



wwPDB X-ray Structure Validation Summary Report i

Mar 1, 2014 – 02:46 AM GMT

PDB ID : 2XR9
Title : CRYSTAL STRUCTURE OF AUTOTAXIN (ENPP2)
Authors : Kamtekar, S.; Hausmann, J.; Day, J.E.; Christodoulou, E.; Perrakis, A.
Deposited on : 2010-09-13
Resolution : 2.05 Å(reported)

This is a wwPDB validation summary report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

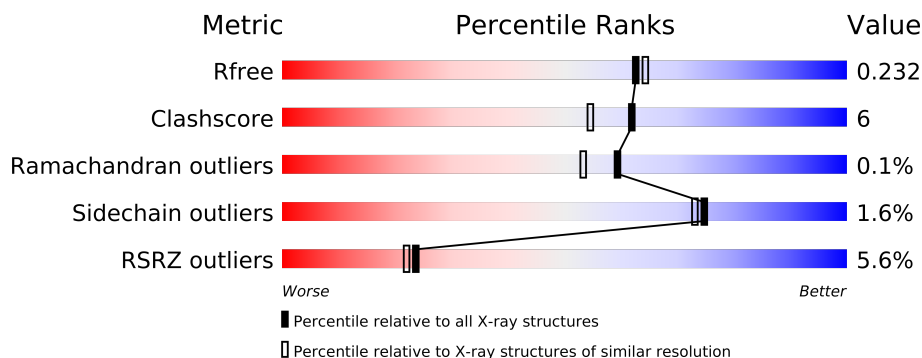
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity	:	4.02b-467
Mogul	:	1.15 2013
Xtriage (Phenix)	:	dev-1323
EDS	:	stable22639
Percentile statistics	:	21963
Refmac	:	5.8.0049
CCP4	:	6.3.0 (Settle)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP)	:	stable22683

1 Overall quality at a glance

The reported resolution of this entry is 2.05 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}	66092	1380 (2.06-2.02)
Clashscore	79885	1577 (2.06-2.02)
Ramachandran outliers	78287	1565 (2.06-2.02)
Sidechain outliers	78261	1565 (2.06-2.02)
RSRZ outliers	66119	1381 (2.06-2.02)

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 on the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	827	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	SCN	A	1863	-	X
3	SCN	A	1864	-	X
3	SCN	A	1865	-	X
3	SCN	A	1866	-	X
7	IOD	A	1878	-	X
7	IOD	A	1885	-	X

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 6753 atoms, of which 0 are hydrogen and 0 are deuterium.

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 ECTONUCLEOTIDE PYROPHOSPHATASE/PHOSPHOD IESTERASEFAMILY MEMBER 2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	783	Total	C	N	O	S	0	1	0
			6334	4019	1094	1172	49			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	410	ALA	ASN	ENGINEERED MUTATION	UNP Q64610
A	591	THR	ARG	CONFLICT	UNP Q64610

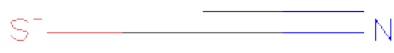
- Molecule 2 is a polymer of unknown type called SUGAR (3-MER).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	3	Total	C	N	O	0	0
			39	22	2	15		

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	410	ALA	ASN	ENGINEERED MUTATION	UNP Q64610
A	591	THR	ARG	CONFLICT	UNP Q64610

- Molecule 3 is THIOCYANATE ION (three-letter code: SCN) (formula: CNS).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	S	0	0
			3	1	1	1		
3	A	1	Total	C	N	S	0	0
			3	1	1	1		
3	A	1	Total	C	N	S	0	0
			3	1	1	1		
3	A	1	Total	C	N	S	0	0
			3	1	1	1		

- Molecule 4 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	2	Total	Zn	0	0
			2	2		

- Molecule 5 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Ca	0	0
			1	1		

- Molecule 6 is PHOSPHATE ION (three-letter code: PO4) (formula: O₄P).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
6	A	1	Total	O	P	0	0
			5	4	1		

- Molecule 7 is IODIDE ION (three-letter code: IOD) (formula: I).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	28	Total	I	0	0
			28	28		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	332	Total	O	0	0
			332	332		

4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	53.81Å 63.29Å 70.47Å 98.78° 106.22° 99.77°	Depositor
Resolution (Å)	19.98 – 2.05 19.98 – 2.05	Depositor EDS
% Data completeness (in resolution range)	96.8 (19.98-2.05) 88.6 (19.98-2.05)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.19 (at 2.06Å)	Xtriage
Refinement program	REFMAC 5.5.0110	Depositor
R, R_{free}	0.173 , 0.221 0.196 , 0.232	Depositor DCC
R_{free} test set	2387 reflections (5.00%)	DCC
Wilson B-factor (Å ²)	31.6	Xtriage
Anisotropy	0.218	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.38 , 29.1	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 47760 reflections	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	6753	wwPDB-VP
Average B, all atoms (Å ²)	35.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.90% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN, BMA, NAG, PO4, SCN, IOD, 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	0.77	2/6515 (0.0%)	0.82	14/8832 (0.2%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	129	CYS	CB-SG	-7.08	1.70	1.82
1	A	854	TYR	CD2-CE2	5.47	1.47	1.39

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	606	ARG	NE-CZ-NH2	7.85	124.22	120.30
1	A	299	ARG	NE-CZ-NH2	-7.51	116.54	120.30
1	A	798	ARG	NE-CZ-NH1	7.20	123.90	120.30
1	A	299	ARG	NE-CZ-NH1	6.98	123.79	120.30
1	A	798	ARG	NE-CZ-NH2	-6.89	116.85	120.30

There are no chirality outliers.

There are no planarity outliers.

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	6334	0	6096	68	0
2	A	39	0	34	0	0
3	A	12	0	0	0	0
4	A	2	0	0	0	0
5	A	1	0	0	0	0
6	A	5	0	0	0	0
7	A	28	0	0	20	0
8	A	332	0	0	3	0
All	All	6753	0	6130	71	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 6.

The worst 5 of 71 close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:124:LEU:HD21	7:A:1878:IOD:I	1.99	1.32
1:A:124:LEU:HD11	7:A:1878:IOD:I	2.12	1.19
7:A:1873:IOD:I	7:A:1883:IOD:I	3.10	1.10
1:A:124:LEU:CD2	7:A:1878:IOD:I	2.82	0.97
1:A:278:SER:OG	7:A:1876:IOD:I	2.53	0.96

There are no symmetry-related clashes.

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	776/827 (94%)	748 (96%)	27 (4%)	1 (0%)	59 53

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	555	ILE

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	709/750 (94%)	698 (98%)	11 (2%)	75 73

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	545	ASP
1	A	569	ASP
1	A	665	ASN
1	A	536	THR
1	A	640	GLU

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

Mol	Chain	Res	Type
1	A	674	GLN
1	A	716	GLN

5.3.3 RNA ⓘ

There are no RNA chains 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 ⓘ

3 carbohydrates are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	NAG	A	1860	1,2	12,14,15	0.99	1 (8%)	15,19,21	1.29	2 (13%)
2	NAG	A	1861	2	12,14,15	0.92	0	15,19,21	1.45	2 (13%)
2	BMA	A	1862	2	10,11,12	0.70	0	11,15,17	2.63	4 (36%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	NAG	A	1860	1,2	-	0/6/23/26	0/1/1/1
2	NAG	A	1861	2	-	0/6/23/26	0/1/1/1
2	BMA	A	1862	2	-	0/2/19/22	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1860	NAG	C2-N2	-2.60	1.43	1.46

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1862	BMA	O5-C5-C4	6.22	118.55	110.65
2	A	1862	BMA	O5-C5-C6	3.21	110.35	106.98
2	A	1861	NAG	C8-C7-N2	3.07	122.11	116.11
2	A	1862	BMA	C3-C4-C5	3.07	115.68	110.20
2	A	1861	NAG	O7-C7-C8	-2.84	116.50	122.04

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.6 Ligand geometry ⓘ

Of 36 ligands modelled in this entry, 31 are monoatomic - leaving 5 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul

statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# $ Z > 2$	Counts	RMSZ	# $ Z > 2$
3	SCN	A	1863	-	2,2,2	1.99	1 (50%)	1,1,1	0.38	0
3	SCN	A	1864	-	2,2,2	1.85	1 (50%)	1,1,1	0.47	0
3	SCN	A	1865	-	2,2,2	1.68	1 (50%)	1,1,1	0.52	0
3	SCN	A	1866	-	2,2,2	1.67	1 (50%)	1,1,1	0.18	0
6	PO4	A	1870	4	4,4,4	0.37	0	6,6,6	0.41	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	SCN	A	1863	-	-	0/0/0/0	0/0/0/0
3	SCN	A	1864	-	-	0/0/0/0	0/0/0/0
3	SCN	A	1865	-	-	0/0/0/0	0/0/0/0
3	SCN	A	1866	-	-	0/0/0/0	0/0/0/0
6	PO4	A	1870	4	-	0/0/0/0	0/0/0/0

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	1863	SCN	C-S	2.79	1.81	1.63
3	A	1864	SCN	C-S	2.58	1.80	1.63
3	A	1865	SCN	C-S	2.36	1.78	1.63
3	A	1866	SCN	C-S	2.31	1.78	1.63

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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 ⓘ

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	783/827 (94%)	0.22	45 (5%) 23 21	15, 33, 62, 87	0

The worst 5 of 45 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	397	ILE	9.4
1	A	161	VAL	6.7
1	A	569	ASP	6.6
1	A	70	PRO	6.5
1	A	69	GLY	5.3

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates ⓘ

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
2	NAG	A	1861	14/15	0.20	1.43	34,40,48,49	0
2	NAG	A	1860	14/15	0.09	-0.01	20,23,29,30	0
2	BMA	A	1862	11/12	0.39	-	58,61,63,65	0

6.4 Ligands

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	RSR	LLDF	B-factors(Å ²)	Q<0.9
7	IOD	A	1878	1/1	1.73	54.36	149,149,149,149	1
7	IOD	A	1885	1/1	0.20	3.96	61,61,61,61	1
3	SCN	A	1865	3/3	0.18	2.85	62,62,62,64	0
3	SCN	A	1866	3/3	0.22	2.83	73,73,73,74	0
3	SCN	A	1863	3/3	0.23	2.79	50,50,50,51	0
3	SCN	A	1864	3/3	0.19	2.01	69,69,69,70	0
7	IOD	A	1892	1/1	0.10	1.52	59,59,59,59	1
7	IOD	A	1895	1/1	0.19	1.32	63,63,63,63	1
7	IOD	A	1889	1/1	0.15	1.28	53,53,53,53	1
7	IOD	A	1897	1/1	0.10	-0.26	55,55,55,55	1
5	CA	A	1869	1/1	0.09	-0.55	25,25,25,25	0
7	IOD	A	1886	1/1	0.11	-0.57	66,66,66,66	1
7	IOD	A	1890	1/1	0.14	-0.64	74,74,74,74	1
7	IOD	A	1896	1/1	0.09	-0.73	63,63,63,63	1
7	IOD	A	1883	1/1	0.10	-0.79	42,42,42,42	1
7	IOD	A	1882	1/1	0.10	-0.83	47,47,47,47	1
4	ZN	A	1868	1/1	0.09	-0.86	44,44,44,44	0
6	PO4	A	1870	5/5	0.08	-0.89	30,30,37,37	0
7	IOD	A	1888	1/1	0.07	-1.05	44,44,44,44	1
7	IOD	A	1887	1/1	0.05	-1.05	43,43,43,43	1
7	IOD	A	1879	1/1	0.04	-1.50	42,42,42,42	1
7	IOD	A	1872	1/1	0.04	-1.60	33,33,33,33	1
7	IOD	A	1891	1/1	0.08	-1.65	52,52,52,52	1
7	IOD	A	1893	1/1	0.03	-1.74	59,59,59,59	1
4	ZN	A	1867	1/1	0.06	-2.08	33,33,33,33	0
7	IOD	A	1884	1/1	0.04	-2.33	57,57,57,57	1
7	IOD	A	1894	1/1	0.09	-2.48	58,58,58,58	1
7	IOD	A	1898	1/1	0.04	-2.53	55,55,55,55	1
7	IOD	A	1871	1/1	0.05	-2.57	30,30,30,30	0
7	IOD	A	1874	1/1	0.05	-2.57	43,43,43,43	1
7	IOD	A	1875	1/1	0.03	-2.72	42,42,42,42	1
7	IOD	A	1881	1/1	0.03	-3.12	38,38,38,38	1
7	IOD	A	1876	1/1	0.05	-3.36	40,40,40,40	1
7	IOD	A	1873	1/1	0.03	-3.42	43,43,43,43	1
7	IOD	A	1880	1/1	0.03	-3.43	45,45,45,45	1

Continued on next page...

Continued from previous page...

Mol	Type	Chain	Res	Atoms	RSR	LLDF	B-factors(\AA^2)	Q<0.9
7	IOD	A	1877	1/1	0.03	-5.19	45,45,45,45	1

6.5 Other polymers ⓘ

There are no such residues in this entry.