



wwPDB X-ray Structure Validation Summary Report ⓘ

Jul 27, 2026 – 06:05 PM EDT

PDB ID : 9YJU / pdb_00009yju
Title : The structure of the periplasmic chaperone Skp from *Neisseria meningitidis* in space group P212121
Authors : Dubey, S.; Noinaj, N.
Deposited on : 2025-10-04
Resolution : 3.30 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

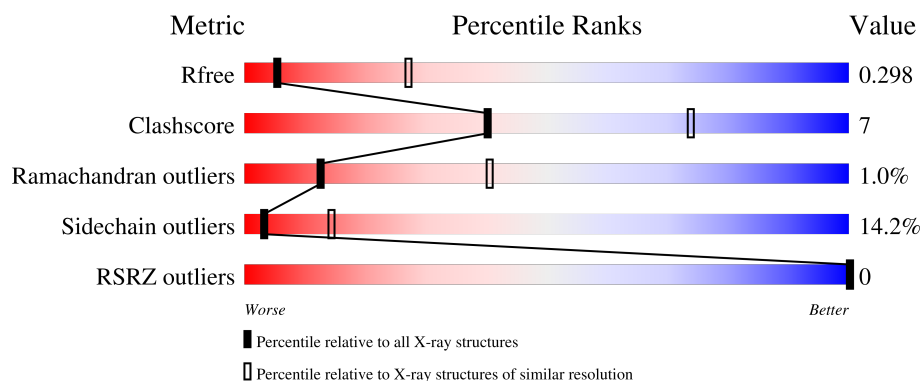
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.30 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}	180053	1169 (3.32-3.28)
Clashscore	190562	1209 (3.32-3.28)
Ramachandran outliers	187476	1188 (3.32-3.28)
Sidechain outliers	187428	1187 (3.32-3.28)
RSRZ outliers	180081	1169 (3.32-3.28)

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 $\leq 5\%$. 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	165	 70% 10% 5% 15%
1	B	165	 64% 16% 5% 15%
1	C	165	 61% 19% 5% 15%
1	D	165	 68% 12% 5% 15%
1	E	165	 66% 13% 5% 15%

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Mol	Chain	Length	Quality of chain
1	F	165	63% 16% 5% • 15%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 6780 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 Outer membrane protein H.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	140	Total	C	N	O	Se	0	0	0
			1142	713	206	222	1			
1	B	140	Total	C	N	O	Se	0	0	0
			1131	706	203	221	1			
1	C	140	Total	C	N	O	Se	0	0	0
			1136	710	203	222	1			
1	D	140	Total	C	N	O	Se	0	0	0
			1117	695	199	222	1			
1	E	140	Total	C	N	O	Se	0	0	0
			1136	710	203	222	1			
1	F	140	Total	C	N	O	Se	0	0	0
			1118	697	199	221	1			

There are 132 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
A	3	SER	-	expression tag	UNP A0A0H5QDK9
A	4	ASN	-	expression tag	UNP A0A0H5QDK9
A	5	HIS	-	expression tag	UNP A0A0H5QDK9
A	6	HIS	-	expression tag	UNP A0A0H5QDK9
A	7	HIS	-	expression tag	UNP A0A0H5QDK9
A	8	HIS	-	expression tag	UNP A0A0H5QDK9
A	9	HIS	-	expression tag	UNP A0A0H5QDK9
A	10	HIS	-	expression tag	UNP A0A0H5QDK9
A	11	HIS	-	expression tag	UNP A0A0H5QDK9
A	12	HIS	-	expression tag	UNP A0A0H5QDK9
A	13	HIS	-	expression tag	UNP A0A0H5QDK9
A	14	HIS	-	expression tag	UNP A0A0H5QDK9
A	15	GLU	-	expression tag	UNP A0A0H5QDK9
A	16	ASN	-	expression tag	UNP A0A0H5QDK9
A	17	LEU	-	expression tag	UNP A0A0H5QDK9
A	18	TYR	-	expression tag	UNP A0A0H5QDK9

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Chain	Residue	Modelled	Actual	Comment	Reference
A	19	PHE	-	expression tag	UNP A0A0H5QDK9
A	20	GLN	-	expression tag	UNP A0A0H5QDK9
A	21	GLY	-	expression tag	UNP A0A0H5QDK9
A	22	ALA	-	expression tag	UNP A0A0H5QDK9
A	23	MSE	-	expression tag	UNP A0A0H5QDK9
B	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
B	3	SER	-	expression tag	UNP A0A0H5QDK9
B	4	ASN	-	expression tag	UNP A0A0H5QDK9
B	5	HIS	-	expression tag	UNP A0A0H5QDK9
B	6	HIS	-	expression tag	UNP A0A0H5QDK9
B	7	HIS	-	expression tag	UNP A0A0H5QDK9
B	8	HIS	-	expression tag	UNP A0A0H5QDK9
B	9	HIS	-	expression tag	UNP A0A0H5QDK9
B	10	HIS	-	expression tag	UNP A0A0H5QDK9
B	11	HIS	-	expression tag	UNP A0A0H5QDK9
B	12	HIS	-	expression tag	UNP A0A0H5QDK9
B	13	HIS	-	expression tag	UNP A0A0H5QDK9
B	14	HIS	-	expression tag	UNP A0A0H5QDK9
B	15	GLU	-	expression tag	UNP A0A0H5QDK9
B	16	ASN	-	expression tag	UNP A0A0H5QDK9
B	17	LEU	-	expression tag	UNP A0A0H5QDK9
B	18	TYR	-	expression tag	UNP A0A0H5QDK9
B	19	PHE	-	expression tag	UNP A0A0H5QDK9
B	20	GLN	-	expression tag	UNP A0A0H5QDK9
B	21	GLY	-	expression tag	UNP A0A0H5QDK9
B	22	ALA	-	expression tag	UNP A0A0H5QDK9
B	23	MSE	-	expression tag	UNP A0A0H5QDK9
C	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
C	3	SER	-	expression tag	UNP A0A0H5QDK9
C	4	ASN	-	expression tag	UNP A0A0H5QDK9
C	5	HIS	-	expression tag	UNP A0A0H5QDK9
C	6	HIS	-	expression tag	UNP A0A0H5QDK9
C	7	HIS	-	expression tag	UNP A0A0H5QDK9
C	8	HIS	-	expression tag	UNP A0A0H5QDK9
C	9	HIS	-	expression tag	UNP A0A0H5QDK9
C	10	HIS	-	expression tag	UNP A0A0H5QDK9
C	11	HIS	-	expression tag	UNP A0A0H5QDK9
C	12	HIS	-	expression tag	UNP A0A0H5QDK9
C	13	HIS	-	expression tag	UNP A0A0H5QDK9
C	14	HIS	-	expression tag	UNP A0A0H5QDK9
C	15	GLU	-	expression tag	UNP A0A0H5QDK9
C	16	ASN	-	expression tag	UNP A0A0H5QDK9

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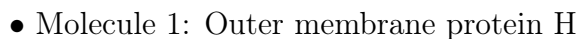
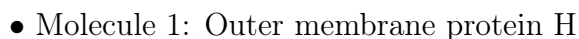
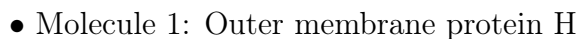
Chain	Residue	Modelled	Actual	Comment	Reference
C	17	LEU	-	expression tag	UNP A0A0H5QDK9
C	18	TYR	-	expression tag	UNP A0A0H5QDK9
C	19	PHE	-	expression tag	UNP A0A0H5QDK9
C	20	GLN	-	expression tag	UNP A0A0H5QDK9
C	21	GLY	-	expression tag	UNP A0A0H5QDK9
C	22	ALA	-	expression tag	UNP A0A0H5QDK9
C	23	MSE	-	expression tag	UNP A0A0H5QDK9
D	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
D	3	SER	-	expression tag	UNP A0A0H5QDK9
D	4	ASN	-	expression tag	UNP A0A0H5QDK9
D	5	HIS	-	expression tag	UNP A0A0H5QDK9
D	6	HIS	-	expression tag	UNP A0A0H5QDK9
D	7	HIS	-	expression tag	UNP A0A0H5QDK9
D	8	HIS	-	expression tag	UNP A0A0H5QDK9
D	9	HIS	-	expression tag	UNP A0A0H5QDK9
D	10	HIS	-	expression tag	UNP A0A0H5QDK9
D	11	HIS	-	expression tag	UNP A0A0H5QDK9
D	12	HIS	-	expression tag	UNP A0A0H5QDK9
D	13	HIS	-	expression tag	UNP A0A0H5QDK9
D	14	HIS	-	expression tag	UNP A0A0H5QDK9
D	15	GLU	-	expression tag	UNP A0A0H5QDK9
D	16	ASN	-	expression tag	UNP A0A0H5QDK9
D	17	LEU	-	expression tag	UNP A0A0H5QDK9
D	18	TYR	-	expression tag	UNP A0A0H5QDK9
D	19	PHE	-	expression tag	UNP A0A0H5QDK9
D	20	GLN	-	expression tag	UNP A0A0H5QDK9
D	21	GLY	-	expression tag	UNP A0A0H5QDK9
D	22	ALA	-	expression tag	UNP A0A0H5QDK9
D	23	MSE	-	expression tag	UNP A0A0H5QDK9
E	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
E	3	SER	-	expression tag	UNP A0A0H5QDK9
E	4	ASN	-	expression tag	UNP A0A0H5QDK9
E	5	HIS	-	expression tag	UNP A0A0H5QDK9
E	6	HIS	-	expression tag	UNP A0A0H5QDK9
E	7	HIS	-	expression tag	UNP A0A0H5QDK9
E	8	HIS	-	expression tag	UNP A0A0H5QDK9
E	9	HIS	-	expression tag	UNP A0A0H5QDK9
E	10	HIS	-	expression tag	UNP A0A0H5QDK9
E	11	HIS	-	expression tag	UNP A0A0H5QDK9
E	12	HIS	-	expression tag	UNP A0A0H5QDK9
E	13	HIS	-	expression tag	UNP A0A0H5QDK9
E	14	HIS	-	expression tag	UNP A0A0H5QDK9

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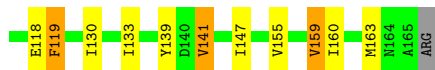
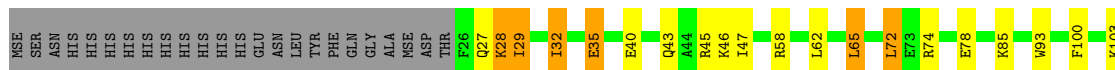
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Chain	Residue	Modelled	Actual	Comment	Reference
E	15	GLU	-	expression tag	UNP A0A0H5QDK9
E	16	ASN	-	expression tag	UNP A0A0H5QDK9
E	17	LEU	-	expression tag	UNP A0A0H5QDK9
E	18	TYR	-	expression tag	UNP A0A0H5QDK9
E	19	PHE	-	expression tag	UNP A0A0H5QDK9
E	20	GLN	-	expression tag	UNP A0A0H5QDK9
E	21	GLY	-	expression tag	UNP A0A0H5QDK9
E	22	ALA	-	expression tag	UNP A0A0H5QDK9
E	23	MSE	-	expression tag	UNP A0A0H5QDK9
F	2	MSE	-	initiating methionine	UNP A0A0H5QDK9
F	3	SER	-	expression tag	UNP A0A0H5QDK9
F	4	ASN	-	expression tag	UNP A0A0H5QDK9
F	5	HIS	-	expression tag	UNP A0A0H5QDK9
F	6	HIS	-	expression tag	UNP A0A0H5QDK9
F	7	HIS	-	expression tag	UNP A0A0H5QDK9
F	8	HIS	-	expression tag	UNP A0A0H5QDK9
F	9	HIS	-	expression tag	UNP A0A0H5QDK9
F	10	HIS	-	expression tag	UNP A0A0H5QDK9
F	11	HIS	-	expression tag	UNP A0A0H5QDK9
F	12	HIS	-	expression tag	UNP A0A0H5QDK9
F	13	HIS	-	expression tag	UNP A0A0H5QDK9
F	14	HIS	-	expression tag	UNP A0A0H5QDK9
F	15	GLU	-	expression tag	UNP A0A0H5QDK9
F	16	ASN	-	expression tag	UNP A0A0H5QDK9
F	17	LEU	-	expression tag	UNP A0A0H5QDK9
F	18	TYR	-	expression tag	UNP A0A0H5QDK9
F	19	PHE	-	expression tag	UNP A0A0H5QDK9
F	20	GLN	-	expression tag	UNP A0A0H5QDK9
F	21	GLY	-	expression tag	UNP A0A0H5QDK9
F	22	ALA	-	expression tag	UNP A0A0H5QDK9
F	23	MSE	-	expression tag	UNP A0A0H5QDK9

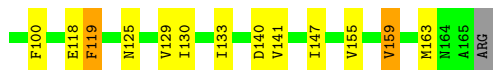
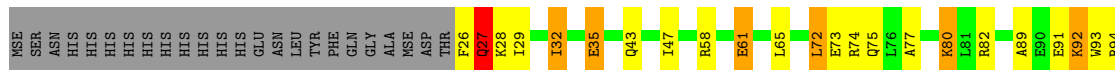
- Molecule 1: Outer membrane protein H



- Molecule 1: Outer membrane protein H



- Molecule 1: Outer membrane protein H



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	68.41Å 118.96Å 141.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.77 – 3.30 38.77 – 3.30	Depositor EDS
% Data completeness (in resolution range)	99.5 (38.77-3.30) 99.6 (38.77-3.30)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.37 (at 3.32Å)	Xtriage
Refinement program	PHENIX (dev_4788: ???)	Depositor
R, R_{free}	0.239 , 0.298 0.239 , 0.298	Depositor DCC
R_{free} test set	873 reflections (4.86%)	wwPDB-VP
Wilson B-factor (Å ²)	117.0	Xtriage
Anisotropy	0.093	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 78.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	6780	wwPDB-VP
Average B, all atoms (Å ²)	122.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 15.18% 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](#)

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	0.12	0/1153	0.26	0/1545
1	B	0.11	0/1142	0.25	0/1533
1	C	0.11	0/1147	0.24	0/1538
1	D	0.11	0/1128	0.24	0/1518
1	E	0.10	0/1147	0.24	0/1538
1	F	0.11	0/1129	0.28	0/1518
All	All	0.11	0/6846	0.25	0/9190

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 [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	1142	0	1126	15	0
1	B	1131	0	1100	18	0
1	C	1136	0	1115	19	0
1	D	1117	0	1062	11	0
1	E	1136	0	1115	17	0
1	F	1118	0	1069	20	0
All	All	6780	0	6587	88	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 7.

The worst 5 of 88 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:65:LEU:HD22	1:F:100:PHE:HB2	1.76	0.66
1:C:27:GLN:HA	1:C:140:ASP:OD2	1.97	0.64
1:A:32:ILE:HD11	1:C:147:ILE:HG13	1.80	0.64
1:C:65:LEU:HD22	1:C:100:PHE:HB2	1.80	0.64
1:A:29:ILE:HG23	1:A:141:VAL:HG13	1.81	0.63

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	138/165 (84%)	130 (94%)	7 (5%)	1 (1%)	18	49
1	B	138/165 (84%)	130 (94%)	7 (5%)	1 (1%)	18	49
1	C	138/165 (84%)	128 (93%)	7 (5%)	3 (2%)	5	26
1	D	138/165 (84%)	133 (96%)	5 (4%)	0	100	100
1	E	138/165 (84%)	135 (98%)	3 (2%)	0	100	100
1	F	138/165 (84%)	126 (91%)	9 (6%)	3 (2%)	5	26
All	All	828/990 (84%)	782 (94%)	38 (5%)	8 (1%)	12	40

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	82	ARG
1	C	83	ASN
1	C	27	GLN
1	F	77	ALA
1	F	80	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	118/142 (83%)	107 (91%)	11 (9%)	8	30
1	B	115/142 (81%)	95 (83%)	20 (17%)	2	9
1	C	117/142 (82%)	99 (85%)	18 (15%)	2	12
1	D	112/142 (79%)	94 (84%)	18 (16%)	2	12
1	E	117/142 (82%)	101 (86%)	16 (14%)	3	16
1	F	112/142 (79%)	97 (87%)	15 (13%)	4	16
All	All	691/852 (81%)	593 (86%)	98 (14%)	3	14

5 of 98 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	73	GLU
1	E	35	GLU
1	D	78	GLU
1	D	159	VAL
1	E	72	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 17 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	125	ASN
1	F	63	GLN
1	C	75	GLN
1	C	125	ASN
1	D	106	GLN

5.3.3 RNA ⓘ

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](#)

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 [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	139/165 (84%)	-0.80	0 100 100	75, 110, 172, 191	0
1	B	139/165 (84%)	-0.63	0 100 100	84, 115, 165, 189	0
1	C	139/165 (84%)	-0.79	0 100 100	78, 109, 150, 184	0
1	D	139/165 (84%)	-0.74	0 100 100	88, 131, 192, 208	0
1	E	139/165 (84%)	-0.79	0 100 100	85, 112, 171, 195	0
1	F	139/165 (84%)	-0.66	0 100 100	72, 122, 180, 197	0
All	All	834/990 (84%)	-0.74	0 100 100	72, 115, 176, 208	0

There are no RSRZ outliers to report.

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 oligosaccharides 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.