



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 27, 2018 – 03:57 PM EST

PDB ID : 6AQZ
Title : Crystal structure of a gdp-l-fucose synthetase from *Naegleria fowleri* bound to NADP
Authors : Seattle Structural Genomics Center for Infectious Disease; Seattle Structural Genomics Center for Infectious Disease (SSGCID)
Deposited on : 2017-08-21
Resolution : 2.40 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	:	rb-20030736
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)	:	rb-20030736

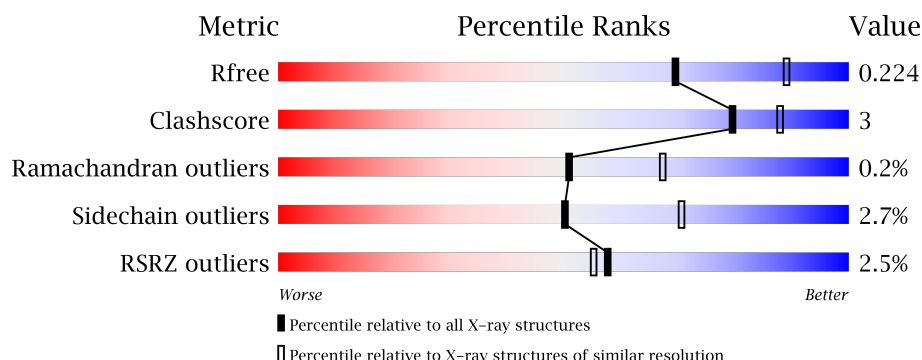
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.40 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	3166 (2.40-2.40)
Clashscore	112137	3674 (2.40-2.40)
Ramachandran outliers	110173	3616 (2.40-2.40)
Sidechain outliers	110143	3617 (2.40-2.40)
RSRZ outliers	101464	3195 (2.40-2.40)

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	A	341	<div> <div>90%</div> <div>8%</div> <div>•</div> </div>
1	B	341	<div> <div>•</div> <div>87%</div> <div>7%</div> <div>5%</div> </div>
1	C	341	<div> <div>88%</div> <div>10%</div> <div>•</div> </div>
1	D	341	<div> <div>5%</div> <div>82%</div> <div>13%</div> <div>5%</div> </div>
1	E	341	<div> <div>8%</div> <div>81%</div> <div>9%</div> <div>•</div> <div>8%</div> </div>

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Mol	Chain	Length	Quality of chain
1	F	341	 88% 6% 6%

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	NAP	B	401	-	-	-	X
3	EDO	B	402	-	-	-	X

2 Entry composition ⓘ

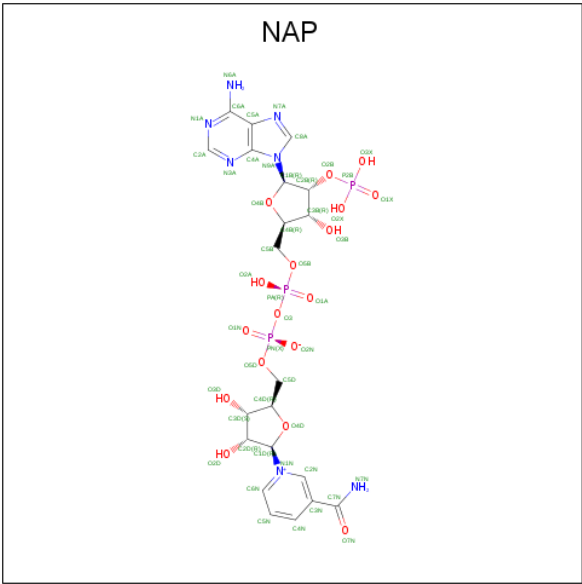
There are 4 unique types of molecules in this entry. The entry contains 15349 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 gdp-l-fucose synthetase.

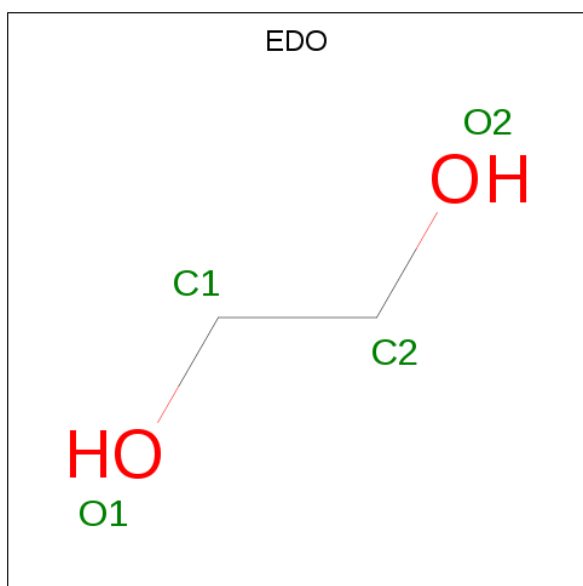
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	334	Total	C	N	O	S	0	1	0
			2610	1675	432	485	18			
1	B	323	Total	C	N	O	S	0	0	0
			2488	1594	414	464	16			
1	C	334	Total	C	N	O	S	0	1	0
			2605	1665	432	489	19			
1	D	324	Total	C	N	O	S	0	0	0
			2398	1526	406	450	16			
1	E	313	Total	C	N	O	S	0	0	0
			2246	1436	377	418	15			
1	F	321	Total	C	N	O	S	0	0	0
			2508	1612	414	466	16			

- Molecule 2 is NADP NICOTINAMIDE-ADENINE-DINUCLEOTIDE PHOSPHATE (three-letter code: NAP) (formula: C₂₁H₂₈N₇O₁₇P₃).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
2	B	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
2	C	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
2	E	1	Total	C	N	O	P	0	0
			48	21	7	17	3		
2	F	1	Total	C	N	O	P	0	0
			48	21	7	17	3		

- Molecule 3 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C₂H₆O₂).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	B	1	Total	C	O	0	0
			4	2	2		

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	70	Total	O	0	0
			70	70		
4	B	64	Total	O	0	0
			64	64		
4	C	51	Total	O	0	0
			51	51		
4	D	11	Total	O	0	0
			11	11		

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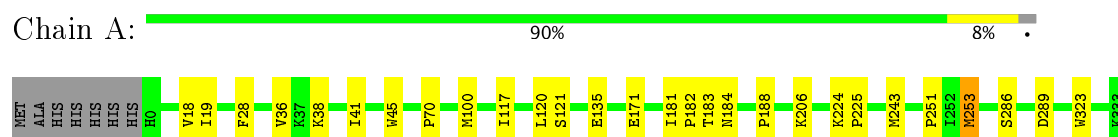
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	E	6	Total	O	0	0
			6	6		
4	F	48	Total	O	0	0
			48	48		

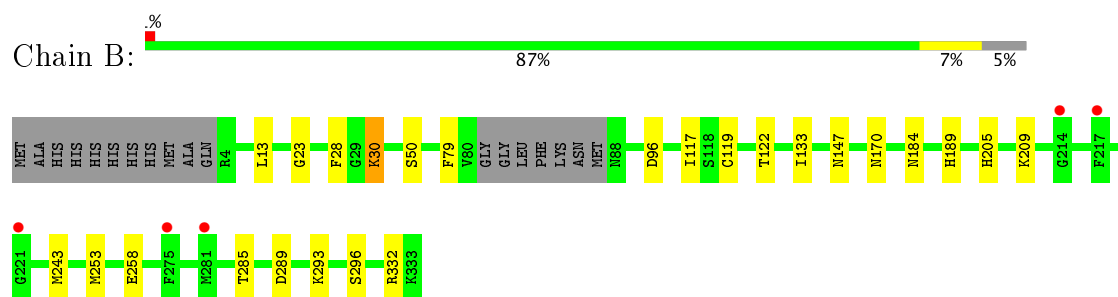
3 Residue-property plots

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.

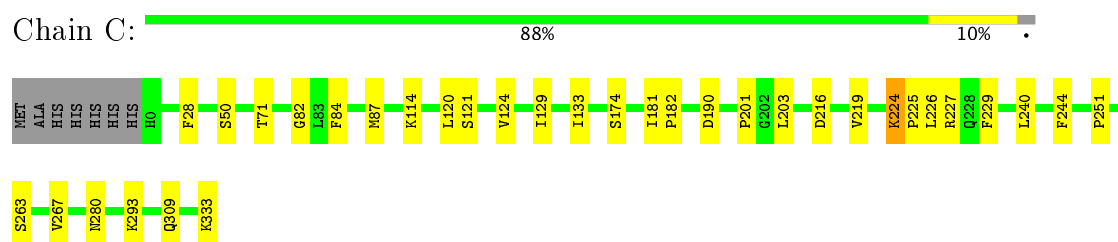
- Molecule 1: gdp-l-fucose synthetase



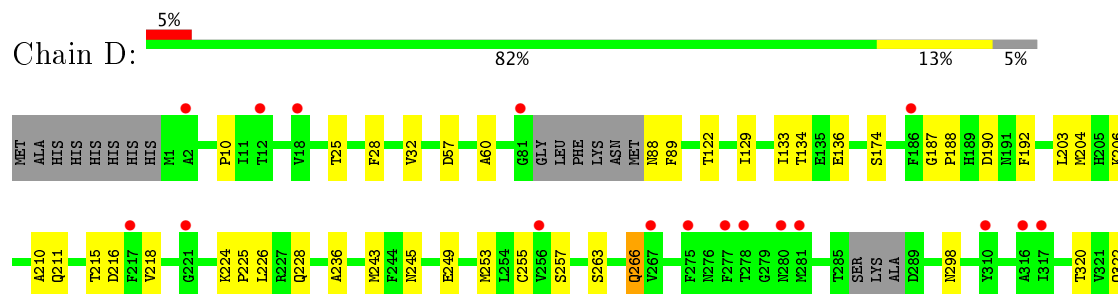
- Molecule 1: gdp-l-fucose synthetase

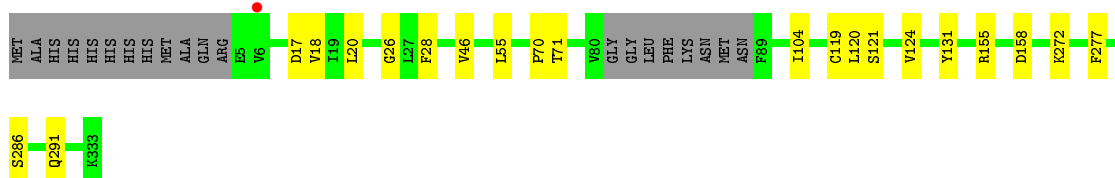


- Molecule 1: gdp-l-fucose synthetase



- Molecule 1: gdp-l-fucose synthetase





4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	97.37Å 104.03Å 120.17Å 90.00° 108.67° 90.00°	Depositor
Resolution (Å)	46.12 – 2.40 48.49 – 2.40	Depositor EDS
% Data completeness (in resolution range)	98.8 (46.12-2.40) 98.9 (48.49-2.40)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.19 (at 2.39Å)	Xtriage
Refinement program	PHENIX (1.12_2829: ???)	Depositor
R, R_{free}	0.178 , 0.224 0.175 , 0.224	Depositor DCC
R_{free} test set	2037 reflections (2.32%)	DCC
Wilson B-factor (Å ²)	53.4	Xtriage
Anisotropy	0.305	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 48.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	15349	wwPDB-VP
Average B, all atoms (Å ²)	67.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.26% 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](#)

Bond lengths and bond angles in the following residue types are not validated in this section: NAP, 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	0.46	0/2681	0.60	2/3639 (0.1%)
1	B	0.45	1/2552 (0.0%)	0.57	0/3468
1	C	0.44	0/2675	0.57	0/3631
1	D	0.36	0/2460	0.54	0/3350
1	E	0.37	1/2306 (0.0%)	0.52	0/3155
1	F	0.44	1/2573 (0.0%)	0.58	0/3492
All	All	0.42	3/15247 (0.0%)	0.56	2/20735 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	119	CYS	CB-SG	-5.85	1.72	1.81
1	F	119	CYS	CB-SG	-5.66	1.72	1.81
1	B	119	CYS	CB-SG	-5.50	1.72	1.81

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	253	MET	CA-CB-CG	-6.26	102.66	113.30
1	A	100	MET	CG-SD-CE	5.55	109.08	100.20

There are no chirality outliers.

There are no planarity outliers.

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	2610	0	2468	13	0
1	B	2488	0	2311	10	0
1	C	2605	0	2444	18	0
1	D	2398	0	2110	22	0
1	E	2246	0	1911	17	0
1	F	2508	0	2385	12	0
2	A	48	0	25	2	0
2	B	48	0	23	2	0
2	C	48	0	25	3	0
2	E	48	0	24	2	0
2	F	48	0	23	2	0
3	B	4	0	6	1	0
4	A	70	0	0	0	0
4	B	64	0	0	0	0
4	C	51	0	0	1	0
4	D	11	0	0	0	0
4	E	6	0	0	0	0
4	F	48	0	0	1	0
All	All	15349	0	13755	91	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 3.

The worst 5 of 91 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:D:263:SER:N	1:D:266:GLN:OE1	2.05	0.89
1:D:206:LYS:NZ	1:D:218:VAL:O	2.16	0.79
1:C:226:LEU:O	1:C:227:ARG:NH1	2.18	0.75
1:A:181:ILE:HB	1:A:253:MET:HG2	1.69	0.74
1:F:17:ASP:HB2	1:F:71:THR:OG1	1.87	0.74

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	333/341 (98%)	327 (98%)	6 (2%)	0	100	100
1	B	319/341 (94%)	313 (98%)	5 (2%)	1 (0%)	44	60
1	C	333/341 (98%)	329 (99%)	3 (1%)	1 (0%)	44	60
1	D	318/341 (93%)	312 (98%)	5 (2%)	1 (0%)	44	60
1	E	309/341 (91%)	296 (96%)	13 (4%)	0	100	100
1	F	317/341 (93%)	312 (98%)	5 (2%)	0	100	100
All	All	1929/2046 (94%)	1889 (98%)	37 (2%)	3 (0%)	51	67

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	184	ASN
1	D	224	LYS
1	C	224	LYS

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	273/298 (92%)	267 (98%)	6 (2%)	57	76
1	B	255/298 (86%)	246 (96%)	9 (4%)	41	61
1	C	272/298 (91%)	268 (98%)	4 (2%)	70	85
1	D	227/298 (76%)	216 (95%)	11 (5%)	30	47
1	E	200/298 (67%)	191 (96%)	9 (4%)	32	50
1	F	265/298 (89%)	264 (100%)	1 (0%)	93	97
All	All	1492/1788 (83%)	1452 (97%)	40 (3%)	50	71

5 of 40 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	333	LYS
1	D	134	THR
1	E	270	THR
1	D	28	PHE
1	D	174	SER

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 7 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	212	GLN
1	F	291	GLN
1	D	245	ASN
1	B	211	GLN
1	F	269	GLN

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 carbohydrates in this entry.

5.6 Ligand geometry [i](#)

6 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	NAP	A	401	-	44,52,52	2.98	11 (25%)	51,80,80	1.83	13 (25%)
2	NAP	B	401	1	44,52,52	3.00	17 (38%)	51,80,80	1.87	14 (27%)
3	EDO	B	402	-	3,3,3	0.46	0	2,2,2	0.28	0
2	NAP	C	401	-	44,52,52	2.83	11 (25%)	51,80,80	1.74	12 (23%)
2	NAP	E	401	-	44,52,52	2.86	10 (22%)	51,80,80	1.85	15 (29%)
2	NAP	F	401	-	44,52,52	2.76	12 (27%)	51,80,80	1.78	10 (19%)

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	NAP	A	401	-	-	0/27/67/67	0/5/5/5
2	NAP	B	401	1	-	0/27/67/67	0/5/5/5
3	EDO	B	402	-	-	0/1/1/1	0/0/0/0
2	NAP	C	401	-	-	0/27/67/67	0/5/5/5
2	NAP	E	401	-	-	0/27/67/67	0/5/5/5
2	NAP	F	401	-	-	0/27/67/67	0/5/5/5

The worst 5 of 61 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	401	NAP	C3N-C7N	-4.16	1.44	1.50
2	E	401	NAP	O2D-C2D	-3.33	1.35	1.43
2	F	401	NAP	O3D-C3D	-2.81	1.36	1.43
2	F	401	NAP	O2D-C2D	-2.74	1.36	1.43
2	A	401	NAP	O2B-C2B	-2.70	1.33	1.44

The worst 5 of 64 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	401	NAP	C5N-C4N-C3N	-6.74	112.42	120.35
2	B	401	NAP	C5N-C4N-C3N	-6.69	112.48	120.35
2	A	401	NAP	C5N-C4N-C3N	-5.94	113.37	120.35
2	C	401	NAP	C5N-C4N-C3N	-5.28	114.14	120.35
2	F	401	NAP	C5N-C4N-C3N	-5.18	114.26	120.35

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

6 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	401	NAP	2	0
2	B	401	NAP	2	0
3	B	402	EDO	1	0
2	C	401	NAP	3	0
2	E	401	NAP	2	0
2	F	401	NAP	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 ⓘ

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	334/341 (97%)	-0.27	0 100 100	32, 56, 83, 105	0
1	B	323/341 (94%)	-0.10	5 (1%) 74 72	34, 57, 104, 141	0
1	C	334/341 (97%)	-0.24	0 100 100	38, 55, 86, 112	0
1	D	324/341 (95%)	0.22	17 (5%) 28 26	46, 84, 112, 145	0
1	E	313/341 (91%)	0.38	26 (8%) 12 11	52, 90, 130, 170	0
1	F	321/341 (94%)	-0.31	1 (0%) 93 93	36, 58, 85, 106	0
All	All	1949/2046 (95%)	-0.06	49 (2%) 58 55	32, 65, 108, 170	0

The worst 5 of 49 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	225	PRO	6.1
1	E	226	LEU	5.9
1	E	220	PHE	4.9
1	E	269	GLN	4.8
1	E	265	GLY	3.7

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 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
2	NAP	B	401	48/48	0.75	0.32	5.82	43,74,87,90	48
3	EDO	B	402	4/4	0.92	0.48	5.54	81,81,81,81	0
2	NAP	C	401	48/48	0.98	0.14	0.02	39,47,57,59	0
2	NAP	F	401	48/48	0.98	0.14	-0.14	39,45,55,67	0
2	NAP	E	401	48/48	0.95	0.13	-0.59	51,68,81,94	0
2	NAP	A	401	48/48	0.98	0.13	-0.90	34,46,58,59	0

6.5 Other polymers [i](#)

There are no such residues in this entry.