WORLDWIDE wwPDB PROTEIN DATA BANK

wwPDB X-ray Structure Validation Summary Report (i)

Sep 13, 2023 – 10:03 PM EDT

PDB ID : 4PP6

Title : Crystal Structure of the Estrogen Receptor alpha Ligand-binding Domain in Complex with Resveratrol

Authors : Nwachukwu, J.C.; Srinivasan, S.; Bruno, N.E.; Parent, A.A.; Hughes, T.S.; Pollock, J.A.; Gjyshi, O.; Cavett, V.; Nowak, J.; Garcia-Ordonez, R.D.; Houtman, R.; Griffin, P.R.; Kojetin, D.J.; Katzenellenbogen, J.A.; Conkright, M.D.; Nettles, K.W.

Deposited on : 2014-02-26

Resolution : 2.20 Å(reported)

The following versions of software and data (see references (i)) were used in the production of this report:

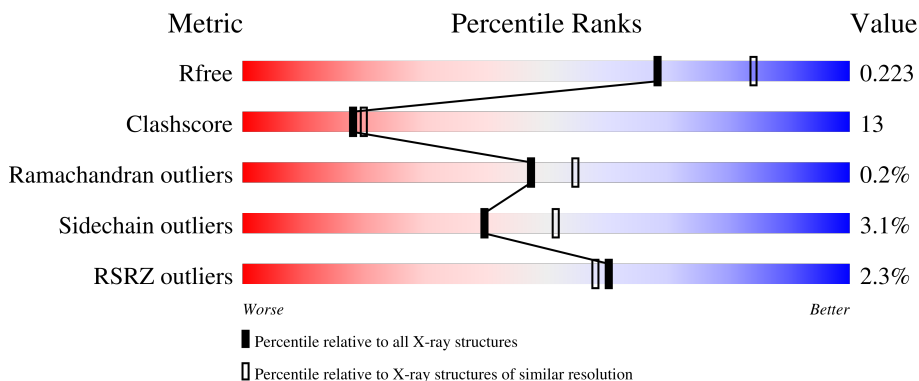|		
MolProbity	:	4.02b-467
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.35.1
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)

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 2.20 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	Percentile Ranks	Value
Rfree		0.223
Clashscore		13
Ramachandran outliers		0.2%
Sidechain outliers		3.1%
RSRZ outliers		2.3%

Worse   *Better*

▮ Percentile relative to all X-ray structures

▯ Percentile relative to X-ray structures of similar resolution

Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	130704	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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 <=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	244	% 75% 18% • •
1	B	244	2% 73% 20% • 6%
2	C	9	56% 33% 11%
2	D	9	22% 33% 56% 11%

Validation Pipeline (wwPDB-VP)   :   2.35.1

2 Entry composition ⓘ

There are 4 unique types of molecules in this entry. The entry contains 4198 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 Estrogen receptor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	234	Total	C	N	O	S	5	7	0
			1870	1202	316	330	22			
1	B	230	Total	C	N	O	S	0	5	0
			1821	1168	313	321	19			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	537	SER	TYR	engineered mutation	UNP P03372
B	537	SER	TYR	engineered mutation	UNP P03372

- Molecule 2 is a protein called Nuclear receptor coactivator 2.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	9	Total	C	N	O	0	0	0
			79	51	16	12			
2	D	9	Total	C	N	O	0	0	0
			70	47	13	10			

- Molecule 3 is RESVERATROL (three-letter code: STL) (formula: $C_{14}H_{12}O_3$).

STL
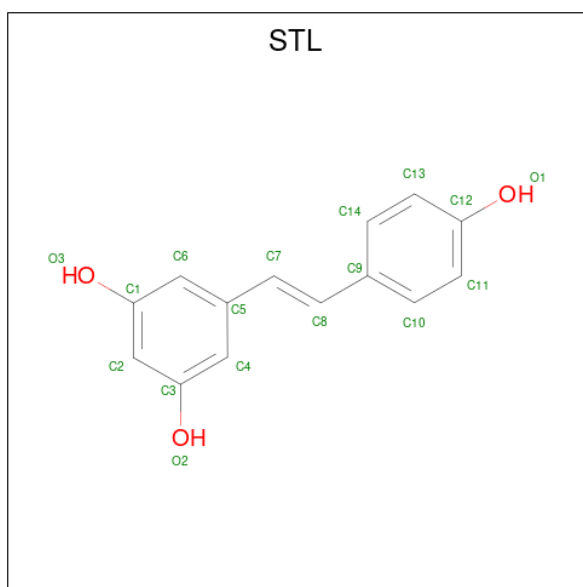
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total 34	C 28	O 6	0	1
3	B	1	Total 17	C 14	O 3	0	0

- Molecule 4 is water.

| Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	166	Total 166	O 166	0	0
4	B	133	Total 133	O 133	0	0
4	C	4	Total 4	O 4	0	0
4	D	4	Total 4	O 4	0	0

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 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.
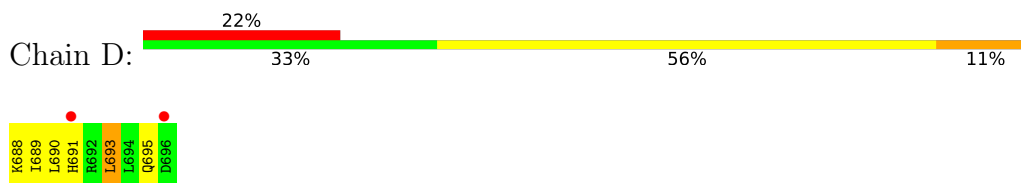
- Molecule 1: Estrogen receptor
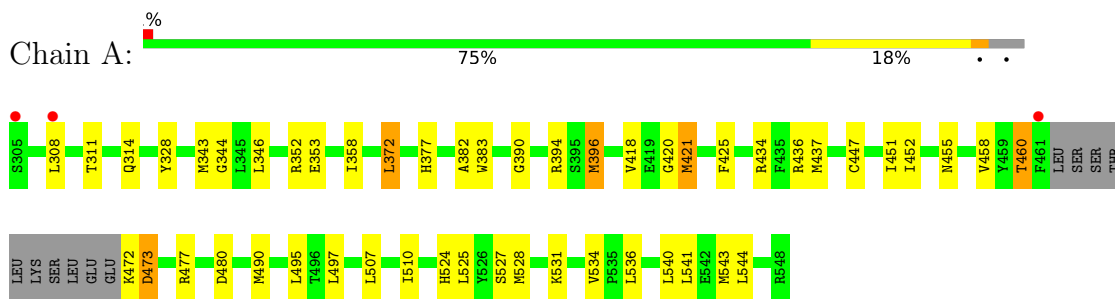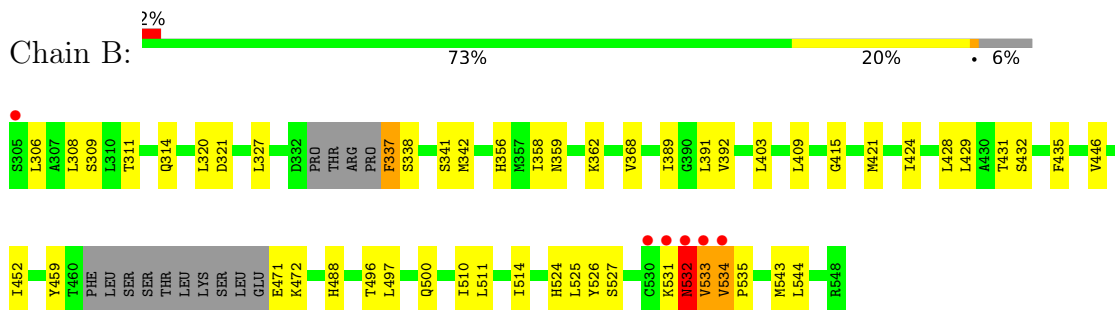
Chain A:

- Molecule 1: Estrogen receptor

Chain B:

- Molecule 2: Nuclear receptor coactivator 2

Chain C:

- Molecule 2: Nuclear receptor coactivator 2

Chain D:

4 Data and refinement statistics ⓘ

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α, β, γ	56.04Å　　84.67Å　　58.42Å 90.00°　　108.32°　　90.00°	Depositor
Resolution (Å)	33.65　–　2.20 33.65　–　2.20	Depositor EDS
% Data completeness (in resolution range)	81.1 (33.65-2.20) 80.8 (33.65-2.20)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.39 (at 2.20Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8_1066)	Depositor
R, R_{free}	0.167　,　0.221 0.169　,　0.223	Depositor DCC
R_{free} test set	1149 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å^2)	16.5	Xtriage
Anisotropy	0.136	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.35 , 53.1	EDS
L-test for twinning[2]	$< |L| > = 0.50, < L^2 > = 0.33$	Xtriage
Estimated twinning fraction	0.030 for l,-k,h	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	4198	wwPDB-VP
Average B, all atoms (Å^2)	26.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.64% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.
[2]Theoretical values of $< |L| >$, $< L^2 >$ 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 ⓘ

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

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	0.39	0/1927	0.53	0/2608
1	B	0.41	0/1868	0.51	0/2524
2	C	0.36	0/79	0.46	0/104
2	D	0.91	0/70	0.87	0/93
All	All	0.42	0/3944	0.53	0/5329

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 ⓘ

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	1870	0	1906	54	0
1	B	1821	0	1856	41	0
2	C	79	0	88	8	0
2	D	70	0	75	8	0
3	A	34	0	18	7	0
3	B	17	0	10	2	0
4	A	166	0	0	5	0
4	B	133	0	0	10	0
4	C	4	0	0	5	0

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W O R L D W I D E
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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
4	D	4	0	0	1	0
All	All	4198	0	3953	105	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 13.

The worst 5 of 105 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)
2:D:688:LYS:HB2	2:D:691:HIS:HD2	1.23	1.03
2:D:688:LYS:HB2	2:D:691:HIS:CD2	2.03	0.92
1:A:346:LEU:HD11	1:A:421[B]:MET:HE3	1.55	0.88
2:C:696:ASP:O	4:C:703:HOH:O	1.96	0.84
1:B:471:GLU:O	1:B:472:LYS:HG2	1.77	0.84

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	237/244 (97%)	236 (100%)	1 (0%)	0	100	100
1	B	229/244 (94%)	223 (97%)	5 (2%)	1 (0%)	34	37
2	C	7/9 (78%)	7 (100%)	0	0	100	100
2	D	7/9 (78%)	7 (100%)	0	0	100	100
All	All	480/506 (95%)	473 (98%)	6 (1%)	1 (0%)	47	55

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	532	ASN

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	210/220 (96%)	204 (97%)	6 (3%)	42	54
1	B	202/220 (92%)	196 (97%)	6 (3%)	41	53
2	C	9/9 (100%)	8 (89%)	1 (11%)	6	5
2	D	7/9 (78%)	6 (86%)	1 (14%)	3	2
All	All	428/458 (93%)	414 (97%)	14 (3%)	40	49

5 of 14 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	337	PHE
1	B	362	LYS
2	D	693	LEU
1	B	534	VAL
2	C	693	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
2	D	691	HIS

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 ⓘ

There are no monosaccharides in this entry.

5.6 Ligand geometry ⓘ

3 ligands 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	$\#|Z| > 2$
3	STL	B	601	-	18,18,18	1.41	3 (16%)	24,24,24	0.59	0
3	STL	A	601[A]	-	18,18,18	1.41	3 (16%)	24,24,24	0.63	0
3	STL	A	601[B]	-	18,18,18	1.41	3 (16%)	24,24,24	0.59	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
3	STL	B	601	-	-	0/5/5/5	0/2/2/2
3	STL	A	601[A]	-	-	0/5/5/5	0/2/2/2
3	STL	A	601[B]	-	-	0/5/5/5	0/2/2/2

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	B	601	STL	C8-C7	4.55	1.54	1.31
3	A	601[B]	STL	C8-C7	4.49	1.53	1.31
3	A	601[A]	STL	C8-C7	4.43	1.53	1.31
3	A	601[A]	STL	C9-C8	-2.82	1.39	1.47
3	A	601[B]	STL	C5-C7	-2.73	1.39	1.47

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	B	601	STL	2	0
3	A	601[A]	STL	4	0
3	A	601[B]	STL	3	0

5.7 Other polymers ⓘ

There are no such residues in this entry.

5.8 Polymer linkage issues ⓘ

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, 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(Å²)	Q<0.9
1	A	234/244 (95%)	-0.24	3 (1%)	77	75	11, 22, 42, 73	0
1	B	230/244 (94%)	0.03	6 (2%)	56	53	11, 25, 56, 89	0
2	C	9/9 (100%)	-0.09	0	100	100	19, 27, 42, 61	0
2	D	9/9 (100%)	0.62	2 (22%)	0	0	24, 30, 41, 56	0
All	All	482/506 (95%)	-0.09	11 (2%)	60	58	11, 24, 52, 89	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	533	VAL	4.7
1	B	530	CYS	3.5
2	D	691	HIS	3.4
1	A	308	LEU	3.4
1	B	532	ASN	2.9

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3   Carbohydrates ⓘ

There are no monosaccharides in this entry.

6.4   Ligands ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	STL	B	601	17/17	0.88	0.16	26,36,46,50	0
3	STL	A	601[B]	17/17	0.92	0.20	23,26,43,44	17
3	STL	A	601[A]	17/17	0.92	0.20	21,32,45,46	17

6.5 Other polymers (i)

There are no such residues in this entry.