



# Full wwPDB X-ray Structure Validation Report ⓘ

Feb 1, 2016 – 10:39 AM GMT

PDB ID : 3MLG  
Title : 2ouf-2x, a designed knotted protein  
Authors : King, N.P.; Sawaya, M.R.; Jacobitz, A.W.; Yeates, T.O.  
Deposited on : 2010-04-16  
Resolution : 2.29 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  
<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

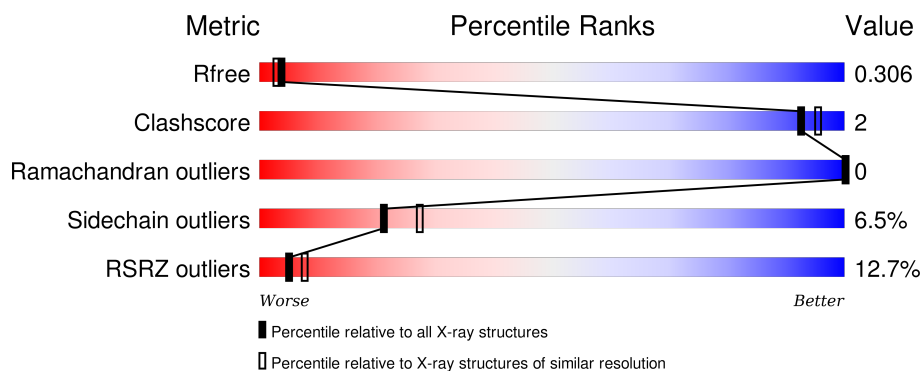
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.29 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	3852 (2.30-2.30)
Clashscore	102246	4452 (2.30-2.30)
Ramachandran outliers	100387	4410 (2.30-2.30)
Sidechain outliers	100360	4409 (2.30-2.30)
RSRZ outliers	91569	3857 (2.30-2.30)

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	189	<div> <div>11%</div> <div> <div></div> <div>77%</div> <div>8%</div> <div>15%</div> </div> </div>
1	B	189	<div> <div>11%</div> <div> <div></div> <div>75%</div> <div>10%</div> <div>15%</div> </div> </div>

## 2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2570 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 Putative uncharacterized protein, LINKER, Putative uncharacterized protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	161	Total	C	N	O	S	0	0	0
			1266	811	205	248	2			
1	B	161	Total	C	N	O	S	0	0	0
			1254	803	202	247	2			

There are 34 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	93	SER	-	LINKER	UNP O25025
A	94	GLY	-	LINKER	UNP O25025
A	95	SER	-	LINKER	UNP O25025
A	96	GLY	-	LINKER	UNP O25025
A	97	SER	-	LINKER	UNP O25025
A	98	GLY	-	LINKER	UNP O25025
A	99	SER	-	LINKER	UNP O25025
A	100	SER	-	LINKER	UNP O25025
A	101	GLY	-	LINKER	UNP O25025
A	182	LEU	-	EXPRESSION TAG	UNP O25025
A	183	GLU	-	EXPRESSION TAG	UNP O25025
A	184	HIS	-	EXPRESSION TAG	UNP O25025
A	185	HIS	-	EXPRESSION TAG	UNP O25025
A	186	HIS	-	EXPRESSION TAG	UNP O25025
A	187	HIS	-	EXPRESSION TAG	UNP O25025
A	188	HIS	-	EXPRESSION TAG	UNP O25025
A	189	HIS	-	EXPRESSION TAG	UNP O25025
B	93	SER	-	LINKER	UNP O25025
B	94	GLY	-	LINKER	UNP O25025
B	95	SER	-	LINKER	UNP O25025
B	96	GLY	-	LINKER	UNP O25025
B	97	SER	-	LINKER	UNP O25025
B	98	GLY	-	LINKER	UNP O25025
B	99	SER	-	LINKER	UNP O25025

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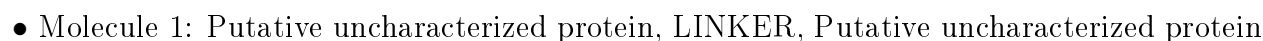
Chain	Residue	Modelled	Actual	Comment	Reference
B	100	SER	-	LINKER	UNP O25025
B	101	GLY	-	LINKER	UNP O25025
B	182	LEU	-	EXPRESSION TAG	UNP O25025
B	183	GLU	-	EXPRESSION TAG	UNP O25025
B	184	HIS	-	EXPRESSION TAG	UNP O25025
B	185	HIS	-	EXPRESSION TAG	UNP O25025
B	186	HIS	-	EXPRESSION TAG	UNP O25025
B	187	HIS	-	EXPRESSION TAG	UNP O25025
B	188	HIS	-	EXPRESSION TAG	UNP O25025
B	189	HIS	-	EXPRESSION TAG	UNP O25025

- Molecule 2 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	26	Total O 26 26	0	0
2	B	24	Total O 24 24	0	0



- Molecule 1: Putative uncharacterized protein, LINKER, Putative uncharacterized protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	44.94Å 75.39Å 118.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	21.99 – 2.29 21.93 – 2.29	Depositor EDS
% Data completeness (in resolution range)	(Not available) (21.99-2.29) 92.0 (21.93-2.29)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.46 (at 2.28Å)	Xtriage
Refinement program	BUSTER 2.8.0	Depositor
R, $R_{free}$	0.248 , 0.278 0.261 , 0.306	Depositor DCC
$R_{free}$ test set	873 reflections (5.33%)	DCC
Wilson B-factor (Å <sup>2</sup> )	26.2	Xtriage
Anisotropy	0.042	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 47.1	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.52$ , $\langle L^2 \rangle = 0.36$	Xtriage
Outliers	3 of 17260 reflections (0.017%)	Xtriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	2570	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 43.83 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 1.6673e-04. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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

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	0.50	0/1280	0.65	0/1717
1	B	0.49	0/1268	0.64	0/1708
All	All	0.49	0/2548	0.65	0/3425

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	1266	0	1255	5	0
1	B	1254	0	1222	5	0
2	A	26	0	0	0	0
2	B	24	0	0	0	0
All	All	2570	0	2477	10	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.

All (10) 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:15:LEU:HD22	1:B:124:GLU:HG2	1.71	0.70

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:51:GLU:HB3	1:B:53:LEU:HD12	1.81	0.62
1:A:51:GLU:HB3	1:A:53:LEU:HD12	1.81	0.61
1:B:133:LEU:O	1:B:137:ILE:HG12	2.12	0.49
1:A:133:LEU:O	1:A:137:ILE:HG12	2.14	0.47
1:B:21:ILE:HG21	1:B:86:MET:HG2	1.97	0.46
1:A:18:TRP:HB2	1:A:82:VAL:HG13	1.98	0.46
1:A:82:VAL:HG23	1:A:127:LEU:HD21	1.97	0.46
1:A:150:ALA:HA	1:A:153:LEU:HB2	1.98	0.46
1:B:150:ALA:HA	1:B:153:LEU:HB2	1.99	0.45

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	157/189 (83%)	156 (99%)	1 (1%)	0	100	100
1	B	157/189 (83%)	156 (99%)	1 (1%)	0	100	100
All	All	314/378 (83%)	312 (99%)	2 (1%)	0	100	100

There are no Ramachandran outliers to report.

### 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	133/172 (77%)	126 (95%)	7 (5%)	28	37
1	B	130/172 (76%)	120 (92%)	10 (8%)	16	20
All	All	263/344 (76%)	246 (94%)	17 (6%)	21	27

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	17	LYS
1	A	27	LYS
1	A	38	LEU
1	A	56	LYS
1	A	75	GLU
1	A	159	LEU
1	A	180	SER
1	B	17	LYS
1	B	38	LEU
1	B	80	ASP
1	B	84	GLN
1	B	85	SER
1	B	90	LEU
1	B	117	LYS
1	B	153	LEU
1	B	159	LEU
1	B	180	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	84	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 [i](#)

There are no carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

There are no ligands in this entry.

## 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, 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	161/189 (85%)	0.61	20 (12%) 5 8	15, 45, 94, 111	0
1	B	161/189 (85%)	0.65	21 (13%) 5 7	17, 47, 108, 126	0
All	All	322/378 (85%)	0.63	41 (12%) 5 8	15, 47, 100, 126	0

All (41) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	152	ALA	6.9
1	A	66	ILE	6.6
1	A	152	ALA	6.1
1	B	64	LEU	5.5
1	A	64	LEU	5.3
1	A	92	GLY	5.3
1	A	144	GLU	4.6
1	A	55	GLU	4.5
1	B	66	ILE	4.4
1	A	69	GLU	4.0
1	B	143	GLU	4.0
1	B	155	ILE	3.8
1	A	68	GLU	3.8
1	B	144	GLU	3.7
1	A	101	GLY	3.3
1	A	65	ARG	3.3
1	A	147	GLU	3.2
1	B	147	GLU	3.2
1	B	67	ASP	3.2
1	B	65	ARG	3.2
1	B	151	LYS	3.2
1	A	151	LYS	2.9
1	A	71	GLN	2.9
1	B	92	GLY	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	155	ILE	2.7
1	B	70	LEU	2.7
1	A	181	GLY	2.6
1	B	69	GLU	2.5
1	B	153	LEU	2.5
1	B	157	GLU	2.5
1	A	67	ASP	2.5
1	A	90	LEU	2.4
1	B	24	HIS	2.4
1	A	148	SER	2.4
1	B	55	GLU	2.4
1	B	68	GLU	2.2
1	B	72	GLN	2.2
1	B	179	LEU	2.2
1	A	63	ALA	2.2
1	B	181	GLY	2.2
1	A	72	GLN	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 carbohydrates in this entry.

## 6.4 Ligands [i](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.