

Protein Data Bank Changes Guide

New Changes in Version 3.20 September 15, 2008

Version 3.20 of the PDB file format introduces a small number of changes and extensions supporting the annotation practices adopted by the wwPDB. These annotation practices are described in detail in the documentation section of the wwPDB website. The complete details of the PDB file format can be found at <http://www.wwpdb.org/docs.html>.

1. SPLIT

When a structure has too many atoms to be represented in a single PDB formatted file, it will be split into smaller entries that will all be identified with a new record named SPLIT. Appears after TITLE.

```

1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890
SPLIT      1VOQ 1VOR 1VOS 1VOU 1VOV 1VOW 1VOX 1VOY
SPLIT      2 1VP0 1VOZ

```

Example:

```

1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890
HEADER     RIBOSOME                                06-OCT-04  1VOV
TITLE      CRYSTAL STRUCTURE OF FIVE 70S RIBOSOMES FROM ESCHERICHIA
TITLE      2 COLI IN COMPLEX WITH PROTEIN Y. THIS FILE CONTAINS THE 30S
TITLE      3 SUBUNIT OF ONE 70S RIBOSOME.
SPLIT      1VOQ 1VOR 1VOS 1VOU 1VOV 1VOW 1VOX 1VOY 1VOZ
SPLIT      2 1VP0 1VOZ

```

2. COMPND

An additional column will be added to extend the continuation lines up to 999.

Example:

```

1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890
COMPND  97 MOL_ID: 25;
COMPND  98 MOLECULE: 50S RIBOSOMAL PROTEIN L32E;
COMPND  99 CHAIN: Y;
COMPND 100 SYNONYM: HL5;
COMPND 101 MOL_ID: 26;
COMPND 102 MOLECULE: 50S RIBOSOMAL PROTEIN L37AE;
COMPND 103 CHAIN: Z;
COMPND 104 MOL_ID: 27;
COMPND 105 MOLECULE: 50S RIBOSOMAL PROTEIN L37E;
COMPND 106 CHAIN: 1;
COMPND 107 SYNONYM: L35E;

```

3. SOURCE

The NCBI Taxonomy IDs for the organism (ORGANISM_TAXID) and expression system (EXPRESSION_SYSTEM_TAXID) are now included in the SOURCE record if they are available.

Example:

```

1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890
SOURCE   MOL_ID: 1;
SOURCE   2 ORGANISM_SCIENTIFIC: LACTOBACILLUS CASEI;
SOURCE   4 ORGANISM_TAXID: 1582;
SOURCE   5 GENE: THYA;
SOURCE   6 EXPRESSION_SYSTEM: ESCHERICHIA COLI;
SOURCE   8 EXPRESSION_SYSTEM_TAXID: 562
SOURCE   9 EXPRESSION_SYSTEM_STRAIN: CHI2913RECA;
SOURCE  10 EXPRESSION_SYSTEM_VECTOR_TYPE: PLASMID;
SOURCE  11 EXPRESSION_SYSTEM_PLASMID: PSCTS9

```

An additional column will be added to extend the continuation lines up to 999.

Example:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

SOURCE	99	ORGANISM_SCIENTIFIC:	ESCHERICHIA COLI;
SOURCE	100	MOL_ID:	29;
SOURCE	101	ORGANISM_SCIENTIFIC:	ESCHERICHIA COLI;
SOURCE	102	MOL_ID:	30;
SOURCE	103	ORGANISM_SCIENTIFIC:	ESCHERICHIA COLI;
SOURCE	104	MOL_ID:	31;
SOURCE	105	ORGANISM_SCIENTIFIC:	ESCHERICHIA COLI;

4. EXPDTA

The experimental methods have been standardized and follow an enumeration list. Multiple exp methods will be listed here for joint refinement or hybrid methods. NMR entries will be identified by solution and solid state. EM entries will be identified by electron crystallography and electron microscopy.

X-RAY DIFFRACTION
NEUTRON DIFFRACTION
FIBER DIFFRACTION
ELECTRON CRYSTALLOGRAPHY
ELECTRON MICROSCOPY
SOLUTION NMR
SOLID-STATE NMR
SOLUTION SCATTERING

Example 1:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

EXPDTA	SOLID-STATE NMR
--------	-----------------

Example 2, joint refinement:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

EXPDTA	X-RAY DIFFRACTION; NEUTRON DIFFRACTION
--------	--

5. NUMMDL

The new record NUMMDL specifies the number of models. Appears after EXPDTA.

Example, ensemble without minimized average:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

EXPDTA	SOLUTION NMR
NUMMDL	20

6. MDLTYP

The new record MDLTYP specifies the minimized average or Ca/P atoms chains. Appears after EXPDTA with continuous lines.

Example 1, only one minimized average:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

EXPDTA	SOLUTION NMR
MDLTYP	MINIMIZED AVERAGE

Example 2, chains contain Ca or P atoms only:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
MDLTYP	CA ATOMS ONLY, CHAIN A, B, C, D, E, F, G, H, I, J, K; P ATOMS ONLY,							
MDLTYP	2 CHAIN X, Y, Z							

Example 3, minimized average AND chains contain Ca or P atoms only:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
MDLTYP	MINIMIZED AVERAGE; CA ATOMS ONLY, CHAIN A, B							

7. JRNL

Country code, ASTM and ISBN have been removed.

The PubMed ID and corresponding Digital Object Identifier (DOI) for the primary citation have been added. Each DOI consists of a publisher prefix, a slash ("/"), and a suffix of numbers and letters of any length. The PubMed ID and DOI start at column 20.

Example:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
JRNL	REF	PROC.NATL.ACAD.SCI.USA			V. 105 4621 2008			
JRNL	REFN	ISSN 0027-8424						
JRNL	PMID	18344321						
JRNL	DOI	10.1073/pnas.0712393105						

8. REMARK 2

Format has been changed to allow display of low resolution.
Resolution becomes f7.2 to allow for space and 100.00 ANGSTROM.

Example:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
REMARK	2 RESOLUTION. 1.74 ANGSTROMS.							

9. REMARK 4

The versioning now has format x.xx with uniform date format dd-mmm-yy.

Example:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
REMARK	4 2G86 COMPLIES WITH FORMAT V. 3.20, 01-AUG-07							

10. REMARK 100

For entries processed at RCSB, PDBe, or PDBJ, this remark indicates the data processing site, processing date with uniform format dd-mmm-yy, and site ID code. For entries processed at BNL, this record will only include the data processing site.

Examples:

	1	2	3	4	5	6	7	8
	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890
REMARK	100 THIS ENTRY HAS BEEN PROCESSED BY RCSB on 10-MAR-06.							
REMARK	100 THE RCSB ID CODE IS RCSB036809.							

REMARK	100 THIS ENTRY HAS BEEN PROCESSED BY PDBe on 13-FEB-07.							
REMARK	100 THE PDBe ID CODE IS EBI-28843.							

REMARK	100 THIS ENTRY HAS BEEN PROCESSED BY PDBJ on 21-MAR-05.							
--------	---	--	--	--	--	--	--	--

REMARK 100 THE RCSB ID CODE IS RCSB026278.

REMARK 100 THIS ENTRY HAS BEEN PROCESSED BY BNL.

11. REMARK 200

This remark will have the uniform date format dd-mmm-yy.

Example:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

REMARK 200 DATE OF DATA COLLECTION : 01-JAN-96

12. REMARK 240

This remark is mandatory for ELECTRON CRYSTALLOGRAPHY. Three new records have been added: RECONSTRUCTION METHOD, SAMPLE TYPE, and SPECIMEN TYPE. The DATE OF DATA COLLECTION will have the uniform date format dd-mmm-yy.

Example:

1	2	3	4	5	6	7	8
1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890	1234567890

REMARK 240									
REMARK 240	EXPERIMENTAL DETAILS								
REMARK 240	RECONSTRUCTION METHOD						:	CRYSTALLOGRAPHY	
REMARK 240	SAMPLE TYPE						:	2D CRYSTAL	
REMARK 240	SPECIMEN TYPE						:	VITREOUS ICE (CRYO EM)	
REMARK 240	DATA AQUISITION								
REMARK 240	DATE OF DATA COLLECTION						:	01-DEC-03	
REMARK 240	TEMPERATURE	(KELVIN)						:	300.0
REMARK 240	PH						:	6.00	
REMARK 240	NUMBER OF CRYSTALS USED						:	286	
REMARK 240	MICROSCOPE MODEL						:	JEM3000SFF	
REMARK 240	DETECTOR TYPE						:	CCD	
REMARK 240	ACCELERATION VOLTAGE (KV)						:	300	
REMARK 240	NUMBER OF UNIQUE REFLECTIONS						:	22293	
REMARK 240	RESOLUTION RANGE HIGH	(A)						:	1.9
REMARK 240	RESOLUTION RANGE LOW	(A)						:	20.000
REMARK 240	DATA SCALING SOFTWARE						:	SOFTWARE	
REMARK 240	COMPLETENESS FOR RANGE	(%)						:	80.0
REMARK 240	DATA REDUNDANCY						:	5.700	
REMARK 240	IN THE HIGHEST RESOLUTION SHELL.								
REMARK 240	HIGHEST RESOLUTION SHELL, RANGE HIGH	(A)						:	1.90
REMARK 240	HIGHEST RESOLUTION SHELL, RANGE LOW	(A)						:	2.0
REMARK 240	COMPLETENESS FOR SHELL	(%)						:	82.0
REMARK 240	DATA REDUNDANCY IN SHELL						:	5.70	
REMARK 240	R MERGE FOR SHELL	(I)						:	0.166
REMARK 240	METHOD USED TO DETERMINE THE STRUCTURE: MOLECULAR								
REMARK 240	REPLACEMENT								
REMARK 240	SOFTWARE USED						:	CNS	
REMARK 240	STARTING MODEL						:	PDB ENTRY 1SOR	

13. REMARK 245

This remark is mandatory for ELECTRON MICROSCOPY. Four new PDB records have been added: RECONSTRUCTION METHOD, SAMPLE TYPE, SPECIMEN TYPE, and PARTICLE TYPE if SAMPLE TYPE is PARTICLE. The DATE OF EXPERIMENT will have the uniform date format dd-mm-yy.

Example:

```

1      2      3      4      5      6      7      8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 245
REMARK 245 EXPERIMENTAL DETAILS
REMARK 245 RECONSTRUCTION METHOD           : SINGLE PARTICLE
REMARK 245 SPECIMEN TYPE                   : VITREOUS ICE (CRYO EM)
REMARK 245
REMARK 245 ELECTRON MICROSCOPE SAMPLE
REMARK 245 SAMPLE TYPE                     : PARTICLE
REMARK 245 PARTICLE TYPE                   : MIXED SYMMETRY
REMARK 245 NAME OF SAMPLE                  : BACTERIOPHAGE T4
REMARK 245 SAMPLE CONCENTRATION (MG ML-1) : 20.00
REMARK 245 SAMPLE SUPPORT DETAILS         : NULL
REMARK 245 SAMPLE VITRIFICATION DETAILS  : NULL
REMARK 245 SAMPLE BUFFER                  : H2O
REMARK 245 PH                             : 7.50
REMARK 245 SAMPLE DETAILS                 : PHAGE
REMARK 245
REMARK 245 DATA ACQUISITION
REMARK 245 DATE OF EXPERIMENT             : 06-JAN-02
REMARK 245 NUMBER OF MICROGRAPHS-IMAGES  : NULL
REMARK 245 TEMPERATURE (KELVIN)          : 100.00
REMARK 245 MICROSCOPE MODEL               : FEI/PHILIPS CM300FEG/T
REMARK 245 DETECTOR TYPE                  : NULL
REMARK 245 MINIMUM DEFOCUS (NM)           : 500.00
REMARK 245 MAXIMUM DEFOCUS (NM)          : 3400.00
REMARK 245 MINIMUM TILT ANGLE (DEGREES)   : 0.00
REMARK 245 MAXIMUM TILT ANGLE (DEGREES)   : 0.00
REMARK 245 NOMINAL CS                     : 1.40
REMARK 245 IMAGING MODE                   : BRIGHT FIELD
REMARK 245 ELECTRON DOSE (ELECTRONS NM**-2) : 20.00
REMARK 245 ILLUMINATION MODE              : SPOT SCAN
REMARK 245 NOMINAL MAGNIFICATION          : 45000
REMARK 245 CALIBRATED MAGNIFICATION       : 47000
REMARK 245 SOURCE                         : FIELD EMISSION GUN
REMARK 245 ACCELERATION VOLTAGE (KV)      : 300
REMARK 245 IMAGING DETAILS                : NULL

```

14. REMARK 300

The point symmetry will be in the last line of REMARK 300.

Example:

```

1      2      3      4      5      6      7      8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 300 THE ASSEMBLY REPRESENTED IN THIS ENTRY HAS REGULAR
REMARK 300 CYCLIC POINT SYMMETRY (SCHOENFLIES SYMBOL = C38).

```

15. REMARK 350

In SPLIT entries, REMARK 350 reports the quaternary structure for the partial structure. Surface area is not reported.

Example, SPLIT entries:

```

1          2          3          4          5          6          7          8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 350 COORDINATES FOR A COMPLETE MULTIMER REPRESENTING THE KNOWN
REMARK 350 BIOLOGICALLY SIGNIFICANT OLIGOMERIZATION STATE OF THE
REMARK 350 MOLECULE CAN BE GENERATED BY APPLYING BIOMT TRANSFORMATIONS
REMARK 350 GIVEN BELOW. BOTH NON-CRYSTALLOGRAPHIC AND
REMARK 350 CRYSTALLOGRAPHIC OPERATIONS ARE GIVEN.
REMARK 350
REMARK 350 BIOMOLECULE: 1
REMARK 350 QUATERNARY STRUCTURE FOR THIS ENTRY: 21MERIC
REMARK 350 APPLY THE FOLLOWING TO CHAINS: A, B, C, D, E, F, G, H, I,
REMARK 350 AND CHAINS: J, K, L, M, N, O, P, Q, R,
REMARK 350 AND CHAINS: S, T, a
REMARK 350 BIOMT1 1 1.000000 0.000000 0.000000 0.000000
REMARK 350 BIOMT2 1 0.000000 1.000000 0.000000 0.000000
REMARK 350 BIOMT3 1 0.000000 0.000000 1.000000 0.000000

```

In non-SPLIT entries, REMARK 350 reports the full quaternary structure and software-calculated outputs, if available.

Example, non-SPLIT entries:

```

1          2          3          4          5          6          7          8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 350 BIOMOLECULE: 1
REMARK 350 AUTHOR DETERMINED BIOLOGICAL UNIT: DODECAMERIC
REMARK 350 SOFTWARE DETERMINED QUATERNARY STRUCTURE: DODECAMERIC
REMARK 350 SOFTWARE USED: PISA
REMARK 350 TOTAL BURIED SURFACE AREA: 2990 ANGSTROM**2
REMARK 350 SURFACE AREA OF THE COMPLEX: 9330 ANGSTROM**2
REMARK 350 CHANGE IN SOLVENT FREE ENERGY: -40.1 KCAL/MOL
REMARK 350 APPLY THE FOLLOWING TO CHAINS: A, B, C, D, E, F, G, H, I,
REMARK 350 AND CHAINS: J, K, L
REMARK 350 BIOMT1 1 1.000000 0.000000 0.000000 0.000000
REMARK 350 BIOMT2 1 0.000000 1.000000 0.000000 0.000000
REMARK 350 BIOMT3 1 0.000000 0.000000 1.000000 0.000000

```

16. REMARK 465

For NMR ensembles, the missing residues will be listed in model range.

Example:

```

1          2          3          4          5          6          7          8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 465 MISSING RESIDUES
REMARK 465 THE FOLLOWING RESIDUES WERE NOT LOCATED IN THE
REMARK 465 EXPERIMENT. (RES=RESIDUE NAME; C=CHAIN IDENTIFIER;
REMARK 465 SSSEQ=SEQUENCE NUMBER; I=INSERTION CODE.)
REMARK 465 MODELS 1-20
REMARK 465 RES C SSSEQI
REMARK 465 MET A 1
REMARK 465 GLY A 2

```

17. REMARK 470

For NMR ensembles, the missing atoms will be listed in model range.

Example:

```

      1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 470 MISSING ATOM
REMARK 470 THE FOLLOWING RESIDUES HAVE MISSING ATOMS(RES=RESIDUE NAME;
REMARK 470 C=CHAIN IDENTIFIER; SSEQ=SEQUENCE NUMBER; I=INSERTION CODE):
REMARK 470   MODELS 1-25
REMARK 470     RES CSSEQI  ATOMS
REMARK 470     ILE A  20    CD1
REMARK 470     THR A  59    CG2

```

18. REMARK 800

REMARK 800 will distinguish between author-provided and software-generated SITE records with an "EVIDENCE CODE" where the value can be AUTHOR/SOFTWARE/UNKNOWN. This appears after SITE_IDENTIFIER.

Example:

```

      1           2           3           4           5           6           7           8
1234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 800
REMARK 800 SITE
REMARK 800 SITE_IDENTIFIER: AC1
REMARK 800 EVIDENCE_CODE: SOFTWARE
REMARK 800 SITE_DESCRIPTION: BINDING SITE FOR RESIDUE BIL A 19
REMARK 800
REMARK 800 SITE_IDENTIFIER: CAT
REMARK 800 EVIDENCE_CODE: AUTHOR
REMARK 800 SITE_DESCRIPTION: DESIGNATED RECOGNITION REGION IN PRIMARY
REMARK 800 REFERENCE. PROPOSED TO AFFECT SUBSTRATE SPECIFICITY.

```


19. DBREF, DBREF1, and DBREF2

The DBREF record provides cross-reference links between PDB sequences and the corresponding database entry or entries in a given, fixed character space. This record will continue to be used as long as an accession code fits in the space provided (e.g., UNP code). Two new DBREF records (DBREF1 and DBREF2) will only be used when the accession code or sequence numbering does not fit to DBREF format such as (e.g., UNIMES or GB).

Example, DBREF:

	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
DBREF	2J83 A	61	322	UNP	Q8TL28	Q8TL28_METAC	61	322

In the new format, 20 characters are reserved for accession code and 10 characters are reserved for DB numbering.

Example, DBREF1 and DBREF2:

	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
DBREF1	2J83 A	61	322	UNIMES		UPI000148A153		
DBREF2	2J83 A		MES00005880000			61		322
DBREF1	2J83 A	61	322	GB		AE017221		
DBREF2	2J83 A		46197919			1534489		1537377

All entries will self-reference if a database sequence is not available.

Example, No Database Sequence:

	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
DBREF	2J83 A	1	23	PDB	2J83	2J83	1	23

20. REMARK 630, Peptide inhibitors

New record REMARK 630 describes the chemistry, function, or structure features for any antibiotics, inhibitors or peptide inhibitors that are treated as single molecules.

Template:

	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
REMARK	630	MOLECULE	TYPE:					
REMARK	630	MOLECULE	NAME:					
REMARK	630	(M=MODEL	NUMBER;	RES=RESIDUE	NAME;	C=CHAIN	IDENTIFIER;	
REMARK	630	SSSEQ=SEQUENCE	NUMBER;	I=INSERTION	CODE.)			
REMARK	630							
REMARK	630	M	RES	C	SSSEQI			
REMARK	630	SOURCE:						
REMARK	630	SUBCOMP:						
REMARK	630	STRUCTURE	DETAILS:					
REMARK	630	OTHER	DETAILS:					

21. REMARK 3 for Phenix template/example and joint refinement for X-ray/Neutron

Phenix templates have been added to REMARK 3.

Example, PHENIX:

	1	2	3	4	5	6	7	8
	1234567890123456789012345678901234567890123456789012345678901234567890							
REMARK	3							

```

REMARK 3 REFINEMENT.
REMARK 3 PROGRAM : PHENIX (PHENIX.REFINE)
REMARK 3 AUTHORS : PAUL ADAMS,PAVEL AFONINE,VICENT CHEN,IAN
REMARK 3 : DAVIS,KRESHNA GOPAL,RALF GROSSE-
REMARK 3 : KUNSTLEVE,LI-WEI HUNG,ROBERT IMMORMINO,
REMARK 3 : TOM IOERGER,AIRLIE MCCOY,ERIK MCKEE,NIGEL
REMARK 3 : MORIARTY,REETAL PAI,RANDY READ,JANE
REMARK 3 : RICHARDSON,DAVID RICHARDSON,TOD ROMO,JIM
REMARK 3 : SACCHETTINI,NICHOLAS SAUTER,JACOB SMITH,
REMARK 3 : LAURENT STORONI,TOM TERWILLIGER,PETER
REMARK 3 : ZWART
REMARK 3
REMARK 3 REFINEMENT TARGET : ML
REMARK 3
REMARK 3 DATA USED IN REFINEMENT.
REMARK 3 RESOLUTION RANGE HIGH (ANGSTROMS) : 2.99
REMARK 3 RESOLUTION RANGE LOW (ANGSTROMS) : 40.07
REMARK 3 MIN(FOBS/SIGMA_FOBS) : 0.000
REMARK 3 COMPLETENESS FOR RANGE (%) : 96.7
REMARK 3 NUMBER OF REFLECTIONS : 242645
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT.
REMARK 3 R VALUE (WORKING + TEST SET) : 0.293
REMARK 3 R VALUE (WORKING SET) : 0.291
REMARK 3 FREE R VALUE : 0.335
REMARK 3 FREE R VALUE TEST SET SIZE (%) : 4.980
REMARK 3 FREE R VALUE TEST SET COUNT : 12081
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT (IN BINS).
REMARK 3 BIN RESOLUTION RANGE COMPL. NWORK NFREE RWORK RFREE
REMARK 3 1 40.0700 - 9.2600 0.98 8197 419 0.1970 0.2050
REMARK 3 2 9.2600 - 7.3700 0.98 7994 409 0.1560 0.1990
REMARK 3 3 7.3700 - 6.4400 0.99 7965 413 0.2060 0.2470
REMARK 3 4 6.4400 - 5.8500 0.99 7924 426 0.2330 0.2740
REMARK 3 5 5.8500 - 5.4300 0.98 7833 444 0.2550 0.3160
REMARK 3 6 5.4300 - 5.1200 0.98 7811 408 0.2530 0.3110
REMARK 3 7 5.1200 - 4.8600 0.97 7819 387 0.2550 0.3210
REMARK 3 8 4.8600 - 4.6500 0.97 7693 423 0.2690 0.3260
REMARK 3 9 4.6500 - 4.4700 0.97 7737 394 0.2790 0.2920
REMARK 3 10 4.4700 - 4.3200 0.97 7691 403 0.2690 0.3280
REMARK 3 11 4.3200 - 4.1800 0.97 7731 402 0.2560 0.3040
REMARK 3 12 4.1800 - 4.0600 0.98 7760 407 0.2610 0.3170
REMARK 3 13 4.0600 - 3.9500 0.97 7685 398 0.2710 0.3070
REMARK 3 14 3.9500 - 3.8600 0.98 7758 403 0.2970 0.3650
REMARK 3 15 3.8600 - 3.7700 0.98 7713 431 0.2890 0.3260
REMARK 3 16 3.7700 - 3.6900 0.98 7737 386 0.2870 0.3520
REMARK 3 17 3.6900 - 3.6200 0.98 7719 410 0.2910 0.3230
REMARK 3 18 3.6200 - 3.5500 0.98 7683 426 0.2770 0.3200
REMARK 3 19 3.5500 - 3.4800 0.98 7756 375 0.2950 0.3480
REMARK 3 20 3.4800 - 3.4300 0.98 7720 414 0.3110 0.3780
REMARK 3 21 3.4300 - 3.3700 0.98 7742 372 0.3200 0.3760
REMARK 3 22 3.3700 - 3.3200 0.98 7667 411 0.3440 0.4360
REMARK 3 23 3.3200 - 3.2700 0.98 7700 414 0.3410 0.3840
REMARK 3 24 3.2700 - 3.2200 0.97 7667 411 0.3350 0.3870
REMARK 3 25 3.2200 - 3.1800 0.97 7541 419 0.3400 0.3790
REMARK 3 26 3.1800 - 3.1400 0.96 7637 402 0.3460 0.4220
REMARK 3 27 3.1400 - 3.1000 0.96 7613 381 0.3580 0.3940
REMARK 3 28 3.1000 - 3.0600 0.96 7538 427 0.3790 0.4290
REMARK 3 29 3.0600 - 3.0300 0.95 7440 376 0.3760 0.4350
REMARK 3 30 3.0300 - 2.9900 0.77 6093 290 0.3950 0.4490
REMARK 3
REMARK 3 BULK SOLVENT MODELLING.

```

```

REMARK 3 METHOD USED : FLAT BULK SOLVENT MODEL
REMARK 3 SOLVENT RADIUS : 1.11
REMARK 3 SHRINKAGE RADIUS : 0.90
REMARK 3 K_SOL : 0.30
REMARK 3 B_SOL : 56.99
REMARK 3
REMARK 3 ERROR ESTIMATES.
REMARK 3 COORDINATE ERROR (MAXIMUM-LIKELIHOOD BASED) : 0.510
REMARK 3 PHASE ERROR (DEGREES, MAXIMUM-LIKELIHOOD BASED) : 36.180
REMARK 3
REMARK 3 B VALUES.
REMARK 3 FROM WILSON PLOT (A**2) : 50.24
REMARK 3 MEAN B VALUE (OVERALL, A**2) : 62.67
REMARK 3 OVERALL ANISOTROPIC B VALUE.
REMARK 3 B11 (A**2) : -12.34000
REMARK 3 B22 (A**2) : -11.49000
REMARK 3 B33 (A**2) : 23.84000
REMARK 3 B12 (A**2) : 0.00000
REMARK 3 B13 (A**2) : 0.00000
REMARK 3 B23 (A**2) : 0.00000
REMARK 3
REMARK 3 TWINNING INFORMATION.
REMARK 3 FRACTION: NULL
REMARK 3 OPERATOR: NULL
REMARK 3
REMARK 3 DEVIATIONS FROM IDEAL VALUES.
REMARK 3 RMSD COUNT
REMARK 3 BOND : 0.059 59703
REMARK 3 ANGLE : 3.995 80640
REMARK 3 CHIRALITY : 0.243 9800
REMARK 3 PLANARITY : 0.013 10535
REMARK 3 DIHEDRAL : 24.960 22449
REMARK 3
REMARK 3 TLS DETAILS
REMARK 3 NUMBER OF TLS GROUPS : 2
REMARK 3 TLS GROUP : 1
REMARK 3 SELECTION: CHAIN A
REMARK 3 ORIGIN FOR THE GROUP (A): 34.3280 -44.3362 -33.2464
REMARK 3 T TENSOR
REMARK 3 T11: -0.3752 T22: -0.2836
REMARK 3 T33: -0.1972 T12: -0.0686
REMARK 3 T13: 0.0888 T23: -0.1454
REMARK 3 L TENSOR
REMARK 3 L11: -0.0328 L22: -0.0264
REMARK 3 L33: -0.0458 L12: -0.0047
REMARK 3 L13: 0.0289 L23: -0.0435
REMARK 3 S TENSOR
REMARK 3 S11: -0.0220 S12: 0.7030 S13: 0.0888
REMARK 3 S21: -0.7542 S22: -0.0140 S23: -0.0265
REMARK 3 S31: -0.2584 S32: 0.0315 S33: 0.0000
REMARK 3 TLS GROUP : 2
REMARK 3 SELECTION: CHAIN B
REMARK 3 ORIGIN FOR THE GROUP (A): 45.1940 -82.3594 -33.3841
REMARK 3 T TENSOR
REMARK 3 T11: -0.0302 T22: -0.0378
REMARK 3 T33: -0.0668 T12: -0.0642
REMARK 3 T13: 0.1450 T23: -0.0811
REMARK 3 L TENSOR
REMARK 3 L11: 0.0154 L22: 0.0032
REMARK 3 L33: -0.0145 L12: 0.0014
REMARK 3 L13: 0.0441 L23: 0.0209
REMARK 3 S TENSOR

```

```

REMARK 3      S11: -0.0023 S12:  0.6259 S13:  0.1176
REMARK 3      S21: -0.6677 S22: -0.0510 S23:  0.0868
REMARK 3      S31: -0.1498 S32: -0.2360 S33:  0.0000
REMARK 3
REMARK 3 NCS DETAILS
REMARK 3   NUMBER OF NCS GROUPS : 3
REMARK 3   NCS GROUP : 1
REMARK 3     NCS OPERATOR : 1
REMARK 3       REFERENCE SELECTION: CHAIN A AND (RESSEQ 2:525 )
REMARK 3       SELECTION           : CHAIN B AND (RESSEQ 2:525 )
REMARK 3       ATOM PAIRS NUMBER   : 3856
REMARK 3       RMSD                 : 0.214
REMARK 3     NCS OPERATOR : 2
REMARK 3       REFERENCE SELECTION: CHAIN A AND (RESSEQ 2:525 )
REMARK 3       SELECTION           : CHAIN C AND (RESSEQ 2:525 )
REMARK 3       ATOM PAIRS NUMBER   : 3856
REMARK 3       RMSD                 : 0.214
REMARK 3   NCS GROUP : 2
REMARK 3     NCS OPERATOR : 1
REMARK 3       REFERENCE SELECTION: CHAIN H AND (RESSEQ 2:525 )
REMARK 3       SELECTION           : CHAIN I AND (RESSEQ 2:525 )
REMARK 3       ATOM PAIRS NUMBER   : 3856
REMARK 3       RMSD                 : 0.224
REMARK 3     NCS OPERATOR : 2
REMARK 3       REFERENCE SELECTION: CHAIN H AND (RESSEQ 2:525 )
REMARK 3       SELECTION           : CHAIN J AND (RESSEQ 2:525 )
REMARK 3       ATOM PAIRS NUMBER   : 3856
REMARK 3       RMSD                 : 0.231
REMARK 3   NCS GROUP : 3
REMARK 3     NCS OPERATOR : 1
REMARK 3       REFERENCE SELECTION: CHAIN O AND (RESSEQ 1:97 )
REMARK 3       SELECTION           : CHAIN P AND (RESSEQ 1:97 )
REMARK 3       ATOM PAIRS NUMBER   : 728
REMARK 3       RMSD                 : 0.207
REMARK 3     NCS OPERATOR : 2
REMARK 3       REFERENCE SELECTION: CHAIN O AND (RESSEQ 1:97 )
REMARK 3       SELECTION           : CHAIN Q AND (RESSEQ 1:97 )
REMARK 3       ATOM PAIRS NUMBER   : 728
REMARK 3       RMSD                 : 0.211
REMARK 3
REMARK 3 OTHER REFINEMENT REMARKS: NULL

```

Example, PHENIX X-ray/neutron joint refinement:

```

1      2      3      4      5      6      7      8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

```

```

REMARK 3
REMARK 3 REFINEMENT.
REMARK 3 PROGRAM      : PHENIX (PHENIX.REFINE)
REMARK 3 AUTHORS       : PAUL ADAMS, PAVEL AFONINE, VICENT CHEN, IAN
REMARK 3               : DAVIS, KRESHNA GOPAL, RALF GROSSE-KUNSTLEVE,
REMARK 3               : LI-WEI HUNG, ROBERT IMMORMINO, TOM IOERGER,
REMARK 3               : AIRLIE MCCOY, ERIK MCKEE, NIGEL MORIARTY,
REMARK 3               : REETAL PAI, RANDY READ, JANE RICHARDSON,
REMARK 3               : DAVID RICHARDSON, TOD ROMO, JIM
REMARK 3               : SACCHETTINI, NICHOLAS SAUTER, JACOB SMITH,
REMARK 3               : LAURENT STORONI, TOM TERWILLIGER, PETER
REMARK 3               : ZWART
REMARK 3
REMARK 3 X-RAY DATA.
REMARK 3
REMARK 3 REFINEMENT TARGET : ML
REMARK 3

```

```

REMARK 3 DATA USED IN REFINEMENT.
REMARK 3 RESOLUTION RANGE HIGH (ANGSTROMS) : 1.752
REMARK 3 RESOLUTION RANGE LOW (ANGSTROMS) : 33.563
REMARK 3 MIN(FOBS/SIGMA_FOBS) : 1.33
REMARK 3 COMPLETENESS FOR RANGE (%) : 98.78
REMARK 3 NUMBER OF REFLECTIONS : 31524
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT.
REMARK 3 R VALUE (WORKING + TEST SET) : 0.1320
REMARK 3 R VALUE (WORKING SET) : 0.1286
REMARK 3 FREE R VALUE : 0.1660
REMARK 3 FREE R VALUE TEST SET SIZE (%) : 9.36
REMARK 3 FREE R VALUE TEST SET COUNT : 2952
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT (IN BINS).
REMARK 3 BIN RESOLUTION RANGE COMPL. NWORK NFREE RWORK RFREE
REMARK 3 1 33.5691 - 4.8295 99.36 1424 130 14.09 17.98
REMARK 3 2 4.8295 - 3.8351 99.68 1420 125 10.35 11.36
REMARK 3 3 3.8351 - 3.3508 99.87 1378 129 10.50 12.46
REMARK 3 4 3.3508 - 3.0447 100.00 1413 122 11.75 13.73
REMARK 3 5 3.0447 - 2.8265 100.00 1385 138 11.98 16.91
REMARK 3 6 2.8265 - 2.6600 100.00 1384 131 12.78 16.50
REMARK 3 7 2.6600 - 2.5268 100.00 1351 162 12.18 17.96
REMARK 3 8 2.5268 - 2.4168 100.00 1394 137 12.38 15.72
REMARK 3 9 2.4168 - 2.3238 99.80 1381 130 12.31 15.43
REMARK 3 10 2.3238 - 2.2437 99.87 1385 142 12.59 17.55
REMARK 3 11 2.2437 - 2.1735 100.00 1368 123 12.06 18.73
REMARK 3 12 2.1735 - 2.1114 99.80 1377 143 11.86 15.53
REMARK 3 13 2.1114 - 2.0558 99.74 1337 171 11.30 16.96
REMARK 3 14 2.0558 - 2.0057 99.80 1353 143 11.92 15.94
REMARK 3 15 2.0057 - 1.9601 99.48 1386 144 12.20 16.05
REMARK 3 16 1.9601 - 1.9184 99.80 1340 136 12.98 19.21
REMARK 3 17 1.9184 - 1.8800 99.54 1380 142 13.77 21.17
REMARK 3 18 1.8800 - 1.8445 99.60 1371 141 14.14 18.20
REMARK 3 19 1.8445 - 1.8116 99.61 1344 172 15.59 22.03
REMARK 3 20 1.8116 - 1.7809 99.46 1321 158 16.78 22.15
REMARK 3 21 1.7809 - 1.7522 79.23 1080 133 20.53 25.69
REMARK 3
REMARK 3 BULK SOLVENT MODELLING.
REMARK 3 METHOD USED : FLAT BULK SOLVENT MODEL
REMARK 3 SOLVENT RADIUS : 1.11
REMARK 3 SHRINKAGE RADIUS : 0.90
REMARK 3 GRID STEP FACTOR : 4.00
REMARK 3 K_SOL : 0.347
REMARK 3 B_SOL : 29.392
REMARK 3
REMARK 3 ERROR ESTIMATES.
REMARK 3 COORDINATE ERROR (MAXIMUM-LIKELIHOOD BASED) : 0.19
REMARK 3 PHASE ERROR (DEGREES, MAXIMUM-LIKELIHOOD BASED) : 15.39
REMARK 3
REMARK 3 OVERALL SCALE FACTORS.
REMARK 3 SCALE = SUM(|F_OBS|*|F_MODEL|)/SUM(|F_MODEL|**2) : 0.8070
REMARK 3 ANISOTROPIC SCALE MATRIX ELEMENTS (IN CARTESIAN BASIS).
REMARK 3 B11 : 5.3378
REMARK 3 B22 : 5.4560
REMARK 3 B33 : 4.2407
REMARK 3 B12 : 0.0000
REMARK 3 B13 : 0.4309
REMARK 3 B23 : 0.0000
REMARK 3
REMARK 3 NEUTRON DATA.
REMARK 3

```

```

REMARK 3 REFINEMENT TARGET : ML
REMARK 3
REMARK 3 DATA USED IN REFINEMENT.
REMARK 3 RESOLUTION RANGE HIGH (ANGSTROMS) : 2.194
REMARK 3 RESOLUTION RANGE LOW (ANGSTROMS) : 40.110
REMARK 3 MIN(FOBS/SIGMA_FOBS) : 1.53
REMARK 3 COMPLETENESS FOR RANGE (%) : 72.79
REMARK 3 NUMBER OF REFLECTIONS : 11884
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT.
REMARK 3 R VALUE (WORKING + TEST SET) : 0.2596
REMARK 3 R VALUE (WORKING SET) : 0.2566
REMARK 3 FREE R VALUE : 0.2912
REMARK 3 FREE R VALUE TEST SET SIZE (%) : 8.35
REMARK 3 FREE R VALUE TEST SET COUNT : 992
REMARK 3
REMARK 3 FIT TO DATA USED IN REFINEMENT (IN BINS).
REMARK 3 BIN RESOLUTION RANGE COMPL. NWORK NFREE RWORK RFREE
REMARK 3 1 40.1164 - 4.1959 92.61 2018 176 19.78 20.59
REMARK 3 2 4.1959 - 3.3309 88.97 1915 175 21.10 25.35
REMARK 3 3 3.3309 - 2.9100 77.65 1669 152 25.71 30.82
REMARK 3 4 2.9100 - 2.6440 69.69 1475 141 26.71 30.75
REMARK 3 5 2.6440 - 2.4545 63.92 1350 133 28.77 33.51
REMARK 3 6 2.4545 - 2.3098 59.97 1269 117 30.95 33.64
REMARK 3 7 2.3098 - 2.1942 56.09 1196 98 32.32 36.32
REMARK 3
REMARK 3 BULK SOLVENT MODELLING.
REMARK 3 METHOD USED : FLAT BULK SOLVENT MODEL
REMARK 3 SOLVENT RADIUS : 1.11
REMARK 3 SHRINKAGE RADIUS : 0.90
REMARK 3 GRID STEP FACTOR : 4.00
REMARK 3 K_SOL : 0.530
REMARK 3 B_SOL : 82.904
REMARK 3
REMARK 3 ERROR ESTIMATES.
REMARK 3 COORDINATE ERROR (MAXIMUM-LIKELIHOOD BASED) : 0.45
REMARK 3 PHASE ERROR (DEGREES, MAXIMUM-LIKELIHOOD BASED) : 26.92
REMARK 3
REMARK 3 OVERALL SCALE FACTORS.
REMARK 3 SCALE = SUM(|F_OBS|*|F_MODEL|)/SUM(|F_MODEL|**2) : 0.7477
REMARK 3 ANISOTROPIC SCALE MATRIX ELEMENTS (IN CARTESIAN BASIS).
REMARK 3 B11 : -0.7034
REMARK 3 B22 : -6.6254
REMARK 3 B33 : -7.0719
REMARK 3 B12 : -0.0000
REMARK 3 B13 : -1.2513
REMARK 3 B23 : -0.0000
REMARK 3
REMARK 3 MODEL CONTENT.
REMARK 3 ELEMENT ATOM RECORD COUNT OCCUPANCY SUM
REMARK 3 C 1659 1659.00
REMARK 3 D 2552 2552.00
REMARK 3 F 2 2.00
REMARK 3 O 769 769.00
REMARK 3 N 434 434.00
REMARK 3 P 3 3.00
REMARK 3 S 14 14.00
REMARK 3 Br 1 1.00
REMARK 3 TOTAL 5434 5434.00
REMARK 3
REMARK 3 DEVIATIONS FROM IDEAL VALUES.
REMARK 3 RMSD MAX COUNT

```

```

REMARK 3 BOND      : 0.018  0.153  5216
REMARK 3 ANGLE     : 1.759  18.550  9458
REMARK 3 CHIRALITY : 0.160  1.197   392
REMARK 3 PLANARITY : 0.011  0.144   779
REMARK 3 DIHEDRAL  : 25.100 176.474  1363
REMARK 3 MIN NONBONDED DISTANCE : 1.736
REMARK 3
REMARK 3 DEVIATIONS FROM IDEAL VALUES (HISTOGRAM).
REMARK 3 BONDS          ANGLES          NONBONDED
REMARK 3 0.00-0.02  4077  0.00 -1.85    7402  1.74-2.03   98
REMARK 3 0.02-0.03   733  1.85 -3.71    1672  2.03-2.33  1573
REMARK 3 0.03-0.05   247  3.71 -5.56     282  2.33-2.63  5095
REMARK 3 0.05-0.06    92  5.56 -7.42     67  2.63-2.92  7736
REMARK 3 0.06-0.08    33  7.42 -9.27     21  2.92-3.22  7666
REMARK 3 0.08-0.09    17  9.27 -11.13     5  3.22-3.51  9214
REMARK 3 0.09-0.11     8 11.13 -12.98     5  3.51-3.81 11450
REMARK 3 0.11-0.12     4 12.98 -14.84     2  3.81-4.11 14012
REMARK 3 0.12-0.14     3 14.84 -16.69     1  4.11-4.40 16177
REMARK 3 0.14-0.15     2 16.69 -18.55     1  4.40-4.70 20263
REMARK 3
REMARK 3 ATOMIC DISPLACEMENT PARAMETERS.
REMARK 3 WILSON B : 17.52
REMARK 3 ATOMS          NUMBER OF ATOMS  ISOTROPIC OR EQUIVALENT
REMARK 3              ISO.  ANISO.      MIN      MAX      MEAN
REMARK 3 ALL           : 5434      0      0.63    96.73   17.02
REMARK 3 ALL (NO H)    : 2882      0      1.76    96.73   17.15
REMARK 3 SOLVENT       : 285       0      4.56    74.96   33.18
REMARK 3 NON-SOLVENT   : 2597      0      1.76    96.73   15.39
REMARK 3 HYDROGENS    : 2552      0      0.63    91.23   16.87
REMARK 3
REMARK 3 ATOMIC DISPLACEMENT PARAMETERS (HISTOGRAM, NON-H).
REMARK 3 ISOTROPIC OR EQUIVALENT
REMARK 3 1.76-11.26    1375
REMARK 3 11.26-20.75   764
REMARK 3 20.75-30.25   309
REMARK 3 30.25-39.75   172
REMARK 3 39.75-49.24   114
REMARK 3 49.24-58.74    65
REMARK 3 58.74-68.24    43
REMARK 3 68.24-77.74    26
REMARK 3 77.74-87.23     9
REMARK 3 87.23-96.73     5
REMARK 3

```