



Full wwPDB EM Validation Report ⓘ

Dec 14, 2025 – 12:08 AM JST

PDB ID : 9WST / pdb_00009wst
EMDB ID : EMD-66205
Title : Cryo-EM structure of DAMGO-muOR-Gz-scFv16 complex
Authors : Zhang, H.; Wang, X.; Xi, K.; Shen, Q.; Xue, J.; Zhu, Y.; Yang, G.; Zhang, Y.
Deposited on : 2025-09-15
Resolution : 2.80 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 ⓘ 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:

EMDB validation analysis : **FAILED**
Mogul : 1.8.5 (274361), CSD as541be (2020)
MolProbity : 4-5-2 with Phenix2.0
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) : 2.47

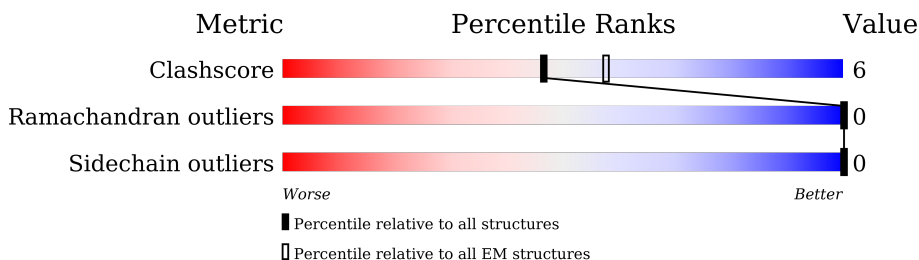
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 2.80 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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	355	
2	B	371	
3	G	71	
4	R	575	
5	P	5	

2 Entry composition

There are 6 unique types of molecules in this entry. The entry contains 7090 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 Engineered guanine nucleotide-binding protein G(z) subunit alpha.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
1	A	223	1812	1154	309	339	10	0	0

- Molecule 2 is a protein called Guanine nucleotide-binding protein G(I)/G(S)/G(T) subunit beta-1.

Mol	Chain	Residues	Atoms					AltConf	Trace
			Total	C	N	O	S		
2	B	336	2579	1591	464	503	21	0	0

There are 32 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-4	GLY	-	expression tag	UNP P62873
B	-3	PRO	-	expression tag	UNP P62873
B	-2	GLY	-	expression tag	UNP P62873
B	-1	SER	-	expression tag	UNP P62873
B	0	SER	-	expression tag	UNP P62873
B	1	GLY	-	expression tag	UNP P62873
B	341	GLY	-	expression tag	UNP P62873
B	342	SER	-	expression tag	UNP P62873
B	343	SER	-	expression tag	UNP P62873
B	344	GLY	-	expression tag	UNP P62873
B	345	GLY	-	expression tag	UNP P62873
B	346	GLY	-	expression tag	UNP P62873
B	347	GLY	-	expression tag	UNP P62873
B	348	SER	-	expression tag	UNP P62873
B	349	GLY	-	expression tag	UNP P62873
B	350	GLY	-	expression tag	UNP P62873
B	351	GLY	-	expression tag	UNP P62873
B	352	GLY	-	expression tag	UNP P62873
B	353	SER	-	expression tag	UNP P62873

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Chain	Residue	Modelled	Actual	Comment	Reference
B	354	SER	-	expression tag	UNP P62873
B	355	GLY	-	expression tag	UNP P62873
B	356	VAL	-	expression tag	UNP P62873
B	357	SER	-	expression tag	UNP P62873
B	358	GLY	-	expression tag	UNP P62873
B	359	TRP	-	expression tag	UNP P62873
B	360	ARG	-	expression tag	UNP P62873
B	361	LEU	-	expression tag	UNP P62873
B	362	PHE	-	expression tag	UNP P62873
B	363	LYS	-	expression tag	UNP P62873
B	364	LYS	-	expression tag	UNP P62873
B	365	ILE	-	expression tag	UNP P62873
B	366	SER	-	expression tag	UNP P62873

- Molecule 3 is a protein called Guanine nucleotide-binding protein G(I)/G(S)/G(O) subunit gamma-2.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	G	53	Total	C	N	O	S	0	0
			407	257	70	77	3		

- Molecule 4 is a protein called Mu-type opioid receptor,LgBiT.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	R	283	Total	C	N	O	S	0	0
			2254	1493	361	376	24		

There are 30 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
R	-4	ASP	-	expression tag	UNP P35372
R	-3	TYR	-	expression tag	UNP P35372
R	-2	LYS	-	expression tag	UNP P35372
R	-1	ASP	-	expression tag	UNP P35372
R	0	ASP	-	expression tag	UNP P35372
R	1	ASP	-	expression tag	UNP P35372
R	2	ASP	-	expression tag	UNP P35372
R	3	LYS	-	expression tag	UNP P35372
R	4	GLY	-	expression tag	UNP P35372
R	6	GLY	THR	conflict	UNP P35372
R	8	ILE	ALA	conflict	UNP P35372
R	10	ASP	ASN	conflict	UNP P35372

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Chain	Residue	Modelled	Actual	Comment	Reference
R	12	SER	THR	conflict	UNP P35372
R	14	PRO	ALA	conflict	UNP P35372
R	17	PRO	TYR	conflict	UNP P35372
R	18	ALA	SER	conflict	UNP P35372
R	30	LEU	VAL	conflict	UNP P35372
R	35	VAL	LEU	conflict	UNP P35372
R	39	GLN	LEU	conflict	UNP P35372
R	49	GLY	ASP	conflict	UNP P35372
R	53	SER	ARG	conflict	UNP P35372
R	54	HIS	ASP	conflict	UNP P35372
R	59	GLN	PRO	conflict	UNP P35372
R	66	VAL	ILE	conflict	UNP P35372
R	137	ASN	THR	conflict	UNP P35372
R	187	VAL	ILE	conflict	UNP P35372
R	306	ILE	VAL	conflict	UNP P35372
R	357	THR	ASN	conflict	UNP P35372
R	364	ALA	THR	conflict	UNP P35372
R	372	GLU	ASP	conflict	UNP P35372

- Molecule 5 is a protein called DAMGO.

Mol	Chain	Residues	Atoms				AltConf	Trace
5	P	5	Total	C	N	O	0	0
			37	26	5	6		

- Molecule 6 is water.

Mol	Chain	Residues	Atoms		AltConf
6	R	1	Total	O	0
			1	1	



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	136606	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	NONE	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	52	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2000	Depositor
Magnification	Not provided	
Image detector	FEI FALCON IV (4k 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: MEA, ETA, DAL

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	0.18	0/1837	0.39	0/2463
2	B	0.20	0/2626	0.46	0/3561
3	G	0.16	0/413	0.37	0/558
4	R	0.19	0/2309	0.37	0/3147
5	P	2.72	2/15 (13.3%)	0.73	0/17
All	All	0.22	2/7200 (0.0%)	0.41	0/9746

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	P	3	GLY	C-O	-5.57	1.12	1.23
5	P	1	TYR	C-O	-5.26	1.13	1.23

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1812	0	1838	17	0
2	B	2579	0	2482	48	0
3	G	407	0	418	6	0
4	R	2254	0	2342	18	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
5	P	37	0	29	0	0
6	R	1	0	0	0	0
All	All	7090	0	7109	83	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 6.

All (83) 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:251:ASP:HB2	1:A:310:LEU:HD23	1.61	0.83
1:A:34:ILE:HD11	1:A:343:ILE:HD11	1.67	0.77
1:A:184:ILE:HG12	1:A:201:VAL:HG12	1.72	0.71
2:B:119:ASN:ND2	2:B:144:GLY:O	2.24	0.70
1:A:339:VAL:O	1:A:343:ILE:HG13	1.95	0.67
2:B:15:LYS:HG3	3:G:19:LEU:HD21	1.77	0.65
2:B:61:MET:HE3	2:B:328:ALA:HB3	1.79	0.64
2:B:30:LEU:HB3	2:B:262:MET:HE3	1.80	0.62
1:A:271:LYS:HD3	1:A:323:PHE:HB3	1.83	0.59
1:A:227:LEU:HG	1:A:274:LEU:HD22	1.87	0.56
2:B:271:CYS:HB2	2:B:290:ASP:HB2	1.88	0.55
1:A:186:GLU:OE2	2:B:99:TRP:NE1	2.38	0.54
2:B:325:MET:O	2:B:340:ASN:ND2	2.39	0.54
2:B:286:LEU:HD22	2:B:327:VAL:HG11	1.89	0.54
2:B:30:LEU:HD12	2:B:261:LEU:HB3	1.89	0.54
1:A:235:TYR:HB2	1:A:240:THR:HG21	1.90	0.53
4:R:77:ILE:O	4:R:81:VAL:HG22	2.09	0.53
3:G:12:ALA:O	3:G:16:VAL:HG23	2.09	0.53
1:A:329:THR:HB	1:A:332:ILE:HG22	1.90	0.51
2:B:6:GLN:NE2	2:B:10:GLU:HB3	2.26	0.51
2:B:79:LEU:HD11	2:B:114:CYS:HB3	1.93	0.51
1:A:230:TYR:HB3	1:A:243:MET:HE2	1.92	0.50
1:A:226:GLU:OE1	1:A:242:ARG:NH1	2.42	0.50
1:A:196:PHE:HE1	1:A:339:VAL:HG21	1.76	0.50
2:B:180:PHE:HB3	2:B:211:TRP:CE3	2.46	0.50
4:R:90:MET:HE1	4:R:112:LEU:HA	1.94	0.50
2:B:153:ASP:OD1	2:B:156:GLN:N	2.38	0.49
4:R:139:LEU:HD23	4:R:142:ILE:HD11	1.93	0.49
4:R:267:GLY:HA3	4:R:271:LYS:HD2	1.96	0.48
4:R:109:ASN:HB2	4:R:188:ASN:ND2	2.28	0.48
4:R:292:CYS:HA	4:R:324:LEU:HG	1.96	0.48

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:6:GLN:HA	2:B:9:GLN:NE2	2.28	0.47
2:B:19:ARG:HG2	2:B:22:ARG:HH21	1.79	0.47
2:B:149:CYS:O	2:B:150:ARG:NH1	2.46	0.47
2:B:145:TYR:O	2:B:162:GLY:N	2.47	0.47
4:R:93:ILE:HD11	4:R:107:ILE:HG22	1.97	0.47
2:B:58:ILE:HD13	2:B:336:LEU:HD12	1.98	0.46
2:B:81:ILE:HB	2:B:91:HIS:HB2	1.98	0.46
2:B:137:ARG:HG3	2:B:171:ILE:HG23	1.98	0.46
2:B:64:GLY:HA2	2:B:105:TYR:CD2	2.51	0.46
2:B:82:TRP:CH2	2:B:89:LYS:HE3	2.51	0.46
4:R:89:VAL:HG21	4:R:333:PRO:HB3	1.96	0.46
4:R:236:VAL:O	4:R:240:ALA:HB3	2.17	0.45
2:B:180:PHE:CE1	2:B:216:GLY:HA2	2.52	0.45
2:B:245:SER:OG	2:B:247:ASP:OD1	2.35	0.45
1:A:209:LYS:NZ	2:B:228:ASP:OD2	2.36	0.44
2:B:25:CYS:HB3	2:B:259:GLN:HE22	1.83	0.44
2:B:34:THR:O	2:B:301:LYS:NZ	2.39	0.44
2:B:192:LEU:HD23	2:B:199:PHE:HB3	2.00	0.44
1:A:204:GLN:NE2	2:B:145:TYR:HD2	2.16	0.43
2:B:166:CYS:HB2	2:B:180:PHE:HB2	1.99	0.43
4:R:157:THR:O	4:R:161:MET:HG3	2.18	0.43
2:B:296:VAL:O	2:B:305:ALA:N	2.49	0.43
4:R:298:ILE:O	4:R:302:ILE:HG12	2.19	0.43
4:R:299:TYR:CE2	4:R:318:TRP:HE3	2.36	0.43
2:B:27:ASP:OD1	2:B:27:ASP:N	2.52	0.42
4:R:147:ASP:OD1	4:R:326:TYR:OH	2.32	0.42
3:G:13:ARG:O	3:G:17:GLU:OE1	2.37	0.42
2:B:7:LEU:HA	2:B:10:GLU:HG2	2.02	0.42
2:B:13:GLN:HA	2:B:16:ASN:HD22	1.84	0.42
2:B:49:ARG:HB2	2:B:338:ILE:HD12	2.01	0.42
2:B:199:PHE:CE1	2:B:211:TRP:HB2	2.54	0.42
4:R:86:ASN:O	4:R:90:MET:HG2	2.18	0.42
1:A:227:LEU:HD13	1:A:268:LEU:HB3	2.01	0.42
2:B:145:TYR:OH	2:B:188:MET:HE1	2.19	0.42
2:B:164:THR:HG22	2:B:185:GLY:C	2.45	0.42
2:B:58:ILE:HD13	2:B:336:LEU:CD1	2.49	0.42
2:B:220:GLN:HA	3:G:22:GLU:OE1	2.20	0.42
3:G:16:VAL:HG12	3:G:20:LYS:NZ	2.35	0.42
4:R:306:ILE:HG22	4:R:307:THR:N	2.34	0.42
2:B:236:PRO:HB2	3:G:40:TYR:CE1	2.55	0.41
2:B:6:GLN:HA	2:B:9:GLN:CD	2.46	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:R:244:PRO:O	4:R:248:ILE:HG12	2.21	0.41
2:B:231:ALA:HB1	2:B:276:VAL:HG22	2.02	0.41
2:B:163:ASP:O	2:B:164:THR:OG1	2.34	0.41
1:A:338:ALA:O	1:A:342:VAL:HG23	2.20	0.41
2:B:61:MET:HE1	2:B:63:TRP:CD1	2.56	0.41
2:B:200:VAL:HG22	2:B:234:PHE:CE2	2.56	0.41
2:B:264:TYR:HD1	2:B:302:ALA:HA	1.86	0.41
4:R:200:LEU:HB3	4:R:201:PRO:HD3	2.02	0.41
1:A:41:THR:HB	1:A:235:TYR:OH	2.22	0.40
2:B:121:CYS:HB2	2:B:146:LEU:CD2	2.52	0.40
4:R:106:TYR:HB3	4:R:161:MET:HG2	2.02	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	A	217/355 (61%)	213 (98%)	4 (2%)	0	100	100
2	B	334/371 (90%)	323 (97%)	11 (3%)	0	100	100
3	G	51/71 (72%)	51 (100%)	0	0	100	100
4	R	281/575 (49%)	276 (98%)	5 (2%)	0	100	100
5	P	1/5 (20%)	0	1 (100%)	0	100	100
All	All	884/1377 (64%)	863 (98%)	21 (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	A	201/311 (65%)	201 (100%)	0	100	100
2	B	278/300 (93%)	278 (100%)	0	100	100
3	G	43/58 (74%)	43 (100%)	0	100	100
4	R	254/508 (50%)	254 (100%)	0	100	100
5	P	1/1 (100%)	1 (100%)	0	100	100
All	All	777/1178 (66%)	777 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	306	GLN
2	B	88	ASN
4	R	86	ASN
4	R	124	GLN
4	R	150	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

3 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
5	MEA	P	4	5	11,12,13	1.64	3 (27%)	13,14,16	0.93	0

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
5	ETA	P	5	5	3,3,3	1.67	1 (33%)	2,2,2	0.63	0
5	DAL	P	2	5	3,4,5	1.16	0	2,4,6	1.30	0

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
5	MEA	P	4	5	-	2/5/8/10	0/1/1/1
5	ETA	P	5	5	-	1/1/1/1	-
5	DAL	P	2	5	-	0/0/2/4	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	P	5	ETA	CA-C	2.85	1.60	1.50
5	P	4	MEA	CZ-CE1	2.63	1.45	1.38
5	P	4	MEA	CD1-CG	2.49	1.44	1.38
5	P	4	MEA	CB-CG	2.04	1.56	1.51

There are no bond angle outliers.

There are no chirality outliers.

All (3) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
5	P	4	MEA	O-C-CA-CB
5	P	5	ETA	O-C-CA-N
5	P	4	MEA	N-CA-CB-CG

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

5.7 Other polymers [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.