



wwPDB X-ray Structure Validation Summary Report

Mar 9, 2026 – 11:52 PM UTC

PDB ID : 1PCQ / pdb_00001pcq
Title : Crystal structure of groEL-groES
Authors : Chaudhry, C.; Farr, G.W.; Todd, M.J.; Rye, H.S.; Brunger, A.T.; Adams, P.D.; Horwich, A.L.; Sigler, P.B.
Deposited on : 2003-05-16
Resolution : 2.81 Å (reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the  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)
Xtrriage (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

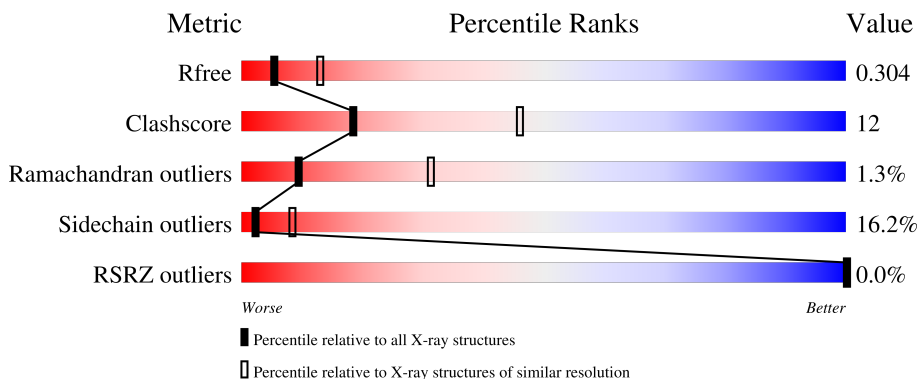
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.81 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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 ≥ 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	524	
1	B	524	
1	C	524	
1	D	524	
1	E	524	

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Mol	Chain	Length	Quality of chain
1	F	524	 73% 22% 5%
1	G	524	 72% 23% 5%
1	H	524	 65% 28% 6%
1	I	524	 64% 29% 6%
1	J	524	 66% 28% 6%
1	K	524	 65% 28% 6%
1	L	524	 66% 29% 5%
1	M	524	 60% 31% 7%
1	N	524	 66% 27% 6%
2	O	97	 75% 19% 6%
2	P	97	 70% 23% 7%
2	Q	97	 72% 23% 5%
2	R	97	 76% 16% 6%
2	S	97	 74% 20% 6%
2	T	97	 72% 22% 5%
2	U	97	 72% 22% 6%

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 59304 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 groEL protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	524	3855	2397	665	773	20	0	0	0
1	B	524	3855	2397	665	773	20	0	0	0
1	C	524	3855	2397	665	773	20	0	0	0
1	D	524	3855	2397	665	773	20	0	0	0
1	E	524	3855	2397	665	773	20	0	0	0
1	F	524	3855	2397	665	773	20	0	0	0
1	G	524	3855	2397	665	773	20	0	0	0
1	H	524	3856	2397	665	774	20	0	0	0
1	I	524	3856	2397	665	774	20	0	0	0
1	J	524	3856	2397	665	774	20	0	0	0
1	K	524	3856	2397	665	774	20	0	0	0
1	L	524	3856	2397	665	774	20	0	0	0
1	M	524	3856	2397	665	774	20	0	0	0
1	N	524	3856	2397	665	774	20	0	0	0

- Molecule 2 is a protein called groES protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	O	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	P	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	Q	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	R	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	S	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	T	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			
2	U	97	Total	C	N	O	S	0	0	0
			728	454	127	145	2			

- Molecule 3 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Mg	0	0
			1	1		
3	B	1	Total	Mg	0	0
			1	1		
3	C	1	Total	Mg	0	0
			1	1		
3	D	1	Total	Mg	0	0
			1	1		
3	E	1	Total	Mg	0	0
			1	1		
3	F	1	Total	Mg	0	0
			1	1		
3	G	1	Total	Mg	0	0
			1	1		

- Molecule 4 is POTASSIUM ION (CCD ID: K) (formula: K).

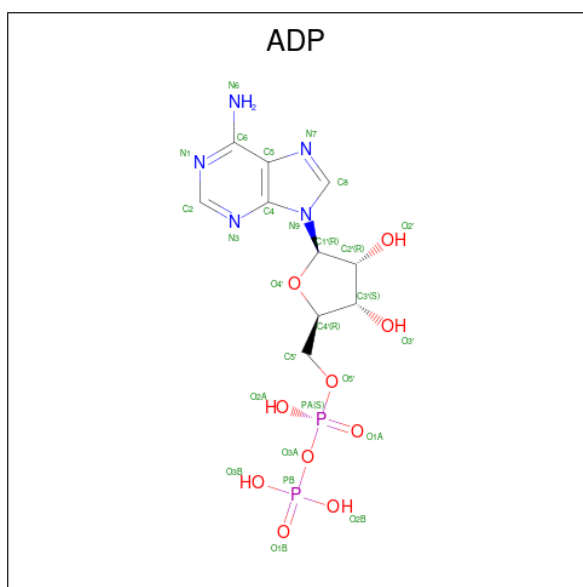
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	K	0	0
			1	1		
4	B	1	Total	K	0	0
			1	1		
4	C	1	Total	K	0	0
			1	1		
4	D	1	Total	K	0	0
			1	1		

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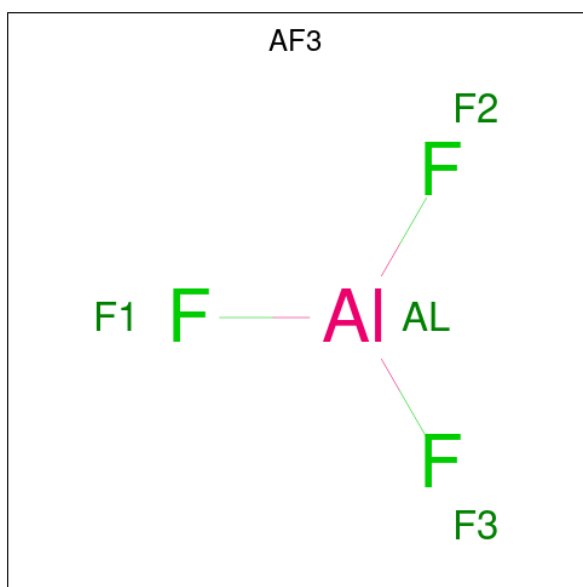
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	E	1	Total K 1 1	0	0
4	F	1	Total K 1 1	0	0
4	G	1	Total K 1 1	0	0

- Molecule 5 is ADENOSINE-5'-DIPHOSPHATE (CCD ID: ADP) (formula: $C_{10}H_{15}N_5O_{10}P_2$).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
5	A	1	Total C N O P 27 10 5 10 2	0	0
5	B	1	Total C N O P 27 10 5 10 2	0	0
5	C	1	Total C N O P 27 10 5 10 2	0	0
5	D	1	Total C N O P 27 10 5 10 2	0	0
5	E	1	Total C N O P 27 10 5 10 2	0	0
5	F	1	Total C N O P 27 10 5 10 2	0	0
5	G	1	Total C N O P 27 10 5 10 2	0	0

- Molecule 6 is ALUMINUM FLUORIDE (CCD ID: AF3) (formula: AlF_3).

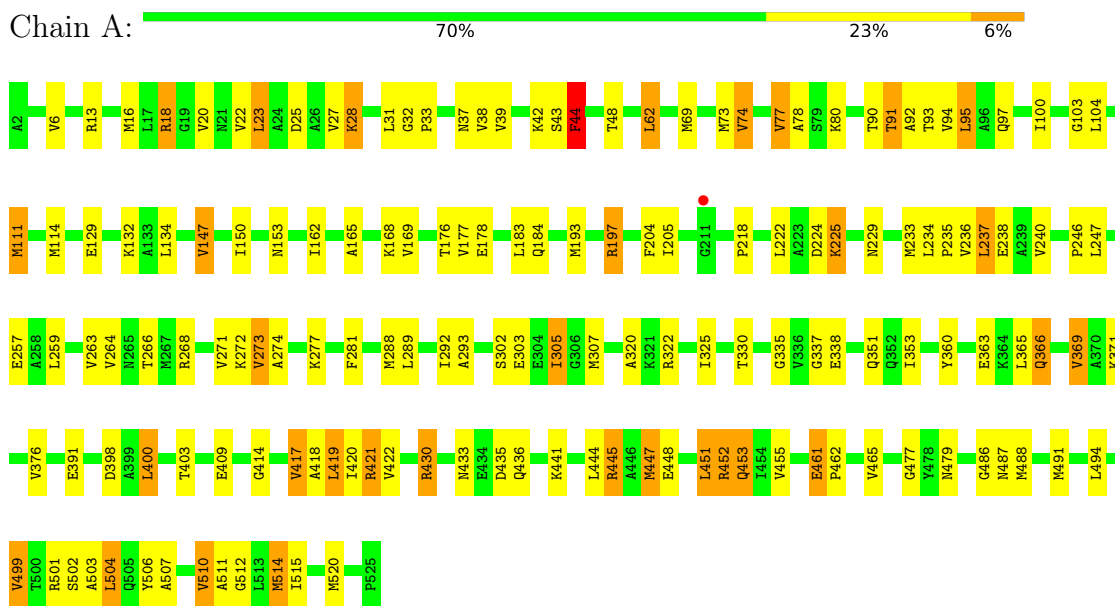


Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
			Total	Al	F		
6	A	1	4	1	3	0	0
6	B	1	4	1	3	0	0
6	C	1	4	1	3	0	0
6	D	1	4	1	3	0	0
6	E	1	4	1	3	0	0
6	F	1	4	1	3	0	0
6	G	1	4	1	3	0	0

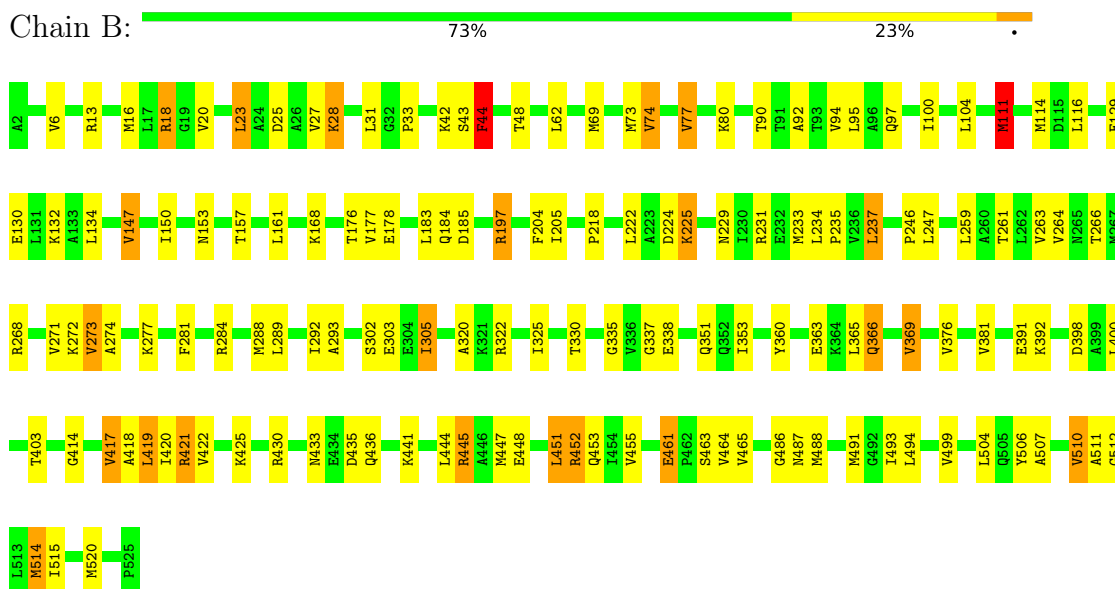
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. A red dot above a residue indicates a poor fit to the electron density ($RSRZ > 2$). Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: groEL protein

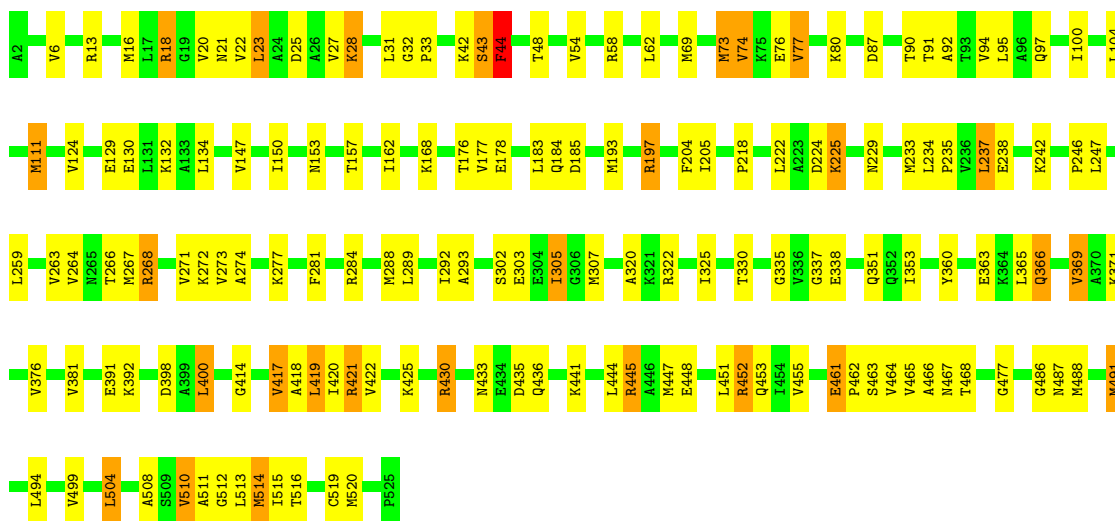


- Molecule 1: groEL protein



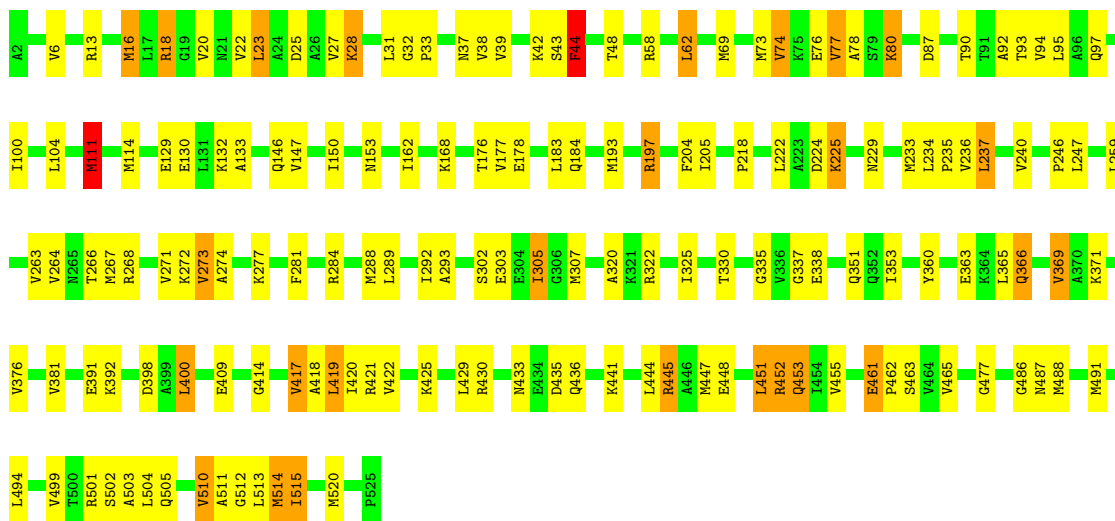
- Molecule 1: groEL protein

Chain C:  69% 25% 5%



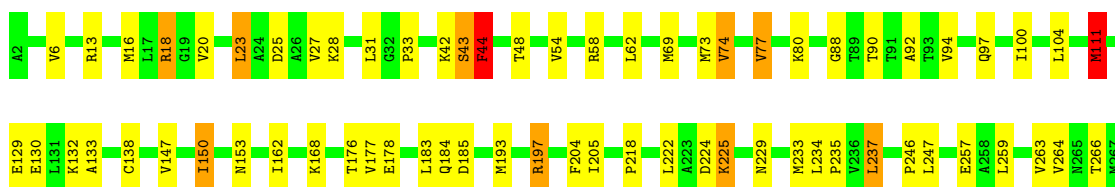
- Molecule 1: groEL protein

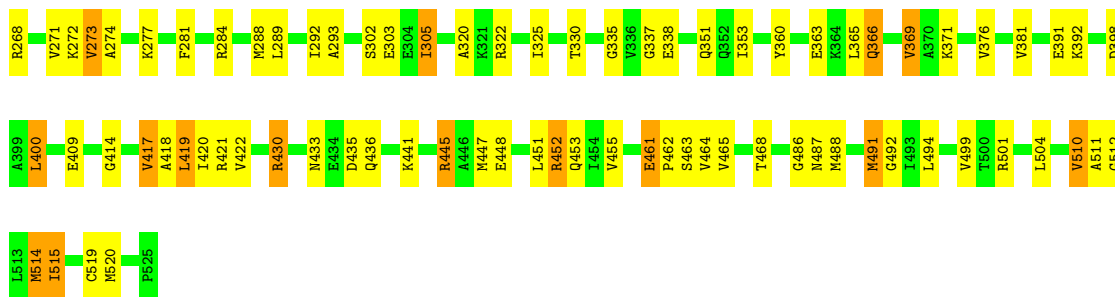
Chain D:  69% 25% 5%



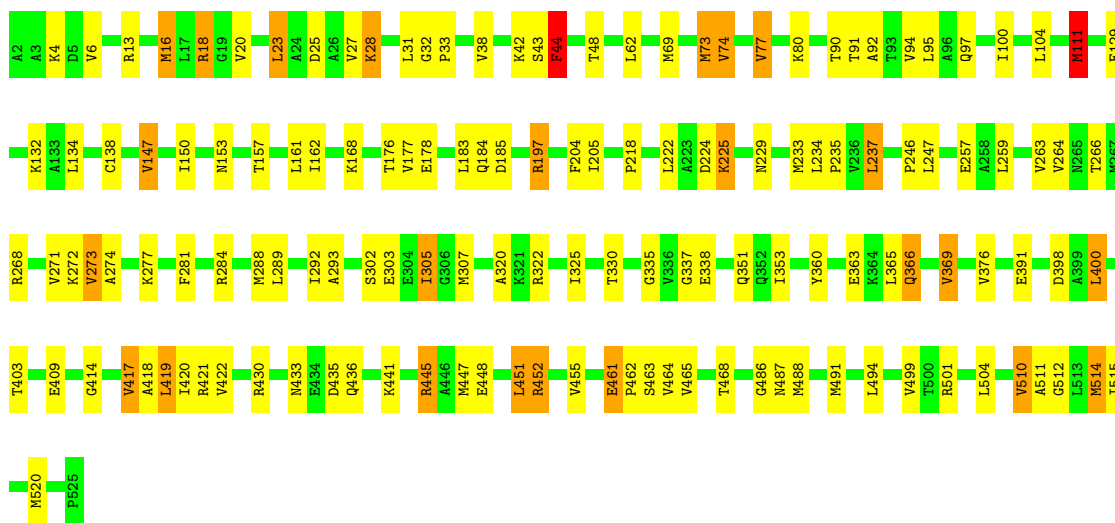
- Molecule 1: groEL protein

Chain E:  72% 23% 5%

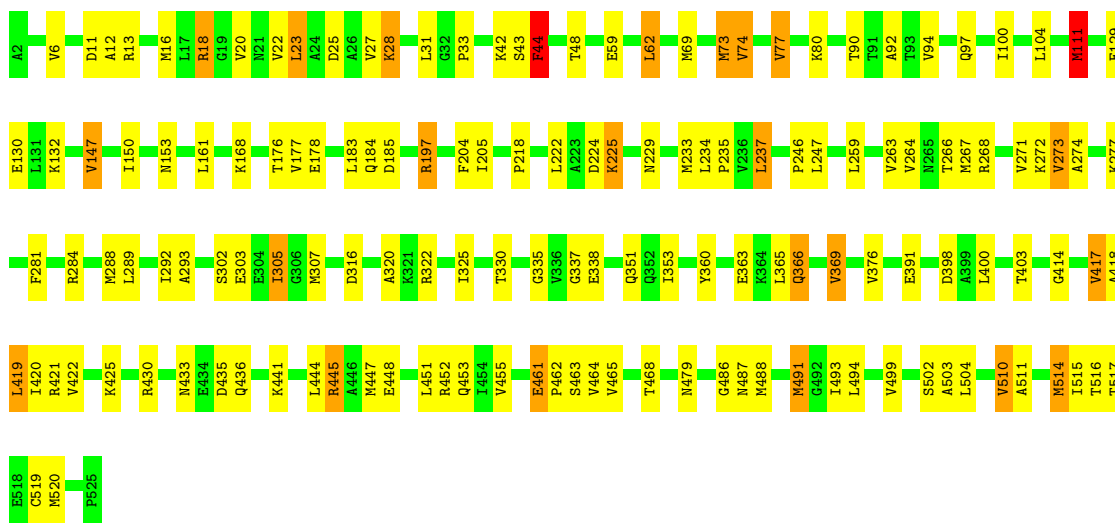




• Molecule 1: groEL protein

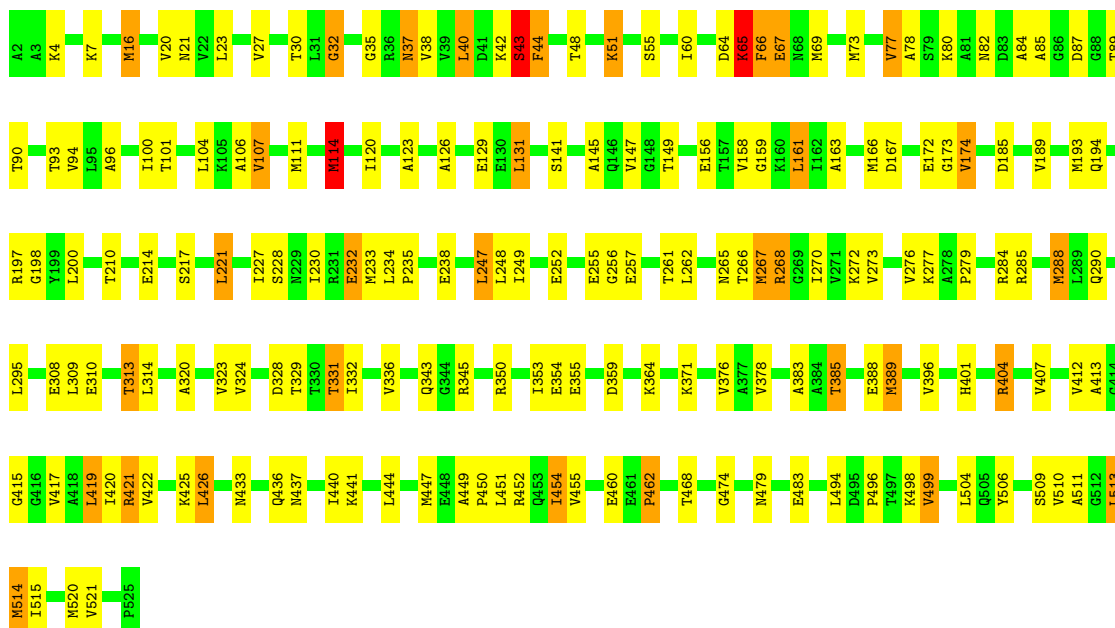


• Molecule 1: groEL protein



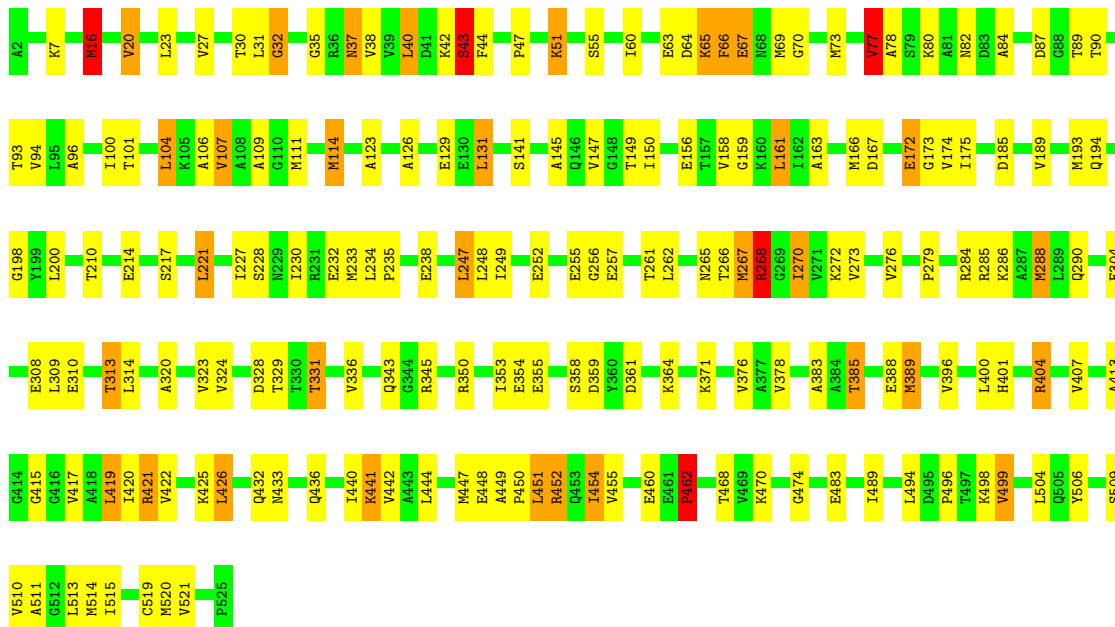
• Molecule 1: groEL protein

Chain H:  65% 28% 6%



• Molecule 1: groEL protein

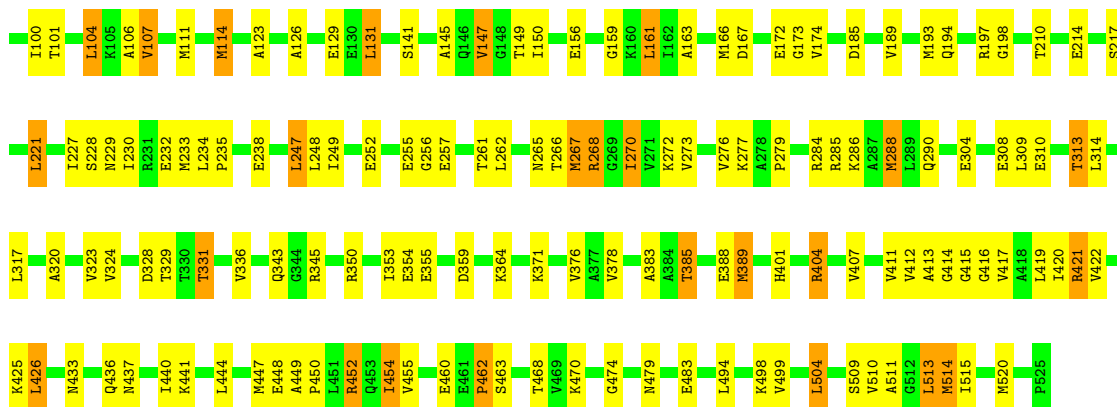
Chain I:  64% 29% 6%



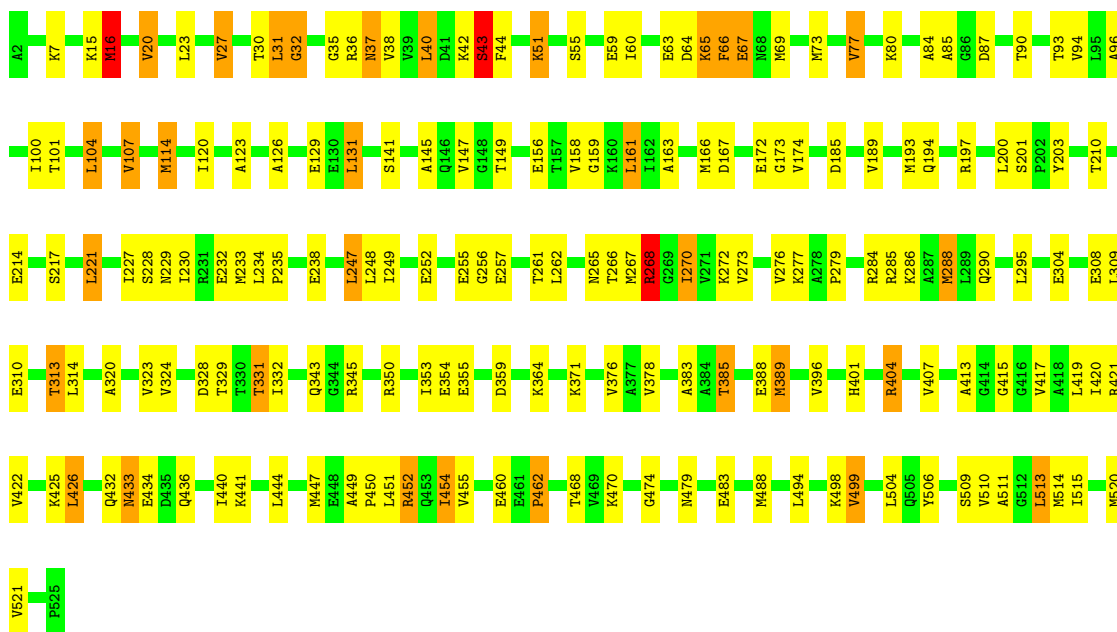
• Molecule 1: groEL protein

Chain J:  66% 28% 6%

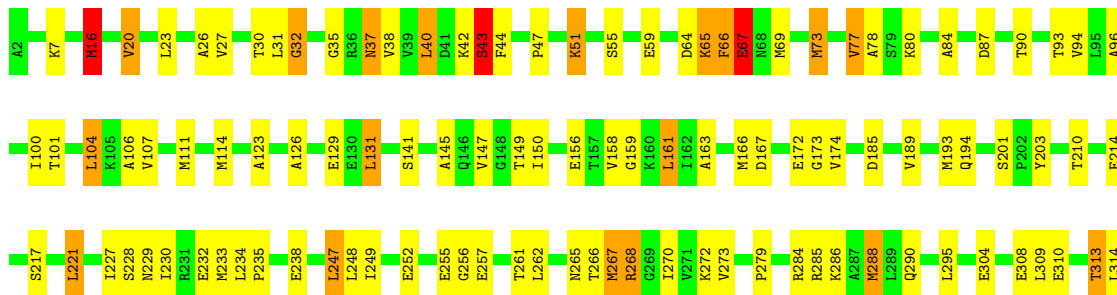


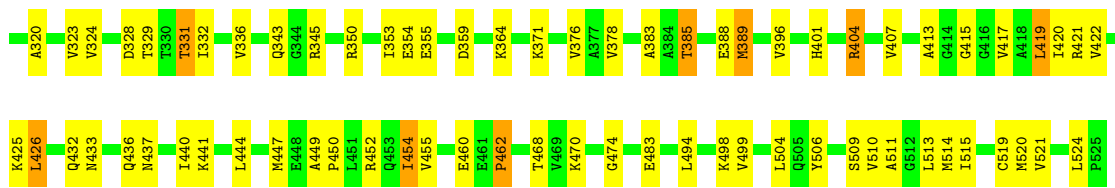


• Molecule 1: groEL protein

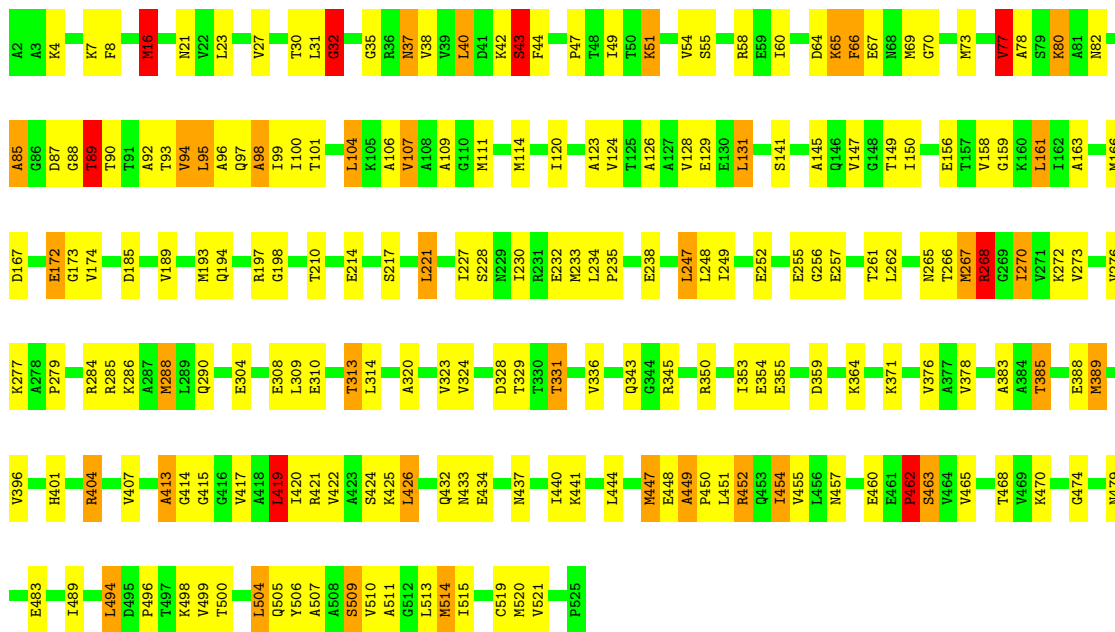


• Molecule 1: groEL protein

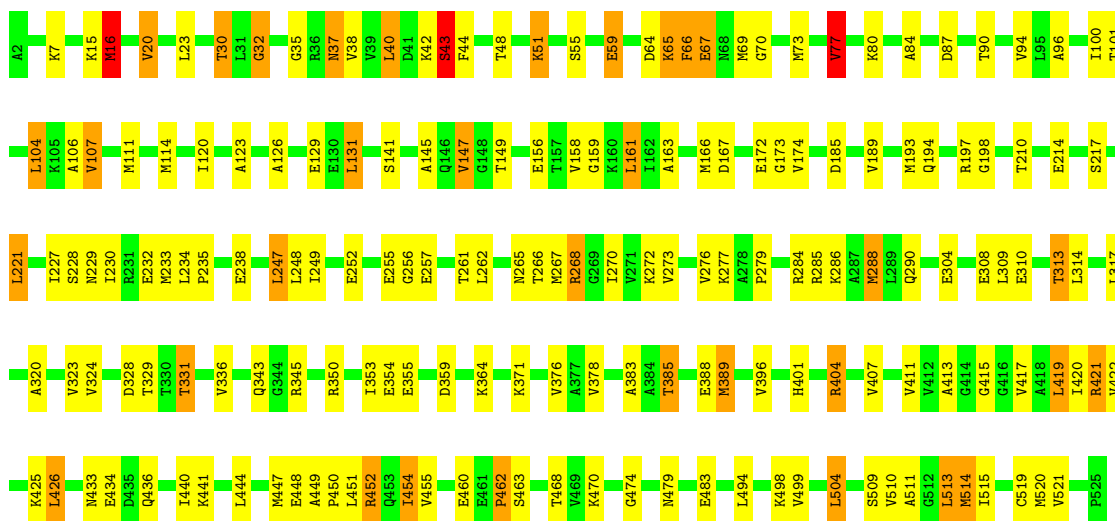




• Molecule 1: groEL protein



• Molecule 1: groEL protein



• Molecule 2: groES protein

Chain O:  75% 19% 6%



• Molecule 2: groES protein

Chain P:  70% 23% 7%



• Molecule 2: groES protein

Chain Q:  72% 23% 5%



• Molecule 2: groES protein

Chain R:  76% 16% 8%



• Molecule 2: groES protein

Chain S:  74% 20% 6%



• Molecule 2: groES protein

Chain T:  72% 22% 6%



• Molecule 2: groES protein

Chain U:  72% 22% 6%



4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 2	Depositor
Cell constants a, b, c, α , β , γ	255.55Å 266.86Å 187.05Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.39 – 2.81 49.39 – 2.81	Depositor EDS
% Data completeness (in resolution range)	(Not available) (49.39-2.81) 78.9 (49.39-2.81)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.03 (at 2.32Å)	Xtrriage
Refinement program	REFMAC refinac_5.1.24 24/04/2001	Depositor
R, R_{free}	0.262 , 0.278 (Not available) , 0.304	Depositor DCC
R_{free} test set	6710 reflections (1.94%)	wwPDB-VP
Wilson B-factor (Å ²)	43.9	Xtrriage
Anisotropy	0.958	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 27.5	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	0.012 for k,h,-l	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	59304	wwPDB-VP
Average B, all atoms (Å ²)	2.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.16% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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

Bond lengths and bond angles in the following residue types are not validated in this section: AF3, MG, ADP, K

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	0.87	3/3883 (0.1%)	1.07	6/5243 (0.1%)
1	B	0.80	3/3883 (0.1%)	1.07	10/5243 (0.2%)
1	C	0.84	2/3883 (0.1%)	1.07	6/5243 (0.1%)
1	D	0.87	4/3883 (0.1%)	1.07	4/5243 (0.1%)
1	E	0.71	3/3883 (0.1%)	1.01	3/5243 (0.1%)
1	F	0.73	3/3883 (0.1%)	1.02	6/5243 (0.1%)
1	G	0.81	3/3883 (0.1%)	1.04	5/5243 (0.1%)
1	H	0.79	3/3884 (0.1%)	1.02	3/5243 (0.1%)
1	I	0.83	2/3884 (0.1%)	1.04	4/5243 (0.1%)
1	J	0.80	3/3884 (0.1%)	1.03	5/5243 (0.1%)
1	K	0.70	2/3884 (0.1%)	1.01	6/5243 (0.1%)
1	L	0.66	1/3884 (0.0%)	0.98	2/5243 (0.0%)
1	M	1.07	17/3884 (0.4%)	1.14	12/5243 (0.2%)
1	N	0.80	3/3884 (0.1%)	1.04	1/5243 (0.0%)
2	O	0.52	0/732	0.81	0/983
2	P	0.51	0/732	0.81	1/983 (0.1%)
2	Q	0.51	0/732	0.82	0/983
2	R	0.51	0/732	0.82	0/983
2	S	0.51	0/732	0.81	0/983
2	T	0.51	0/732	0.82	0/983
2	U	0.51	0/732	0.82	0/983
All	All	0.79	52/59493 (0.1%)	1.03	74/80283 (0.1%)

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	M	0	1

The worst 5 of 52 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	J	16	MET	SD-CE	10.71	2.06	1.79
1	M	447	MET	SD-CE	10.15	2.04	1.79
1	M	16	MET	SD-CE	9.36	2.02	1.79
1	H	114	MET	SD-CE	9.02	2.02	1.79
1	F	73	MET	SD-CE	8.84	2.01	1.79

The worst 5 of 74 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	231	ARG	NE-CZ-NH2	11.64	129.68	119.20
1	B	231	ARG	NE-CZ-NH1	-11.00	110.50	121.50
1	B	231	ARG	CD-NE-CZ	8.82	136.74	124.40
1	M	414	GLY	N-CA-C	8.77	124.13	114.40
1	G	197	ARG	NE-CZ-NH2	7.45	125.90	119.20

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	M	32	GLY	Peptide

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	3855	0	3976	104	0
1	B	3855	0	3976	82	0
1	C	3855	0	3976	109	0
1	D	3855	0	3976	100	0
1	E	3855	0	3976	85	0
1	F	3855	0	3976	84	0
1	G	3855	0	3976	92	0
1	H	3856	0	3976	98	0
1	I	3856	0	3976	106	0
1	J	3856	0	3976	104	0
1	K	3856	0	3976	100	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	L	3856	0	3976	90	0
1	M	3856	0	3976	136	0
1	N	3856	0	3976	110	0
2	O	728	0	762	14	0
2	P	728	0	762	20	0
2	Q	728	0	762	17	0
2	R	728	0	762	13	0
2	S	728	0	762	13	0
2	T	728	0	762	16	0
2	U	728	0	762	16	0
3	A	1	0	0	0	0
3	B	1	0	0	0	0
3	C	1	0	0	0	0
3	D	1	0	0	0	0
3	E	1	0	0	0	0
3	F	1	0	0	0	0
3	G	1	0	0	0	0
4	A	1	0	0	0	0
4	B	1	0	0	0	0
4	C	1	0	0	0	0
4	D	1	0	0	0	0
4	E	1	0	0	0	0
4	F	1	0	0	0	0
4	G	1	0	0	0	0
5	A	27	0	12	4	0
5	B	27	0	12	1	0
5	C	27	0	12	5	0
5	D	27	0	12	2	0
5	E	27	0	12	1	0
5	F	27	0	12	3	0
5	G	27	0	12	1	0
6	A	4	0	0	1	0
6	B	4	0	0	0	0
6	C	4	0	0	1	0
6	D	4	0	0	0	0
6	E	4	0	0	0	0
6	F	4	0	0	0	0
6	G	4	0	0	1	0
All	All	59304	0	61082	1443	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 12.

The worst 5 of 1443 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:M:95:LEU:CG	1:M:95:LEU:CD1	1.80	1.60
1:F:73:MET:SD	1:F:73:MET:CE	2.01	1.48
1:G:73:MET:SD	1:G:73:MET:CE	2.01	1.48
1:H:114:MET:CE	1:H:114:MET:SD	2.02	1.48
1:N:16:MET:SD	1:N:16:MET:CE	2.01	1.47

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	522/524 (100%)	486 (93%)	32 (6%)	4 (1%)	16	44
1	B	522/524 (100%)	486 (93%)	32 (6%)	4 (1%)	16	44
1	C	522/524 (100%)	484 (93%)	34 (6%)	4 (1%)	16	44
1	D	522/524 (100%)	486 (93%)	31 (6%)	5 (1%)	12	38
1	E	522/524 (100%)	488 (94%)	30 (6%)	4 (1%)	16	44
1	F	522/524 (100%)	487 (93%)	31 (6%)	4 (1%)	16	44
1	G	522/524 (100%)	489 (94%)	29 (6%)	4 (1%)	16	44
1	H	522/524 (100%)	483 (92%)	33 (6%)	6 (1%)	11	36
1	I	522/524 (100%)	480 (92%)	36 (7%)	6 (1%)	11	36
1	J	522/524 (100%)	477 (91%)	39 (8%)	6 (1%)	11	36
1	K	522/524 (100%)	483 (92%)	33 (6%)	6 (1%)	11	36
1	L	522/524 (100%)	485 (93%)	31 (6%)	6 (1%)	11	36
1	M	522/524 (100%)	468 (90%)	42 (8%)	12 (2%)	5	18
1	N	522/524 (100%)	479 (92%)	37 (7%)	6 (1%)	11	36

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	O	95/97 (98%)	74 (78%)	18 (19%)	3 (3%)	3	11
2	P	95/97 (98%)	74 (78%)	17 (18%)	4 (4%)	2	7
2	Q	95/97 (98%)	74 (78%)	16 (17%)	5 (5%)	1	5
2	R	95/97 (98%)	74 (78%)	17 (18%)	4 (4%)	2	7
2	S	95/97 (98%)	74 (78%)	18 (19%)	3 (3%)	3	11
2	T	95/97 (98%)	74 (78%)	16 (17%)	5 (5%)	1	5
2	U	95/97 (98%)	73 (77%)	18 (19%)	4 (4%)	2	7
All	All	7973/8015 (100%)	7278 (91%)	590 (7%)	105 (1%)	9	31

5 of 105 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	44	PHE
1	A	337	GLY
1	B	44	PHE
1	B	337	GLY
1	C	44	PHE

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	404/404 (100%)	349 (86%)	55 (14%)	3	13
1	B	404/404 (100%)	347 (86%)	57 (14%)	3	12
1	C	404/404 (100%)	348 (86%)	56 (14%)	3	12
1	D	404/404 (100%)	349 (86%)	55 (14%)	3	13
1	E	404/404 (100%)	347 (86%)	57 (14%)	3	12
1	F	404/404 (100%)	346 (86%)	58 (14%)	3	11
1	G	404/404 (100%)	349 (86%)	55 (14%)	3	13
1	H	404/404 (100%)	328 (81%)	76 (19%)	1	5
1	I	404/404 (100%)	325 (80%)	79 (20%)	1	5

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	J	404/404 (100%)	329 (81%)	75 (19%)	1	5
1	K	404/404 (100%)	326 (81%)	78 (19%)	1	5
1	L	404/404 (100%)	328 (81%)	76 (19%)	1	5
1	M	404/404 (100%)	326 (81%)	78 (19%)	1	5
1	N	404/404 (100%)	326 (81%)	78 (19%)	1	5
2	O	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	P	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	Q	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	R	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	S	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	T	80/80 (100%)	69 (86%)	11 (14%)	3	12
2	U	80/80 (100%)	69 (86%)	11 (14%)	3	12
All	All	6216/6216 (100%)	5206 (84%)	1010 (16%)	2	8

5 of 1010 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	468	THR
1	N	221	LEU
1	J	172	GLU
1	N	120	ILE
2	P	6	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 155 such sidechains are listed below:

Mol	Chain	Res	Type
1	L	194	GLN
2	Q	45	ASN
1	L	453	GLN
1	N	82	ASN
2	S	80	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 oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 28 ligands modelled in this entry, 14 are monoatomic - leaving 14 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
5	ADP	B	700	4,3,6	28,29,29	1.08	3 (10%)	43,45,45	1.97	13 (30%)
5	ADP	A	600	4,3,6	28,29,29	1.02	4 (14%)	43,45,45	2.16	15 (34%)
5	ADP	G	1200	4,3,6	28,29,29	1.21	4 (14%)	43,45,45	2.13	15 (34%)
6	AF3	G	1202	4,3,1,5	0,3,3	-	-	-		
6	AF3	B	702	4,3,1,5	0,3,3	-	-	-		
5	ADP	C	800	4,3,6	28,29,29	1.25	3 (10%)	43,45,45	2.07	13 (30%)
5	ADP	F	1100	4,3,6	28,29,29	1.15	4 (14%)	43,45,45	1.95	11 (25%)
6	AF3	F	1102	4,3,1,5	0,3,3	-	-	-		
6	AF3	D	902	4,3,1,5	0,3,3	-	-	-		
5	ADP	D	900	4,3,6	28,29,29	1.15	5 (17%)	43,45,45	2.30	14 (32%)
6	AF3	E	1002	4,3,1,5	0,3,3	-	-	-		
5	ADP	E	1000	4,3,6	28,29,29	1.05	2 (7%)	43,45,45	2.20	12 (27%)
6	AF3	A	602	4,3,1,5	0,3,3	-	-	-		
6	AF3	C	802	4,3,1,5	0,3,3	-	-	-		

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. '2' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
5	ADP	B	700	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	A	600	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	G	1200	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	C	800	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	F	1100	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	D	900	4,3,6	-	5/16/32/32	0/3/3/3
5	ADP	E	1000	4,3,6	-	6/16/32/32	0/3/3/3

The worst 5 of 25 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	C	800	ADP	PA-O3A	3.79	1.63	1.59
5	G	1200	ADP	C2-N1	3.40	1.40	1.33
5	C	800	ADP	C2-N1	2.91	1.39	1.33
5	B	700	ADP	C2-N1	2.80	1.38	1.33
5	D	900	ADP	PA-O3A	2.79	1.62	1.59

The worst 5 of 93 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	E	1000	ADP	N3-C2-N1	-6.21	119.18	128.58
5	D	900	ADP	N3-C2-N1	-6.05	119.42	128.58
5	D	900	ADP	N9-C8-N7	-5.76	105.76	113.94
5	F	1100	ADP	N3-C2-N1	-5.68	119.99	128.58
5	B	700	ADP	N3-C2-N1	-5.64	120.05	128.58

There are no chirality outliers.

5 of 36 torsion outliers are listed below:

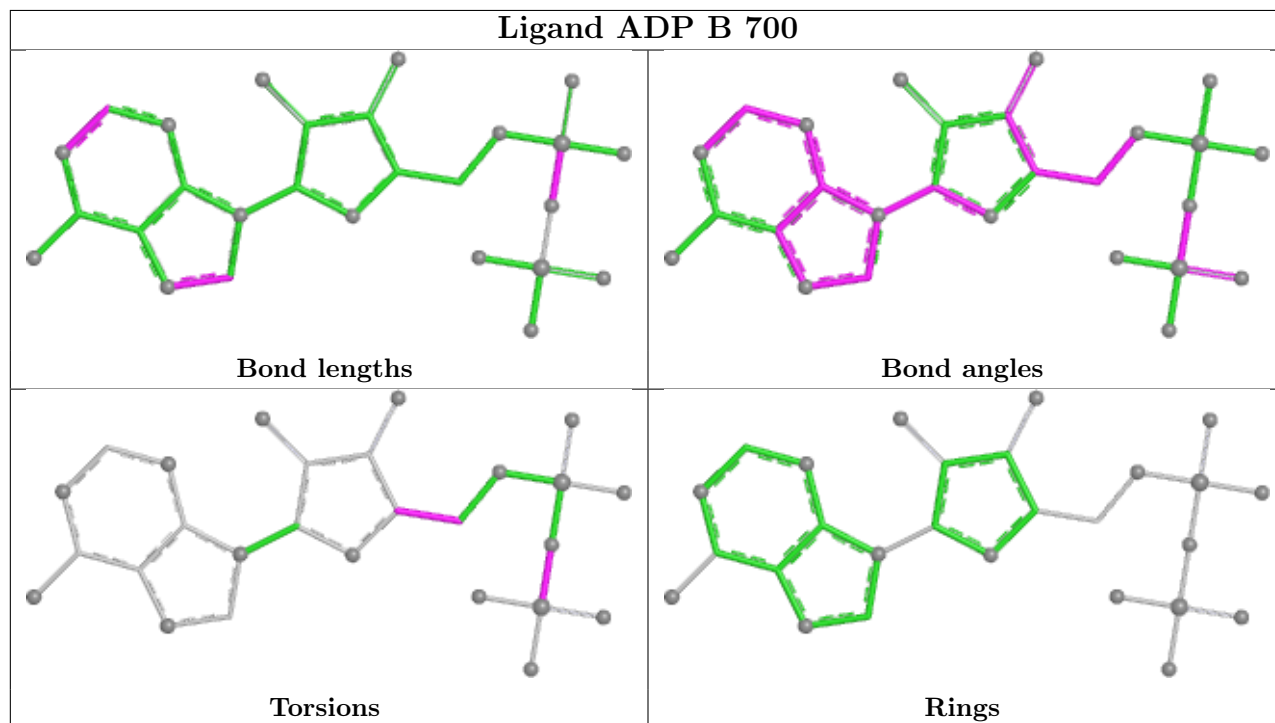
Mol	Chain	Res	Type	Atoms
5	A	600	ADP	O4'-C4'-C5'-O5'
5	B	700	ADP	O4'-C4'-C5'-O5'
5	C	800	ADP	O4'-C4'-C5'-O5'
5	D	900	ADP	O4'-C4'-C5'-O5'
5	E	1000	ADP	O4'-C4'-C5'-O5'

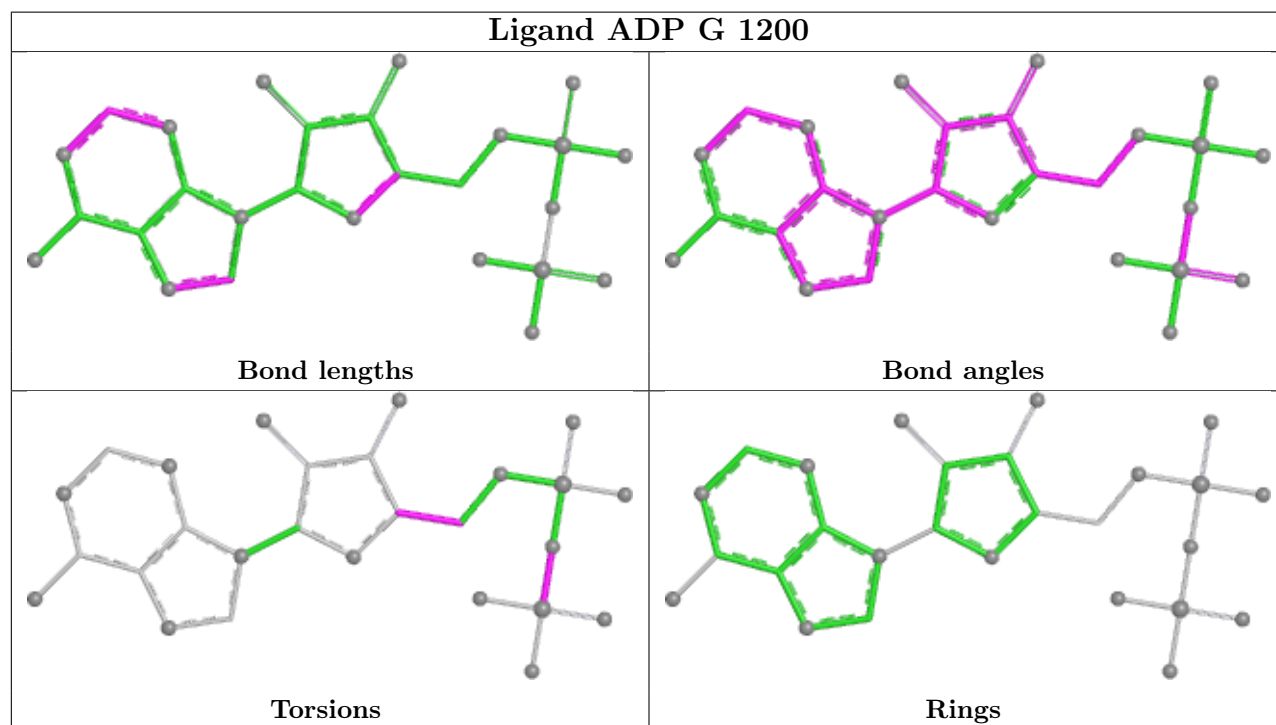
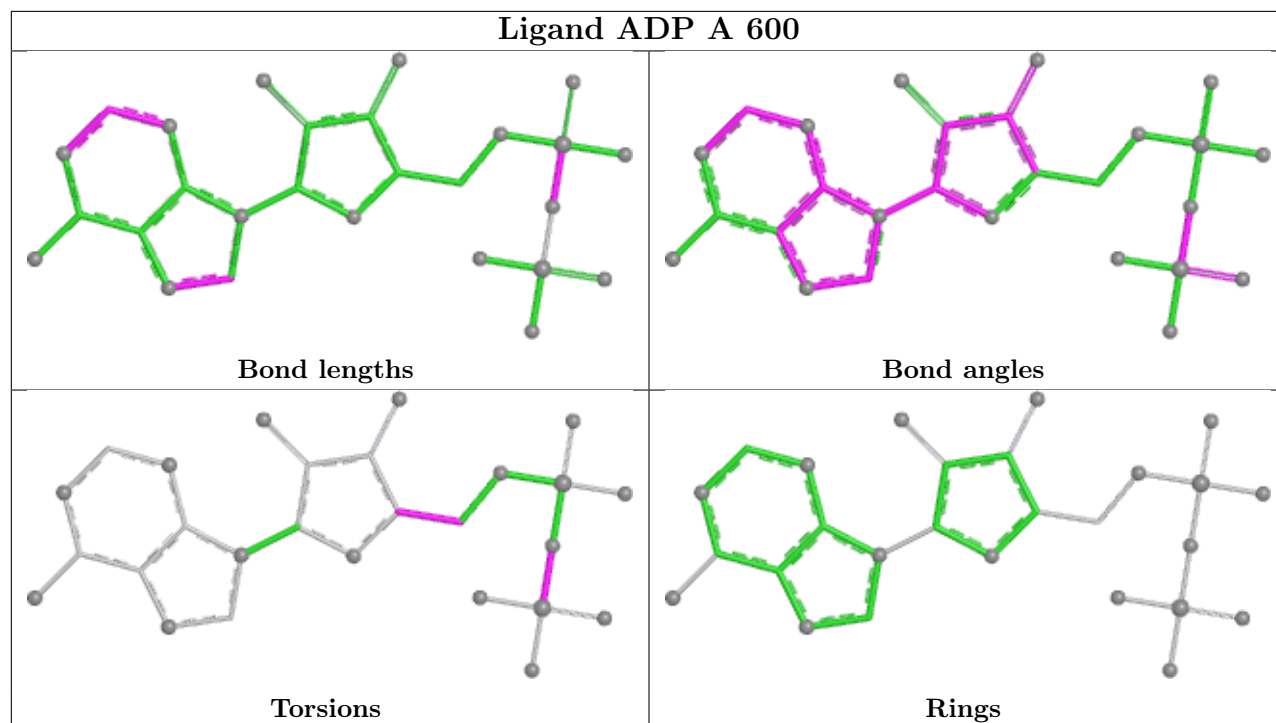
There are no ring outliers.

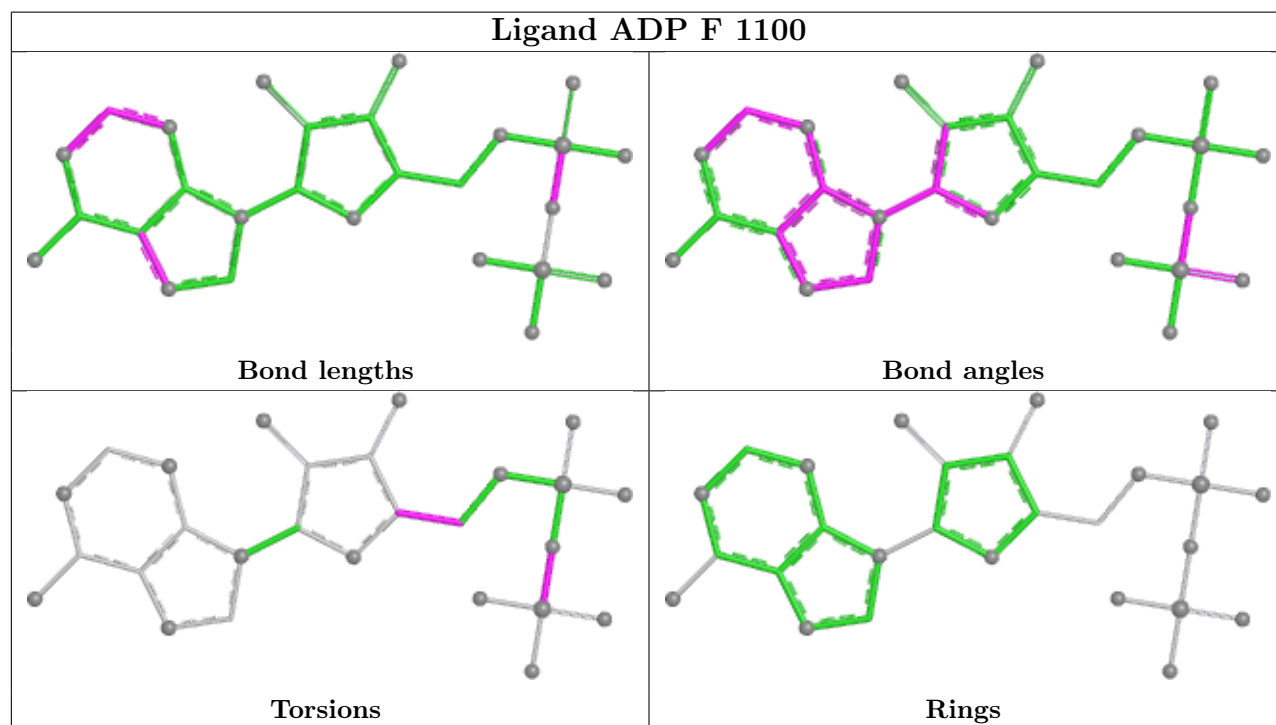
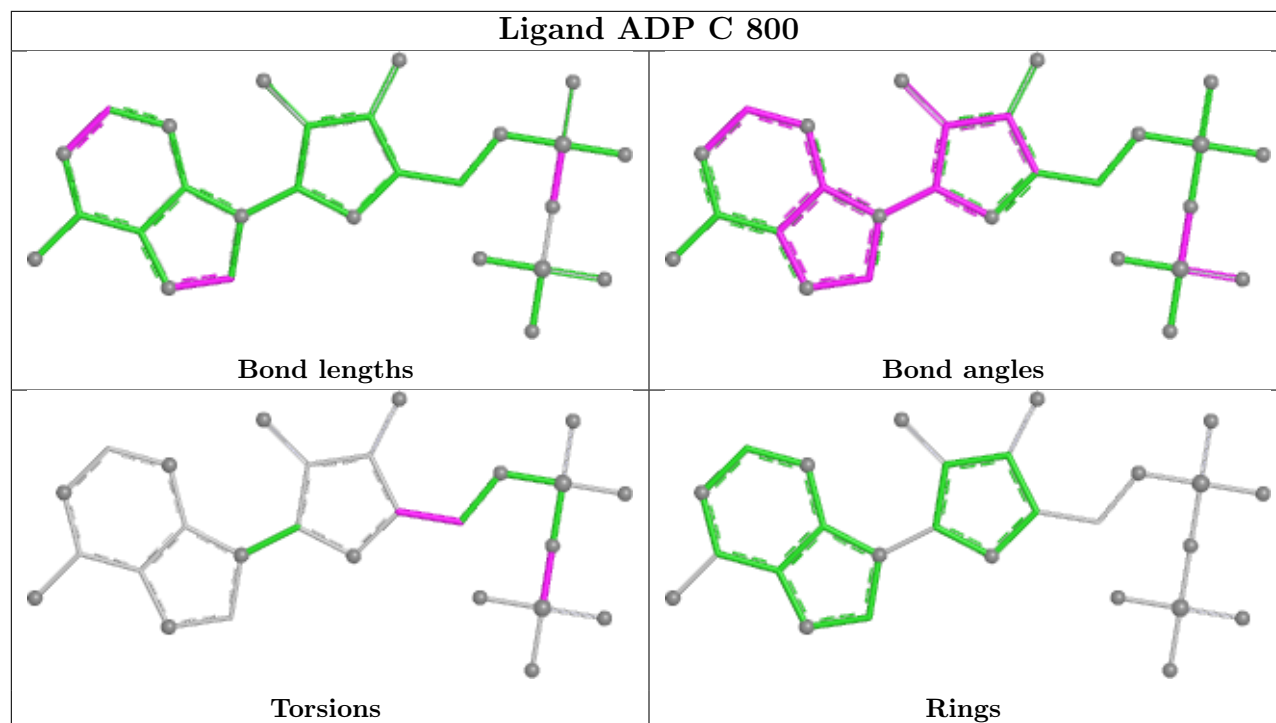
10 monomers are involved in 17 short contacts:

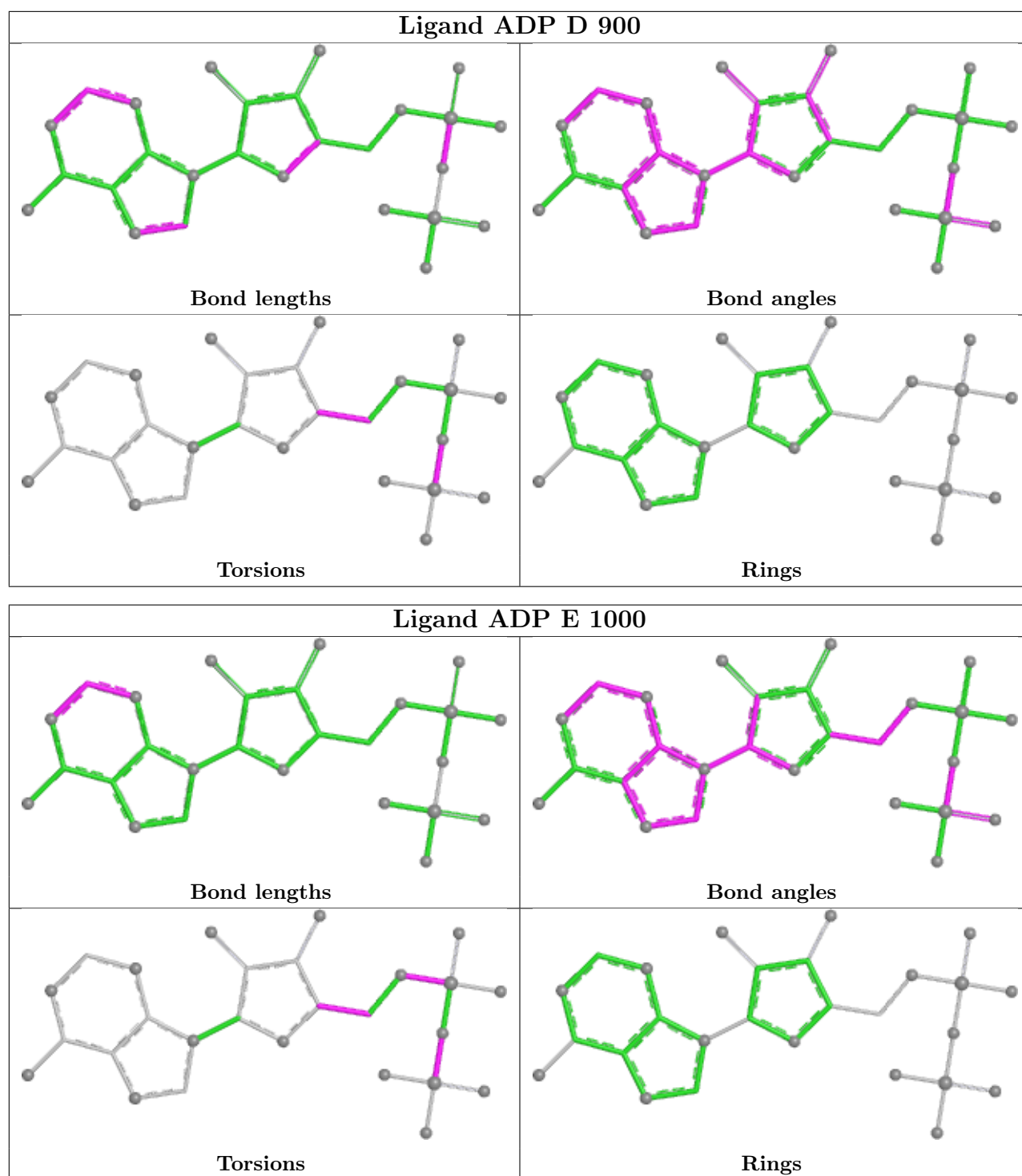
Mol	Chain	Res	Type	Clashes	Symm-Clashes
5	B	700	ADP	1	0
5	A	600	ADP	4	0
5	G	1200	ADP	1	0
6	G	1202	AF3	1	0
5	C	800	ADP	5	0
5	F	1100	ADP	3	0
5	D	900	ADP	2	0
5	E	1000	ADP	1	0
6	A	602	AF3	1	0
6	C	802	AF3	1	0

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 than 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.









5.7 Other polymers [\(i\)](#)

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.

6 Fit of model and data [i](#)

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

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, 95th 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	524/524 (100%)	-1.43	1 (0%) 91 88	2, 2, 4, 6	0
1	B	524/524 (100%)	-1.45	0 100 100	2, 2, 4, 6	0
1	C	524/524 (100%)	-1.45	0 100 100	2, 2, 4, 6	0
1	D	524/524 (100%)	-1.49	0 100 100	2, 2, 4, 6	0
1	E	524/524 (100%)	-1.45	0 100 100	2, 2, 4, 6	0
1	F	524/524 (100%)	-1.46	0 100 100	2, 2, 4, 6	0
1	G	524/524 (100%)	-1.44	0 100 100	2, 2, 4, 6	0
1	H	524/524 (100%)	-1.52	0 100 100	2, 2, 4, 6	0
1	I	524/524 (100%)	-1.53	0 100 100	2, 2, 4, 6	0
1	J	524/524 (100%)	-1.53	0 100 100	2, 2, 4, 6	0
1	K	524/524 (100%)	-1.53	0 100 100	2, 2, 4, 6	0
1	L	524/524 (100%)	-1.48	0 100 100	2, 2, 4, 6	0
1	M	524/524 (100%)	-1.49	0 100 100	2, 2, 4, 6	0
1	N	524/524 (100%)	-1.50	0 100 100	2, 2, 4, 6	0
2	O	97/97 (100%)	-1.39	0 100 100	2, 2, 2, 3	0
2	P	97/97 (100%)	-1.41	0 100 100	2, 2, 2, 3	0
2	Q	97/97 (100%)	-1.40	0 100 100	2, 2, 2, 2	0
2	R	97/97 (100%)	-1.36	0 100 100	2, 2, 2, 2	0
2	S	97/97 (100%)	-1.34	0 100 100	2, 2, 2, 3	0
2	T	97/97 (100%)	-1.40	0 100 100	2, 2, 2, 2	0
2	U	97/97 (100%)	-1.42	0 100 100	2, 2, 2, 2	0
All	All	8015/8015 (100%)	-1.47	1 (0%) 100 100	2, 2, 4, 6	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	211	GLY	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, 95th 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.

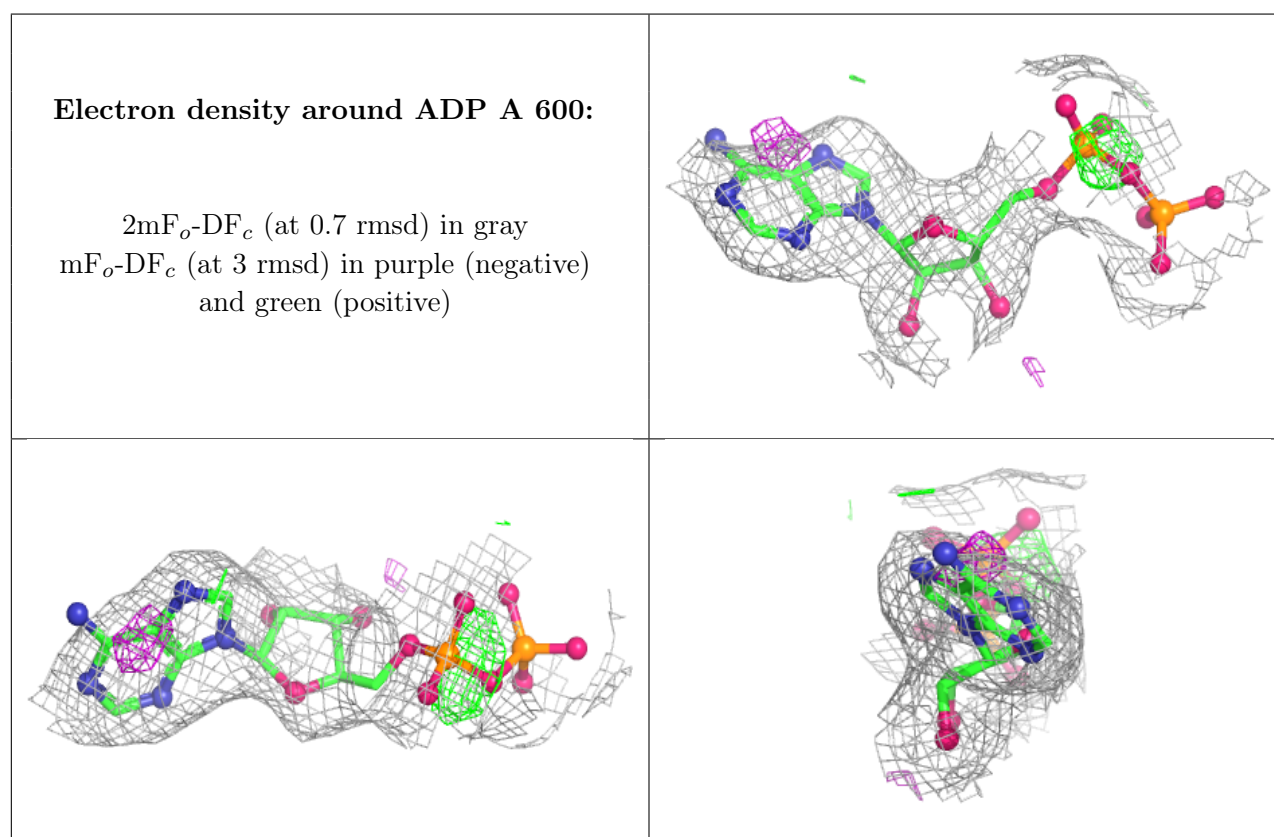
Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
4	K	A	603	1/1	0.99	0.04	24,24,24,24	0
4	K	B	703	1/1	0.99	0.04	24,24,24,24	0
4	K	D	903	1/1	0.99	0.05	24,24,24,24	0
4	K	E	1003	1/1	0.99	0.05	24,24,24,24	0
4	K	G	1203	1/1	0.99	0.03	24,24,24,24	0
6	AF3	C	802	4/4	0.99	0.04	5,7,8,12	0
6	AF3	D	902	4/4	0.99	0.05	5,7,8,12	0
3	MG	A	601	1/1	1.00	0.03	2,2,2,2	0
3	MG	B	701	1/1	1.00	0.01	2,2,2,2	0
4	K	C	803	1/1	1.00	0.02	24,24,24,24	0
3	MG	C	801	1/1	1.00	0.05	2,2,2,2	0
3	MG	D	901	1/1	1.00	0.02	2,2,2,2	0
4	K	F	1103	1/1	1.00	0.01	24,24,24,24	0
3	MG	E	1001	1/1	1.00	0.02	2,2,2,2	0
5	ADP	A	600	27/27	1.00	0.03	2,2,6,8	0
5	ADP	B	700	27/27	1.00	0.02	2,2,5,8	0
5	ADP	C	800	27/27	1.00	0.03	2,2,5,8	0
5	ADP	D	900	27/27	1.00	0.03	2,2,5,8	0
5	ADP	E	1000	27/27	1.00	0.02	2,2,5,8	0
5	ADP	F	1100	27/27	1.00	0.02	2,2,5,8	0
5	ADP	G	1200	27/27	1.00	0.02	2,2,6,8	0
6	AF3	A	602	4/4	1.00	0.02	5,7,8,12	0
6	AF3	B	702	4/4	1.00	0.04	5,7,8,12	0

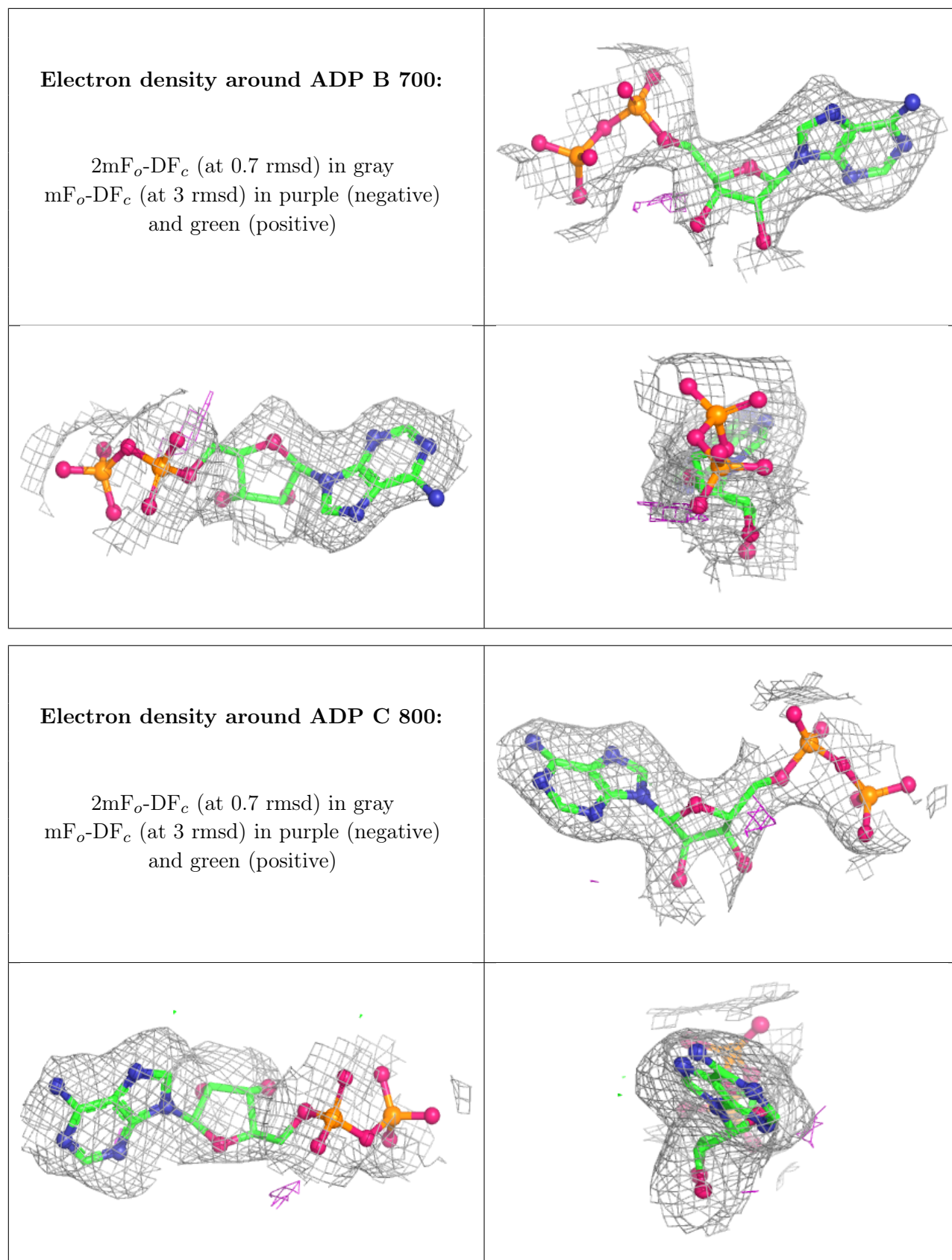
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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(\AA^2)	Q<0.9
3	MG	F	1101	1/1	1.00	0.01	2,2,2,2	0
3	MG	G	1201	1/1	1.00	0.03	2,2,2,2	0
6	AF3	E	1002	4/4	1.00	0.03	5,7,8,12	0
6	AF3	F	1102	4/4	1.00	0.02	5,7,8,12	0
6	AF3	G	1202	4/4	1.00	0.02	5,7,8,12	0

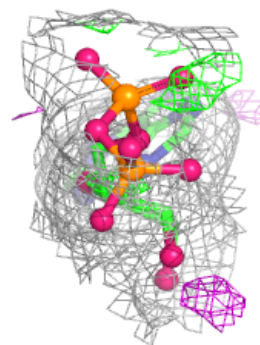
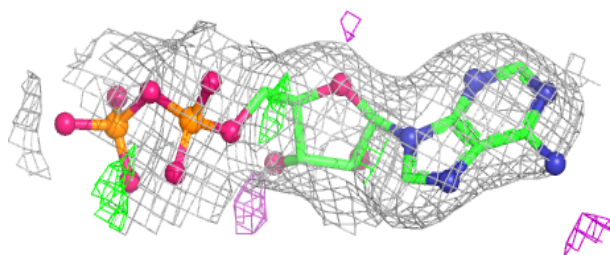
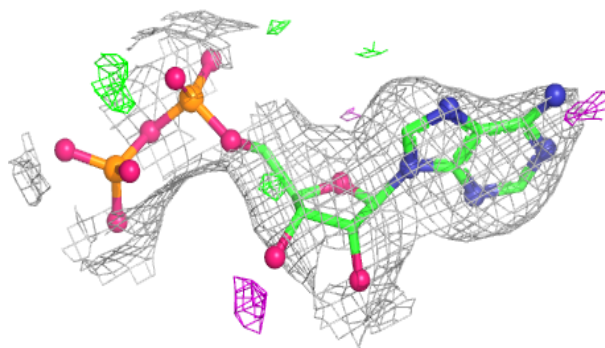
The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation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



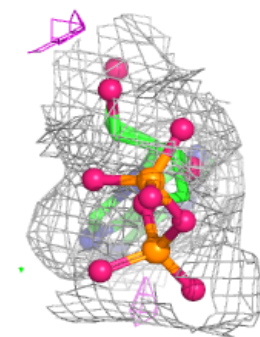
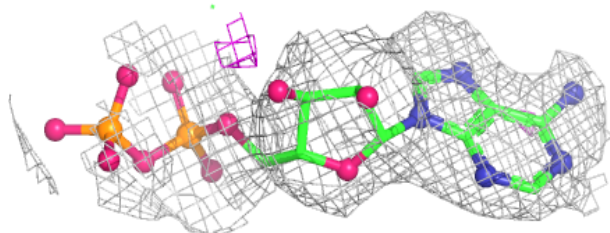
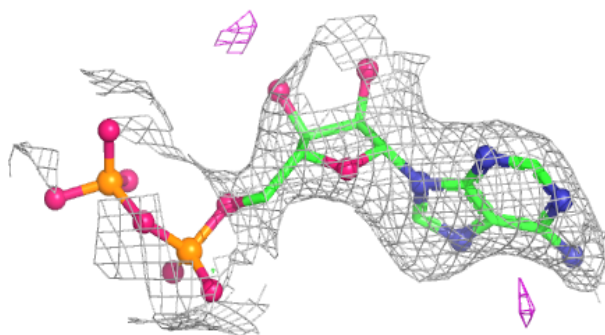


Electron density around ADP D 900:

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

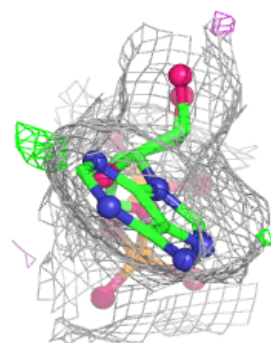
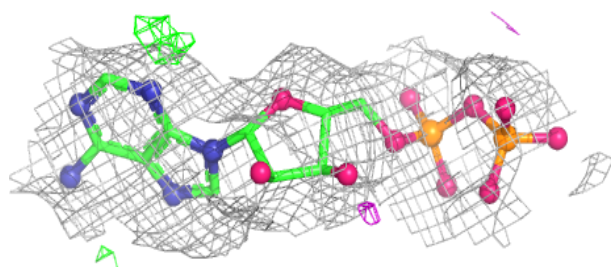
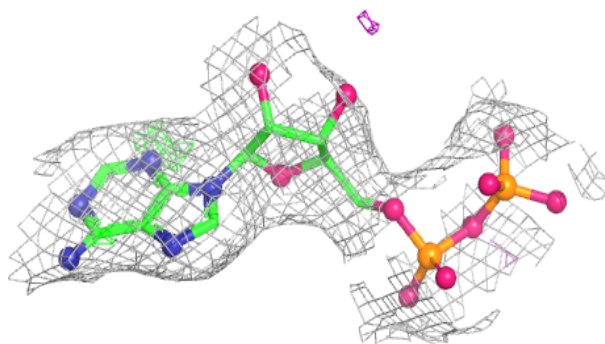
**Electron density around ADP E 1000:**

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

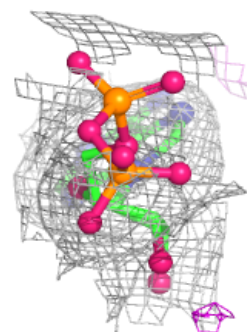
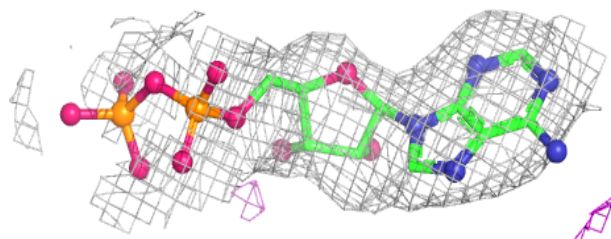
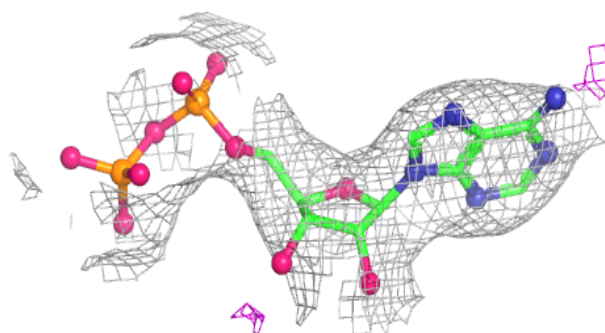


Electron density around ADP F 1100:

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

**Electron density around ADP G 1200:**

$2mF_o-DF_c$ (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.