wwPDB X-ray Structure Validation Summary Report (i)

Aug 6, 2026 – 12:08 AM EDT

PDB ID	:	9DID / pdb_00009did
Title	:	Rous sarcoma virus frameshifting pseudoknot RNA
Authors	:	Jones, C.P.; Ferre-D'Amare, A.R.
Deposited on	:	2024-09-05
Resolution	:	2.80 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
https://www.wwpdb.org/validation/2017/XrayValidationReportHelp
with specific help available everywhere you see the (i) 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 (i)) were used in the production of this report:

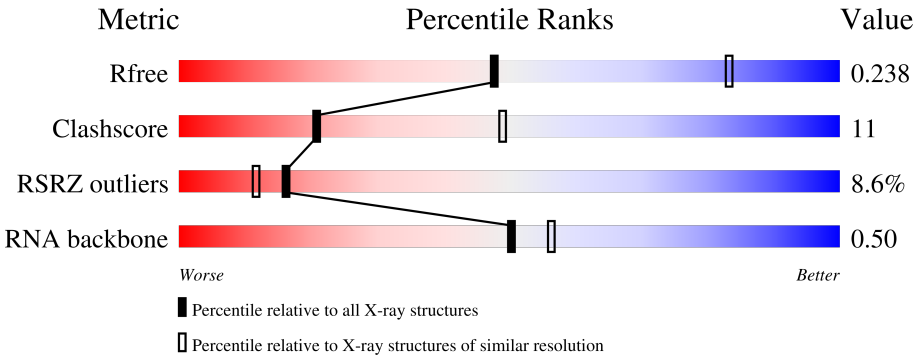
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.015 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.50

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 2.80 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	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)
RNA backbone	3983	1114 (3.00-2.60)

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 <=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	111	10% 42% 38% 6% 14%
1	B	111	5% 54% 30% 8% 8%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 4298 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.

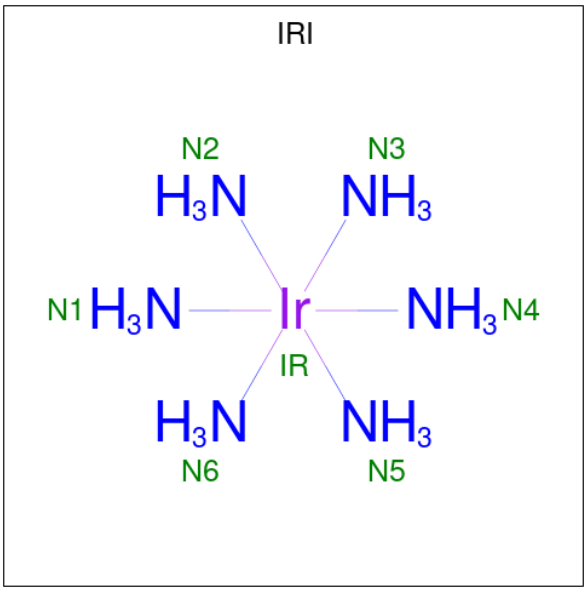
- Molecule 1 is a RNA chain called frameshifting pseudoknot RNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	96	Total	C	N	O	P	0	0	0
			2014	899	358	663	94			
1	B	102	Total	C	N	O	P	0	0	0
			2149	959	379	710	101			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	40	G	C	conflict	GB 210171
A	?	-	C	deletion	GB 210171
A	?	-	U	deletion	GB 210171
A	?	-	C	deletion	GB 210171
A	63	A	C	conflict	GB 210171
A	64	A	C	conflict	GB 210171
A	65	A	U	conflict	GB 210171
B	40	G	C	conflict	GB 210171
B	?	-	C	deletion	GB 210171
B	?	-	U	deletion	GB 210171
B	?	-	C	deletion	GB 210171
B	63	A	C	conflict	GB 210171
B	64	A	C	conflict	GB 210171
B	65	A	U	conflict	GB 210171

- Molecule 2 is IRIDIUM HEXAMMINE ION (CCD ID: IRI) (formula: $H_{18}IrN_6$).

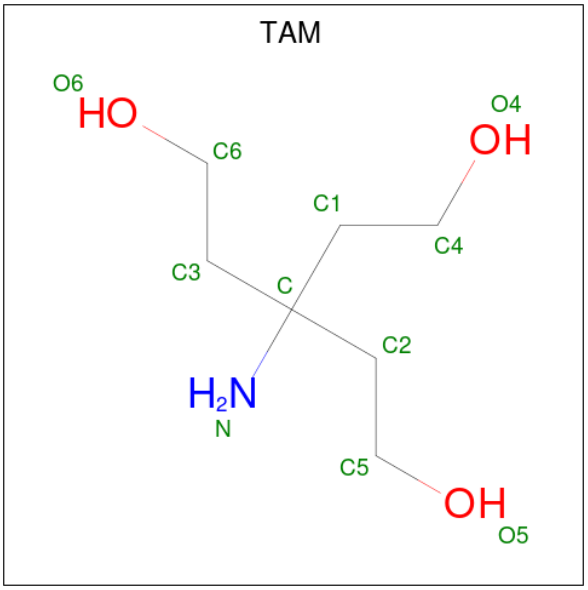


Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	A	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 7 1 6	0	0
2	B	1	Total Ir N 14 2 12	0	1
2	B	1	Total Ir N 7 1 6	0	0

- Molecule 3 is POTASSIUM ION (CCD ID: K) (formula: K).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total K 1 1	0	0
3	B	4	Total K 4 4	0	0

- Molecule 4 is TRIS(HYDROXYETHYL)AMINOMETHANE (CCD ID: TAM) (formula: $C_7H_{17}NO_3$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	1	Total C N O 11 7 1 3	0	0

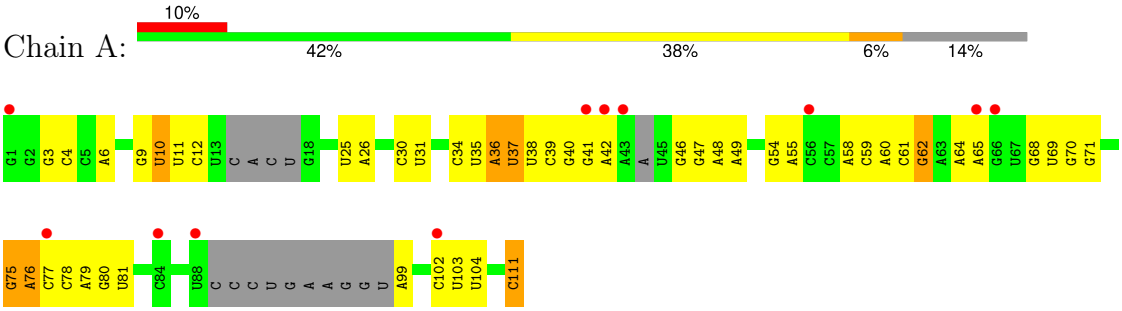
- Molecule 5 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	5	Total O 5 5	0	0
5	B	9	Total O 9 9	0	0

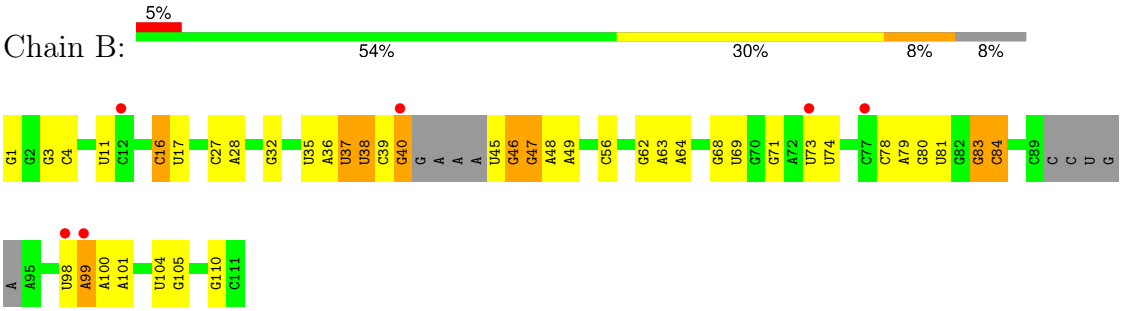
3 Residue-property plots (i)

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: frameshifting pseudoknot RNA



• Molecule 1: frameshifting pseudoknot RNA



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	43.86Å 68.47Å 210.10Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.96 – 2.80 48.96 – 2.80	Depositor EDS
% Data completeness (in resolution range)	99.5 (48.96-2.80) 95.4 (48.96-2.80)	Depositor EDS
R_{merge}	0.12	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	0.81 (at 2.51Å)	Xtriage
Refinement program	PHENIX (1.19.2_4158: ???)	Depositor
R, R_{free}	0.218 , 0.277 0.239 , 0.238	Depositor DCC
R_{free} test set	2000 reflections (9.06%)	wwPDB-VP
Wilson B-factor (Å^2)	60.4	Xtriage
Anisotropy	0.567	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.33 , 97.3	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	0.92	EDS
Total number of atoms	4298	wwPDB-VP
Average B, all atoms (Å^2)	79.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.63% 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

Bond lengths and bond angles in the following residue types are not validated in this section: TAM, K, IRI

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	0.31	0/2247	0.48	0/3495
1	B	0.45	0/2398	0.59	0/3731
All	All	0.39	0/4645	0.54	0/7226

There are no bond length outliers.

There are no bond angle outliers.

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	A	2014	0	1025	38	1
1	B	2149	0	1090	32	1
2	A	49	0	0	8	0
2	B	56	0	0	10	0
3	A	1	0	0	0	0
3	B	4	0	0	0	0
4	A	11	0	17	2	0
5	A	5	0	0	0	0
5	B	9	0	0	1	0
All	All	4298	0	2132	69	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 11.

The worst 5 of 69 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:40:G:N2	1:B:45:U:O4	2.13	0.80
1:B:105:G:N7	2:B:206[A]:IRI:N2	2.33	0.76
1:B:38:U:O4	2:B:203:IRI:N3	2.25	0.69
1:B:62:G:N7	2:B:207:IRI:N6	2.41	0.69
1:B:99:A:H2'	1:B:100:A:C8	2.32	0.65

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)
1:A:46:G:O2'	1:B:78:C:O2'[4_566]	2.19	0.01

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

There are no protein molecules in this entry.

5.3.2 Protein sidechains (i)

There are no protein molecules in this entry.

5.3.3 RNA (i)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	A	91/111 (81%)	14 (15%)	0
1	B	98/111 (88%)	18 (18%)	1 (1%)
All	All	189/222 (85%)	32 (16%)	1 (0%)

5 of 32 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	A	6	A
1	A	9	G
1	A	10	U

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type
1	A	36	A
1	A	37	U

All (1) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	B	73	U

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 oligosaccharides in this entry.

5.6 Ligand geometry (i)

Of 21 ligands modelled in this entry, 5 are monoatomic - leaving 16 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	$\#\|Z\| > 2$
2	IRI	A	202	-	0,6,6	-	-	-		
2	IRI	B	201	-	0,6,6	-	-	-		
2	IRI	B	202	-	0,6,6	-	-	-		
2	IRI	A	205	-	0,6,6	-	-	-		
2	IRI	B	203	-	0,6,6	-	-	-		
2	IRI	B	207	-	0,6,6	-	-	-		
2	IRI	A	207	-	0,6,6	-	-	-		
2	IRI	B	206[B]	-	0,6,6	-	-	-		
2	IRI	A	201	-	0,6,6	-	-	-		
4	TAM	A	209	-	10,10,10	0.60	0	12,12,12	1.51	3 (25%)
2	IRI	B	204	-	0,6,6	-	-	-		

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\#\|Z\|>2$	Counts	RMSZ	$\#\|Z\|>2$
2	IRI	B	205	-	0,6,6	-	-	-		
2	IRI	A	204	-	0,6,6	-	-	-		
2	IRI	A	206	-	0,6,6	-	-	-		
2	IRI	B	206[A]	-	0,6,6	-	-	-		
2	IRI	A	203	-	0,6,6	-	-	-		

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	TAM	A	209	-	-	8/12/12/12	-

There are no bond length outliers.

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	A	209	TAM	C4-C1-C	-3.61	111.71	115.97
4	A	209	TAM	C5-C2-C	-2.56	112.94	115.97
4	A	209	TAM	C6-C3-C	-2.07	113.53	115.97

There are no chirality outliers.

5 of 8 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
4	A	209	TAM	C2-C-C1-C4
4	A	209	TAM	C3-C-C1-C4
4	A	209	TAM	N-C-C1-C4
4	A	209	TAM	C1-C-C2-C5
4	A	209	TAM	C3-C-C2-C5

There are no ring outliers.

13 monomers are involved in 20 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	202	IRI	1	0
2	B	201	IRI	1	0
2	B	202	IRI	1	0
2	B	203	IRI	1	0

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	207	IRI	2	0
2	A	207	IRI	1	0
2	B	206[B]	IRI	2	0
4	A	209	TAM	2	0
2	B	204	IRI	1	0
2	A	204	IRI	1	0
2	A	206	IRI	2	0
2	B	206[A]	IRI	2	0
2	A	203	IRI	3	0

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	96/111 (86%)	0.88	11 (11%) 9 7	61, 92, 119, 158	0
1	B	102/111 (91%)	0.27	6 (5%) 28 21	33, 53, 121, 145	0
All	All	198/222 (89%)	0.57	17 (8%) 16 12	33, 84, 121, 158	0

The worst 5 of 17 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	98	U	3.7
1	A	65	A	3.2
1	A	42	A	3.2
1	A	66	G	3.1
1	A	41	G	3.0

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

There are no oligosaccharides 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. The B-factors column lists the minimum, median, 95^{th} 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	RSCC	RSR	B-factors(Å^2)	Q<0.9
3	K	B	211	1/1	0.26	0.33	180,180,180,180	0
4	TAM	A	209	11/11	0.64	0.20	81,83,90,92	0
2	IRI	A	206	7/7	0.66	0.33	70,83,89,99	7
2	IRI	A	207	7/7	0.77	0.35	94,97,101,108	7
2	IRI	B	202	7/7	0.80	0.24	92,96,105,128	7
2	IRI	B	207	7/7	0.80	0.32	48,54,66,84	7
3	K	B	210	1/1	0.81	0.28	121,121,121,121	0
3	K	B	209	1/1	0.83	0.24	115,115,115,115	0
3	K	A	208	1/1	0.85	0.27	123,123,123,123	0
2	IRI	A	205	7/7	0.89	0.27	61,70,78,91	7
2	IRI	A	204	7/7	0.89	0.27	68,81,96,99	7
2	IRI	A	202	7/7	0.92	0.15	66,76,98,113	7
2	IRI	B	206[A]	7/7	0.93	0.15	42,45,63,112	7
2	IRI	B	206[B]	7/7	0.93	0.15	38,47,55,68	7
2	IRI	A	201	7/7	0.93	0.14	72,92,118,163	7
2	IRI	B	204	7/7	0.93	0.16	48,55,63,89	7
2	IRI	B	203	7/7	0.94	0.12	79,102,108,143	7
2	IRI	A	203	7/7	0.97	0.10	79,87,117,119	7
2	IRI	B	205	7/7	0.97	0.14	63,69,105,118	0
2	IRI	B	201	7/7	0.98	0.10	42,55,74,97	0
3	K	B	208	1/1	0.98	0.21	82,82,82,82	0

6.5 Other polymers (i)

There are no such residues in this entry.