



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 9, 2026 – 01:34 PM UTC

PDB ID : 2CHE / pdb\_00002che  
Title : STRUCTURE OF THE MG<sup>2+</sup>-BOUND FORM OF CHEY AND MECHANISM OF PHOSPHORYL TRANSFER IN BACTERIAL CHEMOTAXIS  
Authors : Stock, A.; Martinez-Hackert, E.; Rasmussen, B.; West, A.; Stock, J.; Ringe, D.; Petsko, G.  
Deposited on : 1994-01-17  
Resolution : 1.80 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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

MolProbity : 4-5-2 with Phenix2.0  
Xtrriage (Phenix) : **NOT EXECUTED**  
EDS : **NOT EXECUTED**  
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.49

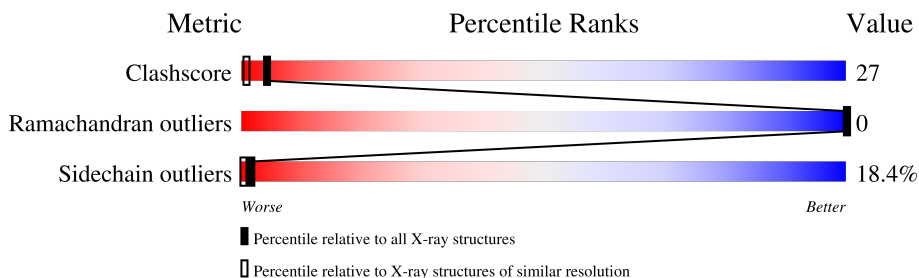
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.80 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))
Clashscore	190562	8479 (1.80-1.80)
Ramachandran outliers	187476	8391 (1.80-1.80)
Sidechain outliers	187428	8390 (1.80-1.80)

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  $\geq 3$ , 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  $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	128	

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 1078 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 CHEY.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	128	981	625	162	188	6	0	0	0

- Molecule 2 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Mg	0	0
			1	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	96	Total	O	0	0
			96	96		

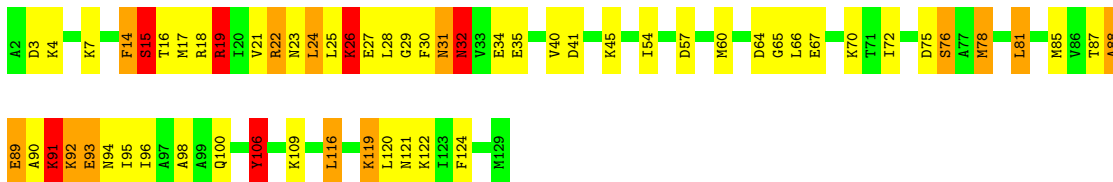
### 3 Residue-property plots [i](#)

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. 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. 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.

Note EDS was not executed.

- Molecule 1: CHEY

Chain A: 



## 4 Data and refinement statistics

Xtrriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	45.71Å 46.98Å 53.91Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	(Not available) – 1.80	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-1.80)	Depositor
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
Refinement program	PROLSQ	Depositor
R, $R_{free}$	0.190 , (Not available)	Depositor
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	1078	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	14.0	wwPDB-VP

## 5 Model quality

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: MG

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	1.43	4/993 (0.4%)	2.16	41/1334 (3.1%)

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 (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	121	ASN	C-N	-5.37	1.27	1.33
1	A	89	GLU	CD-OE1	5.23	1.35	1.25
1	A	85	MET	C-N	-5.17	1.26	1.33
1	A	31	ASN	C-N	-5.12	1.27	1.33

All (41) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	32	ASN	OD1-CG-ND2	13.00	135.60	122.60
1	A	32	ASN	CA-CB-CG	-12.09	100.51	112.60
1	A	32	ASN	CA-C-O	-10.78	109.98	122.37
1	A	32	ASN	O-C-N	9.99	134.35	122.46
1	A	106	TYR	CB-CG-CD2	8.65	133.78	120.80
1	A	14	PHE	CA-CB-CG	8.08	121.88	113.80
1	A	16	THR	CA-CB-OG1	-7.45	98.43	109.60
1	A	15	SER	CA-CB-OG	-7.36	96.38	111.10
1	A	124	PHE	CA-CB-CG	7.08	120.88	113.80

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	3	ASP	CA-C-O	-6.92	112.75	120.70
1	A	106	TYR	CA-CB-CG	-6.72	101.81	113.90
1	A	76	SER	CA-C-O	-6.51	113.59	120.63
1	A	106	TYR	CB-CG-CD1	-6.44	111.14	120.80
1	A	19	ARG	NH1-CZ-NH2	-6.33	111.07	119.30
1	A	19	ARG	CB-CG-CD	6.17	125.50	111.30
1	A	60	MET	O-C-N	6.04	126.17	121.88
1	A	19	ARG	NE-CZ-NH2	6.03	124.63	119.20
1	A	32	ASN	CB-CA-C	-5.94	102.77	112.03
1	A	106	TYR	O-C-N	-5.83	116.28	123.33
1	A	94	ASN	O-C-N	5.81	128.36	122.09
1	A	119	LYS	N-CA-CB	5.79	118.63	110.12
1	A	75	ASP	CA-C-N	5.78	128.31	120.38
1	A	75	ASP	C-N-CA	5.78	128.31	120.38
1	A	21	VAL	O-C-N	5.73	127.43	121.87
1	A	121	ASN	CA-C-N	5.40	127.46	120.44
1	A	121	ASN	C-N-CA	5.40	127.46	120.44
1	A	95	ILE	CA-C-O	-5.32	115.53	121.17
1	A	91	LYS	O-C-N	5.32	129.53	123.31
1	A	94	ASN	CA-CB-CG	5.27	117.87	112.60
1	A	65	GLY	O-C-N	5.26	127.24	122.19
1	A	91	LYS	N-CA-CB	5.22	119.84	110.80
1	A	14	PHE	N-CA-CB	5.22	118.75	110.55
1	A	88	ALA	N-CA-C	-5.22	106.91	113.28
1	A	27	GLU	CG-CD-OE2	-5.20	106.44	118.40
1	A	57	ASP	CA-CB-CG	5.19	117.79	112.60
1	A	26	LYS	CA-C-O	5.19	126.45	120.90
1	A	78	MET	CB-CA-C	-5.18	100.97	109.99
1	A	98	ALA	CA-C-O	-5.14	115.40	120.70
1	A	98	ALA	O-C-N	5.10	127.60	122.09
1	A	30	PHE	O-C-N	5.08	129.11	122.87
1	A	87	THR	CA-CB-CG2	5.02	119.04	110.50

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	22	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	981	0	1003	54	0
2	A	1	0	0	0	0
3	A	96	0	0	20	1
All	All	1078	0	1003	54	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 27.

All (54) 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:A:92:LYS:HD2	3:A:205:HOH:O	1.24	1.30
1:A:106:TYR:HD1	1:A:106:TYR:O	1.32	1.09
1:A:18:ARG:HH21	1:A:19:ARG:NH2	1.70	0.90
1:A:106:TYR:CD1	1:A:106:TYR:N	2.23	0.90
1:A:15:SER:O	1:A:19:ARG:HD2	1.72	0.88
1:A:106:TYR:O	1:A:106:TYR:CD1	2.24	0.87
1:A:23:ASN:HB2	3:A:204:HOH:O	1.79	0.83
1:A:26:LYS:CE	3:A:167:HOH:O	2.34	0.76
1:A:54:ILE:HD13	1:A:72:ILE:HD13	1.68	0.75
1:A:106:TYR:CD1	1:A:106:TYR:C	2.66	0.74
1:A:26:LYS:HE3	1:A:26:LYS:CA	2.19	0.72
1:A:106:TYR:HD1	1:A:106:TYR:C	1.86	0.72
1:A:119:LYS:CE	3:A:184:HOH:O	2.38	0.72
1:A:19:ARG:NH2	1:A:35:GLU:OE1	2.22	0.72
1:A:32:ASN:HB2	3:A:138:HOH:O	1.92	0.68
1:A:26:LYS:HE3	1:A:26:LYS:HA	1.74	0.68
1:A:119:LYS:HE3	3:A:184:HOH:O	1.95	0.67
1:A:96:ILE:CG1	3:A:205:HOH:O	2.43	0.66
1:A:67:GLU:HG3	3:A:217:HOH:O	1.94	0.66
1:A:26:LYS:HE2	1:A:31:ASN:HA	1.79	0.65
1:A:26:LYS:HD3	3:A:167:HOH:O	1.97	0.64
1:A:88:ALA:HB2	1:A:109:LYS:NZ	2.13	0.64
1:A:26:LYS:CD	3:A:167:HOH:O	2.48	0.62
1:A:109:LYS:HE3	3:A:224:HOH:O	2.00	0.61

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:96:ILE:HG13	3:A:205:HOH:O	2.01	0.60
1:A:96:ILE:HG12	3:A:205:HOH:O	2.01	0.60
1:A:88:ALA:CA	1:A:109:LYS:HZ3	2.14	0.60
1:A:4:LYS:HG3	1:A:29:GLY:O	2.04	0.56
1:A:26:LYS:HE2	3:A:167:HOH:O	2.00	0.54
1:A:91:LYS:HE3	3:A:189:HOH:O	2.09	0.53
1:A:92:LYS:HG3	1:A:93:GLU:N	2.23	0.53
1:A:7:LYS:HA	1:A:32:ASN:HB3	1.90	0.52
1:A:18:ARG:NH2	1:A:19:ARG:NH2	2.49	0.50
1:A:15:SER:O	1:A:19:ARG:CD	2.54	0.49
1:A:24:LEU:HB3	1:A:116:LEU:HD12	1.94	0.49
1:A:89:GLU:OE1	3:A:203:HOH:O	2.20	0.48
1:A:41:ASP:O	1:A:45:LYS:HG2	2.14	0.47
1:A:54:ILE:HD13	1:A:72:ILE:CD1	2.42	0.47
1:A:17:MET:HE2	1:A:17:MET:HB2	1.63	0.46
1:A:66:LEU:HG	1:A:70:LYS:HE3	1.98	0.46
1:A:90:ALA:HA	3:A:177:HOH:O	2.14	0.46
1:A:14:PHE:HD1	3:A:132:HOH:O	1.98	0.46
1:A:88:ALA:HB2	1:A:109:LYS:HZ3	1.78	0.46
1:A:116:LEU:O	1:A:120:LEU:HG	2.16	0.45
1:A:18:ARG:HH21	1:A:19:ARG:HH22	1.55	0.45
1:A:93:GLU:H	1:A:93:GLU:CD	2.25	0.45
1:A:93:GLU:N	1:A:93:GLU:CD	2.75	0.44
1:A:88:ALA:CB	1:A:109:LYS:HZ3	2.30	0.44
1:A:88:ALA:HA	1:A:109:LYS:HZ3	1.81	0.44
1:A:88:ALA:HB2	1:A:109:LYS:HZ1	1.82	0.43
1:A:64:ASP:OD1	1:A:67:GLU:HG3	2.19	0.42
1:A:78:MET:HB3	1:A:81:LEU:HD22	2.03	0.41
1:A:92:LYS:HB3	3:A:193:HOH:O	2.21	0.41
1:A:23:ASN:CB	3:A:204:HOH:O	2.53	0.40

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)
3:A:136:HOH:O	3:A:148:HOH:O[3_645]	0.19	2.01

## 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	126/128 (98%)	124 (98%)	2 (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	103/103 (100%)	84 (82%)	19 (18%)	1 0

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	15	SER
1	A	19	ARG
1	A	22	ARG
1	A	24	LEU
1	A	25	LEU
1	A	26	LYS
1	A	28	LEU
1	A	32	ASN
1	A	34	GLU
1	A	40	VAL
1	A	76	SER
1	A	81	LEU
1	A	91	LYS

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Mol	Chain	Res	Type
1	A	92	LYS
1	A	93	GLU
1	A	100	GLN
1	A	106	TYR
1	A	116	LEU
1	A	122	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	44	ASN
1	A	59	ASN
1	A	94	ASN
1	A	100	GLN

### 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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

## 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 [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

EDS was not executed - this section is therefore empty.

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

EDS was not executed - this section is therefore empty.

### 6.3 Carbohydrates [i](#)

EDS was not executed - this section is therefore empty.

### 6.4 Ligands [i](#)

EDS was not executed - this section is therefore empty.

### 6.5 Other polymers [i](#)

EDS was not executed - this section is therefore empty.