



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 04:24 AM UTC

PDB ID : 9DQ3 / pdb_00009dq3
Title : Crystal structure of engineered Ipilimumab (mipi.4) Fab in complex with human CTLA-4
Authors : Diong, S.J.; Lee, P.S.
Deposited on : 2024-09-23
Resolution : 1.64 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

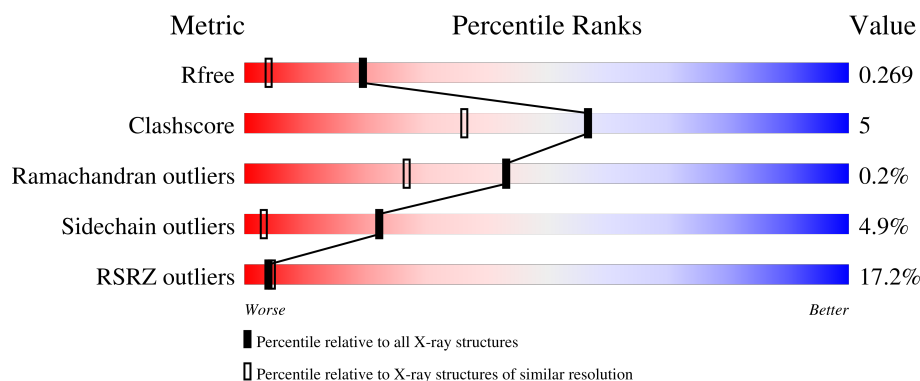
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.64 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	1141 (1.64-1.64)
Clashscore	190562	1171 (1.64-1.64)
Ramachandran outliers	187476	1151 (1.64-1.64)
Sidechain outliers	187428	1150 (1.64-1.64)
RSRZ outliers	180081	1141 (1.64-1.64)

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	C	125	38% 61% 12% • 25%
2	H	229	8% 83% 9% • 7%
3	L	215	11% 90% 9% •

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4274 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 Cytotoxic T-lymphocyte protein 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	C	94	Total	C	N	O	S	0	0	0
			683	436	111	128	8			

There are 7 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	119	GLY	-	expression tag	UNP P16410
C	120	HIS	-	expression tag	UNP P16410
C	121	HIS	-	expression tag	UNP P16410
C	122	HIS	-	expression tag	UNP P16410
C	123	HIS	-	expression tag	UNP P16410
C	124	HIS	-	expression tag	UNP P16410
C	125	HIS	-	expression tag	UNP P16410

- Molecule 2 is a protein called mipi.4 heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	H	214	Total	C	N	O	S	0	0	0
			1618	1029	276	307	6			

- Molecule 3 is a protein called mipi.4 light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	215	Total	C	N	O	S	0	0	0
			1652	1039	280	328	5			

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	C	31	Total	O	0	0
			31	31		

Continued on next page...

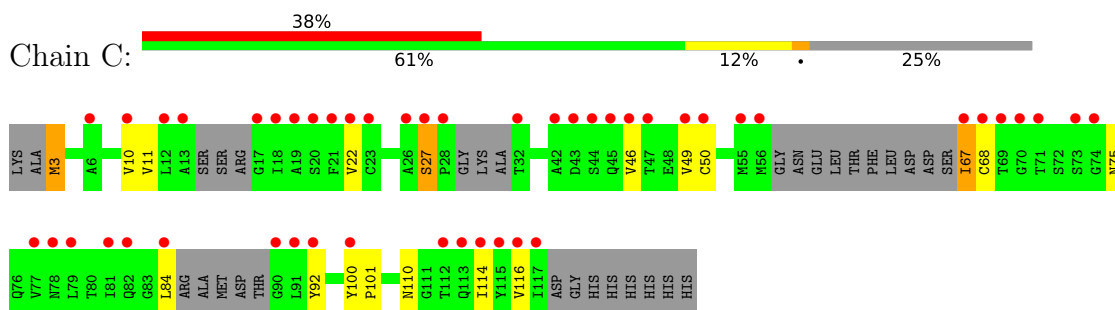
Continued from previous page...

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	H	152	Total 152	O 152	0	0
4	L	138	Total 138	O 138	0	0

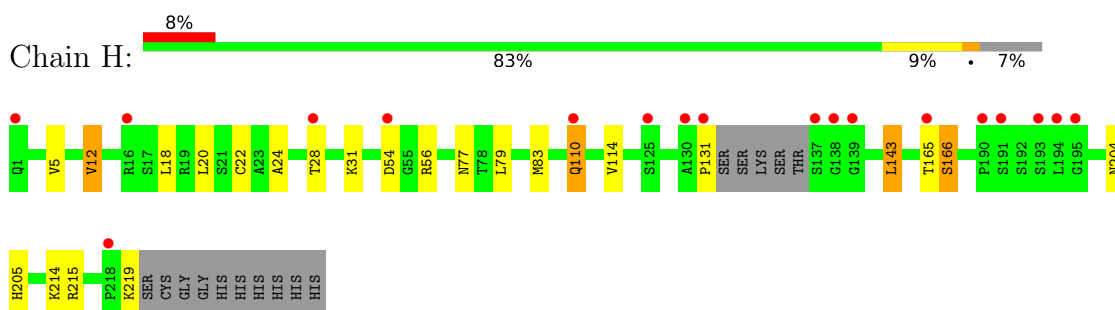
3 Residue-property plots [i](#)

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.

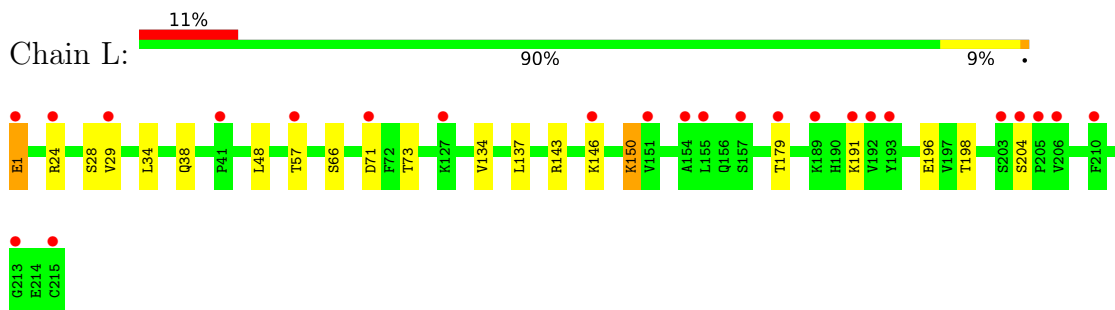
• Molecule 1: Cytotoxic T-lymphocyte protein 4



• Molecule 2: mipi.4 heavy chain



• Molecule 3: mipi.4 light chain



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	84.02Å 148.36Å 48.44Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.96 – 1.64 41.96 – 1.64	Depositor EDS
% Data completeness (in resolution range)	78.2 (41.96-1.64) 78.8 (41.96-1.64)	Depositor EDS
R_{merge}	0.21	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.50 (at 1.63Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487: ???)	Depositor
R, R_{free}	0.232 , 0.268 0.232 , 0.269	Depositor DCC
R_{free} test set	2950 reflections (3.90%)	wwPDB-VP
Wilson B-factor (Å ²)	18.9	Xtriage
Anisotropy	0.036	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 29.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	4274	wwPDB-VP
Average B, all atoms (Å ²)	22.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.72% 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

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	C	0.25	0/692	0.43	0/941
2	H	0.32	0/1660	0.56	0/2262
3	L	0.30	0/1692	0.54	0/2301
All	All	0.30	0/4044	0.53	0/5504

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

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	C	683	0	653	9	0
2	H	1618	0	1568	16	1
3	L	1652	0	1591	11	0
4	C	31	0	0	3	0
4	H	152	0	0	4	1
4	L	138	0	0	5	0
All	All	4274	0	3812	36	1

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 (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)
2:H:77:ASN:O	4:H:301:HOH:O	1.88	0.92
2:H:24:ALA:N	4:H:301:HOH:O	2.10	0.81
3:L:150:LYS:NZ	4:L:302:HOH:O	2.21	0.73
2:H:28:THR:HG22	4:H:431:HOH:O	2.00	0.62
2:H:165:THR:O	2:H:165:THR:OG1	2.17	0.61
1:C:3:MET:N	4:C:203:HOH:O	2.33	0.60
3:L:143:ARG:NH1	4:L:305:HOH:O	2.38	0.57
3:L:1:GLU:N	4:L:301:HOH:O	2.11	0.56
2:H:12:VAL:HG21	2:H:18:LEU:HD22	1.89	0.55
2:H:54:ASP:OD2	2:H:56:ARG:NE	2.42	0.53
3:L:134:VAL:HG22	3:L:179:THR:HG22	1.92	0.52
2:H:22:CYS:HB3	2:H:79:LEU:HB3	1.91	0.51
2:H:83:MET:HE1	2:H:114:VAL:HG21	1.92	0.51
3:L:38:GLN:HB2	3:L:48:LEU:HD11	1.96	0.48
2:H:131:PRO:HD3	2:H:143:LEU:HB3	1.94	0.48
3:L:150:LYS:NZ	3:L:196:GLU:OE1	2.42	0.46
1:C:27:SER:HB3	1:C:75:ASN:OD1	2.17	0.45
2:H:204:ASN:HD22	2:H:205:HIS:N	2.14	0.45
1:C:110:ASN:ND2	4:C:201:HOH:O	2.21	0.45
2:H:110:GLN:NE2	4:H:311:HOH:O	2.47	0.45
1:C:49:VAL:HG12	1:C:50:CYS:SG	2.57	0.45
3:L:66:SER:OG	3:L:73:THR:OG1	2.35	0.44
3:L:57:THR:HG22	4:L:407:HOH:O	2.18	0.43
2:H:20:LEU:HG	2:H:83:MET:HE2	1.99	0.43
3:L:191:LYS:NZ	4:L:308:HOH:O	2.47	0.42
1:C:100:TYR:CD1	1:C:101:PRO:HA	2.55	0.42
1:C:67:ILE:N	4:C:205:HOH:O	2.51	0.42
1:C:3:MET:HB2	1:C:3:MET:HE2	1.77	0.42
2:H:12:VAL:CG2	2:H:18:LEU:HD22	2.50	0.42
2:H:31:LYS:HE3	2:H:31:LYS:HB3	1.81	0.42
1:C:84:LEU:HB3	1:C:116:VAL:HG21	2.01	0.41
2:H:5:VAL:HG23	2:H:5:VAL:O	2.21	0.41
3:L:146:LYS:HB2	3:L:198:THR:OG1	2.21	0.41
3:L:29:VAL:HG12	3:L:29:VAL:O	2.19	0.41
2:H:165:THR:O	2:H:166:SER:HB2	2.20	0.40
1:C:92:TYR:CE1	1:C:114:ILE:HG12	2.56	0.40

All (1) 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)
2:H:215:ARG:NH1	4:H:301:HOH:O[4_456]	1.97	0.23

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	C	84/125 (67%)	81 (96%)	3 (4%)	0	100	100
2	H	210/229 (92%)	207 (99%)	2 (1%)	1 (0%)	24	9
3	L	213/215 (99%)	210 (99%)	3 (1%)	0	100	100
All	All	507/569 (89%)	498 (98%)	8 (2%)	1 (0%)	43	27

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	H	166	SER

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	C	70/103 (68%)	62 (89%)	8 (11%)	5	0
2	H	174/192 (91%)	169 (97%)	5 (3%)	37	11
3	L	183/186 (98%)	175 (96%)	8 (4%)	25	4
All	All	427/481 (89%)	406 (95%)	21 (5%)	22	3

All (21) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	3	MET
1	C	10	VAL

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	C	11	VAL
1	C	22	VAL
1	C	27	SER
1	C	46	VAL
1	C	67	ILE
1	C	68	CYS
2	H	12	VAL
2	H	110	GLN
2	H	143	LEU
2	H	214	LYS
2	H	219	LYS
3	L	1	GLU
3	L	24	ARG
3	L	28	SER
3	L	34	LEU
3	L	71	ASP
3	L	137	LEU
3	L	150	LYS
3	L	204	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
2	H	110	GLN
2	H	204	ASN

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

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 [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	C	94/125 (75%)	2.18	48 (51%)	0 0	16, 36, 49, 58	0
2	H	214/229 (93%)	0.35	18 (8%)	17 20	9, 17, 35, 51	0
3	L	215/215 (100%)	0.53	24 (11%)	10 11	11, 19, 35, 59	0
All	All	523/569 (91%)	0.76	90 (17%)	4 4	9, 19, 44, 59	0

All (90) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	L	215	CYS	6.8
1	C	23	CYS	5.7
1	C	84	LEU	5.6
3	L	204	SER	5.6
1	C	20	SER	5.0
1	C	22	VAL	4.8
1	C	13	ALA	4.8
1	C	114	ILE	4.7
1	C	28	PRO	4.7
1	C	26	ALA	4.5
1	C	67	ILE	4.3
1	C	18	ILE	4.3
2	H	195	GLY	4.1
1	C	44	SER	4.0
1	C	17	GLY	4.0
1	C	56	MET	3.9
1	C	90	GLY	3.9
2	H	1	GLN	3.9
1	C	43	ASP	3.9
1	C	68	CYS	3.9
1	C	32	THR	3.8
2	H	137	SER	3.7
1	C	100	TYR	3.7

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	C	21	PHE	3.7
3	L	29	VAL	3.7
1	C	12	LEU	3.7
2	H	194	LEU	3.6
1	C	117	ILE	3.5
2	H	138	GLY	3.5
1	C	55	MET	3.3
1	C	81	ILE	3.3
2	H	54	ASP	3.3
1	C	42	ALA	3.2
2	H	165	THR	3.2
3	L	213	GLY	3.2
2	H	28	THR	3.2
3	L	192	VAL	3.1
1	C	45	GLN	3.0
1	C	115	TYR	3.0
3	L	127	LYS	3.0
3	L	203	SER	3.0
1	C	10	VAL	2.9
2	H	110	GLN	2.9
3	L	205	PRO	2.9
3	L	206	VAL	2.9
2	H	131	PRO	2.9
3	L	155	LEU	2.9
3	L	1	GLU	2.8
3	L	154	ALA	2.8
1	C	46	VAL	2.8
1	C	47	THR	2.8
3	L	210	PHE	2.7
1	C	116	VAL	2.7
1	C	74	GLY	2.7
3	L	191	LYS	2.7
3	L	189	LYS	2.6
1	C	73	SER	2.5
1	C	49	VAL	2.5
2	H	218	PRO	2.5
1	C	91	LEU	2.5
1	C	50	CYS	2.5
1	C	92	TYR	2.4
3	L	157	SER	2.4
1	C	27	SER	2.4
1	C	19	ALA	2.3

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	RSRZ
1	C	71	THR	2.3
1	C	112	THR	2.3
3	L	57	THR	2.3
3	L	179	THR	2.3
1	C	113	GLN	2.3
2	H	139	GLY	2.3
1	C	82	GLN	2.2
2	H	190	PRO	2.2
1	C	6	ALA	2.2
2	H	130	ALA	2.2
2	H	125	SER	2.2
2	H	191	SER	2.2
1	C	69	THR	2.2
1	C	70	GLY	2.1
1	C	79	LEU	2.1
3	L	193	TYR	2.1
3	L	151	VAL	2.1
1	C	78	ASN	2.1
2	H	193	SER	2.1
2	H	16	ARG	2.1
3	L	146	LYS	2.1
3	L	71	ASP	2.0
3	L	24	ARG	2.0
3	L	41	PRO	2.0
1	C	77	VAL	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.