



wwPDB X-ray Structure Validation Summary Report

Aug 17, 2022 – 02:25 PM EDT

PDB ID : 4QG6
Title : crystal structure of PKM2-Y105E mutant
Authors : Wang, P.; Sun, C.; Zhu, T.; Xu, Y.
Deposited on : 2014-05-22
Resolution : 3.21 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.29
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.29

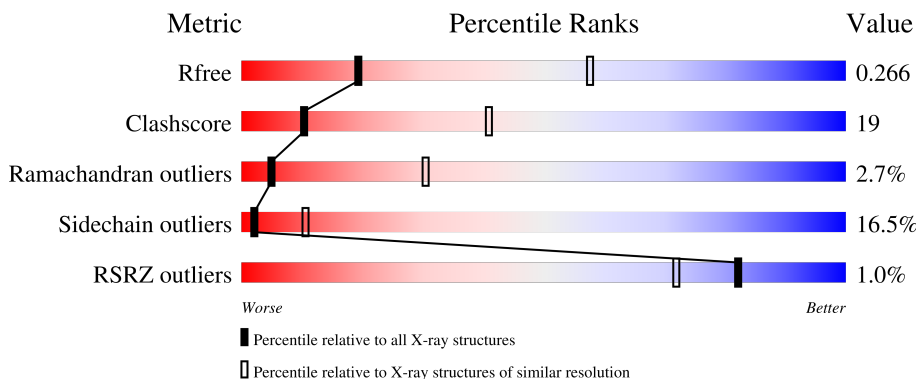
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.21 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}	130704	1133 (3.20-3.20)
Clashscore	141614	1253 (3.20-3.20)
Ramachandran outliers	138981	1234 (3.20-3.20)
Sidechain outliers	138945	1233 (3.20-3.20)
RSRZ outliers	127900	1095 (3.20-3.20)

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	535	
1	B	535	
1	C	535	
1	D	535	

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
2	PRO	C	1001	-	-	X	-

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 13991 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.

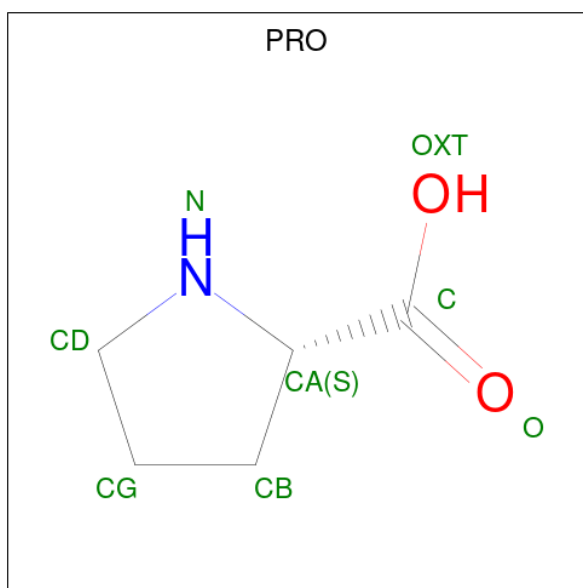
- Molecule 1 is a protein called Pyruvate kinase PKM.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	406	3122	1958	564	579	21	0	0	0
1	B	502	3849	2420	682	723	24	0	0	0
1	C	406	3122	1958	564	579	21	0	0	0
1	D	505	3870	2434	686	726	24	0	0	0

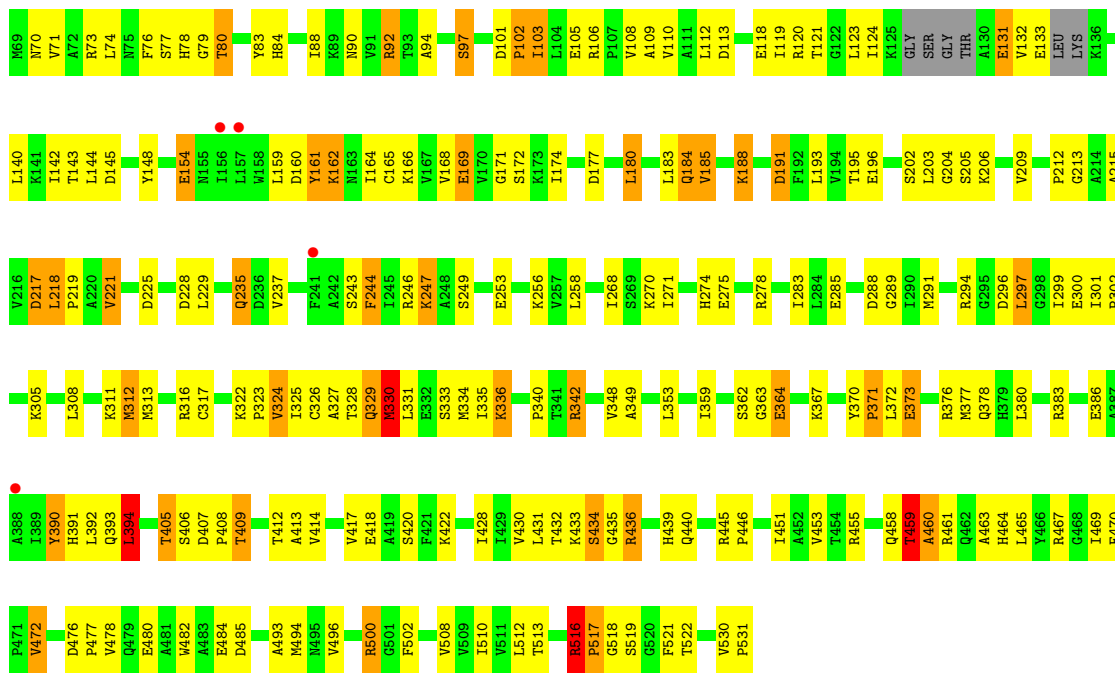
There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	expression tag	UNP P14618
A	-2	PRO	-	expression tag	UNP P14618
A	-1	GLY	-	expression tag	UNP P14618
A	0	SER	-	expression tag	UNP P14618
A	105	GLU	TYR	engineered mutation	UNP P14618
B	-3	GLY	-	expression tag	UNP P14618
B	-2	PRO	-	expression tag	UNP P14618
B	-1	GLY	-	expression tag	UNP P14618
B	0	SER	-	expression tag	UNP P14618
B	105	GLU	TYR	engineered mutation	UNP P14618
C	-3	GLY	-	expression tag	UNP P14618
C	-2	PRO	-	expression tag	UNP P14618
C	-1	GLY	-	expression tag	UNP P14618
C	0	SER	-	expression tag	UNP P14618
C	105	GLU	TYR	engineered mutation	UNP P14618
D	-3	GLY	-	expression tag	UNP P14618
D	-2	PRO	-	expression tag	UNP P14618
D	-1	GLY	-	expression tag	UNP P14618
D	0	SER	-	expression tag	UNP P14618
D	105	GLU	TYR	engineered mutation	UNP P14618

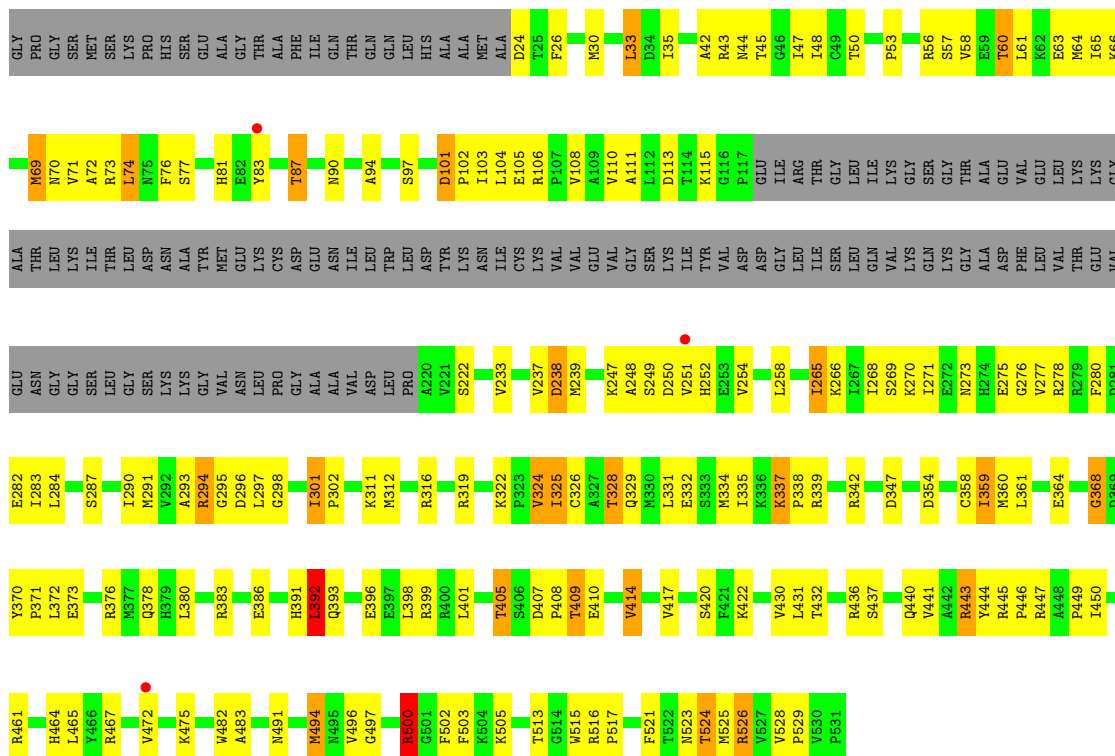
- Molecule 2 is PROLINE (three-letter code: PRO) (formula: $C_5H_9NO_2$).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	N	O	0	0
			7	5	1	1		
2	B	1	Total	C	N	O	0	0
			7	5	1	1		
2	C	1	Total	C	N	O	0	0
			7	5	1	1		
2	D	1	Total	C	N	O	0	0
			7	5	1	1		

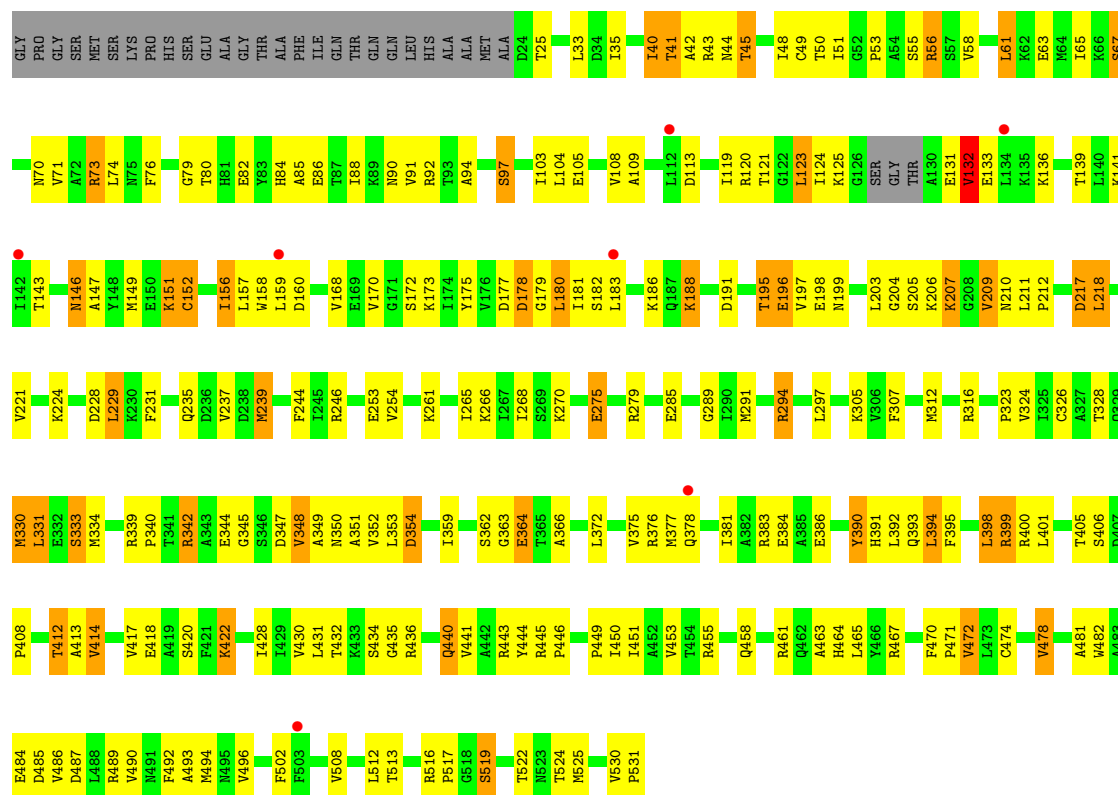


• Molecule 1: Pyruvate kinase PKM



• Molecule 1: Pyruvate kinase PKM





4 Data and refinement statistics i

Property	Value	Source
Space group	P 31	Depositor
Cell constants a, b, c, α , β , γ	124.45Å 124.45Å 257.05Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	45.62 – 3.21 46.40 – 3.21	Depositor EDS
% Data completeness (in resolution range)	98.2 (45.62-3.21) 98.3 (46.40-3.21)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	4.61 (at 3.19Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8_1069)	Depositor
R, R_{free}	0.220 , 0.265 0.222 , 0.266	Depositor DCC
R_{free} test set	3622 reflections (5.05%)	wwPDB-VP
Wilson B-factor (Å ²)	95.0	Xtrriage
Anisotropy	0.504	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , -15.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.53$, $\langle L^2 \rangle = 0.37$	Xtrriage
Estimated twinning fraction	0.000 for -h,-k,l 0.438 for h,-h-k,-l 0.000 for -k,-h,-l	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	13991	wwPDB-VP
Average B, all atoms (Å ²)	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.52% 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 [i](#)

5.1 Standard geometry [i](#)

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	0.48	0/3175	0.68	0/4287
1	B	0.49	0/3909	0.70	1/5276 (0.0%)
1	C	0.47	0/3175	0.66	0/4287
1	D	0.48	0/3931	0.69	0/5306
All	All	0.48	0/14190	0.68	1/19156 (0.0%)

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	D	0	2

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	436	ARG	NE-CZ-NH1	9.39	124.99	120.30

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	D	217	ASP	Peptide
1	D	218	LEU	Peptide

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	3122	0	3177	134	0
1	B	3849	0	3929	150	0
1	C	3122	0	3177	120	0
1	D	3870	0	3957	153	0
2	A	7	0	7	2	0
2	B	7	0	7	3	0
2	C	7	0	7	4	0
2	D	7	0	7	0	0
All	All	13991	0	14268	527	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 19.

The worst 5 of 527 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:73:ARG:NH1	1:B:113:ASP:OD2	2.03	0.92
1:D:73:ARG:NH1	1:D:113:ASP:OD2	2.03	0.91
1:C:73:ARG:NH1	1:C:113:ASP:OD2	2.10	0.83
1:D:147:ALA:O	1:D:151:LYS:NZ	2.12	0.83
1:C:422:LYS:HG3	1:D:414:VAL:HG21	1.62	0.82

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	402/535 (75%)	344 (86%)	49 (12%)	9 (2%)	6 35
1	B	496/535 (93%)	413 (83%)	61 (12%)	22 (4%)	2 19

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	402/535 (75%)	344 (86%)	51 (13%)	7 (2%)	9	42
1	D	501/535 (94%)	434 (87%)	57 (11%)	10 (2%)	7	38
All	All	1801/2140 (84%)	1535 (85%)	218 (12%)	48 (3%)	5	30

5 of 48 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	265	ILE
1	A	299	ILE
1	B	58	VAL
1	B	102	PRO
1	B	371	PRO

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	335/438 (76%)	281 (84%)	54 (16%)	2	11
1	B	415/438 (95%)	350 (84%)	65 (16%)	2	12
1	C	335/438 (76%)	281 (84%)	54 (16%)	2	11
1	D	417/438 (95%)	341 (82%)	76 (18%)	1	8
All	All	1502/1752 (86%)	1253 (83%)	249 (17%)	2	10

5 of 249 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	508	VAL
1	D	342	ARG
1	C	294	ARG
1	D	331	LEU
1	D	412	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	464	HIS
1	D	84	HIS
1	C	44	ASN
1	D	464	HIS
1	C	464	HIS

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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

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
2	PRO	C	1001	-	5,7,8	0.91	0	7,8,10	1.63	1 (14%)
2	PRO	B	1001	-	5,7,8	0.61	0	7,8,10	2.24	2 (28%)
2	PRO	A	1001	-	5,7,8	0.60	0	7,8,10	1.77	1 (14%)
2	PRO	D	1001	-	5,7,8	0.66	0	7,8,10	1.62	1 (14%)

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	PRO	C	1001	-	-	0/0/9/11	0/1/1/1
2	PRO	B	1001	-	-	0/0/9/11	0/1/1/1
2	PRO	A	1001	-	-	0/0/9/11	0/1/1/1
2	PRO	D	1001	-	-	0/0/9/11	0/1/1/1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	B	1001	PRO	O-C-CA	-4.91	111.91	124.78
2	A	1001	PRO	O-C-CA	-3.79	114.86	124.78
2	C	1001	PRO	O-C-CA	-3.69	115.11	124.78
2	D	1001	PRO	O-C-CA	-3.50	115.61	124.78
2	B	1001	PRO	CB-CA-C	-2.54	109.21	112.70

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	C	1001	PRO	4	0
2	B	1001	PRO	3	0
2	A	1001	PRO	2	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 [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	406/535 (75%)	0.07	5 (1%) 79 67	3, 36, 78, 121	0
1	B	502/535 (93%)	0.11	4 (0%) 86 78	1, 34, 101, 128	0
1	C	406/535 (75%)	0.08	3 (0%) 87 81	2, 35, 80, 134	0
1	D	505/535 (94%)	0.09	7 (1%) 75 63	2, 32, 97, 127	0
All	All	1819/2140 (85%)	0.09	19 (1%) 82 72	1, 35, 91, 134	0

The worst 5 of 19 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	83	TYR	3.3
1	A	74	LEU	3.3
1	A	229	LEU	3.2
1	B	156	ILE	3.1
1	D	134	LEU	3.1

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 monosaccharides 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(\AA^2)	Q<0.9
2	PRO	D	1001	7/8	0.84	0.39	23,23,33,33	0
2	PRO	B	1001	7/8	0.87	0.30	9,9,19,19	0
2	PRO	C	1001	7/8	0.91	0.26	16,16,26,26	0
2	PRO	A	1001	7/8	0.91	0.30	19,19,29,29	0

6.5 Other polymers [i](#)

There are no such residues in this entry.