Tev120
Stretcher Ring
(part II)

Mike Syphers

FT Historical Comparisons

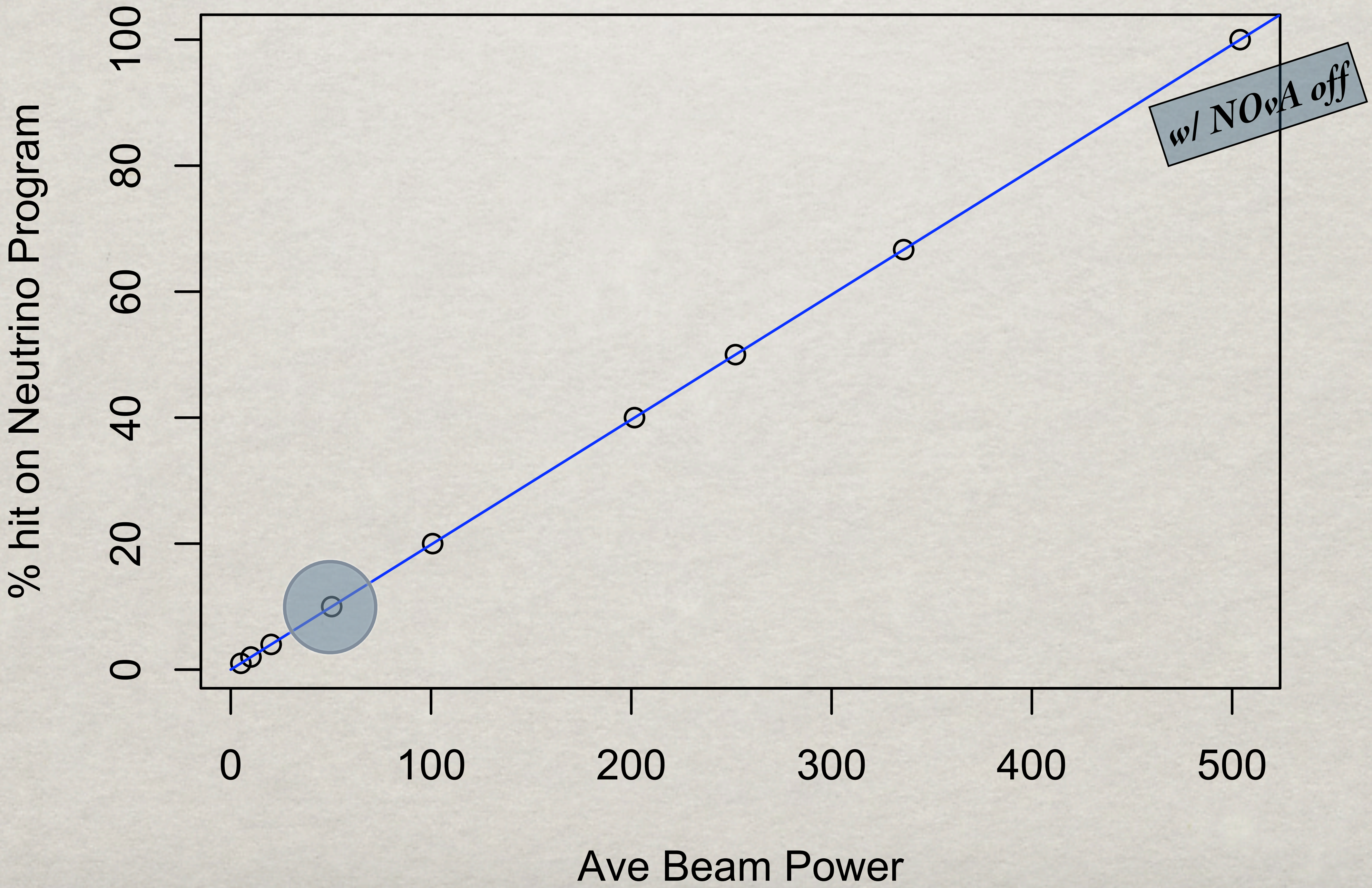
(Tp = 10^{12} protons)

		protons / spill time	cycle time	<P>*	P_{inst}*	
ca. 1981	400 GeV MR	30 Tp / 2 s	10 s	190	950	kW
ca. 1993	800 GeV Tev	30 Tp / 20 s	60 s	64	190	kW
ca. 2009	120 GeV MI	1 Tp / 4 s	120 s	0.2	5	kW
	120 GeV Tev	30 Tp / 1.333 s	2.667 s	220	440	kW
		50 Tp / 1.333 s	2.667 s	360	720	kW
		100 Tp / 1.333 s	2.667 s	720	1400	kW
E-871 rare Kaon Decay	24 GeV AGS	70 Tp / 2.8 s	5.1 s	52	96	kW
	120 GeV Tev	70 Tp / 25.333	26.7 s	50	53	kW

*assumes all "slow spill"

Tev120 w/ NOvA

Assume 2 MI pulses to fill Tev, with 35 Tp each



Other Comments, Considerations

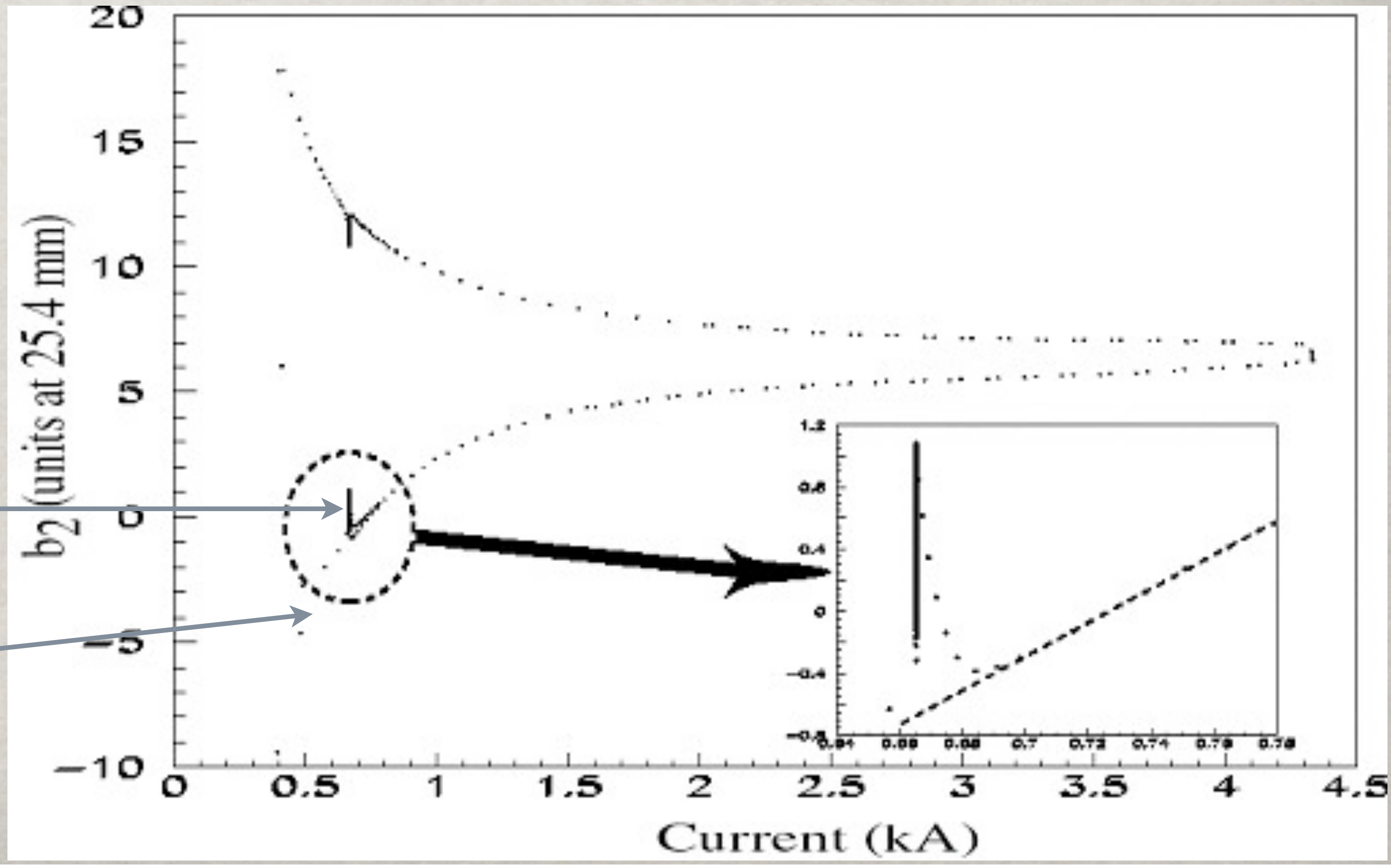
1. Can use existing A0 abort system in this scenario.
    a. 100 Tp @ 120 GeV ~ 12 Tp @ 1000 GeV
2. Improvements made to impedances and to damper systems during Run II would help with possible beam intensity-related instabilities.
3. Consider using F0 Lambertson magnet for both injection and extraction -- needs polarity reversal switch. Could then use ESEP @ C0, or E48. Use existing SY120 beam line -- no need to re-establish A0 extraction area.
4. Beam is 2.5x larger at 120 GeV than at 800 GeV (for same emittance), so somewhat less aperture available for slow spill process.
5. Use barrier bucket scheme to contain beam during injection *and* slow spill -- no 53 MHz RF necessary (reserved for MI/NOvA??)
6. Reconfigure to 1983 optics in long straight sections. Re-establish QXR system.
7. $5-10M (ops) + $15M (labor) = $20-25M/year
    a. Would running part of year save any $$'s?

Other Comments, Considerations -- II

8. No magnet ramping, low-beta optics removed, and lower current (thus higher operating margin) --> more reliable operation of magnet system.
9. b_2 at 120 GeV ~ 25% worse than at 150 GeV, would affect chromaticity range, dynamic aperture, etc. However, b_2 drifts with time and would eventually reach asymptotic value (toward zero) -- not so bad?
10. Note: 8 GeV program not affected whatsoever; Booster batches to fill MI on SY120 cycles are same as on NOvA cycles; same spare Booster cycles still available

30 min. drift at 660 A
(150 GeV condition)

120 GeV = 528 A

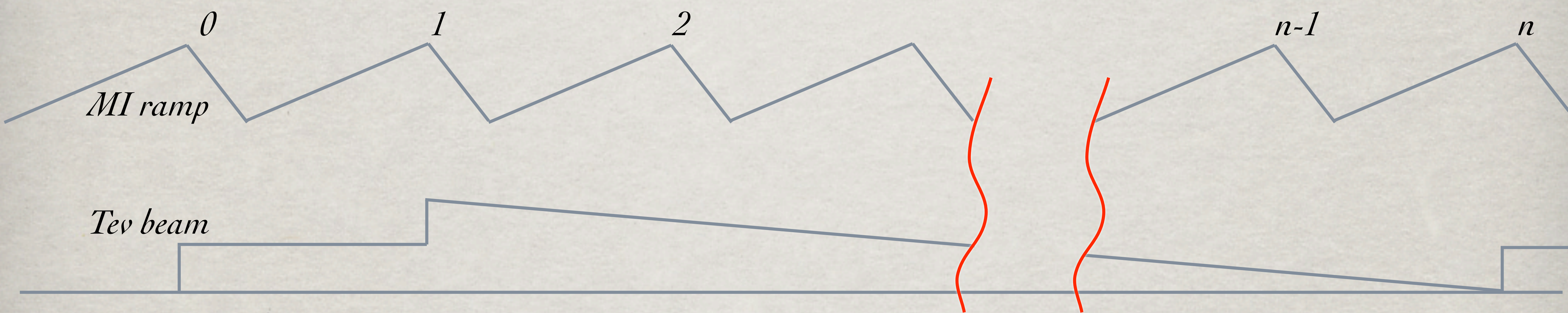


BACK UP

NOvA Era

- Assume 1.333 s cycle time for Main Injector
  - = 20/15 s, or 20 Booster pulses
  - uses Recycler as stretcher prior to injection
  - slip stacking --> 12 pulse max. into REC
- Assume Booster delivers 4e12 (4 Tp) per cycle
- Use SY120 more or less "as is" for Fixed Target program

Using the Tevatron



- Tev circumference = 2x MI
  - take two MI cycles to fill
- use 2 cycles out of *n*, *n*>1, for use in Tev120, the other *n*-2 used for NOvA
- slow spill during the available *n*-1 MI cycles

800 GeV FT Intensity

Max Tevatron intensity = 30 Tp = 3e13 at 120 GeV

n	T[s]	df[%]	hit[%]	Pave[kW]	Pmax[kW]	NdotAve[Tp/s]	NdotMax[Tp/s]
2	2.667	50	100	216	432	11.2	22.5
3	4.000	67	67	144	216	7.5	11.2
4	5.333	75	50	108	144	5.6	7.5
5	6.667	80	40	86	108	4.5	5.6
10	13.333	90	20	43	48	2.2	2.5
20	26.667	95	10	22	23	1.1	1.2
50	66.667	98	4	9	9	0.5	0.5
100	133.333	99	2	4	4	0.2	0.2
200	266.667	100	1	2	2	0.1	0.1

6 Batch Operation

Max Tevatron intensity = 48 Tp = 4.8e13 at 120 GeV

n	T[s]	df[%]	hit[%]	Pave[kW]	Pmax[kW]	NdotAve[Tp/s]	NdotMax[Tp/s]
2	2.667	50	100	346	691	18.0	36.0
3	4.000	67	67	230	346	12.0	18.0
4	5.333	75	50	173	230	9.0	12.0
5	6.667	80	40	138	173	7.2	9.0
10	13.333	90	20	69	77	3.6	4.0
20	26.667	95	10	35	36	1.8	1.9
50	66.667	98	4	14	14	0.7	0.7
100	133.333	99	2	7	7	0.4	0.4
200	266.667	100	1	3	3	0.2	0.2

12 Batch Operation
(slip stacking)

Max Tevatron intensity = 96 Tp = 9.6e13 at 120 GeV

n	T[s]	df[%]	hit[%]	Pave[kW]	Pmax[kW]	NdotAve[Tp/s]	NdotMax[Tp/s]
2	2.667	50	100	691	1382	36.0	72.0
3	4.000	67	67	461	691	24.0	36.0
4	5.333	75	50	346	461	18.0	24.0
5	6.667	80	40	276	346	14.4	18.0
10	13.333	90	20	138	154	7.2	8.0
20	26.667	95	10	69	73	3.6	3.8
50	66.667	98	4	28	28	1.4	1.5
100	133.333	99	2	14	14	0.7	0.7
200	266.667	100	1	7	7	0.4	0.4