May 29, 1997

Dr. John Peoples Jr.
Director,
Fermilab,
MS 105

Dear John,

This is the

Letter of Intent to extend the E835 experiment to the proposed 1999 fixed target run

The E835 collaboration

The E835 experiment studies the spectroscopy of charmonium states formed in $\overline{p}p$ annihilations. It is installed at the antiproton accumulator and it consists of an internal hydrogen jet target and a non magnetic spectrometer for the detection of the electromagnetic decays of charmonium. The higher priority goals of the experimental program of E835 are:

1. The search for the $\eta_c'(2^1S_0)$ and measurement of its mass and width.
2. The measurement of mass and width of the η_c and of the partial width to $\gamma\gamma$.
3. The confirmation of the $^1P_1$ state and measurements of its mass and width.
4. The study of the χ_0 resonance.
5. A search for the missing D states.

So far we have performed a search for the η_c' over a wide energy range (3576$<$ E_{cm} $<$3660 MeV) and with a sensitivity for $BR(\eta_c' \to \overline{p}p) \times BR(\eta_c' \to \gamma\gamma)$ of $< 10^{-7}$ for a total width of the resonance $\geq 5MeV$. We have not found a statistically significant enhancement due to η_c' in the mass region scanned so far.

We are at present completing a scan of the η_c resonance which will yield ~ 4 times the data collected at this resonance by E760.

We have also taken a substantial amount of data at the χ_2 resonance which will allow us to improve significantly on the measurements of the decay width to $\gamma\gamma$ and of the angular distributions of the radiative decay.

Data were also collected at the J/ψ and ψ' resonances mainly for calibration purposes.

For these measurements we have used a total luminosity of $75 pb^{-1}$.

The performance of the experimental apparatus has been very satisfactory so far, allowing us to use the available beam with very high efficiency. The only major problem was given by the silicon detector that, because of an accident in the control system, became very noisy a few days after the beginning of data taking; however this only impaired our ability to study the $\phi\phi$ final state and had no other consequences on our data taking program. It should also be mentioned that recently we have replaced the forward electromagnetic calorimeter to improve on the acceptance for the $^1P_1 \to \psi + \pi^0$ channel. This was done without interfering with data taking using scheduled shutdowns for installation.

In contrast, the performance of the accumulator has been disappointing. In particular, the deceleration to energies below transition has so far been rather poor. Its low efficiency has caused much lost time and considerably slowed down the η_c scan.

Since the accumulated luminosity so far amounts to less than 10 pb^{-1} per month it is inconceivable to reach the 200 pb^{-1} we have been approved for. As a consequence we will certainly not be able to complete the physics program.

For this reason the possibility of having another run in 1999 is welcomed by the collaboration.

The physics goals of the 1999 run will, of course, depend on how much of the experimental program of E835 will be accomplished by the end of the current run. At this point this is a difficult prediction to make, as it will be significantly affected by the performance of the accumulator in the remainder of the run. We are not sure if our objectives for η_c, η_c' and the $^1P_1$ will be fully realized. Further, we are quite sure that we will not be able to make the most time consuming measurements in our physics

program, i.e. the χ_0 scan and the search for the D states, which are thus the most likely candidates for the 1999 run.

For the χ_0 scan we will measure the $J/\psi + \gamma$ and $\gamma\gamma$ cross sections, in order to determine the resonance mass and total width, as well as its partial width to two photons. For the D state search we plan to scan the energy region above the $\psi'(3686)$, measuring the inclusive cross section $\overline{p}p \to J/\psi + X$.

Both measurements are of considerable physics interest. Whether we will be able to carry out both in the 1999 run will depend on the amount of luminosity delivered.

We would like to consider augmenting our originally proposed program with a direct measurement of J/ψ-nucleon cross section by scanning for the Fermi-broadened J/ψ resonance in a heavy gas target. Such a measurement is expected to be of importance in evaluating the usefulness of J/psi attenuation as signal of QGP formation in heavy-ion collisions.

The study of these channels does not require a major upgrade of the experimental apparatus. We plan to remove the detector immediately after the end of the present run and refurbish the inner detectors. We are considering various options for the replacement of the silicon detector, in case it will not be possible to repair it. In this framework we do not anticipate the need for a large technical support for the detector by the lab. We will however require the attention and significant support of the antiproton source department if the run is to be successful.

Sincerely yours,

Rosanna Cester for
The E835 Collaboration