



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2017 – 02:30 am GMT

PDB ID : 3PUY
Title : Crystal Structure of an outward-facing MBP-Maltose transporter complex bound to AMP-PNP after crystal soaking of the pretranslocation state
Authors : Oldham, M.L.; Chen, J.
Deposited on : 2010-12-06
Resolution : 3.10 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

<http://wwpdb.org/validation/2016/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7.2 (RC1), CSD as538be (2017)
Xtriage (Phenix) : 1.9-1692
EDS : trunk28620
Percentile statistics : 20161228.v01 (using entries in the PDB archive December 28th 2016)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : recalc28949

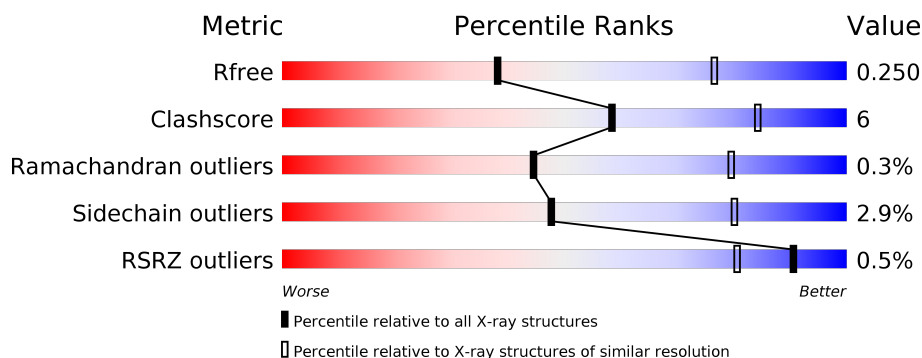
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.10 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}	100719	1001 (3.12-3.08)
Clashscore	112137	1099 (3.12-3.08)
Ramachandran outliers	110173	1057 (3.12-3.08)
Sidechain outliers	110143	1057 (3.12-3.08)
RSRZ outliers	101464	1006 (3.12-3.08)

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. 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	E	378	<div> <div style="width: 100%;"></div> <div> <div style="width: 100%;"></div> <div>87% 12% .</div> </div> </div>
2	F	514	<div> <div style="width: 100%;"></div> <div> <div style="width: 100%;"></div> <div>79% 15% 5%</div> </div> </div>
3	G	296	<div> <div style="width: 100%;"></div> <div> <div style="width: 100%;"></div> <div>84% 14% ..</div> </div> </div>
4	A	381	<div> <div style="width: 100%;"></div> <div> <div style="width: 100%;"></div> <div>82% 14% ..</div> </div> </div>
4	B	381	<div> <div style="width: 100%;"></div> <div> <div style="width: 100%;"></div> <div>76% 18% 6%</div> </div> </div>

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
6	PGV	F	4001	-	-	-	X

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 14789 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 Maltose transporter subunit; periplasmic-binding component of ABC superfamily.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	374	Total	C	N	O	S	0	0	0
			2897	1865	473	553	6			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	371	ALA	-	EXPRESSION TAG	UNP B1XC33
E	372	SER	-	EXPRESSION TAG	UNP B1XC33
E	373	ALA	-	EXPRESSION TAG	UNP B1XC33
E	374	SER	-	EXPRESSION TAG	UNP B1XC33
E	375	HIS	-	EXPRESSION TAG	UNP B1XC33
E	376	HIS	-	EXPRESSION TAG	UNP B1XC33
E	377	HIS	-	EXPRESSION TAG	UNP B1XC33
E	378	HIS	-	EXPRESSION TAG	UNP B1XC33

- Molecule 2 is a protein called Maltose transporter subunit; membrane component of ABC superfamily.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	F	490	Total	C	N	O	S	0	0	0
			3821	2511	608	685	17			

- Molecule 3 is a protein called Maltose transporter subunit; membrane component of ABC superfamily.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	G	293	Total	C	N	O	S	0	0	0
			2257	1510	361	377	9			

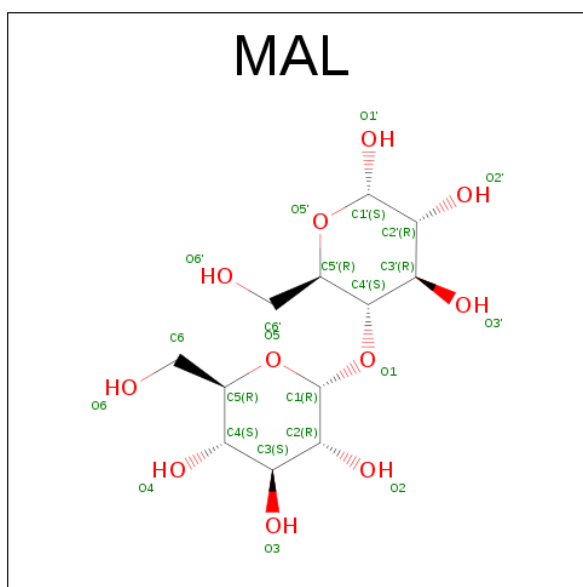
- Molecule 4 is a protein called Fused maltose transport subunit, ATP-binding component of ABC superfamily; regulatory protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	A	371	Total	C	N	O	S	0	0	0
			2876	1819	515	529	13			
4	B	358	Total	C	N	O	S	0	0	0
			2789	1767	498	511	13			

There are 20 discrepancies between the modelled and reference sequences:

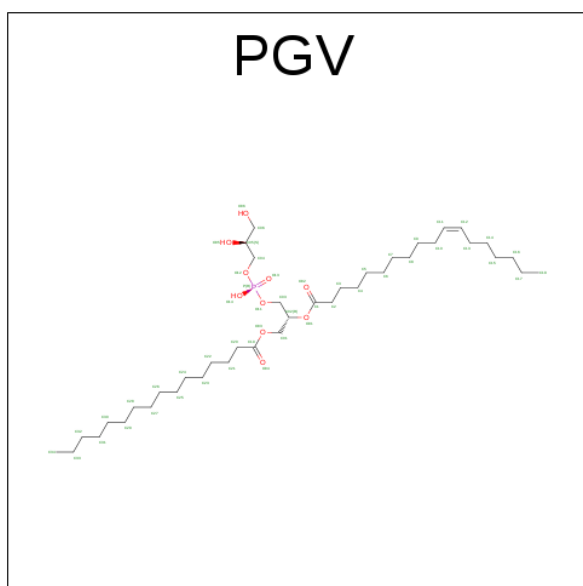
Chain	Residue	Modelled	Actual	Comment	Reference
A	372	ALA	-	EXPRESSION TAG	UNP B1XC34
A	373	SER	-	EXPRESSION TAG	UNP B1XC34
A	374	ALA	-	EXPRESSION TAG	UNP B1XC34
A	375	SER	-	EXPRESSION TAG	UNP B1XC34
A	376	HIS	-	EXPRESSION TAG	UNP B1XC34
A	377	HIS	-	EXPRESSION TAG	UNP B1XC34
A	378	HIS	-	EXPRESSION TAG	UNP B1XC34
A	379	HIS	-	EXPRESSION TAG	UNP B1XC34
A	380	HIS	-	EXPRESSION TAG	UNP B1XC34
A	381	HIS	-	EXPRESSION TAG	UNP B1XC34
B	372	ALA	-	EXPRESSION TAG	UNP B1XC34
B	373	SER	-	EXPRESSION TAG	UNP B1XC34
B	374	ALA	-	EXPRESSION TAG	UNP B1XC34
B	375	SER	-	EXPRESSION TAG	UNP B1XC34
B	376	HIS	-	EXPRESSION TAG	UNP B1XC34
B	377	HIS	-	EXPRESSION TAG	UNP B1XC34
B	378	HIS	-	EXPRESSION TAG	UNP B1XC34
B	379	HIS	-	EXPRESSION TAG	UNP B1XC34
B	380	HIS	-	EXPRESSION TAG	UNP B1XC34
B	381	HIS	-	EXPRESSION TAG	UNP B1XC34

- Molecule 5 is SUGAR (MALTOSE) (three-letter code: MAL) (formula: C₁₂H₂₂O₁₁).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
5	F	1	Total	C	O	0	0
			23	12	11		

- Molecule 6 is (1R)-2-{{{[(2S)-2,3-DIHYDROXYPROPYL]OXY}(HYDROXY)PHOSPHORYL]OXY}-1-[(PALMITOYLOXY)METHYL]ETHYL (11E)-OCTADEC-11-ENOATE (three-letter code: PGV) (formula: C₄₀H₇₇O₁₀P).

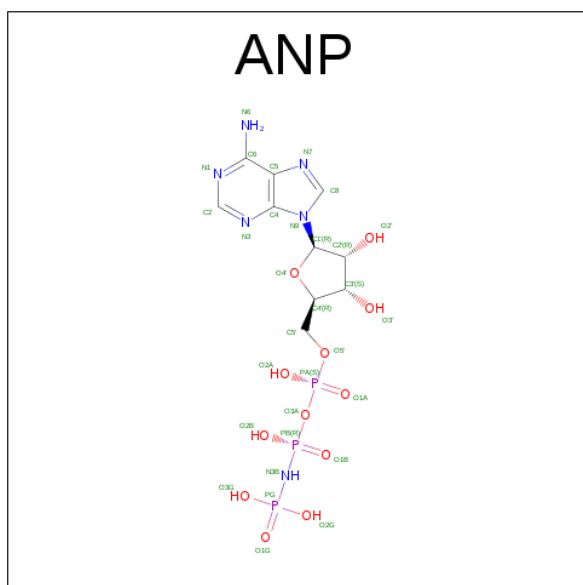


Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
6	F	1	Total	C	O	P	0	0
			51	40	10	1		

- Molecule 7 is MAGNESIUM ION (three-letter code: MG) (formula: Mg).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	B	1	Total Mg 1 1	0	0
7	A	1	Total Mg 1 1	0	0

- Molecule 8 is PHOSPHOAMINOPHOSPHONIC ACID-ADENYLATE ESTER (three-letter code: ANP) (formula: $C_{10}H_{17}N_6O_{12}P_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	1	Total C N O P 31 10 6 12 3	0	0
8	B	1	Total C N O P 31 10 6 12 3	0	0

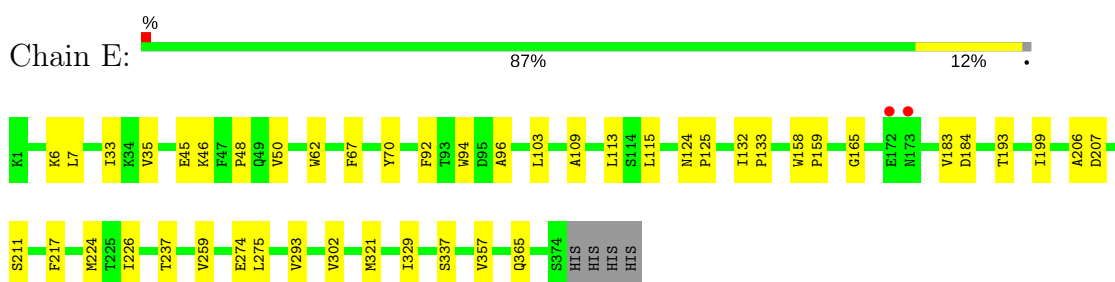
- Molecule 9 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
9	F	2	Total O 2 2	0	0
9	A	6	Total O 6 6	0	0
9	B	3	Total O 3 3	0	0

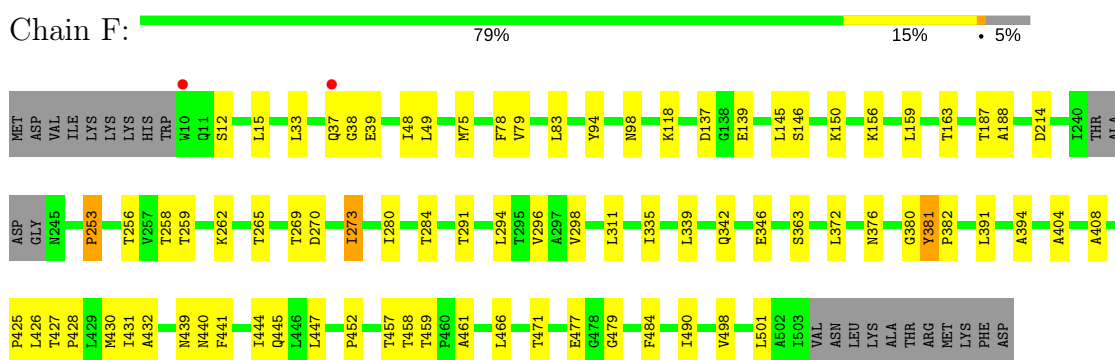
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

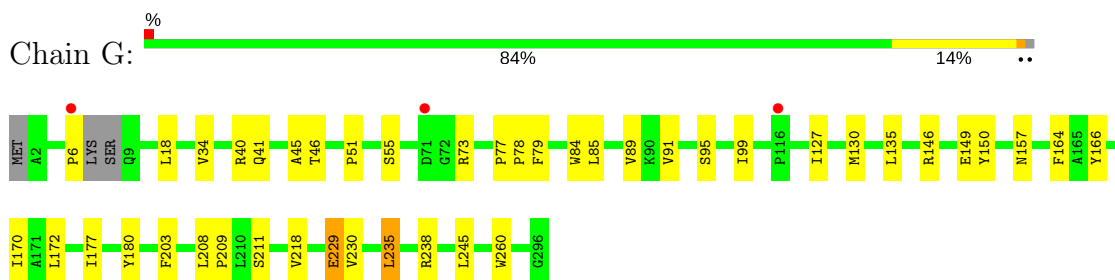
- Molecule 1: Maltose transporter subunit; periplasmic-binding component of ABC superfamily



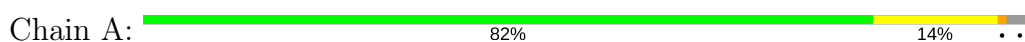
- Molecule 2: Maltose transporter subunit; membrane component of ABC superfamily

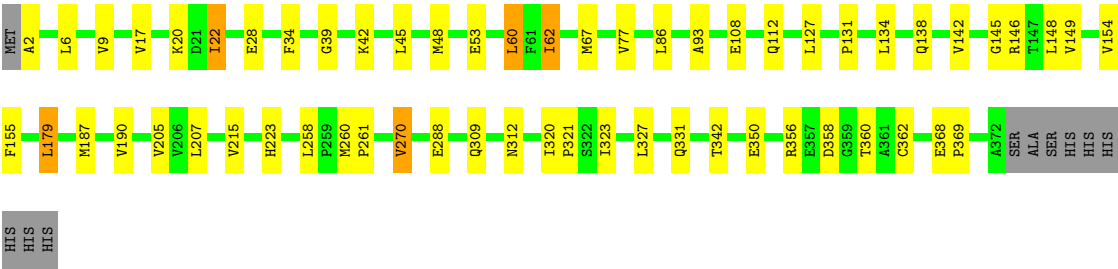


- Molecule 3: Maltose transporter subunit; membrane component of ABC superfamily

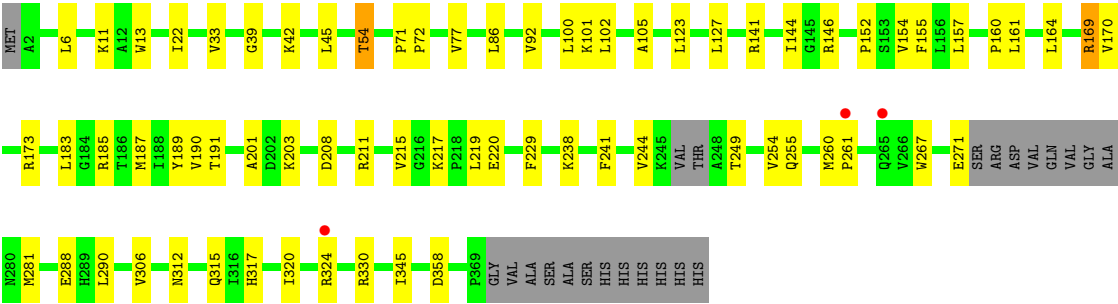
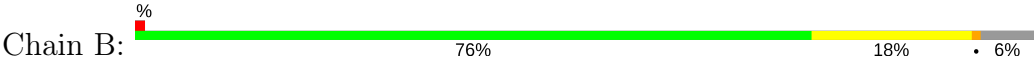


- Molecule 4: Fused maltose transport subunit, ATP-binding component of ABC superfamily; regulatory protein





● Molecule 4: Fused maltose transport subunit, ATP-binding component of ABC superfamily; regulatory protein



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	76.55Å 96.28Å 112.28Å 86.91° 80.87° 74.32°	Depositor
Resolution (Å)	20.00 – 3.10 19.91 – 3.10	Depositor EDS
% Data completeness (in resolution range)	82.7 (20.00-3.10) 82.5 (19.91-3.10)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.23 (at 3.09Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.214 , 0.254 0.212 , 0.250	Depositor DCC
R_{free} test set	2301 reflections (5.32%)	DCC
Wilson B-factor (Å ²)	65.7	Xtriage
Anisotropy	0.028	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 27.6	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	0.92	EDS
Total number of atoms	14789	wwPDB-VP
Average B, all atoms (Å ²)	81.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.71% 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

Bond lengths and bond angles in the following residue types are not validated in this section: PGV, MG, ANP, MAL

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	E	0.33	0/2966	0.46	0/4026
2	F	0.36	0/3916	0.51	1/5330 (0.0%)
3	G	0.36	0/2318	0.51	1/3167 (0.0%)
4	A	0.34	0/2926	0.53	0/3968
4	B	0.32	0/2837	0.50	0/3843
All	All	0.34	0/14963	0.50	2/20334 (0.0%)

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
3	G	235	LEU	CA-CB-CG	5.98	129.05	115.30
2	F	253	PRO	N-CA-C	5.08	125.31	112.10

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	E	2897	0	2873	26	0
2	F	3821	0	3849	50	0
3	G	2257	0	2345	31	0
4	A	2876	0	2941	37	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	B	2789	0	2850	39	0
5	F	23	0	22	1	0
6	F	51	0	76	0	0
7	A	1	0	0	0	0
7	B	1	0	0	0	0
8	A	31	0	13	2	0
8	B	31	0	13	2	0
9	A	6	0	0	0	0
9	B	3	0	0	1	0
9	F	2	0	0	0	0
All	All	14789	0	14982	164	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 6.

The worst 5 of 164 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)
4:A:62:ILE:HG23	4:A:67:MET:HG3	1.40	1.04
2:F:471:THR:HG23	2:F:490:ILE:HD13	1.48	0.96
4:B:39:GLY:H	8:B:2502:ANP:HNB1	1.07	0.94
4:A:39:GLY:N	8:A:2501:ANP:HNB1	1.72	0.87
4:A:39:GLY:H	8:A:2501:ANP:HNB1	0.86	0.80

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	E	372/378 (98%)	355 (95%)	16 (4%)	1 (0%)	44 79
2	F	486/514 (95%)	461 (95%)	22 (4%)	3 (1%)	28 67

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
3	G	289/296 (98%)	277 (96%)	11 (4%)	1 (0%)	44	79
4	A	369/381 (97%)	347 (94%)	22 (6%)	0	100	100
4	B	352/381 (92%)	328 (93%)	24 (7%)	0	100	100
All	All	1868/1950 (96%)	1768 (95%)	95 (5%)	5 (0%)	44	79

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	F	37	GLN
1	E	165	GLY
2	F	253	PRO
3	G	230	VAL
2	F	38	GLY

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	E	297/303 (98%)	294 (99%)	3 (1%)	80	92
2	F	402/424 (95%)	388 (96%)	14 (4%)	41	76
3	G	234/237 (99%)	229 (98%)	5 (2%)	59	85
4	A	314/323 (97%)	303 (96%)	11 (4%)	41	76
4	B	305/323 (94%)	293 (96%)	12 (4%)	37	73
All	All	1552/1610 (96%)	1507 (97%)	45 (3%)	48	80

5 of 45 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	G	229	GLU
4	A	53	GLU
4	B	271	GLU
4	A	17	VAL
4	A	60	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
2	F	437	ASN
2	F	440	ASN
3	G	41	GLN
3	G	53	GLN
3	G	282	GLN

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 carbohydrates in this entry.

5.6 Ligand geometry ⓘ

Of 6 ligands modelled in this entry, 2 are monoatomic - leaving 4 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	$\# Z > 2$
8	ANP	A	2501	7	29,33,33	1.96	8 (27%)	28,52,52	2.04	7 (25%)
8	ANP	B	2502	7	29,33,33	2.01	7 (24%)	28,52,52	2.08	7 (25%)
5	MAL	F	2001	-	24,24,24	0.47	0	35,35,35	0.69	1 (2%)
6	PGV	F	4001	-	50,50,50	1.09	3 (6%)	51,56,56	1.07	2 (3%)

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
8	ANP	A	2501	7	-	0/13/38/38	0/3/3/3
8	ANP	B	2502	7	-	0/13/38/38	0/3/3/3
5	MAL	F	2001	-	-	0/8/48/48	0/2/2/2
6	PGV	F	4001	-	-	0/55/55/55	0/0/0/0

The worst 5 of 18 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
8	B	2502	ANP	PG-O2G	-2.31	1.50	1.56
8	A	2501	ANP	PG-O2G	-2.31	1.50	1.56
8	A	2501	ANP	PG-O3G	-2.10	1.51	1.56
8	B	2502	ANP	PG-O3G	-2.06	1.51	1.56
8	A	2501	ANP	PB-O2B	-2.00	1.51	1.56

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
8	B	2502	ANP	N3-C2-N1	-6.59	123.12	128.86
8	A	2501	ANP	N3-C2-N1	-6.32	123.35	128.86
8	B	2502	ANP	O1B-PB-N3B	-3.45	106.63	111.79
8	B	2502	ANP	PA-O3A-PB	-3.26	120.88	132.38
8	B	2502	ANP	O1G-PG-N3B	-3.22	106.98	111.79

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
8	A	2501	ANP	2	0
8	B	2502	ANP	2	0
5	F	2001	MAL	1	0

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 [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	E	374/378 (98%)	-0.49	2 (0%) 90 80	41, 78, 122, 140	0
2	F	490/514 (95%)	-0.40	2 (0%) 92 84	34, 82, 136, 183	0
3	G	293/296 (98%)	-0.57	3 (1%) 82 67	32, 58, 104, 162	0
4	A	371/381 (97%)	-0.56	0 100 100	43, 74, 101, 112	0
4	B	358/381 (93%)	-0.37	3 (0%) 86 71	44, 91, 188, 261	0
All	All	1886/1950 (96%)	-0.47	10 (0%) 90 80	32, 78, 133, 261	0

The worst 5 of 10 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	G	6	PRO	5.7
1	E	173	ASN	3.4
2	F	37	GLN	3.3
1	E	172	GLU	3.3
3	G	71	ASP	2.7

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 carbohydrates 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. 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	RSCC	RSR	LLDF	B-factors(Å ²)	Q<0.9
6	PGV	F	4001	51/51	0.82	0.31	3.34	106,110,114,115	0
5	MAL	F	2001	23/23	0.94	0.16	0.25	80,81,82,83	0
8	ANP	A	2501	31/31	0.97	0.15	0.01	52,64,73,75	0
7	MG	B	1502	1/1	0.99	0.12	-0.10	54,54,54,54	0
8	ANP	B	2502	31/31	0.96	0.15	-0.11	59,74,82,84	0
7	MG	A	1501	1/1	0.98	0.11	-1.59	53,53,53,53	0

6.5 Other polymers

There are no such residues in this entry.