4 Resources, Cost, Schedule

4.1 Luminosity Schedule

The project schedule was developed to accommodate the luminosity schedule shown in Table 4.1.1. Such a schedule is illustrated in terms of initial store luminosity in Figure 4.1.1 and in terms of integrated luminosity in Figure 4.1.2. One notes that the goal of 15 fb^{-1} is indeed achievable if an initial luminosity of $4x10^{32}$ $cm^{-2}sec^{-1}$ can be achieved.

Fiscal Year	Luminosity $\mu barn^{-1}/sec$	$pbarn^{-1}$ per week	Months of Operations	Shutdowns (months)	$fbarn^{-1}$ per year	$fbarn^{-1}$ Total
FY02	75	17	10	2[i]	0.32	0.32
FY03	120	24	10	2[ii]	0.83	1.2
FY04	220	43	9	3[iii]	1.3	2.5
FY05	310	61	8	4[iv]	1.8	4.4
FY06	410	81	11	1	3.4	7.6
FY07	410	81	10	1	3.9	11.5
FY08	410	81	10	1	3.9	15.0

Table 4.1.1 *Luminosity Schedule. The values in the table are assumed to be obtained at the end of the fiscal year. The shutdowns are planned shutdowns. The effects of "unplanned" shutdowns are incorporated in estimate of the integrated luminosity per week.*

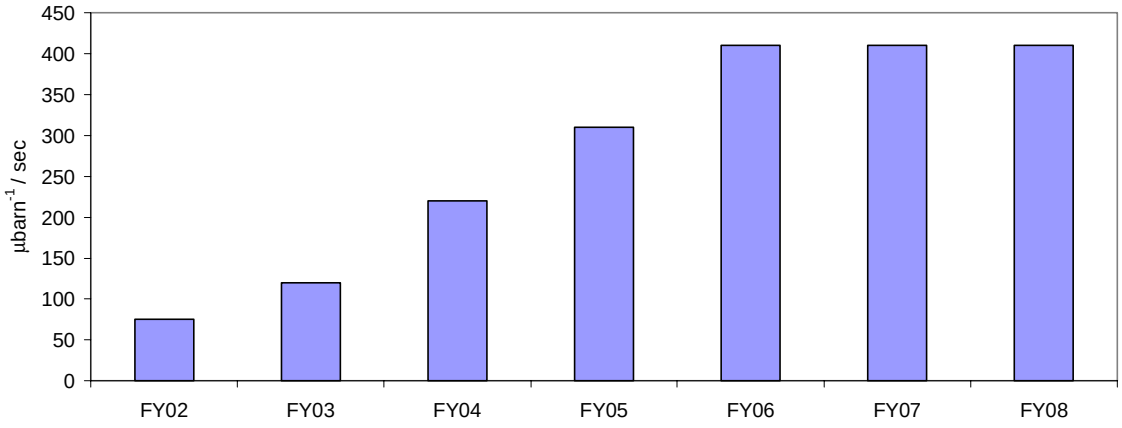

Figure 4.1.1 *Peak Luminosity Schedule*

[i] Shutdown in October for Recycler alignment. Shutdown in September to install Electron Cooling push pipe.
[ii] Assume Recycler is working. Shutdown in August to install 132 nS hardware and Electron Cooling into the Recycler
[iii] Finish installation of 132 nS and Electron Cooling. Spend 1 month commissioning 132 nS.
[iv] Shutdown for Run IIb silicon and CO I-R. Initiate NUMI with 20% impact

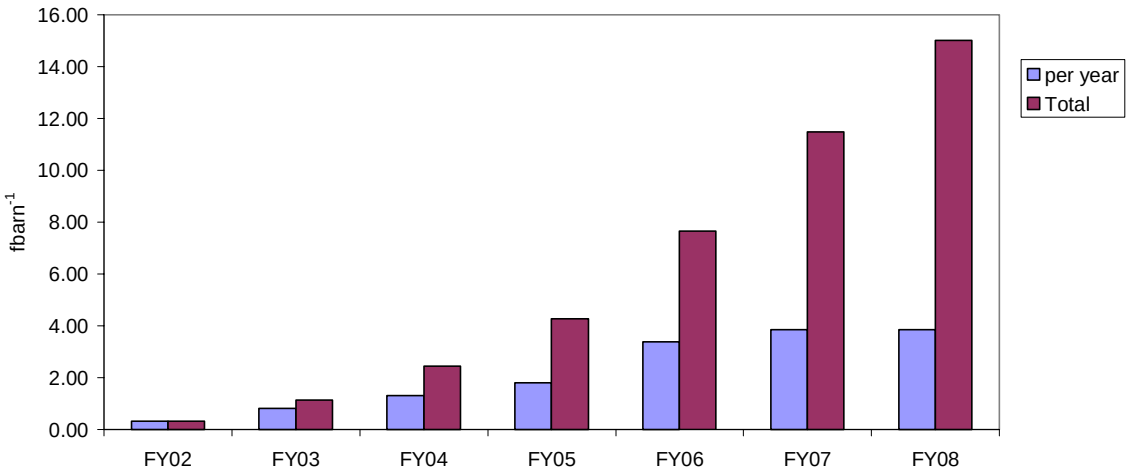

Figure 4.1.2 *Integrated Luminosity Schedule*

4.2 Costs by Fiscal Year

The following tables and charts contain a summary of the material and service costs and the labor costs for specific sub-projects.

	Project Total	FYO2 Total	FYO3 Total	FYO4 Total	FYO5 Total
Slip Stacking	1160	770	390	0	0
Antiproton Target Station	2870	820	1140	710	200
Pbar Collection Aperture	7485	1410	2955	2180	940
Stacktail Upgrade	500	100	400	0	0
Electron Cooling	7995	4070	2605	1320	0
Pbar Transport	1080	380	700	0	0
Beam-Beam Compensation	7890	2070	2070	1875	1875
Total	28980	9620	10260	6085	3015

Table 4.2.1 *Total sub-project cost by fiscal year in k$*

	Project M&S	FYO2 M&S	FYO3 M&S	FYO4 M&S	FYO5 M&S
Slip Stacking	260	170	90	0	0
Antiproton Target Station	1190	380	450	260	100
Pbar Collection Aperture	3725	550	1425	1200	550
Stacktail Upgrade	100	0	100	0	0
Electron Cooling	4745	2445	1500	800	0
Pbar Transport	390	90	300	0	0
Beam-Beam Compensation	2690	770	770	575	575
Total	13100	4405	4635	2835	1225

Table 4.2.2 *Material and service sub-project costs by fiscal year in k$*

	Project Labor	FYO2 Labor	FYO3 Labor	FYO4 Labor	FYO5 Labor
Slip Stacking	900	600	300	0	0
Antiproton Target Station	1680	440	690	450	100
Pbar Collection Aperture	3760	860	1530	980	390
Stacktail Upgrade	400	100	300	0	0
Electron Cooling	3250	1625	1105	520	0
Pbar Transport	690	290	400	0	0
Beam-Beam Compensation	5200	1300	1300	1300	1300
Total	15880	5215	5625	3250	1790

Table 4.2.3 *Labor sub-project costs by fiscal year in k$. Estimate of $100k per Full-Time-Equivalent (FTE)*

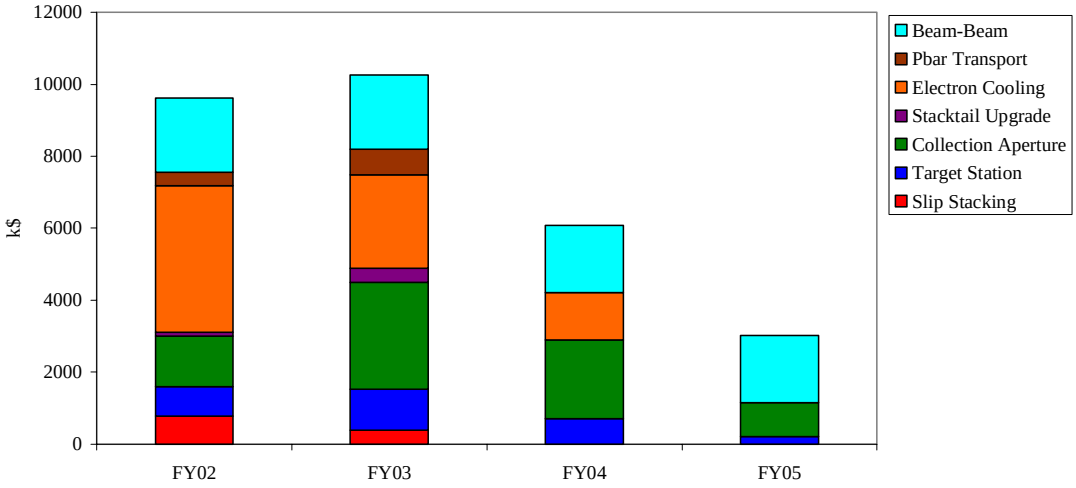

Figure 4.2.1 *Total Project Cost*

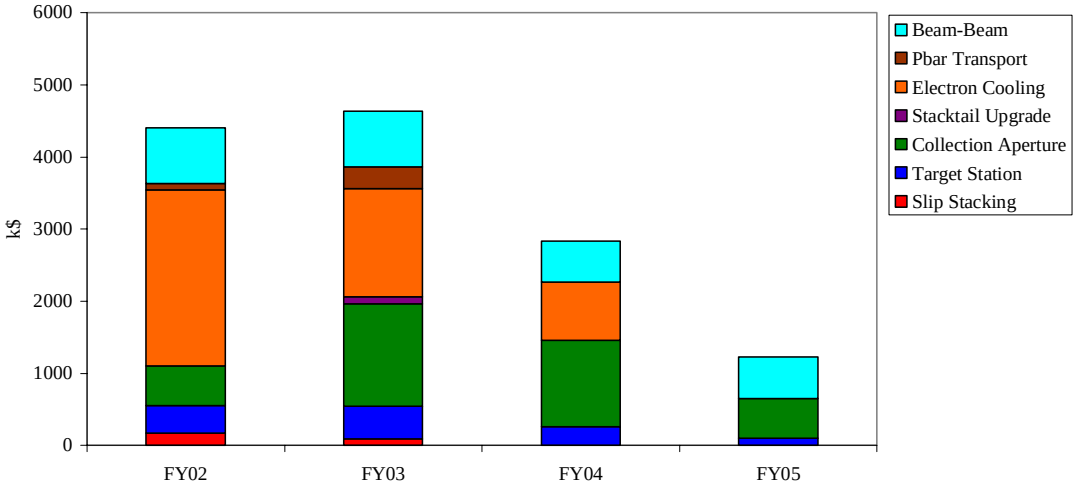

Figure 4.2.2 *Total M&S Cost*

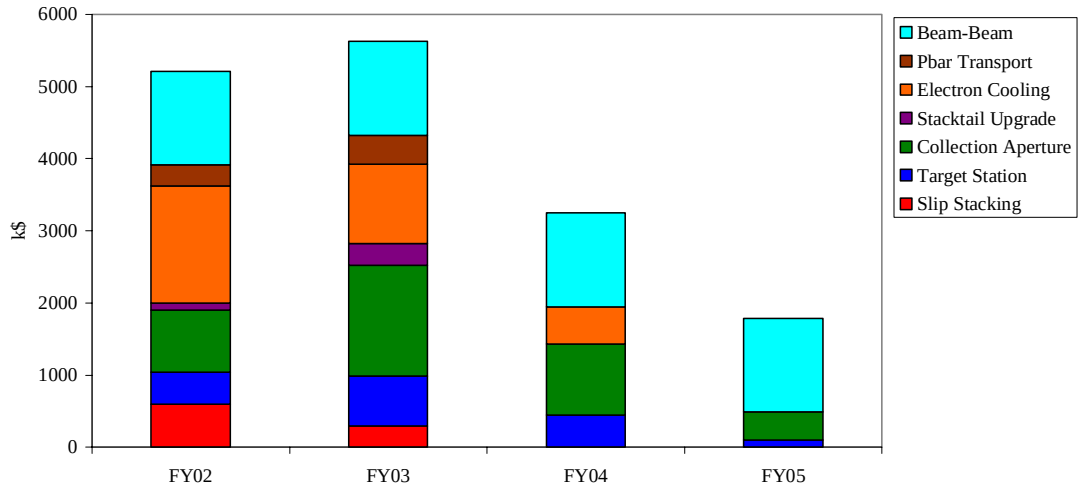

Figure 4.2.3 *Total Labor Cost assuming $100k per FTE*

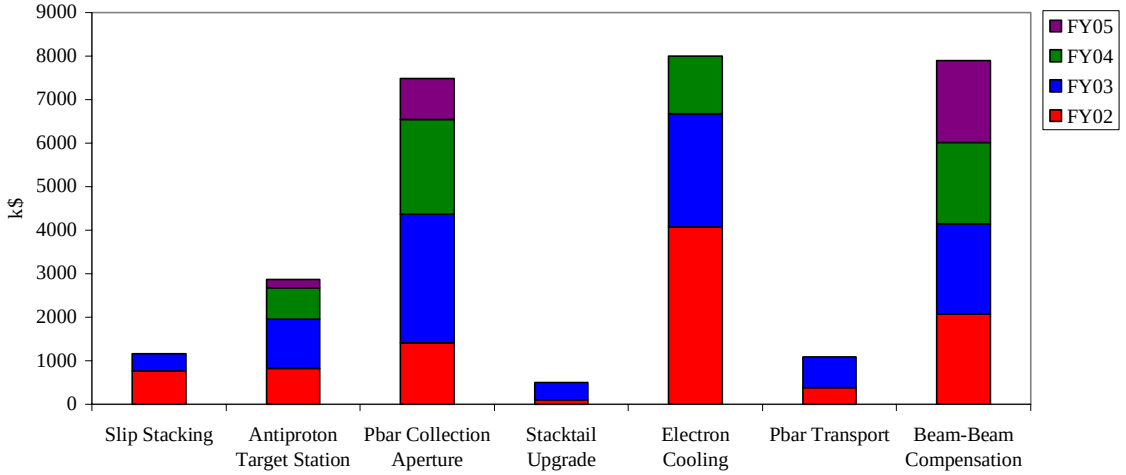

Figure 4.2.*4 Total sub-project cost*

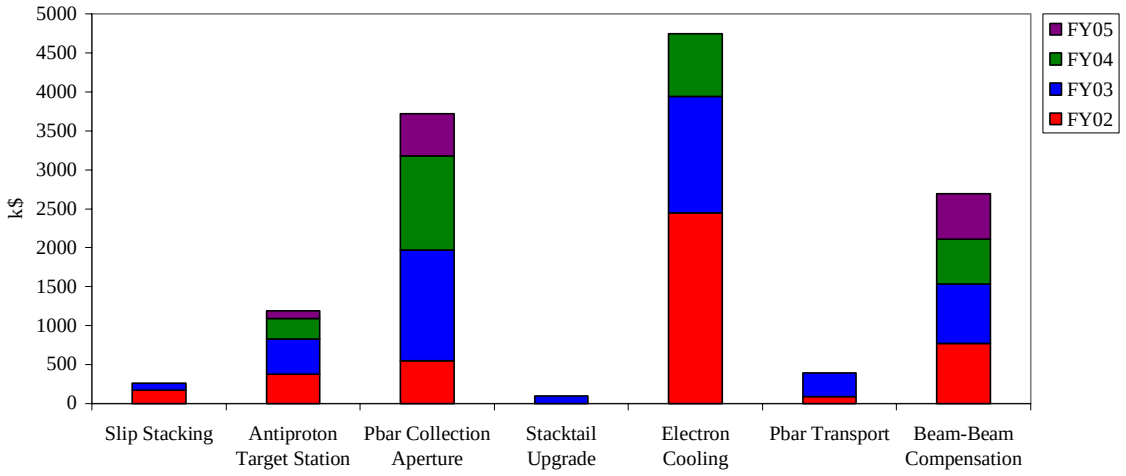

Figure 4.2.5 *Material and service sub-project costs*

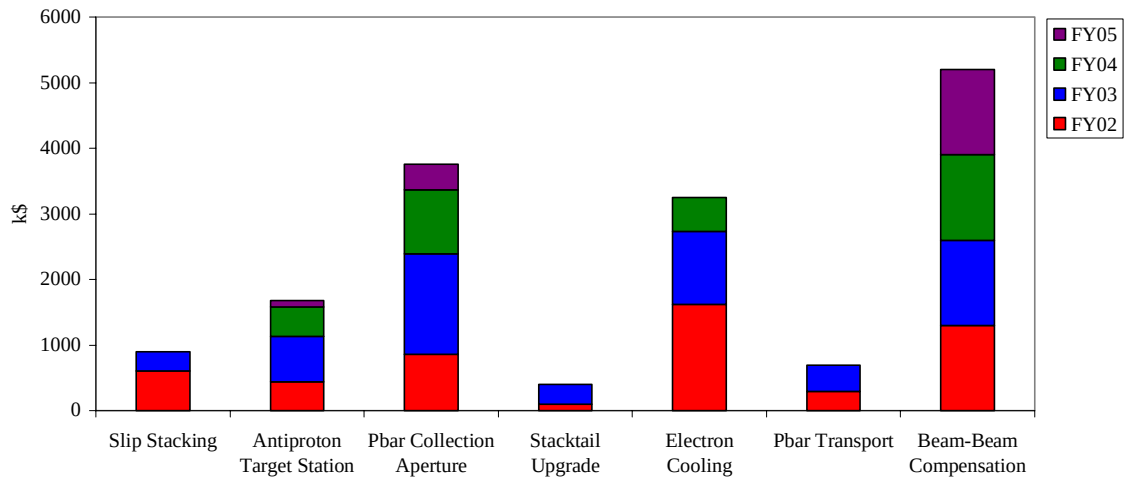

Figure 4.2.6 *Labor sub-project costs*

4.3 Sub-Project Resources

The following tables and charts contain a summary of the resources need for specific sub-projects. The estimates in costs are in units of k$. The estimates in manpower are in units of full-time-equivalents (FTEs)

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	9620	4405	5215	18.2	15.4	3.8	11.95	2.8
FY03	10260	4635	5625	14.05	16.35	4.95	16.9	4
FY04	6085	2835	3250	8.55	9.35	3.45	9.75	1.4
FY05	3015	1225	1790	5.6	6.1	1.5	3.7	1
Project	28980	13100	15880	46.4	47.2	13.7	42.3	9.2

Table 4.3.1 *Total Run IIb resources*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	770	170	600	2	2	0	2	0
FY03	390	90	300	1	1	0	1	0
FY04	0	0	0	0	0	0	0	0
FY05	0	0	0	0	0	0	0	0
Project	1160	260	900	3	3	0	3	0

Table 4.3.2 *Slip Stacking*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	820	380	440	0.9	1.2	0.7	1.5	0.1
FY03	1140	450	690	0.6	2	1.2	2.6	0.5
FY04	710	260	450	0.6	1.1	0.3	2.3	0.2
FY05	200	100	100	0.4	0.2	0	0.4	0
Project	2870	1190	1680	2.5	4.5	2.2	6.8	0.8

Table 4.3.3 *Antiproton Source Target Station*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	1410	550	860	2.2	2	0.5	2.7	1.2
FY03	2955	1425	1530	2.2	3.1	2	6.3	1.7
FY04	2180	1200	980	1.7	1.5	1.9	4.2	0.5
FY05	940	550	390	1.2	0.4	0.5	1.3	0.5
Project	7485	3725	3760	7.3	7	4.9	14.5	3.9

Table 4.3.4 *Antiproton Collection Aperture*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	100	0	100	0.8	0.2	0	0	0
FY03	400	100	300	1	1	0	1	0
FY04	0	0	0	0	0	0	0	0
FY05	0	0	0	0	0	0	0	0
Project	500	100	400	1.8	1.2	0	1	0

Table 4.3.5 *Accumulator Stacktail Upgrade*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	4070	2445	1625	7	4	1	3.75	0.5
FY03	2605	1500	1105	4.75	2.75	0.75	2.5	0.3
FY04	1320	800	520	2.25	1.25	0.25	1.25	0.2
FY05	0	0	0	0	0	0	0	0
Project	7995	4745	3250	14	8	2	7.5	1

Table 4.3.6 *Recycler Electron Cooling*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	380	90	290	1.3	0.5	0.6	0	0.5
FY03	700	300	400	0.5	1	0	1.5	1
FY04	0	0	0	0	0	0	0	0
FY05	0	0	0	0	0	0	0	0
Project	1080	390	690	1.8	1.5	0.6	1.5	1.5

Table 4.3.7 *Antiproton Transport*

	Total	M&S	Labor	Phys.	Eng.	Draft	Tech	CP
FY02	2070	770	1300	4	5.5	1	2	0.5
FY03	2070	770	1300	4	5.5	1	2	0.5
FY04	1875	575	1300	4	5.5	1	2	0.5
FY05	1875	575	1300	4	5.5	1	2	0.5
Project	7890	2690	5200	16	22	4	8	2

Table 4.3.8 *Antiproton Tuneshift in the Tevatron*

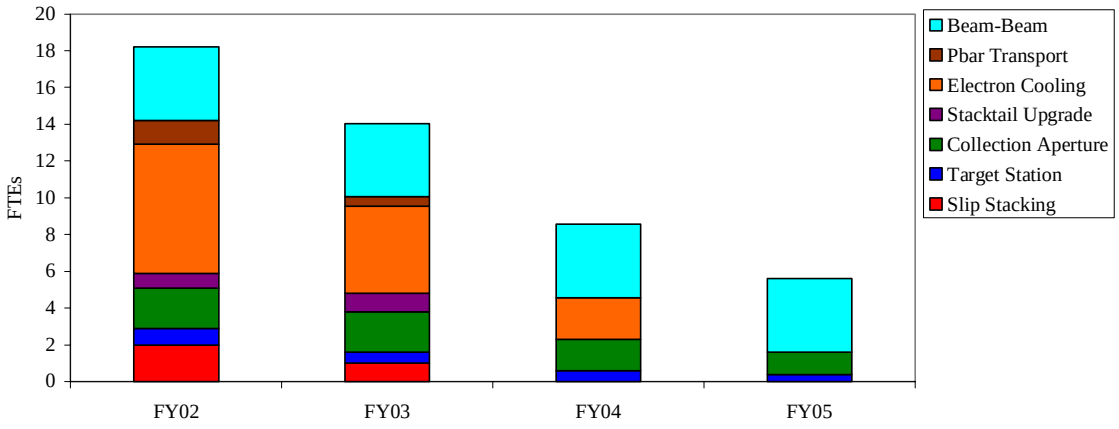

Figure 4.3.*1 Physicist Resources*

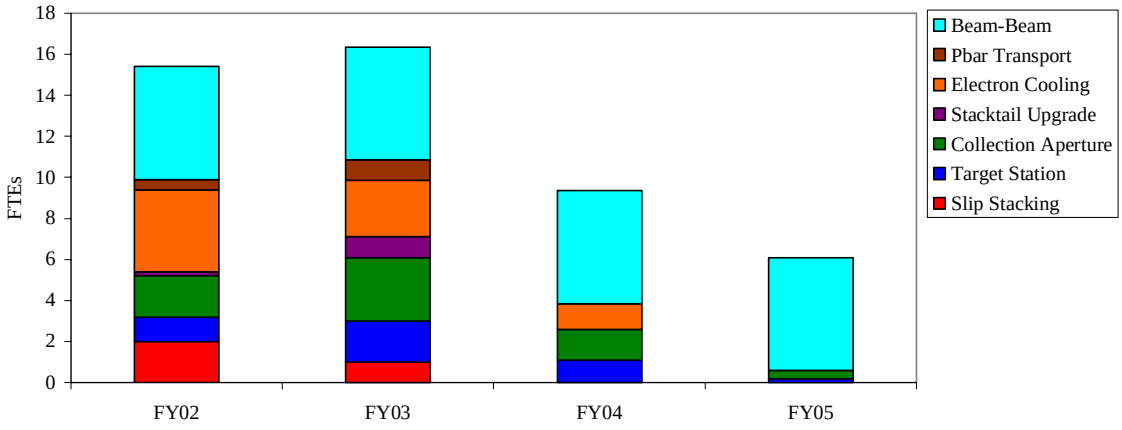

Figure 4.3.2 *Engineer Resources*

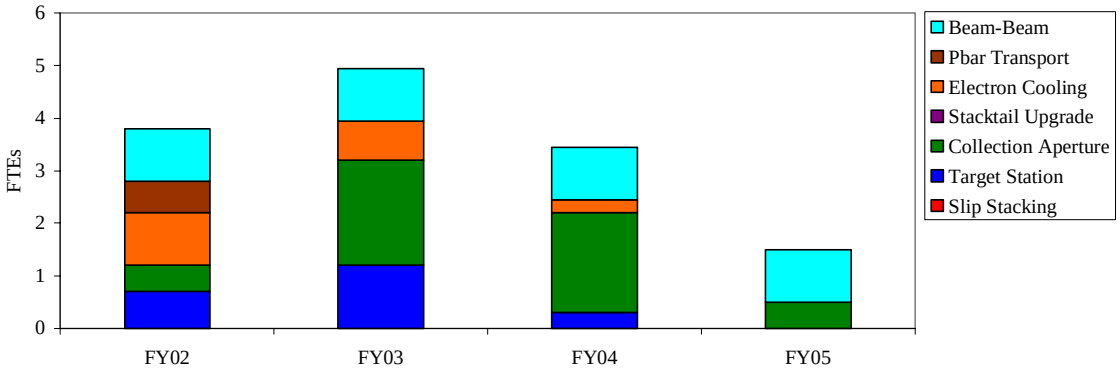

Figure 4.3.3 Drafting Resources

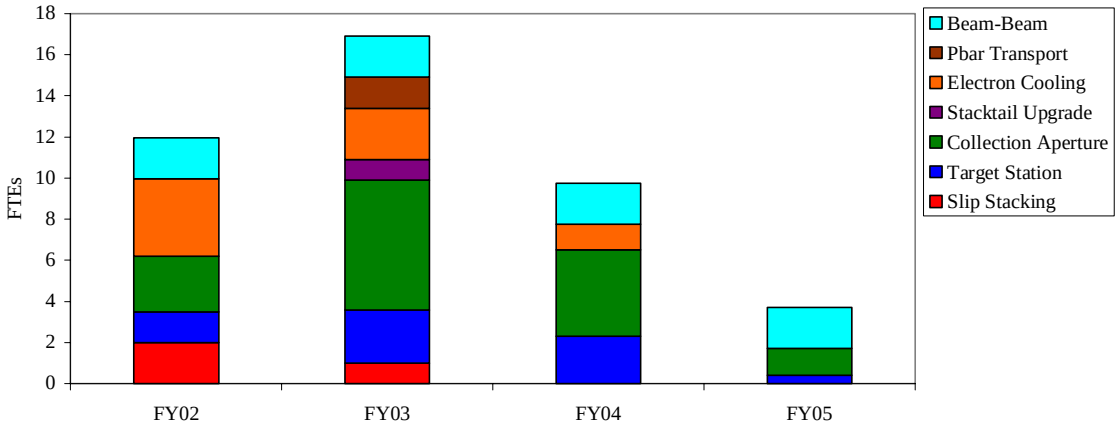

Figure 4.3.4 Technician Resources

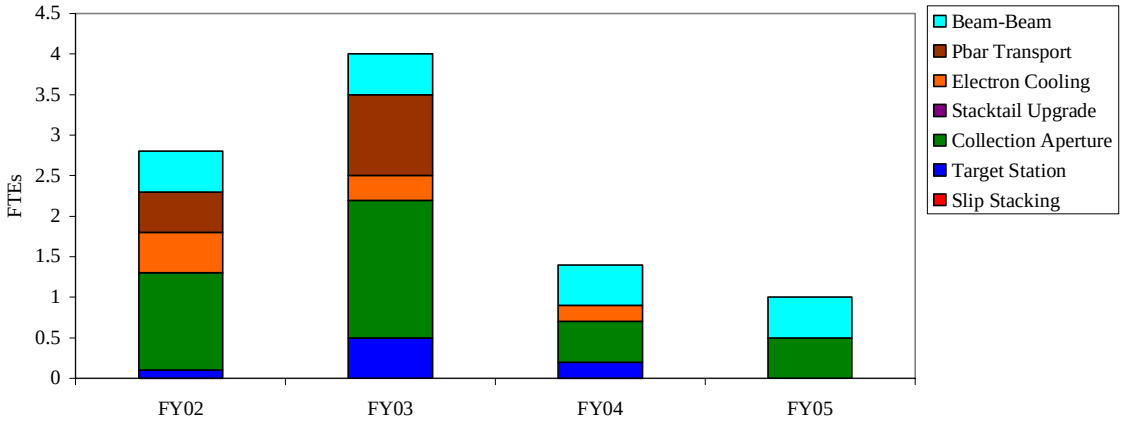

Figure 4.3.5 Computing Professional Resources

5 Summary

The goal of Run IIb is integrate 15 fb^{-1} by 2008. This document describes a plan for obtaining this goal by tripling the antiproton production rate over the anticipated Run IIa target. The increase in antiproton flux through the accelerator complex is obtained by a series of relatively modest accelerator upgrades. To reach the luminosity goal by 2008, the upgrades must be completed quickly, inexpensively, and with minimal impact on Run IIa. With these constraints in mind, the upgrades exploit many features of the Main Injector Project.

The major improvements in antiproton yield result from:

- increasing the number of protons on the antiproton production target by a factor of 1.8 by slip stacking two Booster batches in the Main Injector. (The extra Main Injector cycle time required for NUMI will reduce this factor to 1.5)
- increasing the antiproton collection efficiency by a factor of 2.0 –2.7 by:
    - increasing the gradient of the antiproton collection lens by 30%
    - increasing the effective aperture of the antiproton collection transfer line and Debuncher ring by a factor of 2.7.

The large increase in antiproton flux will require:

- an increase in the antiproton flux capability of the Accumulator Stacktail momentum stochastic cooling system
- implementation electron cooling in the Recycler Ring
- the streamlining and improvement of antiproton transfers between the Accumulator and the Recycler.

Finally we are pursuing an aggressive R&D project to build an electron lens that would compensate the beam-beam tune spread of the antiproton bunches in the Tevatron. The use of such a device could lead to a longer luminosity lifetime in the Tevatron and hence to a large integrated luminosity. Because of the R&D nature of this project, we have not explicitly assigned any luminosity gains for Run IIb from this project.

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