wwPDB X-ray Structure Validation Summary Report (i)

Nov 6, 2023 – 09:25 AM EST

PDB ID	:	6PYQ
Title	:	Assembly of VIQKI D455(beta-L-homoaspartic acid)with human parainfluenza virus type 3 (HPIV3) fusion glycoprotein N-terminal heptad repeat domain
Authors	:	Outlaw, V.K.; Gellman, S.H.
Deposited on	:	2019-07-30
Resolution	:	1.79 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
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

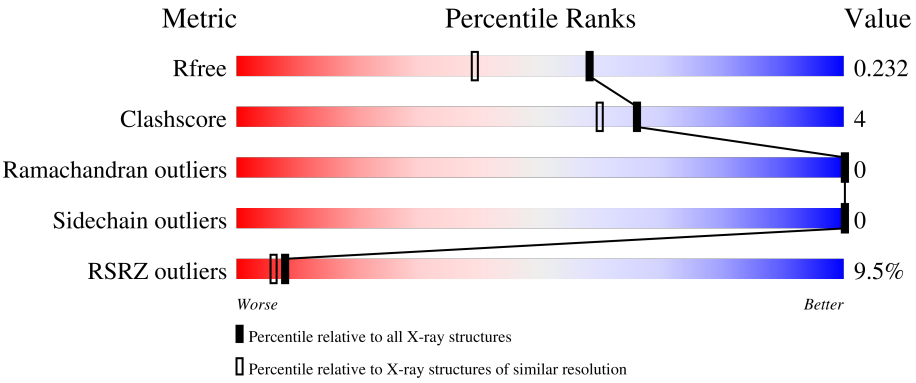
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 1.79 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	5950 (1.80-1.80)
Clashscore	141614	6793 (1.80-1.80)
Ramachandran outliers	138981	6697 (1.80-1.80)
Sidechain outliers	138945	6696 (1.80-1.80)
RSRZ outliers	127900	5850 (1.80-1.80)

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 >=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 <=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	53	17% 87% 9% •
1	C	53	4% 75% 6% • 17%
1	E	53	8% 68% 9% • 21%
2	B	38	5% 76% 11% • 11%
2	D	38	8% 79% 8% • 11%

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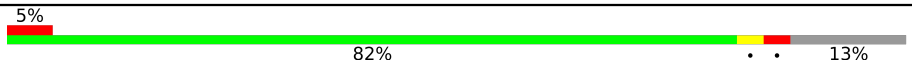
Mol	Chain	Length	Quality of chain
2	F	38	

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 3799 atoms, of which 1903 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 Fusion glycoprotein F1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	51	Total	C	H	N	O	0	0	0
			769	236	389	67	77			
1	C	44	Total	C	H	N	O	0	2	0
			684	208	346	60	70			
1	E	42	Total	C	H	N	O	0	1	0
			661	200	336	59	66			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	138	ACE	-	acetylation	UNP Q84193
A	190	NH2	-	amidation	UNP Q84193
C	138	ACE	-	acetylation	UNP Q84193
C	190	NH2	-	amidation	UNP Q84193
E	138	ACE	-	acetylation	UNP Q84193
E	190	NH2	-	amidation	UNP Q84193

- Molecule 2 is a protein called synthetic peptide derived from Fusion glycoprotein F1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	34	Total	C	H	N	O	0	0	1
			549	169	281	48	51			
2	D	34	Total	C	H	N	O	0	1	1
			568	174	294	48	52			
2	F	33	Total	C	H	N	O	0	0	0
			514	161	257	47	49			

There are 21 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	448	ACE	-	acetylation	UNP P06828
B	459	VAL	GLU	engineered mutation	UNP P06828

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Chain	Residue	Modelled	Actual	Comment	Reference
B	463	ILE	ALA	engineered mutation	UNP P06828
B	466	GLN	ASP	engineered mutation	UNP P06828
B	479	LYS	GLN	engineered mutation	UNP P06828
B	480	ILE	LYS	engineered mutation	UNP P06828
B	485	NH2	-	amidation	UNP P06828
D	448	ACE	-	acetylation	UNP P06828
D	459	VAL	GLU	engineered mutation	UNP P06828
D	463	ILE	ALA	engineered mutation	UNP P06828
D	466	GLN	ASP	engineered mutation	UNP P06828
D	479	LYS	GLN	engineered mutation	UNP P06828
D	480	ILE	LYS	engineered mutation	UNP P06828
D	485	NH2	-	amidation	UNP P06828
F	448	ACE	-	acetylation	UNP P06828
F	459	VAL	GLU	engineered mutation	UNP P06828
F	463	ILE	ALA	engineered mutation	UNP P06828
F	466	GLN	ASP	engineered mutation	UNP P06828
F	479	LYS	GLN	engineered mutation	UNP P06828
F	480	ILE	LYS	engineered mutation	UNP P06828
F	485	NH2	-	amidation	UNP P06828

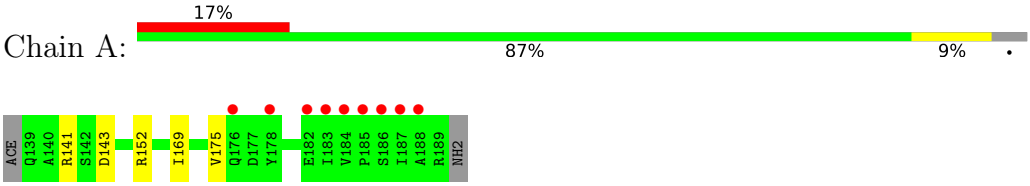
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	6	Total O 6 6	0	0
3	B	13	Total O 13 13	0	0
3	C	12	Total O 12 12	0	0
3	D	11	Total O 11 11	0	0
3	E	5	Total O 5 5	0	0
3	F	7	Total O 7 7	0	0

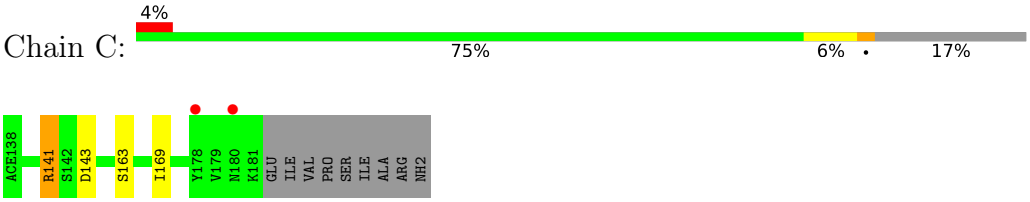
3 Residue-property plots (i)

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.

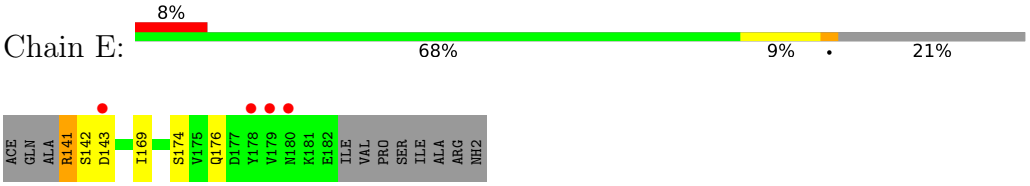
• Molecule 1: Fusion glycoprotein F1



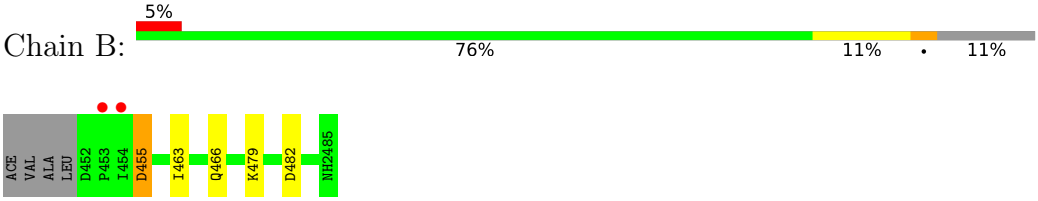
• Molecule 1: Fusion glycoprotein F1



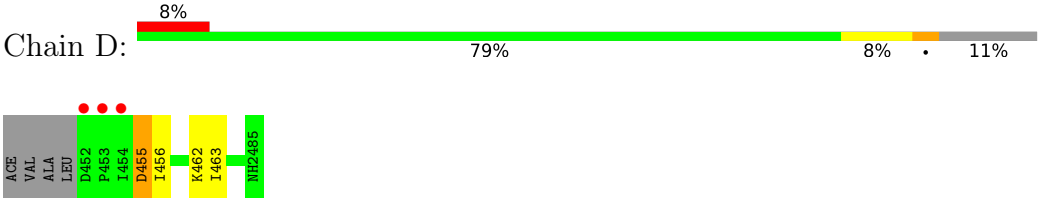
• Molecule 1: Fusion glycoprotein F1



• Molecule 2: synthetic peptide derived from Fusion glycoprotein F1

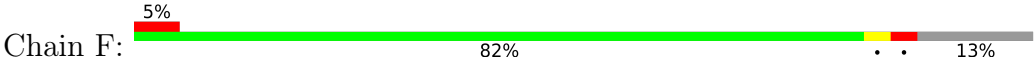


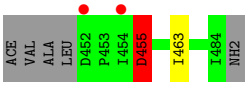
• Molecule 2: synthetic peptide derived from Fusion glycoprotein F1



• Molecule 2: synthetic peptide derived from Fusion glycoprotein F1

Chain F:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	39.85Å 49.34Å 56.18Å 90.00° 103.61° 90.00°	Depositor
Resolution (Å)	24.73 – 1.79 24.73 – 1.79	Depositor EDS
% Data completeness (in resolution range)	99.7 (24.73-1.79) 92.4 (24.73-1.79)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	0.85 (at 1.79Å)	Xtriage
Refinement program	PHENIX 1.13_2998	Depositor
R, R_{free}	0.207 , 0.232 0.207 , 0.232	Depositor DCC
R_{free} test set	1998 reflections (9.95%)	wwPDB-VP
Wilson B-factor (Å^2)	26.6	Xtriage
Anisotropy	0.056	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.42 , 65.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.52$, $< L^2 > = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	3799	wwPDB-VP
Average B, all atoms (Å^2)	49.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 19.17% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ 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: NH2, ACE, B3D

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	0.50	0/381	0.52	0/515
1	C	0.93	0/342	0.84	0/460
1	E	0.88	0/328	0.76	0/439
2	B	0.53	0/259	0.66	0/345
2	D	0.64	0/268	0.66	0/357
2	F	0.55	0/249	0.61	0/332
All	All	0.70	0/1827	0.69	0/2448

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	C	0	1
1	E	0	1
2	B	0	2
2	D	0	2
2	F	0	2
All	All	0	8

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

5 of 8 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	B	455	B3D	Peptide,Mainchain
1	C	141	ARG	Sidechain

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Mol	Chain	Res	Type	Group
2	D	455	B3D	Peptide,Mainchain
1	E	141	ARG	Sidechain
2	F	455	B3D	Mainchain

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	380	389	389	6	0
1	C	338	346	353	4	0
1	E	325	336	337	7	1
2	B	268	281	274	4	0
2	D	274	294	289	4	0
2	F	257	257	253	1	1
3	A	6	0	0	0	0
3	B	13	0	0	0	0
3	C	12	0	0	0	0
3	D	11	0	0	1	0
3	E	5	0	0	0	0
3	F	7	0	0	0	0
All	All	1896	1903	1895	15	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 4.

The worst 5 of 15 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:A:143:ASP:OD1	1:E:141:ARG:NH1	2.07	0.87
1:C:141:ARG:NH2	1:E:143:ASP:OD1	2.19	0.72
2:B:479:LYS:NZ	2:B:482:ASP:OD2	2.19	0.70
1:A:175:VAL:HG22	1:E:176:GLN:HE21	1.64	0.62
1:A:141:ARG:NH2	1:C:143:ASP:OD2	2.26	0.58

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)
1:E:142:SER:OG	2:F:455:B3D:OE2[1_556]	2.15	0.05

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	49/53 (92%)	48 (98%)	1 (2%)	0	100	100
1	C	44/53 (83%)	44 (100%)	0	0	100	100
1	E	41/53 (77%)	39 (95%)	2 (5%)	0	100	100
2	B	31/38 (82%)	30 (97%)	1 (3%)	0	100	100
2	D	32/38 (84%)	32 (100%)	0	0	100	100
2	F	30/38 (79%)	30 (100%)	0	0	100	100
All	All	227/273 (83%)	223 (98%)	4 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	42/45 (93%)	42 (100%)	0	100	100
1	C	39/45 (87%)	39 (100%)	0	100	100
1	E	37/45 (82%)	37 (100%)	0	100	100
2	B	30/34 (88%)	30 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	D	32/34 (94%)	32 (100%)	0	100	100
2	F	27/34 (79%)	27 (100%)	0	100	100
All	All	207/237 (87%)	207 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

3 non-standard protein/DNA/RNA residues 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	B3D	D	455	2	8,8,9	1.26	0	6,9,11	2.26	2 (33%)
2	B3D	F	455	2	8,8,9	1.33	1 (12%)	6,9,11	1.07	0
2	B3D	B	455	2	8,8,9	1.33	1 (12%)	6,9,11	1.62	1 (16%)

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	B3D	D	455	2	-	4/7/7/8	-
2	B3D	F	455	2	-	6/7/7/8	-
2	B3D	B	455	2	-	4/7/7/8	-

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	F	455	B3D	CB-C	2.56	1.56	1.49
2	B	455	B3D	OE1-CD	-2.04	1.23	1.30

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	D	455	B3D	CA-CB-C	4.40	118.73	112.25
2	B	455	B3D	OE1-CD-OE2	-2.72	116.52	123.30
2	D	455	B3D	O-C-CB	-2.23	118.92	125.43

There are no chirality outliers.

5 of 14 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	F	455	B3D	N-CA-CG-CD
2	F	455	B3D	CB-CA-CG-CD
2	B	455	B3D	OE1-CD-CG-CA
2	B	455	B3D	OE2-CD-CG-CA
2	D	455	B3D	OE2-CD-CG-CA

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	F	455	B3D	0	1

5.5 Carbohydrates (i)

There are no monosaccharides in this entry.

5.6 Ligand geometry (i)

There are no ligands in this entry.

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^{th} 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	51/53 (96%)	0.92	9 (17%) 1 1	21, 39, 83, 92	0
1	C	43/53 (81%)	0.38	2 (4%) 31 25	21, 33, 68, 81	0
1	E	42/53 (79%)	0.51	4 (9%) 8 6	20, 35, 77, 97	0
2	B	32/38 (84%)	0.20	2 (6%) 20 15	23, 37, 67, 96	0
2	D	32/38 (84%)	0.47	3 (9%) 8 6	22, 39, 70, 117	0
2	F	32/38 (84%)	0.74	2 (6%) 20 15	26, 42, 68, 84	0
All	All	232/273 (84%)	0.56	22 (9%) 8 6	20, 38, 82, 117	0

The worst 5 of 22 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	186	SER	6.5
2	F	454	ILE	5.9
1	A	185	PRO	5.2
2	D	452	ASP	5.0
1	A	187	ILE	4.9

6.2 Non-standard residues in protein, DNA, RNA chains

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^{th} 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^2)	Q<0.9
2	B3D	F	455	9/10	0.71	0.24	47,64,85,85	0
2	B3D	D	455	9/10	0.92	0.17	40,71,108,109	0
2	B3D	B	455	9/10	0.93	0.22	43,70,119,120	0

6.3 Carbohydrates (i)

There are no monosaccharides in this entry.

6.4 Ligands (i)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.