wwPDB X-ray Structure Validation Summary Report (i)

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PDB ID	:	4NPU
Title	:	Crystal Structure of HIV-1 Protease Multiple Mutant P51
Authors	:	Zhang, Y.; Weber, I.T.
Deposited on	:	2013-11-22
Resolution	:	1.50 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

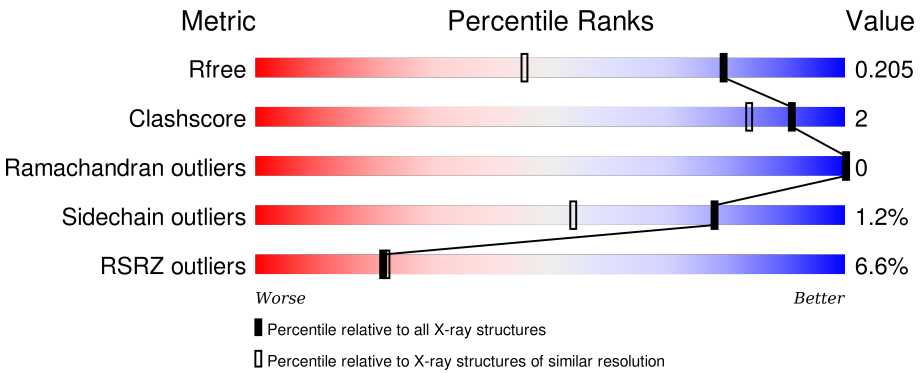
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

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 1.50 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}	91344	2072 (1.50-1.50)
Clashscore	102246	2274 (1.50-1.50)
Ramachandran outliers	100387	2218 (1.50-1.50)
Sidechain outliers	100360	2216 (1.50-1.50)
RSRZ outliers	91569	2075 (1.50-1.50)

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 on the lower bar indicate the fraction of residues that contain outliers for >=3, 2, 1 and 0 types of geometric quality criteria. 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	99	8% 95%
1	B	99	5% 87% 11%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 1693 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 Protease.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	99	777	503	137	135	2	0	3	0
1	B	99	782	503	139	138	2	0	4	0

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	LYS	GLN	ENGINEERED MUTATION	UNP O38896
A	25	ASN	ASP	ENGINEERED MUTATION	UNP O38896
A	32	ILE	VAL	ENGINEERED MUTATION	UNP O38896
A	33	PHE	LEU	ENGINEERED MUTATION	UNP O38896
A	37	SER	ASN	ENGINEERED MUTATION	UNP O38896
A	54	MET	VAL	ENGINEERED MUTATION	UNP O38896
A	67	ALA	CYS	ENGINEERED MUTATION	UNP O38896
A	82	ILE	ALA	ENGINEERED MUTATION	UNP O38896
A	84	VAL	ILE	ENGINEERED MUTATION	UNP O38896
A	95	ALA	CYS	ENGINEERED MUTATION	UNP O38896
B	107	LYS	GLN	ENGINEERED MUTATION	UNP O38896
B	125	ASN	ASP	ENGINEERED MUTATION	UNP O38896
B	132	ILE	VAL	ENGINEERED MUTATION	UNP O38896
B	133	PHE	LEU	ENGINEERED MUTATION	UNP O38896
B	137	SER	ASN	ENGINEERED MUTATION	UNP O38896
B	154	MET	VAL	ENGINEERED MUTATION	UNP O38896
B	167	ALA	CYS	ENGINEERED MUTATION	UNP O38896
B	182	ILE	ALA	ENGINEERED MUTATION	UNP O38896
B	184	VAL	ILE	ENGINEERED MUTATION	UNP O38896
B	195	ALA	CYS	ENGINEERED MUTATION	UNP O38896

- Molecule 2 is water.

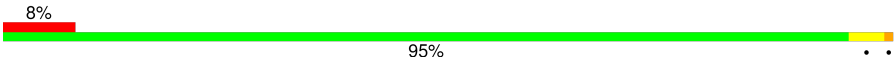
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
2	A	62	62	62	0	0
			Total	O		
2	B	72	72	72	0	0

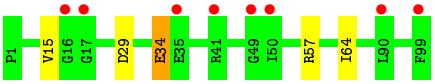
3 Residue-property plots (i)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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: Protease

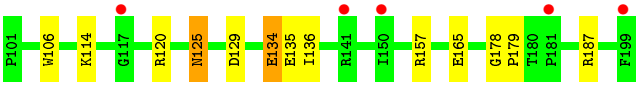
Chain A:





- Molecule 1: Protease

Chain B:



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 41	Depositor
Cell constants a, b, c, α, β, γ	46.69Å 46.69Å 101.62Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	23.64 – 1.50 23.64 – 1.50	Depositor EDS
% Data completeness (in resolution range)	99.4 (23.64-1.50) 99.4 (23.64-1.50)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.55 (at 1.50Å)	Xtriage
Refinement program	REFMAC 5.7.0029	Depositor
R, R_{free}	0.159 , 0.197 0.168 , 0.205	Depositor DCC
R_{free} test set	1735 reflections (5.31%)	DCC
Wilson B-factor (Å^2)	21.9	Xtriage
Anisotropy	0.022	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.41 , 50.9	EDS
Estimated twinning fraction	0.086 for h,-k,-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.50$, $< L^2 > = 0.33$	Xtriage
Outliers	0 of 34414 reflections	Xtriage
F_o,F_c correlation	0.97	EDS
Total number of atoms	1693	wwPDB-VP
Average B, all atoms (Å^2)	25.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 8.42% 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, 0.375 respectively for untwinned datasets, and 0.333, 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	1.07	0/803	1.08	6/1088 (0.6%)
1	B	1.25	5/812 (0.6%)	1.09	5/1100 (0.5%)
All	All	1.17	5/1615 (0.3%)	1.09	11/2188 (0.5%)

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	2

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	134[A]	GLU	CD-OE2	7.65	1.34	1.25
1	B	134[B]	GLU	CD-OE2	7.65	1.34	1.25
1	B	157	ARG	CZ-NH1	-6.89	1.24	1.33
1	B	157	ARG	CD-NE	-5.61	1.36	1.46
1	B	106	TRP	CG-CD1	-5.43	1.29	1.36

The worst 5 of 11 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	57	ARG	NE-CZ-NH2	-9.29	115.65	120.30
1	B	129	ASP	CB-CG-OD2	-7.17	111.84	118.30
1	B	187	ARG	NE-CZ-NH2	-6.58	117.01	120.30
1	A	34[A]	GLU	N-CA-C	5.66	126.28	111.00
1	A	34[B]	GLU	N-CA-C	5.66	126.28	111.00

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	34[A]	GLU	Mainchain
1	A	34[B]	GLU	Mainchain

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	777	0	827	1	0
1	B	782	0	814	6	0
2	A	62	0	0	0	0
2	B	72	0	0	0	0
All	All	1693	0	1641	7	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.

The worst 5 of 7 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:B:120:ARG:NH2	1:B:135[B]:GLU:O	2.25	0.64
1:B:134[A]:GLU:HA	1:B:178:GLY:O	2.02	0.59
1:B:125:ASN:C	1:B:125:ASN:HD22	2.10	0.53
1:A:15:VAL:HG23	1:A:64[A]:ILE:HG22	1.93	0.50
1:B:134[A]:GLU:O	1:B:135[A]:GLU:HB2	2.15	0.46

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	100/99 (101%)	99 (99%)	1 (1%)	0	100	100
1	B	101/99 (102%)	101 (100%)	0	0	100	100
All	All	201/198 (102%)	200 (100%)	1 (0%)	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	84/81 (104%)	84 (100%)	0	100	100
1	B	85/81 (105%)	83 (98%)	2 (2%)	57	22
All	All	169/162 (104%)	167 (99%)	2 (1%)	78	54

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

Mol	Chain	Res	Type
1	B	125	ASN
1	B	179	PRO

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	61	GLN
1	B	125	ASN

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 carbohydrates 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	99/99 (100%)	0.36	8 (8%)	15	14	17, 25, 35, 47	0
1	B	99/99 (100%)	0.30	5 (5%)	32	33	15, 24, 36, 40	0
All	All	198/198 (100%)	0.33	13 (6%)	22	22	15, 25, 35, 47	0

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	150	ILE	4.5
1	A	17	GLY	3.5
1	B	199	PHE	3.5
1	A	41	ARG	3.1
1	A	49	GLY	2.8

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 carbohydrates 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.