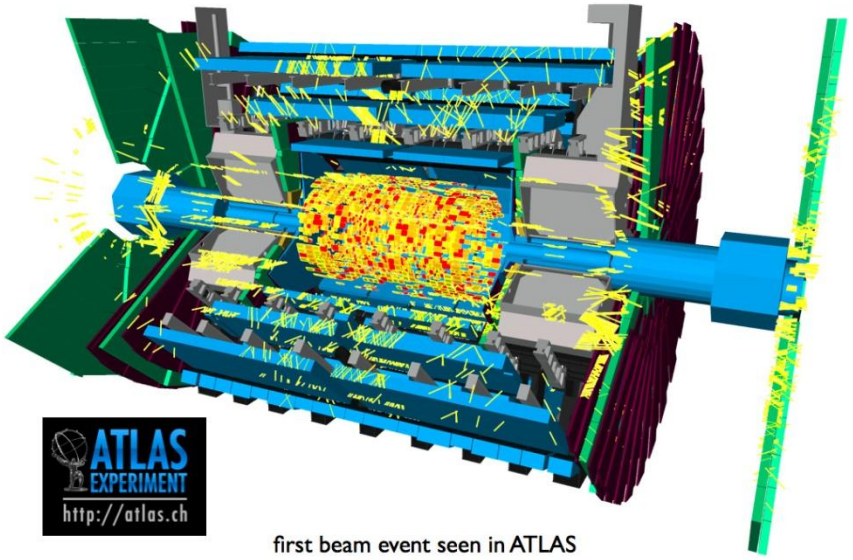
LHC 最初の200日
－ 加速器の状況、全体像 －

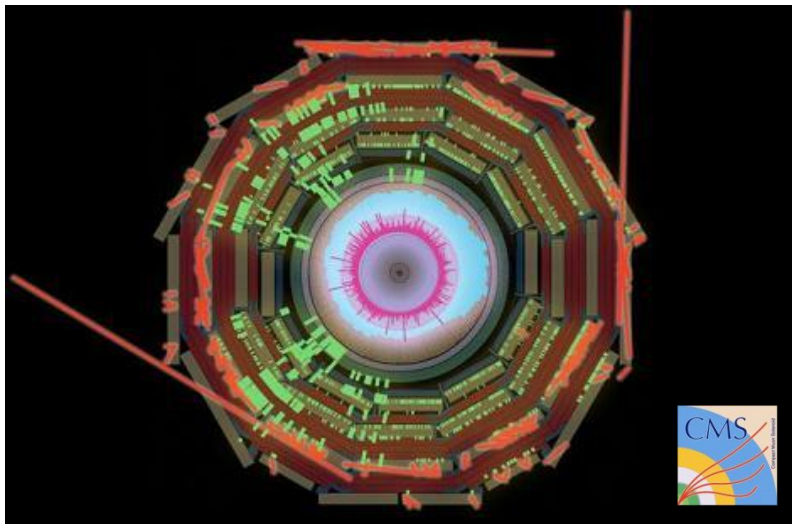
2010年9月11日
物理学会（九州工業大学）
素粒子合同シンポジウム
「エネルギーフロンティアの新たな地平」

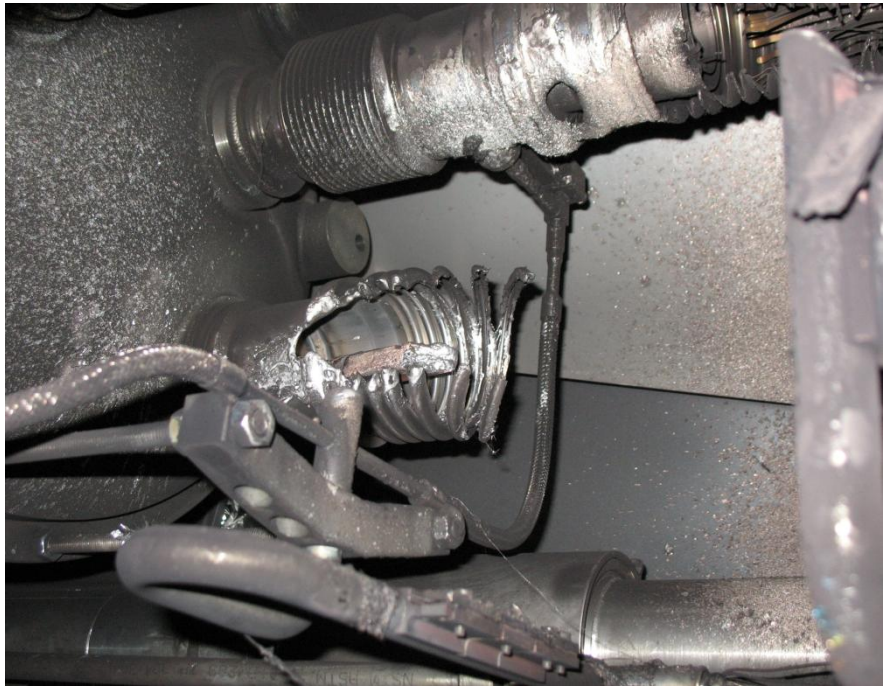
東大素粒子センター
小林富雄

今から2年前・・・
（2008年9月10日）

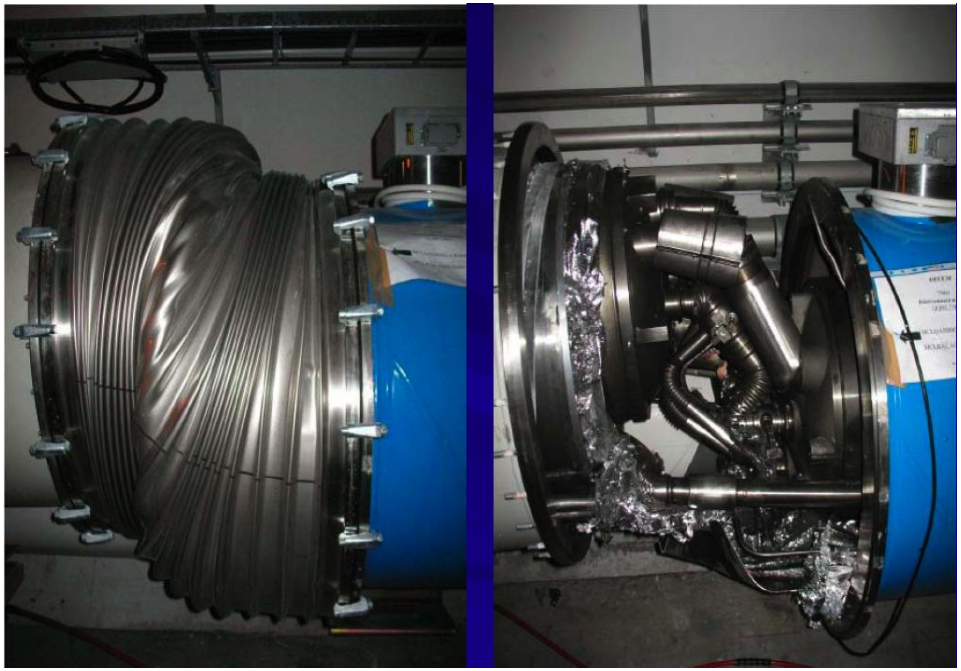


first beam event seen in ATLAS



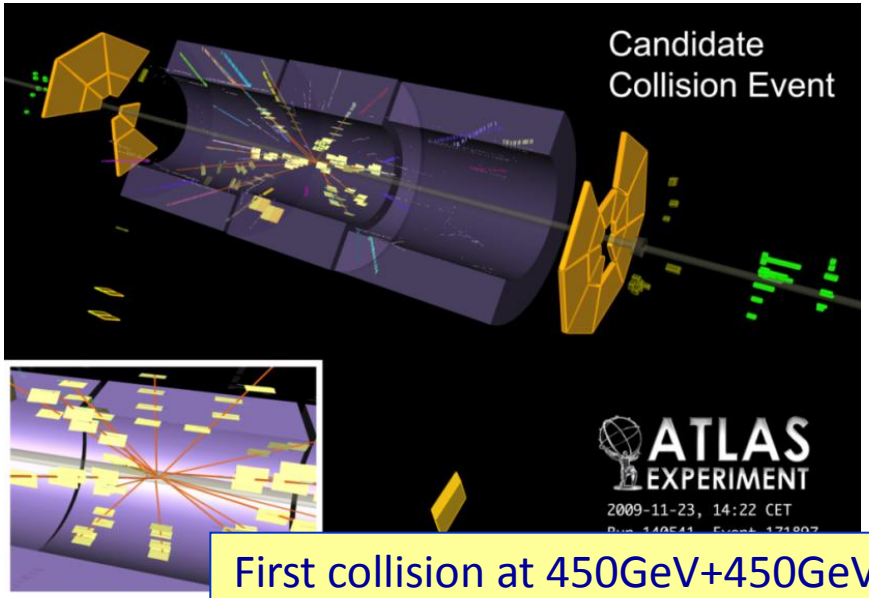


その9日後・・・
(2008年9月19日)



復旧と対策に1年2ヵ月かかりましたが…

やっと始まりました

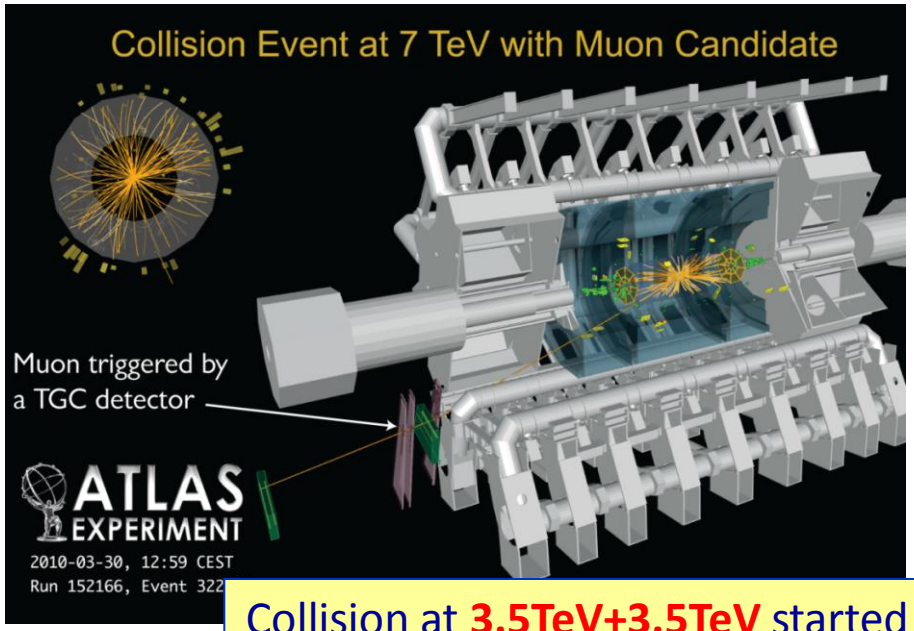


First collision at 450GeV+450GeV
(2009年11月23日)

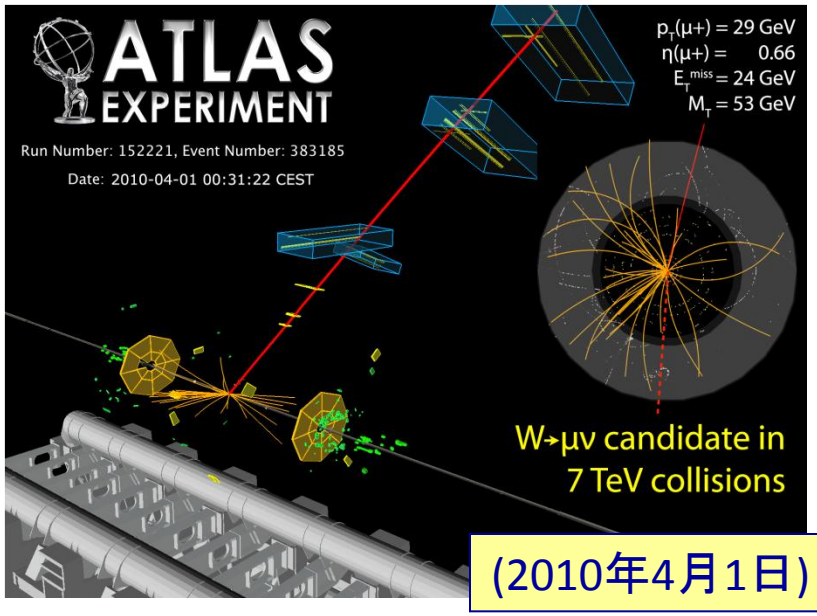
復旧の詳細は高エネルギーニュース

- 27-3 (2008) 163-171
  近藤敬比古「LHC加速器の現状とCERNの将来計画」
- 28-4 (2010) 270-279
  小林富雄「LHC実験始動」

をご覧ください。



Collision at **3.5TeV+3.5TeV** started
(2010年3月30日)



(2010年4月1日)

LHC design parameters

Nominal settings	
Beam energy (TeV)	7.0
Number of particles per bunch	$1.15\ 10^{11}$
Number of bunches per beam	2808
Crossing angle (μrad)	285
Norm transverse emittance (μm rad)	3.75
Bunch length (cm)	7.55
Beta function at IP 1, 2, 5, 8 (m)	0.55,10,0.55,10

Derived parameters	
Luminosity in IP 1 & 5 ($cm^{-2}\ s^{-1}$)	10^{34}
Luminosity in IP 2 & 8 ($cm^{-2}\ s^{-1}$)*	~$5\ 10^{32}$
Transverse beam size at IP 1 & 5 (μm)	16.7
Transverse beam size at IP 2 & 8 (μm)	70.9
Stored energy per beam (MJ)	362

(~10 GJ in magnets)

3.5TeV for 2010 and 2011

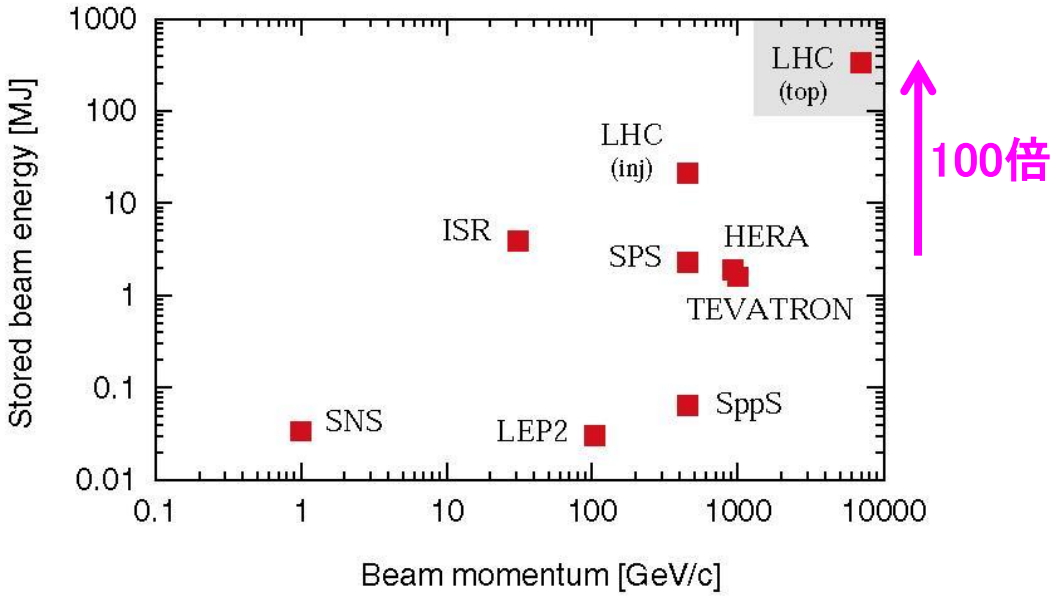
$$\beta^* \propto \sigma_{x(y)}^2$$

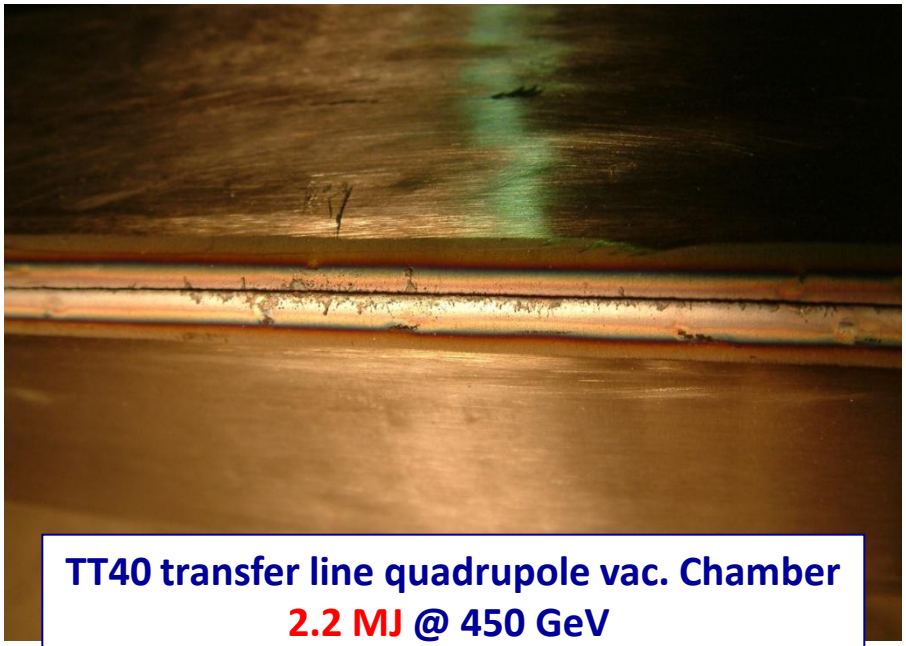
$$L = F \frac{N_b N_1 N_2 f_{rev}}{4\pi\sigma_x\sigma_y}$$

(F: geometric luminosity reduction factor doe to the crossing angle)

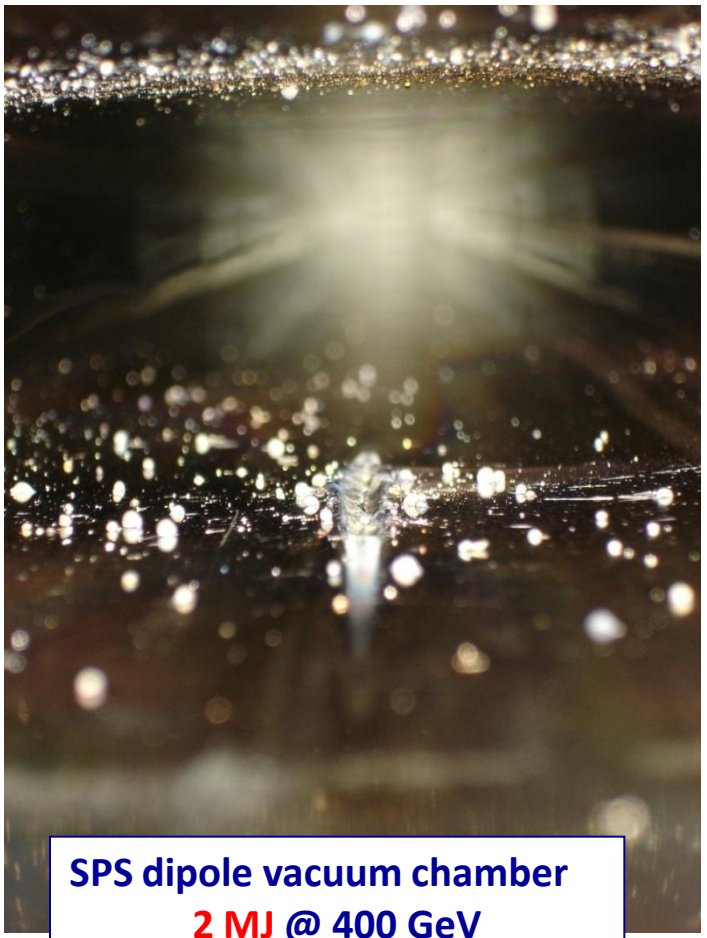
~100 fb^{-1} / year

Stored energy in LHC beam





TT40 transfer line quadrupole vac. Chamber
2.2 MJ @ 450 GeV



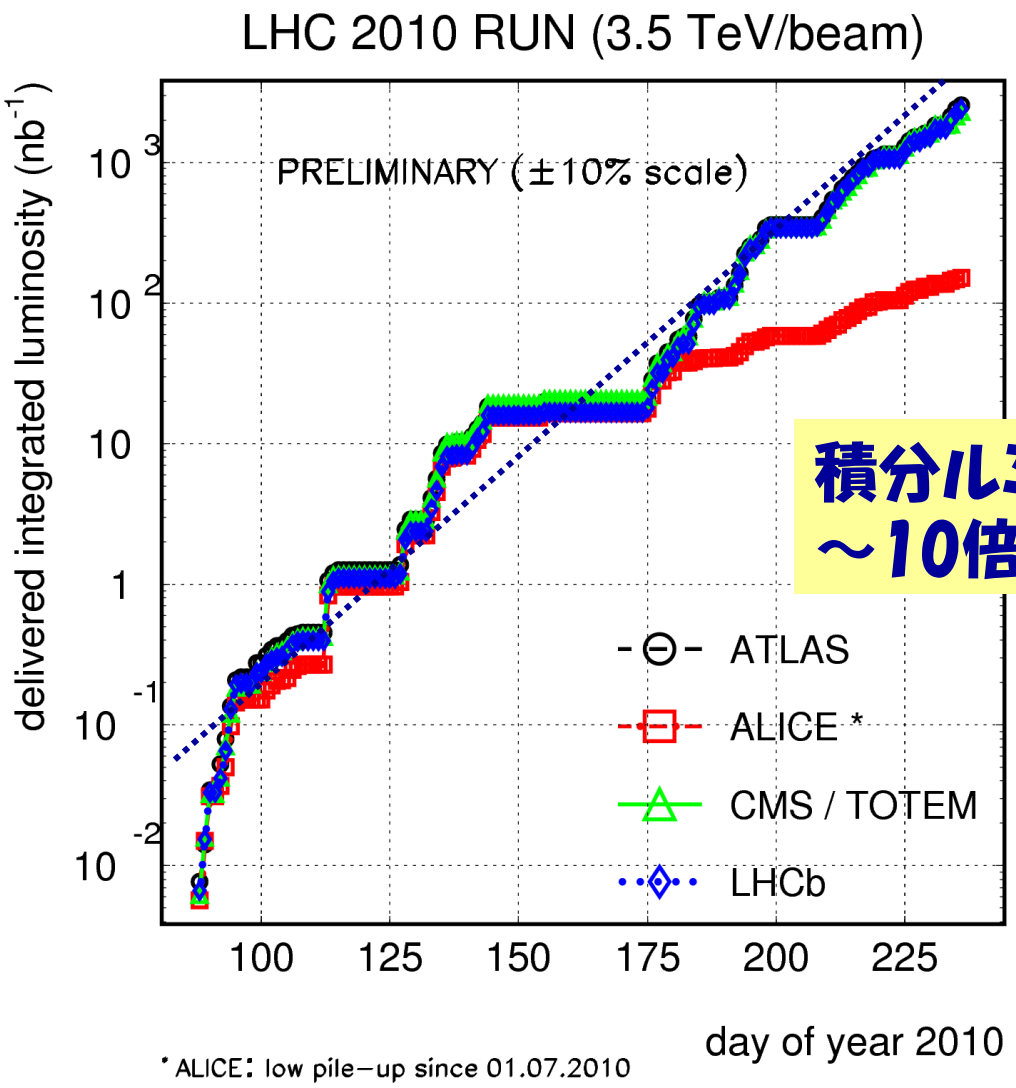
SPS dipole vacuum chamber
2 MJ @ 400 GeV

Collimators must survive expected beam loss…

Milestones reached 2010 (August)

Date	Achieved	
Mar 30	First collisions at 7 TeV centre of mass.	Luminosity ~ 2 10^{27} cm^{-2} s^{-1}
April 24	First stable beams at 7 TeV, 3 on 3, squeeze to 2m.	Luminosity ~ 2 $10^{28}$$cm^{-2}$ s^{-1}
May	Increase bunch intensity to 2 $10^{10,}$ Increase $k_{b.}$	Regular physics runs
May 24	13 on 13, 8 colliding pairs per experiment.	Luminosity ~ 3 $10^{29}$$cm^{-2}$ s^{-1}
June	Increase bunch intensity to nominal, squeeze to 3.5m.	No physics
June 25	First stable beams at 7 TeV, 3 on 3 nominal bunch.	Luminosity ~ 5 $10^{29}$$cm^{-2}$ s^{-1}
July 15	13 on 13, 8 colliding pairs per experiment, 9 10^{10} / bunch	Luminosity ~ 1.5 $10^{30}$$cm^{-2}$ s^{-1}
July 30	25 on 25, 16 colliding pairs per experiment, 9 10^{10} / bunch	Luminosity ~ 3 $10^{30}$$cm^{-2}$ s^{-1}
Aug 19	48 on 48, 36 colliding pairs 1 5 and 8 (< in 2), 9 10^{10} / bunch	Luminosity ~ 6 $10^{30}$$cm^{-2}$ s^{-1}
Aug	Stable running period to consolidate operation and MP	~2 MJ per beam !
Aug 26	50 on 50, 35 colliding pairs 1 5 and 8 (< in 2), 1.1 10^{11} / bunch	Luminosity ~ 1 $10^{31}$$cm^{-2}$ s^{-1}

2010/08/25 18.07



積分ルミノシティーは
～10倍/月のペース

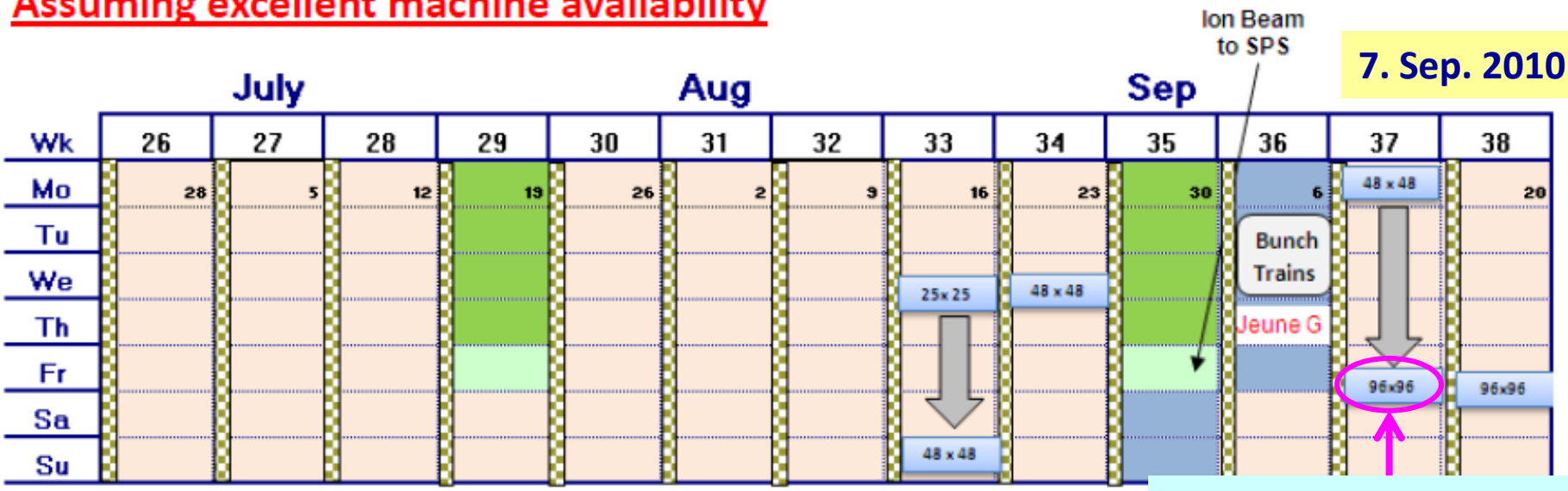
Delivered integrated luminosity > 3 pb^{-1} (Aug.27)

今年後半の予定

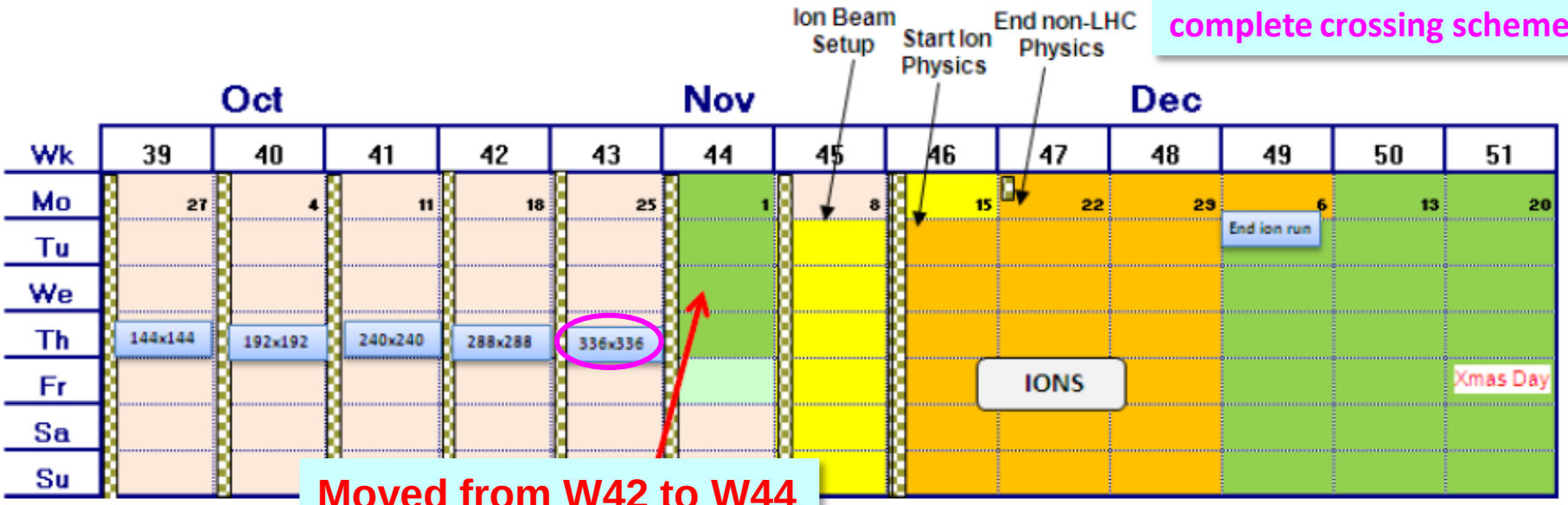
Very AGGRESSIVE schedule!

Assuming excellent machine availability

7. Sep. 2010



Trains need to have complete crossing schemes



Moved from W42 to W44

短期目標

Integrated luminosity of ≥1fb^{-1} by the end of 2011

- requires a peak luminosity of ≥ 1x10^{32} cm^{-2}s^{-1} during 2011
- → must reach ~1 x10^{32} cm^{-2}s^{-1} during 2010

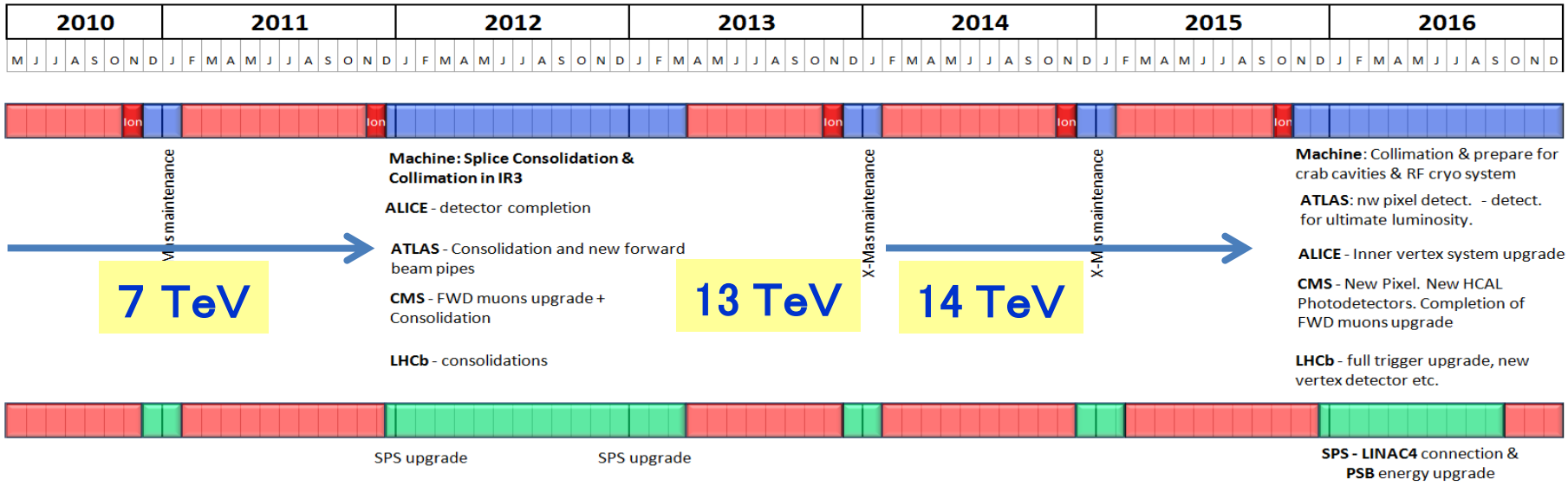
長期目標

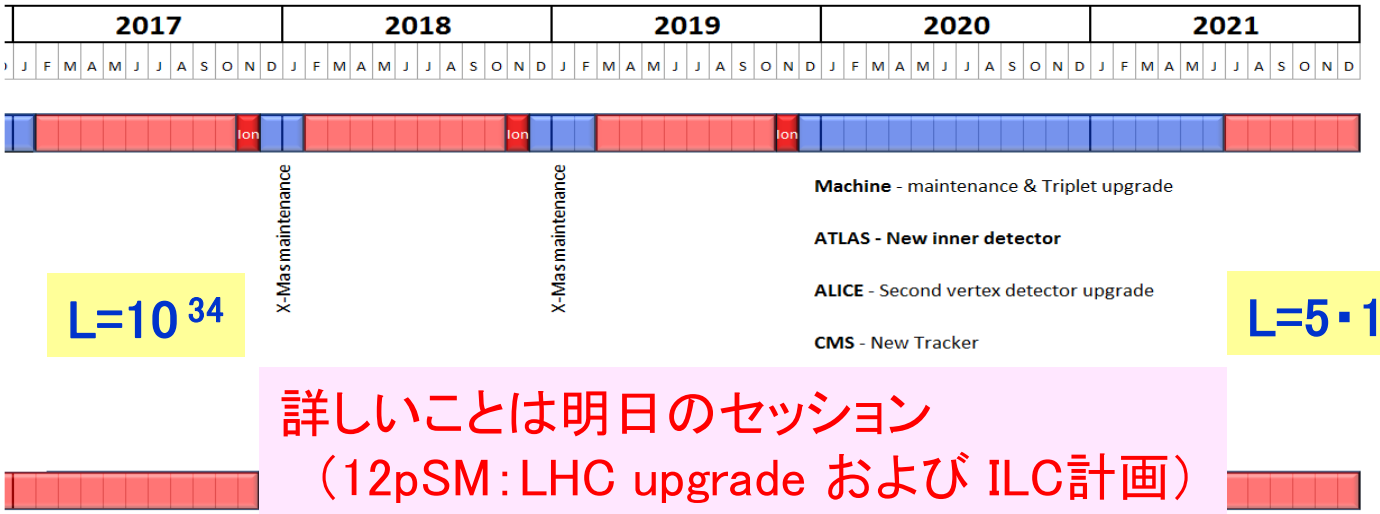
Integrated luminosity of ≥3000fb^{-1} by the end of the LHC life

- requires a peak luminosity of ≥ 5 x10^{34} cm^{-2}s^{-1} during 2021-2030
- → integrated yearly luminosity of around 250-300fb^{-1}

The 10 year technical Plan

Jul. 2010
S. Myers





詳しいことは明日のセッション
（12pSM：LHC upgrade および ILC計画）
をお聴きください

Preliminary Long Term Predictions

Aug. 2010
R. Bailey