



# Full wwPDB X-ray Structure Validation Report

Feb 28, 2014 – 01:36 PM GMT

PDB ID : 3A5O  
Title : Crystal Structure of a Dictyostelium P109I Ca<sup>2+</sup>-Actin in Complex with Human Gelsolin Segment 1  
Authors : Murakami, K.; Yasunaga, T.; Noguchi, T.Q.; Uyeda, T.Q.; Wakabayashi, T.  
Deposited on : 2009-08-09  
Resolution : 2.40 Å(reported)

This is a full wwPDB validation report for a publicly released PDB entry.  
We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)  
A user guide is available at <http://wwpdb.org/ValidationPDFNotes.html>

---

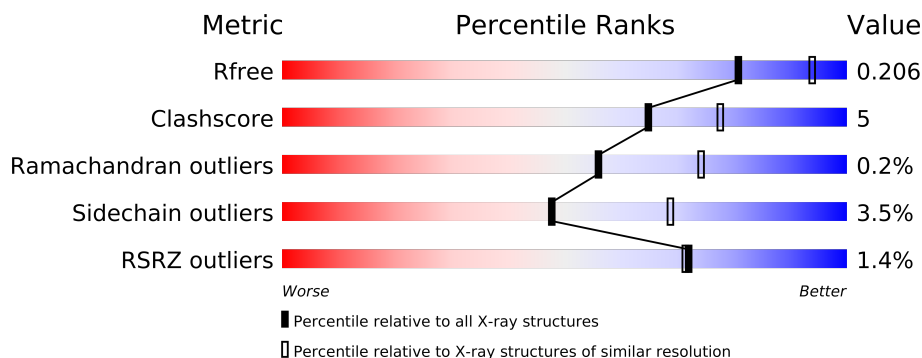
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.15 2013  
Xtriage (Phenix) : dev-1323  
EDS : stable22639  
Percentile statistics : 21963  
Refmac : 5.8.0049  
CCP4 : 6.3.0 (Settle)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)  
Validation Pipeline (wwPDB-VP) : stable22683

# 1 Overall quality at a glance

The reported resolution of this entry is 2.40 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))
$R_{free}$	66092	2207 (2.40-2.40)
Clashscore	79885	2789 (2.40-2.40)
Ramachandran outliers	78287	2736 (2.40-2.40)
Sidechain outliers	78261	2737 (2.40-2.40)
RSRZ outliers	66119	2210 (2.40-2.40)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	S	127	
2	C	375	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 4219 atoms, of which 0 are hydrogen and 0 are deuterium.

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 Gelsolin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	S	123	Total	C	N	O	S	0	0	0
			980	634	162	182	2			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
S	1	MET	-	INITIATING METHIONINE	UNP P06396
S	2	GLY	-	EXPRESSION TAG	UNP P06396
S	3	SER	-	EXPRESSION TAG	UNP P06396
S	35	CYS	ASN	ENGINEERED MUTATION	UNP P06396

- Molecule 2 is a protein called Major actin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	367	Total	C	N	O	S	5	0	0
			2846	1807	478	541	20			

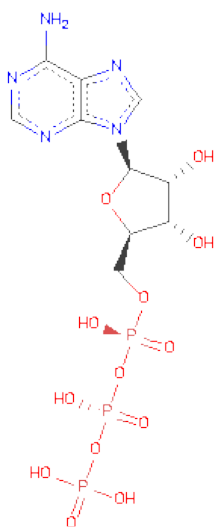
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	109	ILE	PRO	ENGINEERED MUTATION	UNP P07830
C	205	ALA	GLU	ENGINEERED MUTATION	UNP P07830
C	206	ALA	ARG	ENGINEERED MUTATION	UNP P07830
C	207	ALA	GLU	ENGINEERED MUTATION	UNP P07830

- Molecule 3 is CALCIUM ION (three-letter code: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	S	2	Total	Ca	0	0
			2	2		
3	C	1	Total	Ca	0	0
			1	1		

- Molecule 4 is ADENOSINE-5'-TRIPHOSPHATE (three-letter code: ATP) (formula:  $C_{10}H_{16}N_5O_{13}P_3$ ).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	C	1	Total	C	N	O	P	0	0
			31	10	5	13	3		

- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	S	137	Total	O	0	0
			137	137		
5	C	222	Total	O	0	0
			222	222		

### 3 Residue-property plots

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.

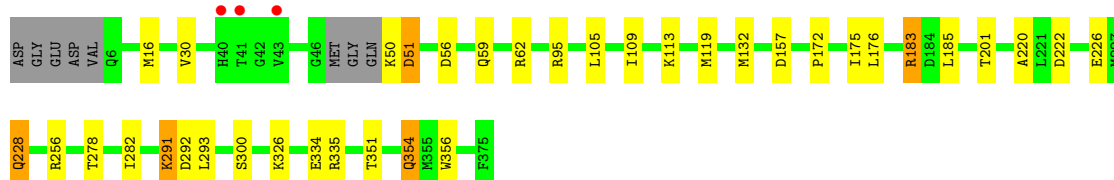
- Molecule 1: Gelsolin

Chain S: 



- Molecule 2: Major actin

Chain C: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.85Å 69.00Å 180.88Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.83 – 2.40 48.13 – 2.40	Depositor EDS
% Data completeness (in resolution range)	96.6 (47.83-2.40) 96.6 (48.13-2.40)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	11.44 (at 2.39Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.171 , 0.207 0.170 , 0.206	Depositor DCC
$R_{free}$ test set	1407 reflections (5.35%)	DCC
Wilson B-factor (Å <sup>2</sup> )	25.0	Xtriage
Anisotropy	0.393	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 22.9	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.49$ , $\langle L^2 \rangle = 0.32$	Xtriage
Outliers	0 of 27728 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	4219	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.48% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

## 5 Model quality

### 5.1 Standard geometry

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

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	S	0.81	0/1006	0.75	0/1359
2	C	0.84	2/2894 (0.1%)	0.80	7/3915 (0.2%)
All	All	0.83	2/3900 (0.1%)	0.79	7/5274 (0.1%)

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
2	C	0	1

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	326	LYS	CD-CE	-18.91	1.03	1.51
2	C	291	LYS	CG-CD	7.75	1.78	1.52

All (7) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	256	ARG	NE-CZ-NH2	-9.05	115.78	120.30
2	C	326	LYS	CG-CD-CE	7.58	134.63	111.90
2	C	256	ARG	NE-CZ-NH1	6.43	123.51	120.30
2	C	335	ARG	NE-CZ-NH1	5.66	123.13	120.30
2	C	51	ASP	N-CA-C	5.42	125.62	111.00
2	C	291	LYS	CG-CD-CE	5.36	127.96	111.90
2	C	222	ASP	CB-CG-OD1	5.22	123.00	118.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
2	C	50	LYS	Peptide

## 5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	S	980	0	942	16	1
2	C	2846	0	2820	34	0
3	C	1	0	0	0	0
3	S	2	0	0	0	0
4	C	31	0	12	0	0
5	C	222	0	0	4	0
5	S	137	0	0	0	2
All	All	4219	0	3774	40	2

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 5.

All (40) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
2:C:157:ASP:OD2	2:C:183:ARG:NH2	1.77	1.16
1:S:6:GLU:H	2:C:354:GLN:NE2	1.48	1.11
1:S:6:GLU:HB2	2:C:354:GLN:HE22	1.29	0.98
2:C:109:ILE:HG12	2:C:175:ILE:HD13	1.54	0.89
1:S:6:GLU:H	2:C:354:GLN:HE22	1.11	0.87
1:S:6:GLU:N	2:C:354:GLN:HE22	1.79	0.80
1:S:6:GLU:HB2	2:C:354:GLN:NE2	1.99	0.78
1:S:6:GLU:CB	2:C:354:GLN:HE22	1.97	0.77
2:C:172:PRO:HA	2:C:175:ILE:HD12	1.66	0.76
1:S:6:GLU:N	2:C:354:GLN:NE2	2.32	0.69
2:C:157:ASP:CG	2:C:183:ARG:HH22	1.96	0.66
1:S:5:VAL:HG12	1:S:7:HIS:H	1.61	0.65
2:C:56:ASP:OD1	5:C:1364:HOH:O	2.13	0.65
2:C:105:LEU:HD12	2:C:132:MET:CE	2.28	0.62
2:C:220:ALA:CB	2:C:226:GLU:HG3	2.30	0.61

*Continued on next page...*



*Continued from previous page...*

Atom-1	Atom-2	Distance(Å)	Clash(Å)
2:C:105:LEU:HD12	2:C:132:MET:HE2	1.82	0.60
1:S:17:PRO:HG3	1:S:53:GLN:HB2	1.84	0.59
2:C:292:ASP:OD1	5:C:1238:HOH:O	2.17	0.58
1:S:22:TRP:CB	1:S:29:LEU:HD22	2.34	0.58
2:C:109:ILE:CG1	2:C:175:ILE:HD13	2.32	0.56
2:C:157:ASP:CG	2:C:183:ARG:NH2	2.57	0.54
2:C:220:ALA:HB1	2:C:226:GLU:HG3	1.90	0.52
2:C:334:GLU:O	2:C:334:GLU:HG2	2.10	0.52
1:S:6:GLU:CA	2:C:354:GLN:HE22	2.23	0.52
2:C:16:MET:CE	2:C:30:VAL:HG12	2.40	0.51
2:C:220:ALA:HB2	2:C:226:GLU:HG3	1.92	0.51
2:C:95:ARG:HD2	5:C:1167:HOH:O	2.13	0.48
1:S:22:TRP:HB2	1:S:29:LEU:HD22	1.96	0.48
2:C:228:GLN:HE21	2:C:228:GLN:HA	1.79	0.47
2:C:109:ILE:HG12	2:C:175:ILE:CD1	2.36	0.46
1:S:5:VAL:HG11	2:C:351:THR:HG21	1.97	0.46
2:C:278:THR:O	2:C:282:ILE:HG13	2.16	0.45
1:S:56:ASN:H	1:S:56:ASN:ND2	2.14	0.45
2:C:16:MET:HE3	2:C:30:VAL:HG12	1.99	0.44
1:S:5:VAL:HG11	2:C:351:THR:CG2	2.48	0.43
2:C:119:MET:HE2	5:C:1215:HOH:O	2.16	0.43
2:C:59:GLN:O	2:C:62:ARG:HB3	2.18	0.43
2:C:16:MET:HE2	2:C:30:VAL:HG12	2.03	0.41
2:C:354:GLN:HG2	2:C:354:GLN:H	1.73	0.41
1:S:81:ILE:O	1:S:85:GLN:HG3	2.21	0.41

All (2) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
5:S:1036:HOH:O	5:S:1189:HOH:O[3_544]	2.05	0.15
1:S:5:VAL:N	5:S:1258:HOH:O[3_544]	2.18	0.02

## 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	S	121/127 (95%)	118 (98%)	3 (2%)	0	100	100
2	C	362/375 (96%)	354 (98%)	7 (2%)	1 (0%)	50	68
All	All	483/502 (96%)	472 (98%)	10 (2%)	1 (0%)	56	74

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	C	51	ASP

### 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	S	101/104 (97%)	98 (97%)	3 (3%)	53	75
2	C	304/311 (98%)	293 (96%)	11 (4%)	47	68
All	All	405/415 (98%)	391 (96%)	14 (4%)	48	69

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

Mol	Chain	Res	Type
1	S	16	GLU
1	S	56	ASN
1	S	86	LEU
2	C	113	LYS
2	C	176	LEU
2	C	183	ARG
2	C	185	LEU
2	C	201	THR
2	C	228	GLN
2	C	291	LYS
2	C	293	LEU
2	C	300	SER
2	C	354	GLN
2	C	356	TRP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	S	56	ASN
1	S	58	ASN
1	S	73	GLN
2	C	228	GLN
2	C	280	ASN
2	C	354	GLN

### 5.3.3 RNA ⓘ

There are no RNA chains in this entry.

## 5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

1 non-standard protein/DNA/RNA residue is 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	$\# Z  > 2$
2	HIC	C	73	2	11,11,12	5.91	3 (27%)	12,14,16	2.10	5 (41%)

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
2	HIC	C	73	2	-	0/4/6/8	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	73	HIC	O-C	18.99	1.24	1.11
2	C	73	HIC	CD2-CG	3.78	1.39	1.36
2	C	73	HIC	CE1-NE2	-2.02	1.33	1.36

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	C	73	HIC	C-CA-N	-4.28	109.55	113.83
2	C	73	HIC	CB-CG-ND1	3.32	127.95	122.17
2	C	73	HIC	CE1-ND1-CG	2.55	109.74	104.93
2	C	73	HIC	CG-CB-CA	-2.32	110.67	113.85
2	C	73	HIC	ND1-CE1-NE2	-2.09	107.63	112.55

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 5.5 Carbohydrates

There are no carbohydrates in this entry.

## 5.6 Ligand geometry

Of 4 ligands modelled in this entry, 3 are monoatomic - leaving 1 for Mogul analysis.

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$
4	ATP	C	376	3	33,33,33	1.18	2 (6%)	52,52,52	1.80	9 (17%)

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
4	ATP	C	376	3	-	0/22/38/38	0/1/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	C	376	ATP	C4-N9	-2.65	1.33	1.37
4	C	376	ATP	C5-C4	2.59	1.46	1.40

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	C	376	ATP	N3-C2-N1	-6.80	123.02	128.71
4	C	376	ATP	N3-C4-N9	5.26	134.93	125.43
4	C	376	ATP	O4'-C1'-N9	4.89	112.99	108.44
4	C	376	ATP	C5-C4-N3	-3.08	119.00	125.70
4	C	376	ATP	O4'-C1'-C2'	-2.64	102.72	106.77
4	C	376	ATP	C4-C5-N7	-2.51	107.37	109.52
4	C	376	ATP	C2-N3-C4	2.42	120.91	114.01
4	C	376	ATP	C8-N9-C4	2.25	108.62	106.90
4	C	376	ATP	O3A-PB-O3B	-2.09	97.41	101.66

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

## 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<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	S	123/127 (96%)	-0.57	4 (3%) 44 42	10, 20, 39, 62	0
2	C	367/375 (97%)	-0.42	3 (0%) 83 82	10, 23, 41, 57	2 (0%)
All	All	490/502 (97%)	-0.46	7 (1%) 72 71	10, 22, 41, 62	2 (0%)

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	S	5	VAL	3.8
1	S	6	GLU	3.3
2	C	43	VAL	2.7
1	S	55	ARG	2.6
1	S	113	LYS	2.5
2	C	40	HIS	2.2
2	C	41	THR	2.1

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

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
2	HIC	C	73	11/12	0.15	1.16	24,26,34,40	0

### 6.3 Carbohydrates ⓘ

There are no carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> 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	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
3	CA	C	377	1/1	0.13	0.18	20,20,20,20	0
3	CA	S	129	1/1	0.12	-0.27	24,24,24,24	0
4	ATP	C	376	31/31	0.10	-0.58	11,16,19,20	0
3	CA	S	128	1/1	0.08	-0.90	15,15,15,15	0

## 6.5 Other polymers

There are no such residues in this entry.