



# wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 16, 2022 – 02:07 PM EDT

PDB ID : 7U5P  
Title : CRYSTAL STRUCTURE OF THE ACTIVIN RECEPTOR TYPE-2A LIG-  
AND BINDING DOMAIN IN COMPLEX WITH ACTIVIN-A  
Authors : Chu, K.Y.; Malik, A.; Thamilselvan, V.; Martinez-Hackert, E.  
Deposited on : 2022-03-02  
Resolution : 3.14 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](mailto: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.

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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 : 2.28.1  
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) : 2.28.1

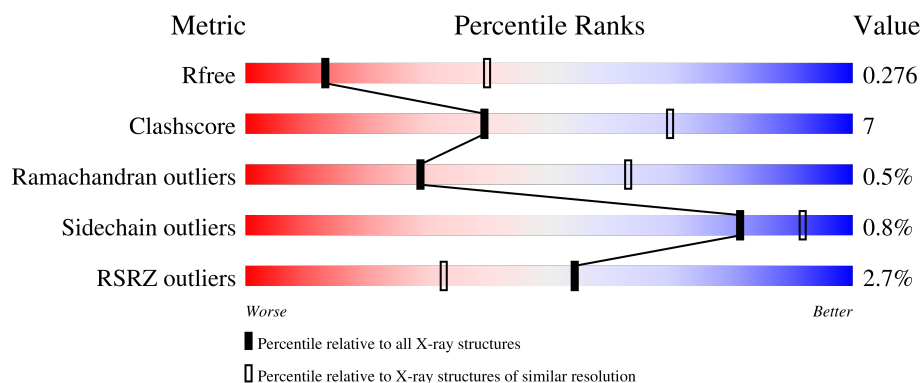
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.14 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.





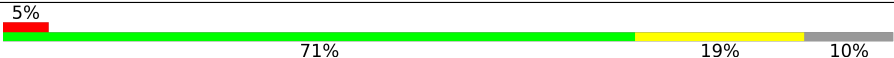
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	1626 (3.18-3.10)
Clashscore	141614	1735 (3.18-3.10)
Ramachandran outliers	138981	1677 (3.18-3.10)
Sidechain outliers	138945	1677 (3.18-3.10)
RSRZ outliers	127900	1588 (3.18-3.10)

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  $\geq 3$ , 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	121	<div> <div>66%</div> <div>11%</div> <div>•</div> <div>22%</div> </div>
1	C	121	<div> <div>2%</div> <div>67%</div> <div>9%</div> <div>•</div> <div>22%</div> </div>
1	E	121	<div> <div>%</div> <div>61%</div> <div>16%</div> <div>•</div> <div>22%</div> </div>
1	G	121	<div> <div>2%</div> <div>62%</div> <div>15%</div> <div>•</div> <div>22%</div> </div>
2	B	116	<div> <div>%</div> <div>79%</div> <div>17%</div> <div>•</div> </div>

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Mol	Chain	Length	Quality of chain
2	D	116	 4% 76% 18% 6%
2	F	116	 4% 75% 17% 8%
2	H	116	 5% 71% 19% 10%

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6332 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 Activin receptor type-2A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	94	Total	C	N	O	S	0	0	0
			729	450	123	145	11			
1	C	94	Total	C	N	O	S	0	0	0
			732	453	123	145	11			
1	E	94	Total	C	N	O	S	0	0	0
			744	461	123	149	11			
1	G	94	Total	C	N	O	S	0	0	0
			744	461	123	149	11			

- Molecule 2 is a protein called Inhibin beta A chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	112	Total	C	N	O	S	0	0	0
			843	531	142	158	12			
2	D	109	Total	C	N	O	S	0	0	0
			826	521	140	153	12			
2	F	107	Total	C	N	O	S	0	0	0
			805	507	136	149	13			
2	H	104	Total	C	N	O	S	0	0	0
			793	497	133	150	13			

- Molecule 3 is 2-acetamido-2-deoxy-beta-D-glucopyranose (three-letter code: NAG) (formula: C<sub>8</sub>H<sub>15</sub>NO<sub>6</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	N	O	0	0
			14	8	1	5		
3	A	1	Total	C	N	O	0	0
			14	8	1	5		
3	C	1	Total	C	N	O	0	0
			14	8	1	5		
3	C	1	Total	C	N	O	0	0
			14	8	1	5		
3	E	1	Total	C	N	O	0	0
			14	8	1	5		
3	E	1	Total	C	N	O	0	0
			14	8	1	5		
3	G	1	Total	C	N	O	0	0
			14	8	1	5		
3	G	1	Total	C	N	O	0	0
			14	8	1	5		

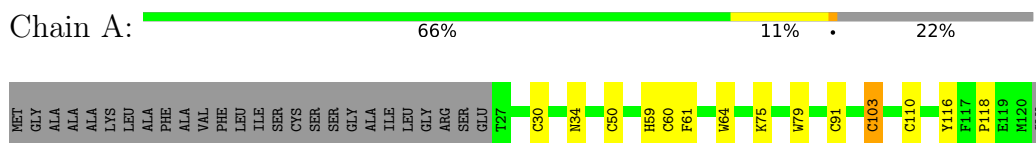
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	O	0	0
			1	1		
4	E	3	Total	O	0	0
			3	3		

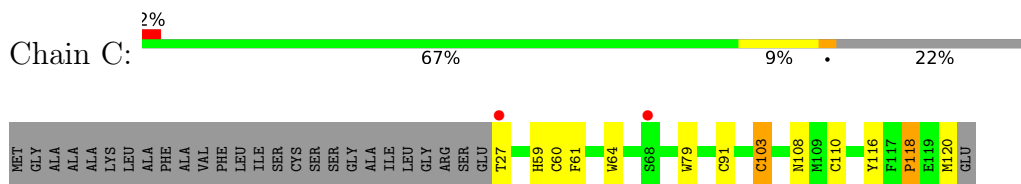
### 3 Residue-property plots [i](#)

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 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.

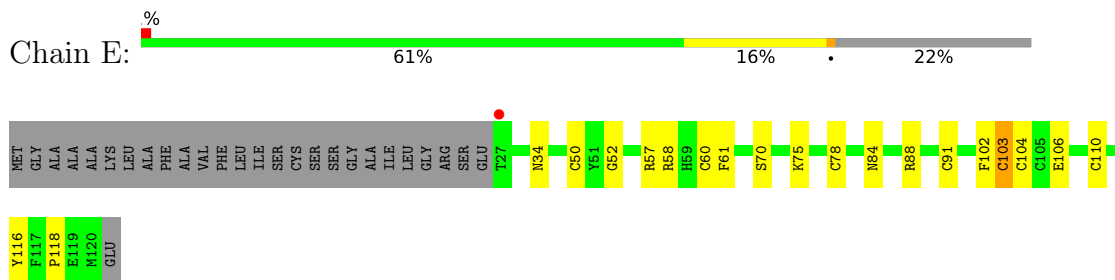
- Molecule 1: Activin receptor type-2A



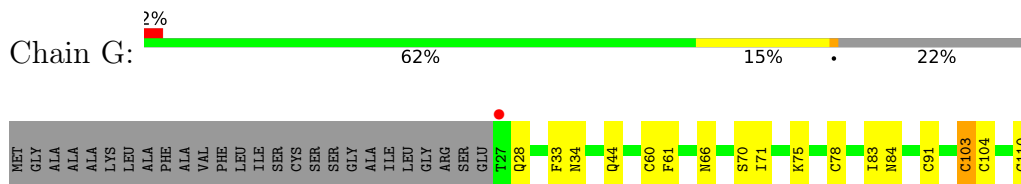
- Molecule 1: Activin receptor type-2A



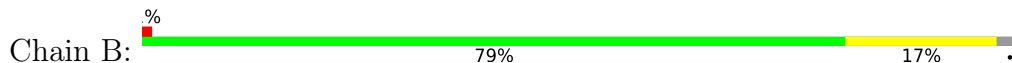
- Molecule 1: Activin receptor type-2A



- Molecule 1: Activin receptor type-2A

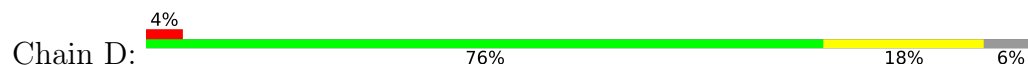


- Molecule 2: Inhibin beta A chain

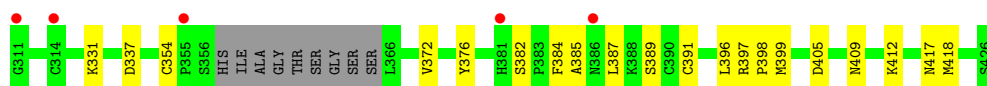
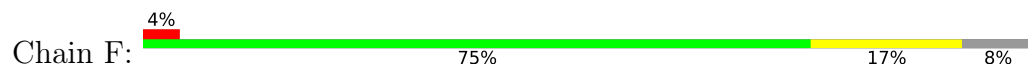




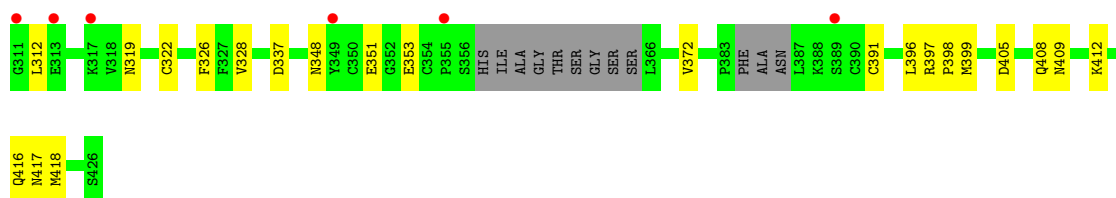
- Molecule 2: Inhibin beta A chain



- Molecule 2: Inhibin beta A chain



- Molecule 2: Inhibin beta A chain



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	82.61Å 82.54Å 151.34Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	24.69 – 3.14 24.69 – 3.14	Depositor EDS
% Data completeness (in resolution range)	95.6 (24.69-3.14) 95.6 (24.69-3.14)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.26 (at 3.17Å)	Xtriage
Refinement program	PHENIX 1.19.2_4158	Depositor
R, $R_{free}$	0.217 , 0.276 0.217 , 0.276	Depositor DCC
$R_{free}$ test set	1769 reflections (9.96%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	79.2	Xtriage
Anisotropy	0.157	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.29 , 34.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.468 for k,h,-l	Xtriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	6332	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	81.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.22% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: NAG

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	0.36	1/746 (0.1%)	0.60	0/1013
1	C	0.37	1/749 (0.1%)	0.59	0/1017
1	E	0.35	1/762 (0.1%)	0.60	0/1034
1	G	0.36	1/762 (0.1%)	0.58	0/1034
2	B	0.26	0/864	0.58	1/1168 (0.1%)
2	D	0.27	0/847	0.59	1/1146 (0.1%)
2	F	0.27	0/826	0.67	1/1118 (0.1%)
2	H	0.26	0/811	0.60	0/1092
All	All	0.31	4/6367 (0.1%)	0.60	3/8622 (0.0%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	103	CYS	CB-SG	-5.81	1.72	1.81
1	E	103	CYS	CB-SG	-5.60	1.72	1.81
1	G	103	CYS	CB-SG	-5.59	1.72	1.81
1	A	103	CYS	CB-SG	-5.56	1.72	1.81

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	F	385	ALA	C-N-CA	6.30	137.45	121.70
2	D	396	LEU	C-N-CA	5.48	135.41	121.70
2	B	396	LEU	C-N-CA	5.45	135.33	121.70

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	729	0	607	10	0
1	C	732	0	616	12	0
1	E	744	0	627	14	1
1	G	744	0	628	13	1
2	B	843	0	759	11	0
2	D	826	0	743	12	0
2	F	805	0	714	12	1
2	H	793	0	715	15	1
3	A	28	0	26	1	0
3	C	28	0	26	3	0
3	E	28	0	26	1	0
3	G	28	0	26	3	0
4	A	1	0	0	0	0
4	E	3	0	0	0	0
All	All	6332	0	5513	87	2

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 7.

The worst 5 of 87 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:G:78:CYS:O	2:H:412:LYS:NZ	2.14	0.80
2:F:399:MET:HB3	2:F:418:MET:HG2	1.68	0.77
1:E:78:CYS:O	2:F:412:LYS:NZ	2.19	0.76
1:G:66:ASN:ND2	3:G:202:NAG:O5	2.19	0.75
2:H:398:PRO:HB3	2:H:416:GLN:HG2	1.68	0.74

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:70:SER:OG	1:G:70:SER:OG[4_545]	2.05	0.15
2:F:337:ASP:O	2:H:408:GLN:NE2[4_545]	2.15	0.05

## 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	92/121 (76%)	87 (95%)	5 (5%)	0	100	100
1	C	92/121 (76%)	85 (92%)	6 (6%)	1 (1%)	14	45
1	E	92/121 (76%)	89 (97%)	3 (3%)	0	100	100
1	G	92/121 (76%)	88 (96%)	4 (4%)	0	100	100
2	B	108/116 (93%)	101 (94%)	6 (6%)	1 (1%)	17	50
2	D	105/116 (90%)	98 (93%)	6 (6%)	1 (1%)	15	47
2	F	103/116 (89%)	93 (90%)	9 (9%)	1 (1%)	15	47
2	H	98/116 (84%)	92 (94%)	6 (6%)	0	100	100
All	All	782/948 (82%)	733 (94%)	45 (6%)	4 (0%)	29	63

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	317	LYS
2	D	317	LYS
2	F	387	LEU
1	C	118	PRO

### 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	76/105 (72%)	76 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	C	77/105 (73%)	77 (100%)	0	100	100
1	E	80/105 (76%)	80 (100%)	0	100	100
1	G	80/105 (76%)	79 (99%)	1 (1%)	69	86
2	B	90/102 (88%)	89 (99%)	1 (1%)	73	88
2	D	88/102 (86%)	87 (99%)	1 (1%)	73	88
2	F	85/102 (83%)	84 (99%)	1 (1%)	71	87
2	H	86/102 (84%)	85 (99%)	1 (1%)	71	87
All	All	662/828 (80%)	657 (99%)	5 (1%)	81	92

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	G	28	GLN
2	B	416	GLN
2	D	416	GLN
2	F	391	CYS
2	H	391	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	G	28	GLN
2	B	369	HIS

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry

8 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	NAG	E	201	1	14,14,15	0.23	0	17,19,21	0.44	0
3	NAG	C	201	1	14,14,15	0.24	0	17,19,21	0.55	0
3	NAG	A	201	1	14,14,15	0.27	0	17,19,21	0.51	0
3	NAG	E	202	1	14,14,15	0.90	1 (7%)	17,19,21	0.48	0
3	NAG	C	202	1	14,14,15	0.30	0	17,19,21	0.82	1 (5%)
3	NAG	G	201	1	14,14,15	0.26	0	17,19,21	0.44	0
3	NAG	A	202	1	14,14,15	0.29	0	17,19,21	0.35	0
3	NAG	G	202	-	14,14,15	0.39	0	17,19,21	0.34	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	NAG	E	201	1	-	0/6/23/26	0/1/1/1
3	NAG	C	201	1	-	0/6/23/26	0/1/1/1
3	NAG	A	201	1	-	0/6/23/26	0/1/1/1
3	NAG	E	202	1	-	2/6/23/26	0/1/1/1
3	NAG	C	202	1	-	4/6/23/26	0/1/1/1
3	NAG	G	201	1	-	0/6/23/26	0/1/1/1
3	NAG	A	202	1	-	0/6/23/26	0/1/1/1
3	NAG	G	202	-	-	0/6/23/26	0/1/1/1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	E	202	NAG	O5-C1	-3.26	1.38	1.43

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	C	202	NAG	C2-N2-C7	2.84	126.94	122.90

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	C	202	NAG	C3-C2-N2-C7
3	C	202	NAG	C4-C5-C6-O6
3	C	202	NAG	O5-C5-C6-O6
3	E	202	NAG	O5-C5-C6-O6
3	E	202	NAG	C1-C2-N2-C7

There are no ring outliers.

4 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	E	202	NAG	1	0
3	C	202	NAG	3	0
3	A	202	NAG	1	0
3	G	202	NAG	3	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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	94/121 (77%)	-0.13	0 <span>100</span> <span>100</span>	49, 71, 108, 139	0
1	C	94/121 (77%)	-0.17	2 (2%) <span>63</span> <span>44</span>	50, 73, 106, 176	0
1	E	94/121 (77%)	-0.13	1 (1%) <span>80</span> <span>66</span>	47, 66, 109, 129	0
1	G	94/121 (77%)	-0.03	2 (2%) <span>63</span> <span>44</span>	47, 68, 119, 136	0
2	B	112/116 (96%)	0.05	1 (0%) <span>84</span> <span>72</span>	52, 88, 134, 151	0
2	D	109/116 (93%)	0.08	5 (4%) <span>32</span> <span>15</span>	52, 83, 134, 149	0
2	F	107/116 (92%)	0.27	5 (4%) <span>31</span> <span>15</span>	45, 83, 146, 173	0
2	H	104/116 (89%)	0.24	6 (5%) <span>23</span> <span>10</span>	48, 85, 149, 183	0
All	All	808/948 (85%)	0.03	22 (2%) <span>54</span> <span>32</span>	45, 77, 134, 183	0

The worst 5 of 22 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	311	GLY	5.3
2	H	355	PRO	4.1
1	G	120	MET	4.0
1	C	27	THR	3.4
1	E	27	THR	3.4

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
3	NAG	C	202	14/15	0.85	0.23	68,86,97,101	0
3	NAG	G	201	14/15	0.85	0.22	90,103,116,126	0
3	NAG	A	201	14/15	0.86	0.19	75,97,108,110	0
3	NAG	A	202	14/15	0.89	0.27	83,98,105,107	0
3	NAG	C	201	14/15	0.90	0.19	71,96,112,113	0
3	NAG	G	202	14/15	0.90	0.22	47,70,89,90	0
3	NAG	E	202	14/15	0.91	0.21	48,69,85,96	0
3	NAG	E	201	14/15	0.92	0.15	81,94,105,108	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.