10/10/73

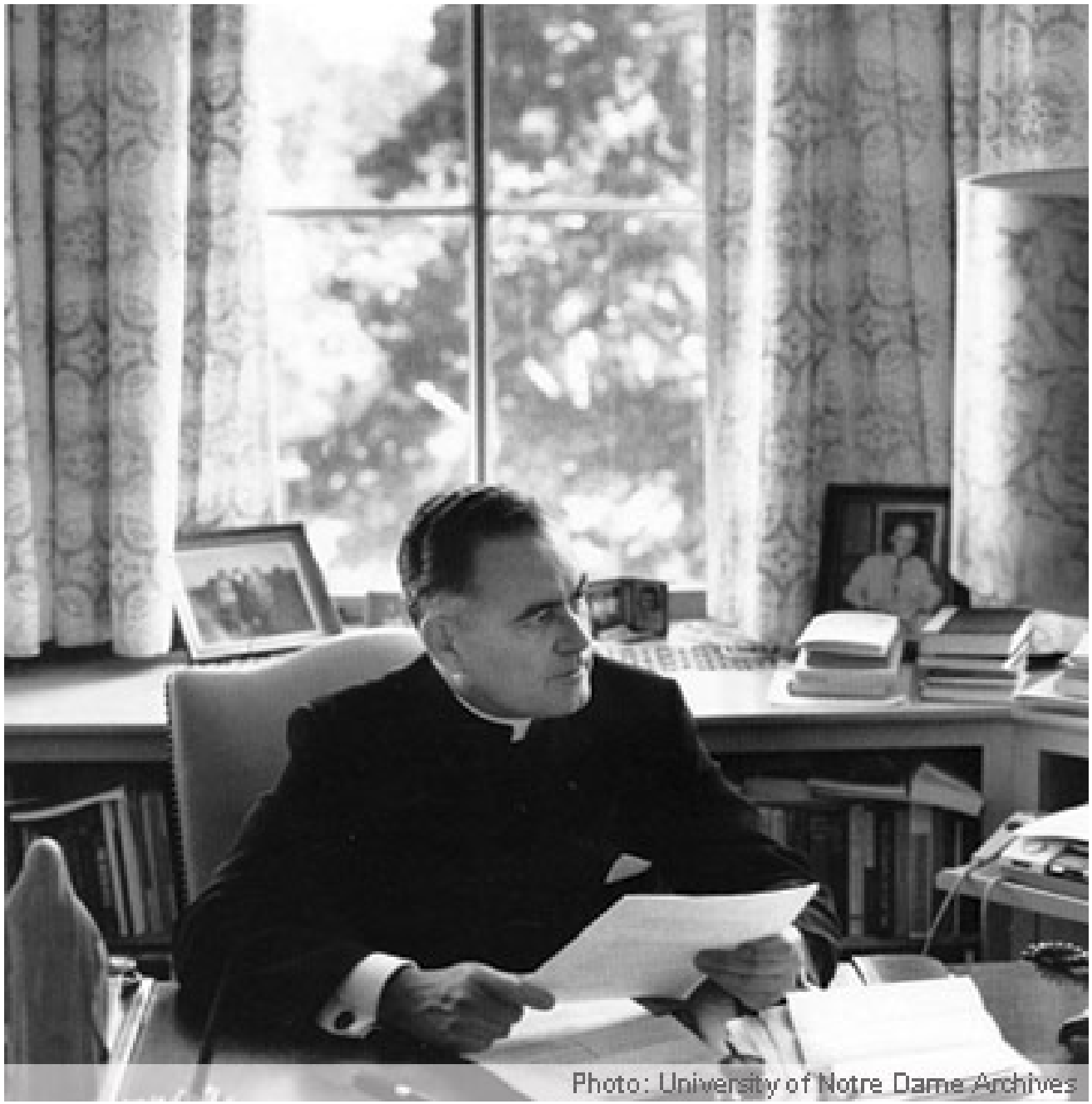
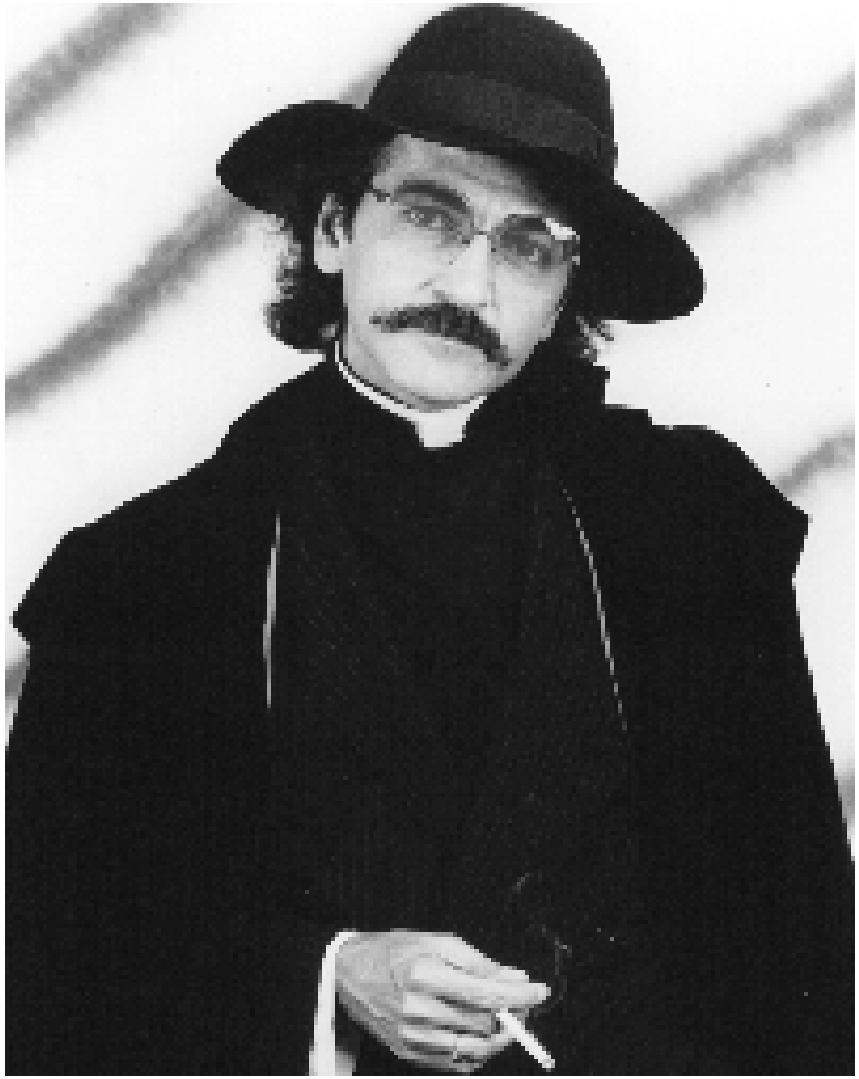
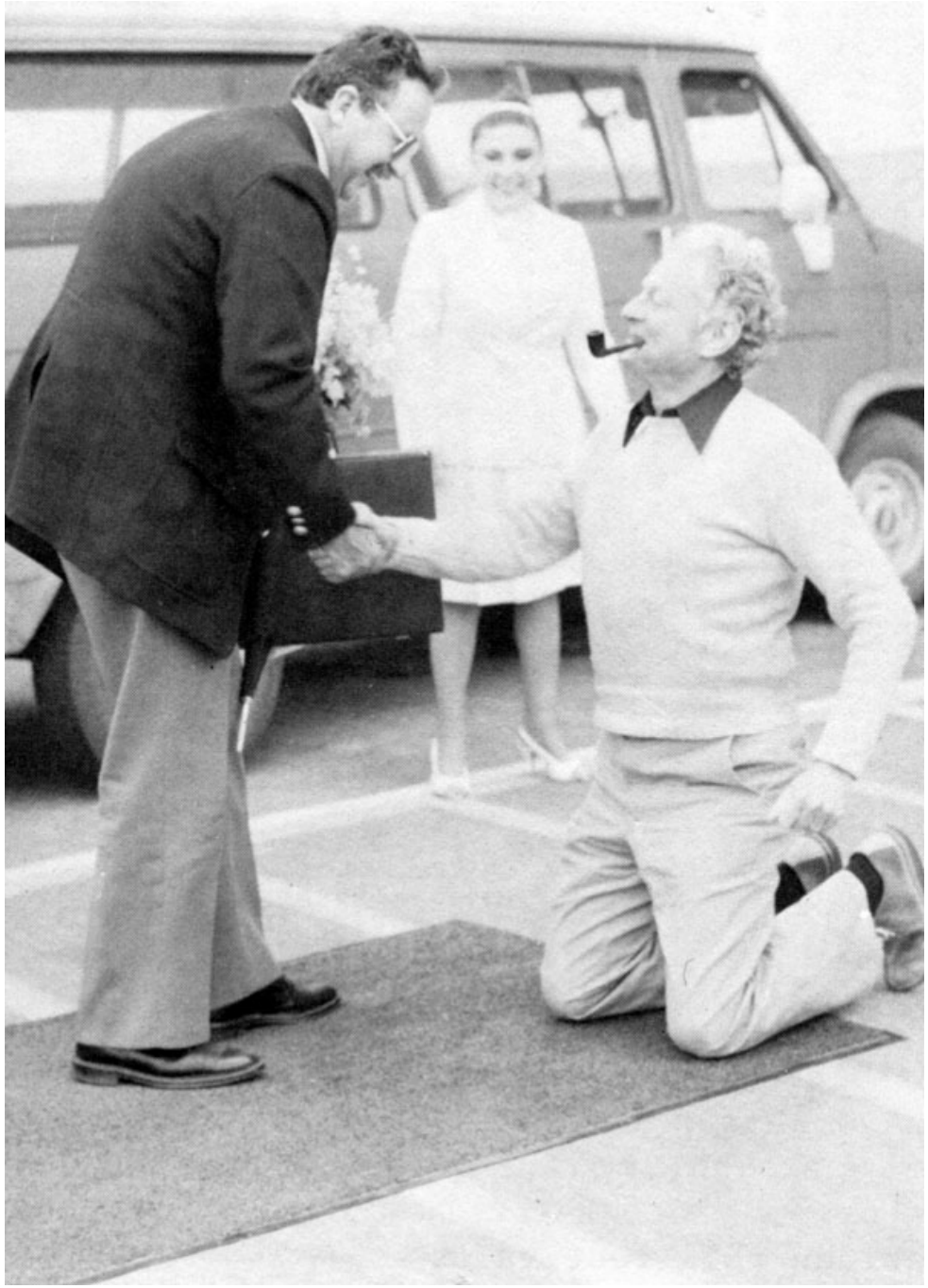


Photo: University of Notre Dame Archives

4/20/83



3/18/83



Upon his return from a visit with His Holiness, Pope John Paul II, in the summer of 1983, Physicist Drasko Jovanovic is greeted by Fermilab Director Leon Lederman on the steps of Wilson Hall.

12/20/83

TEVATRON COLLIDER

SOURCE: COMPLETE, COMMISSIONING IN PROGRESS

TEVATRON CHANGES: ESSENTIALLY COMPLETE, COMMISSIONING IN PROGRESS

- FIRST TEST OF COLLIDING BEAMS SCHEDULED FOR SEPT 1985.
- FIRST RUN WITH A NEARLY COMPLETE CDF (95%) IS OCT 1986 – JAN 1987 PERIOD
- PHYSICS WITH CDF IN 1987
- $\mathcal{L}_{PEAK}$ SHOULD ACHIEVE 10^{30} $cm^{-2}sec^{-1}$ IN 87

  $\sqrt{s}$ SHOULD REACH 900 x 2 IN 87
- FURTHER IMPROVEMENT WILL REQUIRE NEW FUNDS (NOT REQUESTED SO FAR)

  \$5M OR SO FOR E_{MAX} TO 1000 GEV

  ~ \$2.5M FOR $\mathcal{L}_{PEAK}$ TO 10^{31} \$.25M, \$25M

  $\mathcal{L}_{PEAK}$ REQUIRES A SEPARATION SCHEME

Presentation to Coolfont, WV – July, 1985

COLLIDER IMPROVEMENTS

DESIGN LUMINOSITY $= 10^{30}\ cm^{-2}\ sec^{-1}$

FOR $N_{\bar{p}} = N_p = 6 \times 10^{10}$

$N_{BUNCH} = 3.$ (each)

$\Delta\nu_{bb} = .0017$

1. INCREASE N_p TO 10^{11}, $N_{\bar{p}}$, N_b NO CHANGE

   $\mathcal{L} \Rightarrow 1.6 \times 10^{30}$ - $\Delta\nu_{bb} = .003$

2. INCREASE $N_{\bar{p}}$ TO 10^{11}, N_b NO CHANGE

   $\mathcal{L} \Rightarrow 3 \times 10^{30}$ $\Delta\nu_{bb} = .003$

1 & 2 REQUIRE BRINGING SOURCE TO DESIGN VALUE OF 10^{11}/hr. ~~Also~~, IMPROVEMENTS IN rf MANIPULATION, AND PERHAPS A DENSER $\bar{p}$ CORE.

3. INCREASE N_b TO 6 OR 12.

$\mathcal{L} \Longrightarrow \sim 10^{31}\ cm^{-2}\ sec^{-1}$

3. REQUIRES SEPARATORS TO KEEP THE BEAMS APART EXCEPT WHERE EXPERIMENTS EXIST ~ 2 OR 3 PLACES IN 1989.

10/11/85

TEVATRON COLLIDER PERFORMANCE

	$\hat{\mathcal{L}}$ $CM^{-2}SEC^{-1}$	$\int \mathcal{L}\,dt$ Pb^{-1}	$\sqrt{S}$ TEV
1987	1.3×10^{29}	.070	1.8
1988/89	2.1×10^{30}	9.7	1.8

UPGRADE PROPOSAL
FOR
FERMILAB
1990 - 1995

THE MAIN INJECTOR

MAY 16, 1989

J PEEBLES

$$\mathcal{L} = \left(\frac{N_p}{\frac{2}{3}\langle \epsilon_N \rangle}\right)\left(\frac{N_{\bar{p}}\, n_b}{1}\right)\left(\frac{1}{\beta^* G\left(\frac{l_b}{\beta^*}\right)}\right)\frac{f_0 E_b}{M_p c^2}$$

CURRENT STATUS OF THE TEVATRON

$\mathcal{L} = 2 \times 10^{30}\ cm^{-2} sec^{-1}$

$\tau_L = 20\ hr$

n_b = # OF BUNCHES = 6

N_p = PROTONS/BUNCH = 6×10^{10}

$\langle \epsilon_N \rangle$ = AVERAGE EMITTANCE OF p's, $\bar{p}$'s IN x, y = $20\pi \times 10^{-4}$ cm rad

$N_{\bar{p}}$ = $\bar{p}$'s / BUNCH = 2.5×10^{10}

β^* = $\beta(s)$ AT INTERACTION = 50 cm

E_b = BEAM ENERGY = 900 GeV

$\phi_{\bar{p}}$ = $\bar{p}$ STACKING RATE = $2 \times 10^{10}\ hr^{-1}$

HOW MUCH LUMINOSITY IS NEEDED?

IF $70 < m_{top} < 200$ GeV/c^2

IF $e\nu b$ AND $\mu\nu b$ DECAYS CAN PROVIDE A LOW BACKGROUND SIGNAL FOR

$$t + \bar{t}$$
$$\hookrightarrow \ell' \bar{\nu}_{\ell'} \bar{b}$$
$$\hookrightarrow \bar{\ell} \nu_{\ell} b$$

DETECT $\begin{cases} e\mu + J_\mu + \not{E}_T \\ ee + J_\mu + \not{E}_T \\ \mu\mu + J_\mu + \not{E}_T \end{cases}$

THEN $\sigma_{t\bar{t}} \cdot B_{\ell\nu\ell'\nu'} \simeq .1\ pb^{-1}$

- IF ALLOWANCE IS MADE FOR ACCEPTANCE & EFFICIENCY (~20%) THEN $\int \mathcal{L}\, dt > 200\ pb^{-1}$ IS NEEDED.

IS IT PRACTICAL, SINCE A FACTOR OF 20 IS NEEDED?

HOW WILL THE LUMINOSITY TO GREATER THAN 5×10^{31} cm^{-2}

PHASE I $2 \times 10^{30} \longrightarrow \lesssim 10^{31}$ cm^{-2}s

<u>SEPARATORS</u> RELIEVE THE BEAM-BE TUNE SHIFT LIMIT.

<u>MANY IMPROVEMENTS</u> TO THE $\bar{p}$ SOURCE WILL INCREASE THE $N_{\bar{p}}$.

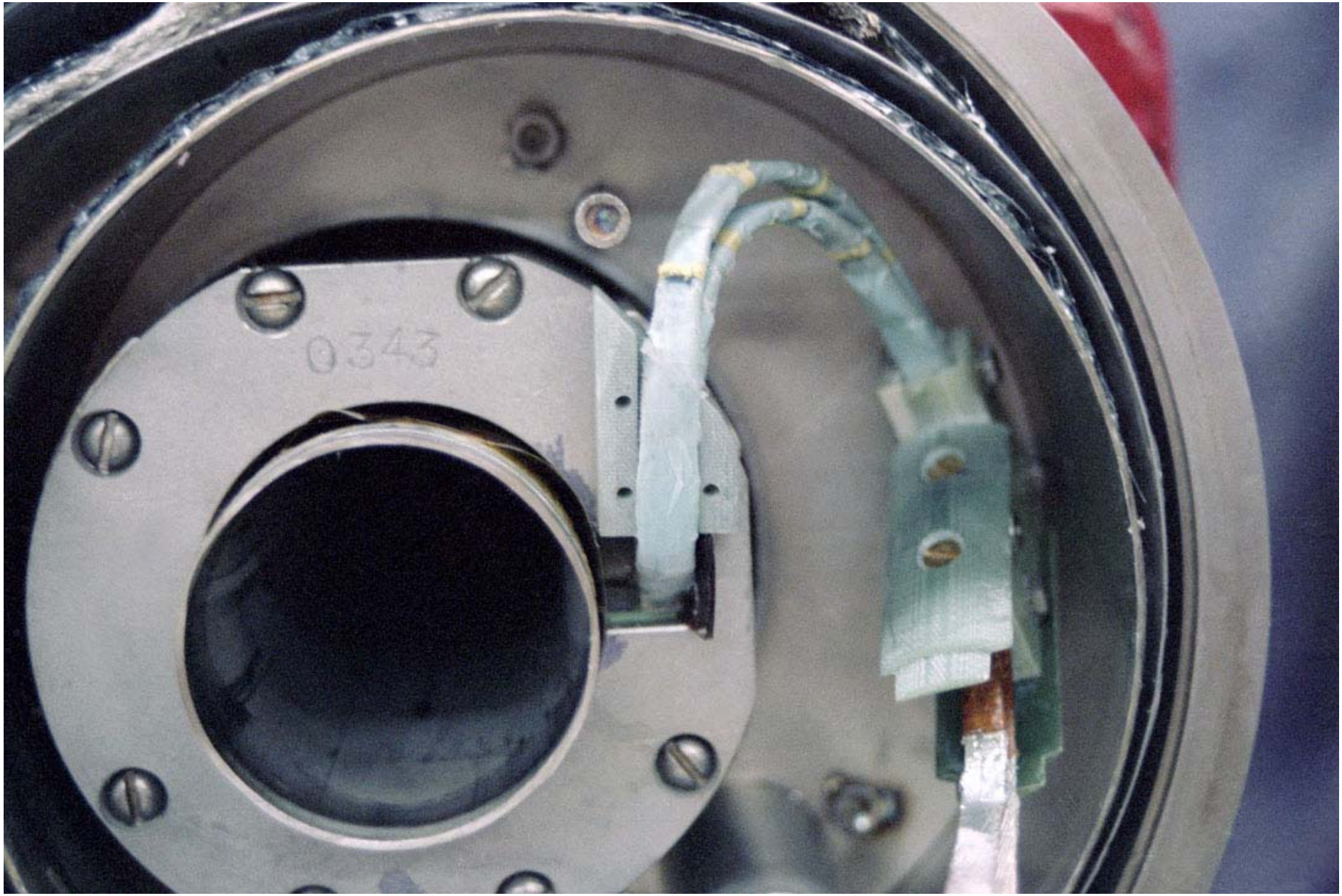
<u>HIGHER ENERGY LINAC</u> WILL INCRE MAIN RING p INTENSITY, HENCE INCREASE $N_{\bar{p}}$ AND N_p.

"<u>MATCHED" LOW β INSERTIONS</u> AT $B\phi$ (CDF) AND $D\phi$ WILL LEAD TO A SMALLER BEAM SIZE AT THE COLLISION POINT

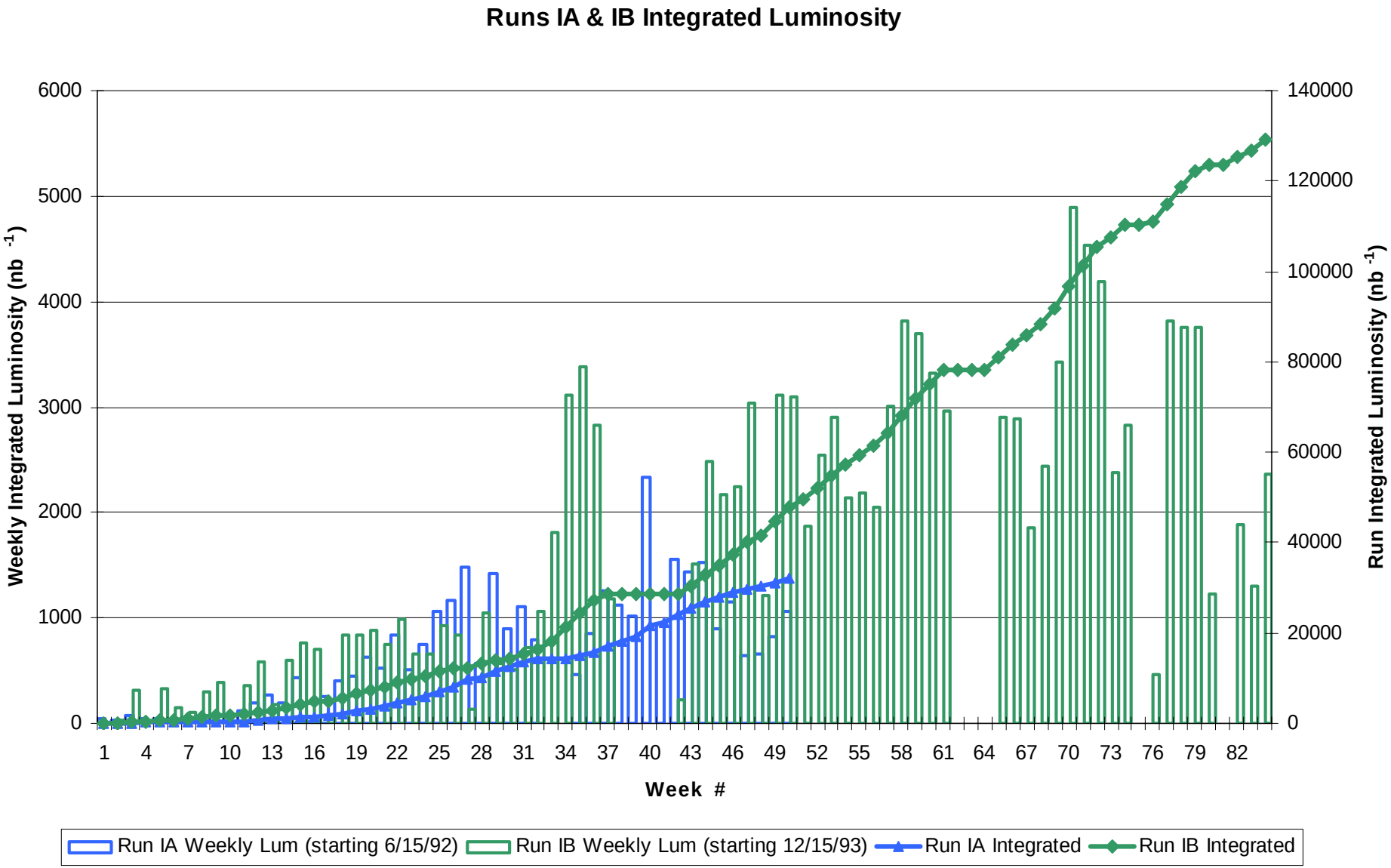
PHASE II $\sim 10^{31}\ cm^{-2} sec^{-1} \longrightarrow > 5 \times 10^{31}$

A NEW INJECTOR FOR THE TEVATRON WHICH WILL SIGNIFICANTLY INCREASE THE PROTON AND $\bar{p}$ INTENSITY

1989 National Medal of Technology recipients: (left to right) Richard A. Lundy, J. Ritchie Orr, Helen T. Edwards and Alvin V. Tollestrup


0343

3/22/93


Runs IA & IB Integrated Luminosity
Weekly Integrated Luminosity (nb -1)
Run Integrated Luminosity (nb -1)
Week #
0
1000
2000
3000
4000
5000
6000
0
20000
40000
60000
80000
100000
120000
140000
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64 67 70 73 76 79 82
Run IA Weekly Lum (starting 6/15/92)
Run IB Weekly Lum (starting 12/15/93)
Run IA Integrated
Run IB Integrated

IS THERE ANOTHER WAY

R&R

"RECOVERY RING"

POSSIBLE PARAMETERS

$E_{MAX} = 20\,GEV \quad (\gamma = 22)$

$E_{MIN} = 7.5\,GEV \quad (\gamma = 9)$

$\gamma_T \approx 7$

CIRCUMFERENCE = 2x ACCUMULATOR

$h_1 = 168$ (2x ACCUMULATOR) 53 MHZ

$h_2 = 24$ 7.5 MHZ

FUTURE IMPROVEMENTS (1999)

+ INCREASE ENERGY TO 1 TeV/BEAM

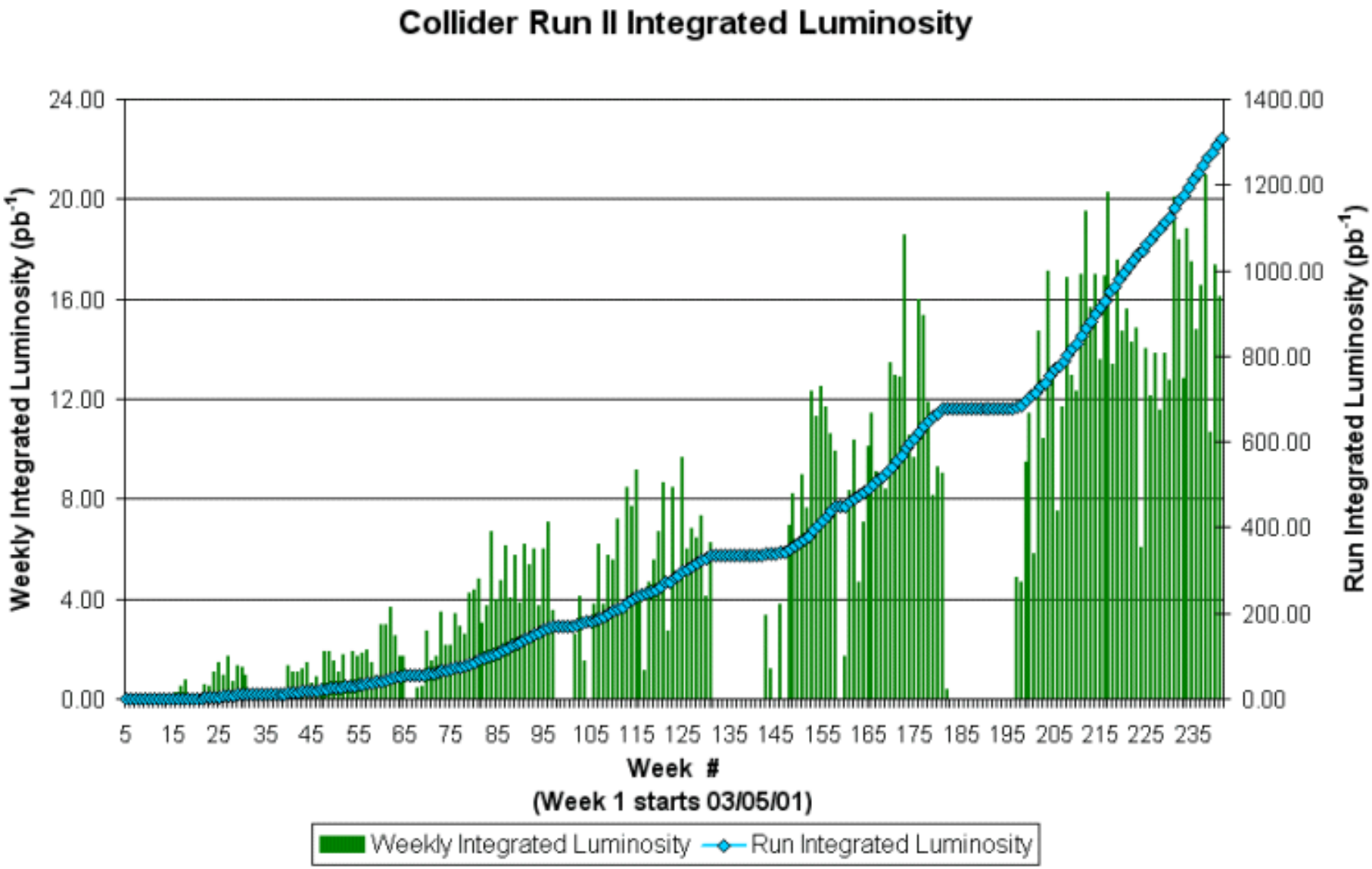
+ INCREASE $\bar{p}$ PRODUCTION AND TRANSFER EFFICIENCIES:
  MAIN INJECTOR: REPLACE MAIN RING

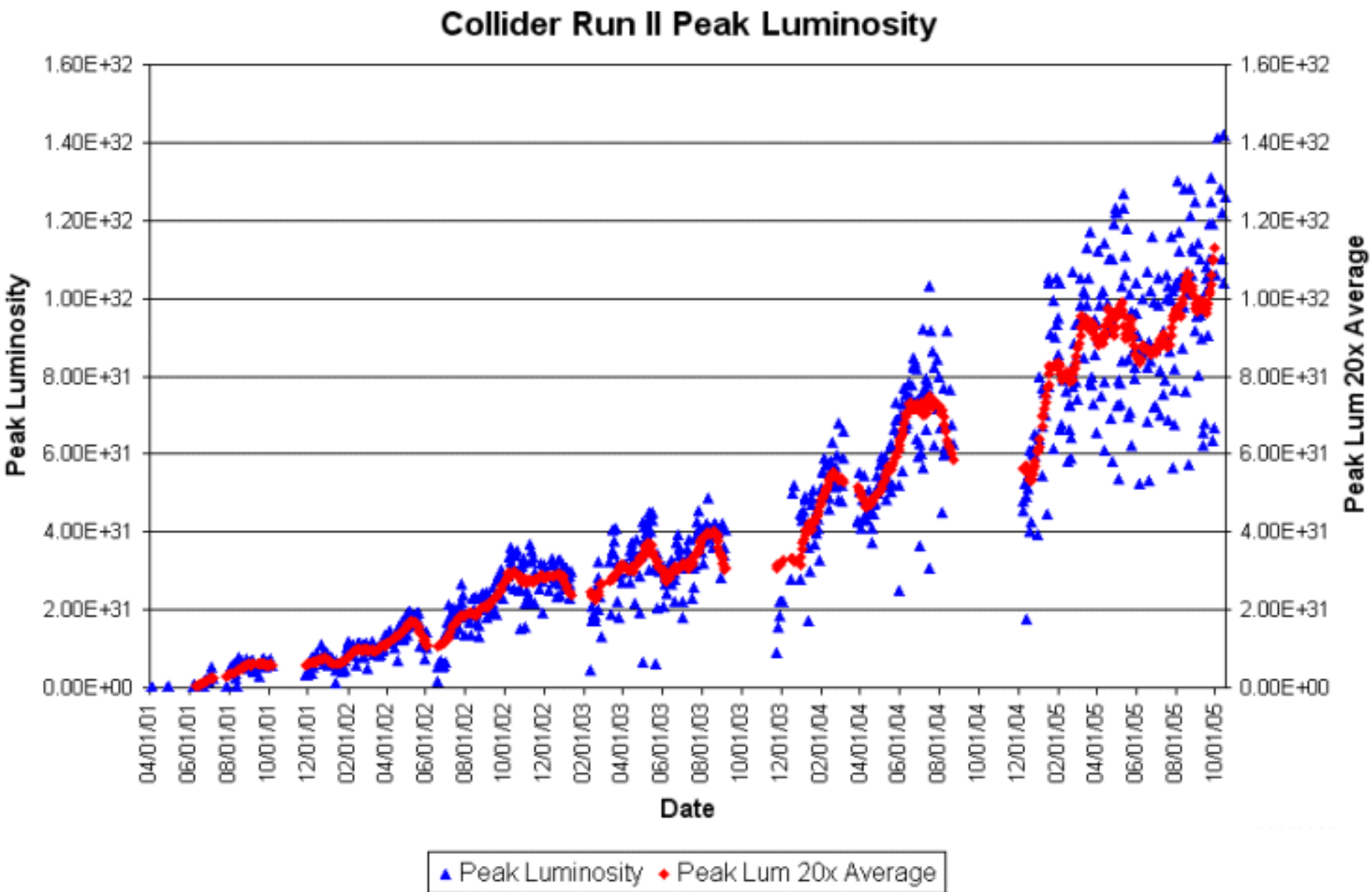
+ INCREASE $\bar{p}$ ACCUMULATION RATE
  8GeV RECYCLER RING IN MI ENCLOSURE. A 3rd STAGE OF COOLING

+ INCREASE NUMBER OF BUNCHES TO ~ 100

+ INITIAL GOAL IS $\hat{L} = 2 \times 10^{32}\ cm^{-2} s^{-1}$, 10^{33} MAY BE FEASIBLE

9/15/97


Collider Run II Integrated Luminosity
Weekly Integrated Luminosity (pb-1)
Run Integrated Luminosity (pb-1)
24.00
20.00
16.00
12.00
8.00
4.00
0.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
5 15 25 35 45 55 65 75 85 95 105 115 125 135 145 155 165 175 185 195 205 215 225 235
Week #
(Week 1 starts 03/05/01)
Weekly Integrated Luminosity
Run Integrated Luminosity


Collider Run II Peak Luminosity
Peak Luminosity
Peak Lum 20x Average
Date
1.60E+32
1.40E+32
1.20E+32
1.00E+32
8.00E+31
6.00E+31
4.00E+31
2.00E+31
0.00E+00
04/01/01
06/01/01
08/01/01
10/01/01
12/01/01
02/01/02
04/01/02
06/01/02
08/01/02
10/01/02
12/01/02
02/01/03
04/01/03
06/01/03
08/01/03
10/01/03
12/01/03
02/01/04
04/01/04
06/01/04
08/01/04
10/01/04
12/01/04
02/01/05
04/01/05
06/01/05
08/01/05
10/01/05
Peak Luminosity
Peak Lum 20x Average

9/25/82

9/25/92