



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 27, 2025 – 12:22 PM EST

PDB ID : 9DQ3  
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](mailto: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>.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Xtriage (Phenix) : 1.21  
EDS : 3.0  
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
CCP4 : 9.0.004 (Gargrove)  
Density-Fitness : 1.0.11  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.40

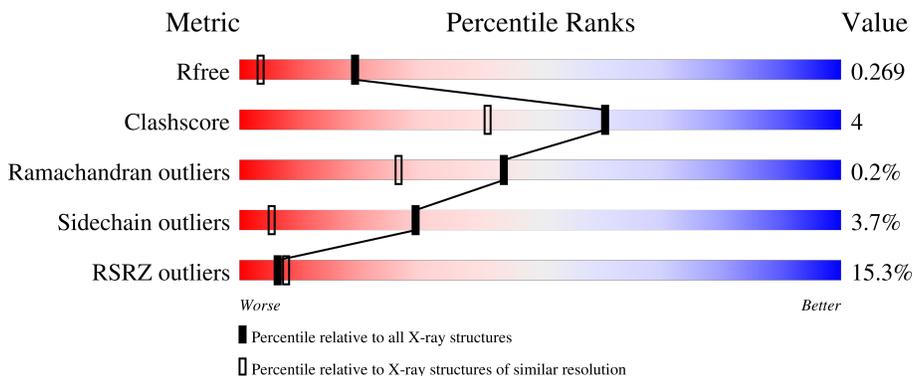
# 1 Overall quality at a glance

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))
$R_{free}$	164625	1015 (1.64-1.64)
Clashscore	180529	1093 (1.64-1.64)
Ramachandran outliers	177936	1077 (1.64-1.64)
Sidechain outliers	177891	1077 (1.64-1.64)
RSRZ outliers	164620	1015 (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  $\geq 3$ , 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	
2	H	229	
3	L	215	

## 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
			Total	C	N	O	S			
1	C	94	683	436	111	128	8	0	0	0

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
			Total	C	N	O	S			
2	H	214	1618	1029	276	307	6	0	0	0

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

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

- Molecule 4 is water.

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

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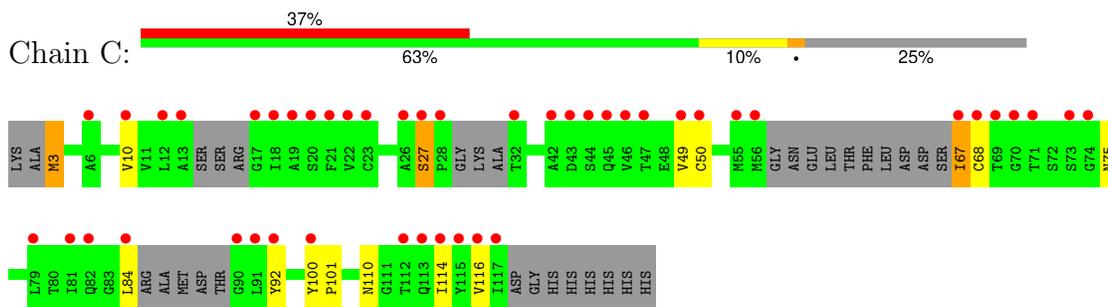
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
4	H	152	Total 152	O 152	0	0
4	L	138	Total 138	O 138	0	0

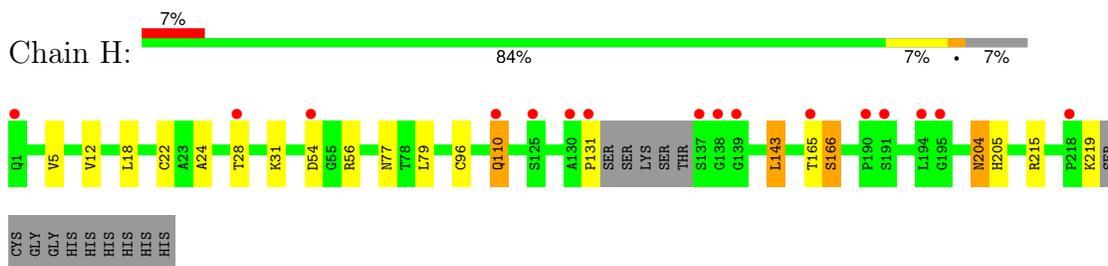
### 3 Residue-property plots [i](#)

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.

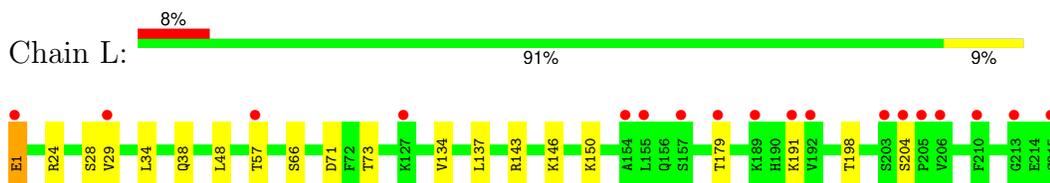
- Molecule 1: Cytotoxic T-lymphocyte protein 4



- 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, $\alpha$ , $\beta$ , $\gamma$	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
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.50 (at 1.63Å)	Xtrriage
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	3732 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.9	Xtrriage
Anisotropy	0.036	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 29.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	4274	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	22.0	wwPDB-VP

Xtrriage'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.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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	C	0.36	0/692	0.54	0/941
2	H	0.41	1/1660 (0.1%)	0.64	0/2262
3	L	0.40	0/1692	0.63	0/2301
All	All	0.40	1/4044 (0.0%)	0.62	0/5504

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	H	96	CYS	CB-SG	-5.49	1.72	1.81

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	C	683	0	653	8	0
2	H	1618	0	1568	14	1
3	L	1652	0	1591	10	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	32	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 4.

All (32) 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:OG1	2:H:165:THR:O	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
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
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
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
2:H:12:VAL:CG2	2:H:18:LEU:HD22	2.50	0.42
3:L:29:VAL:HG12	3:L:29:VAL:O	2.19	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
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 [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	C	84/125 (67%)	81 (96%)	3 (4%)	0	100	100
2	H	210/229 (92%)	207 (99%)	2 (1%)	1 (0%)	25	9
3	L	213/215 (99%)	210 (99%)	3 (1%)	0	100	100
All	All	507/569 (89%)	498 (98%)	8 (2%)	1 (0%)	44	26

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	H	166	SER

#### 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	C	70/103 (68%)	65 (93%)	5 (7%)	12	1
2	H	174/192 (91%)	170 (98%)	4 (2%)	45	17
3	L	183/186 (98%)	176 (96%)	7 (4%)	28	5
All	All	427/481 (89%)	411 (96%)	16 (4%)	29	5

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	3	MET
1	C	10	VAL
1	C	27	SER
1	C	67	ILE
1	C	68	CYS
2	H	110	GLN
2	H	143	LEU
2	H	204	ASN
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	204	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	H	204	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 [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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	C	94/125 (75%)	2.08	46 (48%) 0 0	16, 36, 49, 58	0
2	H	214/229 (93%)	0.27	16 (7%) 22 24	9, 17, 35, 51	0
3	L	215/215 (100%)	0.45	18 (8%) 18 20	11, 19, 35, 59	0
All	All	523/569 (91%)	0.67	80 (15%) 6 8	9, 19, 44, 59	0

All (80) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	L	215	CYS	6.6
1	C	23	CYS	5.5
3	L	204	SER	5.5
1	C	84	LEU	5.4
1	C	20	SER	4.9
1	C	22	VAL	4.6
1	C	13	ALA	4.6
1	C	114	ILE	4.6
1	C	28	PRO	4.5
1	C	26	ALA	4.3
1	C	67	ILE	4.2
1	C	18	ILE	4.1
1	C	44	SER	3.9
2	H	195	GLY	3.9
1	C	56	MET	3.8
2	H	1	GLN	3.8
1	C	17	GLY	3.8
1	C	43	ASP	3.8
1	C	68	CYS	3.7
1	C	90	GLY	3.7
1	C	32	THR	3.7
2	H	137	SER	3.6
1	C	21	PHE	3.6

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	C	100	TYR	3.6
1	C	12	LEU	3.6
3	L	29	VAL	3.5
2	H	194	LEU	3.5
1	C	117	ILE	3.3
2	H	138	GLY	3.3
1	C	55	MET	3.2
2	H	54	ASP	3.2
1	C	81	ILE	3.1
2	H	165	THR	3.1
1	C	42	ALA	3.1
2	H	28	THR	3.1
3	L	213	GLY	3.0
3	L	192	VAL	2.9
1	C	45	GLN	2.9
3	L	127	LYS	2.9
1	C	115	TYR	2.9
3	L	203	SER	2.9
2	H	110	GLN	2.9
1	C	10	VAL	2.8
3	L	205	PRO	2.8
2	H	131	PRO	2.8
3	L	206	VAL	2.8
3	L	1	GLU	2.8
3	L	155	LEU	2.7
3	L	154	ALA	2.7
1	C	46	VAL	2.7
3	L	210	PHE	2.7
1	C	47	THR	2.6
3	L	191	LYS	2.6
1	C	116	VAL	2.6
1	C	74	GLY	2.6
3	L	189	LYS	2.6
1	C	73	SER	2.4
2	H	218	PRO	2.4
1	C	49	VAL	2.4
1	C	91	LEU	2.4
1	C	50	CYS	2.4
1	C	92	TYR	2.3
3	L	157	SER	2.3
1	C	27	SER	2.3
1	C	71	THR	2.2

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Mol	Chain	Res	Type	RSRZ
1	C	19	ALA	2.2
1	C	112	THR	2.2
3	L	57	THR	2.2
1	C	113	GLN	2.2
3	L	179	THR	2.2
1	C	82	GLN	2.2
2	H	125	SER	2.1
2	H	190	PRO	2.1
2	H	139	GLY	2.1
2	H	191	SER	2.1
1	C	6	ALA	2.1
2	H	130	ALA	2.1
1	C	69	THR	2.0
1	C	79	LEU	2.0
1	C	70	GLY	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.