Full wwPDB X-ray Structure Validation Report (i)

Nov 9, 2026 – 10:23 AM EST

PDB ID	:	9Z5P / pdb_00009z5p
Title	:	Calpain-5 (CAPN5) Protease Core (PC) mutant - R289W
Authors	:	Velez, G.; Sun, Y.J.; Wakatsuki, S.; Mahajan, V.B.
Deposited on	:	2025-11-12
Resolution	:	3.20 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 (i)) were used in the production of this report:

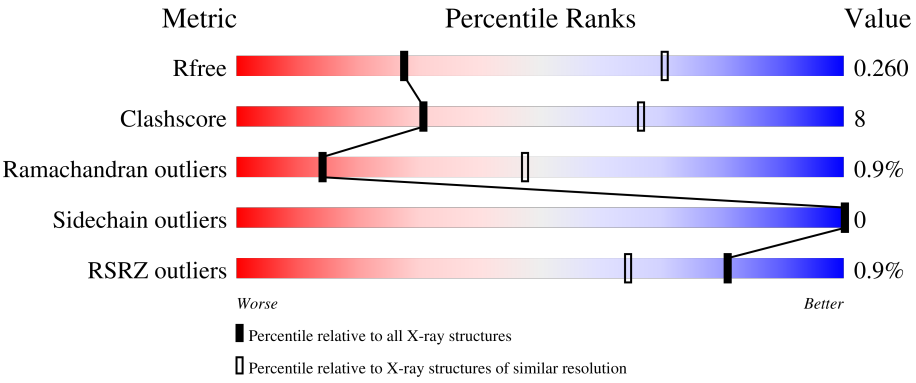
MolProbity	:	4-5-2 with Phenix2.2
Xtriage (Phenix)	:	2.2
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
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 3.20 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	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1466 (3.20-3.20)
Clashscore	190562	1573 (3.20-3.20)
Ramachandran outliers	187476	1548 (3.20-3.20)
Sidechain outliers	187428	1547 (3.20-3.20)
RSRZ outliers	180081	1466 (3.20-3.20)

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	358	% 76% 20% .

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2774 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 Calpain-5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	342	2772	1760	485	511	16	0	0	0

There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-2	GLY	-	expression tag	UNP O15484
A	-1	SER	-	expression tag	UNP O15484
A	0	HIS	-	expression tag	UNP O15484
A	289	TRP	ARG	engineered mutation	UNP O15484
A	344	LEU	-	expression tag	UNP O15484
A	345	GLU	-	expression tag	UNP O15484
A	346	ASN	-	expression tag	UNP O15484
A	347	TYR	-	expression tag	UNP O15484
A	348	PHE	-	expression tag	UNP O15484
A	349	GLN	-	expression tag	UNP O15484
A	350	GLY	-	expression tag	UNP O15484
A	351	HIS	-	expression tag	UNP O15484
A	352	HIS	-	expression tag	UNP O15484
A	353	HIS	-	expression tag	UNP O15484
A	354	HIS	-	expression tag	UNP O15484
A	355	HIS	-	expression tag	UNP O15484

- Molecule 2 is CALCIUM ION (CCD ID: CA) (formula: Ca) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Ca		
2	A	1	1	1	0	0

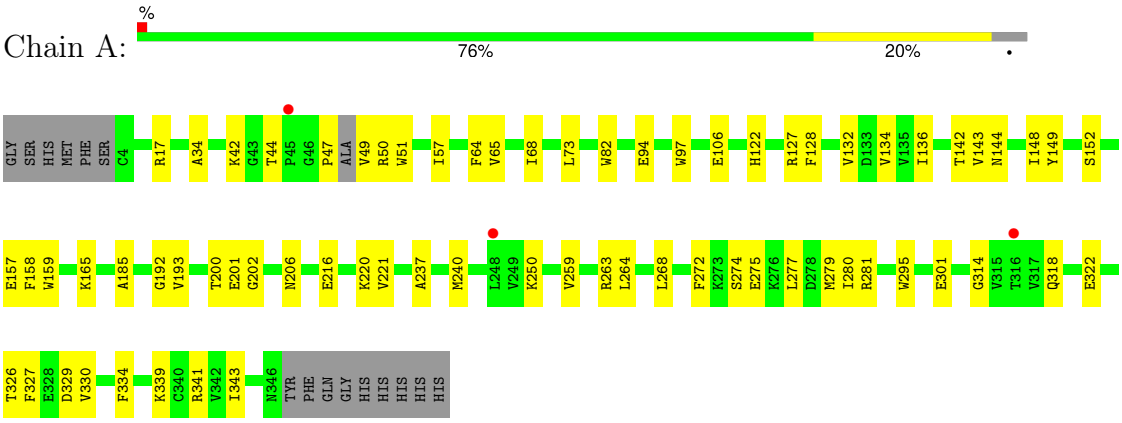
- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O 1 1	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: Calpain-5



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α, β, γ	79.04Å 79.04Å 156.10Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	41.42 – 3.20 41.42 – 3.20	Depositor EDS
% Data completeness (in resolution range)	88.2 (41.42-3.20) 88.1 (41.42-3.20)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.59 (at 3.19Å)	Xtriage
Refinement program	PHENIX 1.21.2_5419	Depositor
R, R_{free}	0.212 , 0.263 0.209 , 0.260	Depositor DCC
R_{free} test set	505 reflections (5.14%)	wwPDB-VP
Wilson B-factor (Å^2)	88.1	Xtriage
Anisotropy	0.107	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 60.5	EDS
L-test for twinning[2]	$< \|L\| > = 0.48$, $< L^2 > = 0.31$	Xtriage
Estimated twinning fraction	0.045 for -h,-k,l	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	2774	wwPDB-VP
Average B, all atoms (Å^2)	93.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.58% 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

5.1 Standard geometry

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

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	0.16	0/2847	0.41	0/3856

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	2772	0	2655	45	0
2	A	1	0	0	0	0
3	A	1	0	0	0	0
All	All	2774	0	2655	45	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 8.

All (45) 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:221:VAL:HG21	1:A:339:LYS:HD3	1.63	0.80

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:259:VAL:HG12	1:A:280:ILE:HG22	1.66	0.76
1:A:237:ALA:HB3	1:A:240:MET:HG2	1.70	0.74
1:A:50:ARG:HB2	1:A:142:THR:HG23	1.71	0.72
1:A:264:LEU:HD11	1:A:277:LEU:HB2	1.74	0.68
1:A:318:GLN:HB3	1:A:322:GLU:HB2	1.80	0.63
1:A:200:THR:HG23	1:A:201:GLU:HG2	1.88	0.55
1:A:281:ARG:HD2	1:A:318:GLN:HG2	1.89	0.55
1:A:326:THR:HG23	1:A:329:ASP:H	1.73	0.54
1:A:216:GLU:O	1:A:220:LYS:HG2	2.08	0.54
1:A:65:VAL:H	1:A:157:GLU:HG3	1.73	0.53
1:A:193:VAL:HG22	1:A:343:ILE:HD11	1.93	0.50
1:A:47:PRO:HG2	1:A:49:VAL:HA	1.96	0.48
1:A:279:MET:HE1	1:A:295:TRP:CE2	2.49	0.48
1:A:64:PHE:CE1	1:A:68:ILE:HD13	2.47	0.48
1:A:94:GLU:HA	1:A:97:TRP:CD1	2.48	0.48
1:A:200:THR:C	1:A:202:GLY:H	2.21	0.48
1:A:136:ILE:HD12	1:A:165:LYS:HD3	1.97	0.47
1:A:264:LEU:HB2	1:A:275:GLU:HG2	1.97	0.47
1:A:57:ILE:HD11	1:A:158:PHE:HE1	1.80	0.46
1:A:34:ALA:HB1	1:A:51:TRP:CG	2.50	0.46
1:A:127:ARG:HG2	1:A:128:PHE:CD2	2.51	0.45
1:A:47:PRO:HG3	1:A:143:VAL:HG22	1.98	0.45
1:A:47:PRO:HG2	1:A:49:VAL:HG23	2.00	0.44
1:A:268:LEU:HG	1:A:272:PHE:CE2	2.53	0.44
1:A:295:TRP:CE2	1:A:301:GLU:HB3	2.52	0.44
1:A:94:GLU:HA	1:A:97:TRP:NE1	2.33	0.43
1:A:127:ARG:HE	1:A:132:VAL:HG11	1.82	0.43
1:A:263:ARG:NH2	1:A:274:SER:HA	2.34	0.43
1:A:73:LEU:HD11	1:A:159:TRP:CZ2	2.54	0.43
1:A:57:ILE:HD11	1:A:158:PHE:CE1	2.54	0.42
1:A:327:PHE:HA	1:A:330:VAL:HG12	2.01	0.42
1:A:148:ILE:HG13	1:A:149:TYR:CD1	2.54	0.42
1:A:73:LEU:HD11	1:A:159:TRP:CH2	2.56	0.41
1:A:314:GLY:O	1:A:318:GLN:HG3	2.20	0.41
1:A:192:GLY:HA3	1:A:341:ARG:O	2.21	0.41
1:A:327:PHE:O	1:A:330:VAL:HG12	2.20	0.41
1:A:50:ARG:NH1	1:A:144:ASN:HA	2.35	0.41
1:A:152:SER:OG	1:A:157:GLU:HB3	2.21	0.41
1:A:82:TRP:CZ3	1:A:185:ALA:HB2	2.56	0.40
1:A:143:VAL:HG23	1:A:148:ILE:HG21	2.04	0.40
1:A:240:MET:HB3	1:A:250:LYS:HZ1	1.86	0.40

Continued on next page...

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:330:VAL:HG23	1:A:334:PHE:CD1	2.56	0.40
1:A:17:ARG:HH12	1:A:106:GLU:HG2	1.86	0.40
1:A:122:HIS:HA	1:A:134:VAL:O	2.22	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	338/358 (94%)	317 (94%)	18 (5%)	3 (1%)	14 47

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	206	ASN
1	A	42	LYS
1	A	44	THR

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	294/307 (96%)	294 (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

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 oligosaccharides in this entry.

5.6 Ligand geometry

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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, 95^{th} 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	342/358 (95%)	-0.07	3 (0%)	81	64	46, 85, 155, 194	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	248	LEU	2.5
1	A	316	THR	2.5
1	A	45	PRO	2.3

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 oligosaccharides in this entry.

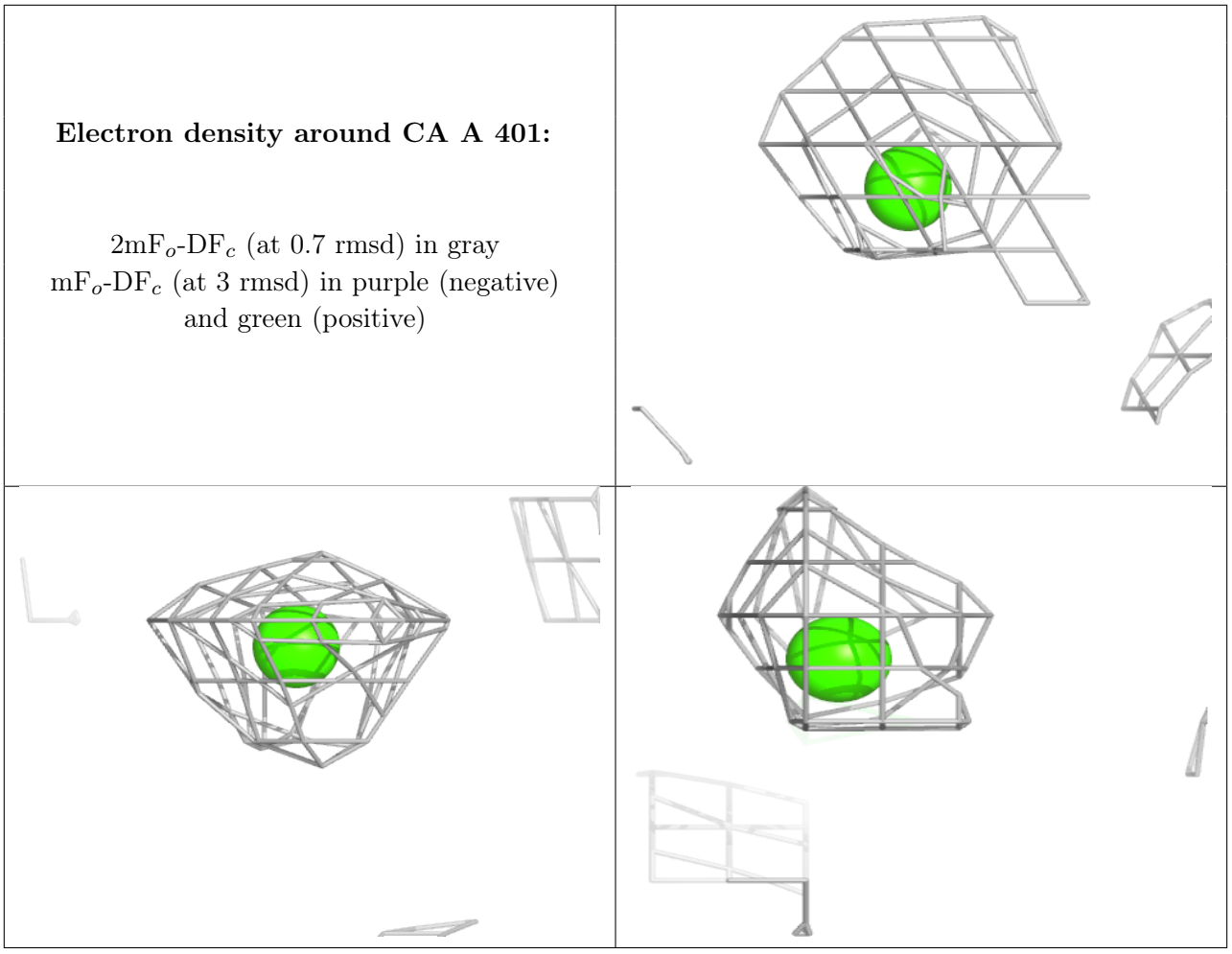
6.4 Ligands

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, 95^{th} 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
2	CA	A	401	1/1	0.86	0.14	98,98,98,98	0

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different

orientation to approximate a three-dimensional view.



6.5 Other polymers (i)

There are no such residues in this entry.