.46)
Ramachandran outliers	187476	8164 (2.50-2.46)
Sidechain outliers	187428	8166 (2.50-2.46)
RSRZ outliers	180081	7593 (2.50-2.46)

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	391	<div> <div>3%</div> <div>90%</div> <div>7%</div> <div>..</div> </div>
1	C	391	<div> <div>8%</div> <div>88%</div> <div>10%</div> <div>.</div> </div>
2	B	12	<div> <div>8%</div> <div>50%</div> <div>8%</div> <div>42%</div> </div>
2	D	12	<div> <div>8%</div> <div>67%</div> <div>8%</div> <div>25%</div> </div>
3	E	82	<div> <div>5%</div> <div>83%</div> <div>6%</div> <div>11%</div> </div>

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Mol	Chain	Length	Quality of chain
3	F	82	 A horizontal bar chart showing the quality of chain F. The bar is divided into four segments: a small red segment at the beginning labeled '5%', a large green segment labeled '83%', a small yellow segment labeled '7%', and a small grey segment at the end labeled '10%'. The segments are separated by thin white lines.

## 2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 9505 atoms, of which 1626 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 E3 ubiquitin-protein ligase CBL.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
1	A	385	Total	C	H	N	O	P	S	42	3	0
			3806	2028	645	531	576	1	25			
1	C	387	Total	C	H	N	O	P	S	75	1	0
			3797	2024	645	528	574	1	25			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	45	GLY	-	expression tag	UNP P22681
A	46	SER	-	expression tag	UNP P22681
A	368	PHE	TYR	engineered mutation	UNP P22681
C	45	GLY	-	expression tag	UNP P22681
C	46	SER	-	expression tag	UNP P22681
C	368	PHE	TYR	engineered mutation	UNP P22681

- Molecule 2 is a protein called Tyrosine protein kinase ZAP70 peptide.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
2	B	7	Total	C	H	N	O	P		0	0	0
			58	33	3	7	14	1				
2	D	9	Total	C	H	N	O	P		0	0	0
			72	40	3	9	19	1				

- Molecule 3 is a protein called UbV.pCBL ubiquitin variant.

Mol	Chain	Residues	Atoms							ZeroOcc	AltConf	Trace
3	E	73	Total	C	H	N	O	S		4	1	0
			759	379	165	103	111	1				
3	F	74	Total	C	H	N	O	S		4	2	0
			772	387	165	106	113	1				

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total 2	Zn 2	0	0
4	C	2	Total 2	Zn 2	0	0

- Molecule 5 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total 1	Ca 1	0	0
5	C	1	Total 1	Ca 1	0	0

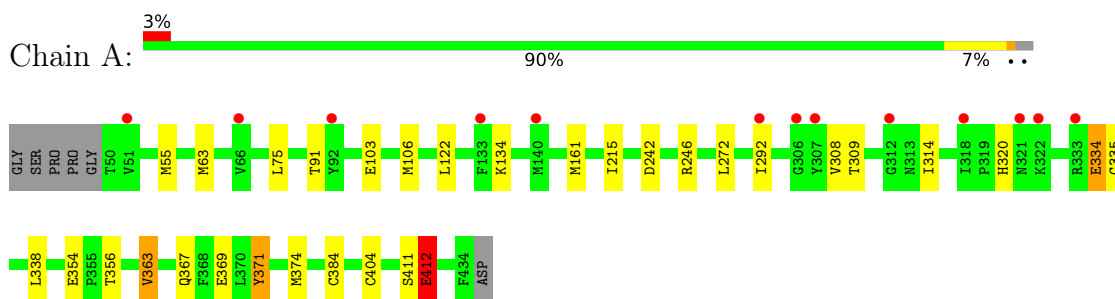
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	127	Total 127	O 127	0	0
6	B	2	Total 2	O 2	0	0
6	C	76	Total 76	O 76	0	0
6	E	17	Total 17	O 17	0	0
6	F	13	Total 13	O 13	0	0

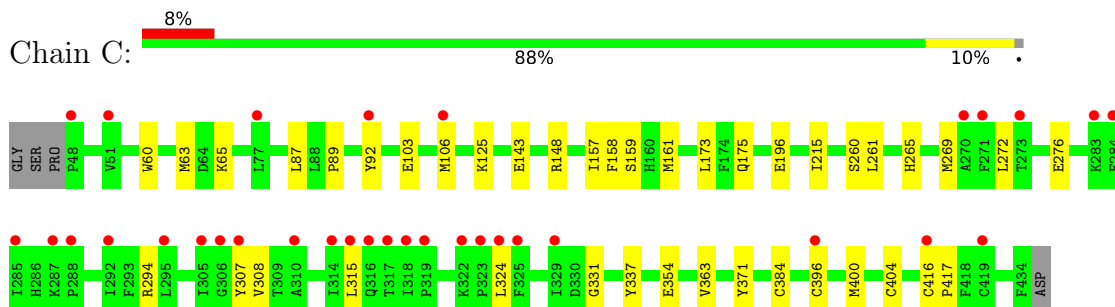
### 3 Residue-property plots [i](#)

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.

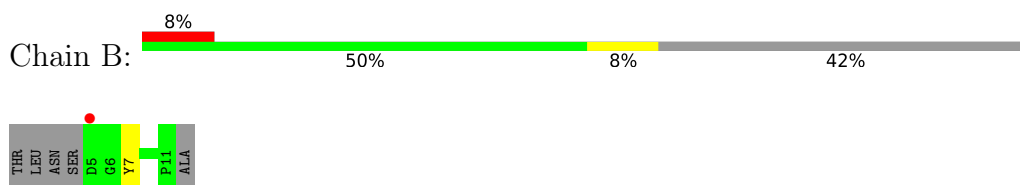
- Molecule 1: E3 ubiquitin-protein ligase CBL



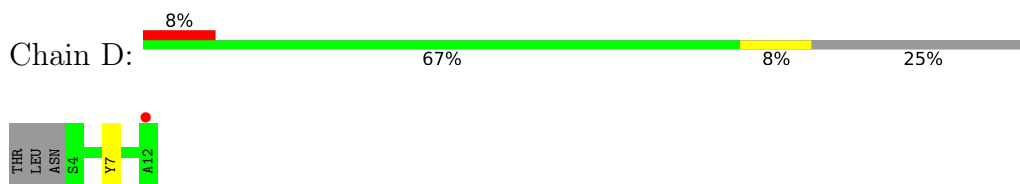
- Molecule 1: E3 ubiquitin-protein ligase CBL



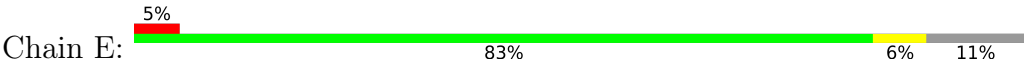
- Molecule 2: Tyrosine protein kinase ZAP70 peptide



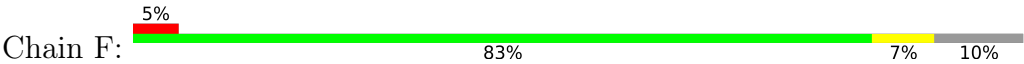
- Molecule 2: Tyrosine protein kinase ZAP70 peptide



- Molecule 3: UbV.pCBL ubiquitin variant



● Molecule 3: UbV.pCBL ubiquitin variant



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	94.79Å 101.28Å 117.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	35.34 – 2.47 35.34 – 2.47	Depositor EDS
% Data completeness (in resolution range)	92.6 (35.34-2.47) 92.9 (35.34-2.47)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.38 (at 2.48Å)	Xtriage
Refinement program	BUSTER 2.10.2	Depositor
R, $R_{free}$	0.218 , 0.248 0.233 , 0.266	Depositor DCC
$R_{free}$ test set	1870 reflections (4.55%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	48.9	Xtriage
Anisotropy	0.607	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 45.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	9505	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	69.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.90% 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 [i](#)

### 5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: PTR, CA, ZN

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	0.69	0/3224	1.27	3/4353 (0.1%)
1	C	0.69	0/3216	1.27	5/4343 (0.1%)
2	B	0.69	0/39	0.89	0/52
2	D	0.80	0/53	1.12	0/71
3	E	0.73	0/602	1.17	2/809 (0.2%)
3	F	0.70	0/616	1.17	2/828 (0.2%)
All	All	0.70	0/7750	1.25	12/10456 (0.1%)

There are no bond length outliers.

The worst 5 of 12 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	215	ILE	CA-C-N	5.63	129.26	120.82
1	C	215	ILE	C-N-CA	5.63	129.26	120.82
1	C	307	TYR	CA-C-N	5.54	128.05	120.46
1	C	307	TYR	C-N-CA	5.54	128.05	120.46
1	C	308	VAL	N-CA-C	5.49	116.22	110.62

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	3161	645	3118	11	0
1	C	3152	645	3115	14	0
2	B	55	3	38	0	0
2	D	69	3	50	0	0
3	E	594	165	620	1	0
3	F	607	165	634	2	0
4	A	2	0	0	0	0
4	C	2	0	0	0	0
5	A	1	0	0	0	0
5	C	1	0	0	0	0
6	A	127	0	0	0	0
6	B	2	0	0	0	0
6	C	76	0	0	0	0
6	E	17	0	0	0	0
6	F	13	0	0	0	0
All	All	7879	1626	7575	28	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 2.

The worst 5 of 28 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:157:ILE:HG22	1:C:161:MET:HE2	1.76	0.67
1:A:63:MET:HE1	1:A:91:THR:HB	1.89	0.55
1:C:89:PRO:HA	1:C:92[A]:TYR:HD2	1.72	0.54
1:C:89:PRO:HA	1:C:92[A]:TYR:CD2	2.45	0.52
1:C:400:MET:HE1	1:C:417:PRO:HG2	1.93	0.51

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	385/391 (98%)	367 (95%)	15 (4%)	3 (1%)	16	28
1	C	385/391 (98%)	366 (95%)	18 (5%)	1 (0%)	36	53
2	B	4/12 (33%)	3 (75%)	1 (25%)	0	100	100
2	D	6/12 (50%)	6 (100%)	0	0	100	100
3	E	71/82 (87%)	70 (99%)	1 (1%)	0	100	100
3	F	74/82 (90%)	69 (93%)	5 (7%)	0	100	100
All	All	925/970 (95%)	881 (95%)	40 (4%)	4 (0%)	30	46

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	412	GLU
1	A	320	HIS
1	C	354	GLU
1	A	314	ILE

### 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	349/350 (100%)	338 (97%)	11 (3%)	34	58
1	C	348/350 (99%)	336 (97%)	12 (3%)	32	57
2	B	4/9 (44%)	4 (100%)	0	100	100
2	D	6/9 (67%)	6 (100%)	0	100	100
3	E	67/72 (93%)	65 (97%)	2 (3%)	36	61
3	F	68/72 (94%)	67 (98%)	1 (2%)	57	78
All	All	842/862 (98%)	816 (97%)	26 (3%)	35	60

5 of 26 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	173	LEU

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Mol	Chain	Res	Type
1	C	272	LEU
3	E	6	LYS
1	C	196	GLU
1	C	276	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
3	E	2	HIS
1	C	367	GLN
1	C	326	GLN
1	A	360	HIS
1	C	346	ASN

### 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
2	PTR	B	7	2	15,16,17	1.74	5 (33%)	17,22,24	0.90	0
1	PTR	A	371	1	15,16,17	1.37	2 (13%)	17,22,24	1.24	2 (11%)
2	PTR	D	7	2	15,16,17	1.55	3 (20%)	17,22,24	1.15	1 (5%)
1	PTR	C	371	1	15,16,17	1.42	3 (20%)	17,22,24	1.64	3 (17%)

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	PTR	B	7	2	-	3/10/11/13	0/1/1/1
1	PTR	A	371	1	-	1/10/11/13	0/1/1/1
2	PTR	D	7	2	-	0/10/11/13	0/1/1/1
1	PTR	C	371	1	-	1/10/11/13	0/1/1/1

The worst 5 of 13 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	7	PTR	P-OH	-3.19	1.53	1.59
1	A	371	PTR	P-OH	-3.08	1.53	1.59
2	D	7	PTR	CE1-CZ	2.92	1.44	1.38
2	B	7	PTR	CE1-CZ	2.70	1.43	1.38
1	C	371	PTR	P-OH	-2.60	1.54	1.59

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	371	PTR	O3P-P-OH	4.65	119.05	105.32
1	A	371	PTR	OH-CZ-CE1	3.08	128.44	119.22
2	D	7	PTR	OH-CZ-CE1	2.65	127.17	119.22
1	C	371	PTR	OH-CZ-CE1	2.38	126.36	119.22
1	C	371	PTR	OH-P-O1P	-2.30	101.79	109.48

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	371	PTR	C-CA-CB-CG
1	C	371	PTR	C-CA-CB-CG
2	B	7	PTR	O-C-CA-CB
2	B	7	PTR	C-CA-CB-CG
2	B	7	PTR	N-CA-CB-CG

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	371	PTR	1	0

## 5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 6 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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	384/391 (98%)	0.26	13 (3%) 48 44	23, 57, 97, 120	12 (3%)
1	C	386/391 (98%)	0.61	33 (8%) 16 14	27, 69, 114, 136	17 (4%)
2	B	6/12 (50%)	1.56	1 (16%) 4 3	104, 107, 110, 112	0
2	D	8/12 (66%)	1.66	1 (12%) 8 6	116, 119, 127, 141	0
3	E	73/82 (89%)	0.44	4 (5%) 30 27	42, 66, 90, 94	2 (2%)
3	F	74/82 (90%)	0.46	4 (5%) 31 28	36, 69, 93, 107	3 (4%)
All	All	931/970 (95%)	0.46	56 (6%) 27 24	23, 65, 107, 141	34 (3%)

The worst 5 of 56 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	E	72[A]	ARG	6.7
1	A	92[A]	TYR	5.1
1	C	92[A]	TYR	4.3
1	C	48	PRO	3.8
1	C	317	THR	3.8

### 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. 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	PTR	B	7	16/17	0.79	0.14	104,104,107,108	0
2	PTR	D	7	16/17	0.85	0.14	111,112,117,118	0
1	PTR	A	371	16/17	0.95	0.08	54,56,65,66	0
1	PTR	C	371	16/17	0.96	0.12	42,47,59,60	0

### 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, 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
4	ZN	C	502	1/1	0.95	0.11	52,52,52,52	0
5	CA	A	503	1/1	0.95	0.13	68,68,68,68	0
5	CA	C	503	1/1	0.97	0.09	67,67,67,67	0
4	ZN	A	501	1/1	1.00	0.03	51,51,51,51	0
4	ZN	A	502	1/1	1.00	0.02	47,47,47,47	0
4	ZN	C	501	1/1	1.00	0.02	53,53,53,53	0

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

There are no such residues in this entry.