Full wwPDB X-ray Structure Validation Report (i)

Oct 8, 2026 – 04:08 PM JST

PDB ID	:	23QC / pdb_000023qc
Title	:	Adeno-associated virus serotype 2 VP1 basic region BR1 mutant in complex with importin alpha 2
Authors	:	Hoad, M.; Forwood, J.K.
Deposited on	:	2026-02-13
Resolution	:	2.60 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 (i) 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 (1)) were used in the production of this report:

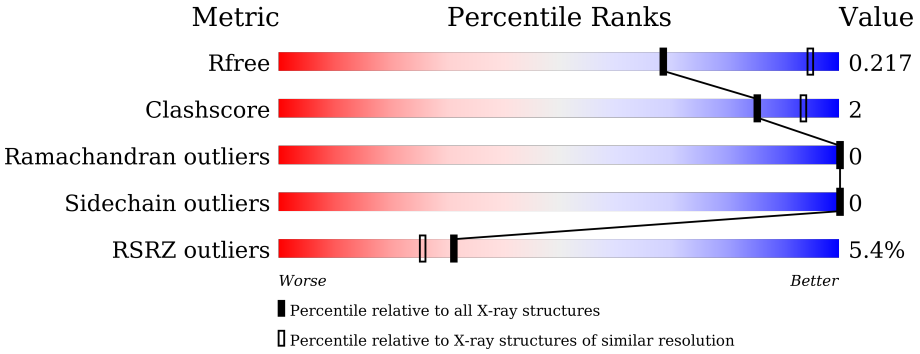
MolProbity	:	4-5-2 with Phenix2.2
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.51

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.60 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}	180053	4008 (2.60-2.60)
Clashscore	190562	4347 (2.60-2.60)
Ramachandran outliers	187476	4277 (2.60-2.60)
Sidechain outliers	187428	4277 (2.60-2.60)
RSRZ outliers	180081	4008 (2.60-2.60)

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	510	4% 79% 5% 16%
2	B	53	9% 28% 72%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 6965 atoms, of which 3468 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 Importin subunit alpha-1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	H	N	O	S			
1	A	427	6581	2071	3328	552	620	10	0	0	0

There are 50 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	20	MET	-	initiating methionine	UNP P52293
A	21	HIS	-	expression tag	UNP P52293
A	22	HIS	-	expression tag	UNP P52293
A	23	HIS	-	expression tag	UNP P52293
A	24	HIS	-	expression tag	UNP P52293
A	25	HIS	-	expression tag	UNP P52293
A	26	HIS	-	expression tag	UNP P52293
A	27	SER	-	expression tag	UNP P52293
A	28	SER	-	expression tag	UNP P52293
A	29	GLY	-	expression tag	UNP P52293
A	30	LEU	-	expression tag	UNP P52293
A	31	VAL	-	expression tag	UNP P52293
A	32	PRO	-	expression tag	UNP P52293
A	33	ARG	-	expression tag	UNP P52293
A	34	GLY	-	expression tag	UNP P52293
A	35	SER	-	expression tag	UNP P52293
A	36	GLY	-	expression tag	UNP P52293
A	37	MET	-	expression tag	UNP P52293
A	38	LYS	-	expression tag	UNP P52293
A	39	GLU	-	expression tag	UNP P52293
A	40	THR	-	expression tag	UNP P52293
A	41	ALA	-	expression tag	UNP P52293
A	42	ALA	-	expression tag	UNP P52293
A	43	ALA	-	expression tag	UNP P52293
A	44	LYS	-	expression tag	UNP P52293
A	45	PHE	-	expression tag	UNP P52293
A	46	GLU	-	expression tag	UNP P52293

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Chain	Residue	Modelled	Actual	Comment	Reference
A	47	ARG	-	expression tag	UNP P52293
A	48	GLN	-	expression tag	UNP P52293
A	49	HIS	-	expression tag	UNP P52293
A	50	MET	-	expression tag	UNP P52293
A	51	ASP	-	expression tag	UNP P52293
A	52	SER	-	expression tag	UNP P52293
A	53	PRO	-	expression tag	UNP P52293
A	54	ASP	-	expression tag	UNP P52293
A	55	LEU	-	expression tag	UNP P52293
A	56	GLY	-	expression tag	UNP P52293
A	57	THR	-	expression tag	UNP P52293
A	58	ASP	-	expression tag	UNP P52293
A	59	ASP	-	expression tag	UNP P52293
A	60	ASP	-	expression tag	UNP P52293
A	61	ASP	-	expression tag	UNP P52293
A	62	LYS	-	expression tag	UNP P52293
A	63	ALA	-	expression tag	UNP P52293
A	64	MET	-	expression tag	UNP P52293
A	65	ALA	-	expression tag	UNP P52293
A	66	ASP	-	expression tag	UNP P52293
A	67	ILE	-	expression tag	UNP P52293
A	68	GLY	-	expression tag	UNP P52293
A	69	SER	-	expression tag	UNP P52293

- Molecule 2 is a protein called Capsid protein VP1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	H	N	O			
2	B	15	264	76	140	30	18	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	123	ALA	LYS	engineered mutation	UNP P03135
B	124	ALA	ARG	engineered mutation	UNP P03135

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	116	116	116	0	0

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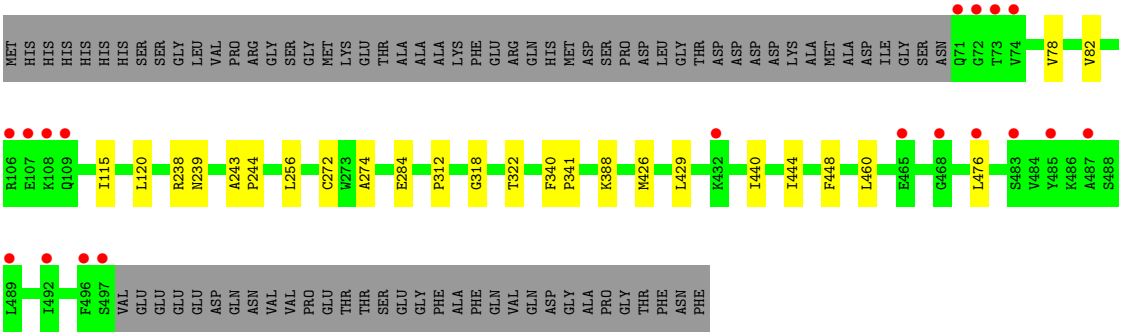
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	B	4	4	4	0	0

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.

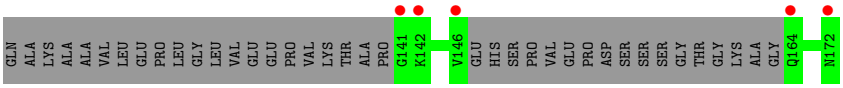
• Molecule 1: Importin subunit alpha-1

Chain A:



• Molecule 2: Capsid protein VP1

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	79.44Å 89.95Å 101.23Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.14 – 2.60 39.14 – 2.60	Depositor EDS
% Data completeness (in resolution range)	98.2 (39.14-2.60) 98.2 (39.14-2.60)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.71 (at 2.61Å)	Xtriage
Refinement program	PHENIX 1.20.1_4487	Depositor
R, R_{free}	0.178 , 0.217 0.178 , 0.217	Depositor DCC
R_{free} test set	1084 reflections (4.72%)	wwPDB-VP
Wilson B-factor (Å^2)	37.9	Xtriage
Anisotropy	0.088	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.40 , 38.8	EDS
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	6965	wwPDB-VP
Average B, all atoms (Å^2)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.67% of the height of the origin peak. No significant pseudotranslation is detected.*

[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 (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	0.21	0/3311	0.33	0/4512
2	B	0.24	0/124	0.42	0/161
All	All	0.21	0/3435	0.34	0/4673

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	3253	3328	3328	15	0
2	B	124	140	140	0	0
3	A	116	0	0	1	0
3	B	4	0	0	0	0
All	All	3497	3468	3468	15	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 2.

All (15) 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:243:ALA:HB1	1:A:244:PRO:HD2	1.93	0.51

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:272:CYS:HB3	1:A:312:PRO:HB2	1.93	0.50
1:A:318:GLY:O	1:A:322:THR:HG23	2.12	0.49
1:A:284:GLU:OE1	1:A:284:GLU:N	2.44	0.49
1:A:426:MET:HE1	1:A:444:ILE:HD13	1.95	0.48
1:A:426:MET:HE1	1:A:444:ILE:CD1	2.44	0.48
1:A:340:PHE:N	1:A:341:PRO:CD	2.78	0.46
1:A:429:LEU:HD22	1:A:476:LEU:HD11	1.98	0.44
1:A:115:ILE:HG23	1:A:120:LEU:HD12	2.01	0.43
1:A:238:ARG:O	1:A:239:ASN:HB2	2.20	0.42
1:A:429:LEU:HG	1:A:440:ILE:HG21	2.02	0.41
1:A:448:PHE:CD1	1:A:460:LEU:HD23	2.55	0.41
1:A:256:LEU:HD11	1:A:274:ALA:HB1	2.02	0.40
1:A:388:LYS:NZ	3:A:607:HOH:O	2.53	0.40
1:A:78:VAL:O	1:A:82:VAL:HG23	2.20	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	425/510 (83%)	419 (99%)	6 (1%)	0	100	100
2	B	11/53 (21%)	11 (100%)	0	0	100	100
All	All	436/563 (77%)	430 (99%)	6 (1%)	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	358/426 (84%)	358 (100%)	0	100	100
2	B	13/42 (31%)	13 (100%)	0	100	100
All	All	371/468 (79%)	371 (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. There are no such sidechains identified.

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 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 (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	427/510 (83%)	0.01	19 (4%)	39	33	28, 43, 101, 118	0
2	B	15/53 (28%)	1.32	5 (33%)	1	1	39, 57, 97, 101	0
All	All	442/563 (78%)	0.05	24 (5%)	31	26	28, 43, 101, 118	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	497	SER	5.1
1	A	492	ILE	4.9
2	B	146	VAL	4.8
2	B	141	GLY	4.4
1	A	73	THR	3.6
1	A	465	GLU	3.5
1	A	74	VAL	3.5
1	A	476	LEU	3.3
1	A	71	GLN	3.2
2	B	164	GLN	3.1
2	B	142	LYS	3.0
1	A	108	LYS	2.9
1	A	109	GLN	2.7
1	A	485	TYR	2.6
1	A	489	LEU	2.5
1	A	106	ARG	2.4
1	A	432	LYS	2.3
1	A	483	SER	2.3
1	A	72	GLY	2.3
2	B	172	ASN	2.2
1	A	496	PHE	2.2
1	A	468	GLY	2.1
1	A	107	GLU	2.1
1	A	487	ALA	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 oligosaccharides 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.