wwPDB X-ray Structure Validation Summary Report ⓘ

Sep 9, 2023 – 10:51 PM EDT

PDB ID	:	4HE4
Title	:	Crystal structure of the yellow fluorescent protein phiYFP (Phialidium sp.)
Authors	:	Pletneva, N.; Pletnev, S.; Pletnev, V.Z.
Deposited on	:	2012-10-03
Resolution	:	2.05 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
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.

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

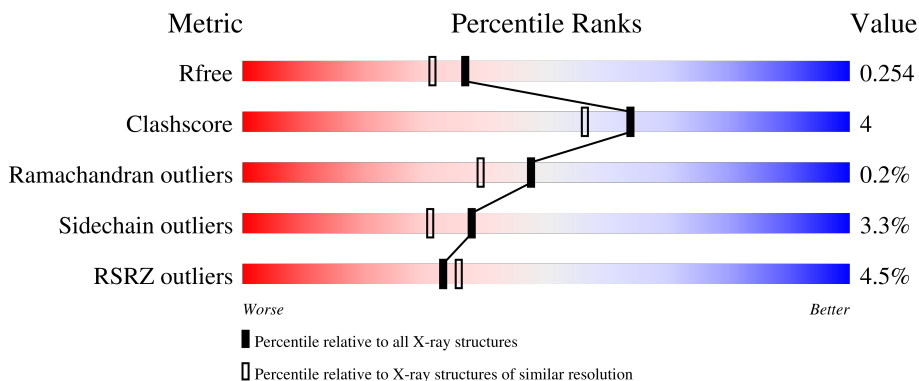|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.35.1

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 2.05 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	Percentile Ranks	Value
Rfree		0.254
Clashscore		4
Ramachandran outliers		0.2%
Sidechain outliers		3.3%
RSRZ outliers		4.5%

Worse — *Better*

▮ Percentile relative to all X-ray structures

◻ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1692 (2.04-2.04)
Clashscore	141614	1773 (2.04-2.04)
Ramachandran outliers	138981	1752 (2.04-2.04)
Sidechain outliers	138945	1752 (2.04-2.04)
RSRZ outliers	127900	1672 (2.04-2.04)

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% 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	244	% 85% 9% · 5%
1	B	244	8% 80% 14% · 5%

2 Entry composition ⓘ

There are 2 unique types of molecules in this entry. The entry contains 3844 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 Yellow fluorescent protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	232	Total	C	N	O	S	0	2	0
			1838	1163	316	347	12			
1	B	232	Total	C	N	O	S	0	0	0
			1825	1155	315	344	11			

There are 50 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	expression tag	UNP Q6RYS7
A	65	CRO	THR	chromophore	UNP Q6RYS7
A	65	CRO	TYR	chromophore	UNP Q6RYS7
A	65	CRO	GLY	chromophore	UNP Q6RYS7
A	88	ASP	GLU	SEE REMARK 999	UNP Q6RYS7
A	103	ASN	VAL	SEE REMARK 999	UNP Q6RYS7
A	166	CYS	MET	SEE REMARK 999	UNP Q6RYS7
A	174	GLY	GLU	SEE REMARK 999	UNP Q6RYS7
A	201	MET	ILE	SEE REMARK 999	UNP Q6RYS7
A	202	SER	THR	SEE REMARK 999	UNP Q6RYS7
A	206	LYS	THR	SEE REMARK 999	UNP Q6RYS7
A	221	LYS	VAL	SEE REMARK 999	UNP Q6RYS7
A	234	ASP	-	SEE REMARK 999	UNP Q6RYS7
A	235	PHE	-	SEE REMARK 999	UNP Q6RYS7
A	236	ASP	-	SEE REMARK 999	UNP Q6RYS7
A	237	ALA	-	SEE REMARK 999	UNP Q6RYS7
A	238	GLY	-	SEE REMARK 999	UNP Q6RYS7
A	239	SER	-	SEE REMARK 999	UNP Q6RYS7
A	240	GLY	-	SEE REMARK 999	UNP Q6RYS7
A	241	ASP	-	SEE REMARK 999	UNP Q6RYS7
A	242	THR	-	SEE REMARK 999	UNP Q6RYS7
A	243	SER	-	SEE REMARK 999	UNP Q6RYS7
A	244	LEU	-	SEE REMARK 999	UNP Q6RYS7
A	245	ILE	-	SEE REMARK 999	UNP Q6RYS7
A	246	SER	-	SEE REMARK 999	UNP Q6RYS7

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Chain	Residue	Modelled	Actual	Comment	Reference
B	1	GLY	-	expression tag	UNP Q6RYS7
B	65	CRO	THR	chromophore	UNP Q6RYS7
B	65	CRO	TYR	chromophore	UNP Q6RYS7
B	65	CRO	GLY	chromophore	UNP Q6RYS7
B	88	ASP	GLU	SEE REMARK 999	UNP Q6RYS7
B	103	ASN	VAL	SEE REMARK 999	UNP Q6RYS7
B	166	CYS	MET	SEE REMARK 999	UNP Q6RYS7
B	174	GLY	GLU	SEE REMARK 999	UNP Q6RYS7
B	201	MET	ILE	SEE REMARK 999	UNP Q6RYS7
B	202	SER	THR	SEE REMARK 999	UNP Q6RYS7
B	206	LYS	THR	SEE REMARK 999	UNP Q6RYS7
B	221	LYS	VAL	SEE REMARK 999	UNP Q6RYS7
B	234	ASP	-	SEE REMARK 999	UNP Q6RYS7
B	235	PHE	-	SEE REMARK 999	UNP Q6RYS7
B	236	ASP	-	SEE REMARK 999	UNP Q6RYS7
B	237	ALA	-	SEE REMARK 999	UNP Q6RYS7
B	238	GLY	-	SEE REMARK 999	UNP Q6RYS7
B	239	SER	-	SEE REMARK 999	UNP Q6RYS7
B	240	GLY	-	SEE REMARK 999	UNP Q6RYS7
B	241	ASP	-	SEE REMARK 999	UNP Q6RYS7
B	242	THR	-	SEE REMARK 999	UNP Q6RYS7
B	243	SER	-	SEE REMARK 999	UNP Q6RYS7
B	244	LEU	-	SEE REMARK 999	UNP Q6RYS7
B	245	ILE	-	SEE REMARK 999	UNP Q6RYS7
B	246	SER	-	SEE REMARK 999	UNP Q6RYS7

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	113	Total 113	O 113	0	0
2	B	68	Total 68	O 68	0	0

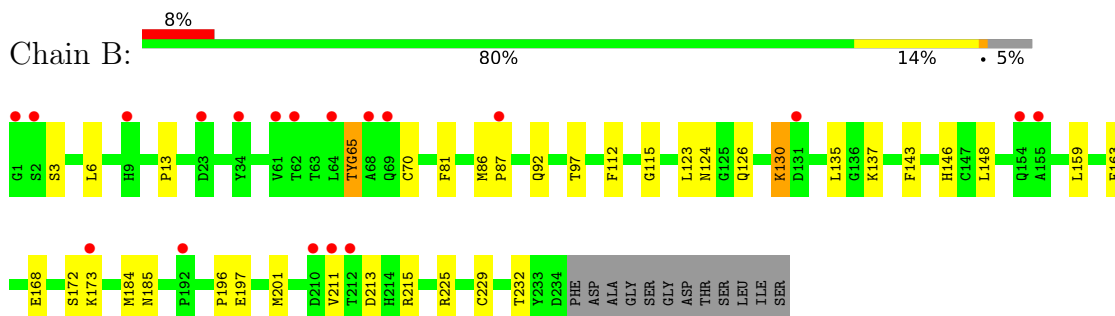# 3   Residue-property plots ⓘ

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: Yellow fluorescent protein
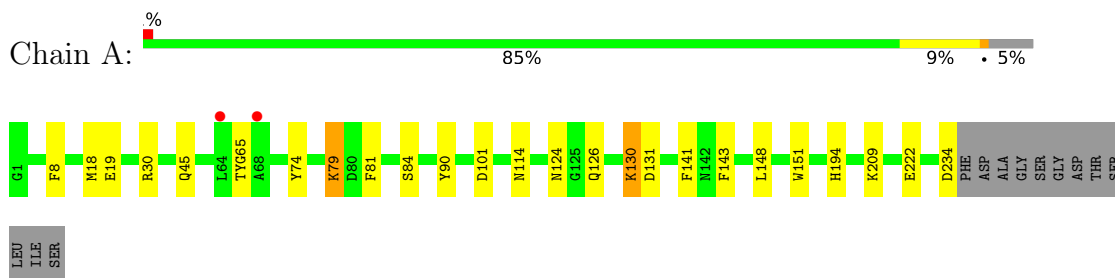
• Molecule 1: Yellow fluorescent protein

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	H 3 2	Depositor
Cell constants a, b, c, α, β, γ	102.87Å 102.87Å 242.53Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	28.70 – 2.05 28.70 – 2.05	Depositor EDS
% Data completeness (in resolution range)	99.7 (28.70-2.05) 99.7 (28.70-2.05)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.49 (at 2.04Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.196 , 0.256 0.196 , 0.254	Depositor DCC
R_{free} test set	1581 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å^2)	39.5	Xtriage
Anisotropy	0.137	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.34 , 50.2	EDS
L-test for twinning[2]	$< |L| > = 0.48, < L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.014 for -h,1/3*h-1/3*k-1/3*l,-4/3*h-8/3*k+1/3*l 0.009 for -1/3*h+1/3*k+1/3*l,-k,8/3*h+4/3*k+1/3*l 0.019 for -2/3*h-1/3*k-1/3*l,-1/3*h-2/3*k+1/3*l,-4/3*h+4/3*k+1/3*l	Xtriage
F_o,F_c correlation	0.96	EDS
Total number of atoms	3844	wwPDB-VP
Average B, all atoms (Å^2)	41.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.42% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 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: CRO

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	1.35	9/1865 (0.5%)	0.94	0/2518
1	B	1.14	1/1849 (0.1%)	0.86	1/2497 (0.0%)
All	All	1.25	10/3714 (0.3%)	0.90	1/5015 (0.0%)

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

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	90	TYR	CD2-CE2	5.68	1.47	1.39
1	A	81	PHE	CB-CG	5.61	1.60	1.51
1	A	222	GLU	CG-CD	5.58	1.60	1.51
1	A	151	TRP	CB-CG	5.48	1.60	1.50
1	B	70	CYS	CB-SG	5.43	1.91	1.82

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	B	172	SER	N-CA-C	-5.02	97.44	111.00

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	1838	0	1757	10	0
1	B	1825	0	1745	21	0
2	A	113	0	0	0	0
2	B	68	0	0	1	0
All	All	3844	0	3502	30	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 4.

The worst 5 of 30 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:130:LYS:H	1:A:130:LYS:HD3	0.95	1.08
1:A:130:LYS:HD3	1:A:130:LYS:N	1.81	0.96
1:A:130:LYS:H	1:A:130:LYS:CD	1.75	0.94
1:A:18:MET:HG2	1:A:19:GLU:N	2.03	0.72
1:B:229:CYS:HA	1:B:232:THR:HG22	1.76	0.67

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	229/244 (94%)	225 (98%)	4 (2%)	0	100	100
1	B	227/244 (93%)	220 (97%)	6 (3%)	1 (0%)	34	24
All	All	456/488 (93%)	445 (98%)	10 (2%)	1 (0%)	47	39

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	137	LYS

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	197/204 (97%)	191 (97%)	6 (3%)	41	34
1	B	195/204 (96%)	188 (96%)	7 (4%)	35	28
All	All	392/408 (96%)	379 (97%)	13 (3%)	38	31

5 of 13 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	6	LEU
1	B	130	LYS
1	B	211	VAL
1	B	184	MET
1	B	197	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	126	GLN
1	B	92	GLN
1	B	126	GLN
1	B	146	HIS
1	B	194	HIS

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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	CRO	A	65	1	23,23,24	1.60	4 (17%)	30,32,34	1.51	5 (16%)
1	CRO	B	65	1	23,23,24	1.64	5 (21%)	30,32,34	1.54	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	CRO	A	65	1	-	0/12/31/32	0/2/2/2
1	CRO	B	65	1	-	0/12/31/32	0/2/2/2

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	65	CRO	CB2-CA2	3.95	1.38	1.35
1	A	65	CRO	CB2-CA2	3.88	1.38	1.35
1	A	65	CRO	CE2-CD2	3.38	1.44	1.38
1	B	65	CRO	CE1-CD1	2.65	1.43	1.38
1	B	65	CRO	CE2-CD2	2.63	1.43	1.38

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	65	CRO	O2-C2-CA2	-4.30	128.55	130.96
1	B	65	CRO	C1-CA1-N1	-3.79	103.82	109.96
1	B	65	CRO	O2-C2-CA2	-3.72	128.87	130.96
1	B	65	CRO	CA1-C1-N3	-3.49	120.56	124.75
1	A	65	CRO	O3-C3-CA3	-3.46	115.93	126.39

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
1	B	65	CRO	1	0

5.5 Carbohydrates ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

There are no ligands in this entry.

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 ⓘ

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(Å²)	Q<0.9
1	A	231/244 (94%)	-0.32	2 (0%)	84	86	22, 34, 49, 63	0
1	B	231/244 (94%)	0.23	19 (8%)	11	12	31, 47, 62, 68	0
All	All	462/488 (94%)	-0.04	21 (4%)	33	35	22, 40, 60, 68	0

The worst 5 of 21 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	212	THR	4.8
1	B	211	VAL	3.9
1	B	23	ASP	3.4
1	B	173	LYS	3.1
1	B	61	VAL	2.9

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

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, 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	B-factors(Å²)	Q<0.9
1	CRO	B	65	22/23	0.94	0.21	35,38,43,45	0
1	CRO	A	65	22/23	0.95	0.21	25,30,34,40	0

6.3 Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4 Ligands ⓘ

There are no ligands in this entry.

6.5 Other polymers ⓘ

There are no such residues in this entry.