



wwPDB X-ray Structure Validation Summary Report ⓘ

Jun 24, 2024 – 09:16 PM EDT

PDB ID : 6LE5
Title : Crystal structure of the mitochondrial calcium uptake 1 and 2 heterodimer (MICU1-MICU2 heterodimer) in an apo state
Authors : Park, J.; Lee, Y.; Park, T.; Kang, J.Y.; Jin, M.; Yang, J.; Eom, S.H.
Deposited on : 2019-11-24
Resolution : 3.10 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 ⓘ 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix) : 1.13
EDS : 2.37.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.37.1

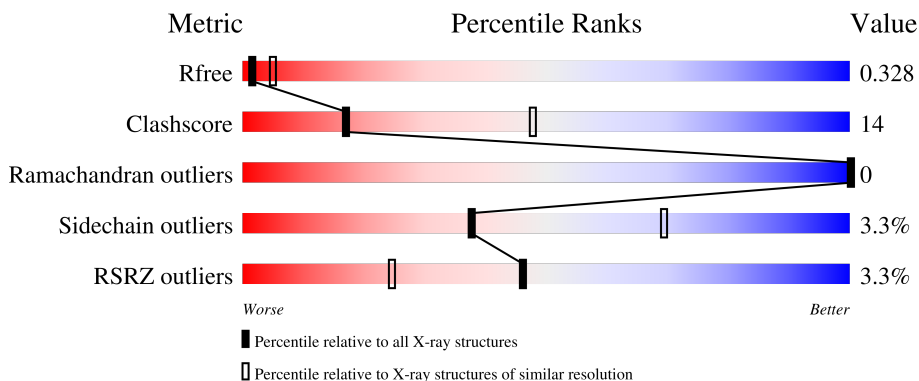
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.10 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.



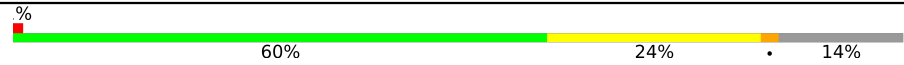

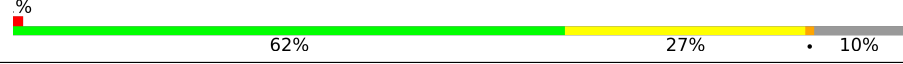
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	1094 (3.10-3.10)
Clashscore	141614	1184 (3.10-3.10)
Ramachandran outliers	138981	1141 (3.10-3.10)
Sidechain outliers	138945	1141 (3.10-3.10)
RSRZ outliers	127900	1067 (3.10-3.10)

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	348	 7% 41% 23% •• 33%
1	D	348	 3% 61% 26% • 13%
1	E	348	 2% 60% 26% • 13%
1	G	348	 6% 53% 14% • 32%
2	B	325	 63% 25% • 11%

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Mol	Chain	Length	Quality of chain
2	C	325	 <p>% 60% 24% • 14%</p>
2	F	325	 <p>% 63% 21% • 14%</p>
2	H	325	 <p>% 62% 27% • 10%</p>

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 17392 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 Calcium uptake protein 1, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	234	1759	1121	300	330	8	0	0	0
1	D	304	2358	1510	390	444	14	0	0	0
1	E	304	2380	1521	398	447	14	0	0	0
1	G	236	1743	1113	296	327	7	0	0	0

- Molecule 2 is a protein called Calcium uptake protein 2, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
2	B	289	2341	1509	394	422	3	13	0	0	0
2	C	280	2258	1452	375	416	3	12	0	0	0
2	F	279	2208	1420	370	404	3	11	0	0	0
2	H	291	2345	1513	393	423	3	13	0	0	0

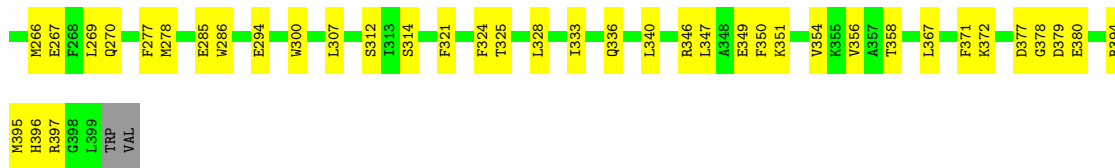
There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	77	HIS	-	expression tag	UNP Q8IYU8
B	78	HIS	-	expression tag	UNP Q8IYU8
B	79	HIS	-	expression tag	UNP Q8IYU8
B	80	HIS	-	expression tag	UNP Q8IYU8
B	81	HIS	-	expression tag	UNP Q8IYU8
B	82	HIS	-	expression tag	UNP Q8IYU8
B	83	MSE	-	expression tag	UNP Q8IYU8
C	77	HIS	-	expression tag	UNP Q8IYU8

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Chain	Residue	Modelled	Actual	Comment	Reference
C	78	HIS	-	expression tag	UNP Q8IYU8
C	79	HIS	-	expression tag	UNP Q8IYU8
C	80	HIS	-	expression tag	UNP Q8IYU8
C	81	HIS	-	expression tag	UNP Q8IYU8
C	82	HIS	-	expression tag	UNP Q8IYU8
C	83	MSE	-	expression tag	UNP Q8IYU8
F	77	HIS	-	expression tag	UNP Q8IYU8
F	78	HIS	-	expression tag	UNP Q8IYU8
F	79	HIS	-	expression tag	UNP Q8IYU8
F	80	HIS	-	expression tag	UNP Q8IYU8
F	81	HIS	-	expression tag	UNP Q8IYU8
F	82	HIS	-	expression tag	UNP Q8IYU8
F	83	MSE	-	expression tag	UNP Q8IYU8
H	77	HIS	-	expression tag	UNP Q8IYU8
H	78	HIS	-	expression tag	UNP Q8IYU8
H	79	HIS	-	expression tag	UNP Q8IYU8
H	80	HIS	-	expression tag	UNP Q8IYU8
H	81	HIS	-	expression tag	UNP Q8IYU8
H	82	HIS	-	expression tag	UNP Q8IYU8
H	83	MSE	-	expression tag	UNP Q8IYU8



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	62.97Å 173.72Å 148.00Å 90.00° 93.88° 90.00°	Depositor
Resolution (Å)	50.01 – 3.10 49.53 – 3.10	Depositor EDS
% Data completeness (in resolution range)	99.9 (50.01-3.10) 100.0 (49.53-3.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.63 (at 3.12Å)	Xtrriage
Refinement program	REFMAC 5.8.0103	Depositor
R, R_{free}	0.293 , 0.332 0.287 , 0.328	Depositor DCC
R_{free} test set	2802 reflections (4.87%)	wwPDB-VP
Wilson B-factor (Å ²)	66.9	Xtrriage
Anisotropy	0.071	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 61.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.28$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.88	EDS
Total number of atoms	17392	wwPDB-VP
Average B, all atoms (Å ²)	75.0	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 52.53 % 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 4.7988e-05. 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

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	0.45	0/1787	0.95	12/2411 (0.5%)
1	D	0.31	0/2401	0.55	0/3239
1	E	0.33	0/2421	0.60	4/3261 (0.1%)
1	G	0.26	0/1771	0.55	1/2395 (0.0%)
2	B	0.27	0/2379	0.57	1/3166 (0.0%)
2	C	0.29	0/2294	0.59	2/3054 (0.1%)
2	F	0.30	0/2243	0.58	4/2994 (0.1%)
2	H	0.28	0/2383	0.54	0/3172
All	All	0.31	0/17679	0.62	24/23692 (0.1%)

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	5
1	G	0	1
2	H	0	2
All	All	0	8

There are no bond length outliers.

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	324	GLU	CB-CA-C	14.64	139.68	110.40
1	G	201	CYS	CB-CA-C	11.90	134.21	110.40
1	A	324	GLU	N-CA-C	-10.77	81.93	111.00
1	A	235	ASP	N-CA-C	-10.15	83.60	111.00
1	A	233	ASN	N-CA-CB	-9.18	94.08	110.60

There are no chirality outliers.

5 of 8 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	119	ARG	Sidechain
1	A	315	HIS	Peptide
1	A	321	ARG	Peptide
1	A	324	GLU	Peptide
1	A	431	LYS	Mainchain

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	1759	0	1548	79	0
1	D	2358	0	2222	59	0
1	E	2380	0	2264	74	0
1	G	1743	0	1529	31	0
2	B	2341	0	2252	70	0
2	C	2258	0	2127	61	0
2	F	2208	0	2044	55	0
2	H	2345	0	2250	62	0
All	All	17392	0	16236	470	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 14.

The worst 5 of 470 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:D:371:LEU:HD21	1:D:437:MET:HB3	1.39	1.02
1:A:147:MET:SD	1:A:152:PHE:HA	2.03	0.97
1:A:119:ARG:HH11	1:A:158:PRO:HA	1.29	0.97
1:G:196:TYR:HA	1:G:201:CYS:O	1.67	0.95
2:B:120:ARG:HE	2:B:122:THR:HG22	1.32	0.91

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	214/348 (62%)	189 (88%)	25 (12%)	0	100	100
1	D	294/348 (84%)	274 (93%)	20 (7%)	0	100	100
1	E	292/348 (84%)	276 (94%)	16 (6%)	0	100	100
1	G	218/348 (63%)	192 (88%)	26 (12%)	0	100	100
2	B	285/325 (88%)	277 (97%)	8 (3%)	0	100	100
2	C	272/325 (84%)	259 (95%)	13 (5%)	0	100	100
2	F	271/325 (83%)	260 (96%)	11 (4%)	0	100	100
2	H	287/325 (88%)	275 (96%)	12 (4%)	0	100	100
All	All	2133/2692 (79%)	2002 (94%)	131 (6%)	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 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	166/309 (54%)	154 (93%)	12 (7%)	14	44
1	D	243/309 (79%)	232 (96%)	11 (4%)	27	60
1	E	247/309 (80%)	238 (96%)	9 (4%)	35	67
1	G	162/309 (52%)	156 (96%)	6 (4%)	34	66
2	B	244/282 (86%)	243 (100%)	1 (0%)	91	96
2	C	235/282 (83%)	228 (97%)	7 (3%)	41	71

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
2	F	223/282 (79%)	216 (97%)	7 (3%)	40 70
2	H	243/282 (86%)	237 (98%)	6 (2%)	47 75
All	All	1763/2364 (75%)	1704 (97%)	59 (3%)	38 69

5 of 59 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	D	435	SER
2	H	278	MSE
1	E	409	SER
2	H	193	GLU
1	G	275	CYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 8 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	385	HIS
1	D	397	GLN
1	A	315	HIS
1	A	300	GLN
1	A	326	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](#)

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.

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	234/348 (67%)	0.53	24 (10%) 6 2	68, 102, 136, 158	0
1	D	304/348 (87%)	0.17	11 (3%) 42 22	38, 82, 120, 130	0
1	E	304/348 (87%)	0.06	8 (2%) 56 33	30, 67, 116, 131	0
1	G	236/348 (67%)	0.45	22 (9%) 8 3	68, 103, 138, 156	0
2	B	276/325 (84%)	-0.06	1 (0%) 92 84	32, 61, 97, 115	0
2	C	267/325 (82%)	-0.02	2 (0%) 87 75	37, 69, 102, 128	0
2	F	266/325 (81%)	-0.01	2 (0%) 86 72	31, 68, 107, 124	0
2	H	278/325 (85%)	-0.10	2 (0%) 87 75	31, 56, 97, 121	0
All	All	2165/2692 (80%)	0.11	72 (3%) 46 24	30, 75, 122, 158	0

The worst 5 of 72 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	328	GLY	6.7
1	D	420	PHE	4.6
1	G	319	ASP	4.6
1	E	345	MET	3.9
1	A	128	PHE	3.9

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

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.