



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 12:27 AM UTC

PDB ID : 4CMH / pdb_00004cmh
Title : Crystal structure of CD38 with a novel CD38-targeting antibody SAR650984
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Deposited on : 2014-01-15
Resolution : 1.53 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

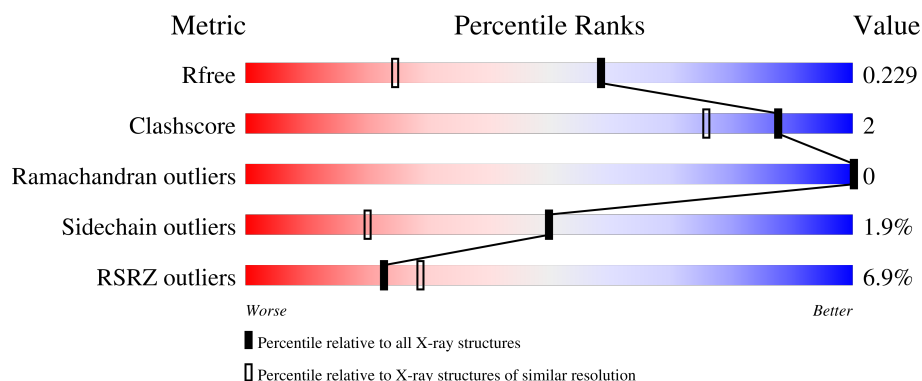
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.53 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	1003 (1.54-1.54)
Clashscore	190562	1025 (1.54-1.54)
Ramachandran outliers	187476	1007 (1.54-1.54)
Sidechain outliers	187428	1007 (1.54-1.54)
RSRZ outliers	180081	1002 (1.54-1.54)

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	256	13% 84% 9% 6%
2	B	234	2% 87% 5% 8%
3	C	214	4% 91% 8%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5901 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 ADP-RIBOSYL CYCLASE 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	240	Total	C	N	O	S	0	4	0
			1961	1242	337	365	17			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	100	ASP	ASN	engineered mutation	UNP P28907
A	164	ALA	ASN	engineered mutation	UNP P28907
A	209	ASP	ASN	engineered mutation	UNP P28907
A	219	ASP	ASN	engineered mutation	UNP P28907

- Molecule 2 is a protein called HEAVY CHAIN OF SAR650984-FAB FRAGMENT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	216	Total	C	N	O	S	0	6	0
			1650	1045	268	330	7			

- Molecule 3 is a protein called LIGHT CHAIN OF SAR650984-FAB FRAGMENT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	213	Total	C	N	O	S	0	7	0
			1700	1069	286	339	6			

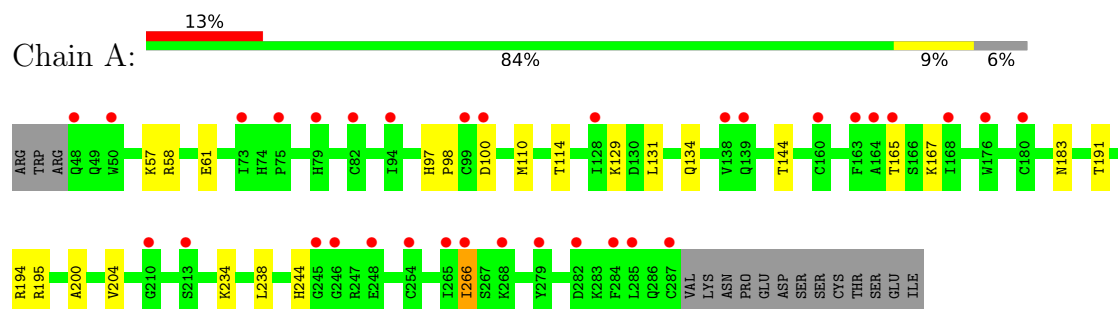
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	130	Total	O	0	0
			130	130		
4	B	242	Total	O	0	0
			242	242		
4	C	218	Total	O	0	0
			218	218		

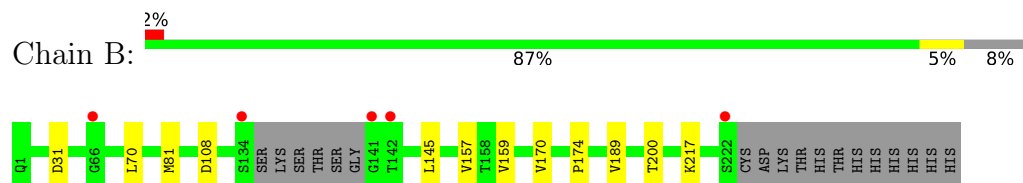
3 Residue-property plots [i](#)

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.

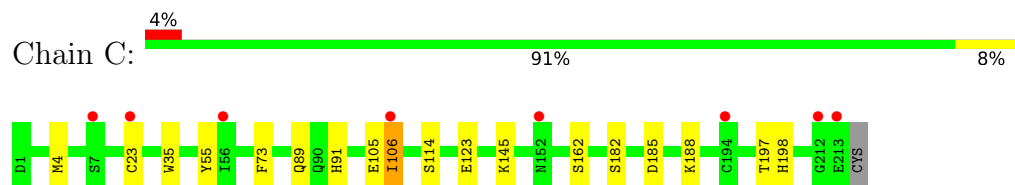
• Molecule 1: ADP-RIBOSYL CYCLASE 1



• Molecule 2: HEAVY CHAIN OF SAR650984-FAB FRAGMENT



• Molecule 3: LIGHT CHAIN OF SAR650984-FAB FRAGMENT



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	43.62Å 111.49Å 147.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	26.21 – 1.53 26.21 – 1.53	Depositor EDS
% Data completeness (in resolution range)	99.5 (26.21-1.53) 93.4 (26.21-1.53)	Depositor EDS
R_{merge}	0.09	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.96 (at 1.53Å)	Xtriage
Refinement program	BUSTER 2.11.4	Depositor
R, R_{free}	0.188 , 0.208 (Not available) , 0.229	Depositor DCC
R_{free} test set	5462 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	23.3	Xtriage
Anisotropy	0.041	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 41.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	5901	wwPDB-VP
Average B, all atoms (Å ²)	32.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.37% 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	0.85	3/2021 (0.1%)	1.15	4/2737 (0.1%)
2	B	0.79	0/1700	0.98	1/2315 (0.0%)
3	C	0.83	1/1744 (0.1%)	1.04	6/2370 (0.3%)
All	All	0.83	4/5465 (0.1%)	1.06	11/7422 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	C	91	HIS	ND1-CE1	5.53	1.38	1.32
1	A	97	HIS	ND1-CE1	5.30	1.37	1.32
1	A	244	HIS	ND1-CE1	5.06	1.37	1.32
1	A	134	GLN	CD-OE1	5.01	1.33	1.23

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	97	HIS	CB-CG-CD2	-7.48	121.47	131.20
2	B	108	ASP	CA-CB-CG	7.26	119.86	112.60
1	A	244	HIS	CB-CG-CD2	-7.20	121.83	131.20
3	C	198	HIS	CB-CG-CD2	-7.02	122.07	131.20
3	C	91	HIS	CB-CG-CD2	-6.38	122.90	131.20
3	C	182	SER	N-CA-C	-5.98	102.48	110.55
1	A	144	THR	N-CA-C	-5.60	102.47	110.59
3	C	114	SER	N-CA-C	-5.20	100.82	109.46
3	C	89	GLN	CA-C-N	-5.01	115.81	122.72
3	C	89	GLN	C-N-CA	-5.01	115.81	122.72
1	A	100	ASP	CA-CB-CG	5.01	117.61	112.60

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	1961	0	1912	11	0
2	B	1650	0	1608	5	0
3	C	1700	0	1655	8	0
4	A	130	0	0	1	0
4	B	242	0	0	0	0
4	C	218	0	0	2	0
All	All	5901	0	5175	21	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 2.

All (21) 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:110[B]:MET:SD	1:A:191:THR:HG22	2.29	0.73
3:C:106[B]:ILE:HD11	4:C:2023:HOH:O	2.04	0.58
1:A:110[B]:MET:SD	1:A:191:THR:CG2	2.94	0.56
2:B:70:LEU:HD21	2:B:81[B]:MET:HE3	1.91	0.53
2:B:170:VAL:HG22	2:B:189[A]:VAL:HG22	1.90	0.53
1:A:195:ARG:HD3	2:B:31:ASP:HB3	1.92	0.51
1:A:114[B]:THR:HG23	4:A:2066:HOH:O	2.11	0.51
1:A:58:ARG:HD2	1:A:61:GLU:OE1	2.15	0.47
3:C:145:LYS:HB3	3:C:197:THR:HB	1.97	0.47
1:A:234:LYS:HD2	3:C:55:TYR:OH	2.17	0.45
1:A:238:LEU:HD22	1:A:266:ILE:HG13	1.98	0.45
1:A:191:THR:O	1:A:194:ARG:HG2	2.18	0.44
2:B:174:PRO:HD2	3:C:162:SER:OG	2.18	0.43
2:B:200:THR:HG23	2:B:217:LYS:HE3	2.01	0.42
3:C:123:GLU:HG3	4:C:2141:HOH:O	2.19	0.42
3:C:35:TRP:CD2	3:C:73:PHE:HB2	2.55	0.42
3:C:185:ASP:O	3:C:188:LYS:HG2	2.21	0.40
1:A:98:PRO:O	1:A:183:ASN:HA	2.21	0.40
3:C:4:MET:HE3	3:C:23:CYS:SG	2.61	0.40
1:A:110[B]:MET:CE	1:A:191:THR:HG22	2.50	0.40
1:A:200:ALA:HB1	1:A:204:VAL:HG22	2.03	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	242/256 (94%)	235 (97%)	7 (3%)	0	100	100
2	B	218/234 (93%)	215 (99%)	3 (1%)	0	100	100
3	C	218/214 (102%)	213 (98%)	5 (2%)	0	100	100
All	All	678/704 (96%)	663 (98%)	15 (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	223/236 (94%)	217 (97%)	6 (3%)	39	10
2	B	186/197 (94%)	183 (98%)	3 (2%)	55	25
3	C	194/188 (103%)	191 (98%)	3 (2%)	57	27
All	All	603/621 (97%)	591 (98%)	12 (2%)	50	18

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	57	LYS
1	A	129	LYS

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Mol	Chain	Res	Type
1	A	131	LEU
1	A	165	THR
1	A	167	LYS
1	A	266	ILE
2	B	145	LEU
2	B	157	VAL
2	B	159	VAL
3	C	105	GLU
3	C	106[A]	ILE
3	C	106[B]	ILE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	134	GLN
1	A	139	GLN
1	A	228	HIS
1	A	231	GLN
1	A	255	GLN
2	B	39	GLN
3	C	38	GLN
3	C	199	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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	240/256 (93%)	1.12	33 (13%) 6 8	13, 38, 67, 96	4 (1%)
2	B	216/234 (92%)	0.13	5 (2%) 61 71	10, 23, 41, 87	6 (2%)
3	C	213/214 (99%)	0.21	8 (3%) 44 53	11, 25, 41, 74	7 (3%)
All	All	669/704 (95%)	0.51	46 (6%) 23 29	10, 27, 60, 96	17 (2%)

All (46) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	176	TRP	4.0
2	B	134	SER	4.0
1	A	180	CYS	3.9
1	A	245	GLY	3.8
3	C	7	SER	3.7
1	A	82	CYS	3.7
2	B	222	SER	3.6
1	A	266	ILE	3.6
1	A	73	ILE	3.6
1	A	138	VAL	3.5
1	A	79	HIS	3.5
1	A	285	LEU	3.5
1	A	164	ALA	3.4
1	A	287	CYS	3.3
1	A	213	SER	3.3
1	A	163	PHE	3.2
1	A	284	PHE	3.2
1	A	254	CYS	3.1
3	C	152	ASN	2.9
1	A	168	ILE	2.8
1	A	268	LYS	2.8
3	C	56	ILE	2.7
3	C	212	GLY	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	75	PRO	2.7
1	A	265	ILE	2.7
1	A	160	CYS	2.6
2	B	141	GLY	2.6
1	A	246	GLY	2.5
1	A	139	GLN	2.5
1	A	210	GLY	2.5
3	C	194	CYS	2.4
2	B	142	THR	2.4
1	A	165	THR	2.3
1	A	48	GLN	2.2
3	C	23	CYS	2.2
1	A	279	TYR	2.1
2	B	66	GLY	2.1
1	A	248	GLU	2.1
1	A	50	TRP	2.1
1	A	94	ILE	2.0
1	A	128	ILE	2.0
3	C	106[A]	ILE	2.0
1	A	100	ASP	2.0
3	C	213	GLU	2.0
1	A	99	CYS	2.0
1	A	282	ASP	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 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.