SLAC Traveler for LCLS BC2 Dipole Magnets

(May 4, 2007)

This traveler is intended to cover reception, preparation, mechanical fiducialization, and magnetic measurements of the four bunch-compressor-2 (BC2) chicane dipole magnets. These magnets are about 54 cm long and have MAD designations of: BX21, BX22, BX23, and BX24, and each has both main and trim coils.

Receiving:

The following information is to be noted upon receipt of the magnets by the SLAC MFD group:

Received by (initials):	
Date received (dd-mmm-yyyy):	8/17/2007
SLAC barcode number:	002805
Vendor serial number from magnet label:	3
SLAC approved electrical safety covers? (Y or N):	
SLAC approved lifting eyes? (Y or N):	
Shipping Damage? (Y or N):	
Vendor tests passed on magnet label? (Y or N):	
SLAC drawing number (enter number):	SA-380-

Place a barcode sticker on the magnet and also duplicate the barcode sticker here →	002805

Preparation:

A beam direction arrow, with text "beam direction", is to be applied to the top and/or tunnel aisle side of the magnet with a sticker supplied by LCLS. Tom Borden (3887) will determine the direction.

Beam-direction arrow in place (initials):	SDA

Fiducialization:

Fiducialization may be done before or after magnetic measurements. The magnet is to be fiducialized by the CMM group. This will require the installation of removable tooling balls, location of the geometric axis of the poles of the magnet, and location of tooling balls with respect to the center of this geometric axis when the poles are aligned precisely horizontal.

CMM technician (initials):	

URL of on-line CMM fiducialization data (please modify or correct if necessary):

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Magnetic Measurements:

1) Verify that the magnets are complete and undamaged, including wiring connections.

Incoming inspection OK (initials):	SDA
Date of arrival to mag. meas.(mmm-dd-yyyy):	8-22-2007

Enter URL of on-line magnetic measurements data (please modify or correct if necessary):

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS/dipole/ 002865/

2) Mark each magnet as BX21, BX22, BX23, *or* BX24. By choosing the magnet location initially, they will be tested in their proper polarities, since two are to be positive and two negative.

Magnet marked as (BX21, BX22, BX23, or BX24):	BX23

3) Determine the main-coil connection polarity (with main supply outputting positive current) which produces a "positive" field polarity for BX21 and BX24 (below left), but a "negative" field polarity for BX22 and BX23 (below right), as shown below:

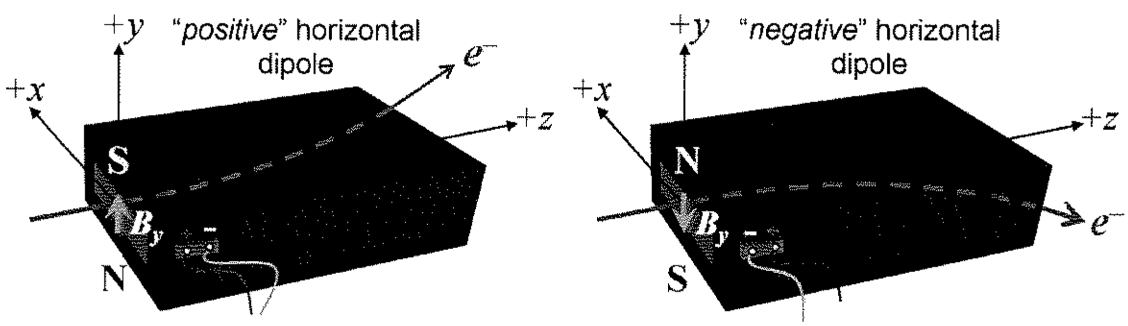


Figure 1. BX21 and BX24 are "positive" (left), while BX22 and BX23 are "negative" (right).

4) Mark the polarity near the **main** magnet leads with clear "+" and "–" labels as shown above.

Main coil polarity chosen from Fig. 1 is (P or N):	N

5) Also mark the **trim** leads with clear "+" and "–" labels such that, with the trim supply outputting positive current, the trim coil *increases* the absolute value of the magnetic field established by the main coil. This will set the trim polarity as "positive" for BX21 and BX24 and "negative" for BX22 and BX23, as described in PRD 1.1-010.

Trim coil polarity chosen from Fig. 1 is (P or N):	N

6) Connect the **main** magnet terminals (not the trims), in the correct polarity as established above, to a unipolar power supply with maximum current $I \geq 200$ A (assuming this current produces about 8.6 kG-m integrated field). Leave the trim coil disconnected for now.

7) Run the magnet up to 200 A for ~1 hour to warm it up (record temperature). Data in Tdat.ru1

Ambient temperature (°C):	20.1 °C
Final magnet temperature (°C):	33.6 °C

8) Standardize the magnet, starting from zero to 200 A and back to zero, through three full cycles, finally ending at zero, with a flat-top pause time (at both 0 and 200 A) of 10 seconds. Use a ramp rate of 10 A/sec, if possible, and record the ramp rate used.

Standardization complete (initials):	SDA
Ramp rate used (A/sec):	10 A/sec

9) Maintaining this cycle history, measure the length-integrated vertical dipole field, $\int B_y dl$, from 0 to 200 A in 20-A steps, including zero (11 'up' measurements). Please record (below) the current necessary to achieve 5.0 kG-m (max.) and call P. Emma at 283-7706 if it is more than 10% different than 115 A. If the maximum integrated field is <5.0 kG-m at 115 A, and after calling 283-7706, please record the current necessary to achieve this field and re-standardize up to the new current, starting the procedure again from that point. Then, still maintaining the cycle history, measure $\int B_y dl$ back down from 200 A to 0 in 20-A steps, including zero (11 'down' measurements).

Main coil excitation current at 5.0 kG-m:	114.93 Amps
Filename & run number of $\int B_y dl$ up & down data:	wiredat.ru2

10) Maintaining the standardization cycle, ramp the magnet back up from zero to a current of 115 A (with trim current at zero), and then carefully verify the peak magnetic field at the physical center of the magnet (in x, y, and z) by using a well calibrated Hall probe.

Hall probe field meas. at $x = y = z = 0$ at $I = 115$ A:	9.085	kG

11) **For the BX22 magnet *only***, ramp up the main coil from zero up to 200 A (trim current at zero), and measure the harmonics using a rotating coil with a diameter as close to the maximum insertable diameter of 1.3-inches as possible. Record the probe designation, radius, and data file names here:

Coil designation (text):		
Coil radius (m):		m
BX22 harmonics filename:		

12) With the **main** coils still hooked up, connect the **trim** coil to a bipolar 12-A (MCOR12) supply with proper trim polarity as determined above.

13) Set the **main** coil to 0 current by ramping first up to 200 A, then down to zero at the same ramp rate used in the standardization cycle. Measure $\int B_y dl$ as a function of **trim** coil current from 0 to −12 in 1-A steps, including zero (13 'down' measurements), and again from −12 to +12 A in 1-A steps (25 'up' measurements). Set the **trim** current to 0.

Filename & run # of $\int B_y dl$ **trim** data at $I_{main} = 0$:	Wiredat.ru6

14) For all four dipoles, with stretched wire, measure the vertical length-integrated field component over a horizontal span of ±44 mm (±1.7 inches), at each 2-mm interval, at the following **main** and **trim** coil current settings.

- $I_{main} = 115$ A, and $I_{trim} = 0$
- $I_{main} = 115$ A, and $I_{trim} = +12$ A
- $I_{main} = 200$ A, and $I_{trim} = 0$

Filename & run # of $\int B_y dl$ vs. x data at 115, 0 A:	Wiredat.ru3
Filename & run # of $\int B_y dl$ vs. x data at 115, +12 A:	Wire dat.ru4
Filename & run # of $\int B_y dl$ vs. x data at 200, 0 A:	Wiredat .ru5

15) **For the BX24 magnet only**, and at a **main** current of 115 A, with **trim** current at zero, measure the vertical magnetic fringe field component, B_y, at $x = y = 0$, as a function of the longitudinal beam-direction coordinate, z (from −10 cm to +30 cm in 1-cm steps, where $z = 0$ is defined at the iron edge), at the *downstream* end of this one magnet. Please also measure the background field at $z = +30$ cm with magnet switched off (separate file).

Filename of B_y vs. z data for BX24 exit edge:	
Background filename of $B_y(z = 30$ cm), magnet OFF:	

16) **For the BX24 magnet only**, perform this final thermal test. Run the **main** current up to 200 A, and with **trim** also set at its maximum operating current of +12 A, measure the magnet temperature after it stabilizes (~1 hour). Record the temperature below.

Ambient temperature (°C):	°C
Final stable BX24 magnet temperature at 200 A (°C):	°C

17) Measure the inductance and resistance of the **main** and **trim** magnet coils:

Inductance of **main** coil (mH):	14.2 mH
Resistance of **main** coil (Ohms):	0.164 Ohm
Inductance of **trim** coil (mH):	3.65 mH
Resistance of **trim** coil (Ohms):	0.365 Ohm

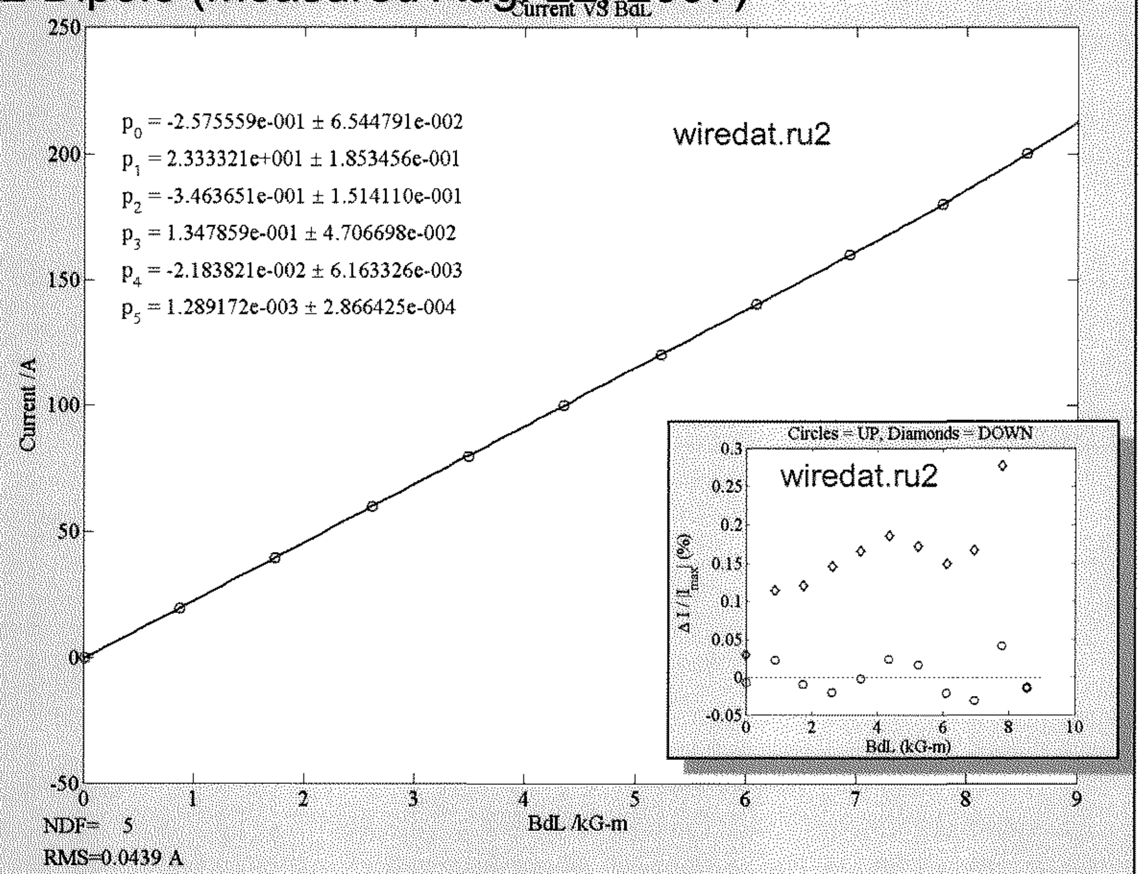
18) Upon completion of tests, send traveler to Paul Emma at mailstop 103.

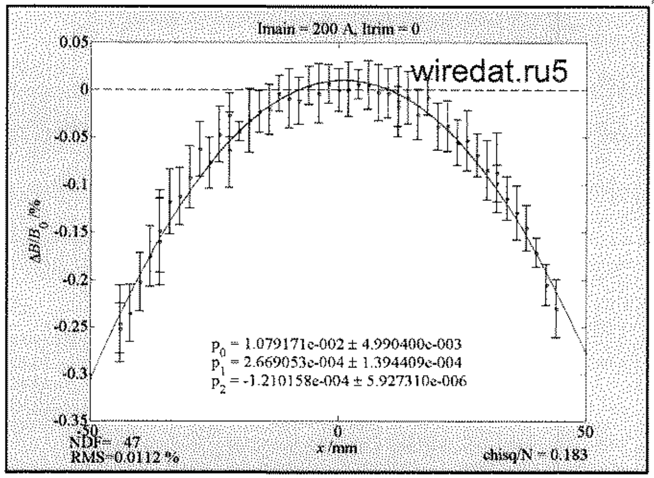
This section is to be completed by P. Emma.

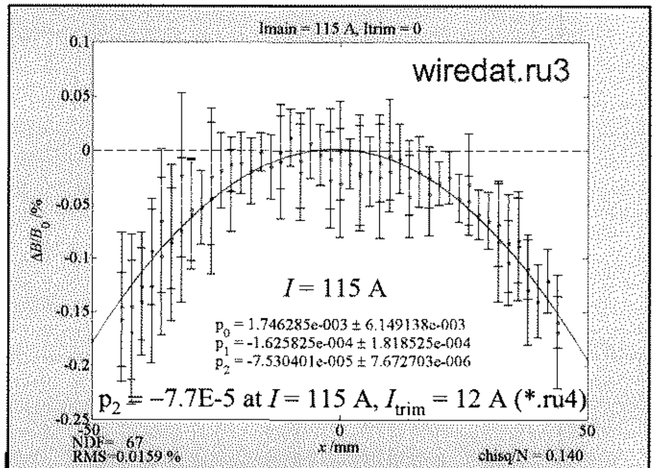
Magnet accepted (signed):	Paul E[signature]
Assigned beamline location (MAD-deck name):	BX23

19) Upon full completion, send this traveler to Kathleen Ratcliffe at mailstop 18.

BX2 Dipole (measured Aug. 22, 2007)

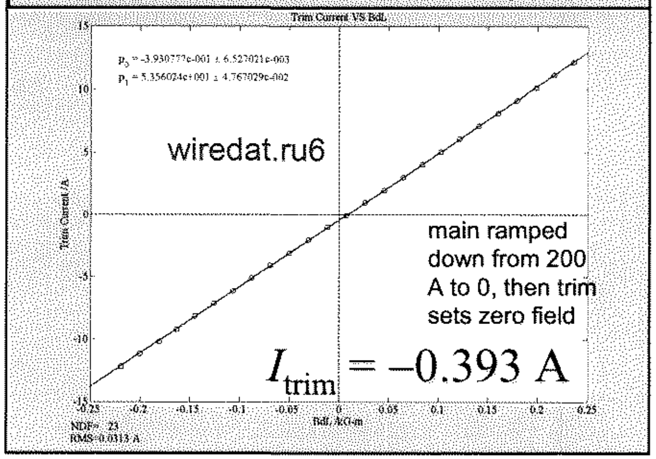






TURNS/MAIN-COIL = 110 (2 COILS/MAG)
TURNS/TRIM-COIL = 48 (2 COILS/MAG)
BTRM IVBU = [0 2.2917]

$L_{eff} = 0.5500$ m



SLAC magnet bar-code: **002805**
serial number: **3**
MAD assignment: **BX23**

http://www-group.slac.stanford.edu/met/MagMeas/MAGDATA/LCLS/dipole/002805/