Full wwPDB X-ray Structure Validation Report (i)

Nov 5, 2023 – 12:04 PM EST

PDB ID	:	1XSS
Title	:	Semi-rational engineering of a green-emitting coral fluorescent protein into an efficient highlighter.
Authors	:	Tsutsui, H.; Karasawa, S.; Shimizu, H.; Nukina, N.; Miyawaki, A.
Deposited on	:	2004-10-20
Resolution	:	1.60 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*
A user guide is available at
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

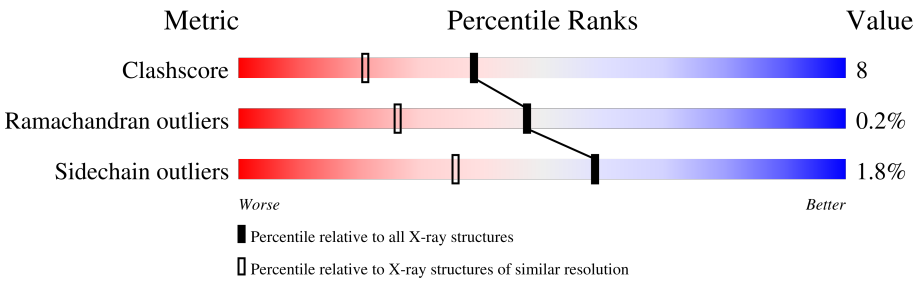
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	NOT EXECUTED
EDS	:	NOT EXECUTED
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.60 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))
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)

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 >=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 <=5%

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	225	83% 15% •
1	B	225	81% 18% •

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 4212 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 fluorescent protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	224	1808	1156	306	334	12	0	0	0
1	B	225	1817	1162	308	335	12	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	VAL	MET	conflict	UNP Q53UG7
A	64	DYG	ASP	chromophore	UNP Q53UG7
A	64	DYG	TYR	chromophore	UNP Q53UG7
A	64	DYG	GLY	chromophore	UNP Q53UG7
B	1	VAL	MET	conflict	UNP Q53UG7
B	64	DYG	ASP	chromophore	UNP Q53UG7
B	64	DYG	TYR	chromophore	UNP Q53UG7
B	64	DYG	GLY	chromophore	UNP Q53UG7

- Molecule 2 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mg		
2	A	1	1	1	0	0
2	B	1	1	1	0	0

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Na		
3	A	1	1	1	0	0
3	B	1	1	1	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
4	A	298	298	298	0	0
			Total	O		
4	B	285	285	285	0	0

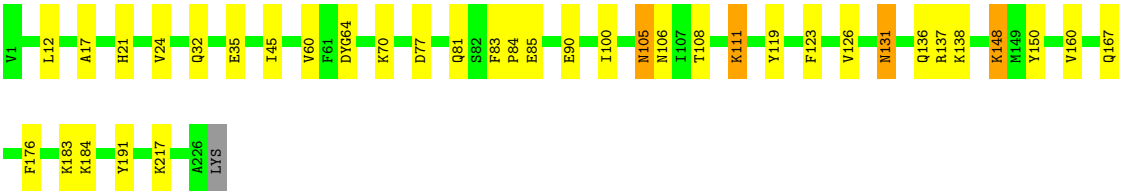
3 Residue-property plots (i)

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. 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. 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.

Note EDS was not executed.

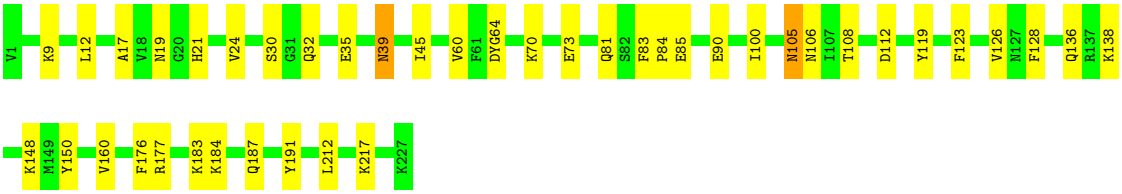
• Molecule 1: fluorescent protein

Chain A:



• Molecule 1: fluorescent protein

Chain B:



4 Data and refinement statistics (i)

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, α, β, γ	96.74Å 119.08Å 49.29Å 90.00° 120.72° 90.00°	Depositor
Resolution (Å)	14.50 – 1.60	Depositor
% Data completeness (in resolution range)	(Not available) (14.50-1.60)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.197 , 0.229	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	4212	wwPDB-VP
Average B, all atoms ($Å^2$)	15.0	wwPDB-VP

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: DYG, NA, MG

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	0.33	0/1828	0.67	0/2463
1	B	0.32	0/1837	0.67	0/2474
All	All	0.33	0/3665	0.67	0/4937

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 (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	1808	0	1761	28	0
1	B	1817	0	1774	30	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
4	A	298	0	0	1	1
4	B	285	0	0	1	2
All	All	4212	0	3535	54	3

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 (54) 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:81:GLN:HE22	1:B:187:GLN:H	1.46	0.62
1:A:111:LYS:N	1:A:111:LYS:HD2	2.16	0.60
1:A:83:PHE:HB3	1:A:84:PRO:HA	1.85	0.59
1:B:83:PHE:HB3	1:B:84:PRO:HA	1.85	0.58
1:A:105:ASN:HD21	1:A:119:TYR:HB3	1.70	0.56
1:A:111:LYS:HD2	1:A:111:LYS:H	1.69	0.56
1:B:73:GLU:CD	1:B:73:GLU:H	2.09	0.54
1:B:85:GLU:CD	1:B:184:LYS:HD3	2.28	0.54
1:B:81:GLN:NE2	1:B:187:GLN:H	2.08	0.52
1:A:12:LEU:HD12	1:A:12:LEU:C	2.32	0.50
1:A:32:GLN:NE2	1:A:35:GLU:HG3	2.27	0.49
1:A:126:VAL:HB	1:B:90:GLU:HB3	1.94	0.49
1:A:90:GLU:HB3	1:B:126:VAL:HB	1.94	0.49
1:B:12:LEU:C	1:B:12:LEU:HD12	2.33	0.49
1:B:70:LYS:HD3	1:B:217:LYS:HE2	1.92	0.49
1:A:32:GLN:HE21	1:A:35:GLU:HG3	1.79	0.47
1:B:105:ASN:HD21	1:B:119:TYR:HB3	1.78	0.47
1:B:32:GLN:HE21	1:B:35:GLU:HG3	1.79	0.46
1:B:85:GLU:OE2	1:B:184:LYS:HD3	2.16	0.46
1:A:70:LYS:HD3	1:A:217:LYS:HE2	1.97	0.46
1:B:17:ALA:HA	1:B:21:HIS:O	2.15	0.46
1:B:177:ARG:NH2	4:B:2425:HOH:O	2.45	0.46
1:A:100:ILE:HD11	1:B:100:ILE:HD13	1.98	0.46
1:B:32:GLN:NE2	1:B:35:GLU:HG3	2.31	0.45
1:A:17:ALA:HA	1:A:21:HIS:O	2.16	0.45
1:A:77:ASP:O	1:A:81:GLN:HG3	2.16	0.45
1:A:160:VAL:CG1	1:A:176:PHE:HB2	2.47	0.45
1:A:105:ASN:HD22	1:A:106:ASN:N	2.15	0.45
1:A:137:ARG:HH21	1:A:137:ARG:HG3	1.82	0.45
1:A:138:LYS:HD2	4:A:1441:HOH:O	2.16	0.45
1:A:85:GLU:CD	1:A:184:LYS:HD3	2.37	0.44
1:A:100:ILE:HD13	1:B:100:ILE:HD11	1.99	0.44
1:A:138:LYS:HA	1:A:167:GLN:NE2	2.32	0.44
1:B:60:VAL:HG21	1:B:123:PHE:CD2	2.53	0.44
1:B:9:LYS:HA	1:B:30:SER:HA	1.99	0.43
1:A:85:GLU:OE2	1:A:184:LYS:HD3	2.18	0.43
1:B:108:THR:HG22	1:B:183:LYS:NZ	2.34	0.42
1:B:105:ASN:HD22	1:B:106:ASN:N	2.17	0.42
1:B:24:VAL:CG1	1:B:45:ILE:HD11	2.50	0.42
1:B:136:GLN:HB3	1:B:138:LYS:HZ3	1.85	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:150:TYR:HB3	1:B:191:TYR:CD1	2.54	0.42
1:A:108:THR:HG22	1:A:183:LYS:NZ	2.34	0.42
1:B:160:VAL:CG1	1:B:176:PHE:HB2	2.50	0.42
1:A:131:ASN:N	1:A:131:ASN:HD22	2.18	0.42
1:A:150:TYR:HB3	1:A:191:TYR:CD1	2.54	0.42
1:A:136:GLN:HB3	1:A:138:LYS:HE3	2.02	0.41
1:B:39:ASN:HD22	1:B:39:ASN:H	1.68	0.41
1:A:60:VAL:HG21	1:A:123:PHE:CD2	2.55	0.41
1:A:24:VAL:CG1	1:A:45:ILE:HD11	2.50	0.41
1:B:39:ASN:HD22	1:B:39:ASN:N	2.19	0.41
1:B:160:VAL:HG13	1:B:176:PHE:HB2	2.02	0.41
1:B:19:ASN:HD21	1:B:128:PHE:H	1.69	0.41
1:B:39:ASN:HA	1:B:212:LEU:O	2.21	0.40
1:A:148:LYS:N	1:A:148:LYS:HD2	2.36	0.40

All (3) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:B:2442:HOH:O	4:B:2442:HOH:O[2_656]	1.12	1.08
4:B:2363:HOH:O	4:B:2363:HOH:O[2_656]	1.73	0.47
4:A:1407:HOH:O	4:A:1407:HOH:O[2_656]	1.85	0.35

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	219/225 (97%)	217 (99%)	2 (1%)	0	100 100
1	B	220/225 (98%)	216 (98%)	3 (1%)	1 (0%)	29 11
All	All	439/450 (98%)	433 (99%)	5 (1%)	1 (0%)	47 26

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	112	ASP

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	194/195 (100%)	190 (98%)	4 (2%)	53	29
1	B	195/195 (100%)	192 (98%)	3 (2%)	65	44
All	All	389/390 (100%)	382 (98%)	7 (2%)	59	36

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	105	ASN
1	A	111	LYS
1	A	131	ASN
1	A	148	LYS
1	B	39	ASN
1	B	105	ASN
1	B	148	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (14) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	32	GLN
1	A	105	ASN
1	A	127	ASN
1	A	131	ASN
1	A	161	ASN
1	A	167	GLN
1	B	19	ASN
1	B	32	GLN
1	B	39	ASN

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Mol	Chain	Res	Type
1	B	81	GLN
1	B	105	ASN
1	B	115	ASN
1	B	127	ASN
1	B	161	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

2 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	DYG	B	64	1	23,24,25	2.03	4 (17%)	30,33,35	2.12	6 (20%)
1	DYG	A	64	1	23,24,25	2.03	4 (17%)	30,33,35	2.11	6 (20%)

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	DYG	B	64	1	-	2/12/31/32	0/2/2/2
1	DYG	A	64	1	-	2/12/31/32	0/2/2/2

All (8) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	64	DYG	CB2-CA2	5.60	1.39	1.35
1	A	64	DYG	CB2-CA2	5.47	1.39	1.35

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	64	DYG	CA2-C2	-4.69	1.44	1.48
1	B	64	DYG	CA2-C2	-4.68	1.44	1.48
1	B	64	DYG	CG2-CB2	-3.78	1.39	1.46
1	A	64	DYG	CG2-CB2	-3.73	1.39	1.46
1	A	64	DYG	CD2-CG2	2.29	1.43	1.39
1	B	64	DYG	CD2-CG2	2.19	1.43	1.39

All (12) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	64	DYG	O2-C2-CA2	7.38	135.10	130.96
1	A	64	DYG	O2-C2-CA2	7.36	135.09	130.96
1	B	64	DYG	C2-N3-C1	5.08	110.54	107.97
1	A	64	DYG	C2-N3-C1	4.99	110.49	107.97
1	B	64	DYG	CA2-N2-C1	4.12	108.81	105.77
1	A	64	DYG	CA2-N2-C1	4.03	108.75	105.77
1	A	64	DYG	N3-C1-N2	-3.42	109.09	111.45
1	B	64	DYG	N3-C1-N2	-3.37	109.12	111.45
1	B	64	DYG	CA2-C2-N3	-2.41	102.23	103.37
1	A	64	DYG	CA2-C2-N3	-2.29	102.29	103.37
1	B	64	DYG	O3-C3-CA3	-2.13	119.95	126.39
1	A	64	DYG	O3-C3-CA3	-2.13	119.97	126.39

There are no chirality outliers.

All (4) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	64	DYG	C3-CA3-N3-C2
1	B	64	DYG	C3-CA3-N3-C2
1	A	64	DYG	N1-CA1-CB1-CG1
1	B	64	DYG	N1-CA1-CB1-CG1

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 4 ligands modelled in this entry, 4 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)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates (i)

EDS was not executed - this section is therefore empty.

6.4 Ligands (i)

EDS was not executed - this section is therefore empty.

6.5 Other polymers (i)

EDS was not executed - this section is therefore empty.