



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 07:04 AM GMT

PDB ID : 2ZBK
Title : Crystal structure of an intact type II DNA topoisomerase: insights into DNA transfer mechanisms
Authors : Graille, M.; Cladiere, L.; Durand, D.; Lecointe, F.; Forterre, P.; van Tilbeurgh, H.; Paris-Sud Yeast Structural Genomics (YSG)
Deposited on : 2007-10-22
Resolution : 3.56 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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

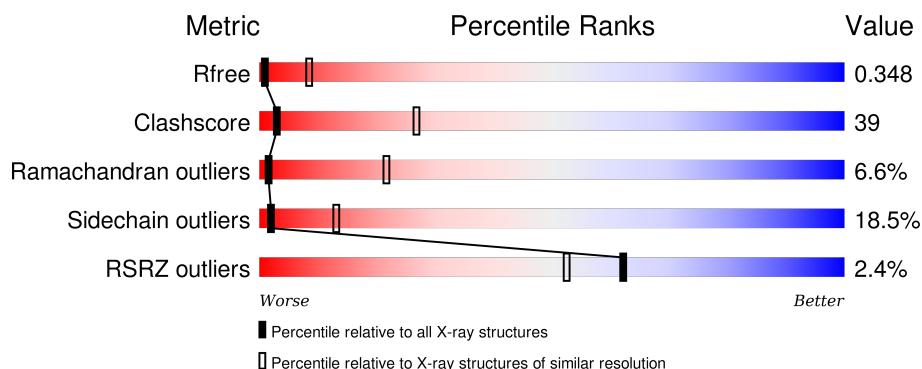
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.56 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	1240 (3.72-3.40)
Clashscore	102246	1057 (3.70-3.42)
Ramachandran outliers	100387	1017 (3.70-3.42)
Sidechain outliers	100360	1017 (3.70-3.42)
RSRZ outliers	91569	1247 (3.72-3.40)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 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	389	<div> <div>24%</div> <div>44%</div> <div>20%</div> <div>•</div> <div>11%</div> </div>
1	C	389	<div> <div>23%</div> <div>44%</div> <div>19%</div> <div>•</div> <div>11%</div> </div>
1	E	389	<div> <div>25%</div> <div>42%</div> <div>19%</div> <div>•</div> <div>11%</div> </div>
1	G	389	<div> <div>25%</div> <div>43%</div> <div>19%</div> <div>•</div> <div>11%</div> </div>
2	B	530	<div> <div>50%</div> <div>36%</div> <div>8%</div> <div>•</div> <div>5%</div> </div>

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Mol	Chain	Length	Quality of chain
2	D	530	
2	F	530	
2	H	530	

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
3	RDC	D	531	-	-	-	X

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 27776 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.

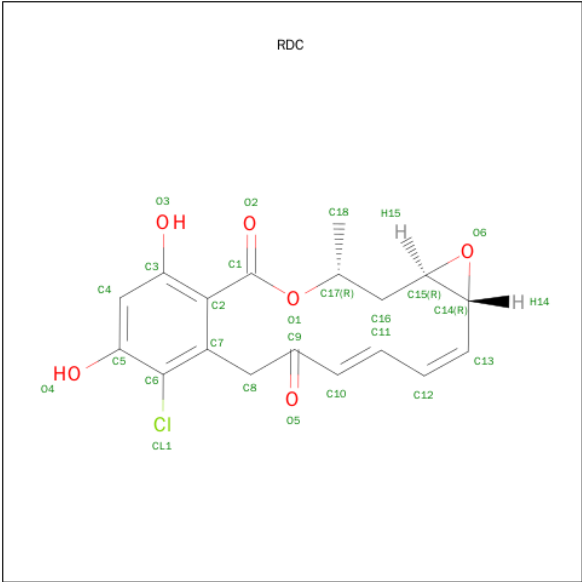
- Molecule 1 is a protein called Type II DNA topoisomerase VI subunit A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	347	Total	C	N	O	S	0	0	0
			2842	1828	483	524	7			
1	C	347	Total	C	N	O	S	0	0	0
			2842	1828	483	524	7			
1	E	347	Total	C	N	O	S	0	0	0
			2842	1828	483	524	7			
1	G	347	Total	C	N	O	S	0	0	0
			2842	1828	483	524	7			

- Molecule 2 is a protein called Type 2 DNA topoisomerase 6 subunit B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	506	Total	C	N	O	S	0	0	0
			4077	2625	683	763	6			
2	D	506	Total	C	N	O	S	0	0	0
			4077	2625	683	763	6			
2	F	506	Total	C	N	O	S	0	0	0
			4077	2625	683	763	6			
2	H	506	Total	C	N	O	S	0	0	0
			4077	2625	683	763	6			

- Molecule 3 is RADICICOL (three-letter code: RDC) (formula: C₁₈H₁₇ClO₆).

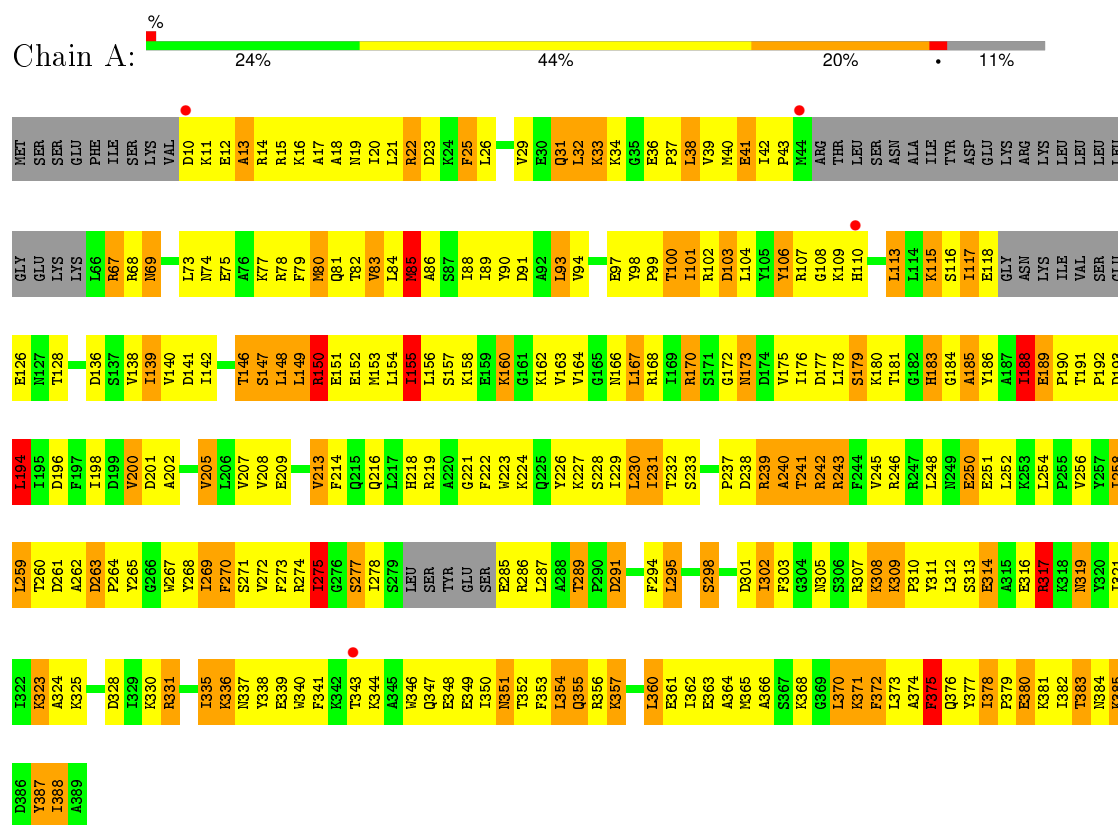


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	B	1	Total	C	Cl	O	0	0
			25	18	1	6		
3	D	1	Total	C	Cl	O	0	0
			25	18	1	6		
3	F	1	Total	C	Cl	O	0	0
			25	18	1	6		
3	H	1	Total	C	Cl	O	0	0
			25	18	1	6		

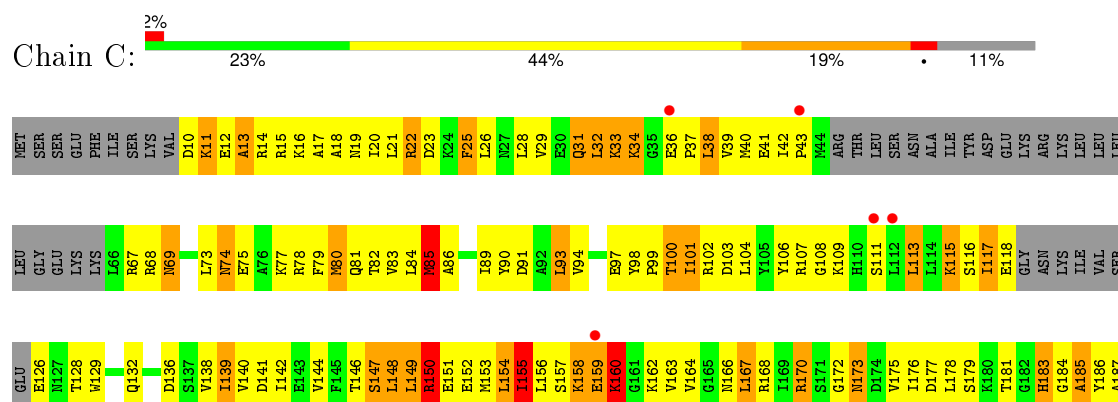
3 Residue-property plots

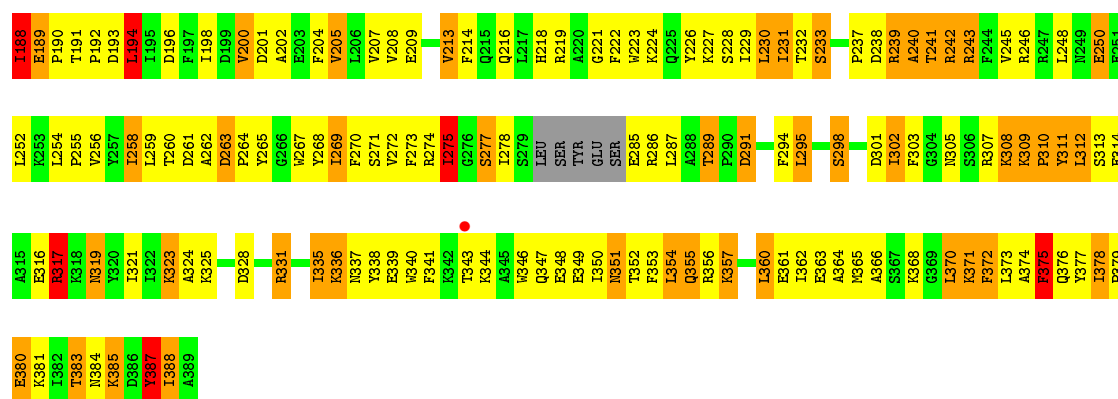
These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according 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.

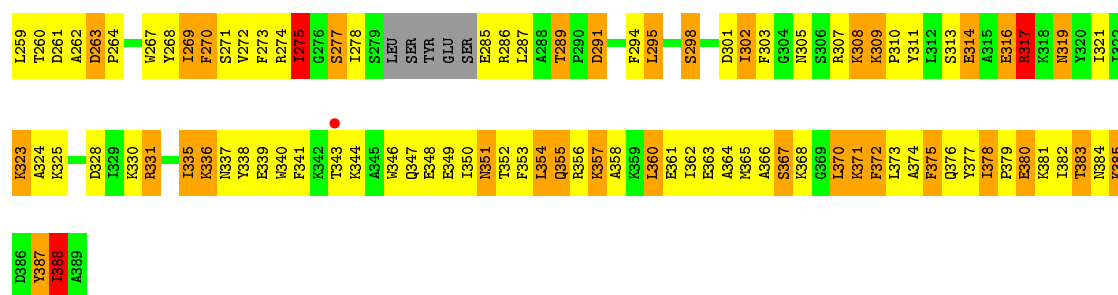
• Molecule 1: Type II DNA topoisomerase VI subunit A



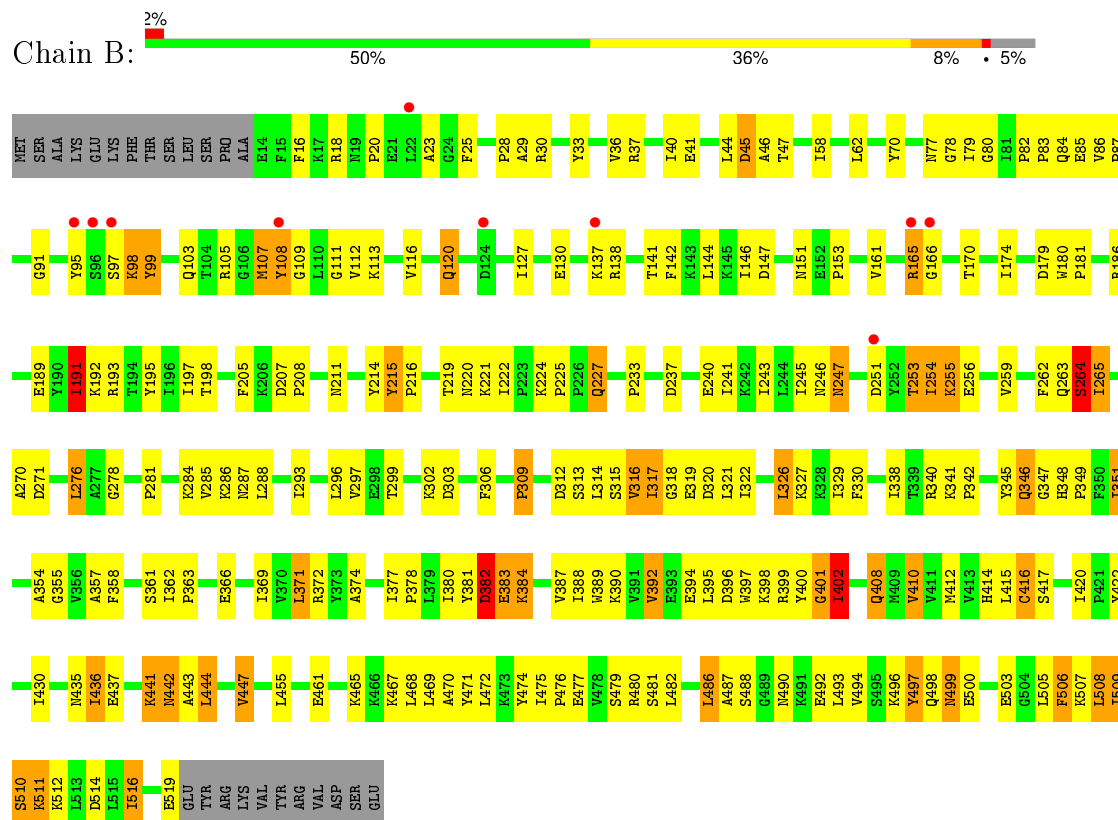
• Molecule 1: Type II DNA topoisomerase VI subunit A



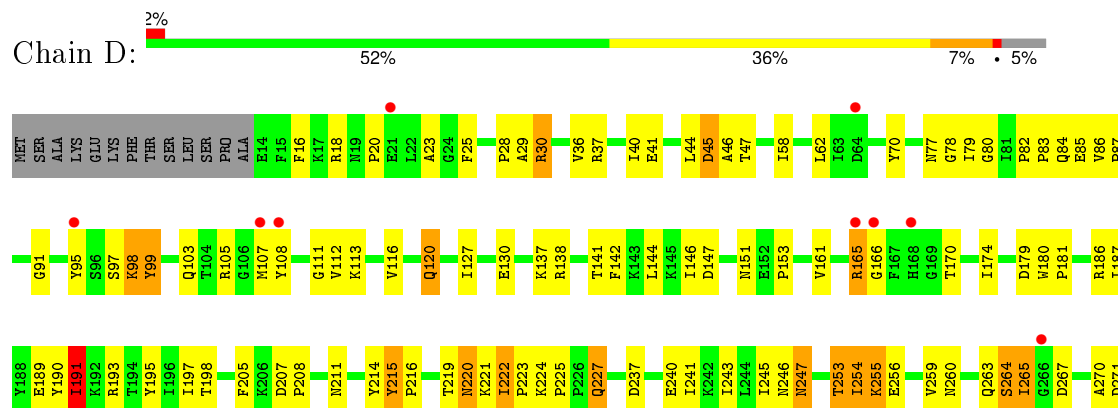


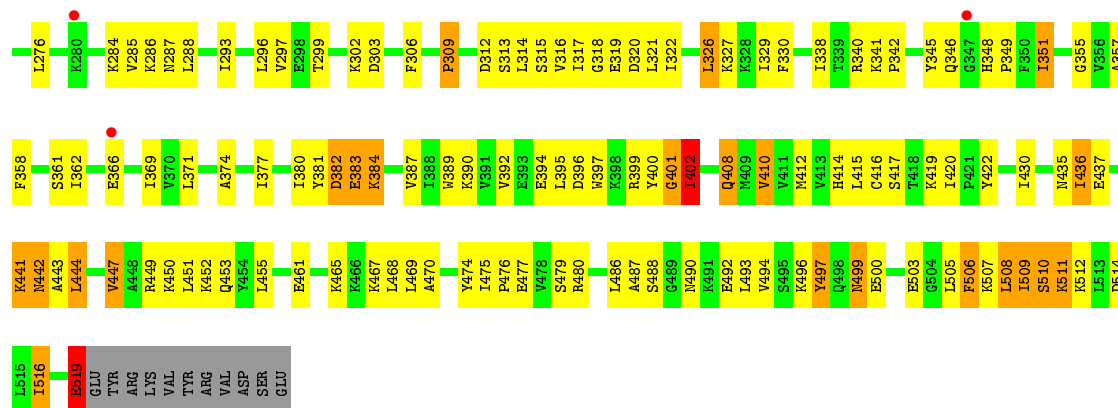


• Molecule 2: Type 2 DNA topoisomerase 6 subunit B



• Molecule 2: Type 2 DNA topoisomerase 6 subunit B

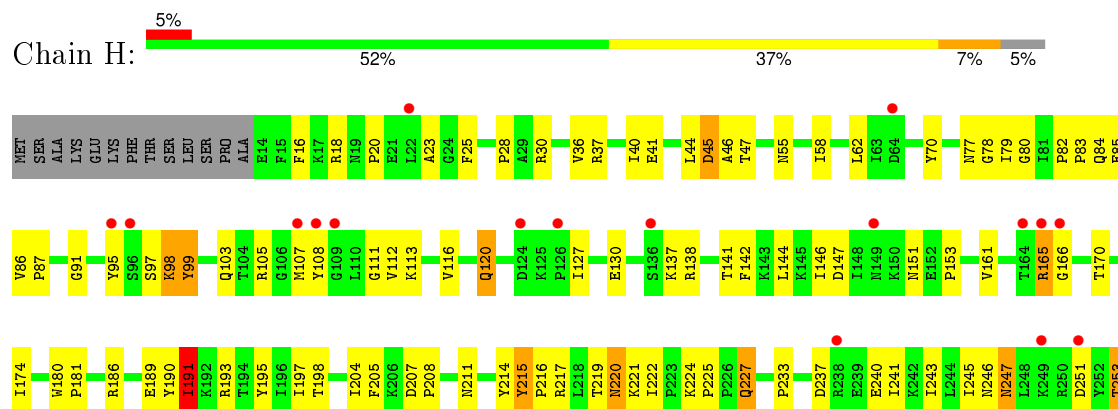


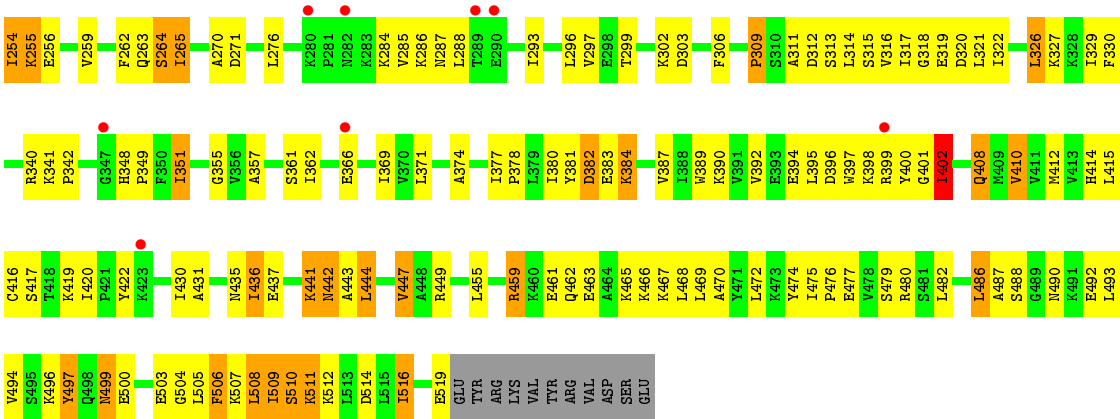


• Molecule 2: Type 2 DNA topoisomerase 6 subunit B



• Molecule 2: Type 2 DNA topoisomerase 6 subunit B





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	114.96Å 200.53Å 329.07Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	19.99 – 3.56 19.99 – 3.56	Depositor EDS
% Data completeness (in resolution range)	100.0 (19.99-3.56) 97.7 (19.99-3.56)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.52 (at 3.52Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.312 , 0.333 0.345 , 0.348	Depositor DCC
R_{free} test set	4435 reflections (5.24%)	DCC
Wilson B-factor (Å ²)	96.3	Xtriage
Anisotropy	0.388	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.23 , -10.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.41$, $\langle L^2 \rangle = 0.24$	Xtriage
Outliers	7 of 88994 reflections (0.008%)	Xtriage
F_o, F_c correlation	0.85	EDS
Total number of atoms	27776	wwPDB-VP
Average B, all atoms (Å ²)	66.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 18.73% 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, 0.375 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: RDC

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	0.76	2/2893 (0.1%)	0.84	2/3890 (0.1%)
1	C	0.78	3/2893 (0.1%)	0.99	5/3890 (0.1%)
1	E	0.73	3/2893 (0.1%)	0.84	4/3890 (0.1%)
1	G	0.70	0/2893	0.80	3/3890 (0.1%)
2	B	0.51	1/4161 (0.0%)	0.58	0/5623
2	D	0.62	3/4161 (0.1%)	0.55	1/5623 (0.0%)
2	F	0.44	0/4161	0.55	0/5623
2	H	0.40	0/4161	0.55	1/5623 (0.0%)
All	All	0.61	12/28216 (0.0%)	0.70	16/38052 (0.0%)

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	C	0	2
1	E	0	2
All	All	0	4

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	D	519	GLU	C-O	29.59	1.79	1.23
1	C	158	LYS	C-N	8.86	1.54	1.34
1	A	317	ARG	C-N	8.32	1.53	1.34
1	C	375	PHE	CE2-CZ	6.33	1.49	1.37
1	E	375	PHE	CE2-CZ	6.19	1.49	1.37

The worst 5 of 16 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	160	LYS	O-C-N	-24.65	81.30	123.20
1	C	160	LYS	CA-C-N	19.50	155.20	116.20
1	E	311	TYR	O-C-N	-14.86	98.93	122.70
1	C	160	LYS	C-N-CA	13.11	149.82	122.30
1	E	311	TYR	CA-C-N	9.53	138.16	117.20

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	160	LYS	Mainchain,Peptide
1	E	311	TYR	Mainchain
1	E	315	ALA	Mainchain

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	2842	0	2894	388	0
1	C	2842	0	2894	400	0
1	E	2842	0	2895	365	0
1	G	2842	0	2895	366	0
2	B	4077	0	4181	198	0
2	D	4077	0	4181	190	0
2	F	4077	0	4181	189	0
2	H	4077	0	4181	202	0
3	B	25	0	15	5	0
3	D	25	0	15	7	0
3	F	25	0	15	5	0
3	H	25	0	17	4	0
All	All	27776	0	28364	2200	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 39.

The worst 5 of 2200 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:E:302:ILE:CG2	1:E:312:LEU:HD11	1.58	1.32
1:C:312:LEU:CD2	1:C:317:ARG:HD3	1.63	1.28
1:C:106:TYR:O	1:C:107:ARG:HD3	1.41	1.20
2:H:455:LEU:CD1	2:H:459:ARG:HH12	1.54	1.20
2:D:519:GLU:C	2:D:519:GLU:O	1.79	1.18

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	339/389 (87%)	235 (69%)	76 (22%)	28 (8%)	1	14
1	C	339/389 (87%)	238 (70%)	73 (22%)	28 (8%)	1	14
1	E	339/389 (87%)	232 (68%)	78 (23%)	29 (9%)	1	14
1	G	339/389 (87%)	235 (69%)	76 (22%)	28 (8%)	1	14
2	B	504/530 (95%)	385 (76%)	88 (18%)	31 (6%)	2	23
2	D	504/530 (95%)	391 (78%)	87 (17%)	26 (5%)	2	27
2	F	504/530 (95%)	387 (77%)	90 (18%)	27 (5%)	2	27
2	H	504/530 (95%)	389 (77%)	91 (18%)	24 (5%)	3	30
All	All	3372/3676 (92%)	2492 (74%)	659 (20%)	221 (7%)	1	22

5 of 221 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	22	ARG
1	A	32	LEU
1	A	151	GLU
1	A	188	ILE
1	A	275	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	306/345 (89%)	214 (70%)	92 (30%)	0	3
1	C	306/345 (89%)	215 (70%)	91 (30%)	0	3
1	E	306/345 (89%)	217 (71%)	89 (29%)	0	3
1	G	306/345 (89%)	214 (70%)	92 (30%)	0	3
2	B	451/473 (95%)	401 (89%)	50 (11%)	8	38
2	D	451/473 (95%)	402 (89%)	49 (11%)	8	39
2	F	451/473 (95%)	404 (90%)	47 (10%)	9	41
2	H	451/473 (95%)	402 (89%)	49 (11%)	8	39
All	All	3028/3272 (92%)	2469 (82%)	559 (18%)	2	13

5 of 559 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	D	312	ASP
1	E	158	LYS
2	H	189	GLU
2	D	382	ASP
1	E	11	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 100 such sidechains are listed below:

Mol	Chain	Res	Type
2	D	287	ASN
1	E	183	HIS
2	H	227	GLN
2	D	414	HIS
1	E	31	GLN

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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

4 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$
3	RDC	B	531	-	27,27,27	2.91	7 (25%)	33,39,39	1.94	10 (30%)
3	RDC	D	531	-	27,27,27	2.89	8 (29%)	33,39,39	1.88	11 (33%)
3	RDC	F	531	-	27,27,27	2.94	7 (25%)	33,39,39	1.95	10 (30%)
3	RDC	H	531	-	27,27,27	3.00	8 (29%)	33,39,39	1.95	11 (33%)

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
3	RDC	B	531	-	-	0/23/28/28	0/1/3/3
3	RDC	D	531	-	-	0/23/28/28	0/1/3/3
3	RDC	F	531	-	-	0/23/28/28	0/1/3/3
3	RDC	H	531	-	-	0/23/28/28	0/1/3/3

The worst 5 of 30 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	D	531	RDC	C6-CL1	-10.64	1.50	1.72
3	B	531	RDC	C6-CL1	-10.49	1.50	1.72

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	H	531	RDC	C6-CL1	-10.43	1.51	1.72
3	F	531	RDC	C6-CL1	-10.26	1.51	1.72
3	H	531	RDC	O1-C17	-2.07	1.43	1.47

The worst 5 of 42 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	531	RDC	C5-C6-C7	-3.92	118.32	122.13
3	H	531	RDC	C5-C6-C7	-3.63	118.61	122.13
3	H	531	RDC	C15-C14-C13	-3.53	111.39	122.31
3	B	531	RDC	C15-C14-C13	-3.52	111.42	122.31
3	H	531	RDC	C12-C11-C10	-3.43	117.04	124.66

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

4 monomers are involved in 21 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	531	RDC	5	0
3	D	531	RDC	7	0
3	F	531	RDC	5	0
3	H	531	RDC	4	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 ⓘ

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	A	347/389 (89%)	-0.21	4 (1%) 81 73	20, 72, 83, 85	0
1	C	347/389 (89%)	-0.17	6 (1%) 73 64	20, 72, 83, 85	0
1	E	347/389 (89%)	-0.20	5 (1%) 78 69	20, 72, 83, 85	0
1	G	347/389 (89%)	-0.17	10 (2%) 55 45	20, 72, 83, 85	0
2	B	506/530 (95%)	-0.11	10 (1%) 68 59	23, 71, 78, 86	0
2	D	506/530 (95%)	-0.04	12 (2%) 62 52	23, 71, 78, 87	0
2	F	506/530 (95%)	-0.09	11 (2%) 65 55	23, 71, 78, 90	0
2	H	506/530 (95%)	0.13	25 (4%) 33 26	23, 71, 78, 86	0
All	All	3412/3676 (92%)	-0.09	83 (2%) 62 52	20, 71, 80, 90	0

The worst 5 of 83 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	166	GLY	5.0
2	D	166	GLY	4.9
2	B	95	TYR	4.3
2	F	95	TYR	4.2
2	D	95	TYR	4.2

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

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, 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	LLDF	B-factors(Å ²)	Q<0.9
3	RDC	D	531	25/25	0.73	0.40	2.16	92,93,94,94	0
3	RDC	B	531	25/25	0.80	0.38	1.77	92,93,94,94	0
3	RDC	H	531	25/25	0.79	0.31	0.96	92,93,94,94	0
3	RDC	F	531	25/25	0.86	0.29	0.76	92,93,94,94	0

6.5 Other polymers [i](#)

There are no such residues in this entry.