October 23, 1978

Multipole Components of the Dipole Field

Definition

On the median plane of the dipole field,

$$B_y(x) = B_o \left[1 + \sum_n b_n x^n \right] \qquad \text{normal components}$$

$$B_x(x) = B_o \sum_n a_n x^n \qquad \text{skew components}$$

(b_n, a_n) correspond to the $(2n+2)$-pole field.

So far, twenty-three dipoles have been measured with a 94"-long rotating coil. For each dipole, three coil positions have been used to cover the entire length. Values of b_n and a_n given in the attached table are the average and the rms with the unit $10^{-4}/\text{inch}^n$. Since B_o = 10 kG at 1,000A, these values can be interpreted as the field in Gauss at $x = +1"$. In evaluating the average and the rms, one dipole (RFA108) is removed from the data. This magnet has an abnormally large quadrupole component.

In the table, the first column specifies the number of poles. For each multipole, the first line is for b_n (normal) and the second line for a_n (skew). The last two columns give the maximum deviation from the average value.

(S. Ohnuma)

	average	rms	max. deviation from ave.	
500 AMPS				unit: $10^{-4}/\text{inch}^n$
4	0,459	1,573	2,124(BA103)	-3,237(BA123)
	1,776	2,773	8,265(BA117)	-4,091(FA107)
6	-15,168	4,166	7,628(PAH98)	-7,102(HA111) for (2n+2) poles.
	0,484	0,781	1,766(BA119)	-1,297(DD114)
8	0,548	0,696	1,148(DA103)	-1,051(CA127)
	0,270	1,617	3,484(DC113)	-2,194(DD114)
10	3,612	1,754	4,488(PAH95)	-2,219(BA115)
	-0,033	0,677	1,380(BA117)	-1,094(CA127)
12	0,319	0,730	2,479(BCB80)	-1,396(PAH98)
	-0,273	0,676	1,360(CA127)	-1,303(BCB82)
14	2,633	0,624	0,890(CA131)	-1,448(BCB80)
	-0,216	0,495	1,121(BA117)	-0,923(DA103)
16	0,335	0,510	1,323(BCB80)	-0,625(DA103)
	0,027	0,574	0,723(FA107)	-1,278(DA103)
18	-12,988	0,667	1,029(DA102)	-2,038(DA103)
	0,169	0,717	2,119(BA119)	-1,441(BA118)
20	0,052	0,820	1,307(BA124)	-2,622(DA103)
	0,148	0,597	1,293(BA118)	-0,828(DD114)
22	4,248	0,518	2,736(BA119)	-1,707(BCB82)
	0,001	0,671	1,984(DA103)	-1,268(BA115)
24	0,086	0,606	1,843(BCB80)	-0,978(BA118)
	0,144	0,776	2,617(DA103)	-1,667(BCB80)
26	-1,074	0,829	1,746(DA103)	-2,783(BCB82)
	0,020	0,675	2,197(DA103)	-1,331(BA117)
28	0,063	0,895	2,497(DA103)	-1,664(BA124)
	0,188	0,614	1,433(BA117)	-0,903(BA124)
30	0,176	0,463	1,473(BA117)	-0,678(BA115)
	0,008	0,672	1,241(BA124)	-1,461(BA122)
1000 AMPS				
4	0,470	1,643	2,223(DA103)	-3,165(BA123)
	1,810	2,738	8,129(BA117)	-4,115(HA111)
6	-10,944	3,989	8,012(CA131)	-7,153(HA111)
	0,523	0,746	1,549(BA117)	-1,258(DD114)
8	0,587	0,592	1,066(BA120)	-0,922(DD114)
	0,175	1,550	3,342(DC113)	-2,174(DD114)
10	3,598	1,755	4,528(PAH95)	-2,210(BA115)
	0,005	0,534	1,286(BA117)	-0,724(PAH98)
12	0,315	0,476	1,560(BCB80)	-0,977(PAH98)
	-0,159	0,526	1,182(DC113)	-1,113(BCB82)
14	3,143	0,495	0,925(CA131)	-0,882(BCB80)
	-0,191	0,301	0,695(BA117)	-0,465(BA123)
16	0,022	0,329	0,634(BCB80)	-0,536(DD114)
	0,163	0,361	0,600(DD114)	-0,641(DA103)
18	-12,981	0,431	0,643(DA122)	-1,233(DA103)
	0,146	0,633	2,291(BA119)	-0,964(BA118)
20	0,035	0,509	0,739(BA124)	-1,568(DA103)
	0,198	0,418	0,833(BA118)	-0,790(DD114)
22	4,293	0,388	0,489(DC113)	-1,173(BCB82)
	0,010	0,427	1,023(DA103)	-1,134(BA119)
24	0,047	0,355	1,116(BCB80)	-0,418(BA118)
	0,081	0,429	1,389(DA103)	-0,581(BCB82)
26	-1,076	0,433	0,734(DA103)	-1,525(BCB80)
	0,015	0,392	1,202(DA123)	-0,768(BA117)
28	0,027	0,477	1,247(DA103)	-0,887(BA124)
	0,114	0,367	0,862(BCB80)	-0,478(BA124)
30	0,090	0,289	0,900(BA117)	-0,485(BA115)

	0.024	0.374	0.615(FA125)	-3.679(FA122)

4000 AMPS

4	0.574	1.736	2.475(FAH98)	-3.154(FA126)
	2.272	2.738	8.064(FA117)	-4.126(FA111)
6	-10.330	3.955	8.469(CA131)	-7.221(FA111)
	0.554	0.771	1.823(FA117)	-1.305(DD114)
8	0.629	0.522	1.169(FA120)	-0.873(DD114)
	0.107	1.509	3.231(DC113)	-2.232(DD114)
10	3.624	1.752	4.531(FAH95)	-2.227(FA111)
	0.043	0.437	1.158(CA117)	-0.570(FAH98)
12	0.312	0.300	0.817(RCB80)	-0.612(FAH98)
	-2.233	0.458	1.115(DC113)	-0.909(RCB84)
14	3.786	0.442	0.749(CA131)	-0.814(FA107)
	-0.175	0.175	0.310(FA101)	-0.314(FA123)
16	0.248	0.275	0.559(CA130)	-0.746(DD114)
	0.232	0.267	0.703(DD114)	-0.409(RCB82)
18	-12.957	0.355	0.718(RCB80)	-0.644(CA103)
	0.129	0.600	2.223(FA119)	-0.782(FA115)
20	-0.025	0.316	0.455(DD114)	-0.798(CA103)
	0.237	0.315	0.674(CA131)	-0.818(DD114)
22	4.369	0.256	0.319(DC113)	-0.723(RCB82)
	0.003	0.288	0.379(FAH95)	-0.979(FA119)
24	0.016	0.178	0.442(RCB80)	-0.203(DC113)
	-0.097	0.208	0.494(CA103)	-0.312(FAH95)
26	-1.065	0.128	0.261(FA118)	-0.336(RCB80)
	0.027	0.210	0.521(CA103)	-0.391(FA117)
28	0.009	0.177	0.464(CA103)	-0.381(FA118)
	0.051	0.151	0.267(RCB80)	-0.268(DD114)
30	0.074	0.165	0.321(CA105)	-0.309(FA115)
	0.018	0.154	0.227(FA124)	-0.426(FA120)