



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 15, 2018 – 10:53 AM EST

PDB ID : 5NSQ
Title : Structure of Leucyl aminopeptidase from Trypanosoma brucei in complex with Actinonin
Authors : Timm, J.; Wilson, K.
Deposited on : 2017-04-26
Resolution : 3.00 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

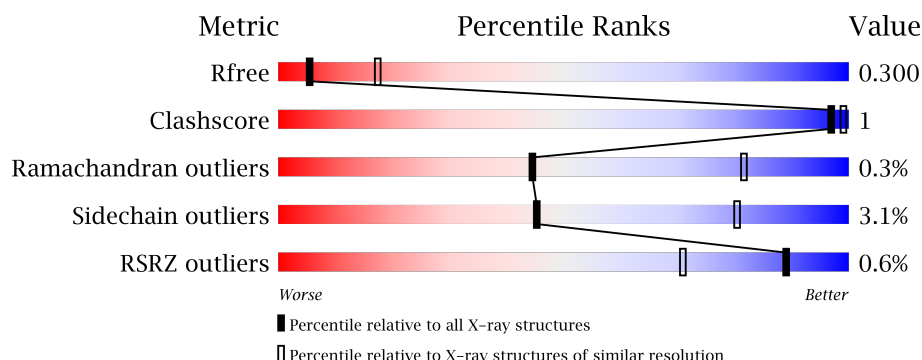
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION


The reported resolution of this entry is 3.00 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	1692 (3.00-3.00)
Clashscore	112137	2037 (3.00-3.00)
Ramachandran outliers	110173	1973 (3.00-3.00)
Sidechain outliers	110143	1976 (3.00-3.00)
RSRZ outliers	101464	1716 (3.00-3.00)

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	521	 94% 5%
1	B	521	 94% 5%
1	C	521	 93% 6% •
1	D	521	 2% 94% 5% •
1	E	521	 94% 5%

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Mol	Chain	Length	Quality of chain
1	F	521	<div><div><div>%</div><div><div></div></div><div>94%</div><div>5%</div><div>.</div></div></div>

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 22720 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 Aminopeptidase, putative.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	519	Total	C	N	O	S	0	2	0
			3775	2391	637	725	22			
1	B	519	Total	C	N	O	S	0	2	0
			3789	2398	639	730	22			
1	C	518	Total	C	N	O	S	0	1	0
			3795	2402	643	728	22			
1	D	519	Total	C	N	O	S	0	0	0
			3738	2369	631	717	21			
1	E	519	Total	C	N	O	S	0	1	0
			3769	2389	635	723	22			
1	F	515	Total	C	N	O	S	0	0	0
			3646	2308	619	697	22			

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	32	ALA	THR	conflict	UNP Q385B0
A	125	UNK	ALA	conflict	UNP Q385B0
A	139	THR	ALA	conflict	UNP Q385B0
B	32	ALA	THR	conflict	UNP Q385B0
B	125	UNK	ALA	conflict	UNP Q385B0
B	139	THR	ALA	conflict	UNP Q385B0
C	32	ALA	THR	conflict	UNP Q385B0
C	125	UNK	ALA	conflict	UNP Q385B0
C	139	THR	ALA	conflict	UNP Q385B0
D	32	ALA	THR	conflict	UNP Q385B0
D	125	UNK	ALA	conflict	UNP Q385B0
D	139	THR	ALA	conflict	UNP Q385B0
E	32	ALA	THR	conflict	UNP Q385B0
E	125	UNK	ALA	conflict	UNP Q385B0
E	139	THR	ALA	conflict	UNP Q385B0
F	32	ALA	THR	conflict	UNP Q385B0
F	125	UNK	ALA	conflict	UNP Q385B0

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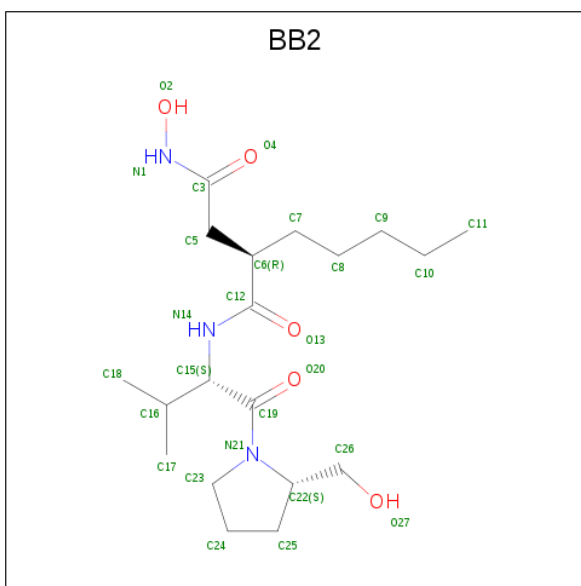
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Chain	Residue	Modelled	Actual	Comment	Reference
F	139	THR	ALA	conflict	UNP Q385B0

- Molecule 2 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	D	2	Total	Mn	0	0
			2	2		
2	E	2	Total	Mn	0	0
			2	2		
2	B	2	Total	Mn	0	0
			2	2		
2	C	2	Total	Mn	0	0
			2	2		
2	A	2	Total	Mn	0	0
			2	2		
2	F	2	Total	Mn	0	0
			2	2		

- Molecule 3 is ACTINONIN (three-letter code: BB2) (formula: C₁₉H₃₅N₃O₅).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			27	19	3	5		
3	B	1	Total	C	N	O	0	0
			27	19	3	5		
3	C	1	Total	C	N	O	0	0
			27	19	3	5		

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Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	D	1	Total	C	N	O	0	0
			27	19	3	5		
3	E	1	Total	C	N	O	0	0
			27	19	3	5		
3	F	1	Total	C	N	O	0	0
			27	19	3	5		

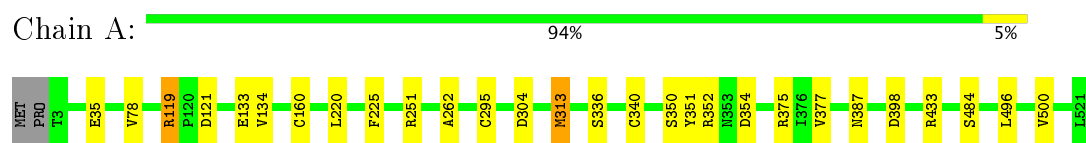
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	8	Total	O	0	0
			8	8		
4	B	6	Total	O	0	0
			6	6		
4	C	8	Total	O	0	0
			8	8		
4	D	1	Total	O	0	0
			1	1		
4	E	9	Total	O	0	0
			9	9		
4	F	2	Total	O	0	0
			2	2		

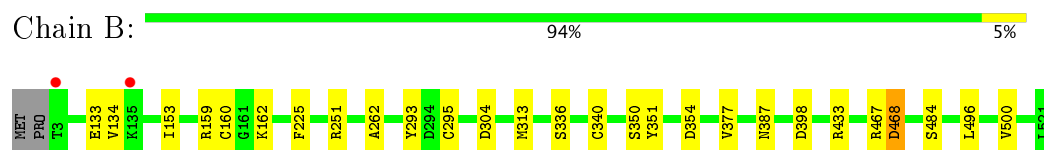
3 Residue-property plots [i](#)

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.

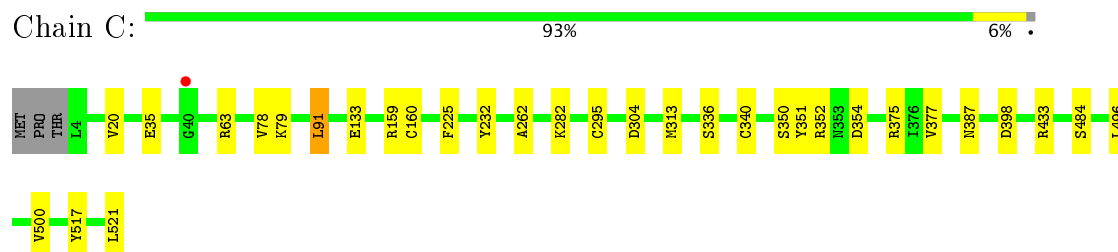
- Molecule 1: Aminopeptidase, putative



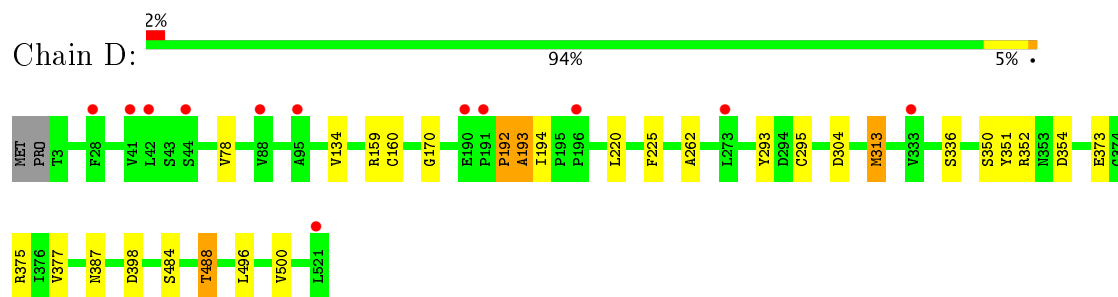
- Molecule 1: Aminopeptidase, putative



- Molecule 1: Aminopeptidase, putative

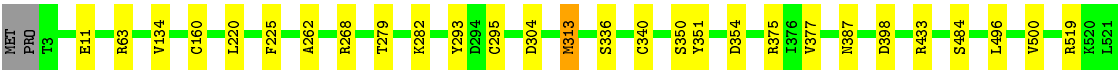


- Molecule 1: Aminopeptidase, putative

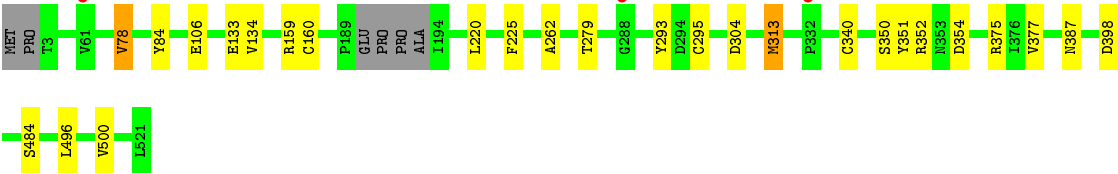
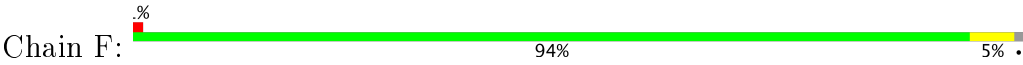


- Molecule 1: Aminopeptidase, putative





● Molecule 1: Aminopeptidase, putative



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	95.91Å 165.73Å 121.98Å 90.00° 112.45° 90.00°	Depositor
Resolution (Å)	41.50 – 3.00 41.50 – 3.00	Depositor EDS
% Data completeness (in resolution range)	95.5 (41.50-3.00) 95.5 (41.50-3.00)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.12 (at 3.01Å)	Xtriage
Refinement program	REFMAC 5.8.0135	Depositor
R, R_{free}	0.265 , 0.296 0.269 , 0.300	Depositor DCC
R_{free} test set	3327 reflections (5.20%)	DCC
Wilson B-factor (Å ²)	32.0	Xtriage
Anisotropy	0.281	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , -4.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.022 for h,-k,-h-l	Xtriage
F_o, F_c correlation	0.81	EDS
Total number of atoms	22720	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.74% 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: MN, BB2

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	0.55	0/3847	0.74	6/5254 (0.1%)
1	B	0.56	0/3864	0.74	3/5279 (0.1%)
1	C	0.55	0/3870	0.76	6/5282 (0.1%)
1	D	0.52	0/3809	0.73	4/5208 (0.1%)
1	E	0.56	1/3844 (0.0%)	0.75	6/5255 (0.1%)
1	F	0.53	0/3713	0.71	2/5082 (0.0%)
All	All	0.54	1/22947 (0.0%)	0.74	27/31360 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	11	GLU	CD-OE2	5.16	1.31	1.25

The worst 5 of 27 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	193	ALA	N-CA-CB	9.64	123.60	110.10
1	C	91	LEU	CA-CB-CG	8.45	134.74	115.30
1	F	313	MET	CG-SD-CE	7.85	112.77	100.20
1	E	313	MET	CG-SD-CE	7.76	112.62	100.20
1	D	313	MET	CG-SD-CE	7.76	112.62	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	3775	0	3629	8	0
1	B	3789	0	3658	6	0
1	C	3795	0	3690	7	0
1	D	3738	0	3594	10	0
1	E	3769	0	3641	7	0
1	F	3646	0	3418	12	0
2	A	2	0	0	0	0
2	B	2	0	0	0	0
2	C	2	0	0	0	0
2	D	2	0	0	0	0
2	E	2	0	0	0	0
2	F	2	0	0	0	0
3	A	27	0	34	0	0
3	B	27	0	34	1	0
3	C	27	0	34	0	0
3	D	27	0	34	0	0
3	E	27	0	34	0	0
3	F	27	0	34	0	0
4	A	8	0	0	1	0
4	B	6	0	0	0	0
4	C	8	0	0	0	0
4	D	1	0	0	0	0
4	E	9	0	0	0	0
4	F	2	0	0	0	0
All	All	22720	0	21834	47	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 1.

The worst 5 of 47 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:F:78:VAL:HG23	1:F:84:TYR:HB2	1.50	0.92
1:F:78:VAL:CG2	1:F:84:TYR:HB2	2.14	0.76
1:F:78:VAL:HG23	1:F:84:TYR:CB	2.16	0.75
1:F:340:CYS:HB3	1:F:377:VAL:HG13	1.77	0.67
1:C:340:CYS:HB3	1:C:377:VAL:HG13	1.78	0.65

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	517/521 (99%)	500 (97%)	16 (3%)	1 (0%)	51	86
1	B	518/521 (99%)	503 (97%)	13 (2%)	2 (0%)	38	78
1	C	516/521 (99%)	502 (97%)	13 (2%)	1 (0%)	51	86
1	D	516/521 (99%)	499 (97%)	14 (3%)	3 (1%)	28	70
1	E	517/521 (99%)	502 (97%)	14 (3%)	1 (0%)	51	86
1	F	510/521 (98%)	495 (97%)	14 (3%)	1 (0%)	51	86
All	All	3094/3126 (99%)	3001 (97%)	84 (3%)	9 (0%)	44	81

5 of 9 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	354	ASP
1	B	354	ASP
1	B	468	ASP
1	C	354	ASP
1	D	192	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	380/411 (92%)	369 (97%)	11 (3%)	48	82
1	B	386/411 (94%)	374 (97%)	12 (3%)	45	80
1	C	389/411 (95%)	376 (97%)	13 (3%)	43	79

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	D	375/411 (91%)	364 (97%)	11 (3%)	48	82
1	E	383/411 (93%)	372 (97%)	11 (3%)	48	82
1	F	349/411 (85%)	338 (97%)	11 (3%)	44	79
All	All	2262/2466 (92%)	2193 (97%)	69 (3%)	45	80

5 of 69 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	295	CYS
1	D	159	ARG
1	F	225	PHE
1	C	304	ASP
1	C	398	ASP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	C	185	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 18 ligands modelled in this entry, 12 are monoatomic - leaving 6 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	BB2	A	603	2	27,27,27	0.84	1 (3%)	33,35,35	1.32	5 (15%)
3	BB2	B	603	2	27,27,27	0.64	0	33,35,35	2.57	11 (33%)
3	BB2	C	603	2	27,27,27	0.62	0	33,35,35	1.18	1 (3%)
3	BB2	D	603	2	27,27,27	0.53	0	33,35,35	1.75	5 (15%)
3	BB2	E	603	2	27,27,27	0.48	0	33,35,35	1.51	3 (9%)
3	BB2	F	603	2	27,27,27	0.43	0	33,35,35	2.32	5 (15%)

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	BB2	A	603	2	-	0/33/43/43	0/1/1/1
3	BB2	B	603	2	-	0/33/43/43	0/1/1/1
3	BB2	C	603	2	-	0/33/43/43	0/1/1/1
3	BB2	D	603	2	-	0/33/43/43	0/1/1/1
3	BB2	E	603	2	-	0/33/43/43	0/1/1/1
3	BB2	F	603	2	-	0/33/43/43	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	A	603	BB2	C3-N1	3.60	1.36	1.32

The worst 5 of 30 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	F	603	BB2	O4-C3-N1	-9.94	112.05	123.40
3	B	603	BB2	O4-C3-N1	-7.16	115.22	123.40
3	F	603	BB2	O2-N1-C3	-6.53	110.00	119.81
3	D	603	BB2	O4-C3-N1	-6.41	116.08	123.40
3	B	603	BB2	O13-C12-C6	-6.21	114.16	122.11

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	603	BB2	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 [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	518/521 (99%)	-0.34	0 100 100	10, 29, 53, 67	0
1	B	518/521 (99%)	-0.38	2 (0%) 92 77	9, 24, 55, 96	0
1	C	517/521 (99%)	-0.40	1 (0%) 94 85	7, 24, 46, 78	0
1	D	518/521 (99%)	0.34	12 (2%) 61 31	24, 56, 91, 117	0
1	E	518/521 (99%)	-0.41	0 100 100	9, 23, 60, 85	0
1	F	514/521 (98%)	0.22	3 (0%) 89 71	20, 52, 85, 109	0
All	All	3103/3126 (99%)	-0.16	18 (0%) 89 71	7, 32, 77, 117	0

The worst 5 of 18 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	40	GLY	3.5
1	D	521	LEU	3.0
1	D	44	SER	2.9
1	D	196	PRO	2.7
1	B	135	LYS	2.6

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
3	BB2	B	603	27/27	0.94	0.23	1.29	22,35,43,44	0
3	BB2	A	603	27/27	0.95	0.23	0.86	24,38,45,49	0
3	BB2	C	603	27/27	0.96	0.20	0.72	18,28,32,33	0
3	BB2	E	603	27/27	0.97	0.20	0.71	22,27,41,42	0
3	BB2	F	603	27/27	0.95	0.22	0.49	38,57,68,68	0
3	BB2	D	603	27/27	0.94	0.22	0.02	37,49,56,62	0
2	MN	C	602	1/1	0.98	0.06	-2.49	17,17,17,17	0
2	MN	B	601	1/1	0.98	0.04	-2.51	21,21,21,21	0
2	MN	D	602	1/1	0.96	0.04	-2.67	45,45,45,45	0
2	MN	D	601	1/1	0.97	0.04	-2.76	42,42,42,42	0
2	MN	A	602	1/1	0.98	0.06	-3.05	21,21,21,21	0
2	MN	F	601	1/1	0.98	0.06	-3.21	38,38,38,38	0
2	MN	E	602	1/1	0.97	0.05	-3.23	22,22,22,22	0
2	MN	F	602	1/1	0.97	0.05	-3.27	36,36,36,36	0
2	MN	C	601	1/1	0.99	0.03	-3.31	20,20,20,20	0
2	MN	E	601	1/1	0.94	0.05	-4.42	20,20,20,20	0
2	MN	B	602	1/1	0.98	0.03	-4.94	25,25,25,25	0
2	MN	A	601	1/1	0.99	0.04	-5.09	22,22,22,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.