



Full wwPDB EM Validation Report i

Dec 7, 2025 – 12:38 AM JST

PDB ID : 9JQZ / pdb_00009jqz
EMDB ID : EMD-61744
Title : Structural Insights into Selective Antagonism Grapiprant and EP4 Prostaglandin Receptor
Authors : Wu, Y.L.; Zhang, H.; Xu, J.Y.; Wu, C.R.; Xu, E.H.
Deposited on : 2024-09-28
Resolution : 2.65 Å(reported)

This is a Full wwPDB EM 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/EMValidationReportHelp>

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:

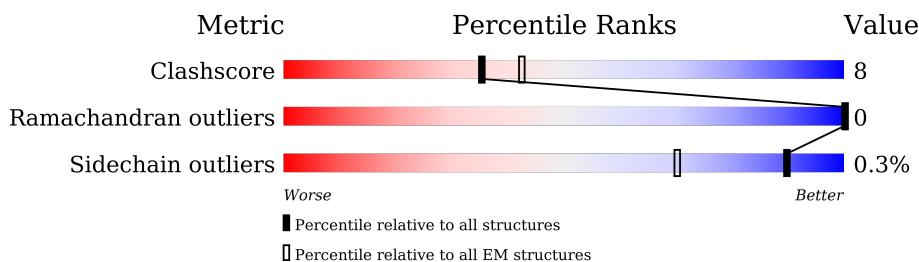
EMDB validation analysis : **FAILED**
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0
buster-report : 1.1.7 (2018)
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics : **NOT EXECUTED**
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.46

1 Overall quality at a glance

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

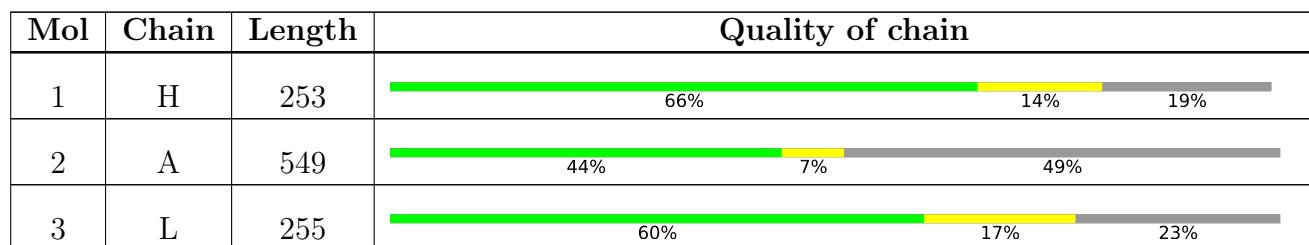
The reported resolution of this entry is 2.65 Å.

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)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$



2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 5381 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Heavy chain of Fab fragment.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	H	204	Total	C	N	O	S	1	0
			1581	1018	253	304	6		

- Molecule 2 is a protein called GFP-like fluorescent chromoprotein, Prostaglandin E2 receptor EP4 subtype.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	A	281	Total	C	N	O	S	0	0
			2209	1458	358	377	16		

There are 47 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	ALA	THR	engineered mutation	UNP P35408
A	4	GLN	ASN	engineered mutation	UNP P35408
A	59	LEU	ALA	engineered mutation	UNP P35408
A	103	ARG	GLY	engineered mutation	UNP P35408
A	174	GLN	ASN	engineered mutation	UNP P35408
A	?	-	MET	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	THR	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408
A	?	-	LEU	deletion	UNP P35408
A	?	-	GLY	deletion	UNP P35408
A	?	-	THR	deletion	UNP P35408
A	?	-	GLU	deletion	UNP P35408
A	?	-	GLN	deletion	UNP P35408
A	?	-	HIS	deletion	UNP P35408
A	?	-	HIS	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408

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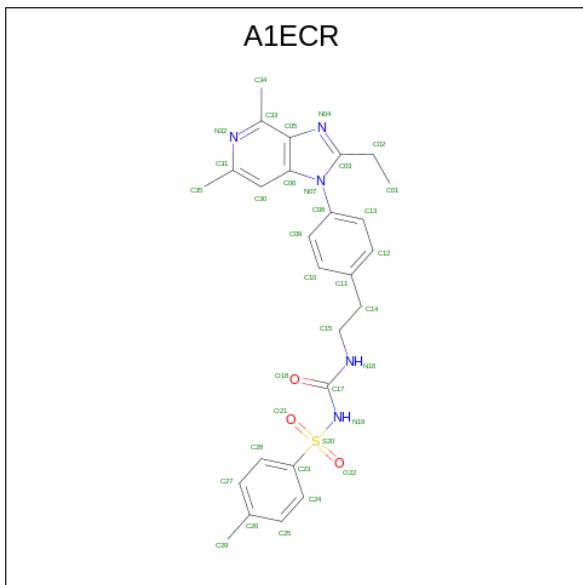
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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ALA	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408
A	?	-	VAL	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	GLY	deletion	UNP P35408
A	?	-	HIS	deletion	UNP P35408
A	?	-	PRO	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408
A	?	-	PRO	deletion	UNP P35408
A	?	-	ALA	deletion	UNP P35408
A	?	-	LEU	deletion	UNP P35408
A	?	-	PRO	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	LEU	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408
A	?	-	ASP	deletion	UNP P35408
A	?	-	PHE	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	ARG	deletion	UNP P35408
A	?	-	SER	deletion	UNP P35408

- Molecule 3 is a protein called Light chain of Fab fragment.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	L	197	Total	C	N	O	S	0	0
			1548	971	255	313	9		

- Molecule 4 is Grapiprant (CCD ID: A1ECR) (formula: C₂₆H₂₉N₅O₃S) (labeled as "Ligand of Interest" by depositor).



Mol	Chain	Residues	Atoms					AltConf
4	A	1	Total	C	N	O	S	0
			35	26	5	3	1	

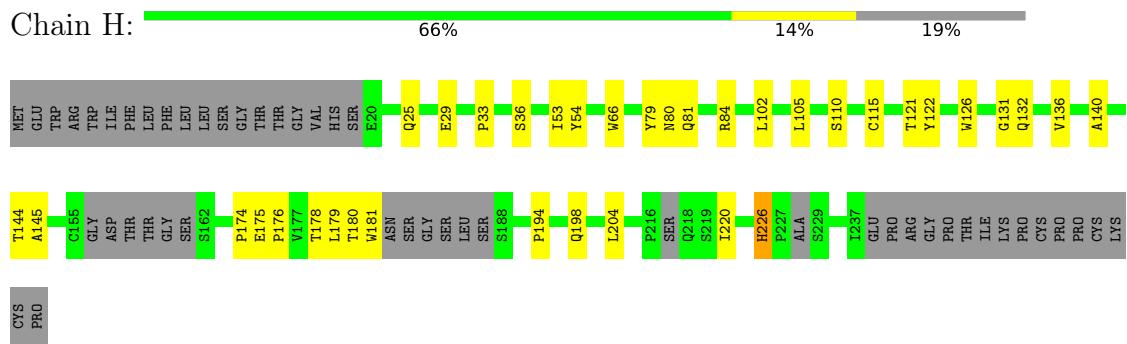
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		AltConf
5	A	8	Total 8	O 8	0

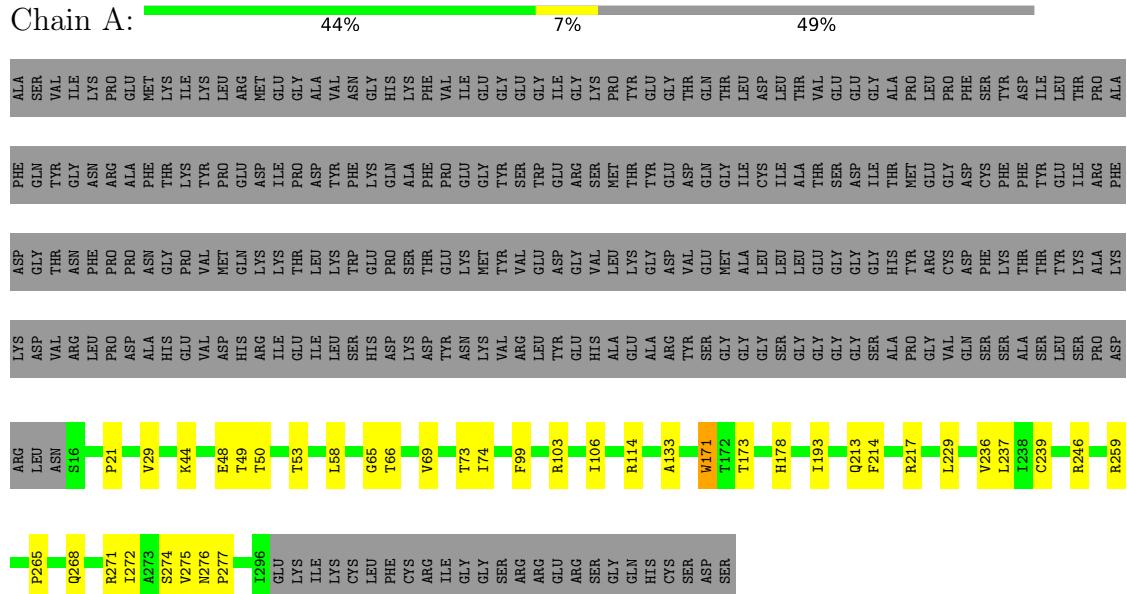
3 Residue-property plots [\(i\)](#)

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. 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. 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.

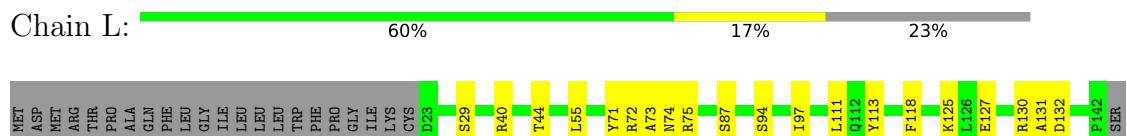
- Molecule 1: Heavy chain of Fab fragments



- Molecule 2: GFP-like fluorescent chromoprotein, Prostaglandin E2 receptor EP4 subtype



- Molecule 3: Light chain of Fab fragment





4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	287641	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	3000	Depositor
Magnification	Not provided	
Image detector	GATAN K3 BIOCONTINUUM (6k x 4k)	Depositor

5 Model quality [\(i\)](#)

5.1 Standard geometry [\(i\)](#)

Bond lengths and bond angles in the following residue types are not validated in this section: A1ECR

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	H	0.14	0/1626	0.32	0/2221
2	A	0.17	0/2261	0.33	0/3084
3	L	0.10	0/1583	0.28	0/2144
All	All	0.14	0/5470	0.31	0/7449

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	H	1581	0	1523	32	0
2	A	2209	0	2301	28	0
3	L	1548	0	1477	26	0
4	A	35	0	0	0	0
5	A	8	0	0	5	0
All	All	5381	0	5301	82	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 8.

All (82) 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:H:179:LEU:HD23	1:H:204:LEU:HD22	1.30	1.11
1:H:179:LEU:CD2	1:H:204:LEU:HD22	1.87	1.05
1:H:121:THR:HG22	1:H:122:TYR:H	1.26	1.00
1:H:179:LEU:HD23	1:H:204:LEU:CD2	2.00	0.92
1:H:121:THR:HG22	1:H:122:TYR:N	1.90	0.85
1:H:121:THR:CG2	1:H:122:TYR:H	1.95	0.79
2:A:29:VAL:HG13	2:A:66:THR:HG21	1.69	0.74
2:A:246:ARG:HD2	2:A:265:PRO:HB2	1.70	0.73
2:A:268:GLN:HG2	5:A:505:HOH:O	1.89	0.72
1:H:53:ILE:HD11	1:H:115:CYS:HB2	1.72	0.71
1:H:110:SER:HA	1:H:136:VAL:O	1.91	0.70
2:A:236:VAL:HG22	2:A:276:ASN:HD21	1.57	0.69
2:A:73:THR:OG1	5:A:501:HOH:O	2.11	0.67
2:A:214:PHE:HB2	2:A:217:ARG:HG3	1.77	0.66
3:L:73:ALA:O	3:L:74:ASN:ND2	2.29	0.66
2:A:29:VAL:HG13	2:A:66:THR:CG2	2.27	0.65
1:H:144:THR:HG22	1:H:145:ALA:N	2.13	0.64
2:A:268:GLN:CG	5:A:505:HOH:O	2.45	0.63
2:A:114:ARG:HG3	2:A:229:LEU:HD22	1.82	0.62
2:A:173:THR:HG21	2:A:178:HIS:HB2	1.82	0.61
2:A:213:GLN:OE1	2:A:217:ARG:NH1	2.35	0.60
3:L:130:ARG:HD3	3:L:193:SER:HB2	1.84	0.59
3:L:185:TRP:NE1	3:L:197:MET:SD	2.75	0.59
3:L:29:SER:OG	3:L:44:THR:OG1	2.22	0.57
3:L:166:ILE:HD11	3:L:218:ALA:HB1	1.86	0.57
2:A:50:THR:HG23	2:A:133:ALA:HB2	1.87	0.56
3:L:177:ARG:HH12	3:L:179:ASN:HB3	1.70	0.56
2:A:171:TRP:H	2:A:171:TRP:CD1	2.23	0.55
2:A:58:LEU:HB2	2:A:106:ILE:HG21	1.87	0.55
3:L:169:LYS:HD3	3:L:171:LYS:HE2	1.90	0.54
1:H:102:LEU:HB3	1:H:105:LEU:HD21	1.90	0.53
1:H:198:GLN:HE21	3:L:182:LEU:HD21	1.73	0.53
2:A:239:CYS:HA	2:A:272:ILE:HG22	1.90	0.53
1:H:178:THR:HG22	1:H:180:THR:HG23	1.93	0.50
2:A:259:ARG:HH12	3:L:113:TYR:HD2	1.59	0.50
1:H:54:TYR:HB3	1:H:66:TRP:HZ3	1.76	0.50
2:A:44:LYS:HB3	2:A:48:GLU:HB2	1.92	0.49
2:A:103:ARG:NH1	5:A:502:HOH:O	2.46	0.49
3:L:55:LEU:HA	3:L:111:LEU:O	2.13	0.49
1:H:33:PRO:HG2	1:H:140:ALA:HB2	1.94	0.48
1:H:144:THR:HG22	1:H:145:ALA:H	1.78	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:L:125:LYS:NZ	3:L:127:GLU:OE2	2.35	0.48
1:H:121:THR:HG22	1:H:122:TYR:CD1	2.49	0.47
1:H:144:THR:CG2	1:H:145:ALA:N	2.76	0.47
2:A:21:PRO:HB2	2:A:74:ILE:HG12	1.96	0.47
2:A:69:VAL:HG12	5:A:501:HOH:O	2.15	0.47
1:H:121:THR:CG2	1:H:122:TYR:N	2.58	0.47
1:H:79:TYR:O	1:H:84:ARG:NH2	2.49	0.46
2:A:50:THR:O	2:A:53:THR:HB	2.16	0.46
3:L:220:HIS:CD2	3:L:221:LYS:H	2.34	0.45
2:A:65:GLY:HA2	2:A:99:PHE:CE2	2.52	0.45
2:A:49:THR:O	2:A:53:THR:OG1	2.30	0.45
3:L:130:ARG:HG2	3:L:131:ALA:H	1.82	0.45
1:H:80:ASN:OD1	1:H:81:GLN:N	2.50	0.44
1:H:126:TRP:HB3	3:L:71:TYR:HB2	1.99	0.44
1:H:194:PRO:HD3	3:L:186:THR:HG22	1.98	0.44
2:A:193:ILE:HG23	2:A:237:LEU:HD22	1.98	0.44
1:H:174:PRO:HD2	1:H:226:HIS:NE2	2.33	0.44
3:L:72:ARG:HB3	3:L:75:ARG:HD2	1.98	0.44
3:L:188:GLN:HE21	3:L:193:SER:HB3	1.83	0.43
1:H:181:TRP:HZ3	1:H:220:ILE:HD12	1.83	0.43
1:H:115:CYS:O	1:H:131:GLY:N	2.52	0.43
3:L:153:SER:HB3	3:L:202:THR:HG22	1.99	0.43
3:L:87:SER:OG	3:L:94:SER:OG	2.37	0.43
3:L:132:ASP:HB3	3:L:222:THR:HG22	2.00	0.43
1:H:179:LEU:CD2	1:H:204:LEU:CD2	2.72	0.43
3:L:167:ASN:HB3	3:L:219:THR:OG1	2.18	0.43
1:H:25:GLN:O	1:H:132:GLN:NE2	2.52	0.42
3:L:111:LEU:HD11	3:L:118:PHE:HB3	2.01	0.42
1:H:144:THR:CG2	1:H:145:ALA:H	2.32	0.42
3:L:155:VAL:HG22	3:L:200:THR:HG22	1.99	0.42
1:H:175:GLU:HB3	1:H:176:PRO:HD3	2.01	0.42
2:A:274:SER:O	2:A:277:PRO:HD2	2.20	0.42
2:A:276:ASN:HB3	2:A:277:PRO:HD3	2.01	0.41
1:H:36:SER:HA	1:H:102:LEU:O	2.21	0.41
2:A:271:ARG:O	2:A:275:VAL:HG23	2.21	0.41
1:H:29:GLU:HB2	1:H:136:VAL:HG22	2.03	0.40
3:L:165:ASP:OD1	3:L:165:ASP:N	2.53	0.40
1:H:179:LEU:HD22	1:H:204:LEU:HD22	1.89	0.40
2:A:44:LYS:HE2	2:A:44:LYS:HB2	1.92	0.40
3:L:40:ARG:HA	3:L:97:ILE:O	2.22	0.40
3:L:205:LYS:O	3:L:209:GLU:HG3	2.20	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 PDB entries followed by that with respect to all EM entries.

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	H	195/253 (77%)	189 (97%)	6 (3%)	0	100 100
2	A	279/549 (51%)	275 (99%)	4 (1%)	0	100 100
3	L	193/255 (76%)	191 (99%)	2 (1%)	0	100 100
All	All	667/1057 (63%)	655 (98%)	12 (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 PDB entries followed by that with respect to all EM entries.

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	H	177/219 (81%)	176 (99%)	1 (1%)	84 92
2	A	246/471 (52%)	245 (100%)	1 (0%)	89 95
3	L	177/230 (77%)	177 (100%)	0	100 100
All	All	600/920 (65%)	598 (100%)	2 (0%)	90 96

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	226	HIS
2	A	171	TRP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (13) such sidechains are listed below:

Mol	Chain	Res	Type
1	H	81	GLN
1	H	198	GLN
1	H	223	ASN
2	A	32	ASN
2	A	81	GLN
2	A	251	GLN
2	A	276	ASN
3	L	59	GLN
3	L	60	GLN
3	L	91	GLN
3	L	160	ASN
3	L	178	GLN
3	L	220	HIS

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 oligosaccharides in this entry.

5.6 Ligand geometry [\(i\)](#)

1 ligand is 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
4	A1ECR	A	401	-	36,38,38	1.88	11 (30%)	46,55,55	2.62	7 (15%)

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
4	A1ECR	A	401	-	-	7/23/23/23	0/4/4/4

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	A	401	A1ECR	C02-C03	5.06	1.52	1.49
4	A	401	A1ECR	C17-N16	4.87	1.45	1.35
4	A	401	A1ECR	C34-C33	3.33	1.53	1.50
4	A	401	A1ECR	C23-S20	3.28	1.81	1.76
4	A	401	A1ECR	S20-N19	3.10	1.70	1.64
4	A	401	A1ECR	C17-N19	2.76	1.45	1.39
4	A	401	A1ECR	O21-S20	2.75	1.46	1.43
4	A	401	A1ECR	O22-S20	2.75	1.46	1.43
4	A	401	A1ECR	C06-N07	-2.42	1.36	1.39
4	A	401	A1ECR	O18-C17	-2.22	1.18	1.23
4	A	401	A1ECR	C03-N07	-2.21	1.33	1.37

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	401	A1ECR	O22-S20-O21	-15.50	100.49	119.55
4	A	401	A1ECR	C23-S20-N19	3.06	110.60	105.97
4	A	401	A1ECR	C30-C06-C05	-2.86	117.84	120.55
4	A	401	A1ECR	C34-C33-N32	2.85	120.00	116.01
4	A	401	A1ECR	O22-S20-C23	2.67	111.26	107.97
4	A	401	A1ECR	N19-C17-N16	2.57	118.94	114.25
4	A	401	A1ECR	O21-S20-C23	2.11	110.56	107.97

There are no chirality outliers.

All (7) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	401	A1ECR	C28-C23-S20-N19

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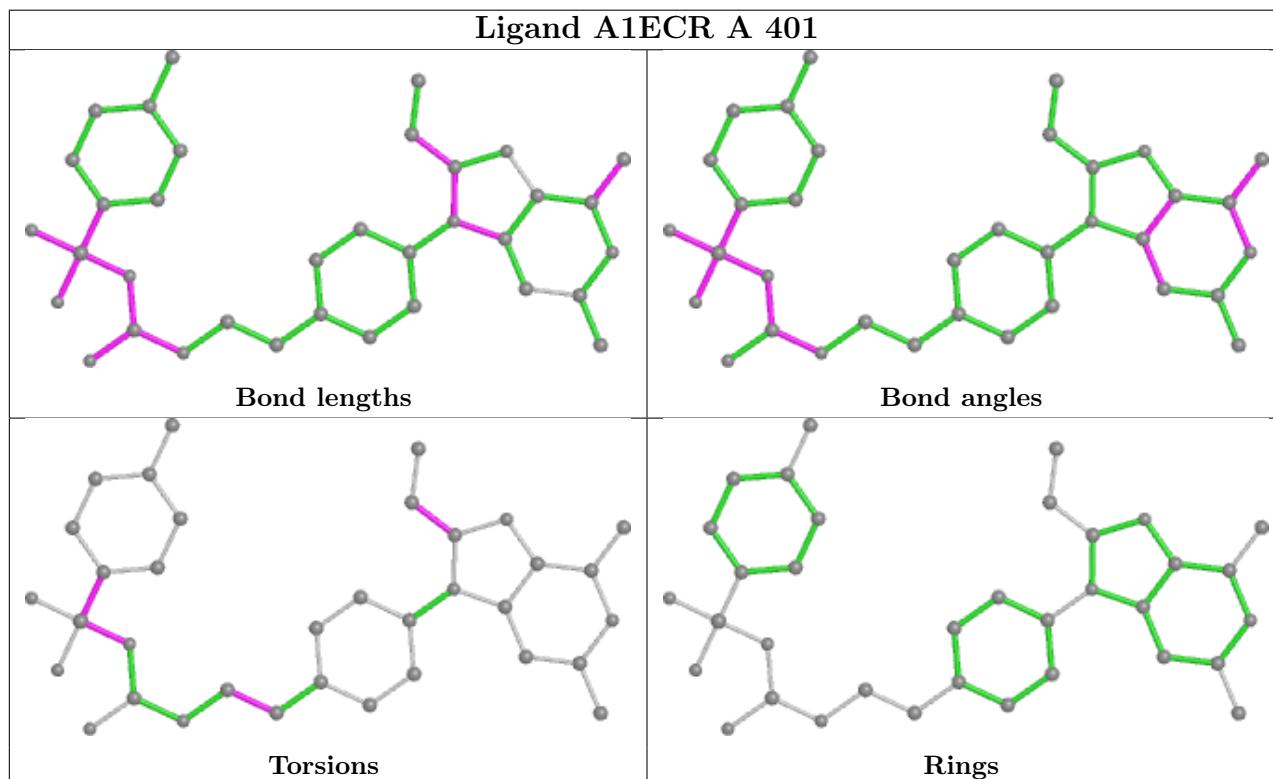
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Mol	Chain	Res	Type	Atoms
4	A	401	A1ECR	C24-C23-S20-N19
4	A	401	A1ECR	C24-C23-S20-O21
4	A	401	A1ECR	C28-C23-S20-O21
4	A	401	A1ECR	C17-N19-S20-O21
4	A	401	A1ECR	C11-C14-C15-N16
4	A	401	A1ECR	C01-C02-C03-N04

There are no ring outliers.

No monomer is involved in short contacts.

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.