



# Full wwPDB X-ray Structure Validation Report ⓘ

May 16, 2020 – 02:44 pm BST

PDB ID : 6I1Z  
Title : Outward facing structure of apo CST  
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Deposited on : 2018-10-31  
Resolution : 3.40 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](mailto: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.

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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

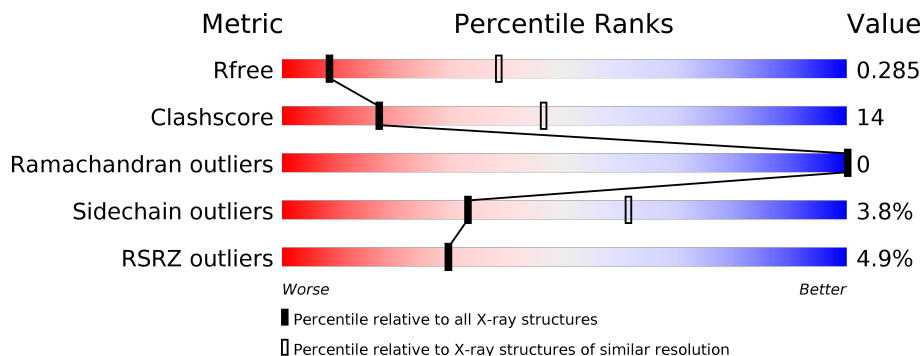
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.40 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))
$R_{free}$	130704	1026 (3.48-3.32)
Clashscore	141614	1055 (3.48-3.32)
Ramachandran outliers	138981	1038 (3.48-3.32)
Sidechain outliers	138945	1038 (3.48-3.32)
RSRZ outliers	127900	2173 (3.50-3.30)

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 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  $\leq 5\%$ . 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	322	 4% 69% 18% 12%
1	B	322	 5% 70% 18% 10%

## 2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 4290 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 CMP-sialic acid transporter 1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	283	2127	1410	323	378	16	0	0	0
1	B	291	2163	1434	333	380	16	0	0	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	58	ARG	HIS	engineered mutation	UNP B4FZ94
A	59	THR	SER	engineered mutation	UNP B4FZ94
A	61	PRO	SER	engineered mutation	UNP B4FZ94
A	62	SER	PRO	engineered mutation	UNP B4FZ94
A	63	VAL	PRO	engineered mutation	UNP B4FZ94
B	58	ARG	HIS	engineered mutation	UNP B4FZ94
B	59	THR	SER	engineered mutation	UNP B4FZ94
B	61	PRO	SER	engineered mutation	UNP B4FZ94
B	62	SER	PRO	engineered mutation	UNP B4FZ94
B	63	VAL	PRO	engineered mutation	UNP B4FZ94



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	51.58Å 69.46Å 102.03Å 82.83° 83.43° 68.22°	Depositor
Resolution (Å)	21.95 – 3.40 21.95 – 3.40	Depositor EDS
% Data completeness (in resolution range)	98.9 (21.95-3.40) 99.3 (21.95-3.40)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.18 (at 3.37Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.268 , 0.286 0.273 , 0.285	Depositor DCC
$R_{free}$ test set	816 reflections (4.63%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	145.8	Xtrriage
Anisotropy	0.055	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.23 , 127.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.41$ , $\langle L^2 \rangle = 0.24$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.91	EDS
Total number of atoms	4290	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	174.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.12% of the height of the origin peak. No significant pseudotranslation is detected.*

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

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 Standard geometry [i](#)

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	0/2170	0.68	0/2966
1	B	0.53	0/2210	0.70	0/3019
All	All	0.52	0/4380	0.69	0/5985

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

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	117	ARG	Sidechain

### 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	2127	0	2121	60	0
1	B	2163	0	2100	72	0
All	All	4290	0	4221	118	0

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 14.

All (118) 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:37:ILE:CG2	1:B:240:VAL:HG22	1.47	1.40
1:B:37:ILE:CG2	1:B:240:VAL:CG2	2.01	1.37
1:B:37:ILE:HG22	1:B:240:VAL:CG2	1.66	1.17
1:A:100:THR:HG23	1:A:155:LEU:HD13	1.24	1.16
1:A:295:ILE:HD11	1:B:137:VAL:HG11	1.18	1.13
1:A:295:ILE:HD11	1:B:137:VAL:CG1	1.85	1.05
1:B:253:LEU:O	1:B:257:SER:O	1.74	1.05
1:B:36:THR:C	1:B:38:PRO:HD2	1.80	1.00
1:B:37:ILE:HG21	1:B:240:VAL:CG2	1.85	1.00
1:A:295:ILE:CD1	1:B:137:VAL:HG11	1.93	0.98
1:B:36:THR:O	1:B:38:PRO:HD2	1.68	0.94
1:A:100:THR:CG2	1:A:155:LEU:HD13	1.96	0.94
1:A:291:LEU:O	1:A:295:ILE:HD13	1.66	0.93
1:A:134:LEU:HD11	1:B:134:LEU:HD11	1.53	0.90
1:B:37:ILE:HG21	1:B:240:VAL:HG23	1.53	0.88
1:A:253:LEU:O	1:A:257:SER:O	1.90	0.88
1:B:37:ILE:HG22	1:B:240:VAL:HG22	0.87	0.85
1:A:100:THR:HG23	1:A:155:LEU:CD1	2.08	0.83
1:A:76:VAL:HG22	1:A:201:PHE:CE1	2.16	0.81
1:B:37:ILE:CG2	1:B:240:VAL:HG23	2.08	0.81
1:A:85:HIS:CE1	1:A:89:GLN:OE1	2.35	0.79
1:B:36:THR:C	1:B:38:PRO:CD	2.52	0.78
1:A:155:LEU:HD12	1:A:156:PHE:H	1.49	0.75
1:B:260:ILE:HG21	1:B:303:TYR:CZ	2.23	0.73
1:A:260:ILE:HG21	1:A:303:TYR:CZ	2.24	0.73
1:B:253:LEU:O	1:B:257:SER:C	2.26	0.73
1:B:221:LEU:H	1:B:221:LEU:HD23	1.54	0.72
1:B:20:LEU:HB3	1:B:239:VAL:HG12	1.72	0.72
1:A:85:HIS:HE1	1:A:89:GLN:OE1	1.73	0.71
1:B:37:ILE:HG21	1:B:240:VAL:HG22	1.55	0.71
1:B:255:LYS:HD2	1:B:256:TYR:CE1	2.28	0.68
1:A:143:GLN:HG3	1:A:270:MET:HE1	1.76	0.67
1:A:255:LYS:HD2	1:A:256:TYR:CE1	2.28	0.67
1:B:37:ILE:HD12	1:B:38:PRO:HD3	1.77	0.66
1:B:37:ILE:N	1:B:38:PRO:CD	2.60	0.65
1:A:301:GLN:O	1:A:305:MET:HB2	1.98	0.64
1:B:301:GLN:O	1:B:305:MET:HB2	1.99	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:37:ILE:CG2	1:B:240:VAL:HG21	2.24	0.63
1:B:181:GLU:OE2	1:B:185:LYS:HE3	2.00	0.61
1:B:36:THR:O	1:B:38:PRO:CD	2.44	0.60
1:B:35:ALA:O	1:B:38:PRO:CD	2.49	0.60
1:B:264:TYR:CD2	1:B:300:LEU:HD12	2.36	0.60
1:B:134:LEU:HB3	1:B:299:SER:HB2	1.83	0.59
1:A:181:GLU:OE2	1:A:185:LYS:HE3	2.02	0.59
1:B:255:LYS:CD	1:B:256:TYR:CE1	2.87	0.58
1:A:143:GLN:CG	1:A:270:MET:HE1	2.33	0.58
1:A:229:PHE:CB	1:A:232:TYR:CD1	2.87	0.58
1:A:255:LYS:CD	1:A:256:TYR:CE1	2.86	0.57
1:A:295:ILE:HD12	1:A:295:ILE:N	2.21	0.55
1:B:255:LYS:HB3	1:B:256:TYR:CD1	2.43	0.54
1:A:155:LEU:CD1	1:A:156:PHE:H	2.20	0.54
1:B:250:VAL:O	1:B:254:MET:HG2	2.08	0.54
1:A:295:ILE:CD1	1:A:295:ILE:N	2.69	0.54
1:B:271:LEU:HD22	1:B:293:ILE:HG13	1.91	0.53
1:A:255:LYS:HB3	1:A:256:TYR:CD1	2.44	0.52
1:A:143:GLN:CG	1:A:270:MET:CE	2.88	0.52
1:B:37:ILE:HG23	1:B:240:VAL:CG2	2.27	0.52
1:B:116:PHE:CE1	1:B:258:ASP:HB2	2.45	0.52
1:A:302:MET:HG3	1:B:130:MET:HE2	1.91	0.52
1:A:116:PHE:CE1	1:A:258:ASP:HB2	2.45	0.51
1:A:250:VAL:O	1:A:254:MET:HG2	2.10	0.51
1:B:264:TYR:CD2	1:B:300:LEU:CD1	2.94	0.51
1:B:268:MET:HE2	1:B:300:LEU:HD13	1.92	0.51
1:A:291:LEU:HD11	1:B:140:THR:HG22	1.92	0.51
1:B:77:VAL:HB	1:B:78:PRO:HD3	1.94	0.50
1:A:253:LEU:O	1:A:257:SER:C	2.50	0.49
1:A:229:PHE:CB	1:A:232:TYR:CE1	2.95	0.49
1:B:155:LEU:O	1:B:156:PHE:HB2	2.14	0.48
1:A:45:LYS:HD2	1:A:244:GLY:HA2	1.96	0.48
1:A:271:LEU:HD22	1:A:293:ILE:HG13	1.95	0.48
1:B:37:ILE:O	1:B:38:PRO:C	2.51	0.48
1:A:127:ILE:HD11	1:B:127:ILE:HD11	1.97	0.47
1:A:295:ILE:H	1:A:295:ILE:CD1	2.28	0.47
1:B:260:ILE:HG21	1:B:303:TYR:CE2	2.48	0.47
1:A:305:MET:HB3	1:A:310:LEU:HG	1.97	0.46
1:B:160:LEU:O	1:B:161:GLU:C	2.53	0.46
1:B:301:GLN:HB3	1:B:305:MET:CE	2.45	0.46
1:A:134:LEU:HB3	1:A:299:SER:HB2	1.98	0.46

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:147:CYS:HA	1:B:146:GLY:O	2.16	0.46
1:A:95:TYR:CE2	1:A:161:GLU:HB2	2.51	0.45
1:A:16:SER:HB2	1:A:242:ASN:HD21	1.82	0.45
1:B:117:ARG:O	1:B:121:LYS:HA	2.15	0.45
1:B:35:ALA:O	1:B:38:PRO:HD3	2.15	0.45
1:B:254:MET:HA	1:B:254:MET:CE	2.47	0.45
1:B:274:MET:HB3	1:B:289:LEU:HD13	1.98	0.45
1:A:302:MET:HG3	1:B:130:MET:CE	2.46	0.45
1:A:130:MET:HE2	1:B:302:MET:HG3	1.99	0.44
1:B:268:MET:CE	1:B:300:LEU:HD13	2.46	0.44
1:A:295:ILE:HD11	1:B:137:VAL:HG13	1.86	0.44
1:A:288:GLN:HG3	1:B:144:VAL:HG11	1.98	0.44
1:A:105:GLY:O	1:A:108:LYS:HG2	2.17	0.44
1:B:84:ILE:O	1:B:88:VAL:HG23	2.17	0.44
1:A:155:LEU:HD12	1:A:156:PHE:N	2.27	0.44
1:B:305:MET:HG2	1:B:306:PRO:HD2	2.00	0.43
1:A:255:LYS:HD2	1:A:256:TYR:HE1	1.82	0.43
1:B:221:LEU:H	1:B:221:LEU:CD2	2.27	0.43
1:B:179:TYR:HE1	1:B:183:LEU:HD21	1.83	0.43
1:B:134:LEU:HA	1:B:134:LEU:HD23	1.89	0.43
1:A:143:GLN:HG3	1:A:270:MET:CE	2.45	0.42
1:A:20:LEU:HB3	1:A:239:VAL:HG12	2.01	0.42
1:B:274:MET:HB3	1:B:289:LEU:CD1	2.50	0.42
1:B:96:VAL:HB	1:B:100:THR:HB	2.02	0.42
1:B:278:ILE:O	1:B:282:SER:HA	2.20	0.42
1:B:105:GLY:O	1:B:108:LYS:HG2	2.20	0.41
1:A:229:PHE:HA	1:A:232:TYR:CD1	2.55	0.41
1:A:134:LEU:CD1	1:B:134:LEU:HD11	2.37	0.41
1:A:134:LEU:HD23	1:A:134:LEU:HA	1.85	0.41
1:A:107:LEU:HD12	1:A:107:LEU:HA	1.82	0.41
1:A:16:SER:CB	1:A:242:ASN:HD21	2.34	0.41
1:A:116:PHE:HE1	1:A:258:ASP:HB2	1.85	0.41
1:B:305:MET:HA	1:B:306:PRO:HD3	1.87	0.41
1:A:77:VAL:HB	1:A:78:PRO:HD3	2.02	0.41
1:A:141:THR:O	1:A:288:GLN:HB3	2.22	0.40
1:B:301:GLN:HB3	1:B:305:MET:HE1	2.02	0.40
1:B:103:ILE:HD11	1:B:144:VAL:HG23	2.02	0.40
1:B:141:THR:O	1:B:288:GLN:HB3	2.21	0.40
1:A:122:ARG:HE	1:A:122:ARG:HB3	1.75	0.40
1:A:130:MET:HE3	1:B:301:GLN:HB2	2.04	0.40

There are no symmetry-related clashes.

## 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	275/322 (85%)	269 (98%)	6 (2%)	0	100	100
1	B	281/322 (87%)	274 (98%)	7 (2%)	0	100	100
All	All	556/644 (86%)	543 (98%)	13 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 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	225/288 (78%)	217 (96%)	8 (4%)	35	63
1	B	220/288 (76%)	211 (96%)	9 (4%)	30	59
All	All	445/576 (77%)	428 (96%)	17 (4%)	33	61

All (17) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	24	SER
1	A	90	PHE
1	A	98	PRO
1	A	132	ILE
1	A	178	VAL
1	A	251	SER
1	A	273	THR
1	A	295	ILE

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Mol	Chain	Res	Type
1	B	37	ILE
1	B	62	SER
1	B	86	ASN
1	B	137	VAL
1	B	144	VAL
1	B	251	SER
1	B	257	SER
1	B	268	MET
1	B	273	THR

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

Mol	Chain	Res	Type
1	A	85	HIS
1	A	89	GLN
1	A	242	ASN
1	A	259	ASN
1	B	242	ASN
1	B	259	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 [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

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	283/322 (87%)	-0.17	13 (4%) 32 32	76, 170, 242, 277	0
1	B	291/322 (90%)	-0.16	15 (5%) 27 27	94, 178, 263, 330	0
All	All	574/644 (89%)	-0.17	28 (4%) 29 29	76, 174, 251, 330	0

All (28) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	MET	6.3
1	B	143	GLN	6.1
1	B	233	SER	4.3
1	A	54	TRP	4.1
1	B	285	ALA	3.9
1	A	230	ASN	3.8
1	B	54	TRP	3.8
1	A	231	GLY	3.7
1	B	228	LEU	3.6
1	B	188	ASN	3.5
1	B	58	ARG	3.4
1	B	57	CYS	3.2
1	A	57	CYS	3.2
1	A	285	ALA	3.1
1	A	307	VAL	2.9
1	A	69	TRP	2.9
1	A	163	TYR	2.7
1	B	62	SER	2.6
1	B	73	ARG	2.6
1	A	284	LYS	2.6
1	A	26	SER	2.5
1	B	189	ASP	2.5
1	A	306	PRO	2.5
1	A	229	PHE	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	214	ASP	2.2
1	B	197	GLN	2.2
1	B	194	GLN	2.1
1	B	226	GLN	2.0

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

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.