wwPDB X-ray Structure Validation Summary Report (i)

May 13, 2020 – 11:02 am BST

PDB ID	:	4HEM
Title	:	Llama vHH-02 binder of ORF49 (RBP) from lactococcal phage TP901-1
Authors	:	Desmyter, A.; Spinelli, S.; Farenc, C.; Blangy, S.; Bebeacua, C.; van Sinderen, D.; Mahony, J.; Cambillau, C.
Deposited on	:	2012-10-04
Resolution	:	1.65 Å(reported)

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	:	2.11
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)	:	2.11

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 1.65 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.
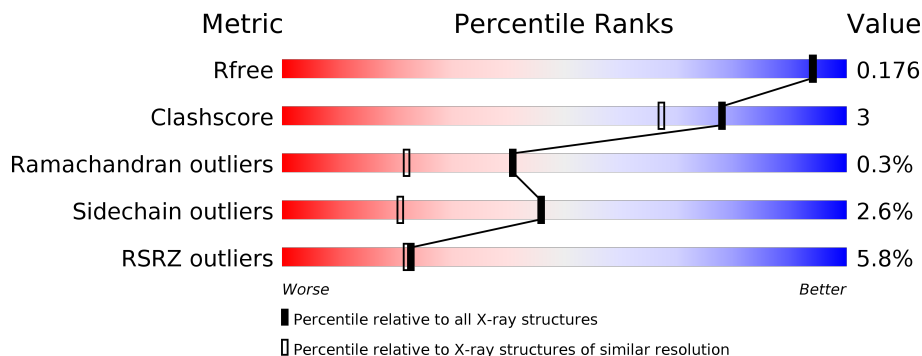
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1827 (1.66-1.66)
Clashscore	141614	1931 (1.66-1.66)
Ramachandran outliers	138981	1891 (1.66-1.66)
Sidechain outliers	138945	1891 (1.66-1.66)
RSRZ outliers	127900	1791 (1.66-1.66)

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 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	163	
1	B	163	
1	C	163	
2	E	123	
2	F	123	
2	G	123	

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 6748 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 BPP.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	130	Total	C	N	O	S	0	4	0
			985	612	174	194	5			
1	B	130	Total	C	N	O	S	0	0	0
			960	598	170	188	4			
1	C	131	Total	C	N	O	S	0	2	0
			980	611	173	192	4			

- Molecule 2 is a protein called Anti-baseplate TP901-1 Llama vHH 02.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	E	121	Total	C	N	O	S	0	3	0
			973	607	167	194	5			
2	F	122	Total	C	N	O	S	0	4	0
			977	611	168	193	5			
2	G	121	Total	C	N	O	S	0	0	0
			952	594	163	190	5			

- Molecule 3 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	197	Total	O	0	0
			197	197		
3	B	200	Total	O	0	0
			200	200		
3	C	166	Total	O	0	0
			166	166		
3	E	93	Total	O	0	0
			93	93		
3	F	142	Total	O	0	0
			142	142		
3	G	123	Total	O	0	0
			123	123		

3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA 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.
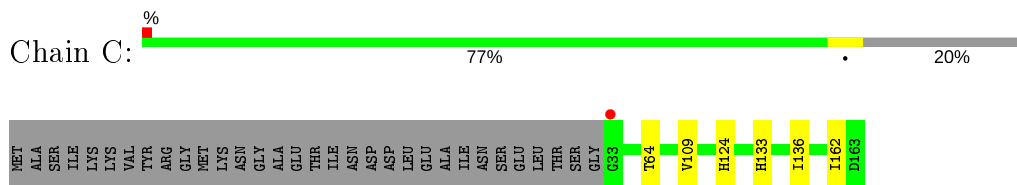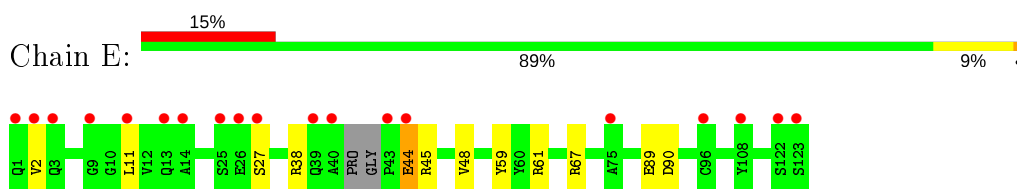
- Molecule 1: BPP
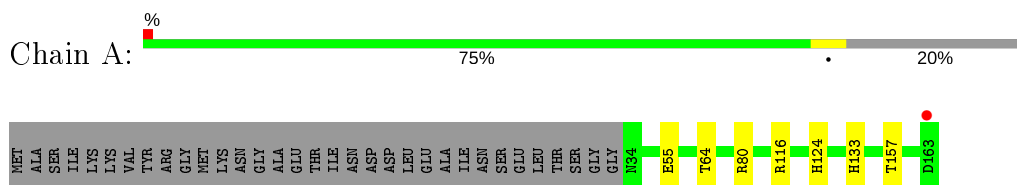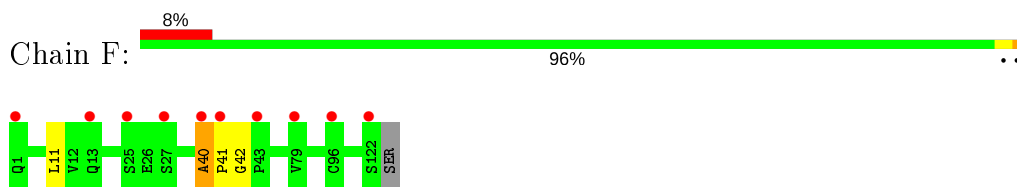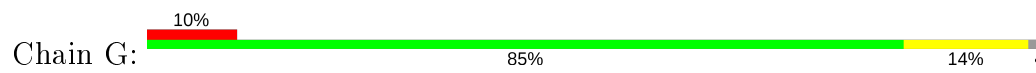

- Molecule 1: BPP
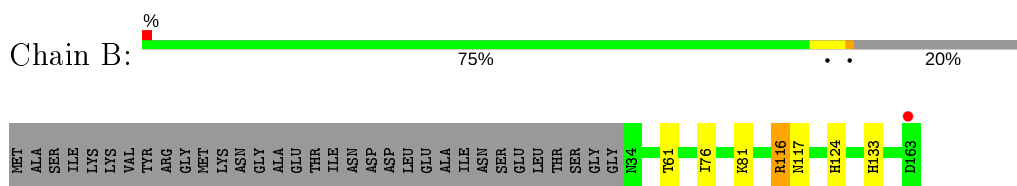
- Molecule 1: BPP

- Molecule 2: Anti-baseplate TP901-1 Llama vHH 02

- Molecule 2: Anti-baseplate TP901-1 Llama vHH 02

- Molecule 2: Anti-baseplate TP901-1 Llama vHH 02

Chain G:

4   Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	70.98Å 104.25Å 122.18Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.16 – 1.65 23.99 – 1.65	Depositor EDS
% Data completeness (in resolution range)	98.7 (24.16-1.65) 98.7 (23.99-1.65)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	5.56 (at 1.65Å)	Xtriage
Refinement program	BUSTER 2.11.2	Depositor
R, R_{free}	0.167 , 0.177 0.169 , 0.176	Depositor DCC
R_{free} test set	3234 reflections (2.99%)	wwPDB-VP
Wilson B-factor (Å^2)	22.3	Xtriage
Anisotropy	0.533	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 42.2	EDS
L-test for twinning[2]	$<|L|> = 0.49, <L^2> = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	6748	wwPDB-VP
Average B, all atoms (Å^2)	31.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.49% 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 ⓘ

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	0.52	0/1006	0.67	0/1365
1	B	0.51	0/981	0.65	0/1331
1	C	0.54	0/1001	0.70	0/1360
2	E	0.44	0/1003	0.66	0/1356
2	F	0.51	0/1012	0.67	0/1372
2	G	0.53	0/973	0.78	3/1317 (0.2%)
All	All	0.51	0/5976	0.69	3/8101 (0.0%)

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	G	8	GLY	N-CA-C	-6.46	96.94	113.10
2	G	60	TYR	O-C-N	-5.67	113.64	122.70
2	G	60	TYR	C-N-CA	5.06	134.35	121.70

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	985	0	960	9	0
1	B	960	0	943	9	0
1	C	980	0	962	7	0
2	E	973	0	912	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	F	977	0	918	1	0
2	G	952	0	882	10	0
3	A	197	0	0	1	0
3	B	200	0	0	3	0
3	C	166	0	0	1	0
3	E	93	0	0	1	0
3	F	142	0	0	0	0
3	G	123	0	0	3	0
All	All	6748	0	5577	33	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 3.

The worst 5 of 33 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:G:46:GLU:HB2	2:G:61:ARG:NH2	1.81	0.96
1:B:124:HIS:ND1	1:C:133:HIS:HD2	1.76	0.83
1:A:124:HIS:ND1	1:B:133:HIS:HD2	1.76	0.83
1:A:133:HIS:HD2	1:C:124:HIS:ND1	1.80	0.80
1:A:157[A]:THR:HG22	3:B:378:HOH:O	1.84	0.78

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	132/163 (81%)	131 (99%)	1 (1%)	0	100	100
1	B	128/163 (78%)	127 (99%)	1 (1%)	0	100	100
1	C	131/163 (80%)	131 (100%)	0	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	E	120/123 (98%)	117 (98%)	3 (2%)	0	100	100
2	F	124/123 (101%)	122 (98%)	0	2 (2%)	9	1
2	G	117/123 (95%)	116 (99%)	1 (1%)	0	100	100
All	All	752/858 (88%)	744 (99%)	6 (1%)	2 (0%)	41	22

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	F	42	GLY
2	F	40	ALA

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	110/133 (83%)	109 (99%)	1 (1%)	78	66
1	B	107/133 (80%)	105 (98%)	2 (2%)	57	34
1	C	109/133 (82%)	108 (99%)	1 (1%)	78	66
2	E	103/101 (102%)	98 (95%)	5 (5%)	25	5
2	F	103/101 (102%)	102 (99%)	1 (1%)	76	62
2	G	99/101 (98%)	93 (94%)	6 (6%)	18	3
All	All	631/702 (90%)	615 (98%)	16 (2%)	46	22

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	E	44	GLU
2	E	61	ARG
2	G	12	VAL
2	E	27	SER
2	G	25	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 13 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	133	HIS
2	E	57	HIS
2	G	39	GLN
1	C	106	ASN
2	F	101	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)

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, 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	130/163 (79%)	-0.31	1 (0%)	86	88	18, 22, 34, 63	0
1	B	130/163 (79%)	-0.41	1 (0%)	86	88	18, 23, 34, 59	0
1	C	131/163 (80%)	-0.44	1 (0%)	86	88	17, 22, 40, 61	0
2	E	121/123 (98%)	0.61	19 (15%)	2	1	23, 38, 62, 77	0
2	F	122/123 (99%)	0.22	10 (8%)	11	11	17, 26, 48, 92	0
2	G	121/123 (98%)	0.52	12 (9%)	7	6	20, 32, 59, 90	0
All	All	755/858 (87%)	0.02	44 (5%)	23	22	17, 25, 53, 92	0

The worst 5 of 44 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	G	43	PRO	7.7
2	E	43	PRO	7.4
2	F	41	PRO	7.1
2	E	44	GLU	5.5
2	G	1	GLN	5.5

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 ⓘ

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.