W O R L D W I D E

wwPDB

P R O T E I N   D A T A   B A N K

wwPDB X-ray Structure Validation Summary Report (i)

Aug 22, 2020 – 10:12 AM BST

PDB ID	:	4HHH
Title	:	Structure of Pisum sativum Rubisco
Authors	:	Loewen, P.C.; Didychuk, A.L.; Switala, J.; Loewen, M.C.
Deposited on	:	2012-10-09
Resolution	:	2.20 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
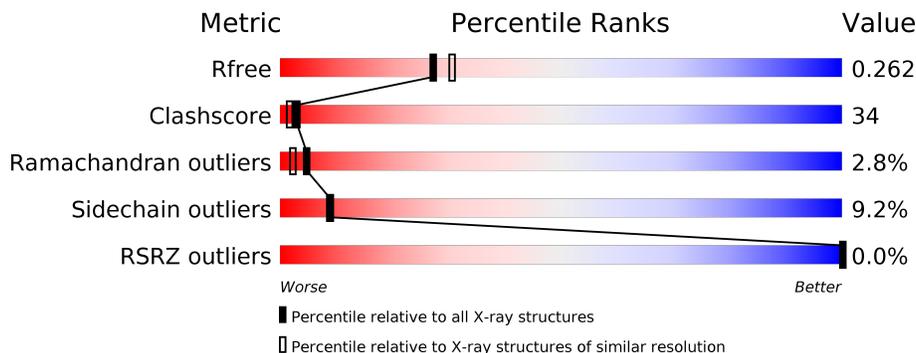with specific help available everywhere you see the (i) symbol.

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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 2.20 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	Percentile Ranks	Value
Rfree		0.262
Clashscore		34
Ramachandran outliers		2.8%
Sidechain outliers		9.2%
RSRZ outliers		0.0%

Worse   *Better*

▌ Percentile relative to all X-ray structures

▐ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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 on 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	475	45% 43% 7% · ·
1	B	475	42% 43% 10% · ·
1	C	475	43% 44% 9% · ·
1	D	475	44% 44% 8% ·
2	S	123	50% 35% 11% ·
2	T	123	38% 52% 10%

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Mol	Chain	Length	Quality of chain
2	U	123	41% 45% 14%
2	V	123	43% 44% 12%

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	RUB	B	501	-	X	-	-

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 19680 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.
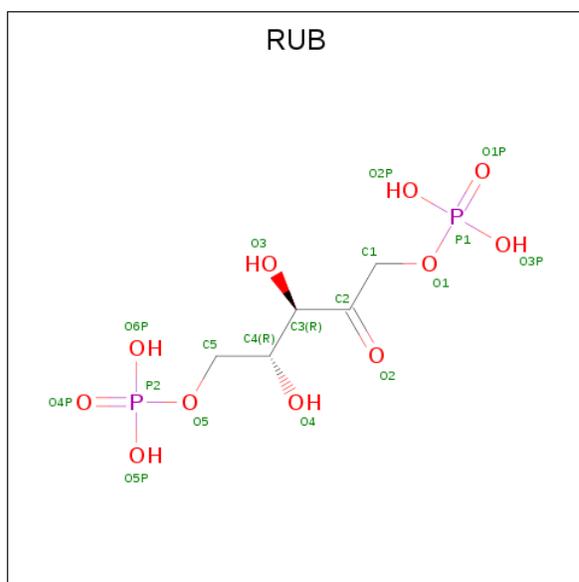
- Molecule 1 is a protein called Ribulose bisphosphate carboxylase large chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	458	Total 3648	C 2332	N 634	O 664	S 18	0	11	0
1	B	458	Total 3653	C 2340	N 635	O 660	S 18	0	13	0
1	C	458	Total 3662	C 2338	N 644	O 662	S 18	0	12	0
1	D	458	Total 3647	C 2323	N 643	O 663	S 18	0	9	0

- Molecule 2 is a protein called Ribulose bisphosphate carboxylase small chain.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	S	123	Total 1049	C 694	N 172	O 178	S 5	0	2	0
2	T	123	Total 1056	C 698	N 175	O 178	S 5	0	3	0
2	U	123	Total 1047	C 690	N 172	O 180	S 5	0	2	0
2	V	123	Total 1057	C 697	N 175	O 180	S 5	0	3	0

- Molecule 3 is RIBULOSE-1,5-DIPHOSPHATE (three-letter code: RUB) (formula: $C_5H_{12}O_{11}P_2$).

RUB

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total 18	C 5	O 11	P 2	0	0
3	B	1	Total 18	C 5	O 11	P 2	0	0
3	C	1	Total 18	C 5	O 11	P 2	0	0
3	D	1	Total 18	C 5	O 11	P 2	0	0

- Molecule 4 is water.

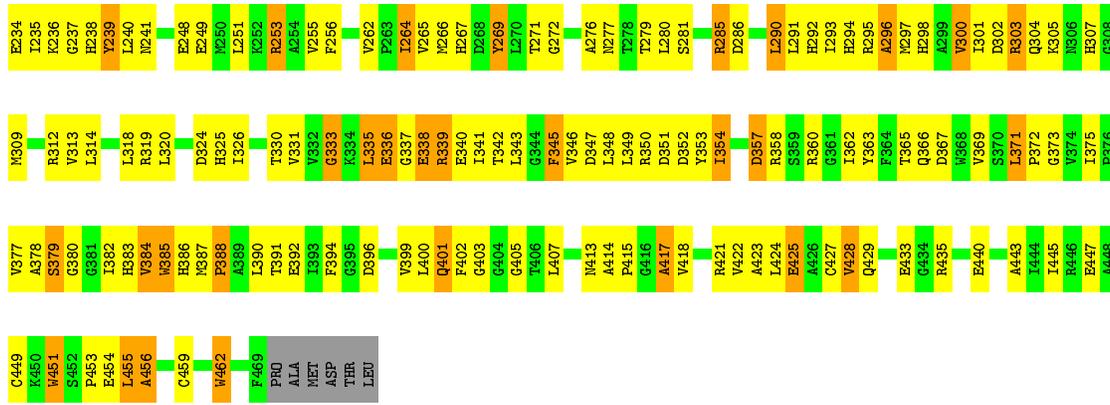| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	161	Total 161	O 161	0	0
4	B	175	Total 175	O 175	0	0
4	C	137	Total 137	O 137	0	0
4	D	147	Total 147	O 147	0	0
4	S	49	Total 49	O 49	0	0
4	T	50	Total 50	O 50	0	0
4	U	30	Total 30	O 30	0	0
4	V	40	Total 40	O 40	0	0

3 Residue-property plots ⓘ

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.

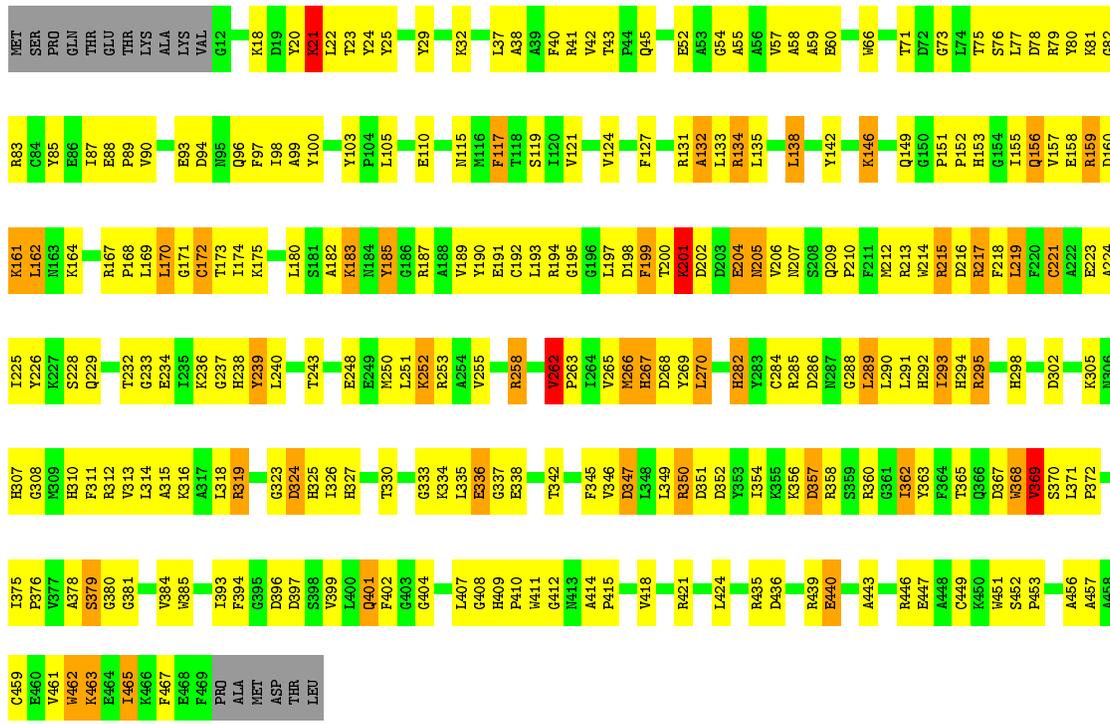- Molecule 1: Ribulose bisphosphate carboxylase large chain

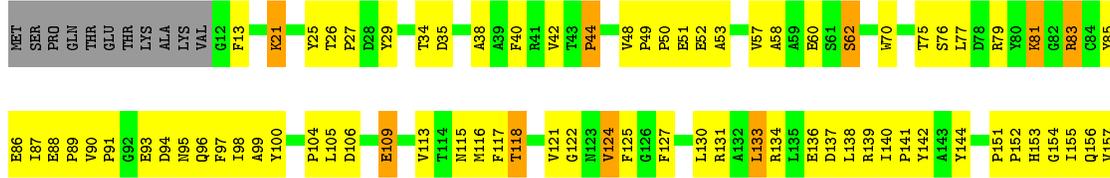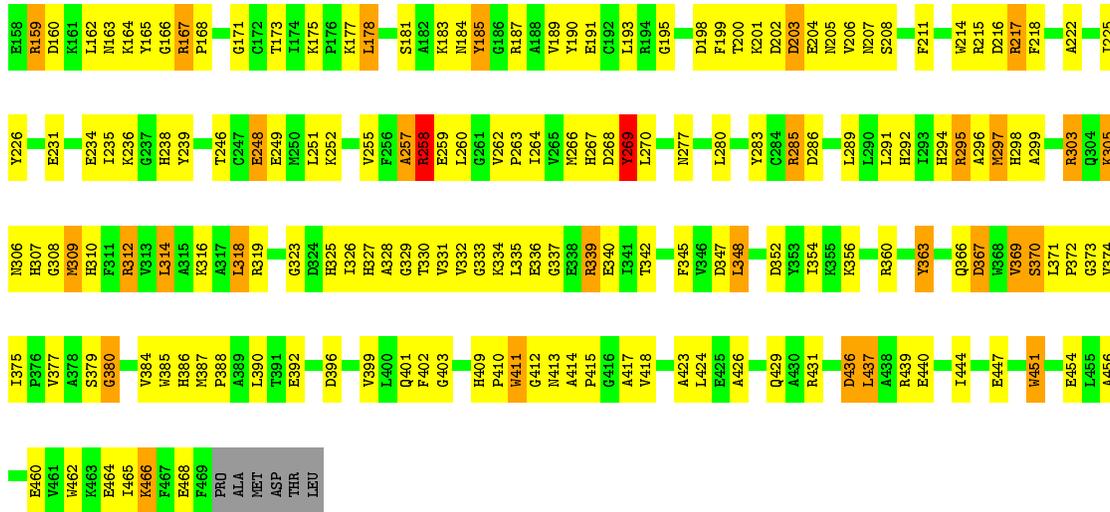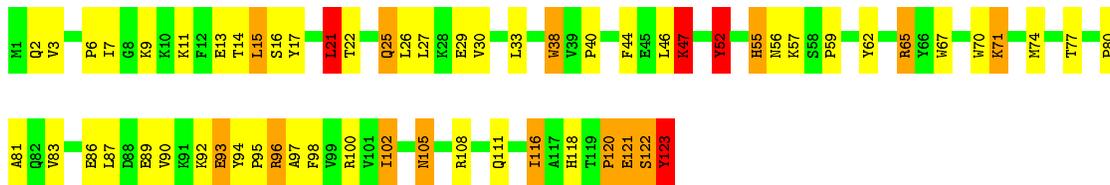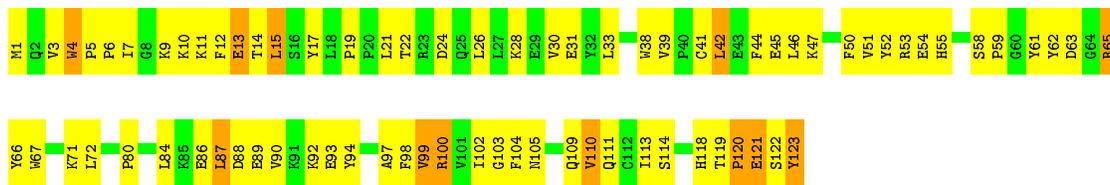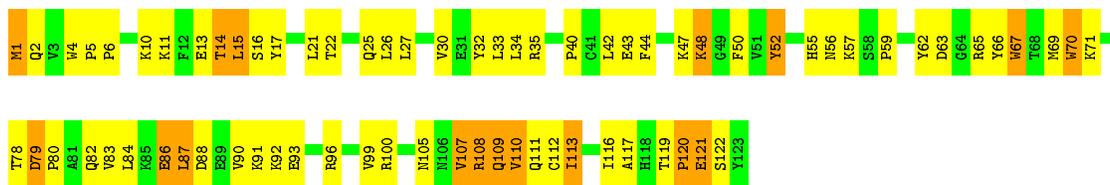- Molecule 1: Ribulose bisphosphate carboxylase large chain
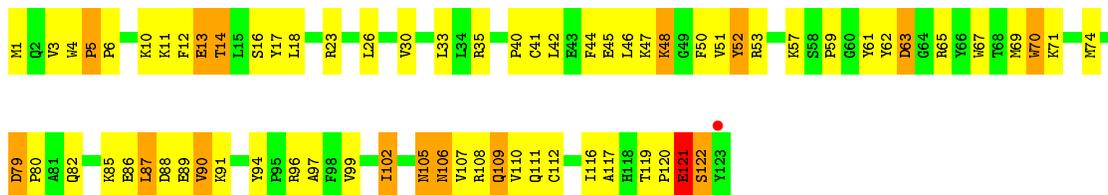
• Molecule 1: Ribulose bisphosphate carboxylase large chain

Chain C:

• Molecule 1: Ribulose bisphosphate carboxylase large chain

Chain D:

E158 R159 D160 K161 L162 N163 K164 Y165 G166 R167 P168 G171 C172 T173 I174 K175 P176 K177 L178 S181 A182 K183 N184 Y185 G186 R187 A188 V189 Y190 E191 C192 L193 R194 G195 D198 F199 T200 K201 D202 D203 E204 N205 V206 N207 S208 F211 W214 R215 D216 R217 F218 A222 I225

Y226 E231 E234 I235 K236 G237 H238 Y239 T246 C247 E248 E249 M250 L251 K252 V255 F256 A257 R258 E259 G261 V262 P263 I264 V265 M266 H267 D268 Y269 L270 N277 L280 Y283 C284 R285 D286 L289 L290 L291 H292 L293 H294 R295 A296 M297 H298 A299 R303 Q304 K305

N306 H307 G308 M309 H310 F311 R312 V313 L314 A315 K316 A317 L318 R319 G323 D324 H325 I326 H327 A328 G329 T330 V331 V332 G333 K334 L335 E336 G337 E338 R339 E340 I341 T342 F345 V346 D347 L348 D352 Y353 I354 K355 K356 R360 Y363 Q366 D367 W368 V369 S370 L371 P372 G373 V374

I375 P376 V377 A378 S379 G380 V384 W385 H386 M387 P388 A389 L390 T391 E392 D396 V399 L400 Q401 F402 G403 H409 P410 W411 G412 N413 A414 G416 A417 V418 A423 L424 E425 A426 Q429 A430 R431 D436 L437 A438 R439 E440 I444 E447 W451 E454 L455 A456

E460 V461 W462 K463 E464 I465 K466 F467 E468 K469 PRO ALA MET ASP THR LEU

• Molecule 2: Ribulose bisphosphate carboxylase small chain

Chain S:

50% 35% 11% •

M1 Q2 V3 P6 I7 G8 K9 K10 K11 F12 E13 T14 L15 S16 Y17 L21 T22 Q25 L26 L27 K28 E29 V30 L33 W38 V39 P40 F44 E45 L46 K47 Y52 H55 N56 K57 S58 P59 Y62 R65 Y66 W67 W70 K71 M74 T77 P80

A81 Q82 V83 E86 L87 D88 E89 V90 K91 K92 E93 Y94 P95 R96 A97 F98 V99 R100 V101 I102 N105 R108 Q111 I116 A117 H118 T119 P120 E121 S122 Y123

• Molecule 2: Ribulose bisphosphate carboxylase small chain

Chain T:

38% 52% 10%

M1 Q2 V3 W4 P5 P6 I7 G8 K9 K10 K11 F12 E13 T14 L15 S16 Y17 L18 P19 P20 L21 T22 R23 D24 Q25 L26 L27 K28 E29 V30 E31 Y32 L33 W38 V39 P40 C41 L42 E43 F44 E45 L46 K47 F50 V51 Y52 R53 E54 H55 S58 P59 G60 Y61 Y62 D63 G64 R65

Y66 W67 K71 L72 P80 L84 K85 E86 L87 D88 E89 V90 K91 K92 E93 Y94 A97 F98 V99 R100 V101 I102 G103 F104 N105 Q109 V110 Q111 C112 I113 S114 H118 T119 P120 E121 S122 Y123

• Molecule 2: Ribulose bisphosphate carboxylase small chain

Chain U:

41% 45% 14%

M1 Q2 V3 W4 P5 P6 K10 K11 F12 E13 T14 L15 S16 Y17 L21 T22 Q25 L26 L27 V30 E31 Y32 L33 L34 R35 P40 C41 L42 E43 F44 K47 K48 G49 F50 V51 Y52 H55 N56 K57 S58 P59 Y62 D63 G64 R65 Y66 W67 T68 M69 W70 K71

T78 D79 P80 A81 Q82 V83 L84 K85 E86 L87 D88 E89 V90 K91 K92 E93 R96 V99 R100 N105 M106 V107 R108 Q109 V110 Q111 C112 I113 I116 A117 H118 T119 P120 E121 S122 Y123

• Molecule 2: Ribulose bisphosphate carboxylase small chain

Chain V:

% 43% 44% 12% •

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 2 21	Depositor
Cell constants a, b, c, α, β, γ	109.79Å 109.95Å 201.44Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	109.95 – 2.20 48.20 – 2.20	Depositor EDS
% Data completeness (in resolution range)	93.0 (109.95-2.20) 93.1 (48.20-2.20)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.22	Depositor
$< I/\sigma(I) >$ [1]	1.84 (at 2.20Å)	Xtriage
Refinement program	REFMAC	Depositor
R, R_{free}	0.197 , 0.279 0.198 , 0.262	Depositor DCC
R_{free} test set	5831 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å^2)	10.4	Xtriage
Anisotropy	0.893	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 3.5	EDS
L-test for twinning [2]	$< |L| > = 0.37, < L^2 > = 0.20$	Xtriage
Estimated twinning fraction	0.349 for k,h,-l	Xtriage
Reported twinning fraction	0.580 for H, K, L 0.420 for K, H, -L	Depositor
Outliers	0 of 116024 reflections	Xtriage
F_o,F_c correlation	0.85	EDS
Total number of atoms	19680	wwPDB-VP
Average B, all atoms (Å^2)	10.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.51% of the height of the origin peak. No significant pseudotranslation is detected.*

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[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: RUB

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	1.15	9/3765 (0.2%)	1.35	33/5104 (0.6%)
1	B	1.15	4/3783 (0.1%)	1.35	31/5128 (0.6%)
1	C	1.01	6/3790 (0.2%)	1.19	24/5135 (0.5%)
1	D	1.03	8/3758 (0.2%)	1.27	25/5090 (0.5%)
2	S	0.95	3/1089 (0.3%)	1.07	3/1474 (0.2%)
2	T	0.94	1/1099 (0.1%)	1.02	1/1487 (0.1%)
2	U	0.81	3/1087 (0.3%)	0.90	0/1472
2	V	0.84	2/1100 (0.2%)	0.94	3/1489 (0.2%)
All	All	1.04	36/19471 (0.2%)	1.23	120/26379 (0.5%)

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	A	0	1
1	C	0	3
2	S	0	1
2	V	0	1
All	All	0	6

The worst 5 of 36 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	214	TRP	NE1-CE2	-6.74	1.28	1.37
1	A	373	GLY	N-CA	6.64	1.56	1.46
1	C	204	GLU	CD-OE2	6.45	1.32	1.25
1	D	70	TRP	CD2-CE2	6.11	1.48	1.41
1	D	411	TRP	CD2-CE2	6.07	1.48	1.41

The worst 5 of 120 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	131	ARG	NE-CZ-NH1	11.31	125.95	120.30
1	D	367	ASP	CB-CG-OD2	9.96	127.27	118.30
1	D	295	ARG	NE-CZ-NH1	9.59	125.09	120.30
1	A	253	ARG	NE-CZ-NH1	9.30	124.95	120.30
1	A	160	ASP	CB-CG-OD2	8.97	126.38	118.30

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	199	PHE	Peptide
1	C	195	GLY	Peptide
1	C	199	PHE	Peptide
1	C	93	GLU	Peptide
2	S	47	LYS	Peptide

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	3648	0	3615	263	2
1	B	3653	0	3642	270	1
1	C	3662	0	3632	268	1
1	D	3647	0	3601	248	3
2	S	1049	0	1065	75	1
2	T	1056	0	1076	83	1
2	U	1047	0	1057	75	1
2	V	1057	0	1071	83	0
3	A	18	0	8	4	0
3	B	18	0	8	4	0
3	C	18	0	8	4	0
3	D	18	0	8	1	0
4	A	161	0	0	28	1
4	B	175	0	0	31	1
4	C	137	0	0	29	1
4	D	147	0	0	30	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	S	49	0	0	8	0
4	T	50	0	0	3	0
4	U	30	0	0	3	0
4	V	40	0	0	6	0
All	All	19680	0	18791	1296	7

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 34.

The worst 5 of 1296 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:C:201:LYS:NZ	1:C:294:HIS:NE2	1.70	1.35
1:C:201:LYS:HE3	1:C:202:ASP:O	1.40	1.16
1:D:201:LYS:NZ	1:D:294:HIS:NE2	1.98	1.11
1:A:60:GLU:HG3	1:A:127:PHE:HZ	1.04	1.09
1:A:409:HIS:HD2	1:A:458:ALA:HB2	1.16	1.08

The worst 5 of 7 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:S:105:ASN:O	4:A:727:HOH:O[2_555]	1.92	0.28
1:D:207:ASN:ND2	4:C:615:HOH:O[2_555]	1.94	0.26
1:D:75:THR:OG1	2:T:109:GLN:NE2[2_555]	2.00	0.20
1:A:106:ASP:OD2	1:A:370[B]:SER:OG[2_555]	2.05	0.15
1:A:65:THR:CG2	4:B:728:HOH:O[2_555]	2.07	0.13

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	467/475 (98%)	405 (87%)	51 (11%)	11 (2%)		6	3
1	B	469/475 (99%)	404 (86%)	48 (10%)	17 (4%)		3	1
1	C	468/475 (98%)	411 (88%)	47 (10%)	10 (2%)		7	4
1	D	465/475 (98%)	408 (88%)	47 (10%)	10 (2%)		6	4
2	S	123/123 (100%)	105 (85%)	12 (10%)	6 (5%)		2	1
2	T	124/123 (101%)	109 (88%)	12 (10%)	3 (2%)		6	3
2	U	123/123 (100%)	97 (79%)	20 (16%)	6 (5%)		2	1
2	V	124/123 (101%)	111 (90%)	9 (7%)	4 (3%)		4	2
All	All	2363/2392 (99%)	2050 (87%)	246 (10%)	67 (3%)		5	2

5 of 67 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	379	SER
1	B	212	MET
1	C	21	LYS
2	S	120	PRO
2	T	120	PRO

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	381/385 (99%)	353 (93%)	28 (7%)	14	15
1	B	383/385 (100%)	348 (91%)	35 (9%)	9	9
1	C	382/385 (99%)	347 (91%)	35 (9%)	9	9
1	D	379/385 (98%)	341 (90%)	38 (10%)	7	7
2	S	115/113 (102%)	101 (88%)	14 (12%)	5	4
2	T	116/113 (103%)	104 (90%)	12 (10%)	7	6
2	U	115/113 (102%)	98 (85%)	17 (15%)	3	2
2	V	116/113 (103%)	103 (89%)	13 (11%)	6	5

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1987/1992 (100%)	1795 (90%)	192 (10%)	9 7

5 of 192 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	293	ILE
1	D	131	ARG
2	U	113	ILE
1	C	365[B]	THR
1	C	465	ILE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 49 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	149	GLN
1	D	30	GLN
2	U	111	GLN
1	C	267	HIS
1	D	96	GLN

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 monosaccharides in this entry.

5.6 Ligand geometry (i)

4 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	RUB	D	501	-	15,17,17	1.01	0	16,25,25	1.90	6 (37%)
3	RUB	C	501	-	15,17,17	0.79	0	16,25,25	2.16	9 (56%)
3	RUB	B	501	-	15,17,17	1.78	4 (26%)	16,25,25	2.34	6 (37%)
3	RUB	A	501	-	15,17,17	1.25	2 (13%)	16,25,25	2.03	7 (43%)

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	RUB	D	501	-	-	10/20/20/20	-
3	RUB	C	501	-	-	8/20/20/20	-
3	RUB	B	501	-	-	16/20/20/20	-
3	RUB	A	501	-	-	14/20/20/20	-

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	501	RUB	O1-C1	3.60	1.45	1.43
3	B	501	RUB	O2-C2	3.48	1.27	1.21
3	B	501	RUB	P2-O5	2.73	1.69	1.60
3	A	501	RUB	O3-C3	2.58	1.47	1.42
3	B	501	RUB	O3-C3	2.39	1.47	1.42

The worst 5 of 28 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
3	B	501	RUB	O2P-P1-O1P	4.74	129.23	110.68
3	B	501	RUB	O5P-P2-O5	-3.96	96.20	106.73
3	D	501	RUB	O5-P2-O4P	-3.74	95.98	106.47
3	B	501	RUB	O6P-P2-O5	3.55	116.18	106.73
3	C	501	RUB	O5P-P2-O5	-3.49	97.46	106.73

There are no chirality outliers.
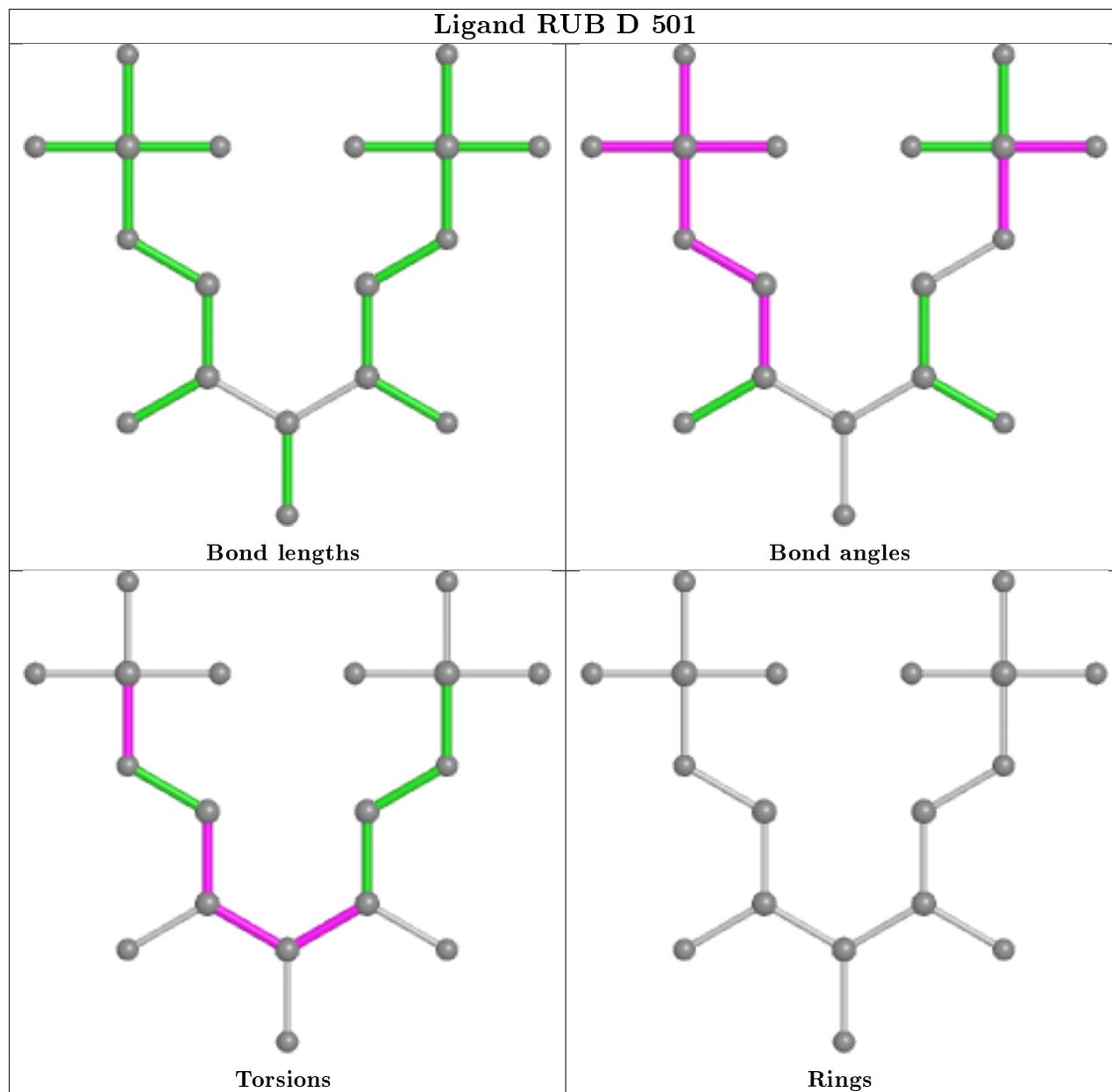
5 of 48 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	D	501	RUB	O2-C2-C3-O3
3	D	501	RUB	C2-C3-C4-C5
3	D	501	RUB	C2-C3-C4-O4
3	D	501	RUB	O3-C3-C4-C5
3	D	501	RUB	O3-C3-C4-O4

There are no ring outliers.

4 monomers are involved in 13 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	D	501	RUB	1	0
3	C	501	RUB	4	0
3	B	501	RUB	4	0
3	A	501	RUB	4	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.

Ligand RUB D 501

Bond lengths

Bond angles

Torsions

Rings

Ligand RUB C 501

Bond lengths

Bond angles

Torsions

Rings

Ligand RUB B 501

Bond lengths

Bond angles

Torsions

Rings

Ligand RUB A 501

Bond lengths

Bond angles

Torsions

Rings
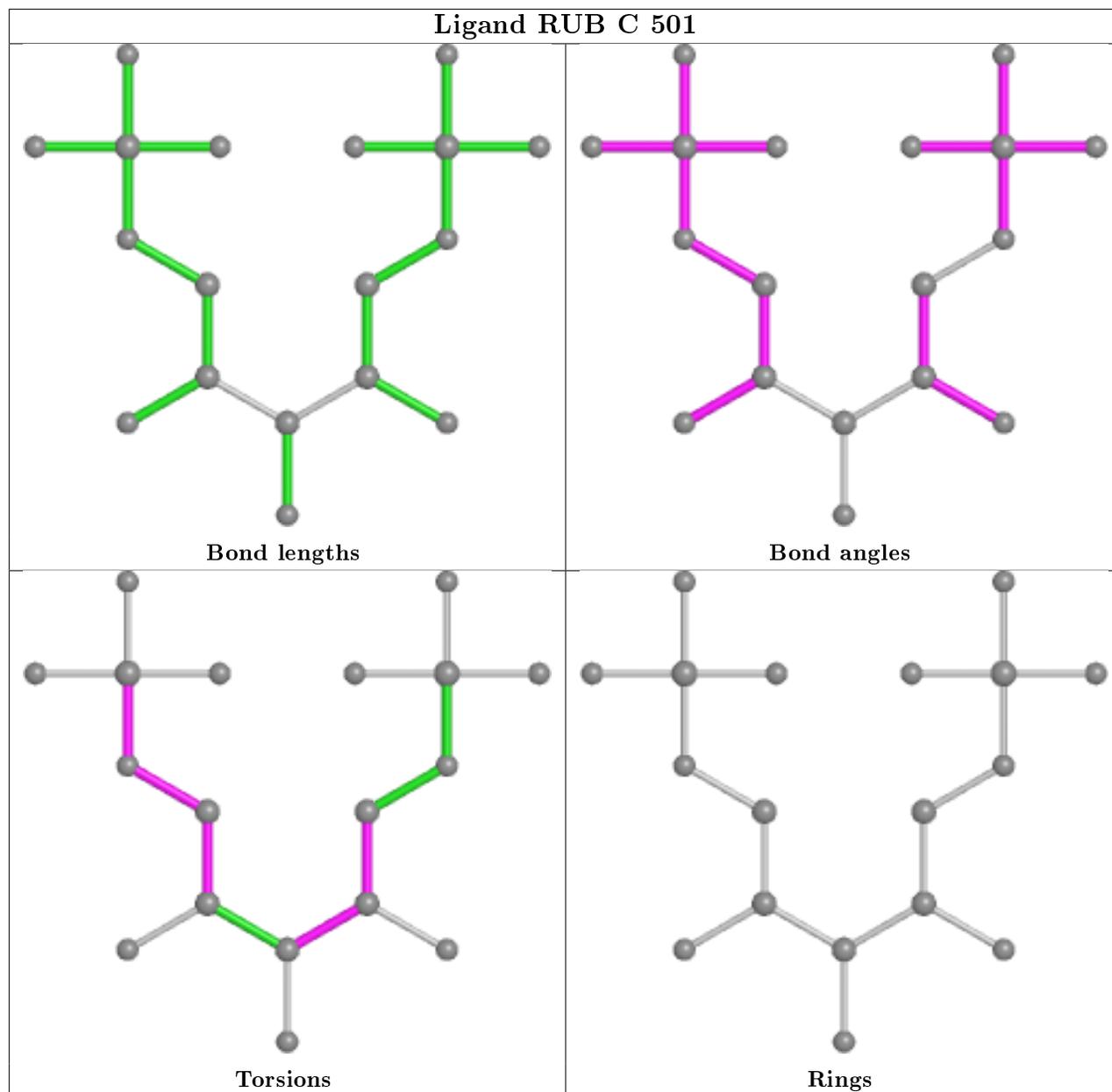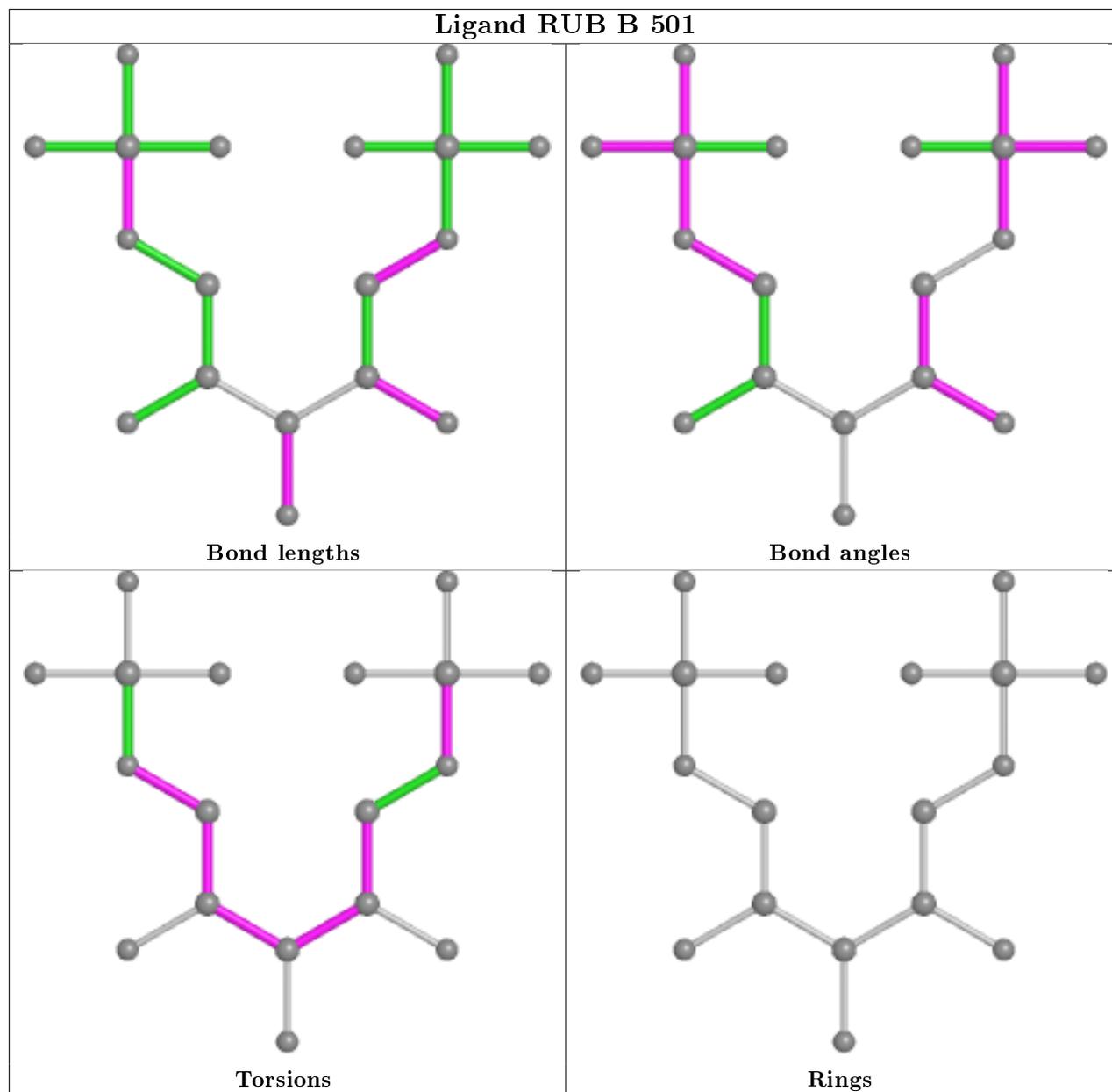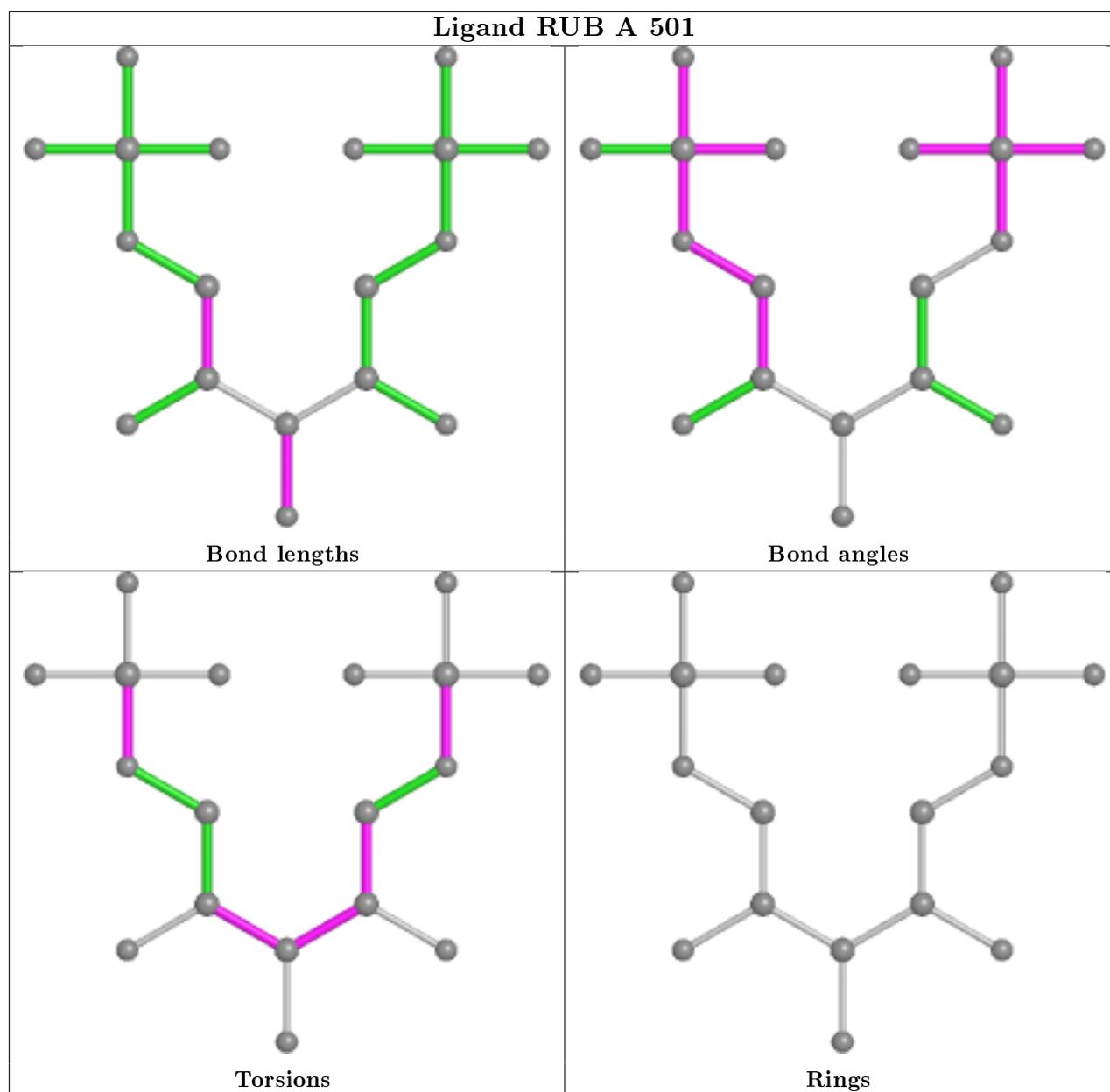
5.7 Other polymers (i)

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	458/475 (96%)	-0.96	0	100	100	2, 2, 20, 43	0
1	B	458/475 (96%)	-0.97	0	100	100	2, 2, 23, 46	0
1	C	458/475 (96%)	-0.86	0	100	100	2, 9, 28, 34	0
1	D	458/475 (96%)	-0.89	0	100	100	2, 10, 30, 37	0
2	S	123/123 (100%)	-0.80	0	100	100	2, 15, 24, 34	0
2	T	123/123 (100%)	-0.80	0	100	100	2, 14, 27, 52	0
2	U	123/123 (100%)	-0.61	0	100	100	7, 23, 37, 46	0
2	V	123/123 (100%)	-0.61	1 (0%)	86	85	5, 19, 31, 58	0
All	All	2324/2392 (97%)	-0.88	1 (0%)	100	100	2, 8, 29, 58	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	V	123	TYR	3.2

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)
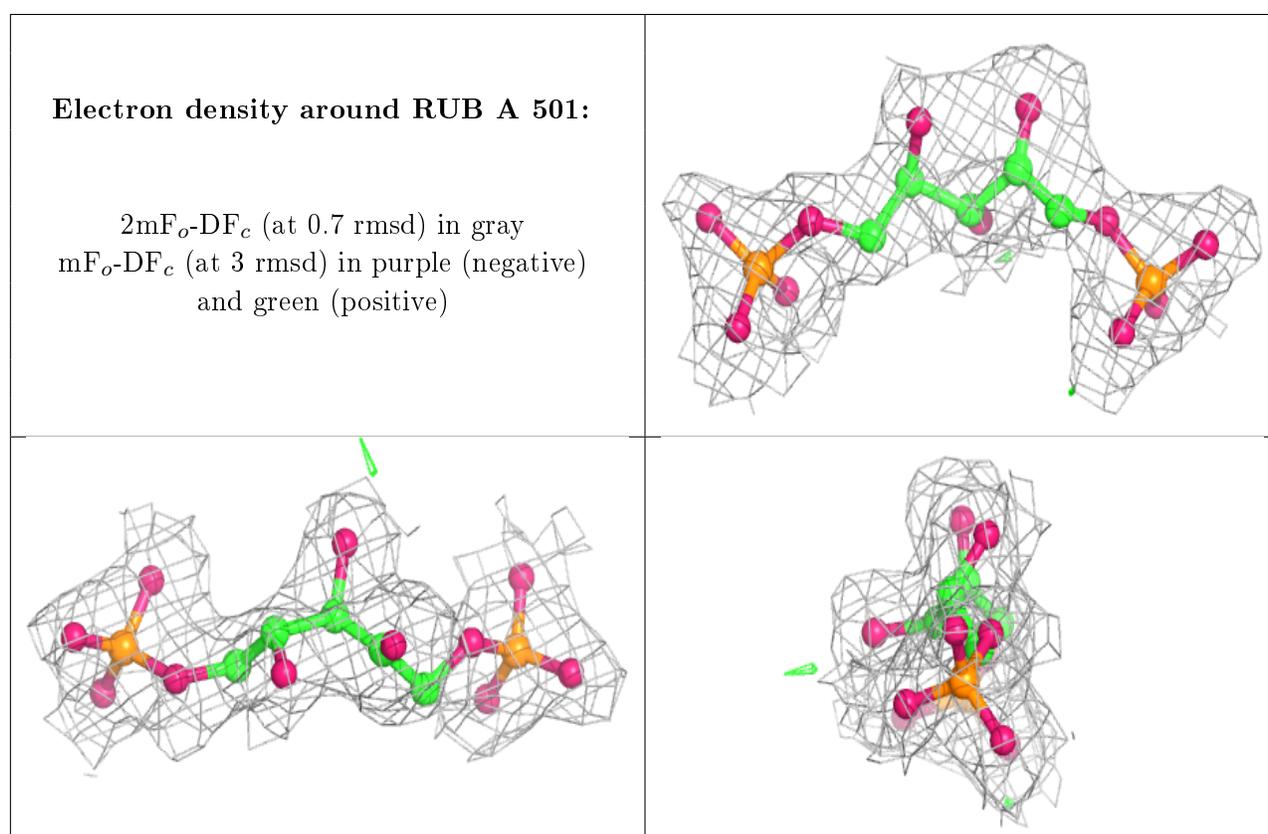
There are no monosaccharides in this entry.
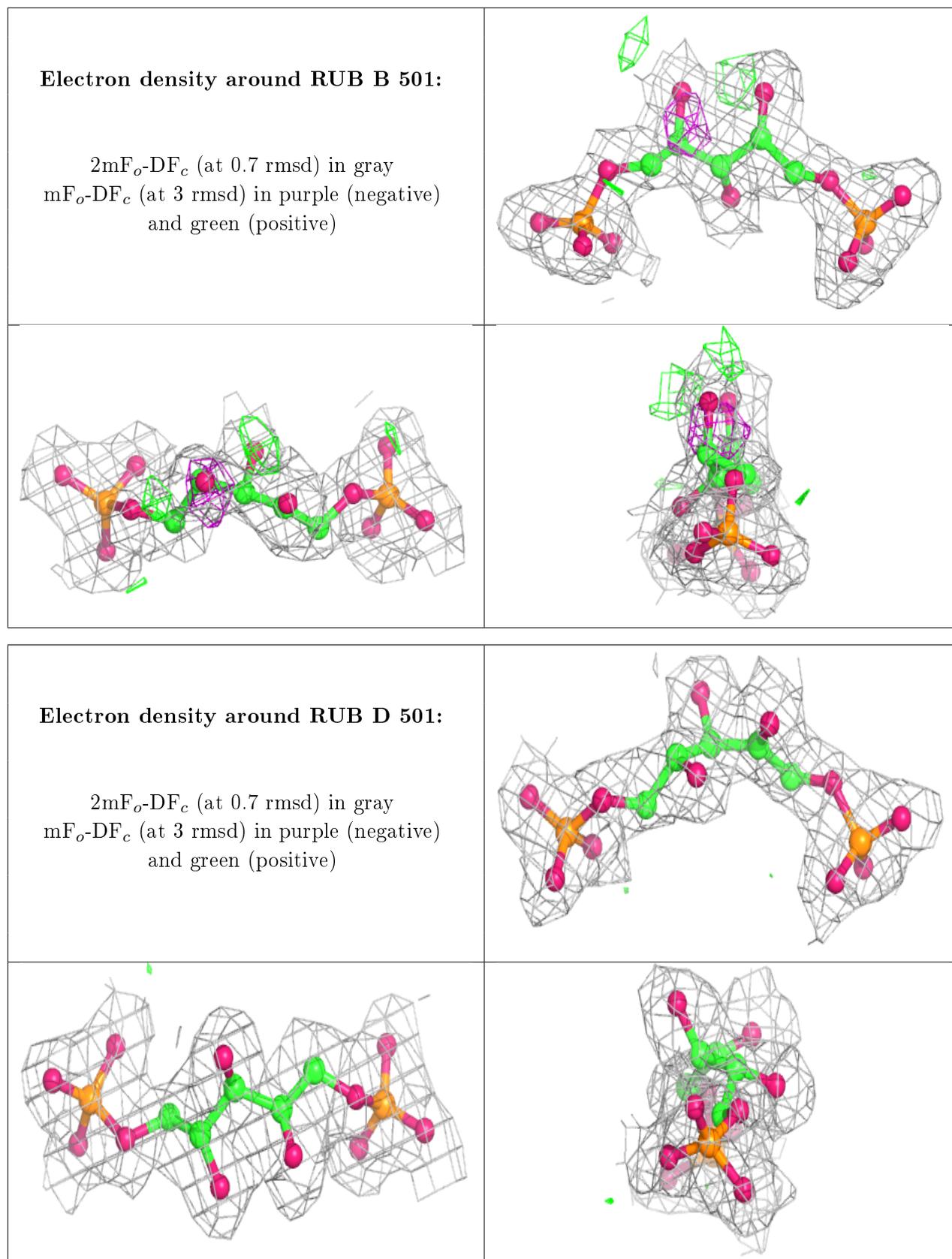
6.4 Ligands (i)

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,
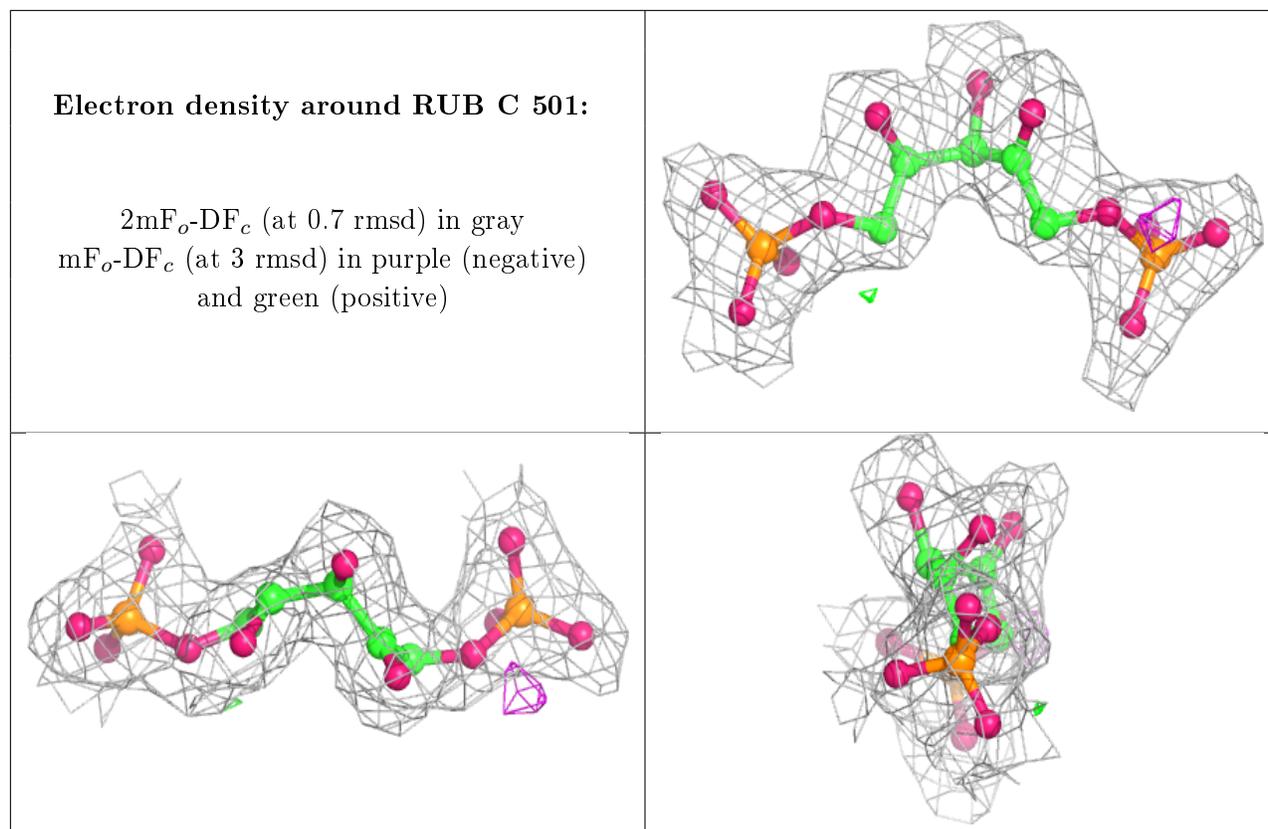
median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	RUB	A	501	18/18	0.97	0.08	6,10,12,12	0
3	RUB	B	501	18/18	0.98	0.09	2,2,2,2	0
3	RUB	D	501	18/18	0.98	0.07	8,14,18,19	0
3	RUB	C	501	18/18	0.99	0.07	8,11,16,17	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.

Electron density around RUB A 501:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around RUB B 501:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around RUB D 501:

$2mF_o\text{-}DF_c$ (at 0.7 rmsd) in gray
$mF_o\text{-}DF_c$ (at 3 rmsd) in purple (negative)
and green (positive)

Electron density around RUB C 501:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative)
and green (positive)

6.5 Other polymers (i)

There are no such residues in this entry.