Letter of Intent

for the Third Fermilab Running Period (1992-93)

from Members of the E672 and E706 Collaboration

1 March 1990

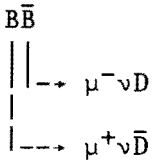
1. Introduction

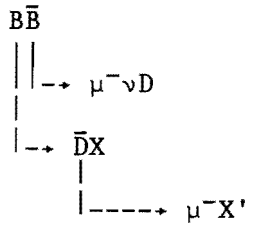
This is a Letter of Intent from members of the E672 and E706 collaborations to use the existing apparatus for a study of b-quark physics. The primary signals for detecting B-mesons would be i) inclusive $B\bar{B}$ decays into high-p_t opposite-sign and like-sign dimuons, and ii) the exclusive channel $B \to \psi X$. One-thousand hours of running with positive beam, and equal time with negative beam, should yield a total of 1K to 2K events. This letter is predicated on encouraging results from the current run, in which about one-twentieth as many B events are expected.

2. Present Status

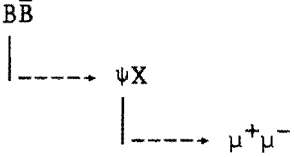
The potential of E672/E706 to study b-quark physics has been recognized both by collaboration members and Fermilab for some time.[1] One of E672's goals for the current running period is a preliminary study of B-meson hadroproduction, including measurements of cross-sections, lifetimes, and mixing. Using E672's dimuon detector and E706's spectrometer, which includes ten SSD planes in the target region, the following types of events can be studied:

i) Inclusive decays, e.g.:





ii) Exclusive decays:



Selecting high-p_t muons, typically $p_t \geq 1.6$ GeV/c, produces a beauty-to-charm ratio greater than 2.5-to-one. Also, studies of ψ decays, opposite-sign dimuons, and like-sign dimuons provide a variety of backgrounds against which to understand the physics.

The number of B events expected in the current running period are summarized below:

Beam	Time (hrs.)	Number of dimuons with $p_t \geq 1.6$ GeV/c
530 GeV/c π^-	900	35 to 70
800 GeV/c p	500	18 to 35

The variations in the estimates are due to current uncertainties in the theoretical cross-sections.[2] Data from the 1987-88 run of E672 indicate that the background in the dimuon channel ($p_t \geq 1.6$ GeV/c for each muon) is negligible. Thus, while the anticipated number of events is modest, it should allow a determination of the B hadroproduction cross-section at the 30-to-50 percent level. In that case, E672 would be the third experiment to measure this important number.

3. Projections

If E672 is successful in achieving the low-statistics goals described above, then a high-statistics measurement is clearly warranted. Except for an increase in the MW beam intensity, no modifications to the existing apparatus are necessary. Thus, the cost to Fermilab would be minimal. Furthermore, the polarized-target studies being discussed by some members of the E706 collaboration may not be realized.

A 20 MHz beam rate and a 10%-interaction target consisting of several spatially separated tungsten foils would yield a 2 MHz interaction rate and allow reconstruction of secondary vertices. The trigger would be generated by the existing E672 dimuon-mass trigger processor set for $M_{\mu\mu} > 1.0$ GeV/c. The corresponding trigger rate is 3×10^{-6} of the interaction rate. The rates expected for these conditions for 10^3 hrs of running are summarized below. Again, the variations in the estimates are due to current theoretical uncertainties.[2]

Beam	EVENTS/10^3 hr $\mu^+\mu^-$	$\mu^\pm\mu^\pm$	ψX	Total	Trigger Rate (Hz)
530 GeV/c π^-	300-600	240-480	200-400	740-1480	6
800 GeV/c p	120-240	100-200	80-160	300-600	6

The number of B events expected constitutes a significant data sample, especially since existing apparatus would be used at minimal cost.

While the proposed measurement would compete with other B-physics measurements planned for 1992-93, we believe that competition is good both for Fermilab and for obtaining the best possible physics. An example of this viewpoint is the fact that several Z° experiments are being carried out simultaneously at LEP. The Fermilab B experiments will have different detectors, different rates, and different backgrounds; hopefully, their results will be the same.

4. Manpower

This Letter of Intent is contingent on successful results from the current run of E672. Thus, it is premature to organize a complete collaboration at this time. Nevertheless, a number of groups have indicated their desire to commit effort and equipment to make the measurements described above. These groups, and their contact persons, are listed below. At this point, an institutional commitment makes more sense than individual commitments. We expect that a successful search for beauty in the current run of E672 will easily produce a sufficient number of collaborators.

H. Goldberg, contact person for the "B in '93" Collaboration

Interested Institutions

University of Illinois at Chicago	(H. Goldberg)
University of Louisville	(C. Davis)
University of Michigan at Flint	(L. Dauwe)
University of Pittsburgh	(E. Engels)
Institute for High-Energy Physics, Serpukhov	(V. Sirotenko)

References

1. J.D. Bjorken, "Rare B-Decays: Experimental Prospects and Problems", Fermilab-Conf.-87/83, May 1987; and Peter H. Garbincius, "Fixed Target Beauty Physics Experimental Programs", Fermilab-Conf.-88/89, Nov. 1987.

2. E.L. Barger, "Heavy Flavor Production", ANL-HEP-CP-88-26, 10 June 1988, and "Physics Landscape-Fixed Target Energies", ANL-HEP-CP-89-125, Oct. 1989.