



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 12, 2026 – 01:34 PM UTC

PDB ID : 8PNL / pdb_00008pnl
Title : Outward-open conformation of a Major Facilitator Superfamily (MFS) transporter MHAS2168, a homologue of Rv1410 from *M. tuberculosis*, in complex with an alpaca nanobody
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Deposited on : 2023-06-30
Resolution : 2.70 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 ⓘ 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 : 4-5-2 with Phenix2.0
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

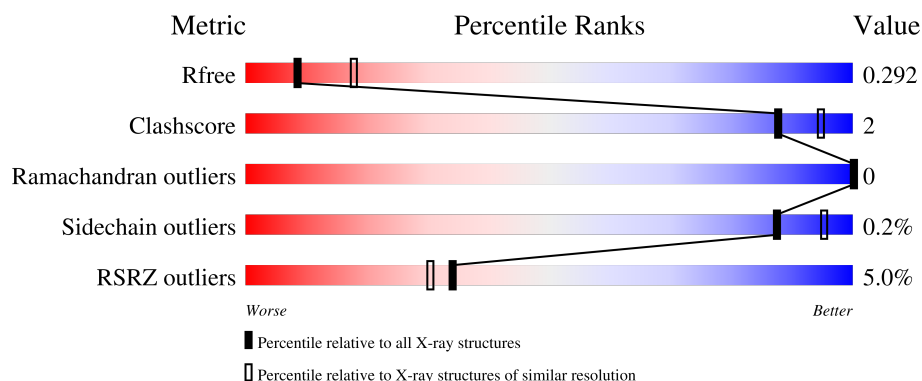
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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}	180053	3538 (2.70-2.70)
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)
RSRZ outliers	180081	3538 (2.70-2.70)

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 $\leq 5\%$. 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	543	4% 85% 11%
1	C	543	5% 84% 10%
2	B	121	2% 88% 8%
2	D	121	6% 84% 9%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 18026 atoms, of which 9202 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 triacylglyceride transporter.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	483	Total	C	H	N	O	S	0	0	0
			7310	2341	3758	601	600	10			
1	C	486	Total	C	H	N	O	S	0	0	0
			7358	2356	3781	605	606	10			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	MET	-	initiating methionine	UNP K5B8L6
A	1	SER	-	expression tag	UNP K5B8L6
A	536	ALA	-	expression tag	UNP K5B8L6
A	537	LEU	-	expression tag	UNP K5B8L6
A	538	GLU	-	expression tag	UNP K5B8L6
A	539	VAL	-	expression tag	UNP K5B8L6
A	540	LEU	-	expression tag	UNP K5B8L6
A	541	PHE	-	expression tag	UNP K5B8L6
A	542	GLN	-	expression tag	UNP K5B8L6
C	0	MET	-	initiating methionine	UNP K5B8L6
C	1	SER	-	expression tag	UNP K5B8L6
C	536	ALA	-	expression tag	UNP K5B8L6
C	537	LEU	-	expression tag	UNP K5B8L6
C	538	GLU	-	expression tag	UNP K5B8L6
C	539	VAL	-	expression tag	UNP K5B8L6
C	540	LEU	-	expression tag	UNP K5B8L6
C	541	PHE	-	expression tag	UNP K5B8L6
C	542	GLN	-	expression tag	UNP K5B8L6

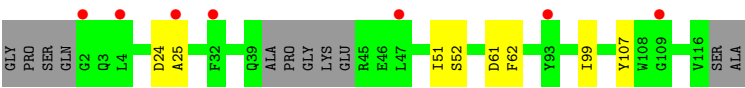
- Molecule 2 is a protein called Nb_H2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	B	111	Total	C	H	N	O	S	0	0	0
			1688	533	836	153	161	5			

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Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
2	D	110	Total	C	H	N	O	S	0	0	0
			1670	528	827	151	159	5			



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	57.78Å 160.70Å 82.96Å 90.00° 109.01° 90.00°	Depositor
Resolution (Å)	44.70 – 2.70 44.70 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.4 (44.70-2.70) 99.4 (44.70-2.70)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.35 (at 2.69Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.245 , 0.291 0.245 , 0.292	Depositor DCC
R_{free} test set	1952 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	79.6	Xtriage
Anisotropy	0.244	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.36 , 51.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.025 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	18026	wwPDB-VP
Average B, all atoms (Å ²)	102.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.05% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ 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	0.14	0/3622	0.39	0/4948
1	C	0.14	0/3648	0.38	0/4985
2	B	0.17	0/867	0.46	0/1168
2	D	0.20	0/858	0.49	0/1156
All	All	0.15	0/8995	0.40	0/12257

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	3552	3758	3755	12	2
1	C	3577	3781	3779	19	2
2	B	852	836	837	2	0
2	D	843	827	826	5	0
All	All	8824	9202	9197	36	2

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 (36) 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:C:468:MET:SD	1:C:468:MET:N	2.59	0.75
1:A:365:TRP:CH2	1:A:384:LEU:HD12	2.40	0.57
1:C:365:TRP:CH2	1:C:384:LEU:HD12	2.39	0.57
1:C:473:MET:O	1:C:477:THR:HG23	2.06	0.56
1:C:508:ILE:HG22	1:C:509:ALA:H	1.71	0.55
1:A:91:ILE:CG2	1:A:195:ILE:HD13	2.38	0.53
1:C:477:THR:HG22	2:D:99:ILE:HG13	1.94	0.49
1:A:83:ASP:OD1	1:A:87:ARG:NH2	2.47	0.47
1:A:91:ILE:HG21	1:A:195:ILE:HD13	1.97	0.47
1:A:185:VAL:HB	1:A:186:PRO:HD3	1.96	0.47
1:C:477:THR:HG21	2:D:107:TYR:HB2	1.96	0.47
1:C:185:VAL:HB	1:C:186:PRO:HD3	1.98	0.45
1:A:129:LEU:HB3	1:A:130:PRO:HD3	1.99	0.45
1:C:296:MET:HG3	1:C:434:ILE:HG21	1.99	0.44
2:D:51:ILE:HG22	2:D:52:SER:O	2.17	0.44
1:C:38:VAL:HG11	1:C:180:VAL:HG11	1.99	0.44
1:C:409:VAL:O	1:C:409:VAL:CG1	2.66	0.44
1:A:279:ARG:HB3	1:A:280:PRO:HD3	1.98	0.44
2:B:38:ARG:NH2	2:B:89:ASP:OD1	2.51	0.43
1:A:320:LEU:HD22	1:A:384:LEU:HD21	2.00	0.43
2:D:24:ASP:OD1	2:D:25:ALA:N	2.51	0.43
1:C:42:ILE:O	1:C:42:ILE:HG22	2.19	0.43
1:C:366:PRO:O	1:C:369:VAL:HG23	2.17	0.43
2:D:61:ASP:OD1	2:D:62:PHE:N	2.52	0.43
1:A:105:THR:HG23	1:A:117:GLY:HA3	2.01	0.43
1:A:82:SER:HA	1:A:90:LEU:HD12	2.00	0.42
1:C:508:ILE:HG22	1:C:509:ALA:N	2.34	0.42
2:B:36:TRP:CD1	2:B:80:LEU:HG	2.55	0.42
1:A:115:VAL:O	1:A:119:VAL:HG23	2.21	0.41
1:C:324:PHE:HB2	1:C:388:LEU:HB3	2.03	0.41
1:C:105:THR:HG23	1:C:114:LEU:HD23	2.03	0.41
1:C:264:ARG:HA	1:C:269:ARG:NH2	2.36	0.41
1:A:94:SER:O	1:A:124:ALA:HB1	2.21	0.40
1:C:61:THR:HG21	1:C:233:ALA:HB1	2.03	0.40
1:C:34:LEU:O	1:C:38:VAL:HG23	2.21	0.40
1:C:368:ASP:O	1:C:369:VAL:C	2.65	0.40

All (2) 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)
1:A:243:GLU:OE2	1:C:16:THR:OG1[1_556]	1.80	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:238:LYS:HZ1	1:C:468:MET:SD[2_555]	1.51	0.09

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	475/543 (88%)	471 (99%)	4 (1%)	0	100	100
1	C	480/543 (88%)	471 (98%)	9 (2%)	0	100	100
2	B	107/121 (88%)	105 (98%)	2 (2%)	0	100	100
2	D	106/121 (88%)	101 (95%)	5 (5%)	0	100	100
All	All	1168/1328 (88%)	1148 (98%)	20 (2%)	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	351/402 (87%)	351 (100%)	0	100	100
1	C	354/402 (88%)	352 (99%)	2 (1%)	78	91
2	B	89/95 (94%)	89 (100%)	0	100	100
2	D	88/95 (93%)	88 (100%)	0	100	100
All	All	882/994 (89%)	880 (100%)	2 (0%)	87	95

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	80	ARG
1	C	468	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
2	B	30	ASN
2	B	73	ASN
2	B	81	GLN
1	C	143	HIS
1	C	239	GLN
1	C	414	GLN
1	C	452	GLN
1	C	481	GLN
2	D	83	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 oligosaccharides 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 ⓘ

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	483/543 (88%)	0.42	24 (4%) 34 30	66, 91, 120, 151	0
1	C	486/543 (89%)	0.46	27 (5%) 30 26	72, 96, 128, 149	0
2	B	111/121 (91%)	0.36	2 (1%) 67 65	70, 101, 116, 127	0
2	D	110/121 (90%)	0.87	7 (6%) 25 22	117, 150, 167, 172	0
All	All	1190/1328 (89%)	0.47	60 (5%) 34 30	66, 96, 148, 172	0

All (60) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	B	2	GLY	5.8
1	A	233	ALA	5.4
1	C	46	ILE	4.7
2	D	25	ALA	4.1
1	A	510	GLY	4.1
1	A	416	GLY	3.4
1	C	109	THR	3.4
1	C	337	TRP	3.3
1	C	52	ILE	3.3
1	A	342	VAL	3.3
2	D	109	GLY	3.2
1	C	169	PHE	3.2
1	C	225	LEU	3.0
1	A	111	LEU	2.9
1	C	379	VAL	2.9
1	C	509	ALA	2.9
1	C	369	VAL	2.8
2	D	4	LEU	2.8
1	C	177	TRP	2.7
1	C	42	ILE	2.6
1	A	458	PRO	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	509	ALA	2.6
1	A	419	SER	2.5
2	D	93	TYR	2.5
1	A	378	PHE	2.5
1	A	508	ILE	2.5
1	C	381	LEU	2.5
1	C	188	ALA	2.4
1	C	378	PHE	2.4
1	A	409	VAL	2.4
1	A	461	ALA	2.4
1	A	51	GLY	2.4
1	A	486	GLN	2.4
1	A	369	VAL	2.4
1	A	304	LEU	2.3
1	A	353	LEU	2.3
1	C	310	LEU	2.3
1	C	50	VAL	2.3
1	A	405	ALA	2.3
1	A	460	PRO	2.3
1	A	64	ILE	2.3
1	C	270	LEU	2.3
1	C	338	ILE	2.3
1	A	337	TRP	2.3
2	B	39	GLN	2.2
2	D	2	GLY	2.2
1	C	490	ILE	2.2
1	C	484	VAL	2.2
1	A	417	ILE	2.2
1	A	459	ALA	2.2
1	C	510	GLY	2.2
2	D	47	LEU	2.2
1	C	461	ALA	2.2
1	A	144	LYS	2.2
2	D	32	PHE	2.2
1	C	234	GLU	2.1
1	C	262	TRP	2.1
1	C	342	VAL	2.1
1	C	349	ALA	2.1
1	C	437	LEU	2.1

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 oligosaccharides 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.