BROOKHAVEN NATIONAL LABORATORY
Associated Universities, Inc.
Upton, New York

ACCELERATOR DEPARTMENT
Informal Report

ISABELLE WITH WARM MAGNETS

E.D. Courant

February 7, 1972

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CRISP 72-4
ISABELLE PROJECT

INTERSECTING STORAGE ACCELERATOR NOTES

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How would the orbit parameters of ISABELLE have to be changed if conventional magnets were to be used?

Assume: 200 GeV at 20 kG.

Radius of circular arc doubled; insertions same length as cold ISABELLE. Overall circumference changed from $(1.4 + 0.6)$ km to $(2.8 + 0.6)$ km, or from $2.5 C_{\text{AGS}}$ to $4.25 C_{\text{AGS}}$. To obtain 15 A, must inject about 50 AGS pulses rather than 30 (10^{15} protons).

Assume same rf bucket parameters; then need rf of $5/3$ the amplitude in ISA, or about 70 kV instead of 40.

The lattice would have to be revised. Taking the same v values as for ISABELLE, I have constructed a main lattice having 84 unit cells rather than 52, each of length 31.2 m instead of 22.6; this gives a maximum β of 53 m instead of 38, and a dispersion function of 2.33 m instead of 1.48. This hardly changes the necessary aperture; it adds only about 2 mm to the horizontal and vertical semiaperture requirements. A gross magnet semiaperture of 45 mm should be sufficient. (Further calculations for lattice optimization can be done, but are not felt to be worthwhile at this time.)

This lattice requires quadrupoles with gradients of 350 kG/m, length 1.5 m; with a gross aperture of 9 cm this means a pole tip field of 16 kG.

The long straight sections and momentum matching sections can be redesigned to match this lattice, with performance specifications similar to those of the cold ISABELLE. Only one small insertion has so far been designed. It employs quadrupole doublets (rather than triplets) because these require less gradient

than triplets for a given focusing strength. The particular straight section that has been designed employs four quadrupole doublets, each with elements of length 2.5 m, the strongest gradient 393 kG/m, a drift space in the center of 100 m, and central β values of 15 m (horizontal), 7 m (vertical). Other combinations can be designed as has been done for the cold ISABELLE.

In summary: An ISA facility using conventional magnets is feasible. A comparison of parameters is given in the following table (in round numbers).

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Outside Users
M. Goldhaber, L.J. Haworth, G.H. Vineyard

	<u>Cold</u>	<u>Warm</u>
Energy	200 GeV	200 GeV
Peak magnetic field	40 kG	20 kG
No. of cells in main arc	52	84
No. of magnets per cell	6	8
Length of magnet	2.9 m	3.2 m
Aperture in magnet	8 cm	9 cm
Radius of arc	220 m	440 m
Total circumference	2000 m	3400 m

Rf parameters in AGS unchanged

No. of AGS pulses injected	30	50
Length of each bucket at 30 GeV	30 m	30 m
Acceleration frequency	4.45 MHz	4.45 MHz
Acceleration time	120 sec	120 sec
Volts per turn to accelerate	10 kV	17 kV
Total rf voltage needed to maintain bucket	40 kV	70 kV
No. of circulating protons	6×10^{14}	10^{15}
Circulating current	15 A	15 A