



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 01:49 AM UTC

PDB ID : 5NOI / pdb_00005noi
Title : human Robo2 extracellular domains 4-5
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Deposited on : 2017-04-12
Resolution : 2.40 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

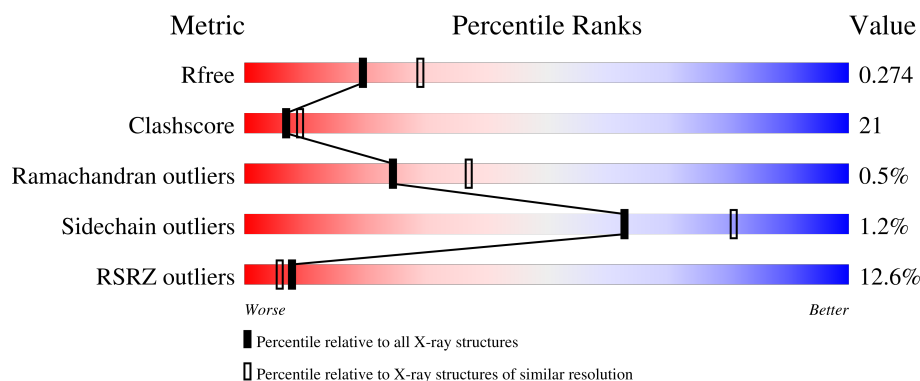
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	4912 (2.40-2.40)
Clashscore	190562	5391 (2.40-2.40)
Ramachandran outliers	187476	5320 (2.40-2.40)
Sidechain outliers	187428	5321 (2.40-2.40)
RSRZ outliers	180081	4916 (2.40-2.40)

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	201	12% 67% 23% 8%

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1490 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 Roundabout homolog 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	198	Total	C	N	O	S	0	0	0
			1476	928	253	289	6			

There are 3 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	426	MET	ASN	conflict	UNP Q9HCK4
A	510	LYS	-	expression tag	UNP Q9HCK4
A	511	LEU	-	expression tag	UNP Q9HCK4

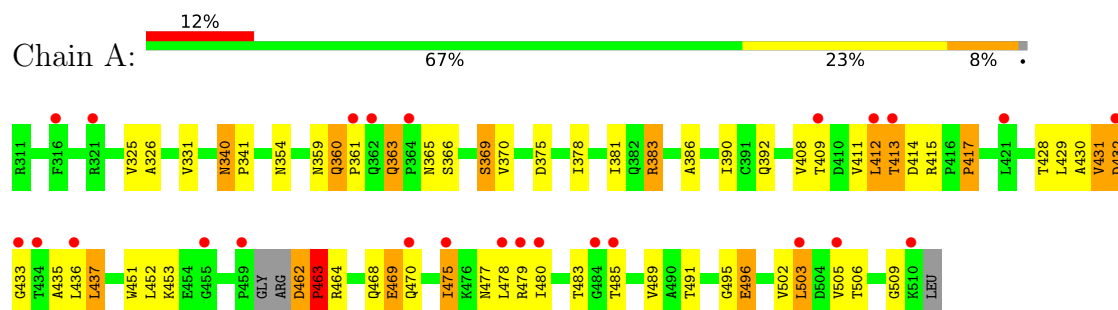
- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	14	Total	O	0	0
			14	14		

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: Roundabout homolog 2



4 Data and refinement statistics

Property	Value	Source
Space group	I 41 2 2	Depositor
Cell constants a, b, c, α , β , γ	99.75Å 99.75Å 123.47Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.80 – 2.40 38.80 – 2.40	Depositor EDS
% Data completeness (in resolution range)	100.0 (38.80-2.40) 92.1 (38.80-2.40)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	0.79 (at 2.39Å)	Xtriage
Refinement program	PHENIX (1.10.1_2155: ???)	Depositor
R, R_{free}	0.237 , 0.267 0.253 , 0.274	Depositor DCC
R_{free} test set	1254 reflections (10.00%)	wwPDB-VP
Wilson B-factor (Å ²)	59.1	Xtriage
Anisotropy	0.243	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 41.9	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	1490	wwPDB-VP
Average B, all atoms (Å ²)	77.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.44% 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	A	1.08	11/1507 (0.7%)	1.26	24/2064 (1.2%)

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	5

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	463	PRO	N-CD	-17.19	1.23	1.47
1	A	417	PRO	N-CD	-12.70	1.29	1.47
1	A	415	ARG	NE-CZ	-7.88	1.24	1.33
1	A	383	ARG	NE-CZ	-6.67	1.25	1.33
1	A	383	ARG	CZ-NH2	-6.29	1.25	1.33
1	A	415	ARG	CZ-NH1	-6.12	1.24	1.32
1	A	496	GLU	CD-OE1	-5.78	1.14	1.25
1	A	437	LEU	CG-CD1	-5.78	1.33	1.52
1	A	503	LEU	CG-CD1	-5.63	1.33	1.52
1	A	453	LYS	CD-CE	-5.34	1.36	1.52
1	A	415	ARG	CZ-NH2	-5.19	1.26	1.33

All (24) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	462	ASP	CA-C-N	15.55	139.28	119.84
1	A	462	ASP	C-N-CA	15.55	139.28	119.84
1	A	431	VAL	CA-C-N	12.55	140.02	122.07
1	A	431	VAL	C-N-CA	12.55	140.02	122.07
1	A	413	THR	O-C-N	-8.90	110.75	122.59

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	360	GLN	CA-C-N	8.27	129.06	119.47
1	A	360	GLN	C-N-CA	8.27	129.06	119.47
1	A	340	ASN	O-C-N	7.09	129.47	121.32
1	A	412	LEU	CA-C-N	6.84	134.61	121.54
1	A	412	LEU	C-N-CA	6.84	134.61	121.54
1	A	468	GLN	CA-C-N	-6.72	110.29	121.92
1	A	468	GLN	C-N-CA	-6.72	110.29	121.92
1	A	469	GLU	O-C-N	-6.64	113.59	122.49
1	A	469	GLU	CA-C-N	6.26	132.09	121.14
1	A	469	GLU	C-N-CA	6.26	132.09	121.14
1	A	475	ILE	CA-C-N	-6.21	112.84	122.59
1	A	475	ILE	C-N-CA	-6.21	112.84	122.59
1	A	475	ILE	O-C-N	-5.69	117.11	123.26
1	A	463	PRO	N-CD-CG	5.55	111.52	103.20
1	A	361	PRO	N-CA-C	5.54	121.85	113.81
1	A	363	GLN	C-N-CD	-5.48	108.55	120.60
1	A	363	GLN	CA-C-N	5.25	139.61	127.00
1	A	363	GLN	C-N-CA	5.25	139.61	127.00
1	A	462	ASP	C-N-CD	-5.08	104.16	125.00

There are no chirality outliers.

All (5) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	413	THR	Mainchain
1	A	432	ASP	Mainchain
1	A	463	PRO	Mainchain
1	A	469	GLU	Mainchain
1	A	470	GLN	Mainchain

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	1476	0	1453	62	1
2	A	14	0	0	4	0
All	All	1490	0	1453	62	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 21.

All (62) 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:479:ARG:O	1:A:505:VAL:HG11	1.53	1.08
1:A:462:ASP:CB	1:A:463:PRO:HD2	1.91	1.00
1:A:462:ASP:CB	1:A:463:PRO:CD	2.45	0.93
1:A:462:ASP:HB2	1:A:463:PRO:CD	1.99	0.93
1:A:462:ASP:HB2	1:A:463:PRO:HD2	1.52	0.91
1:A:480:ILE:HA	1:A:505:VAL:CG1	2.01	0.91
1:A:483:THR:HG22	1:A:505:VAL:H	1.36	0.88
1:A:365:ASN:O	2:A:601:HOH:O	1.97	0.81
1:A:435:ALA:HB3	1:A:475:ILE:CG2	2.10	0.80
1:A:479:ARG:C	1:A:505:VAL:HG11	2.06	0.80
1:A:463:PRO:HG2	1:A:464:ARG:HG3	1.62	0.80
1:A:341:PRO:O	2:A:602:HOH:O	2.01	0.79
1:A:354:ASN:O	2:A:603:HOH:O	2.02	0.78
1:A:483:THR:HG23	1:A:505:VAL:HG12	1.68	0.76
1:A:478:LEU:O	1:A:479:ARG:HG3	1.87	0.74
1:A:462:ASP:HB2	1:A:463:PRO:HD3	1.71	0.73
1:A:462:ASP:CG	1:A:463:PRO:HD2	2.15	0.72
1:A:480:ILE:HA	1:A:505:VAL:HG13	1.72	0.70
1:A:462:ASP:CB	1:A:463:PRO:HD3	2.21	0.70
1:A:432:ASP:HA	1:A:477:ASN:HA	1.75	0.69
1:A:483:THR:HG22	1:A:505:VAL:N	2.08	0.67
1:A:435:ALA:HB3	1:A:475:ILE:HG22	1.78	0.65
1:A:451:TRP:O	1:A:452:LEU:HD23	1.98	0.64
1:A:505:VAL:HG13	1:A:505:VAL:O	1.98	0.63
1:A:483:THR:CG2	1:A:505:VAL:HG12	2.29	0.62
1:A:326:ALA:HA	1:A:409:THR:HG23	1.81	0.61
1:A:369:SER:OG	2:A:604:HOH:O	2.16	0.61
1:A:365:ASN:O	1:A:365:ASN:ND2	2.34	0.60
1:A:478:LEU:HB3	1:A:505:VAL:HG21	1.84	0.59
1:A:431:VAL:HG12	1:A:432:ASP:OD2	2.03	0.58
1:A:478:LEU:O	1:A:479:ARG:CG	2.51	0.58
1:A:503:LEU:C	1:A:503:LEU:HD23	2.28	0.58
1:A:325:VAL:HG13	1:A:381:ILE:HD11	1.86	0.58
1:A:505:VAL:CG1	1:A:505:VAL:O	2.52	0.58
1:A:463:PRO:CG	1:A:464:ARG:HG3	2.32	0.57
1:A:437:LEU:HD23	1:A:437:LEU:N	2.19	0.57
1:A:485:THR:HG22	1:A:502:VAL:CG2	2.36	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:363:GLN:CB	1:A:366:SER:H	2.20	0.55
1:A:390:ILE:HG22	1:A:392:GLN:HG3	1.90	0.52
1:A:478:LEU:HD22	1:A:478:LEU:H	1.75	0.52
1:A:480:ILE:CA	1:A:505:VAL:CG1	2.83	0.52
1:A:340:ASN:HA	1:A:341:PRO:C	2.34	0.51
1:A:430:ALA:HB2	1:A:509:GLY:HA3	1.91	0.51
1:A:433:GLY:O	1:A:478:LEU:HD22	2.11	0.50
1:A:417:PRO:HB3	1:A:495:GLY:HA3	1.93	0.50
1:A:431:VAL:HG23	1:A:506:THR:O	2.13	0.49
1:A:489:VAL:HG12	1:A:491:THR:HG23	1.95	0.47
1:A:370:VAL:HA	1:A:375:ASP:O	2.15	0.46
1:A:485:THR:HG22	1:A:502:VAL:HG22	1.98	0.46
1:A:485:THR:HG22	1:A:502:VAL:HG23	1.99	0.45
1:A:431:VAL:HG13	1:A:479:ARG:HA	1.98	0.45
1:A:386:ALA:HB2	1:A:408:VAL:HG23	1.99	0.44
1:A:432:ASP:HA	1:A:477:ASN:CA	2.44	0.44
1:A:435:ALA:C	1:A:436:LEU:HD12	2.43	0.44
1:A:331:VAL:HG12	1:A:378:ILE:HB	2.00	0.44
1:A:428:THR:O	1:A:429:LEU:HD23	2.19	0.43
1:A:340:ASN:HA	1:A:341:PRO:HA	1.87	0.42
1:A:411:VAL:O	1:A:412:LEU:HD23	2.18	0.42
1:A:491:THR:HG22	1:A:496:GLU:CG	2.50	0.42
1:A:326:ALA:HB1	1:A:411:VAL:HG22	2.02	0.41
1:A:463:PRO:CD	1:A:464:ARG:H	2.34	0.40
1:A:359:ASN:C	1:A:360:GLN:HG2	2.45	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)
1:A:383:ARG:NH1	1:A:383:ARG:NH1[15_557]	1.57	0.63

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	A	194/201 (96%)	183 (94%)	10 (5%)	1 (0%)	24	37

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	463	PRO

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	163/171 (95%)	161 (99%)	2 (1%)	63	81

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

Mol	Chain	Res	Type
1	A	369	SER
1	A	414	ASP

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

Mol	Chain	Res	Type
1	A	365	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 [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 ⓘ

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	198/201 (98%)	0.78	25 (12%) 8 6	46, 67, 129, 150	0

All (25) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	413	THR	5.8
1	A	479	ARG	5.2
1	A	510	LYS	4.2
1	A	412	LEU	3.8
1	A	459	PRO	3.6
1	A	485	THR	3.5
1	A	364	PRO	3.4
1	A	362	GLN	3.4
1	A	434	THR	3.2
1	A	361	PRO	3.2
1	A	484	GLY	3.1
1	A	480	ILE	2.9
1	A	432	ASP	2.8
1	A	433	GLY	2.7
1	A	409	THR	2.5
1	A	505	VAL	2.4
1	A	478	LEU	2.4
1	A	470	GLN	2.4
1	A	475	ILE	2.3
1	A	316	PHE	2.3
1	A	421	LEU	2.1
1	A	503	LEU	2.1
1	A	321	ARG	2.1
1	A	436	LEU	2.0
1	A	455	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 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.