



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 08:52 PM UTC

PDB ID : 8Q9R / pdb_00008q9r
Title : Crystal structure of MADS-box/MEF2D N-terminal domain bound to dsDNA and HDAC9 deacetylase binding motif
Authors : Chinellato, M.; Carli, A.; Perin, S.; Mazzocco, Y.; Di Giorgio, E.; Brancolini, C.; Angelini, A.; Cendron, L.
Deposited on : 2023-08-20
Resolution : 2.25 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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

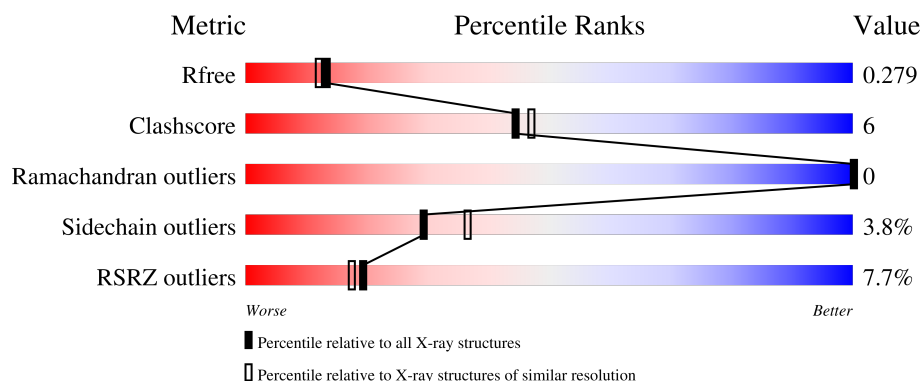
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.25 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	1898 (2.26-2.26)
Clashscore	190562	2005 (2.26-2.26)
Ramachandran outliers	187476	1965 (2.26-2.26)
Sidechain outliers	187428	1966 (2.26-2.26)
RSRZ outliers	180081	1898 (2.26-2.26)

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 $\leq 5\%$. 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	C	18	44% 50% 33% 6% 11%
1	X	18	11% 83% 11% 6%
2	A	95	4% 74% 21% • •
2	B	95	6% 83% 11% • 5%
2	E	95	8% 78% 18% •

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Mol	Chain	Length	Quality of chain
2	F	95	 6% 83% 12% . .
3	G	14	 71% 29%
3	K	14	 50% 43% 7%
4	H	14	 86% 14%
4	L	14	 7% 71% 29%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 4451 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 Histone deacetylase 9 (HDAC9) binding motif peptide: EVKQK-LQEFLLSKS.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
1	X	17	Total	C	N	O	0	0	0
			139	91	23	25			
1	C	16	Total	C	N	O	0	0	0
			125	80	21	24			

- Molecule 2 is a protein called MEF2D protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	A	91	Total	C	N	O	S	0	0	0
			756	477	136	139	4			
2	B	90	Total	C	N	O	S	0	0	0
			752	475	135	138	4			
2	E	91	Total	C	N	O	S	0	0	0
			756	477	136	139	4			
2	F	91	Total	C	N	O	S	0	0	0
			756	477	136	139	4			

- Molecule 3 is a DNA chain called MADS box dsDNA: AACTATTTATAAGA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	K	14	Total 288	C 139	N 53	O 82	P 14	0	0	0
3	G	14	Total 288	C 139	N 53	O 82	P 14	0	0	0

- Molecule 4 is a DNA chain called MADS box dsDNA: TCTTATAAATAGT.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	L	14	Total 286	C 139	N 47	O 86	P 14	0	0	0
4	H	14	Total 286	C 139	N 47	O 86	P 14	0	0	0

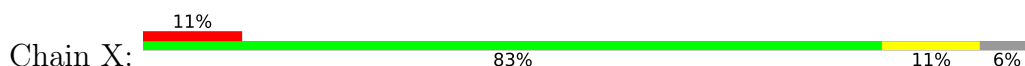
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	4	Total 4	O 4	0	0
5	B	4	Total 4	O 4	0	0
5	K	2	Total 2	O 2	0	0
5	L	2	Total 2	O 2	0	0
5	F	4	Total 4	O 4	0	0
5	G	2	Total 2	O 2	0	0
5	H	1	Total 1	O 1	0	0

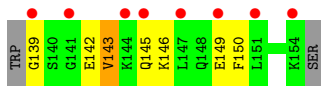
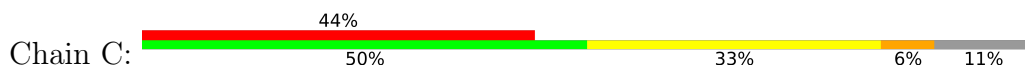
3 Residue-property plots [i](#)

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: Histone deacetylase 9 (HDAC9) binding motif peptide: EVKQKLQEFLLSKS



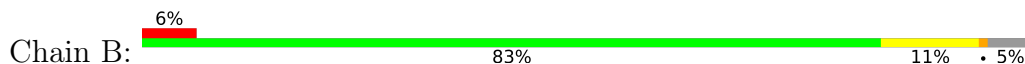
- Molecule 1: Histone deacetylase 9 (HDAC9) binding motif peptide: EVKQKLQEFLLSKS



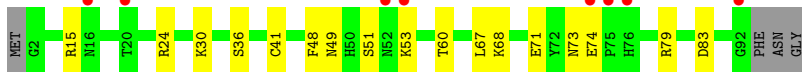
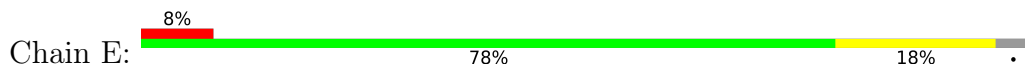
- Molecule 2: MEF2D protein



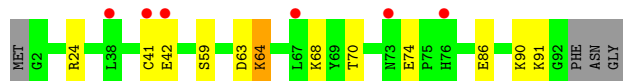
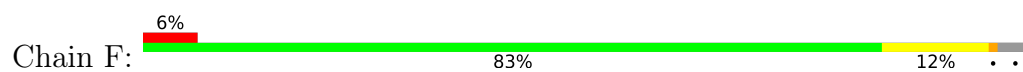
- Molecule 2: MEF2D protein



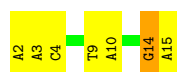
- Molecule 2: MEF2D protein



- Molecule 2: MEF2D protein



- Molecule 3: MADS box dsDNA: AACTATTTATAAGA



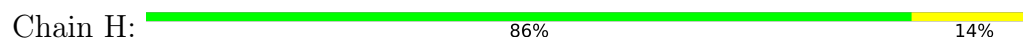
- Molecule 3: MADS box dsDNA: AACTATTTATAAGA



- Molecule 4: MADS box dsDNA: TCTTATAAATAGT



- Molecule 4: MADS box dsDNA: TCTTATAAATAGT



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	57.39Å 60.04Å 77.11Å 90.00° 91.82° 90.00°	Depositor
Resolution (Å)	47.36 – 2.25 47.36 – 2.25	Depositor EDS
% Data completeness (in resolution range)	99.5 (47.36-2.25) 99.6 (47.36-2.25)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.15 (at 2.24Å)	Xtriage
Refinement program	PHENIX (1.18.2_3874: ???)	Depositor
R, R_{free}	0.223 , 0.273 0.226 , 0.279	Depositor DCC
R_{free} test set	1262 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å ²)	44.2	Xtriage
Anisotropy	0.083	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.33 , 39.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.000 for -k,-h,-l 0.000 for k,h,-l 0.046 for h,-k,-l	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	4451	wwPDB-VP
Average B, all atoms (Å ²)	57.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 21.58 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 6.8053e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹Intensities estimated from amplitudes.

²Theoretical 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](#)

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	C	0.78	0/125	1.15	0/163
1	X	0.60	0/141	0.94	0/186
2	A	0.55	0/766	0.94	3/1023 (0.3%)
2	B	0.48	0/762	0.88	2/1018 (0.2%)
2	E	0.88	1/766 (0.1%)	0.90	0/1023
2	F	0.60	0/766	0.88	0/1023
3	G	0.53	0/323	0.95	1/496 (0.2%)
3	K	0.50	0/323	0.81	1/496 (0.2%)
4	H	0.48	0/319	0.73	0/490
4	L	0.51	0/319	0.83	0/490
All	All	0.61	1/4610 (0.0%)	0.89	7/6408 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	60	THR	CA-C	18.62	1.66	1.52

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	73	ASN	CA-C-N	-7.32	109.86	123.55
2	A	73	ASN	C-N-CA	-7.32	109.86	123.55
2	B	89	ARG	CB-CG-CD	-6.51	96.32	111.30
2	B	89	ARG	CA-CB-CG	5.58	125.27	114.10
2	A	74	GLU	N-CA-C	5.52	116.94	110.31
3	K	14	DG	P-O3'-C3'	-5.12	112.51	120.20
3	G	5	DT	P-O3'-C3'	-5.05	112.63	120.20

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	C	125	0	133	5	0
1	X	139	0	143	1	0
2	A	756	0	779	15	0
2	B	752	0	776	10	0
2	E	756	0	779	8	0
2	F	756	0	779	8	0
3	G	288	0	160	2	0
3	K	288	0	160	8	0
4	H	286	0	162	3	0
4	L	286	0	162	4	0
5	A	4	0	0	0	0
5	B	4	0	0	0	0
5	F	4	0	0	0	0
5	G	2	0	0	0	0
5	H	1	0	0	1	0
5	K	2	0	0	0	0
5	L	2	0	0	0	0
All	All	4451	0	4033	49	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 6.

All (49) 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)
3:K:3:DA:H62	4:L:14:DT:H3	1.37	0.72
2:B:86:GLU:HA	2:B:89:ARG:HD2	1.75	0.69
3:K:2:DA:H61	4:L:15:DT:H3	1.40	0.69
2:A:74:GLU:HB3	2:A:75:PRO:HD2	1.83	0.61
2:A:36:SER:HA	2:A:41:CYS:SG	2.41	0.60
2:B:86:GLU:OE1	2:B:89:ARG:NH2	2.36	0.59
2:B:58:ALA:HB2	2:B:62:MET:HE2	1.84	0.59
2:A:76:HIS:HA	2:B:53:LYS:NZ	2.19	0.57
2:A:74:GLU:HB3	2:A:75:PRO:CD	2.35	0.57
2:B:74:GLU:H	2:B:74:GLU:CD	2.13	0.55

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:E:24:ARG:NH2	4:H:12:DA:OP1	2.38	0.55
2:E:36:SER:HA	2:E:41:CYS:HB2	1.89	0.55
4:H:10:DA:N7	5:H:101:HOH:O	2.33	0.54
3:K:2:DA:H1'	3:K:3:DA:H5'	1.90	0.53
2:A:19:VAL:O	2:A:23:LYS:HG3	2.10	0.52
2:E:30:LYS:NZ	4:H:10:DA:OP2	2.42	0.52
2:A:76:HIS:HA	2:B:53:LYS:HZ3	1.76	0.51
2:A:7:GLN:HG2	2:A:9:GLN:HG3	1.94	0.48
2:A:58:ALA:HB2	2:A:62:MET:HE2	1.96	0.47
3:G:14:DG:H1'	3:G:15:DA:H5'	1.95	0.47
2:E:48:PHE:HA	2:E:53:LYS:O	2.14	0.47
2:A:52:ASN:OD1	2:B:68:LYS:NZ	2.47	0.47
3:K:14:DG:H1'	3:K:15:DA:H5'	1.96	0.47
2:F:86:GLU:O	2:F:90:LYS:HG3	2.15	0.47
2:A:17:ARG:HH21	2:A:17:ARG:HD3	1.63	0.46
2:E:49:ASN:HA	2:F:41:CYS:SG	2.56	0.46
3:K:14:DG:H2'	3:K:14:DG:N3	2.32	0.45
2:B:83:ASP:O	2:B:86:GLU:HB3	2.16	0.45
2:B:11:ILE:HD13	2:B:16:ASN:OD1	2.17	0.45
1:C:143:VAL:HG11	2:F:63:ASP:CG	2.42	0.44
2:E:67:LEU:O	2:E:71:GLU:HG3	2.16	0.44
1:C:150:PHE:CD2	2:F:70:THR:HG22	2.52	0.44
1:C:142:GLU:O	1:C:146:LYS:HG3	2.18	0.44
2:A:20:THR:HA	2:A:23:LYS:HE2	2.00	0.44
2:A:86:GLU:O	2:A:90:LYS:HG2	2.17	0.43
2:E:48:PHE:CE2	2:F:68:LYS:HD2	2.53	0.43
1:C:139:GLY:O	1:C:143:VAL:HG12	2.19	0.43
2:F:74:GLU:O	2:F:74:GLU:HG2	2.19	0.42
3:K:10:DA:C2	4:L:8:DA:C2	3.07	0.41
2:F:64:LYS:HD2	2:F:64:LYS:HA	1.66	0.41
2:B:85:ILE:O	2:B:89:ARG:HG3	2.20	0.41
2:F:24:ARG:NH2	3:G:12:DA:OP1	2.48	0.41
2:A:5:LYS:HG3	3:K:9:DT:OP1	2.21	0.41
3:K:3:DA:H1'	3:K:4:DC:H5'	2.04	0.40
4:L:7:DT:H2''	4:L:8:DA:C8	2.57	0.40
2:E:79:ARG:HA	2:E:83:ASP:OD2	2.21	0.40
1:X:143:VAL:HG21	2:A:63:ASP:HB3	2.04	0.40
2:A:61:ASP:OD1	2:A:61:ASP:C	2.65	0.40
1:C:139:GLY:HA3	1:C:142:GLU:HG3	2.02	0.40

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	C	14/18 (78%)	14 (100%)	0	0	100	100
1	X	15/18 (83%)	15 (100%)	0	0	100	100
2	A	89/95 (94%)	86 (97%)	3 (3%)	0	100	100
2	B	88/95 (93%)	84 (96%)	4 (4%)	0	100	100
2	E	89/95 (94%)	86 (97%)	3 (3%)	0	100	100
2	F	89/95 (94%)	85 (96%)	4 (4%)	0	100	100
All	All	384/416 (92%)	370 (96%)	14 (4%)	0	100	100

There are no Ramachandran outliers to report.

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	C	14/16 (88%)	11 (79%)	3 (21%)	1	0
1	X	15/16 (94%)	14 (93%)	1 (7%)	15	14
2	A	84/87 (97%)	83 (99%)	1 (1%)	63	74
2	B	84/87 (97%)	84 (100%)	0	100	100
2	E	84/87 (97%)	79 (94%)	5 (6%)	17	18
2	F	84/87 (97%)	80 (95%)	4 (5%)	23	25
All	All	365/380 (96%)	351 (96%)	14 (4%)	29	36

All (14) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	X	154	LYS
2	A	42	GLU
1	C	143	VAL
1	C	145	GLN
1	C	149	GLU
2	E	15	ARG
2	E	51	SER
2	E	68	LYS
2	E	73	ASN
2	E	74	GLU
2	F	42	GLU
2	F	59	SER
2	F	64	LYS
2	F	91	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	X	145	GLN
2	A	9	GLN
2	E	18	GLN
2	E	56	GLN
2	F	18	GLN
2	F	56	GLN
2	F	76	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 oligosaccharides in this entry.

5.6 Ligand geometry

There are no ligands in this entry.

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(Å ²)	Q<0.9
1	C	16/18 (88%)	2.08	8 (50%) 0 0	30, 80, 90, 97	0
1	X	17/18 (94%)	1.14	2 (11%) 9 8	50, 65, 85, 85	0
2	A	91/95 (95%)	0.28	4 (4%) 39 38	27, 44, 79, 130	0
2	B	90/95 (94%)	0.33	6 (6%) 24 22	27, 45, 86, 123	0
2	E	91/95 (95%)	0.80	8 (8%) 15 14	29, 61, 93, 111	0
2	F	91/95 (95%)	0.70	6 (6%) 24 23	33, 56, 89, 136	0
3	G	14/14 (100%)	0.21	0 100 100	41, 57, 63, 78	0
3	K	14/14 (100%)	0.04	0 100 100	33, 50, 90, 99	0
4	H	14/14 (100%)	0.05	0 100 100	39, 55, 69, 83	0
4	L	14/14 (100%)	0.25	1 (7%) 22 20	34, 53, 94, 134	0
All	All	452/472 (95%)	0.56	35 (7%) 19 17	27, 54, 90, 136	0

All (35) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	139	GLY	4.6
2	F	67	LEU	3.8
2	E	76	HIS	3.7
1	C	151	LEU	3.2
2	B	72	TYR	3.1
2	F	38	LEU	3.0
2	F	41	CYS	2.9
2	A	75	PRO	2.8
1	X	138	TRP	2.8
2	E	92	GLY	2.8
4	L	2	DT	2.8
1	C	147	LEU	2.7
2	A	92	GLY	2.7

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Mol	Chain	Res	Type	RSRZ
2	E	20	THR	2.6
2	B	76	HIS	2.6
2	E	52	ASN	2.6
2	B	91	LYS	2.5
2	B	73	ASN	2.4
2	F	76	HIS	2.4
1	C	141	GLY	2.4
1	C	149	GLU	2.3
2	B	75	PRO	2.3
1	C	144	LYS	2.3
2	E	74	GLU	2.3
2	E	16	ASN	2.2
2	A	74	GLU	2.2
2	F	73	ASN	2.2
2	A	72	TYR	2.1
1	X	152	LEU	2.1
1	C	154	LYS	2.1
2	E	75	PRO	2.1
2	B	59	SER	2.1
2	E	53	LYS	2.1
2	F	42	GLU	2.1
1	C	145	GLN	2.1

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.