Full wwPDB X-ray Structure Validation Report ⓘ

May 15, 2020 – 09:01 pm BST

PDB ID	:	6A77
Title	:	Crystal structure of the fifth immunoglobulin domain (Ig5) of human Robo1 in complex with the Fab fragment of murine monoclonal antibody B5209B
Authors	:	Mizohata, E.; Nakayama, T.; Kado, Y.; Inoue, T.
Deposited on	:	2018-07-02
Resolution	:	2.00 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 following versions of software and data (see references ⓘ) were used in the production of this report:

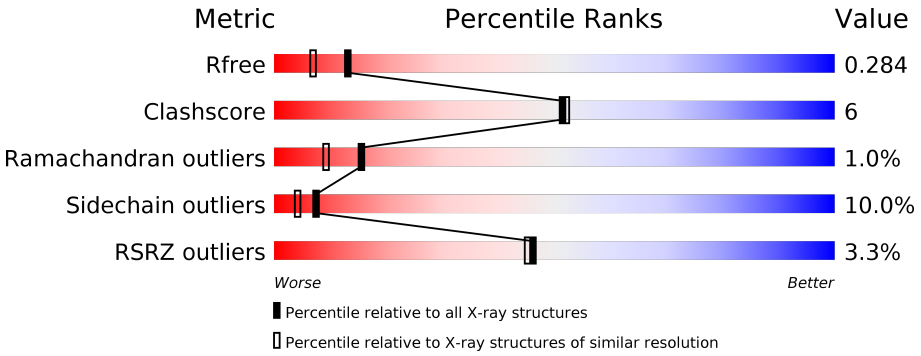
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.11

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 2.00 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}	130704	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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 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	91	7% 80% 18%
2	L	211	3% 75% 21%
3	H	221	2% 81% 15%

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 4104 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 Roundabout homolog 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	91	Total	C	N	O	S	0	0	0
			686	431	119	133	3			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	7	MET	-	expression tag	UNP Q9Y6N7
A	8	GLY	-	expression tag	UNP Q9Y6N7

- Molecule 2 is a protein called Light chain of the anti-human Robo1 antibody B5209B Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	L	211	Total	C	N	O	S	0	1	0
			1630	1014	277	333	6			

- Molecule 3 is a protein called Heavy chain of the anti-human Robo1 antibody B5209B Fab.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	H	217	Total	C	N	O	S	0	1	0
			1629	1026	265	329	9			

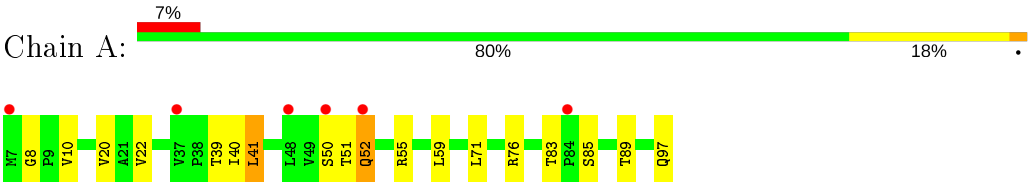
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	21	Total	O	0	0
			21	21		
4	L	77	Total	O	0	0
			77	77		
4	H	61	Total	O	0	0
			61	61		

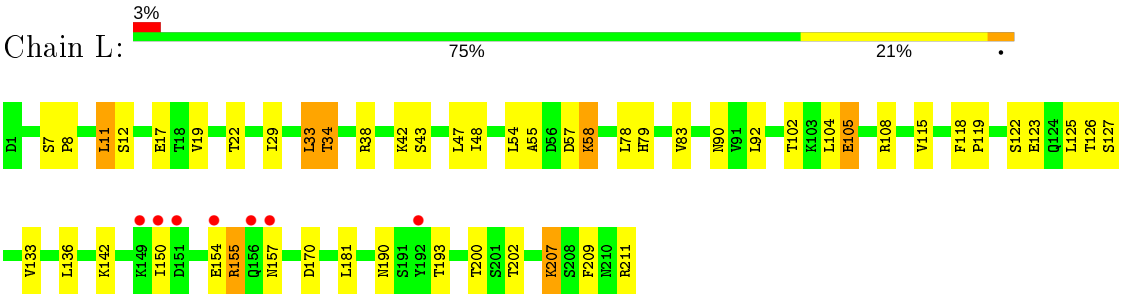
3 Residue-property plots (i)

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

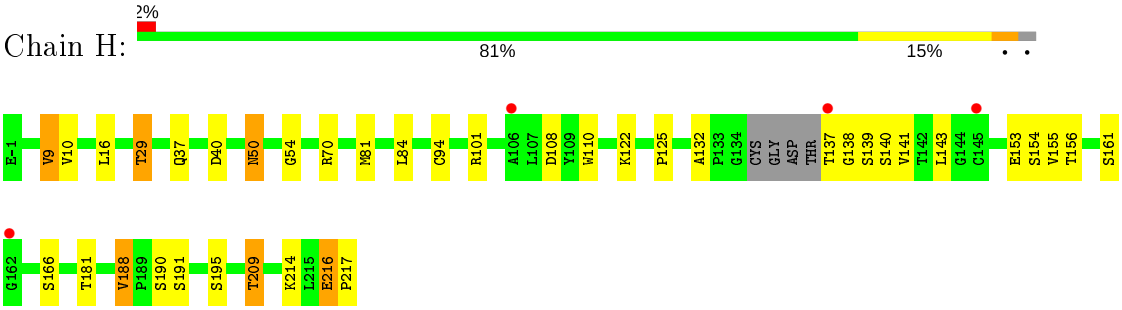
- Molecule 1: Roundabout homolog 1



- Molecule 2: Light chain of the anti-human Robo1 antibody B5209B Fab



- Molecule 3: Heavy chain of the anti-human Robo1 antibody B5209B Fab



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 43 21 2	Depositor
Cell constants a, b, c, α, β, γ	100.57Å 100.57Å 122.76Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.00 32.34 – 2.00	Depositor EDS
% Data completeness (in resolution range)	97.2 (50.00-2.00) 97.2 (32.34-2.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	3.94 (at 2.00Å)	Xtriage
Refinement program	REFMAC 5.8.0158	Depositor
R, R_{free}	0.238 , 0.278 0.247 , 0.284	Depositor DCC
R_{free} test set	2048 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å^2)	38.1	Xtriage
Anisotropy	0.290	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 49.9	EDS
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	4104	wwPDB-VP
Average B, all atoms (Å^2)	58.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.07% 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

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	0.88	0/698	1.07	3/951 (0.3%)
2	L	0.95	0/1667	1.05	5/2261 (0.2%)
3	H	0.98	1/1669 (0.1%)	1.06	9/2280 (0.4%)
All	All	0.95	1/4034 (0.0%)	1.06	17/5492 (0.3%)

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	1

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
3	H	29	THR	CB-CG2	-5.23	1.35	1.52

All (17) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	76	ARG	NE-CZ-NH1	6.70	123.65	120.30
2	L	170	ASP	CB-CG-OD1	6.43	124.09	118.30
2	L	108	ARG	NE-CZ-NH2	-6.19	117.20	120.30
3	H	9	VAL	CB-CA-C	-5.79	100.40	111.40
1	A	55	ARG	NE-CZ-NH2	-5.75	117.42	120.30
3	H	108	ASP	CB-CG-OD1	5.70	123.42	118.30
1	A	76	ARG	NE-CZ-NH2	-5.55	117.53	120.30
3	H	29	THR	N-CA-CB	-5.42	100.01	110.30
3	H	40	ASP	CB-CG-OD2	5.42	123.17	118.30
2	L	58	LYS	CB-CA-C	-5.41	99.58	110.40
3	H	153	GLU	CA-C-N	-5.40	105.31	117.20
3	H	70	ARG	NE-CZ-NH2	-5.31	117.64	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	L	108	ARG	NE-CZ-NH1	5.27	122.94	120.30
2	L	57	ASP	CB-CG-OD2	5.25	123.03	118.30
3	H	108	ASP	CB-CG-OD2	-5.22	113.60	118.30
3	H	216	GLU	N-CA-C	5.18	124.99	111.00
3	H	101	ARG	NE-CZ-NH1	-5.06	117.77	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	8	GLY	Peptide

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	686	0	691	2	0
2	L	1630	0	1579	27	0
3	H	1629	0	1587	17	0
4	A	21	0	0	0	0
4	H	61	0	0	0	0
4	L	77	0	0	1	1
All	All	4104	0	3857	44	1

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 (44) 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:H:139:SER:HA	3:H:190:SER:OG	1.60	1.00
2:L:11:LEU:HD11	2:L:19:VAL:HG21	1.57	0.84
3:H:139:SER:CA	3:H:190:SER:OG	2.28	0.82
2:L:38[B]:ARG:HH12	3:H:37:GLN:HE22	1.32	0.75
3:H:10:VAL:HG11	3:H:16:LEU:HG	1.69	0.73

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:L:34:THR:HG21	4:L:310:HOH:O	1.96	0.64
2:L:123:GLU:O	2:L:126:THR:HB	2.02	0.59
2:L:48:ILE:HD13	2:L:54:LEU:HA	1.83	0.59
2:L:43:SER:HB2	3:H:110:TRP:HB2	1.84	0.58
2:L:38[B]:ARG:NE	2:L:42:LYS:O	2.19	0.55
2:L:193:THR:HG23	2:L:207:LYS:O	2.08	0.54
2:L:190:ASN:HD21	2:L:211:ARG:CG	2.22	0.53
2:L:11:LEU:HD11	2:L:19:VAL:CG2	2.33	0.52
2:L:150:ILE:HD11	2:L:155:ARG:HD2	1.91	0.52
1:A:40:ILE:O	1:A:41:LEU:HD13	2.10	0.52
2:L:47:LEU:HD12	2:L:58:LYS:HG3	1.90	0.52
3:H:10:VAL:CG1	3:H:16:LEU:HG	2.40	0.50
3:H:141:VAL:CG1	3:H:188:VAL:HG23	2.42	0.50
2:L:115:VAL:HG22	2:L:136:LEU:HD22	1.94	0.49
2:L:150:ILE:CD1	2:L:155:ARG:HD2	2.43	0.49
2:L:29:ILE:HA	2:L:92:LEU:HD22	1.95	0.49
3:H:139:SER:O	3:H:190:SER:N	2.25	0.48
3:H:139:SER:C	3:H:190:SER:OG	2.52	0.48
2:L:190:ASN:HD21	2:L:211:ARG:HG2	1.77	0.48
2:L:8:PRO:O	2:L:102:THR:HG23	2.14	0.48
3:H:81:MET:HB3	3:H:84:LEU:HD21	1.97	0.47
2:L:55:ALA:HB3	2:L:58:LYS:HG2	1.96	0.47
2:L:155:ARG:HH11	2:L:181:LEU:HD21	1.80	0.46
3:H:132:ALA:HB3	3:H:217:PRO:HD2	1.97	0.46
3:H:10:VAL:HG21	3:H:84:LEU:HD13	1.96	0.46
3:H:50:ASN:HD21	3:H:54:GLY:N	2.14	0.46
3:H:191:SER:O	3:H:195:SER:OG	2.34	0.46
3:H:132:ALA:CB	3:H:217:PRO:HD2	2.45	0.45
3:H:125:PRO:HB3	3:H:209:THR:HG21	1.98	0.44
2:L:119:PRO:HB3	2:L:209:PHE:CE1	2.53	0.43
2:L:118:PHE:HB2	2:L:133:VAL:HG13	2.00	0.43
2:L:7:SER:HB2	2:L:22:THR:OG1	2.19	0.43
2:L:12:SER:HA	2:L:105:GLU:O	2.19	0.43
2:L:78:LEU:HD11	2:L:104:LEU:HD21	2.00	0.43
3:H:141:VAL:HG12	3:H:188:VAL:HG23	2.01	0.43
2:L:115:VAL:HB	2:L:207:LYS:HD3	2.02	0.42
2:L:33:LEU:HG	2:L:34:THR:N	2.35	0.42
1:A:22:VAL:HG23	1:A:97:GLN:C	2.40	0.41
2:L:155:ARG:NH1	2:L:181:LEU:HD21	2.35	0.41

All (1) 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	Interatomic distance (Å)	Clash overlap (Å)
4:L:351:HOH:O	4:L:351:HOH:O[7_555]	1.21	0.99

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	89/91 (98%)	83 (93%)	5 (6%)	1 (1%)	14 8
2	L	210/211 (100%)	201 (96%)	8 (4%)	1 (0%)	29 23
3	H	214/221 (97%)	206 (96%)	5 (2%)	3 (1%)	11 5
All	All	513/523 (98%)	490 (96%)	18 (4%)	5 (1%)	15 9

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	52	GLN
2	L	154	GLU
3	H	138	GLY
3	H	216	GLU
3	H	154	SER

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	76/76 (100%)	64 (84%)	12 (16%)	2 1
2	L	186/185 (100%)	169 (91%)	17 (9%)	9 5

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
3	H	188/190 (99%)	171 (91%)	17 (9%)	9 6
All	All	450/451 (100%)	404 (90%)	46 (10%)	7 4

All (46) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	10	VAL
1	A	20	VAL
1	A	39	THR
1	A	41	LEU
1	A	50	SER
1	A	51	THR
1	A	52	GLN
1	A	59	LEU
1	A	71	LEU
1	A	83	THR
1	A	85	SER
1	A	89	THR
2	L	11	LEU
2	L	17	GLU
2	L	33	LEU
2	L	34	THR
2	L	79	HIS
2	L	83	VAL
2	L	90	ASN
2	L	105	GLU
2	L	122	SER
2	L	125	LEU
2	L	127	SER
2	L	142	LYS
2	L	155	ARG
2	L	157	ASN
2	L	200	THR
2	L	202	THR
2	L	207	LYS
3	H	9	VAL
3	H	29	THR
3	H	50	ASN
3	H	94[A]	CYS
3	H	94[B]	CYS
3	H	122	LYS
3	H	137	THR

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Mol	Chain	Res	Type
3	H	140	SER
3	H	143	LEU
3	H	155	VAL
3	H	156	THR
3	H	161	SER
3	H	166	SER
3	H	181	THR
3	H	188	VAL
3	H	209	THR
3	H	214	LYS

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

Mol	Chain	Res	Type
2	L	70	GLN
2	L	89	GLN
2	L	190	ASN
2	L	210	ASN
3	H	37	GLN
3	H	50	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

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	91/91 (100%)	0.02	6 (6%)	18	17	43, 60, 90, 124	0
2	L	211/211 (100%)	0.07	7 (3%)	46	45	36, 55, 92, 106	0
3	H	217/221 (98%)	-0.05	4 (1%)	68	66	34, 51, 87, 99	0
All	All	519/523 (99%)	0.01	17 (3%)	46	45	34, 53, 91, 124	0

All (17) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	L	150	ILE	4.5
2	L	192	TYR	4.2
1	A	37	VAL	4.0
1	A	48	LEU	3.1
2	L	154	GLU	2.8
1	A	84	PRO	2.7
3	H	162	GLY	2.7
2	L	156	GLN	2.6
2	L	149	LYS	2.5
1	A	7	MET	2.5
3	H	145	CYS	2.3
2	L	157	ASN	2.3
1	A	52	GLN	2.1
3	H	137	THR	2.1
2	L	151	ASP	2.1
1	A	50	SER	2.0
3	H	106	ALA	2.0

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 (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.