



# Full wwPDB X-ray Structure Validation Report

Sep 10, 2014 – 12:18 PM EDT

PDB ID : 4PY1  
Title : Crystal structure of Tyk2 in complex with compound 15, 6-((2,5-dimethoxyphenyl)thio)-3-(1-methyl-1H-pyrazol-4-yl)-[1,2,4]triazolo[4,3-b]pyridazine  
Authors : Han, S.; Knafels, J.D.  
Deposited on : 2014-03-25  
Resolution : 2.16 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>

---

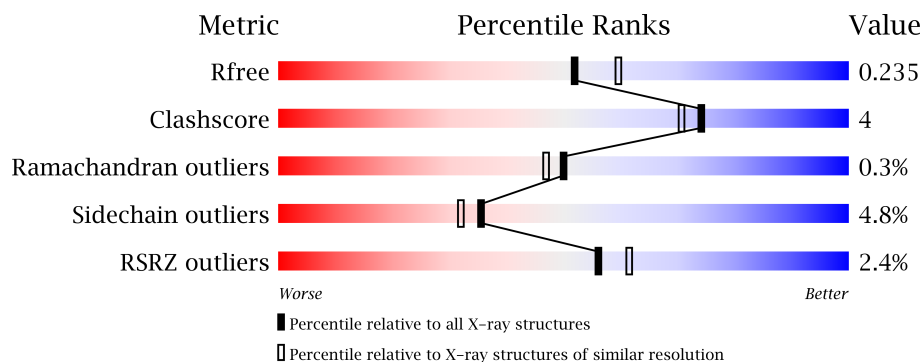
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.16 November 2013  
Xtriage (Phenix) : dev-1439  
EDS : stable23489  
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) : stable23489

# 1 Overall quality at a glance


The reported resolution of this entry is 2.16 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	1094 (2.18-2.14)
Clashscore	79885	1299 (2.18-2.14)
Ramachandran outliers	78287	1272 (2.18-2.14)
Sidechain outliers	78261	1272 (2.18-2.14)
RSRZ outliers	66119	1094 (2.18-2.14)

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	A	318	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2493 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 Non-receptor tyrosine-protein kinase TYK2.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	290	2349	1505	402	428	1	13	0	0	0

There are 29 discrepancies between the modelled and reference sequences:

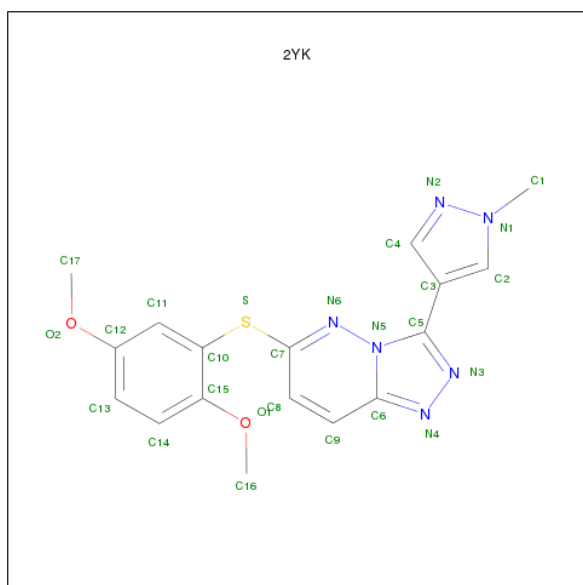
Chain	Residue	Modelled	Actual	Comment	Reference
A	865	MET	-	EXPRESSION TAG	UNP P29597
A	866	ALA	-	EXPRESSION TAG	UNP P29597
A	867	HIS	-	EXPRESSION TAG	UNP P29597
A	868	HIS	-	EXPRESSION TAG	UNP P29597
A	869	HIS	-	EXPRESSION TAG	UNP P29597
A	870	HIS	-	EXPRESSION TAG	UNP P29597
A	871	HIS	-	EXPRESSION TAG	UNP P29597
A	872	HIS	-	EXPRESSION TAG	UNP P29597
A	873	HIS	-	EXPRESSION TAG	UNP P29597
A	874	HIS	-	EXPRESSION TAG	UNP P29597
A	875	HIS	-	EXPRESSION TAG	UNP P29597
A	876	HIS	-	EXPRESSION TAG	UNP P29597
A	877	GLY	-	EXPRESSION TAG	UNP P29597
A	878	ALA	-	EXPRESSION TAG	UNP P29597
A	879	LEU	-	EXPRESSION TAG	UNP P29597
A	880	GLU	-	EXPRESSION TAG	UNP P29597
A	881	VAL	-	EXPRESSION TAG	UNP P29597
A	882	LEU	-	EXPRESSION TAG	UNP P29597
A	883	PHE	-	EXPRESSION TAG	UNP P29597
A	884	GLN	-	EXPRESSION TAG	UNP P29597
A	885	GLY	-	EXPRESSION TAG	UNP P29597
A	886	PRO	-	EXPRESSION TAG	UNP P29597
A	887	GLY	-	EXPRESSION TAG	UNP P29597
A	936	ALA	CYS	ENGINEERED MUTATION	UNP P29597
A	969	ALA	GLN	ENGINEERED MUTATION	UNP P29597
A	971	ALA	GLU	ENGINEERED MUTATION	UNP P29597
A	972	ALA	LYS	ENGINEERED MUTATION	UNP P29597

*Continued on next page...*

Continued from previous page...

Chain	Residue	Modelled	Actual	Comment	Reference
A	1016	SER	ALA	ENGINEERED MUTATION	UNP P29597
A	1142	ALA	CYS	ENGINEERED MUTATION	UNP P29597

- Molecule 2 is 6-[(2,5-DIMETHOXYPHENYL)SULFANYL]-3-(1-METHYL-1H-PYRAZOL-4-YL)[1,2,4]TRIAZOLO[4,3-B]PYRIDAZINE (three-letter code: 2YK) (formula: C<sub>17</sub>H<sub>16</sub>N<sub>6</sub>O<sub>2</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	S	0	0
			26	17	6	2	1		

- Molecule 3 is water.

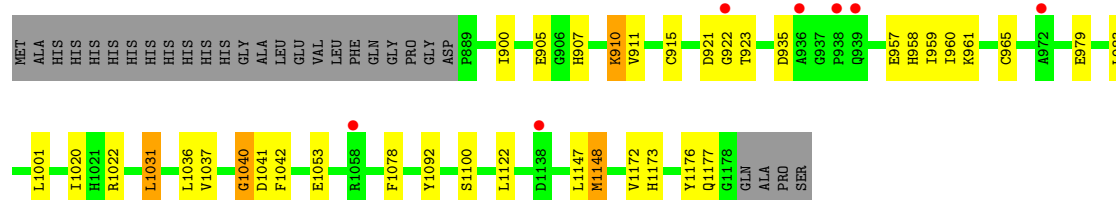
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	118	Total	O	0	0
			118	118		

### 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: Non-receptor tyrosine-protein kinase TYK2

Chain A: 



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	36.47Å 73.51Å 103.63Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.75 – 2.16 34.64 – 2.16	Depositor EDS
% Data completeness (in resolution range)	97.8 (36.75-2.16) 97.8 (34.64-2.16)	Depositor EDS
$R_{merge}$	0.07	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.09 (at 2.16Å)	Xtriage
Refinement program	BUSTER 2.11.5	Depositor
R, $R_{free}$	0.181 , 0.236 0.191 , 0.235	Depositor DCC
$R_{free}$ test set	1017 reflections (7.16%)	DCC
Wilson B-factor (Å <sup>2</sup> )	34.1	Xtriage
Anisotropy	0.412	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 38.5	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 15222 reflections	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	2493	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	46.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.82% 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: 2YK, PTR

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	0.50	0/2394	0.68	1/3239 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed( $^{\circ}$ )	Ideal( $^{\circ}$ )
1	A	1040	GLY	N-CA-C	6.22	128.65	113.10

There are no chirality outliers.

There are no planarity outliers.

### 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	A	2349	0	2306	19	0
2	A	26	0	0	4	0
3	A	118	0	0	1	0
All	All	2493	0	2306	19	0

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 4.

All (19) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:A:1040:GLY:O	2:A:1201:2YK:S	2.55	0.65
1:A:961:LYS:HB2	1:A:979:GLU:HG2	1.81	0.62
1:A:911:VAL:HG21	2:A:1201:2YK:C11	2.30	0.61
1:A:905:GLU:HB3	1:A:910:LYS:HD3	1.85	0.59
1:A:900:ILE:HD11	1:A:915:CYS:HB2	1.85	0.59
1:A:959:ILE:HD12	1:A:1042:PHE:HZ	1.75	0.52
1:A:960:ILE:HD13	1:A:1040:GLY:O	2.11	0.51
1:A:921:ASP:CG	1:A:922:GLY:H	2.15	0.49
1:A:979:GLU:HG3	3:A:1348:HOH:O	2.13	0.47
1:A:957:GLU:HG3	1:A:958:HIS:CD2	2.50	0.47
1:A:983:LEU:HD12	1:A:1031:LEU:HD13	1.99	0.45
1:A:1022:ARG:HA	1:A:1078:PHE:CZ	2.52	0.44
1:A:1092:TYR:HB2	1:A:1148:MET:HE3	1.99	0.44
1:A:1020:ILE:HD12	1:A:1078:PHE:CD2	2.53	0.44
1:A:1041:ASP:HB2	2:A:1201:2YK:C15	2.48	0.42
1:A:911:VAL:CG2	2:A:1201:2YK:C11	2.97	0.42
1:A:1001:LEU:HD13	1:A:1172:VAL:HG12	2.01	0.42
1:A:1172:VAL:O	1:A:1176:TYR:HD2	2.03	0.41
1:A:1173:HIS:O	1:A:1177:GLN:HB2	2.21	0.41

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	A	287/318 (90%)	273 (95%)	13 (4%)	1 (0%)	50	47

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	923	THR



### 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	A	249/271 (92%)	237 (95%)	12 (5%)	35 32

All (12) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	907	HIS
1	A	910	LYS
1	A	935	ASP
1	A	965	CYS
1	A	1031	LEU
1	A	1036	LEU
1	A	1037	VAL
1	A	1053	GLU
1	A	1100	SER
1	A	1122	LEU
1	A	1147	LEU
1	A	1148	MET

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	1005	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	$\# Z  > 2$
1	PTR	A	1054	1	16,16,17	4.57	4 (25%)	20,22,24	1.21	2 (10%)

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
1	PTR	A	1054	1	-	0/9/11/13	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	1054	PTR	O-C	17.32	1.23	1.11
1	A	1054	PTR	P-OH	-2.54	1.56	1.60
1	A	1054	PTR	CE1-CZ	2.31	1.43	1.38
1	A	1054	PTR	CE2-CZ	2.25	1.43	1.38

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	1054	PTR	C-CA-N	-3.14	110.69	113.83
1	A	1054	PTR	P-OH-CZ	-2.85	115.45	123.61

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

1 ligand 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	2YK	A	1201	-	29,29,29	2.36	15 (51%)	39,41,41	2.47	15 (38%)

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	2YK	A	1201	-	-	0/8/12/12	0/4/4/4

All (15) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	1201	2YK	C5-N3	4.29	1.38	1.33
2	A	1201	2YK	C3-C5	-4.16	1.41	1.47
2	A	1201	2YK	C7-S	4.13	1.83	1.77
2	A	1201	2YK	C6-N5	3.54	1.44	1.38
2	A	1201	2YK	C8-C7	3.47	1.47	1.39
2	A	1201	2YK	C11-C10	3.27	1.44	1.39
2	A	1201	2YK	C15-C10	3.13	1.45	1.40
2	A	1201	2YK	C11-C12	3.04	1.44	1.38
2	A	1201	2YK	C2-C3	2.58	1.43	1.37
2	A	1201	2YK	C6-N4	2.49	1.36	1.33
2	A	1201	2YK	C5-N5	2.46	1.38	1.38
2	A	1201	2YK	N6-N5	-2.31	1.33	1.36
2	A	1201	2YK	N2-N1	2.28	1.38	1.36
2	A	1201	2YK	C10-S	2.17	1.81	1.78
2	A	1201	2YK	C2-N1	2.01	1.37	1.35

All (15) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1201	2YK	C10-S-C7	6.59	108.92	101.60
2	A	1201	2YK	O1-C15-C10	6.37	122.53	116.02

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1201	2YK	O1-C15-C14	-5.03	116.10	124.36
2	A	1201	2YK	C17-O2-C12	3.72	126.18	117.54
2	A	1201	2YK	N4-C6-N5	-3.52	107.83	109.97
2	A	1201	2YK	C4-N2-N1	3.46	105.99	103.83
2	A	1201	2YK	C9-C6-N4	3.28	135.93	130.10
2	A	1201	2YK	C3-C5-N3	3.18	128.85	123.16
2	A	1201	2YK	C11-C10-C15	-2.77	116.55	119.29
2	A	1201	2YK	O2-C12-C13	-2.76	106.57	119.83
2	A	1201	2YK	O2-C12-C11	2.73	133.07	119.93
2	A	1201	2YK	C6-N4-N3	2.37	107.99	106.42
2	A	1201	2YK	N3-C5-N5	-2.36	106.73	109.58
2	A	1201	2YK	C5-N3-N4	2.26	110.76	106.67
2	A	1201	2YK	C16-O1-C15	-2.09	114.46	117.56

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	A	290/318 (91%)	-0.07	7 (2%) 56 61	20, 42, 80, 98	0

All (7) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	922	GLY	5.4
1	A	972	ALA	3.8
1	A	936	ALA	3.7
1	A	939	GLN	2.9
1	A	1058	ARG	2.5
1	A	1138	ASP	2.1
1	A	938	PRO	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
1	PTR	A	1054	16/17	0.19	0.56	59,66,80,81	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
2	2YK	A	1201	26/26	0.12	0.20	33,38,42,44	0

## 6.5 Other polymers

There are no such residues in this entry.