

# RLIUP (summary)

Review of LHC and Injector Upgrade Plans

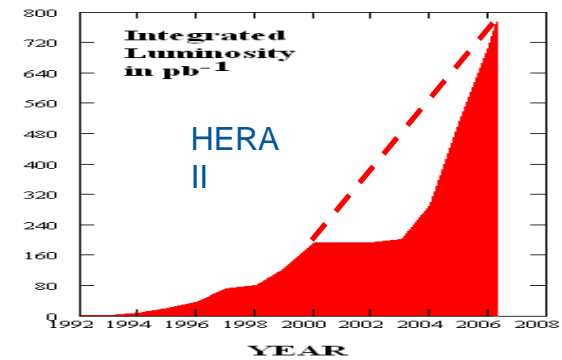
# History

- Present “10 year” schedule was
  - proposed and developed at a time when we had much less information than now
  - and was not developed in a self-consistent way.

# Objectives of RLIUP

- Produce a self consistent **set** of schedules (over the next 20 years) with clear definitions of
  - Expected integrated luminosity (and beam energy) as a function of time
  - Date and duration of shutdowns
- The CERN management and the management of the experiments can then choose between the set of possibilities.

# Limitations



- Time limitations
  - Scrubbing for 25ns
  - Required regular maintenance
  - Shutdowns needed for performance upgrades
  - Long stops needed for replacement of radiation damaged components
- Luminosity Limitations
  - Peak Luminosity
    - LHC
    - Injectors
    - Experiments (pile-up)
  - Integrated Luminosity
    - Machine availability (time limitations)
    - Efficiency of detectors (peak luminosity)
- Resources needed both experiment and machine

# Important Comments

- (A. B. 1st Talk), ESB: *Europe's top priority should be the exploitation of the full potential of the LHC, including the high-luminosity upgrade of the machine and detectors with a view to collecting **ten times more data than in the initial design, by around 2030.***
- (F.G. 2<sup>nd</sup> Talk)
  - *The STRONG physics case for the HL-LHC with 3000 fb<sup>-1</sup> comes from the imperative necessity of exploring this scale as much as we can with the highest-E facility we have today (note: no other planned machine, except a 100 TeV pp collider, has a similar direct discovery potential). Likely, and perhaps more importantly, the HL-LHC will also tell us what are the right questions to ask and how to continue.*
  - *We have NO evidence of new physics. implies that, if New Physics exists at the TeV scale and is discovered at  $\sqrt{s} \sim 14$  TeV in 2015++, its spectrum is quite heavy it will require a lot of luminosity (HL-LHC 3000 fb<sup>-1</sup>) and energy to study it in detail ..implications for future machines (e.g. **most likely not accessible at a 0.5 TeV LC**)*
  - *HL-LHC is a Higgs Factory. It can measure the Higgs self couplings with precision of a few %*

# My Comments/Proposal

- LHC has been constructed, operated and will continue to be operated on a CONSTANT BUDGET
- We have a beautiful scientific facility, unique in the world.
- The community has invested (and are investing) a huge amount of their resources in this unique facility both for construction and for operation.
- **The FULL operational costs integrated over the future operating years greatly exceeds any proposed upgrade costs. WE MUST USE THIS FACILITY EFFICIENTLY.**

**⇒ The most performance improving upgrades MUST be done as soon as technically possible**

# Goals

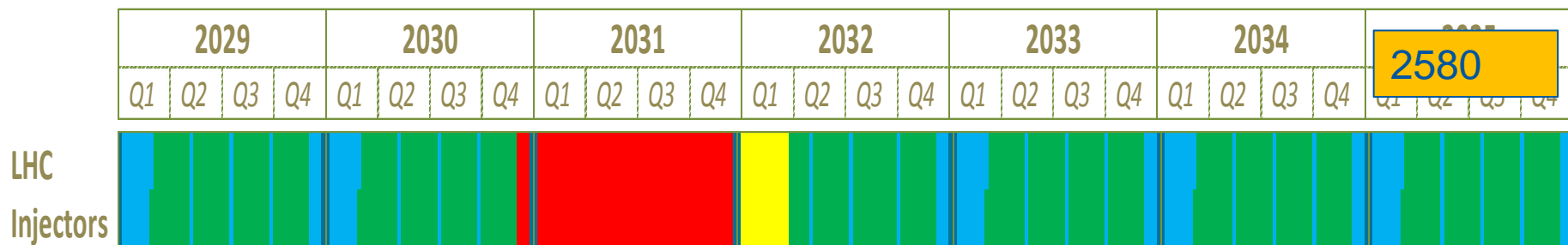
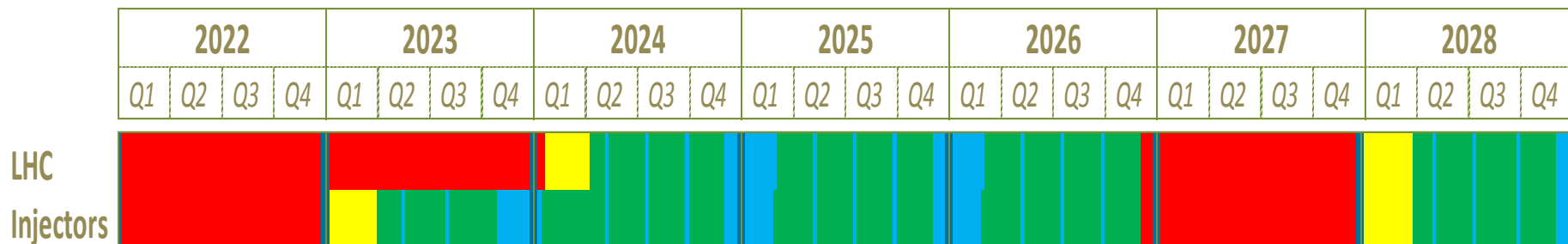
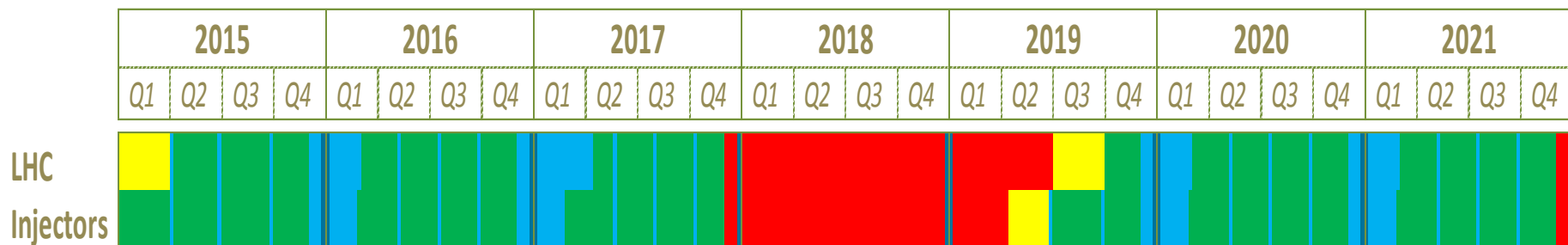
- Propose a schedule which maximises the **useful integrated luminosity** delivered to the 4 LHC large detectors
  - Playoff between lost time needed for upgrades and the increased luminosity
  - Importance of timing of upgrades (to optimize integrated luminosity)
- Implementation need a global plan/schedule for accelerators and experiments
  - Radiation
  - Access to tunnel
  - Start now with requests, strengthen weak areas

# Some scenarios (full LIU asatp)

# The Matrix From Mike Lamont

	Run 2	EYETS	LS2	Run 3	LS3
ALICE		Contingency	18 mo. Shift into 2018		
ATLAS	3 years	No	14 mo. Start 2018		27 (35) mo. Start 2022
CMS	EYETS plus N months	5 months	14 – 18 mo. Not before summer		30 – 35 mo. Start 2023
LHCb		Contingency	18 mo. End 2018		
Cryo	4 years max.	Selective maintenance			
Maintenance		Selective maintenance	16 mo.		20 mo.
LIU		9.5 months for L4 connect/or cable prep.	20.5 mo. beam to pilot		
LHC	3 years max contiguous	Opens way for year 4	18 mo.	3 years	2 years

# Scenario 2 Most Likely (2018 + 2022)



# Relative Integrated Luminosity

Year	S1	S2	S3
2015	35	35	35
2016	50	50	50
2017		50	
2018	25		25
2019	60	25	60
2020	60	60	60
2021		60	60
2022			
2023	150		
2024	250	150	150
2025	250	250	250
2026		250	250
2027	200		
2028	250	200	200
2029	250	250	250
2030		250	250
2031	200		
2032	250	200	200
2033	250	250	250
2034	250	250	250
2035	250	250	250
	2780	2580	2590

# QUESTIONS (to be decided after further discussions)

- CMS connection : EYETS + 6
  - Schedule as proposed 2016-2017
- LINAC4 connection

# Discussion

Thanks to... Preparation has been  
invaluable and crucial for this  
long term planning

- Session chairs and my co-chair Freddy and session co-chair Frank
- Shauna Dillon and Pierre Charrue
- Speakers (talks have been extremely well prepared and very informative)
- CMAC who will continue their work after the review
- All Participants.. Sincere thanks and have a safe journey home.

# END