Full wwPDB X-ray Structure Validation Report ⓘ

Mar 4, 2026 – 06:54 PM UTC

PDB ID	:	6PAO / pdb_00006pao
Title	:	Structure of a bacterial Atm1-family ABC exporter with ATP bound
Authors	:	Fan, C.; Kaiser, J.T.; Rees, D.C.
Deposited on	:	2019-06-11
Resolution	:	3.65 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 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:

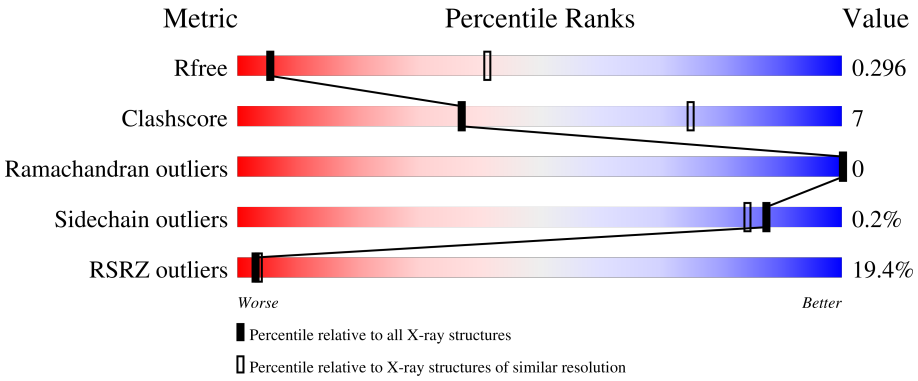
MolProbity	:	4-5-2 with Phenix2.0
Mogul	:	2022.3.0, CSD as543be (2022)
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

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 3.65 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	1062 (3.78-3.54)
Clashscore	190562	1009 (3.76-3.56)
Ramachandran outliers	187476	1054 (3.78-3.54)
Sidechain outliers	187428	1052 (3.78-3.54)
RSRZ outliers	180081	1061 (3.78-3.54)

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	614	19% 74% 18% 8%
1	B	614	17% 78% 14% 8%

2 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 8835 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.

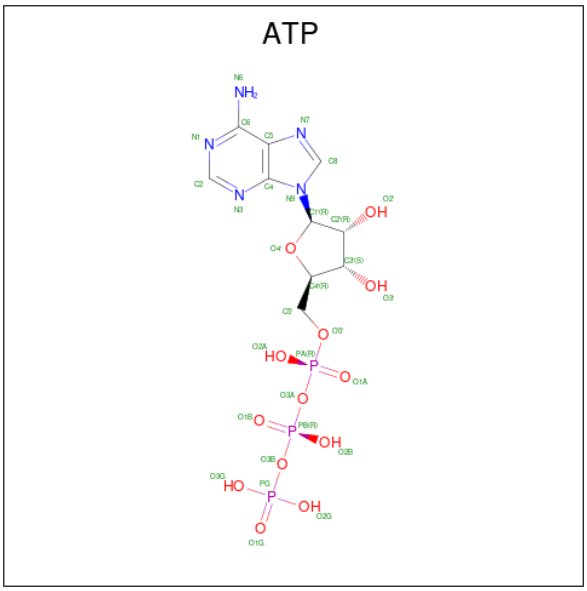
- Molecule 1 is a protein called ATM1-type heavy metal exporter.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	566	Total	C	N	O	S	0	0	0
			4384	2796	779	796	13			
1	B	567	Total	C	N	O	S	0	0	0
			4389	2799	780	797	13			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	525	CYS	THR	engineered mutation	UNP Q2G506
A	609	HIS	-	expression tag	UNP Q2G506
A	610	HIS	-	expression tag	UNP Q2G506
A	611	HIS	-	expression tag	UNP Q2G506
A	612	HIS	-	expression tag	UNP Q2G506
A	613	HIS	-	expression tag	UNP Q2G506
A	614	HIS	-	expression tag	UNP Q2G506
B	525	CYS	THR	engineered mutation	UNP Q2G506
B	609	HIS	-	expression tag	UNP Q2G506
B	610	HIS	-	expression tag	UNP Q2G506
B	611	HIS	-	expression tag	UNP Q2G506
B	612	HIS	-	expression tag	UNP Q2G506
B	613	HIS	-	expression tag	UNP Q2G506
B	614	HIS	-	expression tag	UNP Q2G506

- Molecule 2 is ADENOSINE-5'-TRIPHOSPHATE (CCD ID: ATP) (formula: $C_{10}H_{16}N_5O_{13}P_3$).



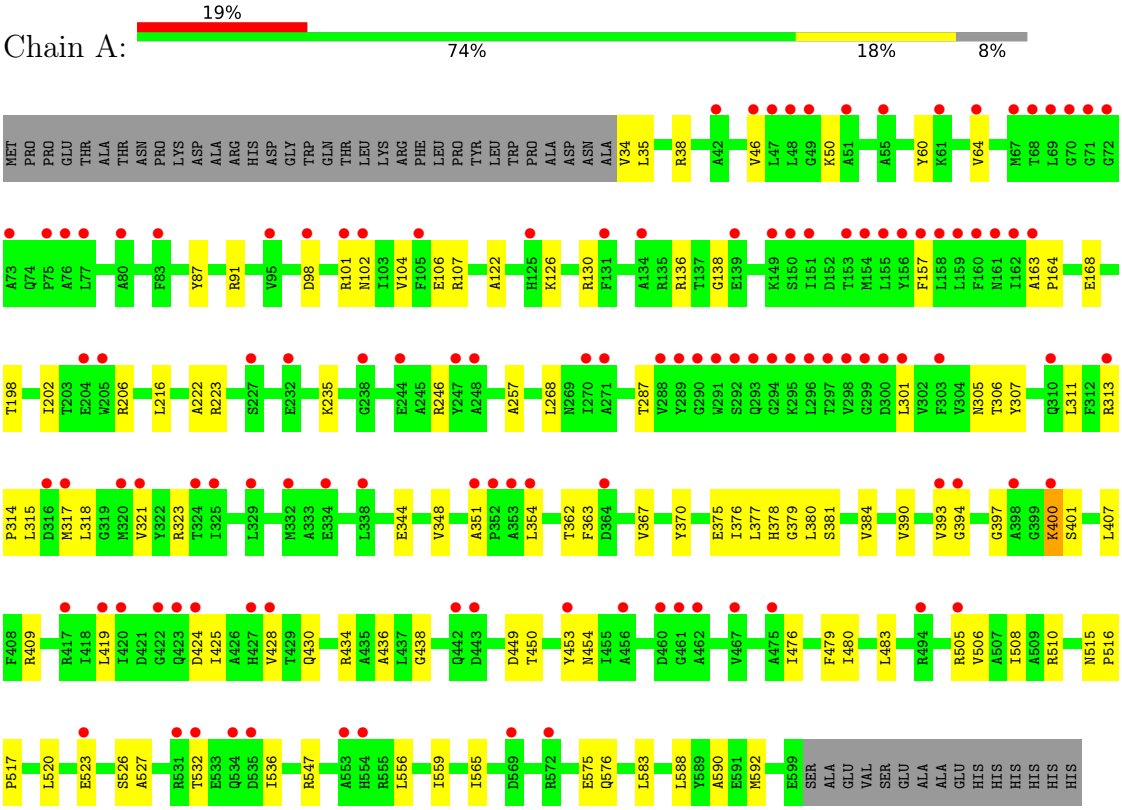
Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			31	10	5	13	3		
2	B	1	Total	C	N	O	P	0	0
			31	10	5	13	3		

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.

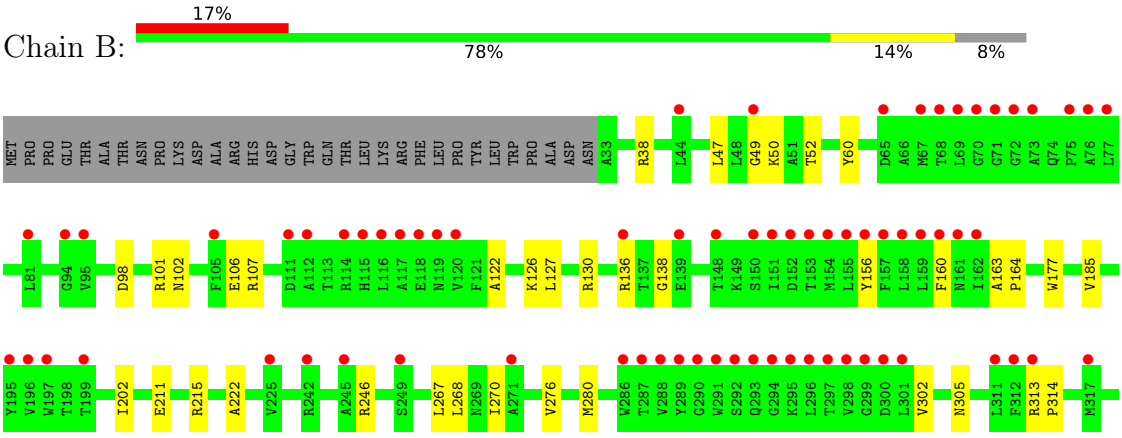
• Molecule 1: ATM1-type heavy metal exporter

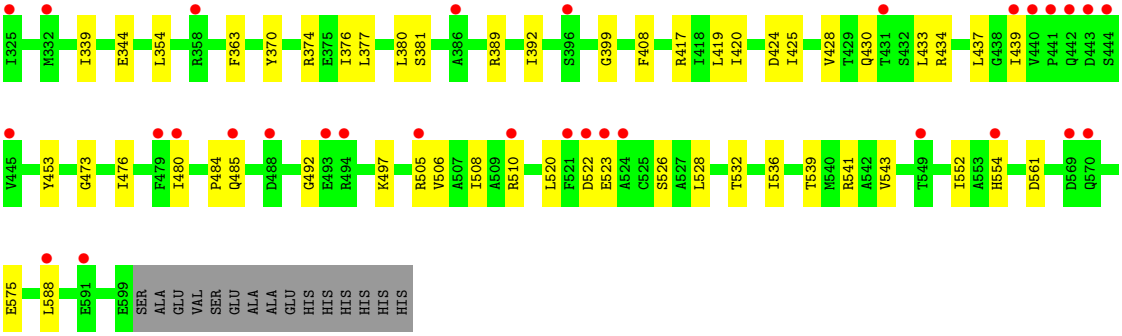
Chain A:



• Molecule 1: ATM1-type heavy metal exporter

Chain B:




I325 M332 I339 E344 L354 R358 F363 Y370 R374 E375 I376 L377 L380 S381 A386 R389 I392 S396 G399 F408 R417 I418 L419 I420 D424 I425 V428 T429 Q430 T431 S432 L433 R434 L437 G438 I439 V440 P441 Q442 D443 S444
V445 Y453 G473 I476 F479 I480 P484 Q485 D488 G492 E493 R494 K497 R505 V506 A507 I508 A509 R510 L520 F521 D522 E523 A524 C525 S526 A527 L528 T532 I536 T539 M540 R541 A542 V543 T549 I552 A553 H554 D561 D569 Q570
E575 L588 E591 E599 SER ALA GLU VAL SER GLU ALA ALA GLU HIS HIS HIS HIS HIS HIS

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	94.16Å 135.41Å 191.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	39.10 – 3.65 39.10 – 3.65	Depositor EDS
% Data completeness (in resolution range)	97.9 (39.10-3.65) 97.9 (39.10-3.65)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.09 (at 3.66Å)	Xtriage
Refinement program	PHENIX 1.15.2_3472, REFMAC	Depositor
R, R_{free}	0.252 , 0.285 0.258 , 0.296	Depositor DCC
R_{free} test set	1359 reflections (3.95%)	wwPDB-VP
Wilson B-factor (Å^2)	170.9	Xtriage
Anisotropy	0.206	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.24 , 142.0	EDS
L-test for twinning[2]	$< \|L\| > = 0.45$, $< L^2 > = 0.28$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o,F_c correlation	0.88	EDS
Total number of atoms	8835	wwPDB-VP
Average B, all atoms (Å^2)	214.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.38% 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: ATP

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	0.16	0/4460	0.34	0/6054
1	B	0.16	0/4465	0.35	0/6061
All	All	0.16	0/8925	0.34	0/12115

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	4384	0	4477	73	0
1	B	4389	0	4482	56	0
2	A	31	0	12	2	0
2	B	31	0	12	2	0
All	All	8835	0	8983	126	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 7.

All (126) 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:392:ILE:HB	1:B:552:ILE:HG22	1.53	0.89
1:A:223:ARG:HD3	1:A:246:ARG:HG2	1.55	0.88
1:A:476:ILE:HG22	1:A:480:ILE:HG13	1.63	0.81
1:B:476:ILE:HG22	1:B:480:ILE:HG13	1.64	0.78
1:A:354:LEU:HB2	1:A:428:VAL:HG11	1.65	0.77
1:A:367:VAL:HG22	1:A:379:GLY:H	1.54	0.71
1:A:130:ARG:NH1	1:A:344:GLU:OE2	2.24	0.70
1:B:508:ILE:HG21	1:B:536:ILE:HD11	1.71	0.70
1:A:268:LEU:HD23	1:A:323:ARG:HE	1.60	0.67
1:A:523:GLU:HG3	1:A:526:SER:HB3	1.77	0.66
1:B:408:PHE:HD1	1:B:437:LEU:HD11	1.60	0.66
1:B:130:ARG:NH1	1:B:344:GLU:OE2	2.31	0.64
1:A:516:PRO:HD2	1:A:547:ARG:HH22	1.63	0.63
1:B:399:GLY:N	2:B:701:ATP:O1A	2.29	0.62
1:B:202:ILE:HB	1:B:268:LEU:HD13	1.81	0.62
1:B:370:TYR:HD1	1:B:376:ILE:HG13	1.64	0.62
1:B:523:GLU:HG3	1:B:526:SER:HB3	1.82	0.61
1:A:363:PHE:O	1:A:381:SER:HA	2.00	0.61
1:A:515:ASN:OD1	1:A:547:ARG:NH1	2.34	0.61
1:A:397:GLY:N	2:A:701:ATP:O1G	2.35	0.60
1:A:98:ASP:OD1	1:A:101:ARG:NH1	2.35	0.60
1:B:102:ASN:O	1:B:106:GLU:HG2	2.03	0.59
1:B:541:ARG:NH2	1:B:561:ASP:OD2	2.35	0.58
1:A:453:TYR:OH	1:B:246:ARG:NH1	2.36	0.58
1:B:420:ILE:HG13	1:B:425:ILE:HD11	1.86	0.57
1:B:354:LEU:HB2	1:B:428:VAL:HG11	1.86	0.57
1:A:575:GLU:OE2	1:A:588:LEU:N	2.30	0.57
1:B:101:ARG:HD2	1:B:160:PHE:HE1	1.70	0.57
1:A:476:ILE:HG23	1:A:479:PHE:HD2	1.70	0.57
1:A:377:LEU:HD11	1:A:380:LEU:HD22	1.87	0.56
1:A:136:ARG:HG2	1:A:222:ALA:HB1	1.87	0.56
1:A:206:ARG:NH2	1:A:268:LEU:HD22	2.22	0.55
1:B:211:GLU:OE2	1:B:215:ARG:NH2	2.39	0.55
1:A:246:ARG:NH2	1:B:453:TYR:OH	2.39	0.55
1:A:102:ASN:O	1:A:106:GLU:HG2	2.06	0.54
1:B:505:ARG:HG3	1:B:528:LEU:HD21	1.90	0.54
1:A:476:ILE:HD11	1:A:505:ARG:CB	2.36	0.54
1:A:508:ILE:HG21	1:A:536:ILE:HD11	1.88	0.54
1:A:515:ASN:HA	1:A:547:ARG:HH12	1.73	0.54
1:B:417:ARG:HE	1:B:419:LEU:HD21	1.72	0.53
1:B:363:PHE:O	1:B:381:SER:HA	2.09	0.53
1:A:362:THR:HB	1:A:419:LEU:HB2	1.90	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:375:GLU:OE2	1:A:378:HIS:HB3	2.09	0.53
1:A:348:VAL:HG23	1:A:351:ALA:HB2	1.92	0.52
1:A:384:VAL:HG13	1:A:390:VAL:HG21	1.91	0.52
1:A:476:ILE:HD11	1:A:505:ARG:HB3	1.92	0.52
1:B:138:GLY:HA3	1:B:222:ALA:HA	1.92	0.52
1:A:556:LEU:HD22	1:A:559:ILE:HD11	1.92	0.51
1:B:101:ARG:HD2	1:B:160:PHE:CE1	2.45	0.51
1:A:202:ILE:HB	1:A:268:LEU:HD13	1.92	0.51
1:A:122:ALA:O	1:A:126:LYS:HG2	2.11	0.51
1:A:438:GLY:HA3	1:A:516:PRO:HG3	1.92	0.51
1:A:370:TYR:HD2	1:A:376:ILE:HG13	1.76	0.50
1:A:313:ARG:HB3	1:A:314:PRO:HD3	1.93	0.50
1:B:49:GLY:O	1:B:52:THR:HG22	2.12	0.49
1:B:136:ARG:HG2	1:B:222:ALA:HB1	1.94	0.49
1:B:408:PHE:CD1	1:B:437:LEU:HD11	2.45	0.49
1:B:389:ARG:NH2	1:B:561:ASP:O	2.45	0.49
1:A:206:ARG:HH11	1:A:323:ARG:HG3	1.77	0.49
1:A:50:LYS:NZ	1:A:168:GLU:HG2	2.28	0.49
1:B:122:ALA:O	1:B:126:LYS:HG2	2.13	0.49
1:B:505:ARG:HE	1:B:532:THR:HG21	1.78	0.49
1:A:138:GLY:HA3	1:A:222:ALA:HA	1.94	0.48
1:B:374:ARG:NH2	2:B:701:ATP:O2'	2.46	0.48
1:B:430:GLN:HB3	1:B:434:ARG:HH11	1.79	0.48
1:A:216:LEU:HD12	1:A:257:ALA:HB2	1.95	0.47
1:A:401:SER:OG	2:A:701:ATP:O1A	2.32	0.47
1:B:267:LEU:O	1:B:270:ILE:HG13	2.14	0.47
1:B:539:THR:O	1:B:543:VAL:HG22	2.15	0.47
1:A:424:ASP:OD1	1:A:425:ILE:N	2.49	0.46
1:B:38:ARG:HH22	1:B:107:ARG:HD2	1.80	0.46
1:A:87:TYR:O	1:A:91:ARG:HG2	2.16	0.46
1:A:301:LEU:HD23	1:A:305:ASN:HD22	1.80	0.46
1:A:476:ILE:HG22	1:A:476:ILE:O	2.16	0.46
1:A:436:ALA:O	1:A:517:PRO:HD2	2.16	0.46
1:B:424:ASP:OD1	1:B:425:ILE:N	2.49	0.45
1:A:409:ARG:HD3	1:A:425:ILE:HG22	1.98	0.45
1:B:313:ARG:HB3	1:B:314:PRO:HD3	1.98	0.45
1:A:407:LEU:HD23	1:A:520:LEU:HD12	1.99	0.45
1:B:439:ILE:HG13	1:B:520:LEU:HD22	1.98	0.45
1:B:492:GLY:HA3	1:B:497:LYS:HG3	1.99	0.45
1:A:38:ARG:HH22	1:A:107:ARG:NH1	2.15	0.44
1:A:476:ILE:HG21	1:A:476:ILE:HD13	1.72	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:377:LEU:HD11	1:B:380:LEU:HD22	2.00	0.44
1:B:425:ILE:HG23	1:B:433:LEU:HD22	1.98	0.44
1:A:157:PHE:HB3	1:A:321:VAL:HG13	2.00	0.43
1:A:198:THR:O	1:A:202:ILE:HG12	2.18	0.43
1:B:522:ASP:HA	1:B:552:ILE:HG12	2.00	0.43
1:A:315:LEU:HD23	1:A:318:LEU:HD21	2.00	0.43
1:A:565:ILE:O	1:A:576:GLN:HA	2.17	0.43
1:B:60:TYR:HB3	1:B:302:VAL:HB	2.00	0.43
1:B:163:ALA:HB3	1:B:164:PRO:HD3	2.00	0.43
1:A:449:ASP:OD1	1:A:450:THR:N	2.41	0.43
1:A:527:ALA:O	1:B:554:HIS:NE2	2.52	0.43
1:B:473:GLY:HA2	1:B:539:THR:HG21	1.99	0.43
1:A:163:ALA:HB3	1:A:164:PRO:HD3	2.00	0.43
1:A:506:VAL:O	1:A:510:ARG:HG3	2.19	0.43
1:A:46:VAL:HG22	1:A:101:ARG:HD2	2.01	0.43
1:A:305:ASN:OD1	1:A:306:THR:N	2.52	0.43
1:B:177:TRP:CE3	1:B:185:VAL:HG21	2.54	0.42
1:B:575:GLU:OE2	1:B:588:LEU:N	2.44	0.42
1:B:476:ILE:HG22	1:B:476:ILE:O	2.20	0.42
1:B:484:PRO:O	1:B:485:GLN:HG2	2.19	0.42
1:B:302:VAL:HA	1:B:305:ASN:HD21	1.83	0.42
1:A:307:TYR:CZ	1:A:311:LEU:HD22	2.54	0.42
1:A:583:LEU:HD12	1:A:590:ALA:HA	2.02	0.42
1:A:313:ARG:HG3	1:A:317:MET:HE2	2.02	0.42
1:A:60:TYR:O	1:A:64:VAL:HG23	2.20	0.41
1:B:276:VAL:O	1:B:280:MET:HG3	2.20	0.41
1:A:34:VAL:HG13	1:A:35:LEU:HG	2.02	0.41
1:A:394:GLY:N	1:A:400:LYS:HZ1	2.18	0.41
1:A:479:PHE:O	1:A:483:LEU:HG	2.21	0.41
1:A:393:VAL:HG23	1:A:592:MET:HE1	2.01	0.41
1:B:47:LEU:O	1:B:50:LYS:HB3	2.20	0.41
1:A:287:THR:HB	1:A:301:LEU:HG	2.01	0.41
1:A:430:GLN:HB3	1:A:434:ARG:HH11	1.86	0.41
1:A:476:ILE:HG23	1:A:479:PHE:CD2	2.55	0.41
1:A:235:LYS:HA	1:A:235:LYS:HD3	1.89	0.41
1:B:101:ARG:NH1	1:B:156:TYR:OH	2.37	0.41
1:A:311:LEU:HG	1:A:315:LEU:HG	2.03	0.40
1:A:454:ASN:O	1:A:510:ARG:HG2	2.20	0.40
1:A:505:ARG:HE	1:A:532:THR:HG21	1.86	0.40
1:B:38:ARG:NH2	1:B:107:ARG:HD2	2.37	0.40
1:B:98:ASP:HA	1:B:101:ARG:NE	2.37	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:127:LEU:HD21	1:B:339:ILE:O	2.22	0.40
1:B:506:VAL:O	1:B:510:ARG:HG3	2.21	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	564/614 (92%)	552 (98%)	12 (2%)	0	100	100
1	B	565/614 (92%)	551 (98%)	14 (2%)	0	100	100
All	All	1129/1228 (92%)	1103 (98%)	26 (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	451/491 (92%)	449 (100%)	2 (0%)	84	79
1	B	451/491 (92%)	451 (100%)	0	100	100
All	All	902/982 (92%)	900 (100%)	2 (0%)	87	84

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	104	VAL
1	A	400	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	115	HIS
1	A	119	ASN
1	A	277	ASN
1	A	365	ASN
1	A	378	HIS
1	B	272	GLN
1	B	365	ASN
1	B	442	GLN

5.3.3 RNA

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains

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

5.5 Carbohydrates

There are no oligosaccharides in this entry.

5.6 Ligand geometry

2 ligands are modelled in this entry.

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	ATP	B	701	-	32,33,33	1.51	6 (18%)	48,52,52	1.83	14 (29%)
2	ATP	A	701	-	32,33,33	1.29	5 (15%)	48,52,52	1.65	9 (18%)

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
2	ATP	B	701	-	-	0/22/38/38	0/3/3/3
2	ATP	A	701	-	-	6/22/38/38	0/3/3/3

All (11) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	701	ATP	C5-C4	4.39	1.46	1.39
2	A	701	ATP	C5-C4	4.27	1.46	1.39
2	B	701	ATP	C5-N7	-3.19	1.33	1.39
2	B	701	ATP	C4-N9	-2.79	1.31	1.37
2	B	701	ATP	C5-C6	2.77	1.48	1.41
2	A	701	ATP	C5-N7	-2.47	1.34	1.39
2	B	701	ATP	PB-O3A	2.45	1.62	1.59
2	A	701	ATP	C4-N9	-2.31	1.32	1.37
2	A	701	ATP	C5-C6	2.29	1.47	1.41
2	A	701	ATP	C8-N7	2.26	1.36	1.31
2	B	701	ATP	PA-O3A	2.18	1.61	1.59

All (23) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	701	ATP	C5-C4-N3	-5.46	119.20	126.72
2	A	701	ATP	C5-C4-N3	-5.29	119.44	126.72
2	B	701	ATP	N3-C4-N9	4.42	134.69	127.17
2	A	701	ATP	N3-C4-N9	4.34	134.55	127.17
2	A	701	ATP	C2-N3-C4	3.44	120.24	111.83
2	B	701	ATP	C2-N3-C4	3.41	120.16	111.83
2	B	701	ATP	O4'-C1'-N9	3.17	114.17	108.09
2	A	701	ATP	N3-C2-N1	-3.13	123.84	128.58
2	B	701	ATP	C4-C5-N7	-3.12	107.01	110.58
2	A	701	ATP	C4-N9-C8	3.11	109.00	105.74
2	A	701	ATP	C4-C5-N7	-3.07	107.08	110.58

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	B	701	ATP	C4-N9-C8	2.92	108.81	105.74
2	B	701	ATP	O3'-C3'-C4'	-2.54	103.80	111.08
2	B	701	ATP	C5-N7-C8	2.53	107.42	103.45
2	B	701	ATP	N3-C2-N1	-2.50	124.79	128.58
2	B	701	ATP	O3G-PG-O3B	-2.47	96.37	104.64
2	B	701	ATP	N9-C8-N7	-2.32	110.65	113.94
2	A	701	ATP	C5-N7-C8	2.30	107.06	103.45
2	B	701	ATP	C6-C5-N7	2.19	136.31	132.09
2	A	701	ATP	N9-C8-N7	-2.18	110.85	113.94
2	B	701	ATP	O2B-PB-O1B	2.13	122.33	112.44
2	B	701	ATP	C5'-C4'-C3'	-2.09	107.70	115.21
2	A	701	ATP	C6-C5-N7	2.08	136.10	132.09

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	701	ATP	C5'-O5'-PA-O1A
2	A	701	ATP	C5'-O5'-PA-O3A
2	A	701	ATP	O4'-C4'-C5'-O5'
2	A	701	ATP	C3'-C4'-C5'-O5'
2	A	701	ATP	PB-O3A-PA-O1A
2	A	701	ATP	PB-O3A-PA-O2A

There are no ring outliers.

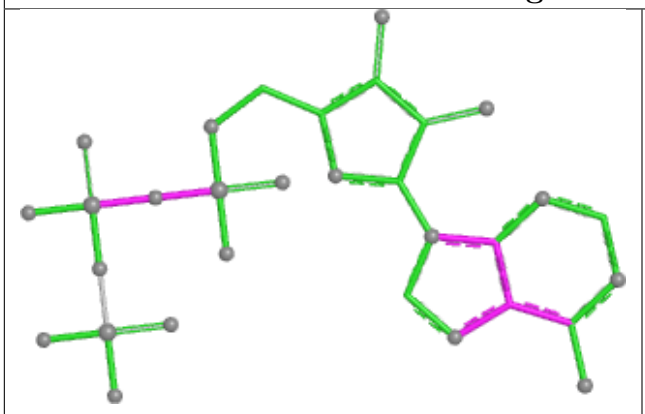
2 monomers are involved in 4 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	B	701	ATP	2	0
2	A	701	ATP	2	0

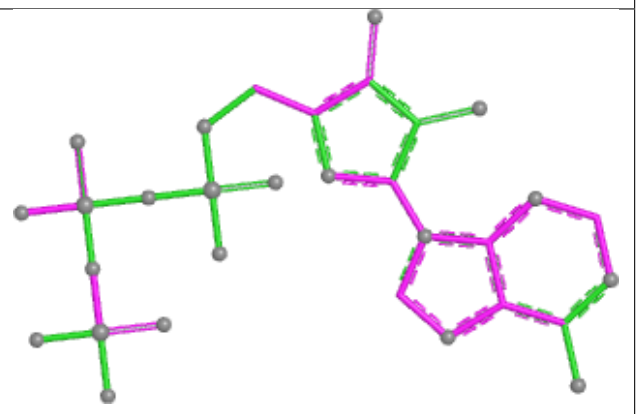
The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less then 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient

equivalents in the CSD to analyse the geometry.

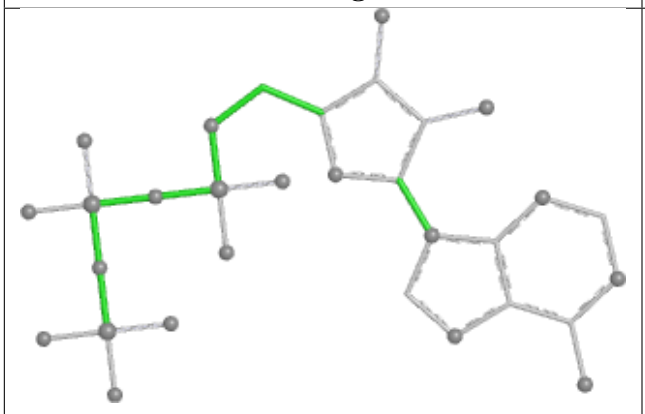
Ligand ATP B 701



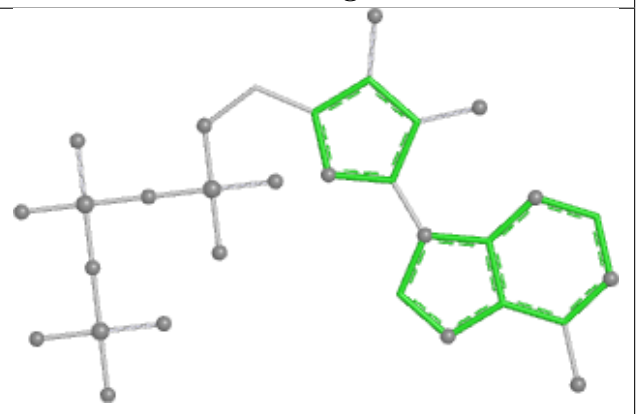
Bond lengths



Bond angles

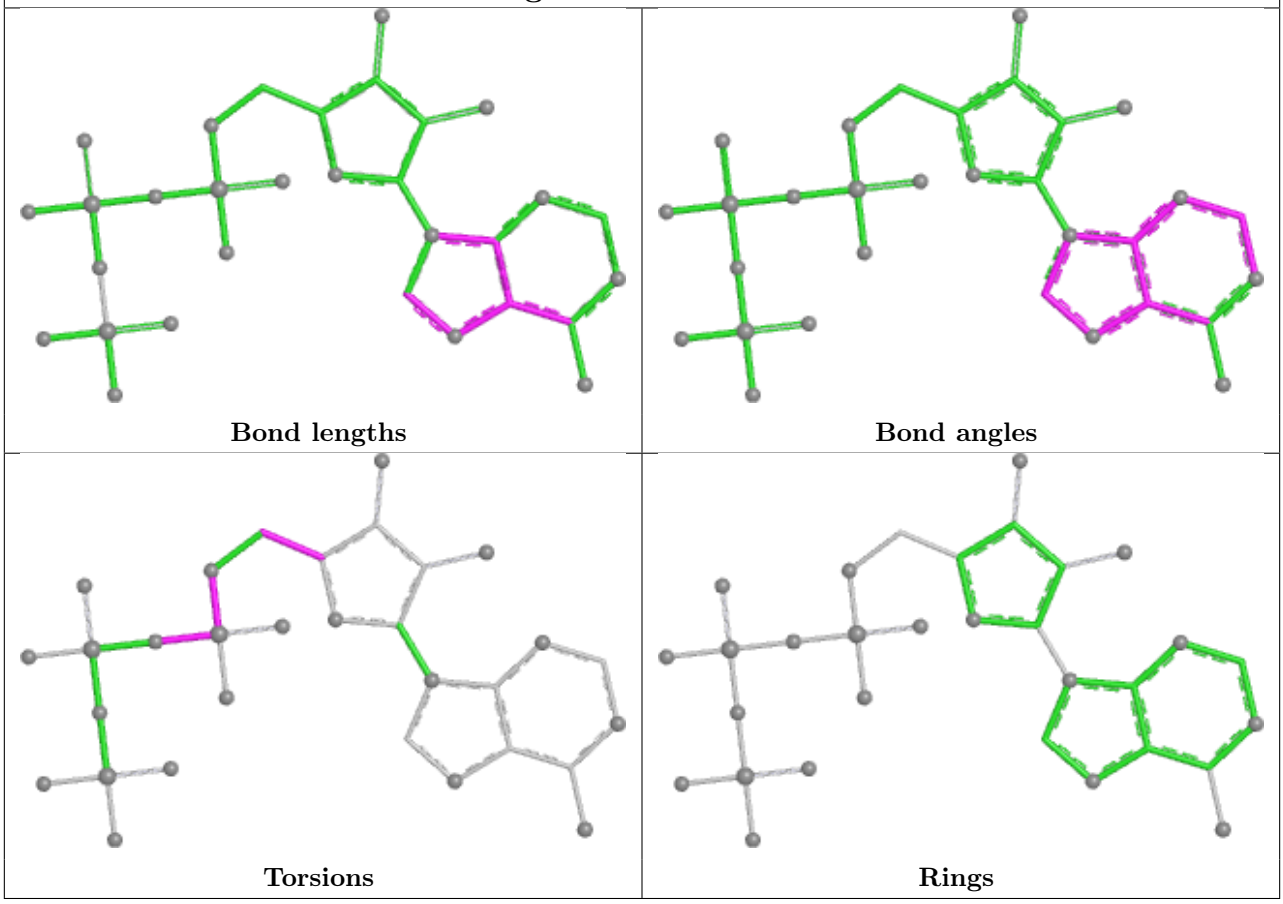


Torsions



Rings

Ligand ATP A 701



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^{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	566/614 (92%)	1.11	118 (20%)	2	3	87, 184, 307, 345	35 (6%)
1	B	567/614 (92%)	1.06	102 (17%)	3	4	72, 190, 299, 344	33 (5%)
All	All	1133/1228 (92%)	1.09	220 (19%)	3	3	72, 187, 307, 345	68 (6%)

All (220) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	289	TYR	14.4
1	B	161	ASN	14.3
1	B	157	PHE	14.0
1	B	155	LEU	12.7
1	A	299	GLY	12.1
1	B	158	LEU	11.5
1	A	298	VAL	9.8
1	B	162	ILE	9.2
1	A	297	THR	8.8
1	B	153	THR	8.8
1	A	295	LYS	8.2
1	B	301	LEU	8.2
1	A	154	MET	8.0
1	A	162	ILE	7.8
1	A	300	ASP	7.7
1	B	116	LEU	7.5
1	B	297	THR	7.1
1	B	298	VAL	7.1
1	B	299	GLY	7.1
1	A	153	THR	6.9
1	B	300	ASP	6.7
1	B	494	ARG	6.7
1	B	118	GLU	6.7
1	A	296	LEU	6.6

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Mol	Chain	Res	Type	RSRZ
1	A	424	ASP	6.5
1	A	294	GLY	6.5
1	A	161	ASN	6.4
1	B	160	PHE	6.4
1	B	522	ASP	6.4
1	A	157	PHE	6.3
1	A	301	LEU	6.3
1	A	352	PRO	6.2
1	B	291	TRP	6.2
1	B	570	GLN	6.1
1	B	77	LEU	6.1
1	A	353	ALA	6.0
1	B	485	GLN	5.9
1	B	591	GLU	5.8
1	B	286	TRP	5.8
1	B	151	ILE	5.7
1	B	288	VAL	5.7
1	A	553	ALA	5.7
1	B	289	TYR	5.6
1	B	287	THR	5.6
1	B	296	LEU	5.6
1	B	569	ASP	5.5
1	A	158	LEU	5.5
1	B	156	TYR	5.5
1	A	291	TRP	5.4
1	A	55	ALA	5.4
1	B	295	LYS	5.3
1	B	313	ARG	5.1
1	B	292	SER	4.9
1	B	115	HIS	4.9
1	A	427	HIS	4.9
1	A	72	GLY	4.8
1	B	117	ALA	4.8
1	B	493	GLU	4.8
1	A	51	ALA	4.7
1	A	75	PRO	4.7
1	A	290	GLY	4.7
1	A	64	VAL	4.6
1	A	461	GLY	4.6
1	A	321	VAL	4.5
1	B	312	PHE	4.5
1	A	159	LEU	4.5

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Mol	Chain	Res	Type	RSRZ
1	A	394	GLY	4.5
1	A	532	THR	4.5
1	A	155	LEU	4.4
1	B	588	LEU	4.4
1	A	531	ARG	4.4
1	A	101	ARG	4.4
1	A	460	ASP	4.4
1	A	68	THR	4.4
1	A	292	SER	4.3
1	B	294	GLY	4.3
1	B	112	ALA	4.3
1	B	150	SER	4.3
1	B	242	ARG	4.3
1	B	152	ASP	4.3
1	B	81	LEU	4.3
1	B	358	ARG	4.2
1	B	75	PRO	4.2
1	A	351	ALA	4.2
1	B	114	ARG	4.2
1	A	400	LYS	4.1
1	B	154	MET	4.1
1	B	290	GLY	4.1
1	A	67	MET	4.0
1	B	71	GLY	4.0
1	B	148	THR	4.0
1	A	320	MET	4.0
1	A	332	MET	4.0
1	A	505	ARG	3.8
1	A	61	LYS	3.8
1	A	77	LEU	3.8
1	B	119	ASN	3.8
1	A	443	ASP	3.8
1	A	150	SER	3.7
1	B	68	THR	3.7
1	A	428	VAL	3.7
1	B	441	PRO	3.7
1	A	247	TYR	3.7
1	A	364	ASP	3.7
1	A	535	ASP	3.7
1	A	417	ARG	3.7
1	B	72	GLY	3.6
1	A	462	ALA	3.6

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Mol	Chain	Res	Type	RSRZ
1	B	445	VAL	3.5
1	A	317	MET	3.5
1	B	396	SER	3.5
1	A	71	GLY	3.4
1	B	95	VAL	3.4
1	A	423	GLN	3.4
1	B	431	THR	3.4
1	B	69	LEU	3.4
1	B	249	SER	3.3
1	A	338	LEU	3.3
1	A	494	ARG	3.3
1	A	69	LEU	3.2
1	B	510	ARG	3.2
1	B	488	ASP	3.2
1	B	271	ALA	3.2
1	A	149	LYS	3.2
1	B	311	LEU	3.2
1	B	67	MET	3.2
1	A	293	GLN	3.1
1	B	111	ASP	3.1
1	B	332	MET	3.1
1	A	139	GLU	3.1
1	B	293	GLN	3.1
1	B	443	ASP	3.1
1	B	70	GLY	3.0
1	A	76	ALA	3.0
1	A	105	PHE	3.0
1	A	456	ALA	3.0
1	A	420	ILE	3.0
1	A	329	LEU	2.9
1	A	95	VAL	2.9
1	A	98	ASP	2.9
1	A	310	GLN	2.9
1	B	225	VAL	2.9
1	A	354	LEU	2.9
1	A	232	GLU	2.9
1	A	422	GLY	2.9
1	A	131	PHE	2.9
1	A	102	ASN	2.9
1	A	156	TYR	2.8
1	A	163	ALA	2.8
1	A	325	ILE	2.8

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Mol	Chain	Res	Type	RSRZ
1	A	334	GLU	2.8
1	B	442	GLN	2.8
1	B	554	HIS	2.8
1	A	248	ALA	2.8
1	A	313	ARG	2.8
1	B	386	ALA	2.8
1	B	159	LEU	2.7
1	A	534	GLN	2.7
1	B	245	ALA	2.7
1	A	316	ASP	2.7
1	A	46	VAL	2.7
1	B	65	ASP	2.6
1	B	136	ARG	2.6
1	A	238	GLY	2.6
1	B	139	GLU	2.6
1	B	440	VAL	2.6
1	A	42	ALA	2.6
1	B	73	ALA	2.6
1	A	48	LEU	2.6
1	A	303	PHE	2.6
1	A	49	GLY	2.5
1	B	549	THR	2.5
1	B	444	SER	2.5
1	B	317	MET	2.5
1	B	105	PHE	2.5
1	A	151	ILE	2.5
1	A	288	VAL	2.5
1	A	419	LEU	2.5
1	B	480	ILE	2.5
1	A	70	GLY	2.5
1	A	134	ALA	2.4
1	A	324	THR	2.4
1	A	453	TYR	2.4
1	B	49	GLY	2.4
1	A	125	HIS	2.4
1	A	398	ALA	2.4
1	A	393	VAL	2.4
1	A	83	PHE	2.4
1	A	160	PHE	2.4
1	A	569	ASP	2.4
1	B	197	TRP	2.4
1	B	325	ILE	2.3

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Mol	Chain	Res	Type	RSRZ
1	B	44	LEU	2.3
1	A	80	ALA	2.3
1	A	205	TRP	2.3
1	B	479	PHE	2.3
1	B	94	GLY	2.3
1	A	554	HIS	2.3
1	A	475	ALA	2.3
1	B	524	ALA	2.3
1	A	244	GLU	2.3
1	B	120	VAL	2.3
1	B	196	VAL	2.3
1	B	76	ALA	2.2
1	A	442	GLN	2.2
1	A	523	GLU	2.2
1	A	271	ALA	2.2
1	B	195	TYR	2.2
1	A	467	VAL	2.2
1	A	73	ALA	2.2
1	B	521	PHE	2.2
1	A	270	ILE	2.1
1	A	204	GLU	2.1
1	B	523	GLU	2.1
1	A	572	ARG	2.1
1	B	505	ARG	2.1
1	A	47	LEU	2.0
1	B	439	ILE	2.0
1	B	199	THR	2.0
1	A	227	SER	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 oligosaccharides in this entry.

6.4 Ligands (i)

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,

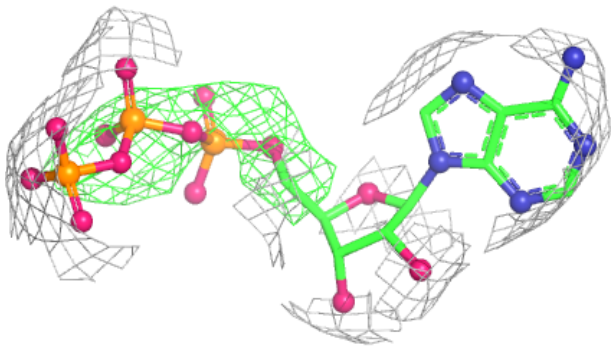
median, 95^{th} percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

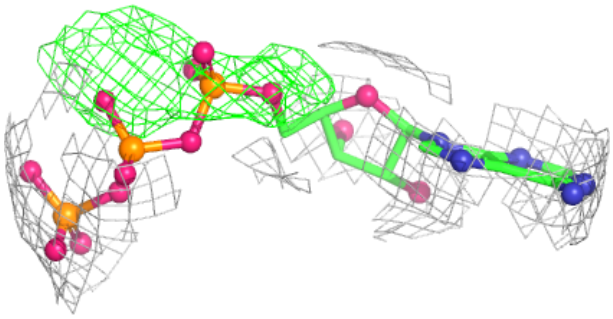
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å^2)	Q<0.9
2	ATP	B	701	31/31	0.94	0.12	160,189,254,258	0
2	ATP	A	701	31/31	0.96	0.12	151,173,212,223	0

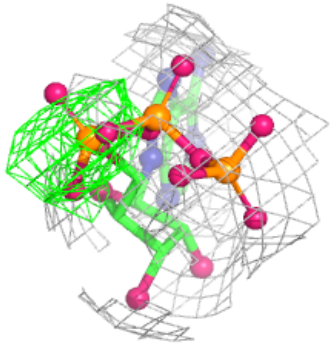
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.

Electron density around ATP B 701:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)

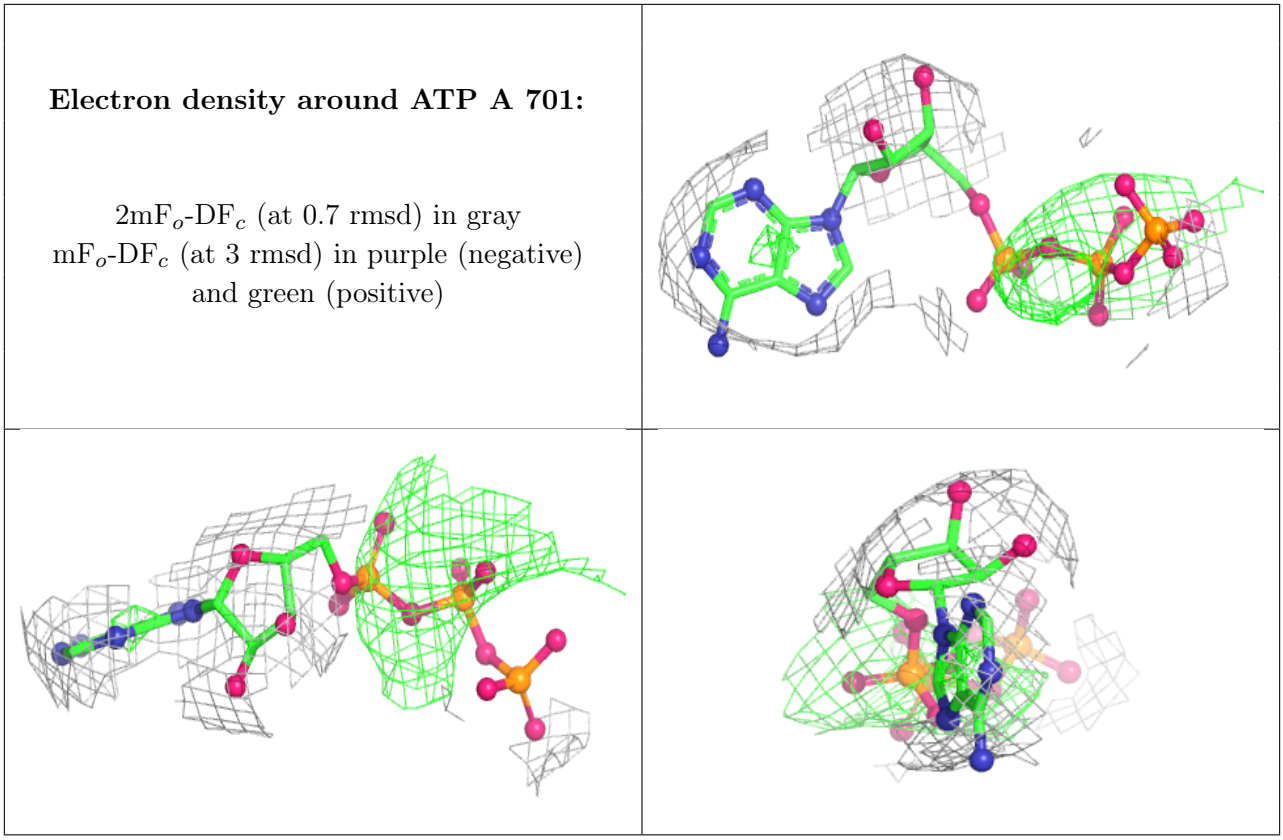






Electron density around ATP A 701:

$2mF_o$-DF_c (at 0.7 rmsd) in gray
mF_o-DF_c (at 3 rmsd) in purple (negative) and green (positive)



6.5 Other polymers (i)

There are no such residues in this entry.