



# Full wwPDB X-ray Structure Validation Report ⓘ

Oct 9, 2023 – 02:25 PM EDT

PDB ID : 7K2A  
Title : Kelch domain of human KEAP1 bound to Nrf2 peptide, LDEETGEFA  
Authors : Muellers, S.N.; Allen, K.N.  
Deposited on : 2020-09-08  
Resolution : 1.90 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](mailto: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>.

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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)  
Xtrriage (Phenix) : 1.13  
EDS : 2.35.1  
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) : 2.35.1

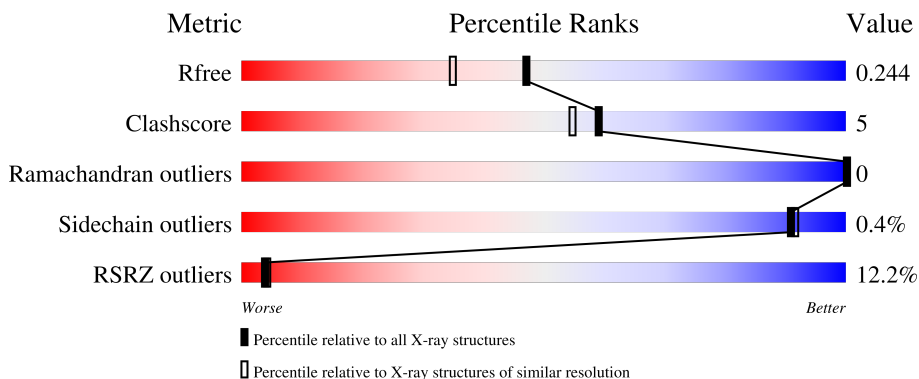
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.90 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	6207 (1.90-1.90)
Clashscore	141614	6847 (1.90-1.90)
Ramachandran outliers	138981	6760 (1.90-1.90)
Sidechain outliers	138945	6760 (1.90-1.90)
RSRZ outliers	127900	6082 (1.90-1.90)

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  $\geq 3$ , 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	301	
1	B	301	
2	P	11	

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 4662 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 Kelch-like ECH-associated protein 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	283	2170	1351	392	412	15	0	0	0
1	B	290	2229	1385	405	423	16	0	1	0

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	540	ALA	GLU	conflict	UNP Q14145
A	542	ALA	GLU	conflict	UNP Q14145
A	613	SER	CYS	conflict	UNP Q14145
B	540	ALA	GLU	conflict	UNP Q14145
B	542	ALA	GLU	conflict	UNP Q14145
B	613	SER	CYS	conflict	UNP Q14145

- Molecule 2 is a protein called ACE-LEU-ASP-GLU-GLU-THR-GLY-GLU-PHE-ALA-NH2.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	P	11	74	45	10	19	0	0	1

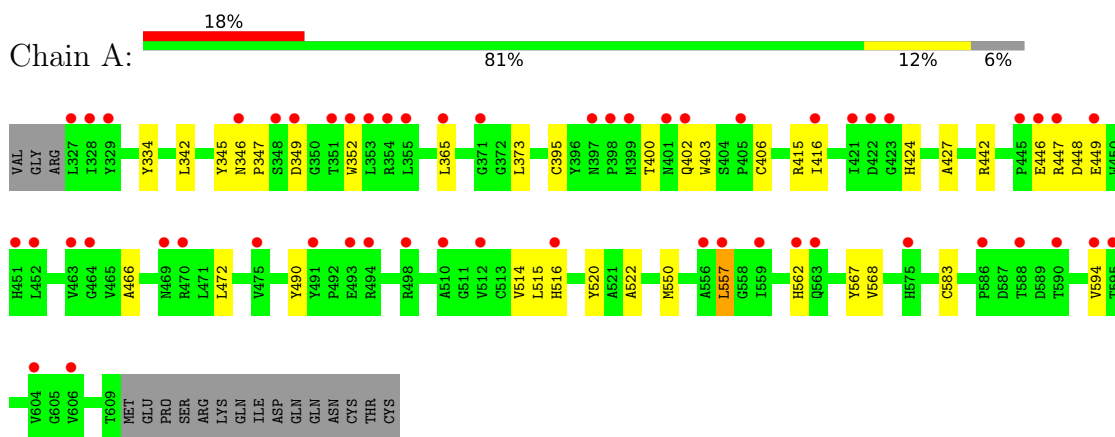
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	52	Total 52	O 52	0	0
3	B	134	Total 134	O 134	0	0
3	P	3	Total 3	O 3	0	0

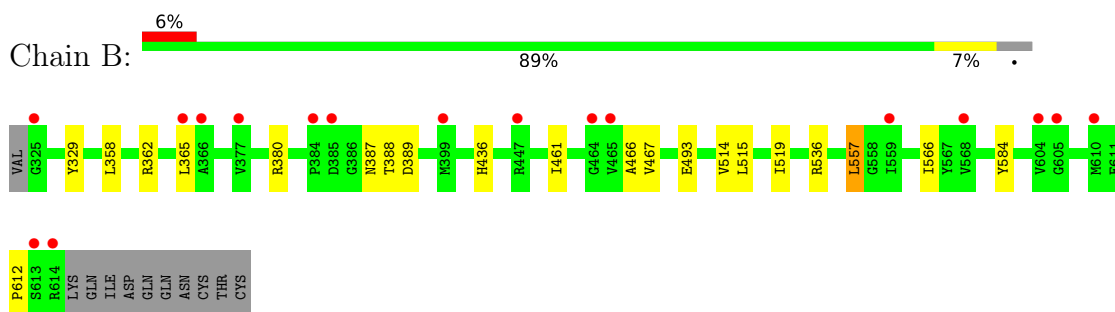
### 3 Residue-property plots [i](#)

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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.

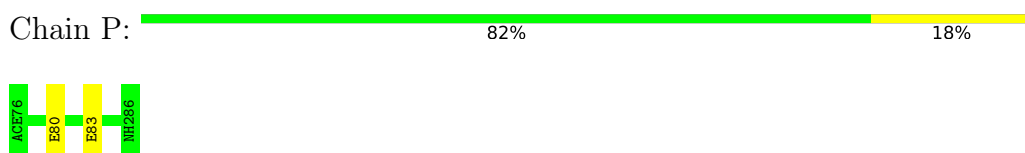
- Molecule 1: Kelch-like ECH-associated protein 1



- Molecule 1: Kelch-like ECH-associated protein 1



- Molecule 2: ACE-LEU-ASP-GLU-GLU-THR-GLY-GLU-PHE-ALA-NH2



## 4 Data and refinement statistics i

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	162.08Å 68.97Å 78.26Å 90.00° 117.81° 90.00°	Depositor
Resolution (Å)	29.63 – 1.90 29.63 – 1.90	Depositor EDS
% Data completeness (in resolution range)	97.5 (29.63-1.90) 97.4 (29.63-1.90)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.63 (at 1.91Å)	Xtrriage
Refinement program	PHENIX 1.17.1_3660	Depositor
R, $R_{free}$	0.210 , 0.244 0.210 , 0.244	Depositor DCC
$R_{free}$ test set	2000 reflections (3.42%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	30.3	Xtrriage
Anisotropy	0.308	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 40.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	0.017 for -h-2*1,-k,l	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	4662	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.17% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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 [i](#)

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

Bond lengths and bond angles in the following residue types are not validated in this section: NH2, ACE

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	0.35	0/2223	0.57	0/3029
1	B	0.39	0/2286	0.62	0/3112
2	P	0.46	0/71	0.97	0/95
All	All	0.37	0/4580	0.60	0/6236

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	A	2170	0	2066	28	0
1	B	2229	0	2127	15	0
2	P	74	0	60	2	0
3	A	52	0	0	0	0
3	B	134	0	0	0	0
3	P	3	0	0	0	0
All	All	4662	0	4253	41	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 (41) 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:466:ALA:HB1	1:A:514:VAL:HG23	1.68	0.74
1:B:466:ALA:HB1	1:B:514:VAL:HG23	1.70	0.73
1:A:516:HIS:CD2	1:B:493:GLU:HG3	2.28	0.68
1:A:550:MET:HE2	1:A:568:VAL:HG21	1.76	0.66
1:A:522:ALA:HB1	1:A:550:MET:HE3	1.78	0.66
1:A:424:HIS:HD2	1:A:442:ARG:HD2	1.68	0.59
1:B:436:HIS:ND1	1:B:461:ILE:HD11	2.18	0.59
1:A:416:ILE:HD11	1:A:427:ALA:HB1	1.88	0.55
1:A:347:PRO:HG2	1:A:562:HIS:CE1	2.43	0.54
1:A:447:ARG:HB3	1:A:449:GLU:OE1	2.08	0.53
1:A:550:MET:CE	1:A:568:VAL:HG11	2.39	0.53
1:A:365:LEU:HD23	1:A:365:LEU:H	1.76	0.51
1:A:346:ASN:HB3	1:A:349:ASP:OD1	2.12	0.50
1:B:388:THR:HG22	1:B:389:ASP:O	2.12	0.49
1:A:415:ARG:NH2	2:P:80:GLU:OE1	2.37	0.49
1:A:345:TYR:HB2	1:A:352:TRP:CZ3	2.49	0.48
1:A:472:LEU:HB3	1:A:490:TYR:HB3	1.96	0.47
1:B:515:LEU:HD22	1:B:566:ILE:HG13	1.97	0.46
1:B:557:LEU:H	1:B:557:LEU:HD23	1.80	0.46
1:A:400:THR:O	1:A:402:GLN:HG3	2.15	0.46
1:A:557:LEU:HD23	1:A:557:LEU:H	1.79	0.46
1:B:467:VAL:O	1:B:514:VAL:HG21	2.15	0.46
1:A:516:HIS:CG	1:B:493:GLU:HG3	2.51	0.45
1:B:365:LEU:H	1:B:365:LEU:HD23	1.80	0.45
1:B:566:ILE:HB	1:B:584:TYR:HB3	1.98	0.45
1:A:345:TYR:HB2	1:A:352:TRP:CH2	2.52	0.45
1:A:406:CYS:HB3	1:A:448:ASP:OD1	2.17	0.45
1:A:562:HIS:HB3	1:A:567:TYR:CE1	2.52	0.45
1:A:373:LEU:HB3	1:A:395:CYS:SG	2.57	0.44
1:A:334:TYR:CE1	2:P:83:GLU:HA	2.52	0.44
1:A:447:ARG:O	1:A:449:GLU:HG3	2.17	0.44
1:A:342:LEU:HD22	1:A:403:TRP:CZ2	2.54	0.42
1:B:519:ILE:O	1:B:536:ARG:HA	2.20	0.42
1:B:380:ARG:NH2	1:B:387:ASN:HB3	2.34	0.42
1:A:446:GLU:HA	1:A:446:GLU:OE2	2.19	0.42
1:A:583:CYS:CB	1:A:594:VAL:HG21	2.50	0.41
1:B:436:HIS:HB3	1:B:461:ILE:HD11	2.03	0.41
1:A:515:LEU:HB3	1:A:520:TYR:CE1	2.56	0.41
1:B:329:TYR:OH	1:B:612:PRO:HD3	2.20	0.40
1:B:358:LEU:HD13	1:B:362:ARG:HG2	2.04	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:424:HIS:CD2	1:A:442:ARG:HD2	2.52	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	281/301 (93%)	269 (96%)	12 (4%)	0	100	100
1	B	289/301 (96%)	282 (98%)	7 (2%)	0	100	100
2	P	9/11 (82%)	9 (100%)	0	0	100	100
All	All	579/613 (94%)	560 (97%)	19 (3%)	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	228/245 (93%)	227 (100%)	1 (0%)	91	91
1	B	235/245 (96%)	234 (100%)	1 (0%)	91	91
2	P	7/7 (100%)	7 (100%)	0	100	100
All	All	470/497 (95%)	468 (100%)	2 (0%)	91	91



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

Mol	Chain	Res	Type
1	A	557	LEU
1	B	557	LEU

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	424	HIS
1	A	563	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

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	283/301 (94%)	0.98	54 (19%) <b>1</b> <b>1</b>	22, 41, 69, 79	0
1	B	290/301 (96%)	0.38	17 (5%) <b>22</b> <b>25</b>	19, 27, 50, 87	0
2	P	9/11 (81%)	0.26	0 <b>100</b> <b>100</b>	28, 35, 50, 51	0
All	All	582/613 (94%)	0.67	71 (12%) <b>4</b> <b>4</b>	19, 32, 66, 87	0

All (71) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	613	SER	7.1
1	A	399	MET	5.6
1	A	446	GLU	5.4
1	A	402	GLN	5.3
1	A	351	THR	5.0
1	B	614	ARG	4.7
1	A	493	GLU	4.7
1	A	575	HIS	4.6
1	A	447	ARG	4.2
1	A	353	LEU	4.2
1	B	385	ASP	4.1
1	A	346	ASN	4.1
1	A	329	TYR	4.0
1	A	562	HIS	3.8
1	A	327	LEU	3.7
1	A	494	ARG	3.7
1	A	397	ASN	3.5
1	B	365	LEU	3.4
1	A	559	ILE	3.2
1	A	422	ASP	3.2
1	A	349	ASP	3.1
1	B	384	PRO	3.1
1	B	366	ALA	3.1

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	398	PRO	3.0
1	A	416	ILE	3.0
1	A	595	THR	3.0
1	A	491	TYR	3.0
1	A	557	LEU	2.9
1	A	348	SER	2.9
1	A	588	THR	2.8
1	A	604	VAL	2.8
1	A	354	ARG	2.8
1	A	470	ARG	2.8
1	A	371	GLY	2.7
1	A	423	GLY	2.7
1	A	451	HIS	2.7
1	B	447	ARG	2.7
1	A	594	VAL	2.6
1	A	405	PRO	2.6
1	A	352	TRP	2.6
1	B	605	GLY	2.5
1	A	516	HIS	2.5
1	B	465	VAL	2.4
1	A	469	ASN	2.4
1	A	563	GLN	2.4
1	B	604	VAL	2.4
1	B	399	MET	2.4
1	A	365	LEU	2.3
1	A	464	GLY	2.3
1	A	421	ILE	2.3
1	A	401	ASN	2.3
1	A	449	GLU	2.3
1	A	463	VAL	2.3
1	A	586	PRO	2.3
1	A	510	ALA	2.2
1	A	556	ALA	2.2
1	A	606	VAL	2.2
1	B	464	GLY	2.2
1	A	328	ILE	2.2
1	A	355	LEU	2.2
1	A	475	VAL	2.2
1	A	512	VAL	2.2
1	B	377	VAL	2.2
1	B	610	MET	2.2
1	A	590	THR	2.2

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Mol	Chain	Res	Type	RSRZ
1	A	452	LEU	2.1
1	A	498	ARG	2.1
1	B	325	GLY	2.0
1	B	559	ILE	2.0
1	A	445	PRO	2.0
1	B	568	VAL	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 monosaccharides in this entry.

## 6.4 Ligands [i](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.