



wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 13, 2026 – 10:35 AM EDT

PDB ID : 9PLP / pdb_00009plp
Title : Crystal structure of netrin-1 in complex with anti-netrin-1 Fab (NP137 Fab)
Authors : Rafiei, F.; Bailey-Elkin, B.A.; Stetefeld, J.
Deposited on : 2025-07-15
Resolution : 4.99 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

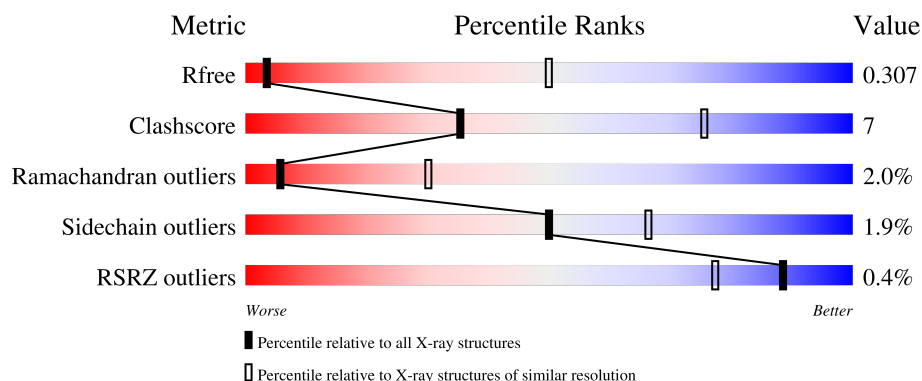
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 4.99 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	1009 (6.02-3.98)
Clashscore	190562	1040 (6.00-4.00)
Ramachandran outliers	187476	1015 (6.06-3.92)
Sidechain outliers	187428	1136 (6.10-3.90)
RSRZ outliers	180081	1004 (6.02-3.98)

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	443	
1	B	443	
2	C	222	
2	H	222	
3	D	225	

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Mol	Chain	Length	Quality of chain
3	L	225	% 40% 7% 52%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 10399 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 Netrin-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	396	Total	C	N	O	S	0	0	0
			3108	1910	579	582	37			
1	B	397	Total	C	N	O	S	0	0	0
			3111	1914	578	582	37			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	22	ALA	-	insertion	UNP Q90922
A	23	PRO	-	insertion	UNP Q90922
A	24	LEU	-	insertion	UNP Q90922
A	25	ALA	-	insertion	UNP Q90922
A	459	GLY	-	expression tag	UNP Q90922
A	460	SER	-	expression tag	UNP Q90922
A	461	LEU	-	expression tag	UNP Q90922
A	462	VAL	-	expression tag	UNP Q90922
A	463	PRO	-	expression tag	UNP Q90922
A	464	ARG	-	expression tag	UNP Q90922
B	22	ALA	-	insertion	UNP Q90922
B	23	PRO	-	insertion	UNP Q90922
B	24	LEU	-	insertion	UNP Q90922
B	25	ALA	-	insertion	UNP Q90922
B	459	GLY	-	expression tag	UNP Q90922
B	460	SER	-	expression tag	UNP Q90922
B	461	LEU	-	expression tag	UNP Q90922
B	462	VAL	-	expression tag	UNP Q90922
B	463	PRO	-	expression tag	UNP Q90922
B	464	ARG	-	expression tag	UNP Q90922

- Molecule 2 is a protein called NP137 Fab heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	182	Total	C	N	O	S	0	0	0
			1199	746	210	238	5			
2	H	115	Total	C	N	O	S	0	0	0
			860	544	140	171	5			

- Molecule 3 is a protein called NP137 Fab light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	197	Total	C	N	O	S	0	0	0
			1280	800	224	253	3			
3	L	108	Total	C	N	O	S	0	0	0
			839	537	135	164	3			

- Molecule 4 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Ca	0	0
			1	1		
4	B	1	Total	Ca	0	0
			1	1		

- Molecule 1: Netrin-1

K395	P396	I397	H398	H399	R400	K401	A402	C406	G412	D429	G430	V431	G443	GLN	GLN	SER	ARG	PRO	SER	PRO	SER	ILE	ALA	CYS	ILE	LYS	ILE	PRO	ALA	GLY	SER	LEU	VAL	ARG													
ASP	SER	GLU	LEU	A270	R271	Y276	L281	Q282	Q283	G284	G285	G286	C287	A293	S294	D299	D300	D301	D302	N303	K309	H310	N311	T312	A313	D318	R319	G320	K321	A332	T333	A334	R335	N346	E357	L358	R364	G367	G368	V369	N372	R380	H381		R391		
Y148	Y149	S150	L151	R157	M161	K165	S166	P167	D168	M173	V174	P175	F176	Q177	F178	Y179	P190	S191	R192	A193	I195	Q198	A203	T204	T210	D211	V212	R213	P214	L215	G218	F222	S223	T224	T247	K250	F253	H257	D261	GLU	ASN	GLU	K269				
ALA	PRO	LEU	ALA	GLY	TYR	PRO	GLY	LEU	ASN	MET	PHE	ALA	VAL	GLN	THR	ALA	GLN	P440	C443	H447	G448	L449	R452	F457	K464	V468	G466	R491	S492	C493	S108	F109	L110	T111	Q123	W122	S126	Y127	V128	Q129	Y130	P131	H132	N133	V134	T135	L136

- Molecule 1: Netrin-1

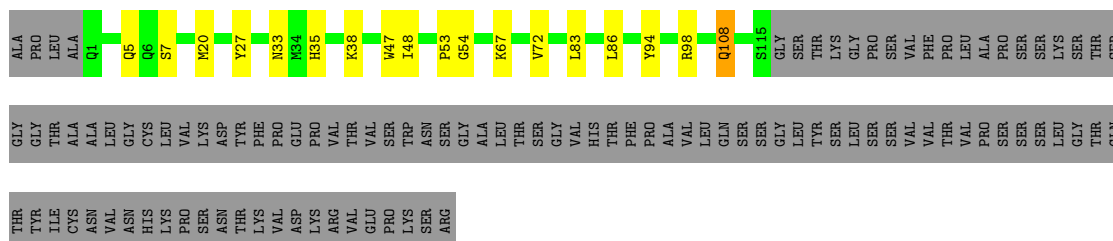
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- Molecule 2: NP137 Fab heavy chain

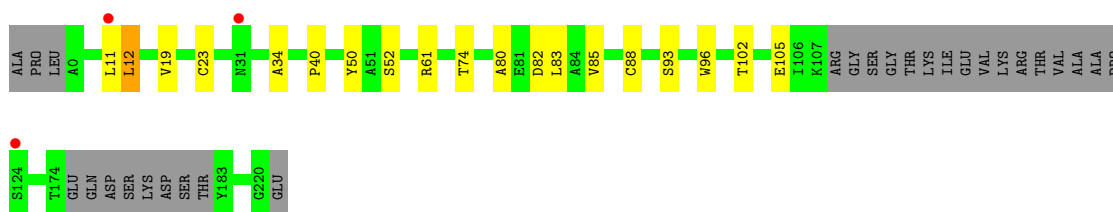
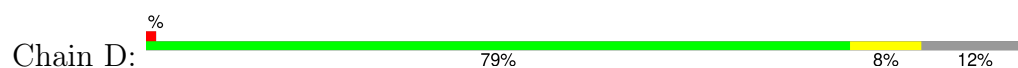
ALA	ALA	PRO	LEU	ALA	Q1	Q5	Q6	S7	K19	N33	P24	H35	K38	V47	L48	P63	G64	K67	V72	Y80	L86	C96	F103	Q108	V114	S115	GLY	SER	THR	LYS	GLY	PRO	S122	P128	SER	SER	LYS	SER	THR	GLY	GLY	F148
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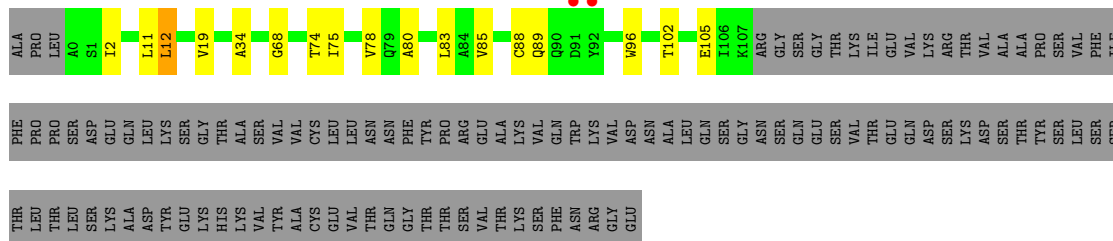
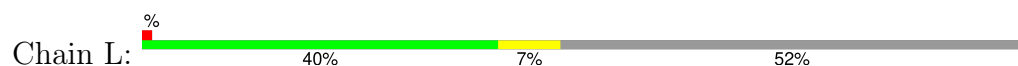
• Molecule 2: NP137 Fab heavy chain



• Molecule 3: NP137 Fab light chain



• Molecule 3: NP137 Fab light chain



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	67.98Å 263.05Å 68.77Å 90.00° 92.51° 90.00°	Depositor
Resolution (Å)	49.39 – 4.99 49.39 – 4.99	Depositor EDS
% Data completeness (in resolution range)	91.0 (49.39-4.99) 91.1 (49.39-4.99)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.30 (at 5.10Å)	Xtriage
Refinement program	REFMAC 5.8.0430 (refmacat 0.4.105)	Depositor
R, R_{free}	0.286 , 0.321 0.303 , 0.307	Depositor DCC
R_{free} test set	967 reflections (9.19%)	wwPDB-VP
Wilson B-factor (Å ²)	312.2	Xtriage
Anisotropy	0.080	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.22 , 310.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.000 for l,k,-h 0.032 for h,-k,-l 0.166 for l,-k,h	Xtriage
Reported twinning fraction	0.547 for H, K, L 0.453 for -L, -K, -H	Depositor
Outliers	0 of 9577 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10399	wwPDB-VP
Average B, all atoms (Å ²)	137.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.13% 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

Bond lengths and bond angles in the following residue types are not validated in this section: CA

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	0.56	0/3186	0.86	0/4310
1	B	0.58	0/3189	0.86	0/4315
2	C	0.50	0/1216	0.74	0/1656
2	H	0.61	0/881	0.84	0/1196
3	D	0.53	0/1299	0.74	0/1779
3	L	0.55	0/860	0.75	0/1170
All	All	0.56	0/10631	0.83	0/14426

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	3
1	B	0	3
All	All	0	6

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	286	ARG	Sidechain
1	A	300	ARG	Sidechain
1	A	335	ARG	Sidechain
1	B	103	ARG	Sidechain
1	B	213	ARG	Sidechain

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	3108	0	2931	62	0
1	B	3111	0	2936	52	0
2	C	1199	0	958	11	0
2	H	860	0	810	9	0
3	D	1280	0	1006	9	0
3	L	839	0	814	8	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
All	All	10399	0	9455	147	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 7.

The worst 5 of 147 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:157:ARG:NH2	1:A:211:ASP:OD1	1.95	1.00
1:B:165:LYS:HB3	1:B:176:PHE:CE2	2.20	0.77
1:A:165:LYS:HB3	1:A:176:PHE:CE2	2.21	0.75
1:A:214:PRO:HG2	1:A:218:GLY:HA2	1.73	0.69
2:H:38:LYS:HB2	2:H:48:ILE:HD11	1.76	0.67

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	392/443 (88%)	341 (87%)	39 (10%)	12 (3%)	3	21
1	B	393/443 (89%)	351 (89%)	33 (8%)	9 (2%)	5	27
2	C	172/222 (78%)	155 (90%)	14 (8%)	3 (2%)	7	34
2	H	113/222 (51%)	101 (89%)	10 (9%)	2 (2%)	6	32
3	D	191/225 (85%)	173 (91%)	17 (9%)	1 (0%)	24	63
3	L	106/225 (47%)	93 (88%)	12 (11%)	1 (1%)	14	50
All	All	1367/1780 (77%)	1214 (89%)	125 (9%)	28 (2%)	6	30

5 of 28 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	319	ARG
1	A	48	GLY
1	A	86	GLY
1	B	48	GLY
1	B	86	GLY

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	A	347/385 (90%)	341 (98%)	6 (2%)	53	68
1	B	347/385 (90%)	343 (99%)	4 (1%)	63	74
2	C	90/183 (49%)	88 (98%)	2 (2%)	45	64
2	H	89/183 (49%)	87 (98%)	2 (2%)	45	64
3	D	92/195 (47%)	89 (97%)	3 (3%)	33	55
3	L	92/195 (47%)	89 (97%)	3 (3%)	33	55
All	All	1057/1526 (69%)	1037 (98%)	20 (2%)	50	66

5 of 20 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	D	23	CYS

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Mol	Chain	Res	Type
3	L	11	LEU
3	L	89	GLN
3	L	12	LEU
1	B	93	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 28 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	94	HIS
3	L	89	GLN
1	B	282	GLN
2	H	5	GLN
1	B	188	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 ⓘ

Of 2 ligands modelled in this entry, 2 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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, 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	396/443 (89%)	-0.97	0 100 100	108, 125, 218, 259	0
1	B	397/443 (89%)	-0.92	1 (0%) 90 80	83, 108, 203, 281	0
2	C	182/222 (81%)	-0.76	0 100 100	170, 185, 204, 216	0
2	H	115/222 (51%)	-0.96	0 100 100	70, 84, 109, 123	0
3	D	197/225 (87%)	-0.81	3 (1%) 72 57	138, 157, 201, 212	0
3	L	108/225 (48%)	-0.82	2 (1%) 66 53	145, 155, 176, 188	0
All	All	1395/1780 (78%)	-0.89	6 (0%) 88 77	70, 135, 203, 281	0

The worst 5 of 6 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	411	VAL	4.2
3	L	91	ASP	2.9
3	D	124	SER	2.9
3	L	92	TYR	2.8
3	D	31	ASN	2.4

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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
4	CA	B	501	1/1	0.99	0.02	50,50,50,50	0
4	CA	A	501	1/1	1.00	0.01	50,50,50,50	0

6.5 Other polymers [i](#)

There are no such residues in this entry.