

BNL-99190-2013-TECH C-A/AP/36;BNL-99190-2013-IR

Correction and Additions to CA/AP/33

E. D. Courant

January 2001

Collider Accelerator Department Brookhaven National Laboratory

U.S. Department of Energy

USDOE Office of Science (SC)

Notice: This technical note has been authored by employees of Brookhaven Science Associates, LLC under Contract No.DE-AC02-98CH10886 with the U.S. Department of Energy. The publisher by accepting the technical note for publication acknowledges that the United States Government retains a non-exclusive, paid-up, irrevocable, world-wide license to publish or reproduce the published form of this technical note, or allow others to do so, for United States Government purposes.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

C-A/AP/36 January 2001

<u>Corrections and Additions to CA/AP/33</u> <u>Coupling Matrices in AGS with different types of partial snakes</u>

E. D. Courant



Collider-Accelerator Department Brookhaven National Laboratory Upton, NY 11973

Corrections and Additions to CA/AP/33

Coupling Matrices in AGS with different types of partial snakes

E D Courant January 9, 2001

- A computational error led to incorrect numbers for the "4-dipole" cases in the above referenced report¹. In addition, computations have now been carried out for the partial snakes utilizing five and six tilted dipoles as described in Spin Note 75².
- Here we present the corrected results for injection energy (1.5 GeV; $\gamma G = 4.659$). The raw AGS, and AGS with solenoidal and helical snakes are the same as in AP/33, the 4-dipole results are different. The four-dipole scheme exhibits coupling distinctly stronger than with the solenoid, as indicated in C-A/AP/33. The five-dipole scheme (dipole fields at 135°, 0°, -90°, 180°, 45°) exhibits somewhat less coupling, and in the six-dipole case the coupling is again weaker, but still stronger than in the solenoid case (at injection energy).
- For higher energy the coupling parameters decrease inversely proportionally to $(\beta\gamma)^2$ just as in Ref. 1. Therefore the dipole snakes have coupling similar to that of the solenoid by the time the first strong resonance ($\gamma G = 8.749$) is reached, but the helical snake is definitely better – both because of the lower coupling and because of the smaller orbit excursions. At higher energies, which is where coupling is really troublesome, the dipole snakes are better than the solenoid,

¹ E. D. Courant, Coupling Matrices in AGS with Different Types of Partial Snakes, C-A/AP/33, Dec. 2000

² E. D. Courant. Partial Snake for AGS using Dipole Magnets, Spin Note 75, August 1988

AGS with different types of partial snakes:

AGS without snakes

-1.31324	-11.2107	0	0	0	2.08681
0.167845	0.671359	0	0	0	-0.318092
0	0	1.57424	-19.7498	0	0
0	0	0.177118	-1.58682	0	0
-0.06747	-2.16502	0	0	1.	-11.5419
0	0	0	0	0	1.

Tunes 8.698, 8.749

AGS with solenoid snake

-1.31093	-11.1934	0.0442375	-0.554929	0	2.08299
0.168355	0.675285	0.00497101	-0.0444856	0	-0.318932
0.0368755	0.31486	1.57265	-19.7279	0	-0.0585927
-0.0047357	-0.0189952	0.176721	-1.58147	0	0.0089713
-0.06747	-2.16502	0	0	1.	-11.5419
0	0	0	0	0	1.

Minimum tune split = 0.0144566; coupling angle 8.08129°; tunes 8.69744, 8.75032

Injection energy (1.5 GeV, γG =4.659)

AGS with helical snake

-1.22928	-10.5597	-0.0130534	0.163223	0	1.89077
0.225534	1.12394	-0.00109317	0.00787587	0	-0.411239
-0.0107148	-0.0920354	1.50408	-18.8079	0	0.0164241
0.00189643	0.00923171	0.133967	-1.01039	0	-0.00368262
-0.0791047	-2.21763	0.000304224	-0.00384195	1.	-11.5189
0	0	0	0	0	1.

Minimum tune split = 0.00442775; coupling angle 2.65338 °; tunes 8.74151, 8.7898



AGS with 4-dipole snake

-1.16851	-10.0816	-0.0159327	0.18963	0	1.84956
0.243827	1.2475	-0.0351435	0.44673	0	-0.443225
0.00648536	0.0692911	1.51749	-19.0392	0	-0.00780593
0.0301393	0.252109	0.12114	-0.860595	0	-0.0469726
-0.0668694	-2.1598	-0.00172722	0.0227037	1.	-11.5333
0	0	0	0	0	1.

Minimum tune split = 0.0539474; Coupling angle = 24.7769 °; tunes 8.74383, 8.81666



AGS with 5-dipole snake

-1.16253	-10.0703	-0.0195133	0.266297	0	1.83811
0.245695	1.26825	-0.0159469	0.210162	0	-0.446139
0.026667	0.202203	1.54064	-19.3094	0	-0.0446274
0.0175521	0.138552	0.139071	-1.09404	0	-0.0292231
-0.0670372	-2.16185	0.000798171	-0.0103494	1.	-11.5361
0	0	0	0	0	1.

Minimum tune split = 0.0277217; Coupling angle = 22.8109 °; tunes 8.75258, 8.79185



AGS with 6-dipole snake

-1.2312	-10.5832	0.0136121	-0.1888	0	1.95039
0.219129	1.07145	0.0105641	-0.139712	0	-0.402887
-0.020312	-0.151786	1.51209	-18.9092	0	0.0336297
-0.0123794	-0.0970729	0.134372	-1.0191	0	0.0202742
-0.0686509	-2.17425	-0.0000490434	0.000538244	1.	-11.5343
0	0	0	0	0	1.

Minimum tune split = 0.0189688; Coupling angle = 10.0308 °; tunes 8.73559, 8.79137 $^{\circ\circ}$

