



Full wwPDB NMR Structure Validation Report ⓘ

Aug 14, 2023 – 04:06 PM EDT

PDB ID : 8G54
BMRB ID : 31074
Title : Temperature-dependent structures of tau aggregates
Authors : El Mammeri, N.; Duan, P.; Dregni, A.J.; Hong, M.
Deposited on : 2023-02-11

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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 : 4.02b-467
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI : v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV : Wang et al. (2010)
wwPDB-ShiftChecker : v1.2
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35

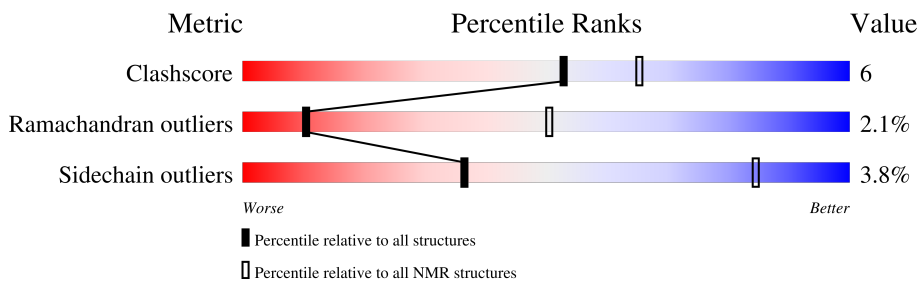
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

SOLID-STATE NMR

The overall completeness of chemical shifts assignment is 7%.

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)	NMR archive (#Entries)
Clashscore	158937	12864
Ramachandran outliers	154571	11451
Sidechain outliers	154315	11428

The table below summarises the geometric issues observed across the polymeric chains and their fit to the experimental data. The red, orange, yellow and green segments indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. A cyan segment indicates the fraction of residues that are not part of the well-defined cores, and 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 $\leq 5\%$

Mol	Chain	Length	Quality of chain
1	A	202	
1	B	202	
1	C	202	
1	D	202	
1	E	202	

2 Ensemble composition and analysis

This entry contains 10 models. Model 1 is the overall representative, medoid model (most similar to other models).

The following residues are included in the computation of the global validation metrics.

Well-defined (core) protein residues			
Well-defined core	Residue range (total)	Backbone RMSD (Å)	Medoid model
1	A:274-A:319, B:274-B:319, C:274-C:319, D:274-D:319, E:274-E:319 (230)	2.74	1

Ill-defined regions of proteins are excluded from the global statistics.

Ligands and non-protein polymers are included in the analysis.

The models can be grouped into 2 clusters and 2 single-model clusters were found.

Cluster number	Models
1	1, 2, 4, 9, 10
2	3, 7, 8
Single-model clusters	5; 6

3 Entry composition

There is only 1 type of molecule in this entry. The entry contains 4030 atoms, of which 2100 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Microtubule-associated protein tau.

Mol	Chain	Residues	Atoms					Trace	
1	A	52	Total	C	H	N	O	S	0
			806	242	420	69	73	2	
1	B	52	Total	C	H	N	O	S	0
			806	242	420	69	73	2	
1	C	52	Total	C	H	N	O	S	0
			806	242	420	69	73	2	
1	D	52	Total	C	H	N	O	S	0
			806	242	420	69	73	2	
1	E	52	Total	C	H	N	O	S	0
			806	242	420	69	73	2	

SER SER PRO GLY SER PRO GLY THR PRO THR GLY SER ARG SER ARG THR SER LEU PRO THR PRO THR PRO THR ARG GLU PRO LYS VAL VAL VAL ARG THR PRO PRO LYS SER SER PRO SER ALA LYS SER ARG LEU GLN THR ALA VAL VAL MET PRO PRO LEU ASP LEU LYS ASN VAL LYS

SER LYS ILE GLY SER THR GLU ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE GLY TYR LYS GLN VAL VAL LYS SER GLU LEU THR VAL VAL LYS ARG LEU LEU PHE LYS ASP LEU LYS ASP ARG VAL LYS

GLN SER LYS ILE GLY SER THR GLU ASP ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS SER GLN VAL THR VAL VAL LYS VAL VAL MET PRO PRO LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

- Molecule 1: Microtubule-associated protein tau

Chain C: 20% . . 74%

SER SER PRO GLY SER PRO GLY THR PRO THR GLY SER ARG SER ARG THR SER LEU PRO THR PRO THR PRO THR ARG GLU PRO LYS VAL VAL VAL ARG GLU ASN ILE HIS LYS HIS PRO SER ALA ILE GLY TYR LYS GLN VAL THR VAL VAL LYS SER SER GLU LEU THR VAL VAL LYS ARG LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

SER LYS ILE GLY SER THR GLU ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS GLN VAL THR VAL VAL LYS SER SER GLU LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

GLN SER LYS ILE GLY SER THR GLU ASP ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS SER SER GLN VAL THR VAL VAL LYS VAL VAL MET PRO PRO LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

- Molecule 1: Microtubule-associated protein tau

Chain D: 20% . . 74%

SER SER PRO GLY SER PRO GLY THR PRO THR GLY SER ARG SER ARG THR SER LEU PRO THR PRO THR PRO THR ARG GLU PRO LYS VAL VAL VAL ARG GLU ASN ILE HIS LYS HIS PRO SER ALA ILE GLY TYR LYS GLN VAL THR VAL VAL LYS SER SER GLU LEU THR VAL VAL LYS ARG LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

SER LYS ILE GLY SER THR GLU ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS GLN VAL THR VAL VAL LYS SER SER GLU LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

GLN SER LYS ILE GLY SER THR GLU ASP ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS SER SER GLN VAL THR VAL VAL LYS VAL VAL MET PRO PRO LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

- Molecule 1: Microtubule-associated protein tau

Chain E: 20% . . 74%

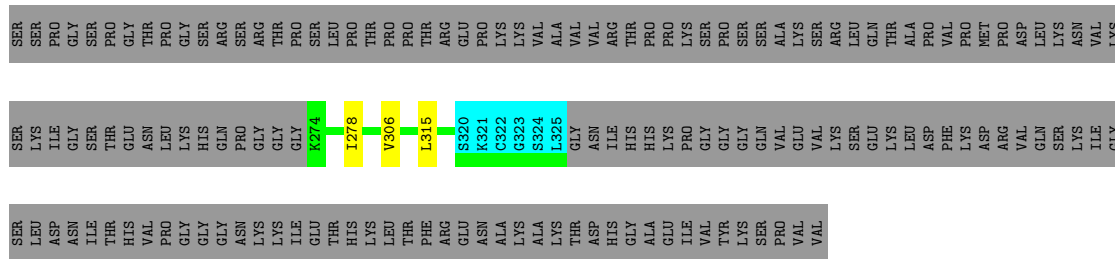
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SER LYS ILE GLY SER THR GLU ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS GLN VAL THR VAL VAL LYS SER SER GLU LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

GLN SER LYS ILE GLY SER THR GLU ASP ASN LEU LEU HIS THR HIS GLN PRO GLY GLY V274 V275 I278 S285 S289 D295 I308 S320 K321 C322 G323 S324 L325 GLY ASN ILE HIS LYS HIS PRO SER ALA ILE VAL TYR LYS SER SER GLN VAL THR VAL VAL LYS VAL VAL MET PRO PRO LEU LEU PHE LYS ASP LEU LYS ASN VAL VAL LYS

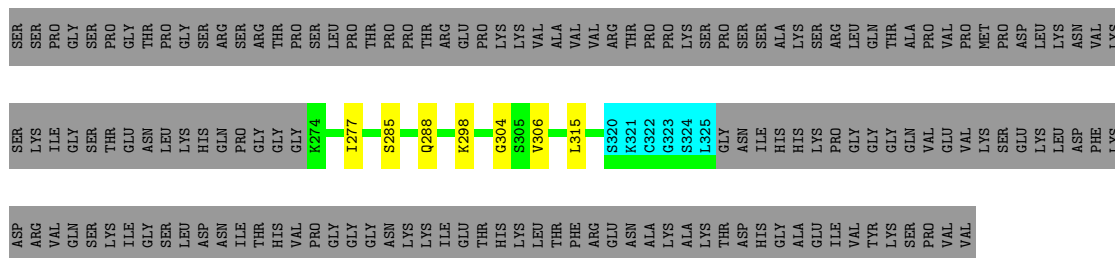
4.2.2 Score per residue for model 2

- Molecule 1: Microtubule-associated protein tau

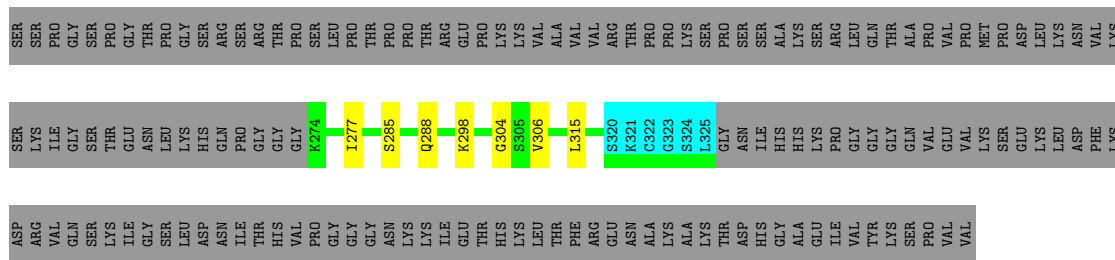


4.2.3 Score per residue for model 3

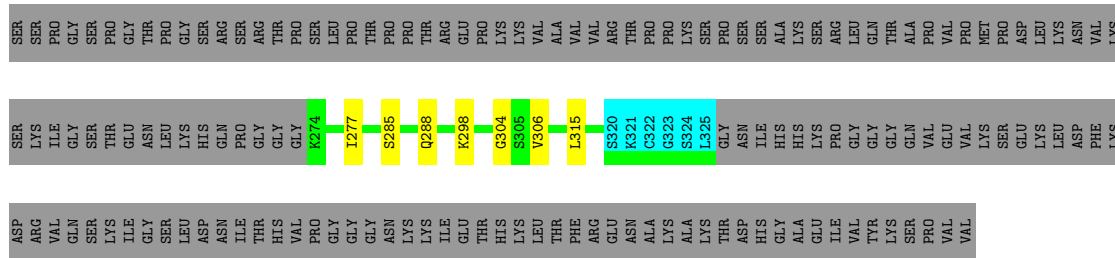
- Molecule 1: Microtubule-associated protein tau



- Molecule 1: Microtubule-associated protein tau



- Molecule 1: Microtubule-associated protein tau



- Molecule 1: Microtubule-associated protein tau

ASP ARG VAL GLN SER LYS ILE GLY SER LEU ASP ASN ILE THR HIS VAL PRO PRO GLY GLY ASN LYS LYS ILE GLU THR HIS LYS LEU THR PHE ARG GLU ASN ALA LYS ALA LYS THR ASP HIS GLY ALA GLU ILE VAL TYR LYS SER PRO VAL VAL

- Molecule 1: Microtubule-associated protein tau

Chain B: 19% 74%

SER SER PRO GLY SER PRO GLY THR ASN LEU PRO SER HIS ARG ASN ARG THR SER LEU PRO THR PRO THR PRO THR PRO LYS VAL ALA VAL VAL ARG THR SER ASN ILE HIS HIS ARG LEU GLN THR ALA GLY GLN VAL PRO MET ASP LEU LYS ASN VAL LYS

SER LYS ILE ARG VAL THR GLU ASN LEU PRO SER HIS GLN ARG ASP PRO GLY GLY K274 I277 L282 D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

PHE LYS ASP ARG VAL GLN SER LYS ILE GLY SER HIS LEU ASP ASN ILE THR HIS VAL PRO GLY GLY D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

- Molecule 1: Microtubule-associated protein tau

Chain C: 19% 74%

SER SER PRO GLY THR ASN LEU PRO SER HIS ARG ASN ARG THR SER LEU PRO THR PRO THR PRO THR PRO LYS VAL ALA VAL VAL ARG THR SER ASN ILE HIS HIS ARG LEU GLN THR ALA GLY GLN VAL PRO MET ASP LEU LYS ASN VAL LYS

SER LYS ILE ARG VAL THR GLU ASN LEU PRO SER HIS GLN ARG ASP PRO GLY GLY K274 I277 L282 D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

PHE LYS ASP ARG VAL GLN SER LYS ILE GLY SER HIS LEU ASP ASN ILE THR HIS VAL PRO GLY GLY D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

- Molecule 1: Microtubule-associated protein tau

Chain D: 19% 74%

SER SER PRO GLY THR ASN LEU PRO SER HIS ARG ASN ARG THR SER LEU PRO THR PRO THR PRO THR PRO LYS VAL ALA VAL VAL ARG THR SER ASN ILE HIS HIS ARG LEU GLN THR ALA GLY GLN VAL PRO MET ASP LEU LYS ASN VAL LYS

SER LYS ILE ARG VAL THR GLU ASN LEU PRO SER HIS GLN ARG ASP PRO GLY GLY K274 I277 L282 D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

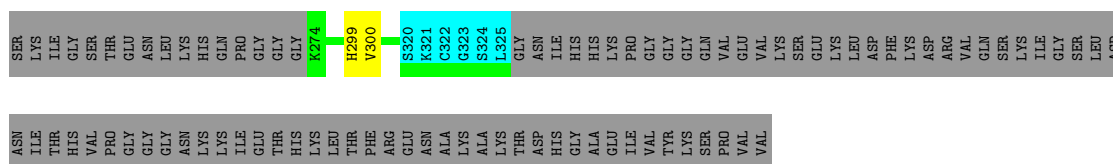
PHE LYS ASP ARG VAL GLN SER LYS ILE GLY SER HIS LEU ASP ASN ILE THR HIS VAL PRO GLY GLY D283 L284 V287 C291 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

- Molecule 1: Microtubule-associated protein tau

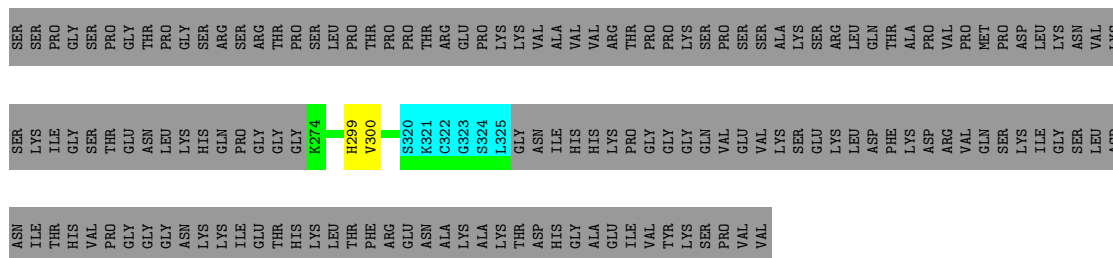
Chain E: 19% 74%

SER SER PRO GLY THR ASN LEU PRO SER HIS ARG ASN ARG THR SER LEU PRO THR PRO THR PRO THR PRO LYS VAL ALA VAL VAL ARG THR SER ASN ILE HIS HIS ARG LEU GLN THR ALA GLY GLN VAL PRO MET ASP LEU LYS ASN VAL LYS

SER LYS ILE ARG VAL THR GLU ASN LEU PRO SER HIS GLN ARG ASP PRO GLY GLY K274 I277 L282 D283 L284 V287 V300 V306 Q307 I308 S320 K321 C322 G323 S324 L325

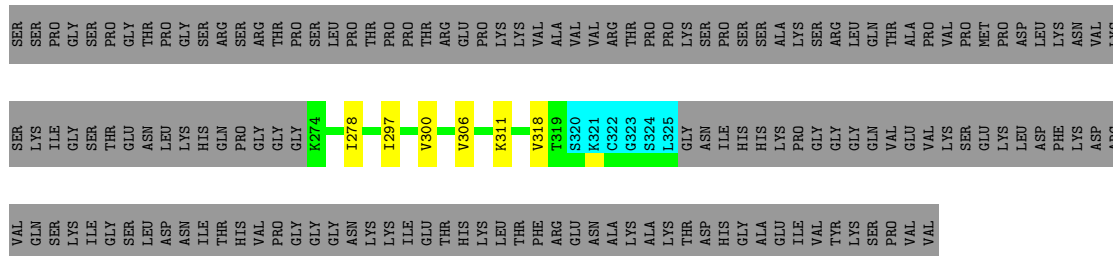


- Molecule 1: Microtubule-associated protein tau

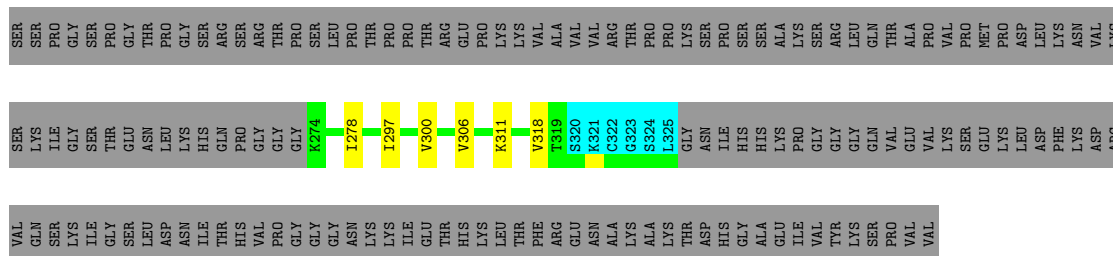


4.2.7 Score per residue for model 7

- Molecule 1: Microtubule-associated protein tau

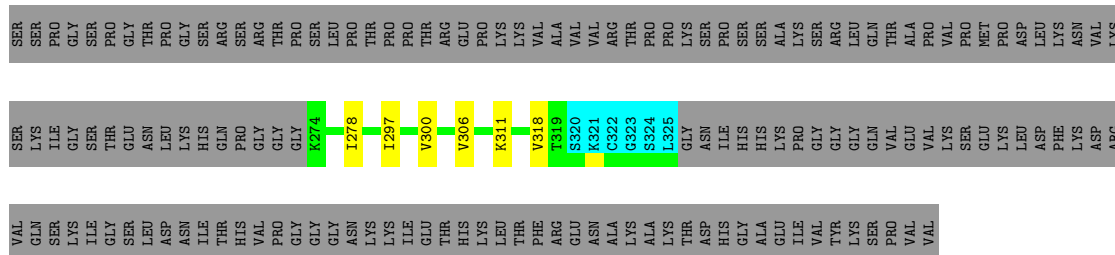


- Molecule 1: Microtubule-associated protein tau

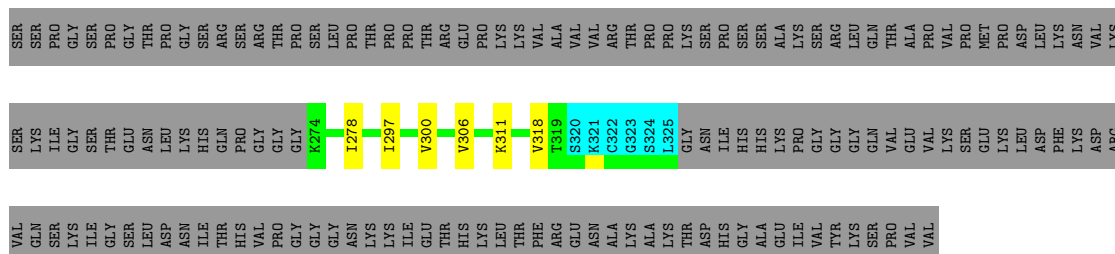


- Molecule 1: Microtubule-associated protein tau

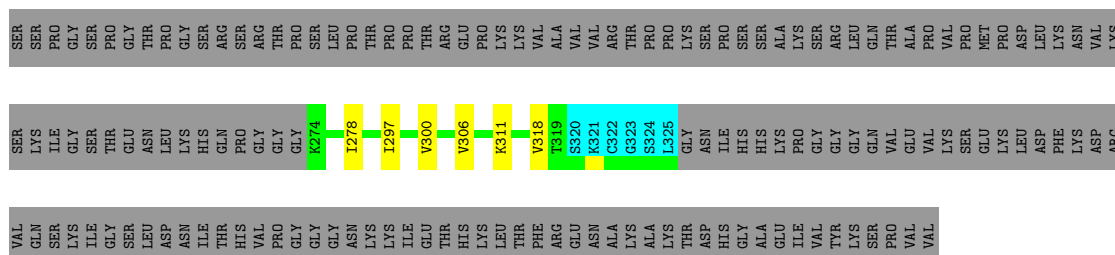




• Molecule 1: Microtubule-associated protein tau

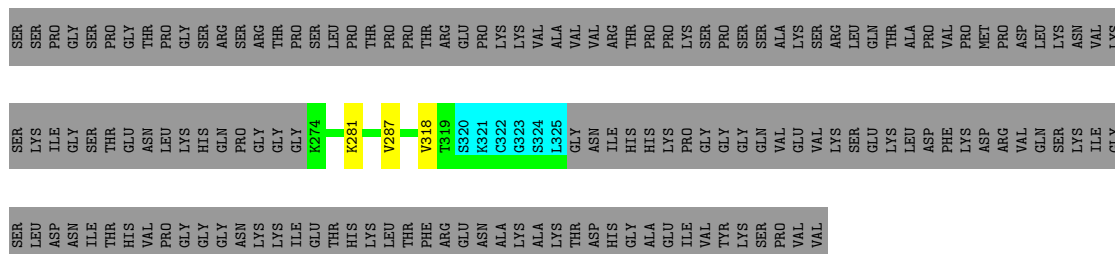


• Molecule 1: Microtubule-associated protein tau



4.2.8 Score per residue for model 8

• Molecule 1: Microtubule-associated protein tau



• Molecule 1: Microtubule-associated protein tau

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LYS
ALA
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ASP
HIS
GLY
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SER
PRO
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- Molecule 1: Microtubule-associated protein tau

Chain D: 20% 74%

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V287
G303
S320
K321
C322
G323
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THR
LYS

- Molecule 1: Microtubule-associated protein tau

Chain E: 20% 74%

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SER
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ASN
GLY
K274
L277
L282
D283
V287
G303
S320
K321
C322
G323
S324
L325
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5 Refinement protocol and experimental data overview

The models were refined using the following method: *simulated annealing*.

Of the 1000 calculated structures, 10 were deposited, based on the following criterion: *structures with the lowest energy*.

The following table shows the software used for structure solution, optimisation and refinement.

Software name	Classification	Version
X-PLOR NIH	refinement	
X-PLOR NIH	structure calculation	

The following table shows chemical shift validation statistics as aggregates over all chemical shift files. Detailed validation can be found in section 7 of this report.

Chemical shift file(s)	working_cs.cif
Number of chemical shift lists	1
Total number of shifts	223
Number of shifts mapped to atoms	219
Number of unparsed shifts	0
Number of shifts with mapping errors	4
Number of shifts with mapping warnings	0
Assignment completeness (well-defined parts)	7%

Note: This is a solid-state NMR structure, where hydrogen atoms are typically not assigned a chemical shift value, which may lead to lower completeness of assignment measure.

6 Model quality i

6.1 Standard geometry i

There are no covalent bond-length or bond-angle outliers.

There are no bond-length outliers.

There are no bond-angle outliers.

There are no chirality outliers.

There are no planarity outliers.

6.2 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 each 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 averaged over the ensemble.

Mol	Chain	Non-H	H(model)	H(added)	Clashes
1	A	347	378	376	5±3
1	B	347	378	376	7±5
1	C	347	378	376	7±5
1	D	347	378	376	7±5
1	E	347	378	376	4±3
All	All	17350	18900	18800	201

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 unique clashes are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:300:VAL:HG13	1:B:300:VAL:HG23	0.78	1.55	7	2
1:C:300:VAL:HG13	1:D:300:VAL:HG23	0.78	1.55	7	2
1:D:300:VAL:HG13	1:E:300:VAL:HG23	0.78	1.55	7	2
1:B:300:VAL:HG13	1:C:300:VAL:HG23	0.78	1.55	7	2
1:A:287:VAL:HG12	1:B:287:VAL:HG22	0.61	1.73	5	4
1:B:287:VAL:HG12	1:C:287:VAL:HG22	0.60	1.73	5	4
1:C:287:VAL:HG12	1:D:287:VAL:HG22	0.60	1.73	5	4
1:D:287:VAL:HG12	1:E:287:VAL:HG22	0.60	1.73	5	4
1:A:277:ILE:HD11	1:A:291:CYS:SG	0.59	2.38	4	1
1:B:277:ILE:HD11	1:B:291:CYS:SG	0.59	2.38	4	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:C:277:ILE:HD11	1:C:291:CYS:SG	0.59	2.38	4	1
1:D:277:ILE:HD11	1:D:291:CYS:SG	0.58	2.38	4	1
1:E:277:ILE:HD11	1:E:291:CYS:SG	0.58	2.38	4	1
1:A:306:VAL:HG12	1:B:306:VAL:HG22	0.57	1.76	2	1
1:D:306:VAL:HG12	1:E:306:VAL:HG22	0.57	1.76	2	1
1:B:306:VAL:HG12	1:C:306:VAL:HG22	0.57	1.76	2	1
1:C:306:VAL:HG12	1:D:306:VAL:HG22	0.57	1.76	2	1
1:A:291:CYS:CB	1:B:277:ILE:HD11	0.56	2.31	5	1
1:D:291:CYS:CB	1:E:277:ILE:HD11	0.56	2.31	5	1
1:B:291:CYS:CB	1:C:277:ILE:HD11	0.56	2.31	5	1
1:C:291:CYS:CB	1:D:277:ILE:HD11	0.56	2.31	5	1
1:A:309:VAL:CG1	1:B:309:VAL:HG23	0.55	2.31	4	1
1:B:309:VAL:CG1	1:C:309:VAL:HG23	0.55	2.31	4	1
1:D:309:VAL:CG1	1:E:309:VAL:HG23	0.55	2.31	4	1
1:C:309:VAL:CG1	1:D:309:VAL:HG23	0.54	2.31	4	1
1:D:291:CYS:SG	1:E:277:ILE:HD11	0.53	2.44	5	1
1:B:291:CYS:SG	1:C:277:ILE:HD11	0.53	2.44	5	1
1:C:291:CYS:SG	1:D:277:ILE:HD11	0.53	2.44	5	1
1:A:291:CYS:SG	1:B:277:ILE:HD11	0.53	2.44	5	1
1:A:275:VAL:HG23	1:B:275:VAL:HG13	0.53	1.80	1	1
1:B:275:VAL:HG23	1:C:275:VAL:HG13	0.53	1.80	1	1
1:C:275:VAL:HG23	1:D:275:VAL:HG13	0.53	1.80	1	1
1:D:275:VAL:HG23	1:E:275:VAL:HG13	0.52	1.80	1	1
1:A:276:GLN:O	1:A:277:ILE:HD13	0.52	2.04	4	1
1:B:276:GLN:O	1:B:277:ILE:HD13	0.52	2.04	4	1
1:D:276:GLN:O	1:D:277:ILE:HD13	0.52	2.04	4	1
1:C:276:GLN:O	1:C:277:ILE:HD13	0.52	2.04	4	1
1:E:276:GLN:O	1:E:277:ILE:HD13	0.52	2.05	4	1
1:D:306:VAL:CG1	1:E:306:VAL:HG22	0.48	2.38	2	1
1:B:306:VAL:CG1	1:C:306:VAL:HG22	0.48	2.39	2	1
1:A:306:VAL:CG1	1:B:306:VAL:HG22	0.48	2.39	2	1
1:C:306:VAL:CG1	1:D:306:VAL:HG22	0.48	2.39	2	1
1:A:284:LEU:HD21	1:B:284:LEU:HB3	0.48	1.85	9	1
1:B:284:LEU:HD21	1:C:284:LEU:HB3	0.48	1.85	9	1
1:B:287:VAL:CG1	1:C:287:VAL:HG22	0.48	2.38	5	2
1:C:287:VAL:CG1	1:D:287:VAL:HG22	0.48	2.38	5	2
1:D:287:VAL:CG1	1:E:287:VAL:HG22	0.48	2.38	5	2
1:C:284:LEU:HD21	1:D:284:LEU:HB3	0.48	1.85	9	1
1:A:287:VAL:CG1	1:B:287:VAL:HG22	0.47	2.38	5	2
1:D:284:LEU:HD21	1:E:284:LEU:HB3	0.47	1.86	9	1
1:E:277:ILE:HD11	1:E:291:CYS:HB2	0.47	1.86	4	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:277:ILE:HD11	1:A:291:CYS:HB2	0.47	1.87	4	1
1:B:277:ILE:HD11	1:B:291:CYS:HB2	0.47	1.87	4	1
1:C:277:ILE:HD11	1:C:291:CYS:HB2	0.47	1.87	4	1
1:D:277:ILE:HD11	1:D:291:CYS:HB2	0.47	1.87	4	1
1:D:277:ILE:N	1:D:277:ILE:HD12	0.46	2.25	3	2
1:E:277:ILE:HD12	1:E:277:ILE:N	0.46	2.25	3	3
1:B:277:ILE:HD12	1:B:277:ILE:N	0.46	2.26	3	3
1:C:277:ILE:N	1:C:277:ILE:HD12	0.46	2.26	3	3
1:A:277:ILE:HD12	1:A:277:ILE:N	0.46	2.26	3	3
1:A:309:VAL:HG13	1:B:309:VAL:HG23	0.46	1.87	4	1
1:B:309:VAL:HG13	1:C:309:VAL:HG23	0.46	1.87	4	1
1:E:300:VAL:O	1:E:300:VAL:HG23	0.46	2.12	9	1
1:A:300:VAL:O	1:A:300:VAL:HG23	0.45	2.11	9	1
1:C:300:VAL:HG23	1:C:300:VAL:O	0.45	2.11	9	1
1:D:300:VAL:HG23	1:D:300:VAL:O	0.45	2.12	9	1
1:C:309:VAL:HG13	1:D:309:VAL:HG23	0.45	1.87	4	1
1:D:309:VAL:HG13	1:E:309:VAL:HG23	0.45	1.87	4	1
1:B:300:VAL:O	1:B:300:VAL:HG23	0.45	2.11	9	1
1:C:308:ILE:HD12	1:C:308:ILE:N	0.45	2.27	1	1
1:D:308:ILE:HD12	1:D:308:ILE:N	0.45	2.27	1	1
1:E:308:ILE:HD12	1:E:308:ILE:N	0.45	2.27	1	1
1:A:308:ILE:N	1:A:308:ILE:HD12	0.45	2.27	1	1
1:B:308:ILE:HD12	1:B:308:ILE:N	0.45	2.27	1	1
1:A:291:CYS:SG	1:B:275:VAL:HG12	0.45	2.52	4	1
1:B:291:CYS:SG	1:C:275:VAL:HG12	0.45	2.52	4	1
1:D:318:VAL:HG12	1:E:318:VAL:HG22	0.45	1.89	8	2
1:C:291:CYS:SG	1:D:275:VAL:HG12	0.45	2.52	4	1
1:D:291:CYS:SG	1:E:275:VAL:HG12	0.45	2.52	4	1
1:C:318:VAL:HG12	1:D:318:VAL:HG22	0.44	1.89	8	2
1:A:318:VAL:HG12	1:B:318:VAL:HG22	0.44	1.89	8	2
1:D:284:LEU:HD21	1:E:284:LEU:CB	0.44	2.42	9	1
1:B:318:VAL:HG12	1:C:318:VAL:HG22	0.44	1.89	8	2
1:A:297:ILE:HD12	1:A:297:ILE:N	0.44	2.28	7	1
1:B:284:LEU:HD21	1:C:284:LEU:CB	0.44	2.42	9	1
1:C:284:LEU:HD21	1:D:284:LEU:CB	0.44	2.42	9	1
1:B:297:ILE:HD12	1:B:297:ILE:N	0.44	2.28	7	1
1:A:284:LEU:HD21	1:B:284:LEU:CB	0.44	2.42	9	1
1:C:297:ILE:N	1:C:297:ILE:HD12	0.44	2.28	7	1
1:D:278:ILE:O	1:E:278:ILE:HA	0.43	2.13	1	1
1:D:297:ILE:HD12	1:D:297:ILE:N	0.43	2.28	7	1
1:E:297:ILE:HD12	1:E:297:ILE:N	0.43	2.27	7	1

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:300:VAL:HG11	1:B:306:VAL:HG23	0.43	1.89	5	1
1:B:300:VAL:HG11	1:C:306:VAL:HG23	0.43	1.89	5	1
1:E:277:ILE:HD11	1:E:291:CYS:CB	0.43	2.43	4	1
1:A:278:ILE:O	1:B:278:ILE:HA	0.43	2.14	1	1
1:A:315:LEU:N	1:A:315:LEU:HD23	0.43	2.29	2	2
1:B:315:LEU:HD23	1:B:315:LEU:N	0.43	2.29	2	2
1:C:315:LEU:HD23	1:C:315:LEU:N	0.43	2.29	2	2
1:E:315:LEU:N	1:E:315:LEU:HD23	0.43	2.29	2	2
1:C:277:ILE:HD11	1:C:291:CYS:CB	0.43	2.43	4	1
1:D:277:ILE:HD11	1:D:291:CYS:CB	0.43	2.43	4	1
1:B:277:ILE:HD11	1:B:291:CYS:CB	0.43	2.43	4	1
1:B:278:ILE:O	1:C:278:ILE:HA	0.43	2.14	1	1
1:D:315:LEU:HD23	1:D:315:LEU:N	0.43	2.29	2	2
1:A:277:ILE:HD11	1:A:291:CYS:CB	0.43	2.43	4	1
1:C:278:ILE:O	1:D:278:ILE:HA	0.43	2.14	1	1
1:A:278:ILE:HG23	1:A:278:ILE:O	0.43	2.13	7	2
1:C:300:VAL:HG11	1:D:306:VAL:HG23	0.43	1.89	5	1
1:E:278:ILE:HG23	1:E:278:ILE:O	0.42	2.14	7	1
1:B:278:ILE:O	1:B:278:ILE:HG23	0.42	2.13	7	2
1:C:278:ILE:O	1:C:278:ILE:HG23	0.42	2.13	7	3
1:D:277:ILE:HD12	1:D:277:ILE:N	0.42	2.29	5	1
1:D:300:VAL:HG11	1:E:306:VAL:HG23	0.42	1.89	5	1
1:D:278:ILE:HG23	1:D:278:ILE:O	0.42	2.14	7	1
1:B:308:ILE:HD11	1:B:310:TYR:CE1	0.42	2.50	4	1
1:A:308:ILE:HD11	1:A:310:TYR:CE1	0.42	2.50	4	1
1:D:308:ILE:HD11	1:D:310:TYR:CE1	0.42	2.50	4	1
1:C:308:ILE:HD11	1:C:310:TYR:CE1	0.42	2.50	4	1
1:E:308:ILE:HD11	1:E:310:TYR:CE1	0.42	2.50	4	1
1:E:300:VAL:HG13	1:E:300:VAL:O	0.42	2.15	7	2
1:E:308:ILE:HG23	1:E:308:ILE:O	0.42	2.15	5	1
1:D:308:ILE:HG23	1:D:308:ILE:O	0.41	2.15	5	1
1:E:278:ILE:O	1:E:278:ILE:HG23	0.41	2.14	2	1
1:C:308:ILE:HG23	1:C:308:ILE:O	0.41	2.15	5	1
1:B:308:ILE:HG23	1:B:308:ILE:O	0.41	2.15	5	1
1:A:300:VAL:CG1	1:B:300:VAL:HG23	0.41	2.39	5	1
1:D:300:VAL:HG13	1:D:300:VAL:O	0.41	2.15	7	2
1:A:308:ILE:HG23	1:A:308:ILE:O	0.41	2.15	5	1
1:B:284:LEU:N	1:B:284:LEU:HD12	0.41	2.31	5	1
1:B:300:VAL:HG13	1:B:300:VAL:O	0.41	2.15	7	2
1:D:284:LEU:N	1:D:284:LEU:HD12	0.41	2.31	5	1
1:C:284:LEU:N	1:C:284:LEU:HD12	0.41	2.31	5	2

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Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:E:284:LEU:N	1:E:284:LEU:HD12	0.41	2.31	5	2
1:A:284:LEU:N	1:A:284:LEU:HD12	0.41	2.31	5	1
1:A:300:VAL:HG13	1:A:300:VAL:O	0.41	2.16	7	2
1:C:300:VAL:HG13	1:C:300:VAL:O	0.41	2.16	7	2
1:D:278:ILE:O	1:D:278:ILE:HG23	0.41	2.15	2	2
1:A:278:ILE:O	1:A:278:ILE:HG23	0.41	2.16	1	1
1:B:278:ILE:HG23	1:B:278:ILE:O	0.41	2.15	2	1
1:A:283:ASP:HA	1:B:283:ASP:O	0.41	2.15	9	1
1:A:291:CYS:HB2	1:B:277:ILE:HD11	0.40	1.93	5	1
1:B:291:CYS:HB2	1:C:277:ILE:HD11	0.40	1.94	5	1
1:C:310:TYR:CZ	1:C:313:VAL:HG21	0.40	2.51	9	1
1:D:310:TYR:CZ	1:D:313:VAL:HG21	0.40	2.51	9	1
1:E:310:TYR:CZ	1:E:313:VAL:HG21	0.40	2.51	9	1
1:C:291:CYS:HB2	1:D:277:ILE:HD11	0.40	1.94	5	1
1:A:310:TYR:CZ	1:A:313:VAL:HG21	0.40	2.51	9	1
1:B:310:TYR:CZ	1:B:313:VAL:HG21	0.40	2.51	9	1
1:D:284:LEU:HD12	1:D:284:LEU:N	0.40	2.31	4	1
1:D:291:CYS:HB2	1:E:277:ILE:HD11	0.40	1.94	5	1

6.3 Torsion angles [i](#)

6.3.1 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 PDB entries followed by that with respect to all NMR entries. 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	45/202 (22%)	40±1 (89±2%)	4±1 (8±2%)	1±1 (2±2%)	10	49
1	B	45/202 (22%)	40±1 (89±2%)	4±1 (8±2%)	1±1 (2±2%)	10	49
1	C	45/202 (22%)	40±1 (89±2%)	4±1 (9±2%)	1±1 (2±2%)	10	49
1	D	45/202 (22%)	40±1 (89±2%)	4±1 (9±2%)	1±1 (2±2%)	11	52
1	E	45/202 (22%)	40±1 (89±2%)	4±1 (9±2%)	1±1 (2±2%)	11	52
All	All	2250/10100 (22%)	2007 (89%)	195 (9%)	48 (2%)	10	50

All 28 unique Ramachandran outliers are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	299	HIS	3
1	B	299	HIS	3
1	C	299	HIS	3
1	D	299	HIS	3
1	E	299	HIS	3
1	A	306	VAL	2
1	B	306	VAL	2
1	C	306	VAL	2
1	D	306	VAL	2
1	E	306	VAL	2
1	A	303	GLY	2
1	B	303	GLY	2
1	C	303	GLY	2
1	D	303	GLY	2
1	E	303	GLY	2
1	A	298	LYS	1
1	A	304	GLY	1
1	B	298	LYS	1
1	B	304	GLY	1
1	C	298	LYS	1
1	C	304	GLY	1
1	D	298	LYS	1
1	D	304	GLY	1
1	E	298	LYS	1
1	E	304	GLY	1
1	A	293	SER	1
1	B	293	SER	1
1	C	293	SER	1

6.3.2 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 PDB entries followed by that with respect to all NMR entries. 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	42/175 (24%)	40±1 (96±2%)	2±1 (4±2%)	36	84
1	B	42/175 (24%)	40±1 (96±2%)	2±1 (4±2%)	36	84
1	C	42/175 (24%)	40±1 (96±2%)	2±1 (4±2%)	36	84
1	D	42/175 (24%)	40±1 (96±2%)	2±1 (4±2%)	36	84

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	42/175 (24%)	40±1 (96±2%)	2±1 (4±2%)	36	84
All	All	2100/8750 (24%)	2020 (96%)	80 (4%)	36	84

All 60 unique residues with a non-rotameric sidechain are listed below. They are sorted by the frequency of occurrence in the ensemble.

Mol	Chain	Res	Type	Models (Total)
1	A	285	SER	3
1	B	285	SER	3
1	C	285	SER	3
1	D	285	SER	3
1	E	285	SER	3
1	A	282	LEU	2
1	B	282	LEU	2
1	C	282	LEU	2
1	D	282	LEU	2
1	E	282	LEU	2
1	A	311	LYS	2
1	B	311	LYS	2
1	C	311	LYS	2
1	D	311	LYS	2
1	E	311	LYS	2
1	A	289	SER	1
1	A	295	ASP	1
1	B	289	SER	1
1	B	295	ASP	1
1	C	289	SER	1
1	C	295	ASP	1
1	D	289	SER	1
1	D	295	ASP	1
1	E	289	SER	1
1	E	295	ASP	1
1	A	288	GLN	1
1	B	288	GLN	1
1	C	288	GLN	1
1	D	288	GLN	1
1	E	288	GLN	1
1	A	274	LYS	1
1	B	274	LYS	1
1	C	274	LYS	1
1	D	274	LYS	1
1	E	274	LYS	1

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Mol	Chain	Res	Type	Models (Total)
1	A	300	VAL	1
1	B	300	VAL	1
1	C	300	VAL	1
1	D	300	VAL	1
1	E	300	VAL	1
1	A	281	LYS	1
1	B	281	LYS	1
1	C	281	LYS	1
1	D	281	LYS	1
1	E	281	LYS	1
1	A	284	LEU	1
1	A	293	SER	1
1	B	284	LEU	1
1	B	293	SER	1
1	C	284	LEU	1
1	C	293	SER	1
1	D	284	LEU	1
1	D	293	SER	1
1	E	284	LEU	1
1	E	293	SER	1
1	A	283	ASP	1
1	B	283	ASP	1
1	C	283	ASP	1
1	D	283	ASP	1
1	E	283	ASP	1

6.3.3 RNA [i](#)

There are no RNA molecules in this entry.

6.4 Non-standard residues in protein, DNA, RNA chains [i](#)

There are no non-standard protein/DNA/RNA residues in this entry.

6.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

6.6 Ligand geometry [i](#)

There are no ligands in this entry.

6.7 Other polymers [i](#)

There are no such molecules in this entry.

6.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

7 Chemical shift validation i

The completeness of assignment taking into account all chemical shift lists is 7% for the well-defined parts and 6% for the entire structure.

7.1 Chemical shift list 1

File name: working_cs.cif

Chemical shift list name: *starch_output*

7.1.1 Bookkeeping i

The following table shows the results of parsing the chemical shift list and reports the number of nuclei with statistically unusual chemical shifts.

Total number of shifts	223
Number of shifts mapped to atoms	219
Number of unparsed shifts	0
Number of shifts with mapping errors	4
Number of shifts with mapping warnings	0
Number of shift outliers (ShiftChecker)	0

The following assigned chemical shifts were not mapped to the molecules present in the coordinate file.

- No matching atom found in the structure. All 4 occurrences are reported below.

List ID	Chain	Res	Type	Atom	Shift Data		
					Value	Uncertainty	Ambiguity
1	A	369	LYS	C	173.583	.	.
1	A	370	LYS	C	171.766	.	.
1	A	370	LYS	N	118.991	.	.
1	A	371	ILE	N	119.925	.	.

7.1.2 Chemical shift referencing i

The following table shows the suggested chemical shift referencing corrections.

Nucleus	# values	Correction \pm precision, ppm	Suggested action
$^{13}\text{C}_\alpha$	40	1.92 ± 0.20	Should be checked
$^{13}\text{C}_\beta$	38	0.55 ± 0.36	None needed (imprecise)
$^{13}\text{C}'$	40	2.84 ± 0.15	Should be applied
^{15}N	44	-2.13 ± 0.51	Should be applied

7.1.3 Completeness of resonance assignments [i](#)

The following table shows the completeness of the chemical shift assignments for the well-defined regions of the structure. The overall completeness is 7%, i.e. 212 atoms were assigned a chemical shift out of a possible 3115. 0 out of 50 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹H	¹³C	¹⁵N
Backbone	115/1150 (10%)	0/470 (0%)	76/460 (17%)	39/220 (18%)
Sidechain	96/1880 (5%)	0/1220 (0%)	93/590 (16%)	3/70 (4%)
Aromatic	1/85 (1%)	0/40 (0%)	1/35 (3%)	0/10 (0%)
Overall	212/3115 (7%)	0/1730 (0%)	170/1085 (16%)	42/300 (14%)

Note: This is a solid-state NMR structure, where hydrogen atoms are typically not assigned a chemical shift value, which may lead to lower completeness of assignment measure.

The following table shows the completeness of the chemical shift assignments for the full structure. The overall completeness is 6%, i.e. 216 atoms were assigned a chemical shift out of a possible 3445. 0 out of 55 assigned methyl groups (LEU and VAL) were assigned stereospecifically.

	Total	¹H	¹³C	¹⁵N
Backbone	118/1305 (9%)	0/535 (0%)	78/520 (15%)	40/250 (16%)
Sidechain	97/2055 (5%)	0/1335 (0%)	94/645 (15%)	3/75 (4%)
Aromatic	1/85 (1%)	0/40 (0%)	1/35 (3%)	0/10 (0%)
Overall	216/3445 (6%)	0/1910 (0%)	173/1200 (14%)	43/335 (13%)

Note: This is a solid-state NMR structure, where hydrogen atoms are typically not assigned a chemical shift value, which may lead to lower completeness of assignment measure.

7.1.4 Statistically unusual chemical shifts [i](#)

There are no statistically unusual chemical shifts.

7.1.5 Random Coil Index (RCI) plots [i](#)

The image below reports *random coil index* values for the protein chains in the structure. The height of each bar gives a probability of a given residue to be disordered, as predicted from the available chemical shifts and the amino acid sequence. A value above 0.2 is an indication of significant predicted disorder. The colour of the bar shows whether the residue is in the well-defined core (black) or in the ill-defined residue ranges (cyan), as described in section 2 on ensemble composition. If well-defined core and ill-defined regions are not identified then it is shown as gray bars.

Random coil index (RCI) for chain A:

