Full wwPDB X-ray Structure Validation Report (i)

Jan 21, 2026 – 09:11 am GMT

PDB ID	:	9R16 / pdb_00009r16
Title	:	Structure of mutant SHP2
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Deposited on	:	2025-04-25
Resolution	:	2.63 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 (i) 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 (i)) were used in the production of this report:

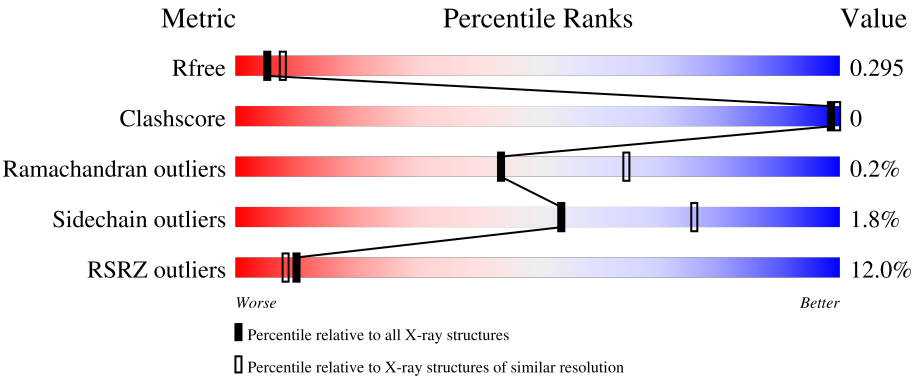
MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.47

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.63 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	4623 (2.64-2.60)
Clashscore	180529	5071 (2.64-2.60)
Ramachandran outliers	177936	5006 (2.64-2.60)
Sidechain outliers	177891	5006 (2.64-2.60)
RSRZ outliers	164620	4622 (2.64-2.60)

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 <=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	536	11% 92% · 5%
1	B	536	11% 92% · 5%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 16635 atoms, of which 8119 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 Tyrosine-protein phosphatase non-receptor type 11.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	510	Total	C	H	N	O	S	4070	3	0
			8209	2597	4070	743	780	19			
1	B	509	Total	C	H	N	O	S	4049	2	0
			8174	2586	4049	741	779	19			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	62	ASP	TYR	engineered mutation	UNP Q06124
A	529	LEU	-	expression tag	UNP Q06124
A	530	GLU	-	expression tag	UNP Q06124
A	531	HIS	-	expression tag	UNP Q06124
A	532	HIS	-	expression tag	UNP Q06124
A	533	HIS	-	expression tag	UNP Q06124
A	534	HIS	-	expression tag	UNP Q06124
A	535	HIS	-	expression tag	UNP Q06124
A	536	HIS	-	expression tag	UNP Q06124
B	62	ASP	TYR	engineered mutation	UNP Q06124
B	529	LEU	-	expression tag	UNP Q06124
B	530	GLU	-	expression tag	UNP Q06124
B	531	HIS	-	expression tag	UNP Q06124
B	532	HIS	-	expression tag	UNP Q06124
B	533	HIS	-	expression tag	UNP Q06124
B	534	HIS	-	expression tag	UNP Q06124
B	535	HIS	-	expression tag	UNP Q06124
B	536	HIS	-	expression tag	UNP Q06124

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	119	Total	O	0	0
			119	119		

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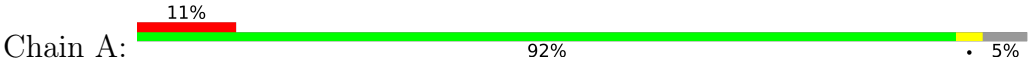
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	B	133	Total 133	O 133	0	0

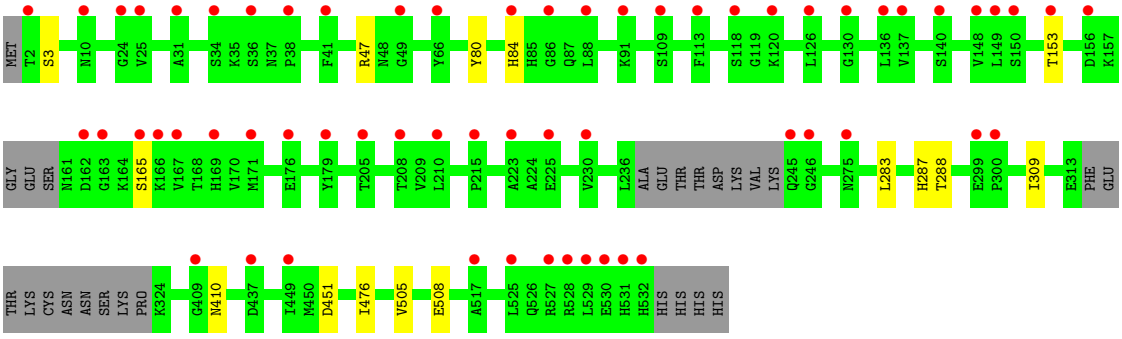
3 Residue-property plots (i)

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: Tyrosine-protein phosphatase non-receptor type 11

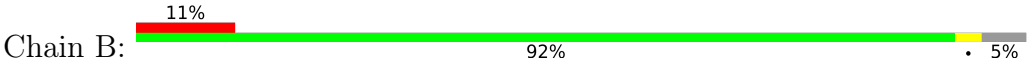
Chain A:

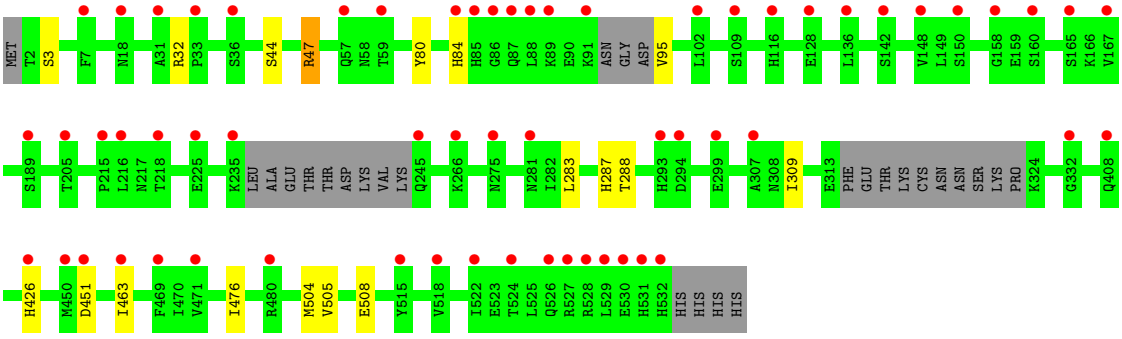




• Molecule 1: Tyrosine-protein phosphatase non-receptor type 11

Chain B:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	45.18Å 212.16Å 54.92Å 90.00° 96.46° 90.00°	Depositor
Resolution (Å)	27.78 – 2.63 27.78 – 2.63	Depositor EDS
% Data completeness (in resolution range)	69.1 (27.78-2.63) 69.0 (27.78-2.63)	Depositor EDS
R_{merge}	0.25	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.11 (at 2.64Å)	Xtriage
Refinement program	BUSTER 2.11.8	Depositor
R, R_{free}	0.280 , 0.304 0.270 , 0.295	Depositor DCC
R_{free} test set	1036 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å^2)	34.4	Xtriage
Anisotropy	0.034	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.32 , 46.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.30$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.83	EDS
Total number of atoms	16635	wwPDB-VP
Average B, all atoms (Å^2)	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.84% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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	0.51	0/4236	0.77	0/5712
1	B	0.52	0/4219	0.77	0/5688
All	All	0.52	0/8455	0.77	0/11400

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	A	4139	4070	4056	3	0
1	B	4125	4049	4035	5	0
2	A	119	0	0	0	0
2	B	133	0	0	0	0
All	All	8516	8119	8091	8	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 0.

All (8) 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:B:47:ARG:NH2	1:B:95:VAL:O	2.05	0.88

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:32:ARG:NH1	1:B:44:SER:OG	2.50	0.44
1:A:80:TYR:O	1:A:84:HIS:HB3	2.18	0.44
1:B:80:TYR:O	1:B:84:HIS:HB3	2.18	0.43
1:A:153:THR:O	1:A:165:SER:HA	2.19	0.43
1:B:463:ILE:O	1:B:504:MET:HA	2.19	0.43
1:B:287:HIS:CD2	1:B:288:THR:HG23	2.55	0.42
1:A:287:HIS:CD2	1:A:288:THR:HG23	2.55	0.41

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	505/536 (94%)	492 (97%)	12 (2%)	1 (0%)	44	65
1	B	503/536 (94%)	492 (98%)	10 (2%)	1 (0%)	44	65
All	All	1008/1072 (94%)	984 (98%)	22 (2%)	2 (0%)	44	65

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	505	VAL
1	B	505	VAL

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	457/478 (96%)	449 (98%)	8 (2%)	54 76
1	B	455/478 (95%)	447 (98%)	8 (2%)	54 76
All	All	912/956 (95%)	896 (98%)	16 (2%)	54 76

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

Mol	Chain	Res	Type
1	A	3	SER
1	A	47	ARG
1	A	283	LEU
1	A	309	ILE
1	A	410	ASN
1	A	451	ASP
1	A	476	ILE
1	A	508	GLU
1	B	3	SER
1	B	47	ARG
1	B	283	LEU
1	B	309	ILE
1	B	426	HIS
1	B	451	ASP
1	B	476	ILE
1	B	508	GLU

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	92	ASN
1	A	255	GLN
1	A	277	ASN
1	A	458	HIS
1	B	87	GLN
1	B	132	HIS
1	B	273	ASN
1	B	277	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

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, 95^{th} 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	510/536 (95%)	0.98	61 (11%)	10	8	7, 23, 41, 66	2 (0%)
1	B	509/536 (94%)	0.99	61 (11%)	10	8	10, 24, 42, 62	1 (0%)
All	All	1019/1072 (95%)	0.98	122 (11%)	10	8	7, 23, 41, 66	3 (0%)

All (122) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	150	SER	5.4
1	B	88	LEU	5.1
1	A	86	GLY	5.1
1	B	529	LEU	4.7
1	B	86	GLY	4.4
1	A	409	GLY	4.1
1	A	162	ASP	4.1
1	B	469	PHE	4.0
1	B	532	HIS	3.9
1	A	531	HIS	3.8
1	A	109	SER	3.7
1	B	87	GLN	3.6
1	B	451	ASP	3.6
1	A	148	VAL	3.5
1	A	532	HIS	3.4
1	B	85	HIS	3.4
1	B	109	SER	3.4
1	A	525	LEU	3.3
1	A	130	GLY	3.3
1	B	531	HIS	3.3
1	A	156	ASP	3.3
1	A	149	LEU	3.3
1	A	167	VAL	3.2
1	A	246	GLY	3.2

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Mol	Chain	Res	Type	RSRZ
1	B	150	SER	3.1
1	A	245	GLN	3.1
1	B	332	GLY	3.1
1	A	88	LEU	3.0
1	B	515	TYR	3.0
1	B	527	ARG	3.0
1	A	275	ASN	3.0
1	B	165	SER	3.0
1	B	522	ILE	3.0
1	A	171	MET	2.9
1	B	528	ARG	2.9
1	A	299	GLU	2.9
1	B	281	ASN	2.9
1	B	31	ALA	2.9
1	B	245	GLN	2.9
1	A	84	HIS	2.8
1	A	120	LYS	2.8
1	A	2	THR	2.8
1	A	529	LEU	2.8
1	B	167	VAL	2.8
1	A	140	SER	2.7
1	B	275	ASN	2.7
1	A	165	SER	2.7
1	B	524	THR	2.7
1	A	210	LEU	2.7
1	A	517	ALA	2.7
1	B	205	THR	2.6
1	B	91	LYS	2.6
1	A	530	GLU	2.5
1	A	38	PRO	2.5
1	A	225	GLU	2.5
1	A	528	ARG	2.5
1	B	225	GLU	2.5
1	A	527	ARG	2.5
1	A	179	TYR	2.5
1	A	31	ALA	2.5
1	A	136	LEU	2.4
1	B	136	LEU	2.4
1	B	216	LEU	2.4
1	A	91	LYS	2.4
1	B	84	HIS	2.4
1	A	49	GLY	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	57	GLN	2.4
1	B	116	HIS	2.4
1	B	293	HIS	2.4
1	B	471	VAL	2.4
1	A	176	GLU	2.4
1	B	526	GLN	2.4
1	A	118	SER	2.4
1	A	153	THR	2.3
1	B	408	GLN	2.3
1	B	463	ILE	2.3
1	A	24	GLY	2.3
1	A	215	PRO	2.3
1	A	437	ASP	2.3
1	B	128	GLU	2.3
1	B	530	GLU	2.3
1	A	36	SER	2.3
1	B	480	ARG	2.3
1	A	230	VAL	2.3
1	A	163	GLY	2.3
1	A	166	LYS	2.2
1	B	235	LYS	2.2
1	A	10	ASN	2.2
1	B	59	THR	2.2
1	A	169	HIS	2.2
1	B	189	SER	2.2
1	A	205	THR	2.2
1	B	215	PRO	2.2
1	B	218	THR	2.2
1	B	89	LYS	2.2
1	B	307	ALA	2.2
1	B	158	GLY	2.2
1	B	36	SER	2.2
1	B	299	GLU	2.2
1	A	113	PHE	2.2
1	A	137	VAL	2.2
1	B	518	VAL	2.2
1	B	142	SER	2.1
1	A	66	TYR	2.1
1	B	18	ASN	2.1
1	A	25	VAL	2.1
1	A	41	PHE	2.1
1	A	449	ILE	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	223	ALA	2.1
1	A	300	PRO	2.1
1	B	450	MET	2.1
1	B	7	PHE	2.1
1	B	294	ASP	2.1
1	A	34	SER	2.1
1	B	266	LYS	2.1
1	B	33	PRO	2.1
1	B	426	HIS	2.1
1	A	208	THR	2.0
1	B	148	VAL	2.0
1	B	102	LEU	2.0
1	A	126	LEU	2.0
1	B	160	SER	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.