



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 6, 2026 – 09:23 PM UTC

PDB ID : 8UMO / pdb_00008umo
Title : Murine CD94-NKG2A receptor in complex with Qa-1b presenting AMAPRTLTL
Authors : MacLachlan, B.J.; Rossjohn, J.; Vivian, J.P.
Deposited on : 2023-10-18
Resolution : 2.60 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

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
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

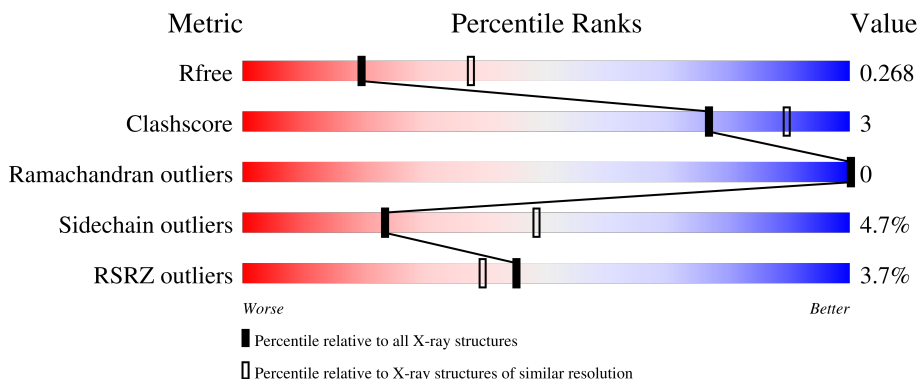
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	278	3% 90% 10%
2	B	99	93% 6%
3	J	120	4% 73% 22%
4	K	117	9% 79% 17%
5	P	9	100%

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 5140 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 H-2 class I histocompatibility antigen, D-37 alpha chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	278	Total	C	N	O	S	0	1	0
			2294	1443	408	434	9			

- Molecule 2 is a protein called Beta-2-microglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	99	Total	C	N	O	S	0	0	0
			821	524	138	152	7			

There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	85	ASP	ALA	variant	UNP P01887

- Molecule 3 is a protein called Killer cell lectin-like receptor, subfamily D, member 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	J	115	Total	C	N	O	S	0	0	0
			948	598	166	173	11			

- Molecule 4 is a protein called Killer cell lectin-like receptor subfamily C, member 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	K	113	Total	C	N	O	S	0	0	0
			907	576	150	169	12			

- Molecule 5 is a protein called Qdm peptide.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	P	9	Total	C	N	O	S	0	0	0
			68	44	12	11	1			

- Molecule 6 is BROMIDE ION (CCD ID: BR) (formula: Br) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	K	1	Total 1	Br 1	0	0

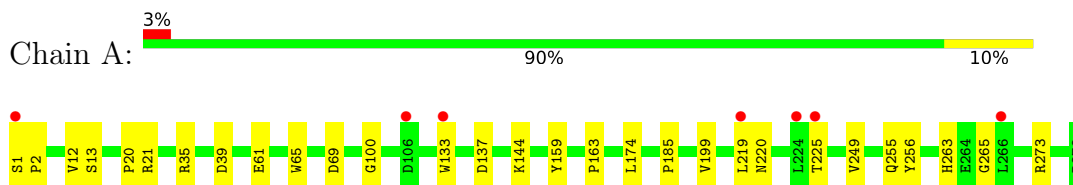
- Molecule 7 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	A	52	Total 52	O 52	0	0
7	B	24	Total 24	O 24	0	0
7	J	13	Total 13	O 13	0	0
7	K	10	Total 10	O 10	0	0
7	P	2	Total 2	O 2	0	0

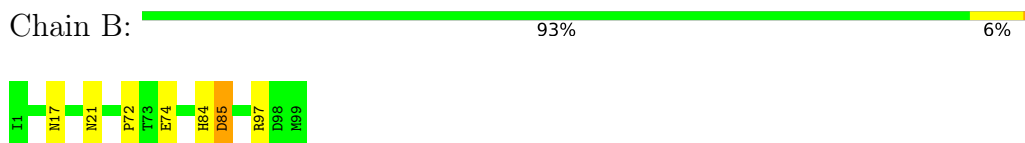
3 Residue-property plots [i](#)

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.

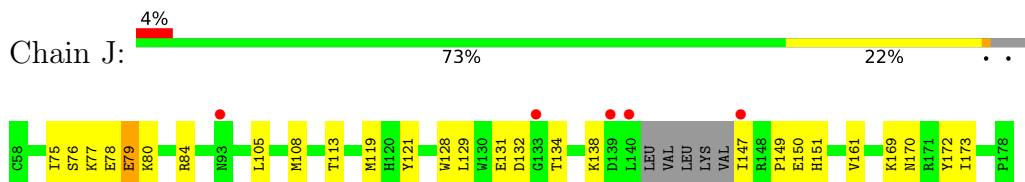
- Molecule 1: H-2 class I histocompatibility antigen, D-37 alpha chain



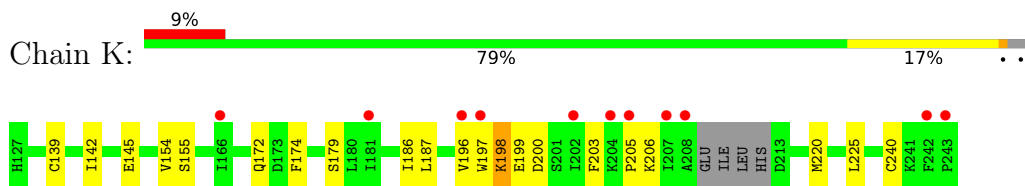
- Molecule 2: Beta-2-microglobulin



- Molecule 3: Killer cell lectin-like receptor, subfamily D, member 1



- Molecule 4: Killer cell lectin-like receptor subfamily C, member 1



- Molecule 5: Qdm peptide



There are no outlier residues recorded for this chain.

4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	52.17Å 65.09Å 198.57Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.46 – 2.60 50.46 – 2.60	Depositor EDS
% Data completeness (in resolution range)	99.9 (50.46-2.60) 99.9 (50.46-2.60)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.95 (at 2.61Å)	Xtriage
Refinement program	BUSTER 2.10.3	Depositor
R, R_{free}	0.206 , 0.251 0.225 , 0.268	Depositor DCC
R_{free} test set	1112 reflections (5.15%)	wwPDB-VP
Wilson B-factor (Å ²)	58.7	Xtriage
Anisotropy	0.180	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 51.9	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	0.93	EDS
Total number of atoms	5140	wwPDB-VP
Average B, all atoms (Å ²)	67.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.02% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section:
BR

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	0.69	0/2367	1.23	8/3226 (0.2%)
2	B	0.70	0/847	1.16	4/1148 (0.3%)
3	J	0.72	0/974	1.26	7/1311 (0.5%)
4	K	0.73	0/931	1.30	4/1257 (0.3%)
5	P	0.67	0/68	0.96	0/90
All	All	0.71	0/5187	1.23	23/7032 (0.3%)

There are no bond length outliers.

All (23) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	100	GLY	N-CA-C	7.12	120.15	110.69
3	J	77	LYS	N-CA-C	-6.35	105.66	113.41
3	J	131	GLU	CA-C-N	6.35	128.78	120.28
3	J	131	GLU	C-N-CA	6.35	128.78	120.28
3	J	138	LYS	N-CA-C	6.34	119.05	109.41
4	K	198	LYS	CA-C-N	6.15	131.34	122.35
4	K	198	LYS	C-N-CA	6.15	131.34	122.35
2	B	85	ASP	CA-CB-CG	6.10	118.70	112.60
1	A	100	GLY	CA-C-N	5.81	131.31	122.65
1	A	100	GLY	C-N-CA	5.81	131.31	122.65
4	K	200	ASP	CA-CB-CG	5.77	118.37	112.60
4	K	199	GLU	CB-CG-CD	5.71	122.31	112.60
3	J	132	ASP	CA-CB-CG	5.66	118.26	112.60
2	B	84	HIS	CA-C-N	5.64	128.61	120.38
2	B	84	HIS	C-N-CA	5.64	128.61	120.38
1	A	69	ASP	CA-CB-CG	5.47	118.07	112.60
1	A	225	THR	N-CA-C	-5.41	106.73	113.55
2	B	21	ASN	CA-CB-CG	5.23	117.83	112.60
1	A	137	ASP	CA-CB-CG	5.11	117.71	112.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
3	J	77	LYS	CA-C-N	5.11	129.87	121.39
3	J	77	LYS	C-N-CA	5.11	129.87	121.39
1	A	61	GLU	CA-C-N	5.05	127.04	120.28
1	A	61	GLU	C-N-CA	5.05	127.04	120.28

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	2294	0	2147	12	0
2	B	821	0	796	2	0
3	J	948	0	898	10	0
4	K	907	0	865	7	0
5	P	68	0	81	0	0
6	K	1	0	0	1	0
7	A	52	0	0	0	0
7	B	24	0	0	0	0
7	J	13	0	0	0	0
7	K	10	0	0	0	0
7	P	2	0	0	0	0
All	All	5140	0	4787	28	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 3.

All (28) 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:65:TRP:HZ2	3:J:113:THR:HG23	1.48	0.77
1:A:65:TRP:CZ2	3:J:113:THR:HG23	2.28	0.68
3:J:105:LEU:HB3	3:J:108:MET:HB2	1.80	0.63
3:J:80:LYS:HD2	3:J:84:ARG:HB3	1.85	0.58
4:K:203:PHE:CE2	4:K:205:PRO:HG3	2.40	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:J:75:ILE:HG13	3:J:173:ILE:HG12	1.88	0.56
4:K:205:PRO:HG2	4:K:225:LEU:HD12	1.88	0.55
2:B:74:GLU:H	2:B:74:GLU:CD	2.18	0.52
1:A:220:ASN:HD21	1:A:256:TYR:HD1	1.57	0.51
4:K:139:CYS:HB2	4:K:240:CYS:HB2	1.94	0.50
1:A:159:TYR:HA	1:A:163:PRO:HD2	1.93	0.50
3:J:128:TRP:HH2	3:J:151:HIS:O	1.95	0.49
1:A:185:PRO:HD3	1:A:263:HIS:CD2	2.49	0.48
4:K:155:SER:HB3	6:K:301:BR:BR	2.69	0.47
1:A:13:SER:HA	1:A:20:PRO:HB3	1.95	0.47
1:A:65:TRP:HZ2	3:J:113:THR:CG2	2.22	0.47
2:B:17:ASN:HA	2:B:72:PRO:O	2.16	0.46
3:J:76:SER:HB3	3:J:172:TYR:H	1.81	0.46
1:A:263:HIS:CD2	1:A:265:GLY:H	2.34	0.45
4:K:186:ILE:HG13	4:K:197:TRP:HB2	1.98	0.45
3:J:79:GLU:HB3	3:J:169:LYS:HB3	1.98	0.45
1:A:255:GLN:HA	1:A:273:ARG:HE	1.82	0.44
1:A:1:SER:HB2	1:A:2:PRO:HD3	2.00	0.43
1:A:133:TRP:HB2	1:A:144:LYS:HG3	2.01	0.42
4:K:203:PHE:HE2	4:K:205:PRO:HG3	1.83	0.42
1:A:21:ARG:HE	1:A:39:ASP:HB2	1.85	0.42
3:J:121:TYR:CD1	3:J:149:PRO:HB3	2.56	0.41
4:K:172:GLN:HG3	4:K:220:MET:HE1	2.03	0.40

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	277/278 (100%)	267 (96%)	10 (4%)	0	100	100
2	B	97/99 (98%)	93 (96%)	4 (4%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
3	J	111/120 (92%)	102 (92%)	9 (8%)	0	100	100
4	K	109/117 (93%)	102 (94%)	7 (6%)	0	100	100
5	P	7/9 (78%)	7 (100%)	0	0	100	100
All	All	601/623 (96%)	571 (95%)	30 (5%)	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	A	244/243 (100%)	238 (98%)	6 (2%)	42	69
2	B	94/94 (100%)	92 (98%)	2 (2%)	47	73
3	J	109/114 (96%)	100 (92%)	9 (8%)	10	23
4	K	104/108 (96%)	95 (91%)	9 (9%)	9	21
5	P	7/7 (100%)	7 (100%)	0	100	100
All	All	558/566 (99%)	532 (95%)	26 (5%)	23	48

All (26) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	12	VAL
1	A	35	ARG
1	A	174	LEU
1	A	199	VAL
1	A	219	LEU
1	A	249	VAL
2	B	85	ASP
2	B	97	ARG
3	J	78	GLU
3	J	79	GLU
3	J	119	MET
3	J	129	LEU

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Mol	Chain	Res	Type
3	J	134	THR
3	J	147	ILE
3	J	150	GLU
3	J	161	VAL
3	J	170	ASN
4	K	142	ILE
4	K	145	GLU
4	K	154	VAL
4	K	174	PHE
4	K	179	SER
4	K	187	LEU
4	K	196	VAL
4	K	198	LYS
4	K	206	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (12) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	188	HIS
1	A	220	ASN
1	A	226	GLN
1	A	263	HIS
2	B	29	GLN
2	B	31	HIS
3	J	69	GLN
3	J	71	ASN
3	J	100	GLN
3	J	170	ASN
4	K	216	ASN
4	K	229	ASN

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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

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, 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	278/278 (100%)	0.26	7 (2%) 58 52	38, 60, 92, 118	1 (0%)
2	B	99/99 (100%)	-0.01	0 100 100	38, 56, 72, 81	0
3	J	115/120 (95%)	0.55	5 (4%) 40 34	47, 71, 103, 116	0
4	K	113/117 (96%)	0.85	11 (9%) 13 10	47, 74, 127, 142	0
5	P	9/9 (100%)	-0.30	0 100 100	40, 43, 49, 50	0
All	All	614/623 (98%)	0.37	23 (3%) 45 39	38, 64, 107, 142	1 (0%)

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	J	140	LEU	6.4
4	K	197	TRP	4.4
4	K	196	VAL	3.7
4	K	208	ALA	3.6
3	J	147	ILE	3.5
4	K	243	PRO	3.3
1	A	224	LEU	3.1
4	K	207	ILE	3.1
1	A	225	THR	2.9
1	A	106	ASP	2.7
3	J	139	ASP	2.6
3	J	93	ASN	2.6
4	K	202	ILE	2.4
4	K	242	PHE	2.3
1	A	266	LEU	2.3
4	K	204	LYS	2.3
4	K	205	PRO	2.3
3	J	133	GLY	2.2
1	A	219	LEU	2.2
4	K	181	ILE	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	1	SER	2.1
1	A	133	TRP	2.1
4	K	166	ILE	2.1

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](#)

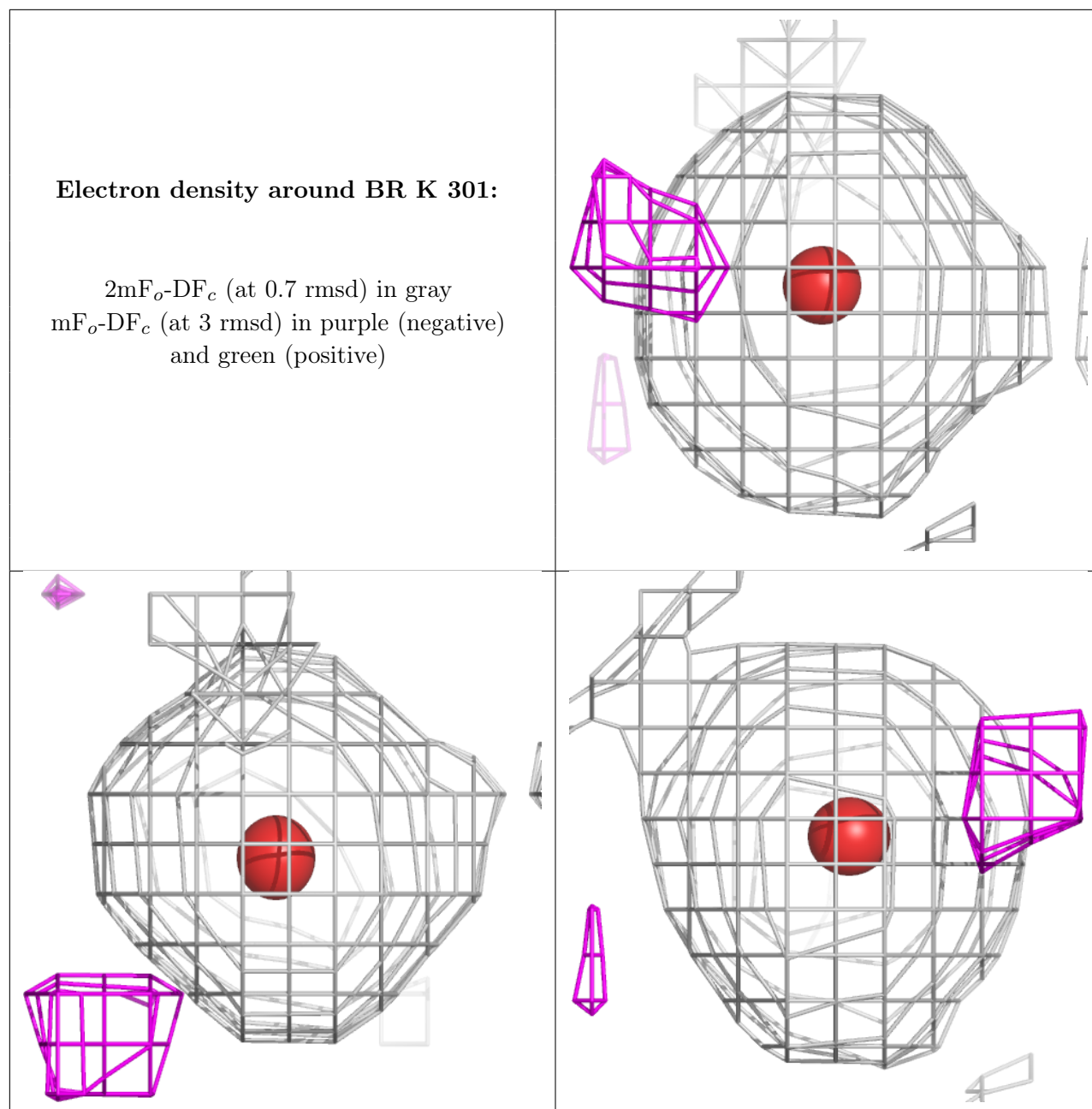
There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

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, 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	B-factors($\text{\AA}^2$)	Q<0.9
6	BR	K	301	1/1	0.98	0.04	73,73,73,73	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



6.5 Other polymers ⓘ

There are no such residues in this entry.