WORLDWIDE
wwPDB
PROTEIN DATA BANK

Full wwPDB X-ray Structure Validation Report (i)

Dec 15, 2024 – 07:30 PM EST

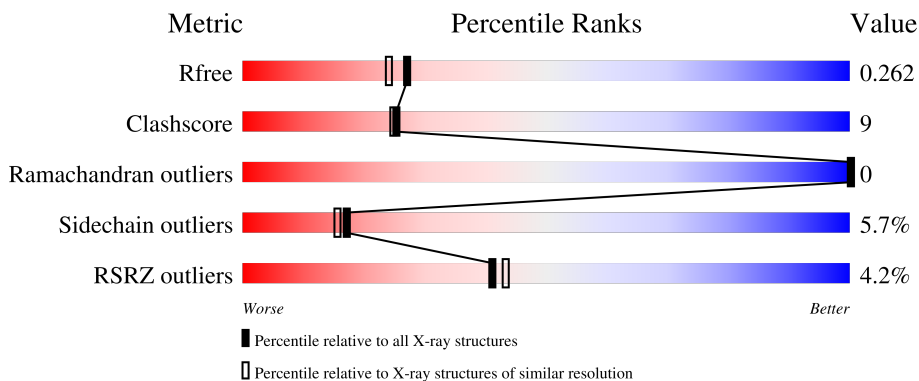|		
PDB ID	:	2AMY
Title	:	X-Ray Structure of Human Phosphomannomutase 2 (PMM2)
Authors	:	Wesenberg, G.E.; Phillips Jr., G.N.; McCoy, J.G.; Bitto, E.; Bingman, C.A.; Allard, S.T.M.; Center for Eukaryotic Structural Genomics (CESG)
Deposited on	:	2005-08-10
Resolution	:	2.09 Å(reported)

1   Overall quality at a glance ⓘ

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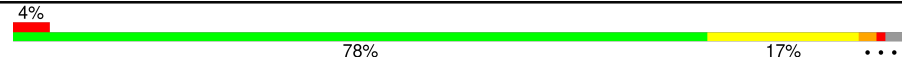*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.09 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	Percentile Ranks	Value
Rfree		0.262
Clashscore		9
Ramachandran outliers		0
Sidechain outliers		5.7%
RSRZ outliers		4.2%

Worse .... *Better*

▮ Percentile relative to all X-ray structures
▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R$_{free}$	164625	6234 (2.10-2.10)
Clashscore	180529	6893 (2.10-2.10)
Ramachandran outliers	177936	6839 (2.10-2.10)
Sidechain outliers	177891	6840 (2.10-2.10)
RSRZ outliers	164620	6234 (2.10-2.10)

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%

Mol	Chain	Length	Quality of chain
1	A	246	4% · 78% · 17% · · ·

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	GLY	A	400	-	X	-	-
3	GLY	A	401	-	-	X	-

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Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	GLY	A	402	-	X	-	-

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 2109 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 Phosphomannomutase 2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	240	1948	1242	330	366	6	4	0	1	0

There are 5 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	SER	-	cloning artifact	UNP O15305
A	28	MSE	MET	modified residue	UNP O15305
A	126	MSE	MET	modified residue	UNP O15305
A	212	MSE	MET	modified residue	UNP O15305
A	227	MSE	MET	modified residue	UNP O15305

- Molecule 2 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: $C_2H_6O_2$).
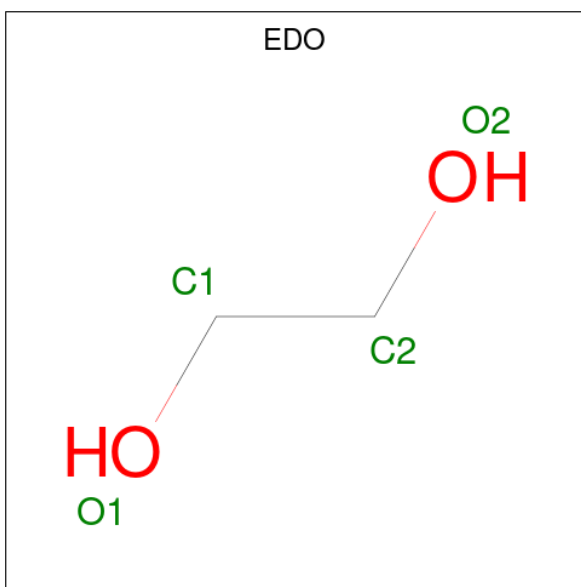
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	C	O		
2	A	1	4	2	2	0	0

- Molecule 3 is GLYCINE (three-letter code: GLY) (formula: $C_2H_5NO_2$).
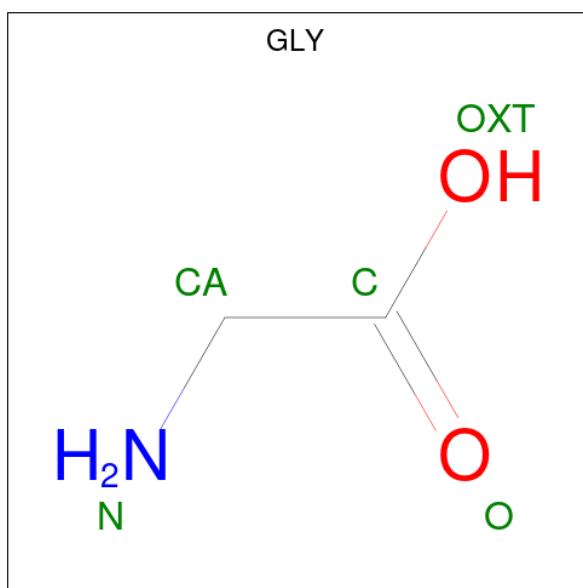
Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total 5	C 2	N 1	O 2	0	0
3	A	1	Total 5	C 2	N 1	O 2	0	0
3	A	1	Total 5	C 2	N 1	O 2	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	142	Total 142	O 142	0	0

3 Residue-property plots ⓘ

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. 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. 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: Phosphomannomutase 2
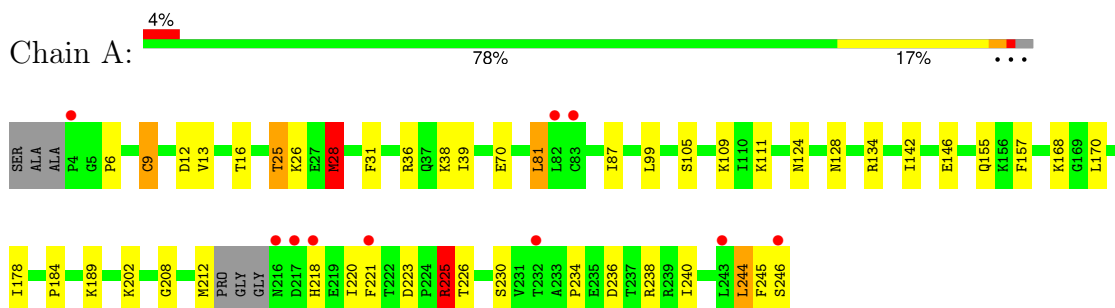
4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	70.62Å 70.62Å 100.15Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	38.74 – 2.09 38.74 – 2.09	Depositor EDS
% Data completeness (in resolution range)	99.5 (38.74-2.09) 99.5 (38.74-2.09)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.57 (at 2.10Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.199 , 0.272 0.205 , 0.262	Depositor DCC
R_{free} test set	924 reflections (5.28%)	wwPDB-VP
Wilson B-factor (Å^2)	45.5	Xtriage
Anisotropy	0.043	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 47.8	EDS
L-test for twinning[2]	$< |L| > = 0.50, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.031 for -h,-k,l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	2109	wwPDB-VP
Average B, all atoms (Å^2)	56.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.10% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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 ⓘ

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

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	0.94	2/1986 (0.1%)	0.90	2/2658 (0.1%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	28	MSE	SE-CE	-6.54	1.56	1.95
1	A	9	CYS	CB-SG	-5.14	1.73	1.81

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	225	ARG	NE-CZ-NH2	-8.14	116.23	120.30
1	A	81	LEU	CA-CB-CG	5.04	126.89	115.30

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	1948	0	1932	36	0
2	A	4	0	6	0	0
3	A	15	0	6	7	0
4	A	142	0	0	6	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
All	All	2109	0	1944	37	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 9.

All (37) 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:25:THR:HG22	1:A:28:MSE:H	1.24	1.02
1:A:221:PHE:O	3:A:401:GLY:HA3	1.65	0.97
1:A:223:ASP:O	3:A:401:GLY:N	2.02	0.93
1:A:6:PRO:HD2	1:A:202:LYS:HD3	1.57	0.87
1:A:226:THR:HG1	3:A:401:GLY:N	1.78	0.82
1:A:168:LYS:HA	1:A:168:LYS:HE2	1.66	0.78
1:A:13:VAL:HG23	4:A:526:HOH:O	1.88	0.71
1:A:245:PHE:O	1:A:246:SER:CB	2.40	0.68
1:A:245:PHE:O	1:A:246:SER:OG	2.14	0.65
1:A:223:ASP:OD1	1:A:225:ARG:CD	2.46	0.64
1:A:155:GLN:HG3	4:A:408:HOH:O	1.97	0.63
1:A:223:ASP:OD1	1:A:225:ARG:HD3	2.00	0.62
1:A:221:PHE:O	3:A:401:GLY:CA	2.43	0.60
1:A:134:ARG:HG3	4:A:403:HOH:O	2.01	0.59
3:A:400:GLY:HA3	4:A:480:HOH:O	2.03	0.58
1:A:128:ASN:OD1	1:A:134:ARG:HD2	2.07	0.54
1:A:109:LYS:HE2	3:A:402:GLY:HA2	1.87	0.54
1:A:240:ILE:HG22	1:A:244:LEU:HD22	1.93	0.51
1:A:105:SER:O	1:A:109:LYS:HG3	2.11	0.51
1:A:223:ASP:OD1	1:A:225:ARG:HD2	2.10	0.51
1:A:212:MSE:HG2	1:A:218:HIS:CE1	2.49	0.48
1:A:99:LEU:HD11	1:A:170:LEU:HD11	1.96	0.47
1:A:25:THR:CG2	1:A:28:MSE:H	2.11	0.47
1:A:70:GLU:OE1	1:A:124:ASN:HB2	2.16	0.46
1:A:31:PHE:HA	4:A:536:HOH:O	2.16	0.45
1:A:12:ASP:O	1:A:16:THR:HB	2.18	0.44
1:A:226:THR:O	3:A:401:GLY:N	2.51	0.43
1:A:168:LYS:HE2	1:A:168:LYS:CA	2.44	0.42
1:A:225:ARG:NH2	4:A:460:HOH:O	2.31	0.42
1:A:28:MSE:SE	1:A:238:ARG:HH11	2.53	0.42
1:A:28:MSE:HE2	1:A:234:PRO:HB3	2.03	0.41
1:A:142:ILE:HD13	1:A:142:ILE:HA	1.87	0.41
1:A:36:ARG:HA	1:A:39:ILE:O	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:208:GLY:O	1:A:230:SER:HA	2.20	0.41
1:A:87:ILE:CD1	1:A:184:PRO:HD3	2.51	0.41
1:A:189:LYS:O	1:A:220:ILE:HD12	2.21	0.41
1:A:9:CYS:SG	1:A:39:ILE:HD13	2.62	0.40

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	237/246 (96%)	230 (97%)	7 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	213/210 (101%)	201 (94%)	12 (6%)	17	16

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	25	THR
1	A	26	LYS

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Mol	Chain	Res	Type
1	A	28	MSE
1	A	38	LYS
1	A	81	LEU
1	A	111	LYS
1	A	146	GLU
1	A	157	PHE
1	A	178	ILE
1	A	225	ARG
1	A	236	ASP
1	A	244	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

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 ⓘ

4 ligands 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	$\#\|Z\| > 2$
3	GLY	A	401	-	4,4,4	0.96	0	3,4,4	1.20	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	#|Z| > 2	Counts	RMSZ	#|Z| > 2
3	GLY	A	402	-	4,4,4	1.26	1 (25%)	3,4,4	1.37	1 (33%)
3	GLY	A	400	-	4,4,4	0.66	0	3,4,4	2.34	2 (66%)
2	EDO	A	300	-	3,3,3	0.53	0	2,2,2	0.51	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	GLY	A	401	-	-	2/2/2/2	-
3	GLY	A	402	-	-	2/2/2/2	-
3	GLY	A	400	-	-	2/2/2/2	-
2	EDO	A	300	-	-	1/1/1/1	-

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	402	GLY	OXT-C	-2.19	1.23	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	A	400	GLY	OXT-C-CA	3.13	125.82	113.38
3	A	400	GLY	OXT-C-O	-2.13	117.86	123.33
3	A	402	GLY	OXT-C-O	-2.08	118.00	123.33

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	402	GLY	O-C-CA-N
3	A	402	GLY	OXT-C-CA-N
3	A	400	GLY	OXT-C-CA-N
3	A	400	GLY	O-C-CA-N
3	A	401	GLY	OXT-C-CA-N
2	A	300	EDO	O1-C1-C2-O2
3	A	401	GLY	O-C-CA-N

There are no ring outliers.

3 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	401	GLY	5	0
3	A	402	GLY	1	0
3	A	400	GLY	1	0

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 ⓘ

> **Warning**: The R factor obtained from EDS is 0.2599, which does not match the depositor's R factor of 0.199. Please interpret the results in this section carefully.

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(Å²)	Q<0.9
1	A	236/246 (95%)	0.66	10 (4%)	41	43	32, 54, 67, 86	1 (0%)

All (10) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	217	ASP	3.8
1	A	221	PHE	3.2
1	A	83	CYS	3.1
1	A	4	PRO	2.8
1	A	243	LEU	2.8
1	A	218	HIS	2.4
1	A	246	SER	2.3
1	A	216	ASN	2.2
1	A	82	LEU	2.1
1	A	232	THR	2.1

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 ⓘ

There are no monosaccharides in this entry.

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. 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(Å^2)	Q<0.9
3	GLY	A	400	5/5	0.72	0.22	60,61,63,64	0
3	GLY	A	402	5/5	0.79	0.18	73,73,75,75	0
3	GLY	A	401	5/5	0.84	0.12	61,62,65,66	0
2	EDO	A	300	4/4	0.89	0.12	68,70,72,80	0

6.5 Other polymers ⓘ

There are no such residues in this entry.