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M E M O R A N D U M

To: J. Lefrançois, SPSC Chairman

From: WA1 Collaboration

Subject: WBB operation in 1983

The SPSC has allocated 5 × 17 days of WBB running in 1983. We intend to use this run in conjunction with our current σ_{tot} measurement in the NBB in order to take a) charged-current data, and b) dimuon data with the improved WA1 detector, to extend the upper end of the Q^2 range of our structure function measurements. Since both ν and $\bar{\nu}$ data are needed for a measurement of F_2 and xF_3, the limitation in the Q^2 range comes mainly from the maximum energy of $\bar{\nu}$ events. Compared to the 200 GeV $\bar{\nu}$ NBB data, with 3×10^{18} protons of 450 GeV in the $\bar{\nu}$ WBB, the Q^2 range can be increased by about a factor of 1.5, and these data will, in addition, profit from the improved hadron energy resolution of the detector. Likewise, the Q^2 range of the strange sea structure function measured in $\bar{\nu}$ dimuon events is increased, and here the closer spacing of drift chambers in the new detector (50 cm Fe instead of 75 cm between chambers) will improve the acceptance.

We therefore state our request for operation of the WBB at 450 GeV. Although present calculations (A. Grant) of the muon leakage rate through the shielding indicate a tolerable level of this background at 8 mr collimation, the reliability of these estimates cannot guarantee safe running conditions. In order to have a possibility for reducing this background, we prefer to have the smaller angle collimator (5-6.5 mr) installed instead of the large one (6.5-8 mr).

Since the WA18 collaboration requested 400 GeV protons, we compare rates and backgrounds for two possible conditions on the basis of calculations of A. Ball (see attached note, S = smaller collimator, L = larger collimator, O = open, C = closed, N = neutrino, A = antineutrino).

The ratio of total event rates with a 450 GeV proton beam, collimated to 6.5 mrad (SO) as compared to a 400 GeV beam with 8 mrad, is 1.03 for neutrinos and 1.03 for antineutrinos, so the νe experiment (CERN-SPSC/83-33, 10.5.83) does not suffer. Similarly, the ν_e background for that experiment is nearly identical in the two configurations.

On the other hand, the event rates needed for our exposure at high energies are considerably higher in the 450 GeV, 6.5 mr configuration, the gain in rate being 50% for E_ν = 175 - 225 GeV and 98% for E_ν > 225, and even more for antineutrinos, 110% gain for $E_{\bar{\nu}}$ = 175 - 225 GeV, and 220% for $E_{\bar{\nu}}$ > 225 GeV.

The 450 GeV WBB therefore gives, at 6.5 mr collimation, nearly the same low energy event rates as the one with 400 GeV and 8 mr, and the ν_e background is not increased, whereas it gains a factor of 2-3 at high energies (> 175 GeV). Since the repetition rate will be the same in both cases, 450 GeV protons are clearly favoured from our point of view.

$\nu_\mu \bar{\nu}_\mu$ event rates in BEBC (D_2 filling) for 10^{19} incident protons

Code N – neutrino beam — $K^+ \pi^+$ decay generated ν_μ
A – anti-neutrino beam — $K^- \pi^-$ " " $\bar{\nu}_\mu$

400 / 450 GeV/c proton beam momentum.

NC – no collimator
LO – large collimator open
LC – " " closed
SO – small collimator open
SC – " " closed
WI – thin titanium window – (otherwise calculated with 30 cm steel wind.

Code	Total	<75	75-125	125-175	175-225	>225 E
N400 LO WI	290200	214360	49310	19294	5329	1907
N400 LO	266700	196740	45270	17897	4999	1794
N400 SO	230400	161830	43890	17881	5005	1794
N450 LO	315300	225730	54450	24000	7559	3561
N450 LC	297900	208350	54450	23980	7559	3561
N450 SO	275800	187810	52880	23980	7569	3561
N450 SC	223300	144140	45170	22960	7470	3560
A400 NC	52120	45780	5195	1030	132	13.1
A400 LO	50910	44557	5178	1030	132	13.2
A400 SO	40480	34421	4885	1029	132	13.2
A450 NC	66930	57683	7224	1706	275	42.4
A450 LO	65130	55884	7217	1712	275	42.7
A450 LC	58710	49495	7184	1714	275	42.7
A450 SO	52430	43527	6877	1709	275	42.7
A450 SC	37120	29756	5460	1592	269	42.7

$\nu_e \bar{\nu}_e$ event rates in BEBC (D_2 filling) for 10^{19} incident protons

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Code	Total	<75	75-125	125-175	175-225	>225 E
400LOWI	4337	2955	1132	210	34.1	5.2
400LO	4000	2723	1046	194	31.9	4.82
400SO	3653	2377	1046	194	31.9	4.82
450LO	4654	2912	1348	313	66.6	14.65
450LC	4507	2766	1346	313	66.7	14.65
450SO	4289	2559	1336	313	66.6	14.65
450SC	3635	2007	1238	309	66.0	14.64
A400NC	504	421	76.8	5.90	0.425	0.031
A400LO	493	410	76.7	5.92	0.429	0.031
A400SO	400	318	76.1	5.93	0.428	0.031
A450NC	636	508	114.3	12.75	1.018	0.086
A450LO	619	489	115.2	12.84	1.008	0.085
A450LC	571	442	115.2	12.81	1.007	0.085
A450SO	520	392	114.1	12.81	1.007	0.085
A450SC	387	279	94.8	12.66	0.993	0.085