



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2025 – 12:40 AM EST

PDB ID : 9AZR  
Title : Lineage 860 UCA Fab bound to A/Massachusetts/1/1990 hemagglutinin head  
Authors : Maurer, D.P.; Schmidt, A.G.  
Deposited on : 2024-03-11  
Resolution : 2.30 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	1.21
EDS	:	3.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
CCP4	:	9.0.004 (Gargrove)
Density-Fitness	:	1.0.11
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.41.4

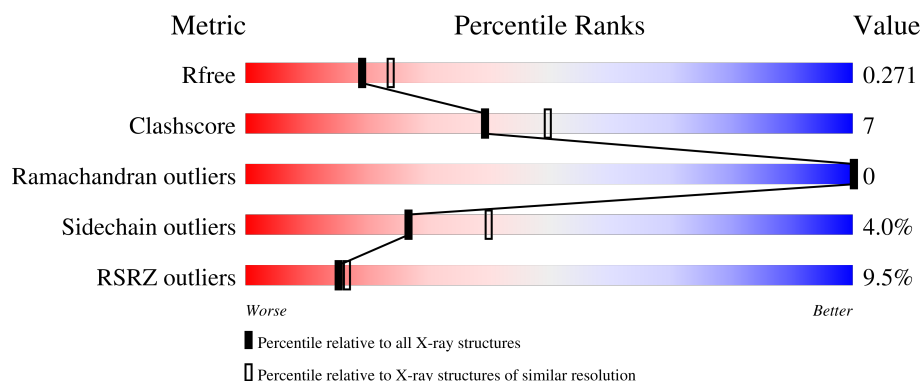
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.30 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))
$R_{free}$	164625	5963 (2.30-2.30)
Clashscore	180529	6698 (2.30-2.30)
Ramachandran outliers	177936	6640 (2.30-2.30)
Sidechain outliers	177891	6640 (2.30-2.30)
RSRZ outliers	164620	5963 (2.30-2.30)

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	E	224	<div> <div>15%</div> <div> <div></div> <div>76%</div> <div>19%</div> <div>5%</div> </div> </div>
2	H	240	<div> <div>8%</div> <div> <div></div> <div>78%</div> <div>15%</div> <div>• 5%</div> </div> </div>
3	L	214	<div> <div>5%</div> <div> <div></div> <div>83%</div> <div>15%</div> <div>•</div> </div> </div>

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 5251 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 Hemagglutinin HA1 chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	E	213	Total	C	N	O	S	0	0	0
			1719	1097	292	326	4			

There are 11 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	264	GLY	-	expression tag	UNP Q07775
E	265	ALA	-	expression tag	UNP Q07775
E	266	GLY	-	expression tag	UNP Q07775
E	267	SER	-	expression tag	UNP Q07775
E	268	SER	-	expression tag	UNP Q07775
E	269	LEU	-	expression tag	UNP Q07775
E	270	GLU	-	expression tag	UNP Q07775
E	271	VAL	-	expression tag	UNP Q07775
E	272	LEU	-	expression tag	UNP Q07775
E	273	PHE	-	expression tag	UNP Q07775
E	274	GLN	-	expression tag	UNP Q07775

- Molecule 2 is a protein called Lineage 860 UCA Fab heavy chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	H	227	Total	C	N	O	S	0	0	0
			1718	1085	289	335	9			

- Molecule 3 is a protein called Lineage 860 UCA Fab light chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	L	212	Total	C	N	O	S	0	0	0
			1583	985	269	325	4			

- Molecule 4 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
4	E	1	Total	C	N	O	0	0
			14	8	1	5		

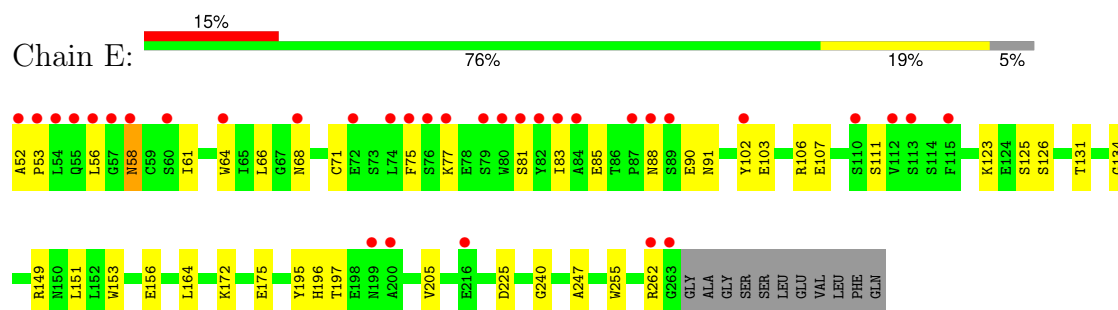
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	E	69	Total	O	0	0
			69	69		
5	H	72	Total	O	0	0
			72	72		
5	L	76	Total	O	0	0
			76	76		

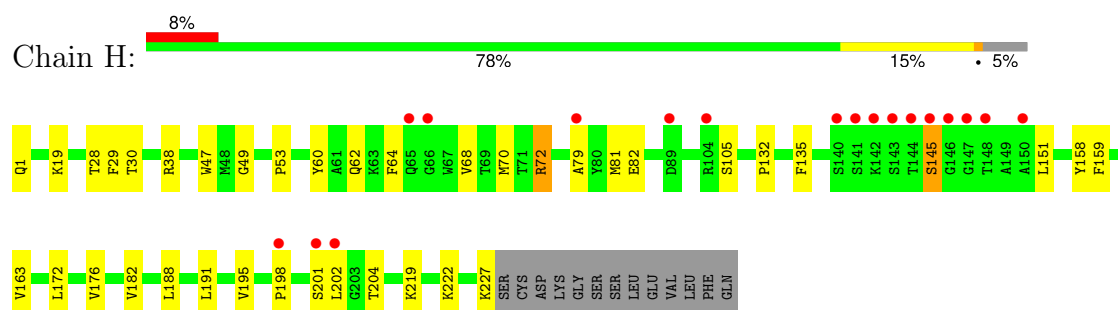
### 3 Residue-property plots [i](#)

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.

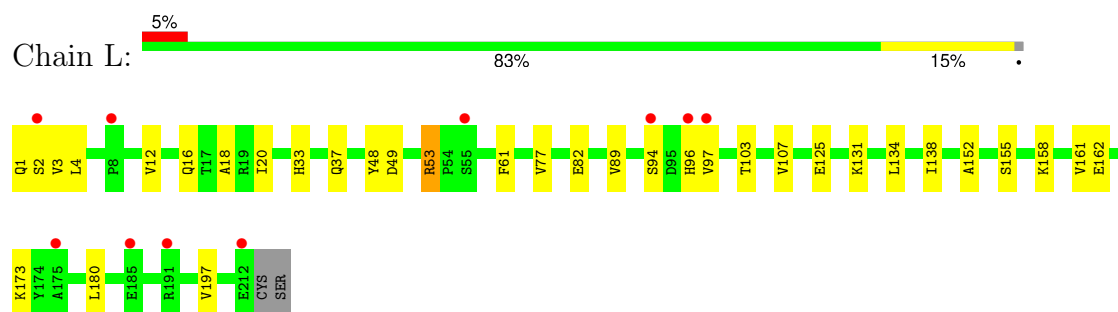
- Molecule 1: Hemagglutinin HA1 chain



- Molecule 2: Lineage 860 UCA Fab heavy chain



- Molecule 3: Lineage 860 UCA Fab light chain



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	202.54Å 71.86Å 65.40Å 90.00° 104.87° 90.00°	Depositor
Resolution (Å)	48.94 – 2.30 48.94 – 2.30	Depositor EDS
% Data completeness (in resolution range)	97.9 (48.94-2.30) 98.1 (48.94-2.30)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.08 (at 2.29Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, $R_{free}$	0.229 , 0.270 0.229 , 0.271	Depositor DCC
$R_{free}$ test set	38568 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	43.6	Xtriage
Anisotropy	0.432	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 37.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	5251	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	54.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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	E	0.26	0/1772	0.48	0/2412
2	H	0.27	0/1764	0.51	0/2405
3	L	0.28	0/1622	0.48	0/2219
All	All	0.27	0/5158	0.49	0/7036

There are no bond length outliers.

There are no bond angle outliers.

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	1719	0	1625	23	0
2	H	1718	0	1667	24	1
3	L	1583	0	1524	23	0
4	E	14	0	13	0	0
5	E	69	0	0	4	0
5	H	72	0	0	3	1
5	L	76	0	0	5	0
All	All	5251	0	4829	65	1

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.

All (65) 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:E:126:SER:O	5:E:401:HOH:O	1.86	0.94
3:L:161:VAL:O	5:L:301:HOH:O	1.91	0.88
2:H:62:GLN:H	3:L:96:HIS:HE1	1.32	0.78
2:H:145:SER:OG	5:H:302:HOH:O	2.05	0.73
3:L:37:GLN:OE1	5:L:302:HOH:O	2.07	0.72
1:E:240:GLY:O	5:E:402:HOH:O	2.09	0.70
3:L:1:GLN:NE2	5:L:303:HOH:O	2.24	0.69
2:H:28:THR:OG1	5:H:301:HOH:O	2.04	0.68
1:E:56:LEU:H	1:E:85:GLU:HG3	1.61	0.66
3:L:1:GLN:N	3:L:1:GLN:OE1	2.27	0.64
2:H:1:GLN:NE2	5:H:307:HOH:O	2.32	0.62
3:L:173:LYS:NZ	5:L:310:HOH:O	2.34	0.61
2:H:62:GLN:H	3:L:96:HIS:CE1	2.18	0.58
2:H:182:VAL:HG21	3:L:162:GLU:HB3	1.86	0.57
2:H:64:PHE:O	2:H:68:VAL:HB	2.05	0.57
3:L:134:LEU:HD12	3:L:180:LEU:HD12	1.87	0.56
1:E:164:LEU:HD21	1:E:247:ALA:HB3	1.87	0.56
1:E:53:PRO:O	1:E:77:LYS:NZ	2.34	0.55
1:E:175:GLU:OE1	5:E:403:HOH:O	2.17	0.55
1:E:58:ASN:N	1:E:58:ASN:OD1	2.40	0.54
1:E:61:ILE:HD11	1:E:83:ILE:HG23	1.91	0.53
2:H:30:THR:HA	2:H:53:PRO:HB2	1.91	0.53
2:H:47:TRP:CZ2	2:H:49:GLY:HA2	2.44	0.53
2:H:198:PRO:O	2:H:201:SER:OG	2.26	0.52
3:L:4:LEU:HD11	3:L:89:VAL:HG22	1.92	0.51
3:L:33:HIS:HD2	3:L:49:ASP:H	1.59	0.51
2:H:68:VAL:HG13	2:H:81:MET:CE	2.41	0.50
1:E:52:ALA:O	1:E:81:SER:N	2.38	0.50
1:E:66:LEU:HD22	1:E:151:LEU:HD11	1.93	0.50
1:E:81:SER:HA	1:E:111:SER:HA	1.93	0.50
1:E:131:THR:OG1	1:E:156:GLU:O	2.26	0.50
2:H:132:PRO:HB3	2:H:158:TYR:HB3	1.94	0.49
1:E:71:CYS:HB3	1:E:75:PHE:HE2	1.78	0.49
3:L:94:SER:O	3:L:96:HIS:HD2	1.95	0.49
2:H:53:PRO:O	2:H:72:ARG:NE	2.42	0.48
1:E:88:ASN:HB2	1:E:102:TYR:CE1	2.49	0.48
1:E:90:GLU:HG3	1:E:91:ASN:OD1	2.14	0.47
1:E:205:VAL:O	5:E:404:HOH:O	2.20	0.47
3:L:82:GLU:HG3	3:L:107:VAL:HG23	1.94	0.47
1:E:156:GLU:OE1	1:E:196:HIS:HE1	1.98	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:H:176:VAL:HG22	2:H:195:VAL:HG22	1.97	0.46
1:E:103:GLU:OE2	1:E:106:ARG:NH1	2.49	0.45
3:L:138:ILE:HG12	3:L:197:VAL:HG21	1.99	0.45
2:H:60:TYR:CE1	2:H:70:MET:HG3	2.52	0.45
3:L:53:ARG:HD3	3:L:61:PHE:O	2.17	0.45
1:E:64:TRP:CZ3	1:E:83:ILE:HD11	2.53	0.44
2:H:159:PHE:HB2	2:H:188:LEU:HD23	1.99	0.44
1:E:134:GLY:HA3	1:E:153:TRP:HB3	1.99	0.44
2:H:19:LYS:HG3	2:H:82:GLU:HG3	1.99	0.44
3:L:12:VAL:HG11	3:L:18:ALA:HB2	2.00	0.44
2:H:47:TRP:CG	3:L:97:VAL:HB	2.53	0.43
2:H:68:VAL:HG13	2:H:81:MET:HE1	1.99	0.43
1:E:195:TYR:O	1:E:197:THR:N	2.50	0.43
2:H:163:VAL:HG22	2:H:191:LEU:HD21	2.00	0.43
3:L:20:ILE:HG12	3:L:103:THR:HG21	1.99	0.42
3:L:16:GLN:O	3:L:77:VAL:HG23	2.18	0.42
1:E:164:LEU:HD23	1:E:247:ALA:O	2.19	0.42
3:L:134:LEU:HB2	3:L:180:LEU:HB3	2.02	0.42
2:H:222:LYS:HA	2:H:222:LYS:HD3	1.94	0.41
2:H:135:PHE:HD1	3:L:125:GLU:HG2	1.85	0.41
2:H:29:PHE:HZ	2:H:79:ALA:HB2	1.86	0.41
2:H:172:LEU:HD21	2:H:195:VAL:HG11	2.02	0.41
1:E:123:LYS:HD2	1:E:255:TRP:CZ2	2.56	0.41
3:L:131:LYS:NZ	5:L:325:HOH:O	2.52	0.41
3:L:152:ALA:O	3:L:155:SER:HB3	2.21	0.41

All (1) 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)
2:H:1:GLN:O	5:H:301:HOH:O[2_556]	2.13	0.07

## 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	211/224 (94%)	195 (92%)	16 (8%)	0	100	100
2	H	225/240 (94%)	217 (96%)	8 (4%)	0	100	100
3	L	210/214 (98%)	207 (99%)	3 (1%)	0	100	100
All	All	646/678 (95%)	619 (96%)	27 (4%)	0	100	100

There are no Ramachandran outliers to report.

### 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	187/195 (96%)	179 (96%)	8 (4%)	25	36
2	H	190/202 (94%)	181 (95%)	9 (5%)	22	32
3	L	179/181 (99%)	174 (97%)	5 (3%)	38	55
All	All	556/578 (96%)	534 (96%)	22 (4%)	27	40

All (22) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	58	ASN
1	E	68	ASN
1	E	107	GLU
1	E	125	SER
1	E	149	ARG
1	E	172	LYS
1	E	225	ASP
1	E	262	ARG
2	H	38	ARG
2	H	72	ARG
2	H	105	SER
2	H	145	SER
2	H	151	LEU

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Mol	Chain	Res	Type
2	H	202	LEU
2	H	204	THR
2	H	219	LYS
2	H	227	LYS
3	L	2	SER
3	L	3	VAL
3	L	48	TYR
3	L	53	ARG
3	L	158	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
3	L	16	GLN
3	L	33	HIS
3	L	96	HIS
3	L	172	ASN

### 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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is 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	$\# Z  > 2$
4	NAG	E	301	1	14,14,15	0.21	0	17,19,21	0.43	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
4	NAG	E	301	1	-	0/6/23/26	0/1/1/1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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, 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	E	213/224 (95%)	1.21	34 (15%) <b>6</b> <b>7</b>	33, 49, 139, 203	0
2	H	227/240 (94%)	0.85	18 (7%) <b>20</b> <b>22</b>	37, 48, 74, 104	0
3	L	212/214 (99%)	0.86	10 (4%) <b>37</b> <b>38</b>	37, 47, 61, 81	0
All	All	652/678 (96%)	0.97	62 (9%) <b>15</b> <b>17</b>	33, 48, 104, 203	0

All (62) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	E	263	GLY	5.3
1	E	74	LEU	5.0
1	E	52	ALA	4.9
1	E	199	ASN	4.6
1	E	75	PHE	4.4
1	E	87	PRO	4.4
1	E	82	TYR	4.3
1	E	72	GLU	3.9
2	H	144	THR	3.9
1	E	83	ILE	3.8
3	L	55	SER	3.7
1	E	88	ASN	3.6
3	L	212	GLU	3.6
1	E	84	ALA	3.6
2	H	142	LYS	3.5
1	E	64	TRP	3.5
2	H	143	SER	3.4
1	E	57	GLY	3.3
2	H	66	GLY	3.3
1	E	53	PRO	3.2
1	E	56	LEU	3.2
1	E	54	LEU	3.1
1	E	89	SER	3.1

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Mol	Chain	Res	Type	RSRZ
1	E	58	ASN	3.1
1	E	55	GLN	3.0
1	E	115	PHE	2.9
1	E	80	TRP	2.9
3	L	191	ARG	2.8
2	H	150	ALA	2.8
2	H	104	ARG	2.7
3	L	94	SER	2.7
2	H	145	SER	2.7
1	E	110	SER	2.7
1	E	216	GLU	2.6
1	E	81	SER	2.6
2	H	89	ASP	2.6
1	E	79	SER	2.6
2	H	141	SER	2.5
2	H	79	ALA	2.5
1	E	68	ASN	2.5
2	H	202	LEU	2.4
1	E	76	SER	2.4
2	H	146	GLY	2.4
1	E	262	ARG	2.4
3	L	8	PRO	2.3
2	H	201	SER	2.3
1	E	102	TYR	2.3
1	E	200	ALA	2.2
3	L	97	VAL	2.2
2	H	147	GLY	2.1
2	H	148	THR	2.1
1	E	112	VAL	2.1
1	E	77	LYS	2.1
2	H	140	SER	2.1
3	L	2	SER	2.1
3	L	175	ALA	2.1
3	L	96	HIS	2.0
3	L	185	GLU	2.0
1	E	60	SER	2.0
1	E	113	SER	2.0
2	H	65	GLN	2.0
2	H	198	PRO	2.0

## 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( $\text{\AA}^2$ )	Q<0.9
4	NAG	E	301	14/15	0.46	0.21	65,86,94,96	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.