Full wwPDB X-ray Structure Validation Report (i)

Sep 9, 2023 – 05:00 PM EDT

PDB ID	:	4HOP
Title	:	Crystal structure of the computationally designed NNOS-Syntrophin complex
Authors	:	Harwood, I.M.; Melero, C.; Ollikainen, N.; Kortemme, T.
Deposited on	:	2012-10-22
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*
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 (1)) were used in the production of this report:

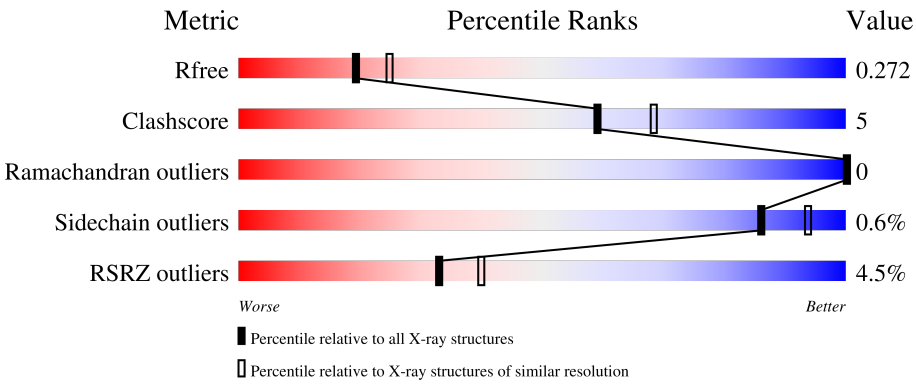
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation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

1 Overall quality at a glance (i)

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}	130704	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (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 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	88	%, 93%, 6% •
1	C	88	%, 90%, 8% ••
1	E	88	6%, 82%, 18%
2	B	123	6%, 85%, 12% •
2	D	123	5%, 87%, 13%

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Mol	Chain	Length	Quality of chain
2	F	123	7% 85% 13%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 5203 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 Alpha-1-syntrophin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	87	647	406	116	124	1	0	0	0
1	C	87	647	406	116	124	1	0	0	0
1	E	88	658	414	117	126	1	0	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	75	GLY	-	expression tag	UNP Q61234
A	76	SER	-	expression tag	UNP Q61234
A	142	PHE	HIS	engineered mutation	UNP Q61234
C	75	GLY	-	expression tag	UNP Q61234
C	76	SER	-	expression tag	UNP Q61234
C	142	PHE	HIS	engineered mutation	UNP Q61234
E	75	GLY	-	expression tag	UNP Q61234
E	76	SER	-	expression tag	UNP Q61234
E	142	PHE	HIS	engineered mutation	UNP Q61234

- Molecule 2 is a protein called Nitric oxide synthase, brain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	120	909	581	161	166	1	0	0	0
2	D	123	932	595	165	171	1	0	0	0
2	F	120	909	581	161	166	1	0	0	0

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	109	MET	THR	engineered mutation	UNP P29476
D	109	MET	THR	engineered mutation	UNP P29476
F	109	MET	THR	engineered mutation	UNP P29476

- Molecule 3 is water.

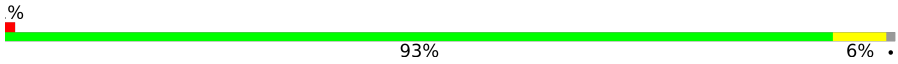
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	76	76	76	0	0
			Total	O		
3	B	107	107	107	0	0
			Total	O		
3	C	64	64	64	0	0
			Total	O		
3	D	101	101	101	0	0
			Total	O		
3	E	42	42	42	0	0
			Total	O		
3	F	111	111	111	0	0

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.

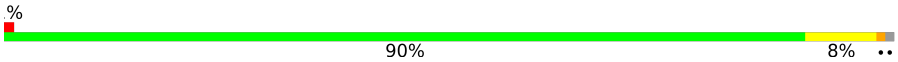
• Molecule 1: Alpha-1-syntrophin

Chain A:



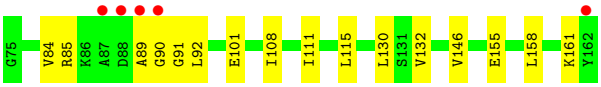
• Molecule 1: Alpha-1-syntrophin

Chain C:



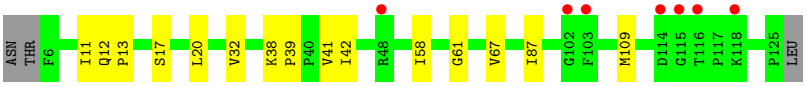
• Molecule 1: Alpha-1-syntrophin

Chain E:



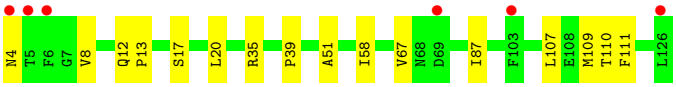
• Molecule 2: Nitric oxide synthase, brain

Chain B:



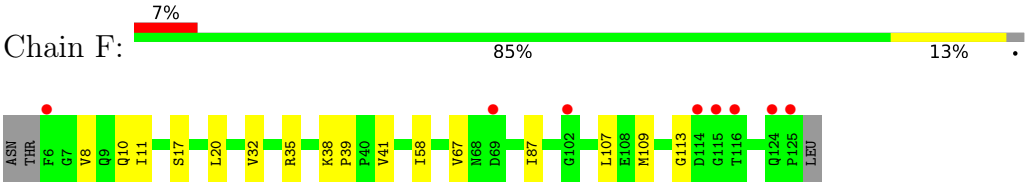
• Molecule 2: Nitric oxide synthase, brain

Chain D:



• Molecule 2: Nitric oxide synthase, brain

Chain F:


7%
85%
13%
ASN
THR
F6
G7
V8
Q9
Q10
I11
S17
L20
V32
R35
K38
P39
P40
V41
I58
V67
N68
D69
I87
G102
L107
E108
M109
G113
D114
G115
T116
Q124
P125
LEU

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	61.20Å 102.50Å 64.10Å 90.00° 118.61° 90.00°	Depositor
Resolution (Å)	47.57 – 2.29 37.89 – 2.29	Depositor EDS
% Data completeness (in resolution range)	96.6 (47.57-2.29) 96.6 (37.89-2.29)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	0.07	Depositor
$< I/\sigma(I) >$ [1]	11.76 (at 2.29Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.223 , 0.273 0.224 , 0.272	Depositor DCC
R_{free} test set	1554 reflections (4.96%)	wwPDB-VP
Wilson B-factor (Å^2)	17.7	Xtriage
Anisotropy	0.171	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 45.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.008 for h,-k,-h-l	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	5203	wwPDB-VP
Average B, all atoms (Å^2)	21.0	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 59.67 % 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 1.7056e-05. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

[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 (i)

5.1 Standard geometry (i)

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	0.34	0/650	0.52	0/869
1	C	0.33	0/650	0.55	0/869
1	E	0.32	0/662	0.51	0/885
2	B	0.32	0/923	0.53	0/1251
2	D	0.33	0/946	0.54	0/1283
2	F	0.32	0/923	0.54	0/1251
All	All	0.32	0/4754	0.54	0/6408

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	647	0	685	4	0
1	C	647	0	685	7	0
1	E	658	0	695	12	0
2	B	909	0	953	9	0
2	D	932	0	977	9	0
2	F	909	0	953	11	0
3	A	76	0	0	0	0
3	B	107	0	0	0	0
3	C	64	0	0	1	0
3	D	101	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	E	42	0	0	0	0
3	F	111	0	0	0	0
All	All	5203	0	4948	45	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 5.

All (45) 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)
2:F:20:LEU:HD11	2:F:58:ILE:HD12	1.76	0.68
1:A:112:PHE:HB3	1:A:115:LEU:HD22	1.83	0.60
1:C:161:LYS:HD3	1:E:89:ALA:HA	1.86	0.58
2:D:67:VAL:HG11	2:D:87:ILE:HD11	1.85	0.57
2:F:67:VAL:HG11	2:F:87:ILE:HD11	1.87	0.57
2:F:20:LEU:HD11	2:F:58:ILE:CD1	2.37	0.54
2:B:67:VAL:HG11	2:B:87:ILE:HD11	1.89	0.54
2:D:12:GLN:HB2	2:D:13:PRO:HD2	1.90	0.54
1:C:152:THR:HB	1:C:156:VAL:HG22	1.91	0.53
1:E:146:VAL:HG21	2:F:109:MET:HE3	1.90	0.52
1:C:77:LEU:HB3	1:E:89:ALA:HB3	1.92	0.52
2:D:8:VAL:HG22	2:D:107:LEU:HD11	1.92	0.51
1:A:112:PHE:CB	1:A:115:LEU:HD22	2.40	0.51
2:B:20:LEU:HD11	2:B:58:ILE:CD1	2.41	0.50
1:C:86:LYS:HA	1:C:116:ALA:HB2	1.93	0.50
2:F:10:GLN:HG3	2:F:107:LEU:HD12	1.94	0.49
2:D:109:MET:HG2	2:D:111:PHE:CE2	2.46	0.49
1:E:91:GLY:HA3	2:F:113:GLY:HA3	1.93	0.49
1:E:130:LEU:HD11	1:E:161:LYS:HE3	1.95	0.48
2:D:20:LEU:HD11	2:D:58:ILE:HD12	1.95	0.48
2:D:35:ARG:HD3	2:D:39:PRO:O	2.12	0.48
1:C:95:SER:OG	2:D:110:THR:HG22	2.14	0.48
2:F:32:VAL:HB	2:F:41:VAL:HG13	1.95	0.47
1:E:90:GLY:HA2	1:E:115:LEU:HD22	1.94	0.47
1:E:132:VAL:HG22	1:E:158:LEU:CD2	2.44	0.47
1:E:84:VAL:HG11	1:E:92:LEU:HD12	1.98	0.46
2:D:20:LEU:HD22	2:D:51:ALA:HB1	1.97	0.45
1:A:146:VAL:HG13	2:B:109:MET:SD	2.56	0.45
1:E:85:ARG:HG2	1:E:155:GLU:HG2	2.00	0.44
2:F:11:ILE:HD11	2:F:17:SER:HB2	2.00	0.44
2:B:32:VAL:HB	2:B:41:VAL:HG13	2.00	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:42:ILE:HD11	2:B:61:GLY:HA2	2.01	0.43
1:C:122:ALA:HB1	3:C:254:HOH:O	2.19	0.42
2:B:11:ILE:HD11	2:B:17:SER:HB2	2.00	0.42
2:D:8:VAL:HA	2:D:17:SER:O	2.19	0.42
1:A:152:THR:HB	1:A:156:VAL:HG22	2.00	0.42
2:B:12:GLN:HB2	2:B:13:PRO:CD	2.49	0.42
2:F:35:ARG:HD3	2:F:39:PRO:O	2.19	0.42
2:B:20:LEU:HD11	2:B:58:ILE:HD12	2.01	0.42
2:B:38:LYS:HA	2:B:39:PRO:C	2.40	0.42
2:F:38:LYS:HA	2:F:39:PRO:C	2.39	0.41
1:E:132:VAL:HG22	1:E:158:LEU:HD23	2.03	0.41
1:C:161:LYS:HG2	1:E:89:ALA:HB2	2.02	0.41
1:E:108:ILE:HG21	1:E:111:ILE:HD11	2.02	0.41
2:F:8:VAL:HG22	2:F:107:LEU:HD11	2.02	0.40

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	85/88 (97%)	85 (100%)	0	0	100	100
1	C	85/88 (97%)	85 (100%)	0	0	100	100
1	E	86/88 (98%)	85 (99%)	1 (1%)	0	100	100
2	B	118/123 (96%)	116 (98%)	2 (2%)	0	100	100
2	D	121/123 (98%)	119 (98%)	2 (2%)	0	100	100
2	F	118/123 (96%)	115 (98%)	3 (2%)	0	100	100
All	All	613/633 (97%)	605 (99%)	8 (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	68/69 (99%)	68 (100%)	0	100	100
1	C	68/69 (99%)	67 (98%)	1 (2%)	65	79
1	E	69/69 (100%)	68 (99%)	1 (1%)	67	81
2	B	100/104 (96%)	100 (100%)	0	100	100
2	D	103/104 (99%)	102 (99%)	1 (1%)	76	87
2	F	100/104 (96%)	100 (100%)	0	100	100
All	All	508/519 (98%)	505 (99%)	3 (1%)	86	94

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	86	LYS
2	D	4	ASN
1	E	101	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA (i)

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates (i)

There are no monosaccharides 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 (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, 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	87/88 (98%)	-0.11	1 (1%)	80	85	14, 22, 29, 32	0
1	C	87/88 (98%)	-0.15	1 (1%)	80	85	14, 21, 30, 33	0
1	E	88/88 (100%)	0.15	5 (5%)	23	30	17, 28, 39, 42	0
2	B	120/123 (97%)	0.04	7 (5%)	23	29	9, 15, 38, 41	0
2	D	123/123 (100%)	0.03	6 (4%)	29	36	8, 15, 30, 38	0
2	F	120/123 (97%)	0.04	8 (6%)	17	23	8, 15, 37, 40	0
All	All	625/633 (98%)	0.00	28 (4%)	33	40	8, 18, 37, 42	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	116	THR	5.9
2	F	114	ASP	5.2
2	F	115	GLY	4.3
1	E	89	ALA	4.2
2	B	115	GLY	3.7
2	B	114	ASP	3.5
2	D	4	ASN	3.3
1	E	87	ALA	3.0
1	E	88	ASP	3.0
1	E	162	TYR	2.9
2	D	126	LEU	2.9
1	E	90	GLY	2.9
2	F	116	THR	2.8
2	F	125	PRO	2.7
1	A	89	ALA	2.6
2	F	124	GLN	2.6
2	B	103	PHE	2.5
2	D	5	THR	2.5
2	D	69	ASP	2.4

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Mol	Chain	Res	Type	RSRZ
2	B	102	GLY	2.4
2	D	6	PHE	2.4
2	F	102	GLY	2.3
1	C	77	LEU	2.3
2	D	103	PHE	2.1
2	F	69	ASP	2.1
2	B	48	ARG	2.1
2	F	6	PHE	2.1
2	B	118	LYS	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 monosaccharides 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.