



Full wwPDB X-ray Structure Validation Report ⓘ

Aug 4, 2026 – 01:59 pm BST

PDB ID : 30JK / pdb_000030jk
Title : crystal structure of [FeFe]-hydrogenase CbA5H from *Clostridium beijerinckii* in Hinact state
Authors : Duan, J.; Rutz, A.; Hofmann, E.; Happe, T.
Deposited on : 2026-04-29
Resolution : 2.15 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
Mogul	:	1.8.4, CSD as541be (2020)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

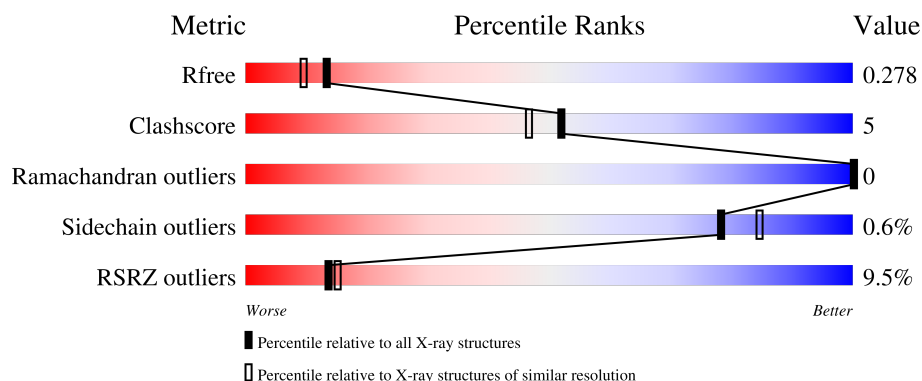
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.15 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	2057 (2.16-2.16)
Clashscore	190562	2159 (2.16-2.16)
Ramachandran outliers	187476	2134 (2.16-2.16)
Sidechain outliers	187428	2133 (2.16-2.16)
RSRZ outliers	180081	2059 (2.16-2.16)

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	674	7% 79% 10% 10%
1	B	674	9% 75% 12% 13%

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 10171 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 [FeFe]-hydrogenase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	604	Total	C	N	O	S	11	1	0
			4726	2985	805	900	36			
1	B	588	Total	C	N	O	S	49	1	0
			4607	2909	788	874	36			

There are 60 discrepancies between the modelled and reference sequences:

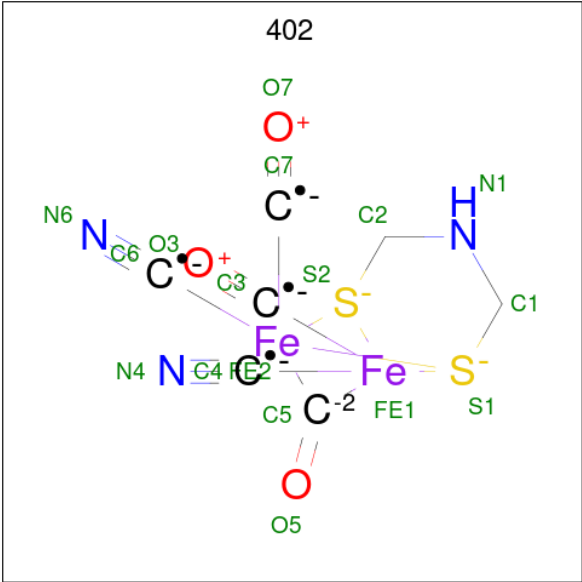
Chain	Residue	Modelled	Actual	Comment	Reference
A	645	ASP	-	expression tag	UNP A0A1I9RYV3
A	646	ILE	-	expression tag	UNP A0A1I9RYV3
A	647	TRP	-	expression tag	UNP A0A1I9RYV3
A	648	SER	-	expression tag	UNP A0A1I9RYV3
A	649	VAL	-	expression tag	UNP A0A1I9RYV3
A	650	GLY	-	expression tag	UNP A0A1I9RYV3
A	651	VAL	-	expression tag	UNP A0A1I9RYV3
A	652	LYS	-	expression tag	UNP A0A1I9RYV3
A	653	LEU	-	expression tag	UNP A0A1I9RYV3
A	654	PHE	-	expression tag	UNP A0A1I9RYV3
A	655	GLY	-	expression tag	UNP A0A1I9RYV3
A	656	GLY	-	expression tag	UNP A0A1I9RYV3
A	657	GLY	-	expression tag	UNP A0A1I9RYV3
A	658	SER	-	expression tag	UNP A0A1I9RYV3
A	659	GLY	-	expression tag	UNP A0A1I9RYV3
A	660	GLY	-	expression tag	UNP A0A1I9RYV3
A	661	GLY	-	expression tag	UNP A0A1I9RYV3
A	662	SER	-	expression tag	UNP A0A1I9RYV3
A	663	GLY	-	expression tag	UNP A0A1I9RYV3
A	664	GLY	-	expression tag	UNP A0A1I9RYV3
A	665	GLY	-	expression tag	UNP A0A1I9RYV3
A	666	SER	-	expression tag	UNP A0A1I9RYV3
A	667	TRP	-	expression tag	UNP A0A1I9RYV3
A	668	SER	-	expression tag	UNP A0A1I9RYV3
A	669	HIS	-	expression tag	UNP A0A1I9RYV3

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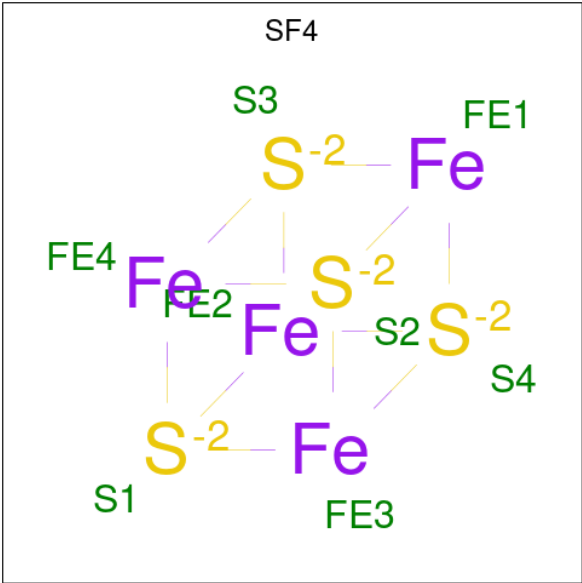
Chain	Residue	Modelled	Actual	Comment	Reference
A	670	PRO	-	expression tag	UNP A0A1I9RYV3
A	671	GLN	-	expression tag	UNP A0A1I9RYV3
A	672	PHE	-	expression tag	UNP A0A1I9RYV3
A	673	GLU	-	expression tag	UNP A0A1I9RYV3
A	674	LYS	-	expression tag	UNP A0A1I9RYV3
B	645	ASP	-	expression tag	UNP A0A1I9RYV3
B	646	ILE	-	expression tag	UNP A0A1I9RYV3
B	647	TRP	-	expression tag	UNP A0A1I9RYV3
B	648	SER	-	expression tag	UNP A0A1I9RYV3
B	649	VAL	-	expression tag	UNP A0A1I9RYV3
B	650	GLY	-	expression tag	UNP A0A1I9RYV3
B	651	VAL	-	expression tag	UNP A0A1I9RYV3
B	652	LYS	-	expression tag	UNP A0A1I9RYV3
B	653	LEU	-	expression tag	UNP A0A1I9RYV3
B	654	PHE	-	expression tag	UNP A0A1I9RYV3
B	655	GLY	-	expression tag	UNP A0A1I9RYV3
B	656	GLY	-	expression tag	UNP A0A1I9RYV3
B	657	GLY	-	expression tag	UNP A0A1I9RYV3
B	658	SER	-	expression tag	UNP A0A1I9RYV3
B	659	GLY	-	expression tag	UNP A0A1I9RYV3
B	660	GLY	-	expression tag	UNP A0A1I9RYV3
B	661	GLY	-	expression tag	UNP A0A1I9RYV3
B	662	SER	-	expression tag	UNP A0A1I9RYV3
B	663	GLY	-	expression tag	UNP A0A1I9RYV3
B	664	GLY	-	expression tag	UNP A0A1I9RYV3
B	665	GLY	-	expression tag	UNP A0A1I9RYV3
B	666	SER	-	expression tag	UNP A0A1I9RYV3
B	667	TRP	-	expression tag	UNP A0A1I9RYV3
B	668	SER	-	expression tag	UNP A0A1I9RYV3
B	669	HIS	-	expression tag	UNP A0A1I9RYV3
B	670	PRO	-	expression tag	UNP A0A1I9RYV3
B	671	GLN	-	expression tag	UNP A0A1I9RYV3
B	672	PHE	-	expression tag	UNP A0A1I9RYV3
B	673	GLU	-	expression tag	UNP A0A1I9RYV3
B	674	LYS	-	expression tag	UNP A0A1I9RYV3

- Molecule 2 is dicarbonyl[bis(cyanide-kappaC)]-mu-(iminodimethanethiolatato-1kappaS:2kappaS)-mu-(oxomethylidene)diiron(2+) (CCD ID: 402) (formula: C₇H₅Fe₂N₃O₃S₂) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	
2	A	1	Total	C	Fe	N	O	S	0	0
			17	7	2	3	3	2		
2	B	1	Total	C	Fe	N	O	S	0	0
			17	7	2	3	3	2		

- Molecule 3 is IRON/SULFUR CLUSTER (CCD ID: SF4) (formula: Fe₄S₄).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	Fe	S	0	0
			8	4	4		
3	A	1	Total	Fe	S	0	0
			8	4	4		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	Fe	S	0	0
			8	4	4		
3	B	1	Total	Fe	S	0	0
			8	4	4		
3	B	1	Total	Fe	S	0	0
			8	4	4		
3	B	1	Total	Fe	S	0	0
			8	4	4		

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Zn	0	0
			1	1		
4	B	1	Total	Zn	0	0
			1	1		

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	1	Total	Mg	0	0
			1	1		
5	B	1	Total	Mg	0	0
			1	1		

- Molecule 6 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

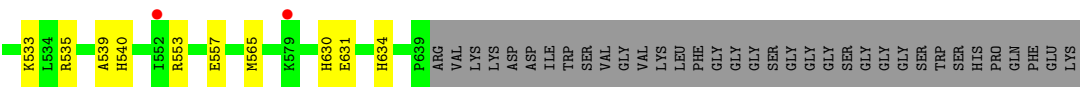
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	4	Total	Cl	0	0
			4	4		
6	B	5	Total	Cl	0	0
			5	5		

- Molecule 7 is UNKNOWN (CCD ID: UNK) (formula: C₄H₉NO₂).

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
7	A	12	Total	C	N	O	0	0
			65	41	12	12		
7	B	12	Total	C	N	O	0	0
			65	41	12	12		

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	A	327	Total 327	O 327	0	0
8	B	286	Total 286	O 286	0	0



4 Data and refinement statistics

Property	Value	Source
Space group	P 42 21 2	Depositor
Cell constants a, b, c, α , β , γ	168.42Å 168.42Å 126.31Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.07 – 2.15 49.07 – 2.15	Depositor EDS
% Data completeness (in resolution range)	98.7 (49.07-2.15) 98.7 (49.07-2.15)	Depositor EDS
R_{merge}	0.48	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.24 (at 2.16Å)	Xtrriage
Refinement program	PHENIX (1.21.2_5419: ???)	Depositor
R, R_{free}	0.249 , 0.280 0.249 , 0.278	Depositor DCC
R_{free} test set	4873 reflections (4.94%)	wwPDB-VP
Wilson B-factor (Å ²)	32.8	Xtrriage
Anisotropy	0.003	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 53.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.35$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	10171	wwPDB-VP
Average B, all atoms (Å ²)	52.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 66.35 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 6.1335e-06. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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: SF4, ZN, CL, MG, 402

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	0/4801	0.31	0/6458
1	B	0.15	0/4679	0.31	0/6293
All	All	0.14	0/9480	0.31	0/12751

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	A	4726	0	4733	48	0
1	B	4607	0	4622	50	0
2	A	17	0	5	2	0
2	B	17	0	5	2	0
3	A	24	0	0	2	0
3	B	24	0	0	1	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
5	A	1	0	0	0	0
5	B	1	0	0	0	0
6	A	4	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	B	5	0	0	0	0
7	A	65	0	42	2	0
7	B	65	0	42	2	0
8	A	327	0	0	2	0
8	B	286	0	0	1	0
All	All	10171	0	9449	96	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 5.

All (96) 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:245:HIS:ND1	3:A:703:SF4:S3	2.60	0.71
1:B:369:PRO:HG2	1:B:425:ALA:HB1	1.72	0.71
1:B:38:GLY:HA3	1:B:107:VAL:H	1.56	0.69
1:A:159:SER:HB2	1:A:163:GLU:HG3	1.77	0.66
1:A:526:GLU:OE1	1:A:535:ARG:NH1	2.29	0.66
1:B:159:SER:HB3	1:B:163:GLU:HG3	1.78	0.66
1:A:38:GLY:HA3	1:A:107:VAL:H	1.63	0.64
1:A:168:ARG:NH1	8:A:802:HOH:O	2.30	0.64
1:A:219:THR:N	1:A:266:ALA:O	2.29	0.61
1:B:167:LEU:HD22	1:B:185:MET:HG2	1.83	0.60
1:B:264:VAL:HG12	1:B:265:ASP:H	1.67	0.60
1:A:49:PRO:HG2	1:A:52:ALA:HB2	1.84	0.59
1:A:264:VAL:HG12	1:A:265:ASP:H	1.69	0.57
1:A:368:CYS:N	2:A:701:402:H8	2.19	0.57
1:A:565:MET:HG2	1:A:570:GLY:HA2	1.87	0.57
1:B:364:LEU:HB3	1:B:386:PRO:HA	1.86	0.57
1:B:314:LYS:NZ	1:B:468:ASP:OD1	2.28	0.56
1:A:514:GLU:HA	1:A:517:ARG:HD2	1.88	0.56
1:B:368:CYS:N	2:B:701:402:H8	2.20	0.56
1:A:221:LYS:NZ	1:A:265:ASP:HB3	2.22	0.54
1:A:175:LYS:HB2	1:A:183:ASN:HB2	1.90	0.54
1:A:484:ILE:O	1:A:490:GLY:HA3	2.08	0.54
1:B:239:GLY:HA3	1:B:245:HIS:HD2	1.73	0.54
1:A:128:LYS:NZ	8:A:805:HOH:O	2.41	0.53
1:B:245:HIS:ND1	3:B:703:SF4:S3	2.80	0.53
1:B:183:ASN:HB3	1:B:186:GLU:HG3	1.91	0.53
1:B:514:GLU:HA	1:B:517:ARG:HD2	1.90	0.53
1:B:229:LYS:HG3	8:B:913:HOH:O	2.08	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:126:LEU:O	1:A:130:LYS:HG3	2.09	0.53
1:A:140:VAL:HG12	1:A:177:LYS:HD2	1.92	0.51
1:B:484:ILE:O	1:B:490:GLY:HA3	2.11	0.51
1:A:565:MET:HG3	3:A:702:SF4:S1	2.51	0.51
1:A:77:LEU:HB3	1:A:78:PRO:HD3	1.94	0.50
1:A:239:GLY:HA3	1:A:245:HIS:HD2	1.75	0.50
1:A:150:ILE:HG23	1:A:163:GLU:HB3	1.94	0.49
1:A:128:LYS:HB3	1:A:134:TYR:CE2	2.48	0.49
1:A:55:ASN:HB2	1:A:88:LEU:HG	1.94	0.49
1:A:293:PRO:HB3	1:A:483:ILE:HD12	1.95	0.49
1:B:565:MET:HE1	2:B:701:402:H9	1.77	0.48
1:A:220:LYS:N	1:A:220:LYS:HD3	2.28	0.48
1:A:232:CYS:SG	1:A:236:CYS:HB3	2.54	0.47
1:B:55:ASN:O	1:B:58:ILE:HG12	2.14	0.47
1:B:77:LEU:HB3	1:B:78:PRO:HD3	1.97	0.47
1:A:467:GLU:HG3	1:A:468:ASP:N	2.29	0.47
1:A:221:LYS:HB3	1:A:221:LYS:HE2	1.67	0.47
1:B:126:LEU:O	1:B:130:LYS:HG3	2.15	0.47
1:B:288:ILE:HG22	1:B:326:TYR:HB2	1.97	0.47
1:A:87:SER:HA	1:A:90:LYS:HD3	1.95	0.46
1:A:520:ASP:HB2	1:A:523:ARG:HG2	1.97	0.46
1:A:288:ILE:HG22	1:A:326:TYR:HB2	1.97	0.46
1:B:458:ASN:HB2	7:B:719:UNK:O	2.16	0.46
1:A:53:THR:O	1:A:57:ILE:HG13	2.15	0.46
1:A:277:LEU:HD21	7:A:718:UNK:HB2	1.98	0.46
1:B:232:CYS:SG	1:B:236:CYS:HB3	2.56	0.46
1:B:402:GLU:CD	1:B:412:ARG:HH21	2.24	0.46
1:B:520:ASP:HB2	1:B:523:ARG:HG2	1.98	0.46
1:A:75:ILE:O	1:A:80:GLY:HA3	2.15	0.46
1:A:221:LYS:HZ1	1:A:264:VAL:HG12	1.80	0.46
1:B:125:LEU:HD12	1:B:125:LEU:O	2.16	0.46
1:A:552:ILE:HD11	1:A:559:PHE:HD2	1.82	0.45
1:A:167:LEU:HD22	1:A:185:MET:HG2	1.98	0.45
1:A:239:GLY:HA3	1:A:245:HIS:CD2	2.51	0.45
1:B:150:ILE:HG23	1:B:163:GLU:HB3	1.99	0.45
1:A:168:ARG:NH2	1:B:631:GLU:OE2	2.50	0.45
1:B:526:GLU:HB3	1:B:533:LYS:HE2	1.98	0.45
1:A:171:ALA:HB2	1:A:185:MET:HB3	1.99	0.44
1:B:122:ILE:HG21	1:B:148:PHE:HB2	1.98	0.44
1:B:448:THR:HG22	1:B:450:ARG:H	1.81	0.44
1:A:631:GLU:OE2	1:B:168:ARG:NH2	2.50	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:381:ASP:OD2	1:B:553:ARG:HD3	2.18	0.44
1:A:299:ILE:HG21	1:A:315:ILE:HD11	1.99	0.44
1:B:419:ALA:HB1	1:B:421:MET:HE3	2.00	0.44
1:B:140:VAL:HG12	1:B:177:LYS:HD2	1.99	0.43
1:B:218:ILE:HG12	1:B:267:ILE:HG12	2.00	0.43
1:B:171:ALA:HB2	1:B:185:MET:HB3	2.00	0.43
1:B:158:VAL:HG21	1:B:439:MET:SD	2.58	0.43
1:B:125:LEU:HD12	1:B:125:LEU:C	2.44	0.43
1:B:521:GLY:O	1:B:539:ALA:HA	2.19	0.43
1:B:448:THR:HG22	1:B:450:ARG:N	2.34	0.42
1:B:630:HIS:HA	1:B:634:HIS:CD2	2.54	0.42
1:A:458:ASN:HB2	7:A:718:UNK:O	2.20	0.42
1:B:118:GLU:CG	1:B:185:MET:HE1	2.49	0.42
1:B:277:LEU:HD21	7:B:719:UNK:HB2	2.02	0.42
1:B:535:ARG:NH2	1:B:557:GLU:OE2	2.53	0.42
1:B:215:LYS:O	1:B:217:THR:HG23	2.19	0.42
1:A:221:LYS:HZ2	1:A:265:ASP:HB3	1.84	0.42
1:B:56:GLU:O	1:B:59:GLN:HB2	2.19	0.41
1:A:521:GLY:O	1:A:539:ALA:HA	2.21	0.41
1:B:139:VAL:HG22	1:B:177:LYS:HD3	2.02	0.41
1:A:364:LEU:HB3	1:A:386:PRO:HA	2.03	0.41
1:B:70:PHE:O	1:B:110:GLN:NE2	2.53	0.41
1:B:224:GLY:HA3	1:B:242:LYS:HA	2.03	0.41
1:A:272:ASN:ND2	1:A:445:TYR:HB2	2.36	0.41
1:B:75:ILE:O	1:B:80:GLY:HA3	2.20	0.41
1:B:39:LYS:HG2	1:B:109:SER:OG	2.20	0.41
1:A:571:CYS:CB	2:A:701:402:C4	3.00	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	601/674 (89%)	584 (97%)	17 (3%)	0	100	100
1	B	583/674 (86%)	566 (97%)	17 (3%)	0	100	100
All	All	1184/1348 (88%)	1150 (97%)	34 (3%)	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	509/565 (90%)	507 (100%)	2 (0%)	84	89
1	B	497/565 (88%)	493 (99%)	4 (1%)	73	79
All	All	1006/1130 (89%)	1000 (99%)	6 (1%)	78	84

All (6) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	264	VAL
1	A	367	CYS
1	B	236	CYS
1	B	264	VAL
1	B	367	CYS
1	B	540	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	458	ASN
1	B	110	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](#)

Of 45 ligands modelled in this entry, 13 are monoatomic and 24 are unknown - leaving 8 for Mogul analysis.

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	SF4	A	702	1	0,12,12	-	-	-		
2	402	A	701	1	13,19,19	2.26	6 (46%)	2,36,36	0.94	0
2	402	B	701	1	13,19,19	2.30	6 (46%)	2,36,36	0.35	0
3	SF4	A	704	1	0,12,12	-	-	-		
3	SF4	B	703	1	0,12,12	-	-	-		
3	SF4	A	703	1	0,12,12	-	-	-		
3	SF4	B	704	1	0,12,12	-	-	-		
3	SF4	B	702	1	0,12,12	-	-	-		

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	SF4	A	702	1	-	-	0/6/5/5
2	402	A	701	1	-	-	0/5/3/3
2	402	B	701	1	-	-	0/5/3/3
3	SF4	A	704	1	-	-	0/6/5/5
3	SF4	B	703	1	-	-	0/6/5/5
3	SF4	A	703	1	-	-	0/6/5/5

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	SF4	B	704	1	-	-	0/6/5/5
3	SF4	B	702	1	-	-	0/6/5/5

All (12) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	701	402	S1-FE2	4.05	2.32	2.26
2	A	701	402	S1-FE2	3.95	2.31	2.26
2	B	701	402	C4-N4	3.88	1.22	1.15
2	A	701	402	C4-N4	3.65	1.21	1.15
2	A	701	402	O3-C3	3.08	1.23	1.15
2	B	701	402	O3-C3	3.01	1.23	1.15
2	A	701	402	S2-FE1	2.82	2.30	2.26
2	B	701	402	S2-FE2	2.65	2.30	2.26
2	B	701	402	S2-FE1	2.59	2.30	2.26
2	A	701	402	C2-S2	2.30	1.89	1.85
2	B	701	402	C2-S2	2.18	1.89	1.85
2	A	701	402	S2-FE2	2.15	2.29	2.26

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

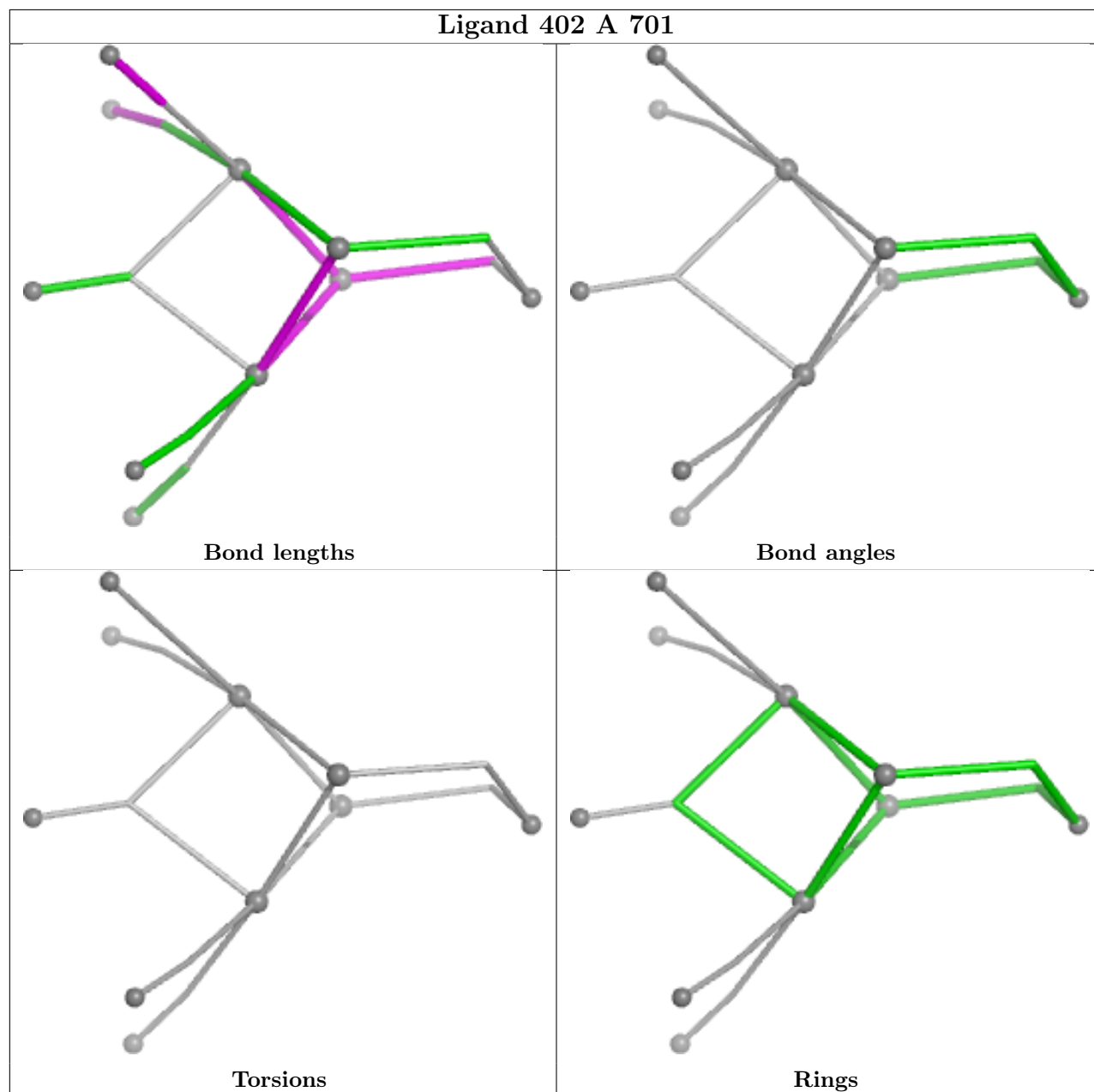
There are no ring outliers.

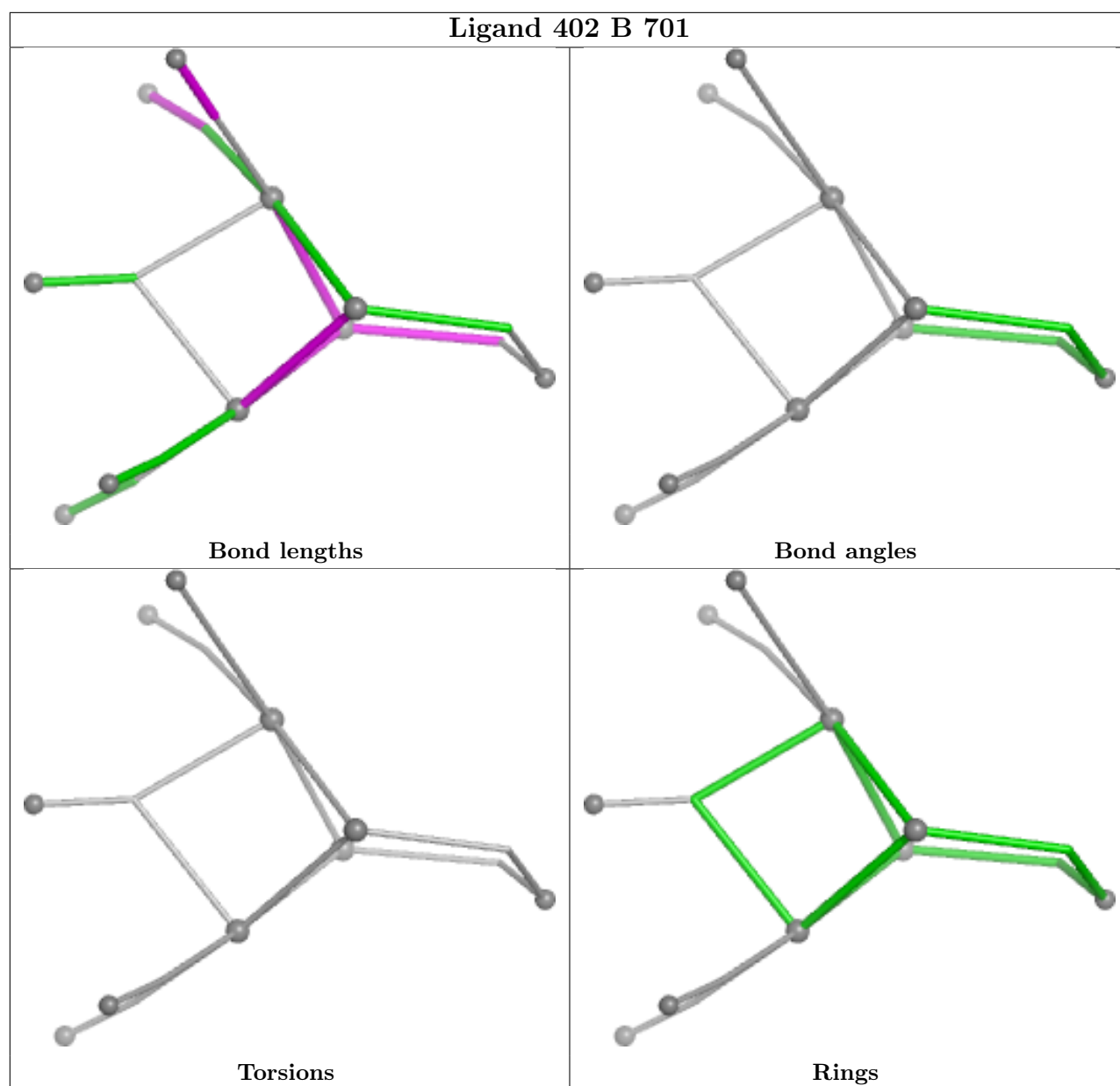
5 monomers are involved in 7 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	702	SF4	1	0
2	A	701	402	2	0
2	B	701	402	2	0
3	B	703	SF4	1	0
3	A	703	SF4	1	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 than 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.





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	604/674 (89%)	0.45	50 (8%) 17 19	20, 44, 94, 145	3 (0%)
1	B	588/674 (87%)	0.58	63 (10%) 11 12	24, 45, 98, 147	11 (1%)
All	All	1192/1348 (88%)	0.52	113 (9%) 14 15	20, 45, 97, 147	14 (1%)

All (113) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	57	ILE	9.1
1	B	79	PHE	7.4
1	B	45	ILE	5.7
1	A	264	VAL	5.6
1	B	37	CYS	4.9
1	B	236	CYS	4.9
1	B	225	CYS	4.9
1	A	77	LEU	4.8
1	B	264	VAL	4.5
1	A	96	ILE	4.5
1	A	78	PRO	4.4
1	B	44	GLY	4.4
1	A	102	ALA	4.2
1	B	70	PHE	4.2
1	B	102	ALA	4.1
1	B	223	ILE	4.0
1	B	83	LEU	3.9
1	B	48	VAL	3.9
1	B	46	ILE	3.8
1	A	241	LEU	3.8
1	B	77	LEU	3.8
1	B	75	ILE	3.7
1	B	105	ILE	3.6
1	A	236	CYS	3.4

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Mol	Chain	Res	Type	RSRZ
1	B	76	GLY	3.4
1	B	184	ILE	3.4
1	B	261	ALA	3.4
1	B	239	GLY	3.3
1	A	92	PHE	3.3
1	B	72	ALA	3.2
1	B	43	PRO	3.2
1	B	35	ALA	3.2
1	A	45	ILE	3.2
1	B	36	ILE	3.2
1	B	241	LEU	3.2
1	B	249	TYR	3.2
1	A	48	VAL	3.1
1	A	184	ILE	3.1
1	B	33	LYS	3.1
1	B	49	PRO	3.1
1	B	60	LEU	3.1
1	B	134	TYR	3.1
1	B	67	LYS	3.1
1	A	265	ASP	3.0
1	B	86	ASP	3.0
1	B	237	ILE	3.0
1	B	104	THR	3.0
1	A	182	HIS	2.9
1	A	225	CYS	2.9
1	A	266	ALA	2.9
1	B	58	ILE	2.8
1	A	80	GLY	2.8
1	A	49	PRO	2.8
1	B	222	CYS	2.8
1	A	223	ILE	2.8
1	B	39	LYS	2.8
1	A	377	GLN	2.7
1	A	93	ASP	2.7
1	A	76	GLY	2.7
1	B	78	PRO	2.7
1	B	180	GLN	2.7
1	A	622	ASP	2.7
1	B	227	ALA	2.7
1	B	263	PRO	2.7
1	B	106	ILE	2.7
1	A	67	LYS	2.7

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Mol	Chain	Res	Type	RSRZ
1	A	533	LYS	2.6
1	A	52	ALA	2.6
1	B	66	ASN	2.6
1	B	353	LEU	2.6
1	A	60	LEU	2.6
1	A	243	LYS	2.6
1	A	239	GLY	2.6
1	B	137	TYR	2.5
1	B	38	GLY	2.5
1	A	250	ASN	2.5
1	B	34	ILE	2.5
1	B	62	GLY	2.4
1	B	55	ASN	2.4
1	A	247	ILE	2.4
1	A	251	ARG	2.4
1	B	265	ASP	2.4
1	B	234	VAL	2.4
1	A	57	ILE	2.4
1	B	552	ILE	2.4
1	B	103	ARG	2.4
1	A	37	CYS	2.4
1	A	54	LEU	2.3
1	A	79	PHE	2.3
1	A	51	GLY	2.3
1	B	229	LYS	2.3
1	B	40	VAL	2.3
1	A	87	SER	2.3
1	B	245	HIS	2.3
1	A	34	ILE	2.3
1	A	105	ILE	2.3
1	B	73	ALA	2.3
1	B	278[A]	ARG	2.2
1	B	242	LYS	2.2
1	A	86	ASP	2.2
1	B	579	LYS	2.2
1	A	242	LYS	2.2
1	A	75	ILE	2.1
1	A	35	ALA	2.1
1	A	240	GLU	2.1
1	A	38	GLY	2.1
1	A	94	PHE	2.1
1	A	134	TYR	2.1

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Mol	Chain	Res	Type	RSRZ
1	A	263	PRO	2.1
1	A	428	TYR	2.1
1	B	355	GLY	2.1
1	A	353	LEU	2.0
1	B	178	MET	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 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(Å ²)	Q<0.9
7	UNK	B	723	6/-	0.32	0.32	108,115,119,120	0
7	UNK	B	722	6/-	0.51	0.26	78,86,89,100	0
7	UNK	A	722	6/-	0.52	0.24	83,87,91,97	0
7	UNK	A	721	6/-	0.56	0.20	55,63,66,72	0
7	UNK	B	712	5/-	0.62	0.17	83,91,92,361	0
7	UNK	A	711	5/-	0.64	0.17	58,65,76,626	0
7	UNK	A	717	5/-	0.70	0.21	34,47,68,74	0
7	UNK	B	720	6/-	0.71	0.22	70,86,90,96	0
7	UNK	A	716	5/-	0.71	0.20	50,56,61,65	0
7	UNK	B	717	5/-	0.71	0.24	80,82,88,89	0
7	UNK	A	715	5/-	0.72	0.26	59,59,79,84	0
7	UNK	B	714	5/-	0.76	0.18	76,76,83,85	0
7	UNK	B	715	5/-	0.76	0.20	63,78,86,94	0
7	UNK	B	721	6/-	0.77	0.19	75,87,89,95	0
7	UNK	B	718	5/-	0.77	0.18	61,70,84,85	0
6	CL	B	710	1/1	0.77	0.23	83,83,83,83	0
6	CL	A	708	1/1	0.78	0.19	75,75,75,75	0
7	UNK	A	714	5/-	0.78	0.18	38,50,57,61	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
7	UNK	B	716	5/-	0.78	0.22	77,78,89,94	0
6	CL	B	707	1/1	0.79	0.14	86,86,86,86	0
7	UNK	A	719	6/-	0.80	0.15	40,50,52,53	0
7	UNK	A	718	6/-	0.81	0.24	46,51,66,70	0
7	UNK	A	720	6/-	0.81	0.17	50,54,58,70	0
7	UNK	B	713	5/-	0.83	0.14	81,84,85,85	0
7	UNK	A	713	5/-	0.83	0.16	46,54,58,65	0
7	UNK	B	719	6/-	0.85	0.30	90,95,99,101	0
6	CL	A	710	1/1	0.86	0.13	66,66,66,66	0
6	CL	B	708	1/1	0.86	0.25	76,76,76,76	0
6	CL	B	711	1/1	0.87	0.21	76,76,76,76	0
7	UNK	A	712	5/-	0.87	0.15	50,60,67,71	0
6	CL	A	709	1/1	0.91	0.11	58,58,58,58	0
5	MG	A	706	1/1	0.91	0.05	32,32,32,32	0
6	CL	A	707	1/1	0.92	0.18	73,73,73,73	0
5	MG	B	706	1/1	0.93	0.07	41,41,41,41	0
6	CL	B	709	1/1	0.94	0.12	60,60,60,60	0
3	SF4	B	703	8/8	0.95	0.07	65,79,83,100	0
3	SF4	A	703	8/8	0.97	0.05	56,65,71,76	0
3	SF4	B	704	8/8	0.98	0.04	37,47,50,54	0
2	402	A	701	17/17	0.99	0.06	22,26,36,42	0
3	SF4	A	704	8/8	0.99	0.03	39,43,46,46	0
3	SF4	B	702	8/8	0.99	0.03	25,30,37,38	0
2	402	B	701	17/17	0.99	0.06	22,30,34,38	0
3	SF4	A	702	8/8	0.99	0.03	24,26,37,38	0
4	ZN	A	705	1/1	0.99	0.05	39,39,39,39	0
4	ZN	B	705	1/1	0.99	0.02	39,39,39,39	0

6.5 Other polymers [i](#)

There are no such residues in this entry.