



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:33 PM UTC

PDB ID : 1LE2 / pdb_00001le2
Title : STRUCTURAL BASIS FOR ALTERED FUNCTION IN THE COMMON
MUTANTS OF HUMAN APOLIPOPROTEIN-E
Authors : Wilson, C.; Agard, D.A.
Deposited on : 1991-08-22
Resolution : 3.00 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
Xtriage (Phenix) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

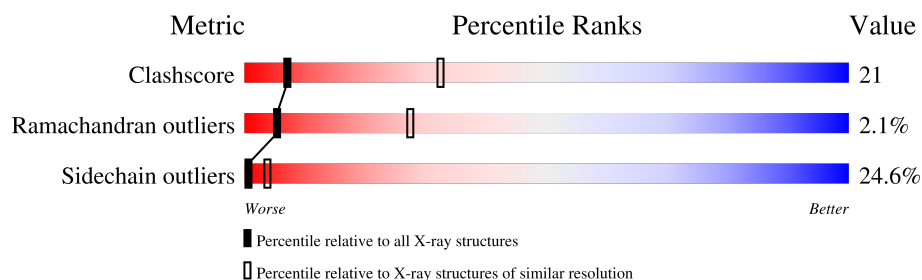
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.00 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))
Clashscore	190562	2977 (3.00-3.00)
Ramachandran outliers	187476	2877 (3.00-3.00)
Sidechain outliers	187428	2880 (3.00-3.00)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	144	

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 1167 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 APOLIPOPROTEIN E2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	144	Total	C	N	O	S	0	0	0
			1167	723	215	223	6			

There is a discrepancy between the modelled and reference sequences:

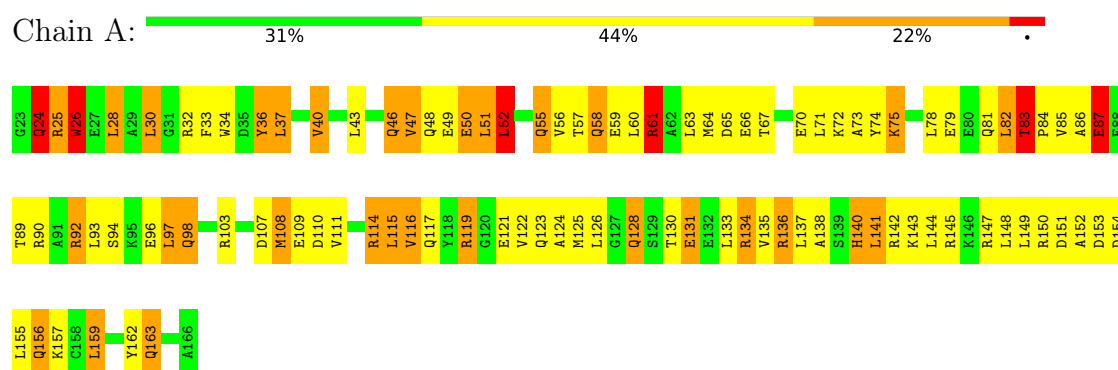
Chain	Residue	Modelled	Actual	Comment	Reference
A	158	CYS	ARG	conflict	UNP P02649

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. 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.

Note EDS was not executed.

• Molecule 1: APOLIPOPROTEIN E2



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	41.06Å 53.94Å 83.91Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 3.00	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-3.00)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	X-PLOR	Depositor
R, R_{free}	0.195 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	1167	wwPDB-VP
Average B, all atoms (Å ²)	33.0	wwPDB-VP

5 Model quality i

5.1 Standard geometry i

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	1.10	2/1179 (0.2%)	2.27	59/1583 (3.7%)

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

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	140	HIS	CD2-NE2	-6.27	1.30	1.37
1	A	140	HIS	CG-ND1	-5.03	1.32	1.38

All (59) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	86	ALA	N-CA-C	11.23	125.33	109.15
1	A	163	GLN	OE1-CD-NE2	-10.21	112.39	122.60
1	A	156	GLN	OE1-CD-NE2	-9.40	113.20	122.60
1	A	131	GLU	CB-CG-CD	9.11	128.09	112.60
1	A	110	ASP	CA-CB-CG	8.24	120.84	112.60
1	A	126	LEU	N-CA-C	8.21	122.75	112.24
1	A	50	GLU	CB-CG-CD	8.07	126.32	112.60
1	A	59	GLU	N-CA-C	-7.98	102.18	112.23
1	A	30	LEU	N-CA-C	-7.66	102.90	111.71
1	A	142	ARG	CA-CB-CG	7.59	129.29	114.10
1	A	24	GLN	OE1-CD-NE2	-7.52	115.08	122.60
1	A	125	MET	N-CA-C	7.48	121.50	112.38
1	A	75	LYS	N-CA-C	-7.38	103.23	111.28
1	A	126	LEU	CA-C-O	7.34	129.92	120.81

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	87	GLU	N-CA-C	7.19	126.11	110.80
1	A	83	THR	CA-C-O	7.05	126.25	119.62
1	A	25	ARG	N-CA-C	-7.05	102.42	111.02
1	A	65	ASP	N-CA-C	7.00	118.56	111.07
1	A	163	GLN	CG-CD-NE2	6.98	126.87	116.40
1	A	72	LYS	N-CA-C	-6.95	103.63	111.07
1	A	163	GLN	N-CA-C	-6.91	104.93	113.15
1	A	152	ALA	N-CA-C	-6.84	103.28	111.69
1	A	48	GLN	OE1-CD-NE2	-6.84	115.76	122.60
1	A	55	GLN	OE1-CD-NE2	-6.73	115.87	122.60
1	A	103	ARG	N-CA-C	-6.65	103.95	111.07
1	A	82	LEU	N-CA-C	6.54	119.45	110.24
1	A	135	VAL	N-CA-C	-6.38	105.95	113.42
1	A	154	ASP	CA-CB-CG	-6.34	106.26	112.60
1	A	51	LEU	N-CA-C	6.34	120.22	112.23
1	A	85	VAL	CG1-CB-CG2	-6.33	96.87	110.80
1	A	119	ARG	O-C-N	6.32	129.38	122.11
1	A	98	GLN	OE1-CD-NE2	-6.29	116.31	122.60
1	A	140	HIS	CA-CB-CG	-6.19	107.61	113.80
1	A	61	ARG	N-CA-C	-6.14	104.22	111.03
1	A	40	VAL	CB-CA-C	-6.05	104.13	111.88
1	A	46	GLN	OE1-CD-NE2	-6.04	116.56	122.60
1	A	49	GLU	CB-CG-CD	5.88	122.59	112.60
1	A	138	ALA	N-CA-C	5.85	117.73	111.36
1	A	108	MET	CA-CB-CG	5.81	125.72	114.10
1	A	163	GLN	CA-CB-CG	5.78	125.67	114.10
1	A	58	GLN	OE1-CD-NE2	-5.73	116.87	122.60
1	A	157	LYS	N-CA-C	5.69	117.16	111.07
1	A	134	ARG	CB-CG-CD	-5.67	98.27	111.30
1	A	156	GLN	CG-CD-NE2	5.47	124.61	116.40
1	A	92	ARG	CA-CB-CG	5.45	125.00	114.10
1	A	34	TRP	CE2-CD2-CG	-5.42	100.69	107.20
1	A	81	GLN	N-CA-C	5.37	119.94	113.17
1	A	103	ARG	CA-C-O	-5.28	115.27	120.82
1	A	126	LEU	N-CA-CB	-5.28	104.27	112.30
1	A	98	GLN	CG-CD-NE2	5.24	124.26	116.40
1	A	156	GLN	N-CA-C	-5.21	104.85	111.11
1	A	140	HIS	CB-CG-CD2	-5.19	124.45	131.20
1	A	103	ARG	O-C-N	5.13	127.35	122.07
1	A	52	LEU	N-CA-C	5.13	119.63	113.17
1	A	26	TRP	N-CA-C	5.09	119.77	111.37
1	A	81	GLN	OE1-CD-NE2	-5.07	117.53	122.60

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	26	TRP	CE2-CD2-CG	-5.05	101.14	107.20
1	A	40	VAL	N-CA-CB	5.05	116.11	110.51
1	A	156	GLN	CA-CB-CG	5.04	124.18	114.10

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	83	THR	Peptide

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	1167	0	1180	49	0
All	All	1167	0	1180	49	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 21.

All (49) 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:51:LEU:HD12	1:A:56:VAL:HG21	1.53	0.88
1:A:33:PHE:HA	1:A:63:LEU:HD13	1.57	0.87
1:A:43:LEU:HD11	1:A:137:LEU:HD12	1.65	0.76
1:A:37:LEU:HD13	1:A:145:ARG:HE	1.57	0.68
1:A:97:LEU:HD21	1:A:159:LEU:HD12	1.79	0.64
1:A:24:GLN:O	1:A:28:LEU:HG	1.98	0.63
1:A:60:LEU:HA	1:A:63:LEU:HD12	1.81	0.61
1:A:70:GLU:O	1:A:73:ALA:HB3	2.01	0.61
1:A:93:LEU:HA	1:A:96:GLU:CD	2.26	0.60
1:A:137:LEU:O	1:A:141:LEU:HD13	2.02	0.60
1:A:33:PHE:CZ	1:A:108:MET:HB2	2.37	0.60
1:A:50:GLU:HG2	1:A:55:GLN:NE2	2.19	0.58

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:26:TRP:CE3	1:A:71:LEU:HD22	2.38	0.58
1:A:30:LEU:HB2	1:A:67:THR:HG21	1.86	0.57
1:A:36:TYR:OH	1:A:56:VAL:HA	2.06	0.56
1:A:60:LEU:HD23	1:A:63:LEU:HD12	1.88	0.55
1:A:121:GLU:O	1:A:124:ALA:HB3	2.07	0.54
1:A:56:VAL:HG23	1:A:57:THR:H	1.74	0.53
1:A:64:MET:SD	1:A:108:MET:HG3	2.50	0.52
1:A:87:GLU:HA	1:A:90:ARG:HB2	1.93	0.50
1:A:64:MET:HA	1:A:108:MET:SD	2.52	0.50
1:A:133:LEU:HA	1:A:136:ARG:HG2	1.94	0.49
1:A:61:ARG:HA	1:A:64:MET:HE2	1.94	0.49
1:A:25:ARG:HB3	1:A:70:GLU:HB3	1.95	0.49
1:A:52:LEU:HD11	1:A:122:VAL:HG11	1.94	0.49
1:A:25:ARG:HA	1:A:28:LEU:HD11	1.94	0.49
1:A:74:TYR:CZ	1:A:78:LEU:HD21	2.48	0.49
1:A:92:ARG:O	1:A:96:GLU:HG2	2.13	0.47
1:A:122:VAL:HG22	1:A:130:THR:HG22	1.96	0.46
1:A:43:LEU:HD21	1:A:137:LEU:HD11	1.98	0.46
1:A:96:GLU:HG3	1:A:97:LEU:H	1.80	0.45
1:A:57:THR:HG21	1:A:116:VAL:HG23	1.98	0.45
1:A:153:ASP:O	1:A:156:GLN:HB2	2.16	0.45
1:A:58:GLN:HA	1:A:61:ARG:HB2	1.99	0.45
1:A:40:VAL:HA	1:A:47:VAL:HG13	2.00	0.44
1:A:144:LEU:O	1:A:147:ARG:HB2	2.18	0.44
1:A:74:TYR:CE1	1:A:78:LEU:HD21	2.53	0.43
1:A:83:THR:HA	1:A:84:PRO:HD3	1.71	0.43
1:A:93:LEU:HB3	1:A:162:TYR:HE1	1.83	0.43
1:A:107:ASP:HB2	1:A:148:LEU:CD1	2.49	0.42
1:A:107:ASP:O	1:A:111:VAL:HG23	2.20	0.42
1:A:43:LEU:HD21	1:A:137:LEU:CD1	2.51	0.41
1:A:89:THR:O	1:A:93:LEU:HG	2.20	0.41
1:A:114:ARG:HD3	1:A:140:HIS:ND1	2.36	0.41
1:A:114:ARG:HA	1:A:117:GLN:HG2	2.01	0.41
1:A:131:GLU:HG2	1:A:134:ARG:HH22	1.86	0.41
1:A:150:ARG:O	1:A:153:ASP:HB3	2.21	0.41
1:A:28:LEU:HD13	1:A:32:ARG:HH21	1.86	0.41
1:A:51:LEU:HD11	1:A:115:LEU:HD12	2.02	0.40

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	142/144 (99%)	114 (80%)	25 (18%)	3 (2%)	5	27

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	87	GLU
1	A	128	GLN
1	A	47	VAL

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	122/122 (100%)	92 (75%)	30 (25%)	1	4

All (30) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	24	GLN
1	A	26	TRP
1	A	28	LEU
1	A	36	TYR
1	A	37	LEU
1	A	46	GLN
1	A	52	LEU
1	A	61	ARG

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Mol	Chain	Res	Type
1	A	66	GLU
1	A	75	LYS
1	A	79	GLU
1	A	82	LEU
1	A	94	SER
1	A	97	LEU
1	A	98	GLN
1	A	109	GLU
1	A	114	ARG
1	A	115	LEU
1	A	116	VAL
1	A	119	ARG
1	A	123	GLN
1	A	128	GLN
1	A	136	ARG
1	A	141	LEU
1	A	143	LYS
1	A	149	LEU
1	A	151	ASP
1	A	155	LEU
1	A	159	LEU
1	A	163	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	48	GLN
1	A	55	GLN
1	A	58	GLN
1	A	101	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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](#)

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

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.