

Introduction to IAC Meetings

CDR: Published in 2012. 600p, 400 cit's



W Kandinsky, Circles in a Circle,
1923, Philadelphia Art Museum

Then:

Higgs Boson \rightarrow L x 10

LHC Physics [no BSM]

SRF and Detector Technology

PERLE

FCC including eh. Four e^+e^- proposals

Mandate by CERN to IAC and Coordination

Workshops:

LHeC: 2014, 2015, 2017, 2018, 2019

PERLE: 2015, 2016, 2017, 2018, 2019

IAC in June 18, Orsay:

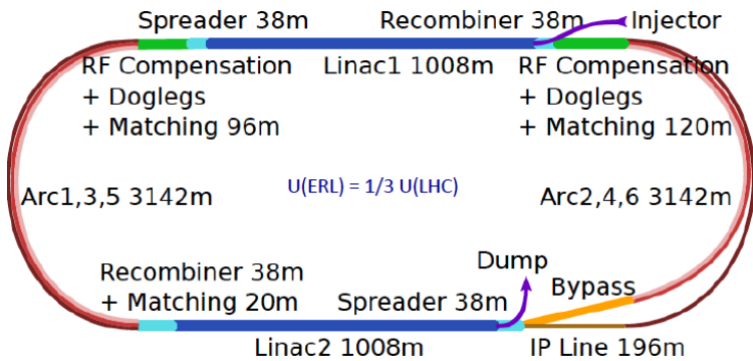
Contributions to European (global) strategy:

PERLE, LHeC + Addendum,

FCC-eh as part of FCC submissions

Max Klein December 10+12, 2018

CERN Collider Prospects: arXiv:1810.13011



Three Raisons d'être of the LHeC

Physics

- **Microscope:** World's Cleanest High Resolution
- **Empowerment** of the LHC Physics Programme
- **Creation** of a high precision, novel Higgs facility
- **Discovery** Beyond the Standard Model
- **Revolution** of Nuclear Particle Physics

Sustainability and Cost

LHC:

- see: SM, Higgs and no BSM
- use: Investment of O(5) BSF
- run: HL LHC until ~2040

LHeC [1206.2913, update 2/19]

- 1.2 TeV ep/A for O(1)BSF

→ Establish novel ep+pp

Twin Collider Facility at CERN:

sustains HL LHC and bridges to CERN's long term future

For installation during LS4 (2030+) and long term use (HE LHC, FCCeh)

Technology

Accelerator: Novel SRF ERL, green power facility

Detector: Novel high tech (CMOS..) apparatus

→ Keep accelerator and detector base uptodate while preparing for colliders that cost O(10)BSF

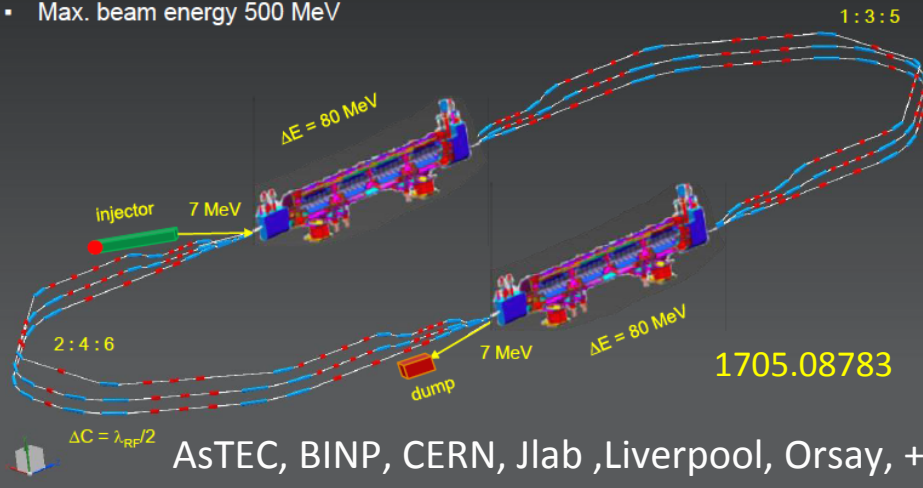
Some Strategic Questions

- LHeC: restore pp-ep-ee 'symmetry' for TeV scale exploration. PP is not only pp & ee!
DIS at LHeC: Hubble Telescope of Micro Universe (protons and ions)
Big questions now: **Higgs** properties and **Where is BSM?**
- **Sustain the HL-LHC operation +CERN in the 30ies.** ep injects discovery + precision
Decades (2 or 4? HTS?) required for ~16 or 22 T magnets, and FCC tunnel
- **Time:** earliest: after LS4: 2031. latest - for twin ep+pp: after LS5: 2035
- **Configuration related to cost and physics**
60 GeV: 9km [~ 1.6 BSF] or 50 GeV: 5 km [~ 1.3 BSF], + Detector ~ 0.3 BSF
(CLIC: 6-7 BSF, FCCee: 12 BSF, ILC officially 5 B ILC units [\$ in 2012], HE LHC ~ 6 BSF)
- **Role of PERLE:** First 10 MW = 500MeV x 20 mA facility: multi-turn, 802 MHz
CDR published in 2017: arXiv:1705.08783. Technical Network of ERL Facilities
- **Main message:** A unique, affordable, fundamental PP opportunity for 3 decades
20ies: build, 30ies+: operate, 40ies: analyse.
- **What is missing for a convincing case?** Update of CDR: ready 3/19
- **LHeC has future potential** for FCCee injection, XFEL, ep at HE LHC and FCC-eh/hh

Acc & Det Technology

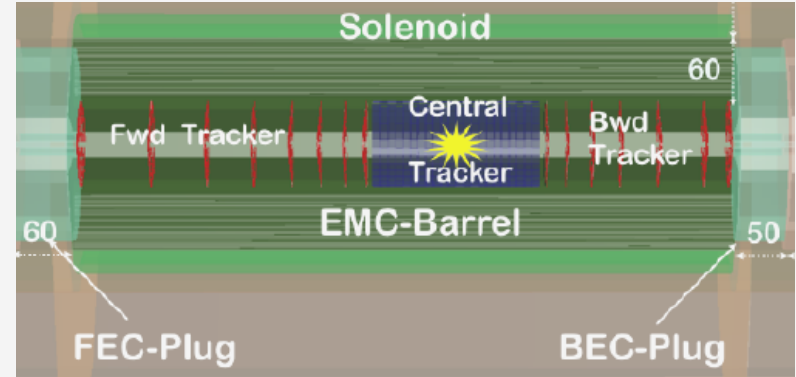
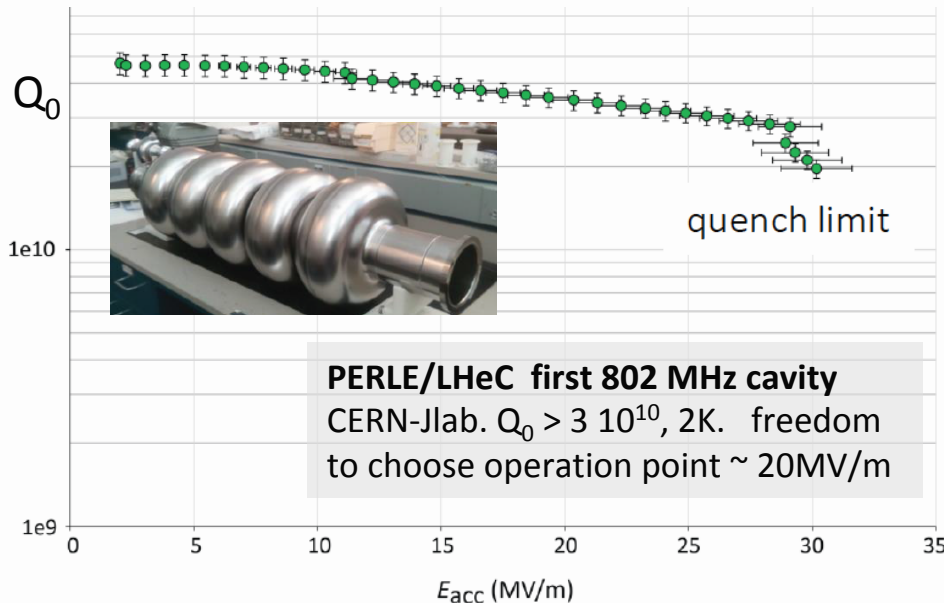
- 2 Linacs (Four 5-Cell 801.58 MHz SC cavities)
- 3 turns (160 MeV/turn)
- Max. beam energy 500 MeV

PERLE at Orsay

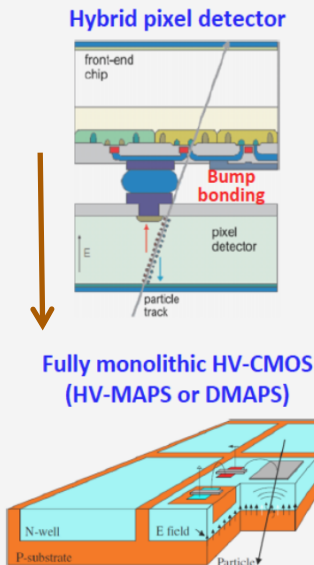


AsTEC, BINP, CERN, Jlab, Liverpool, Orsay, +

Challenge: demonstrate multi-turn ERL (cbeta, 2019)
Develop 802 MHz, LHeC Technology (PERLE > 2022)



Zoom LHeC detector [15.6 x 10.4m² HE LHC]



UK Institutes

Accelerator

AsTEC, Cockcroft (Lancaster, Manchester, Liverpool, Srathclyde), JAI (Oxford)

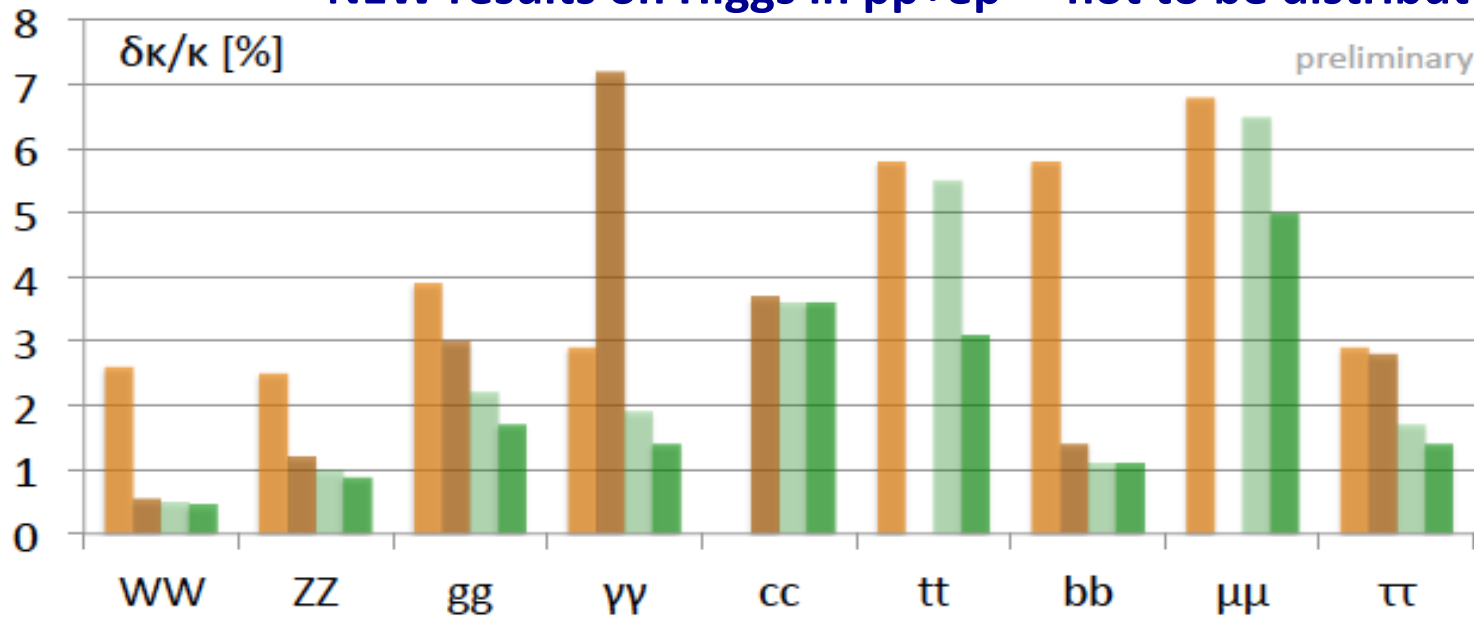
Detector+Physics

Birmingham, Liverpool, Manchester, Oxford, QMW

HERA+LHC have also
Bristol, Glasgow, Imperial, Lancaster, RAL, UCL.

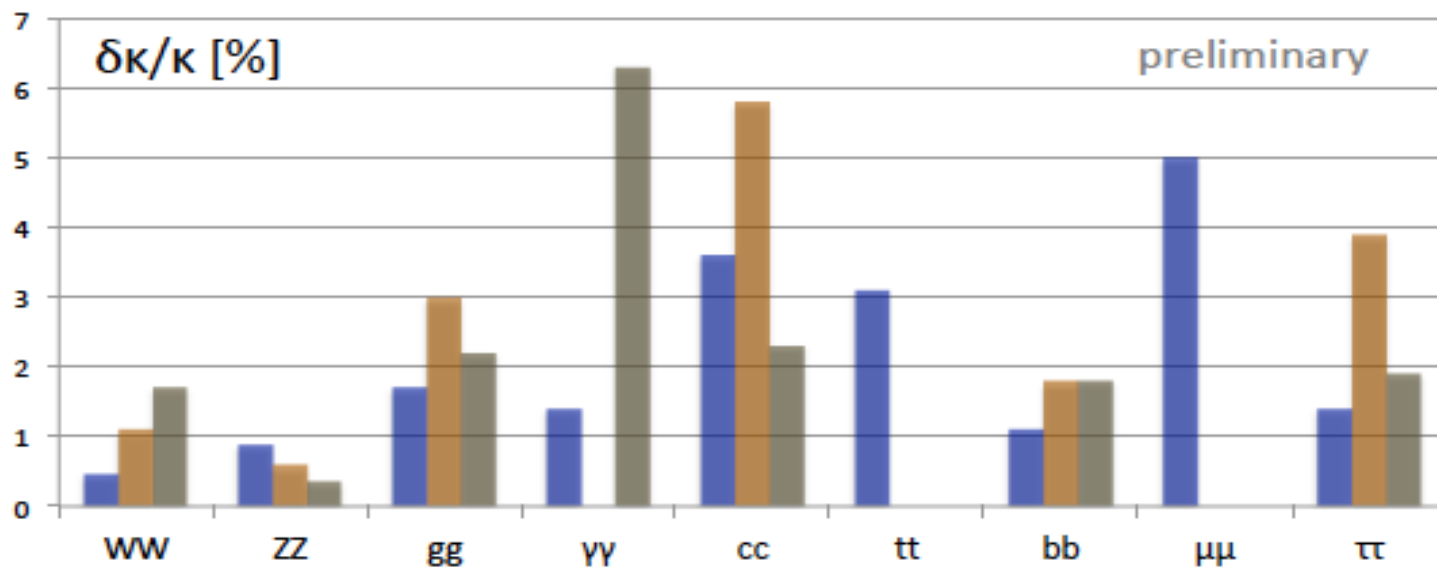
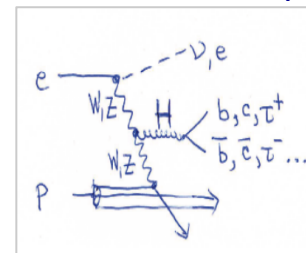
Detector: a new task post HL LHC design
Challenge for Acc+Det: 3 beam-IR design

NEW results on Higgs in pp+ep - not to be distributed yet



- pp1
- ep
- ep+pp1
- ep+pp2

CC and NC in ep



- LHC(pp+ep)
- CLIC
- ILC

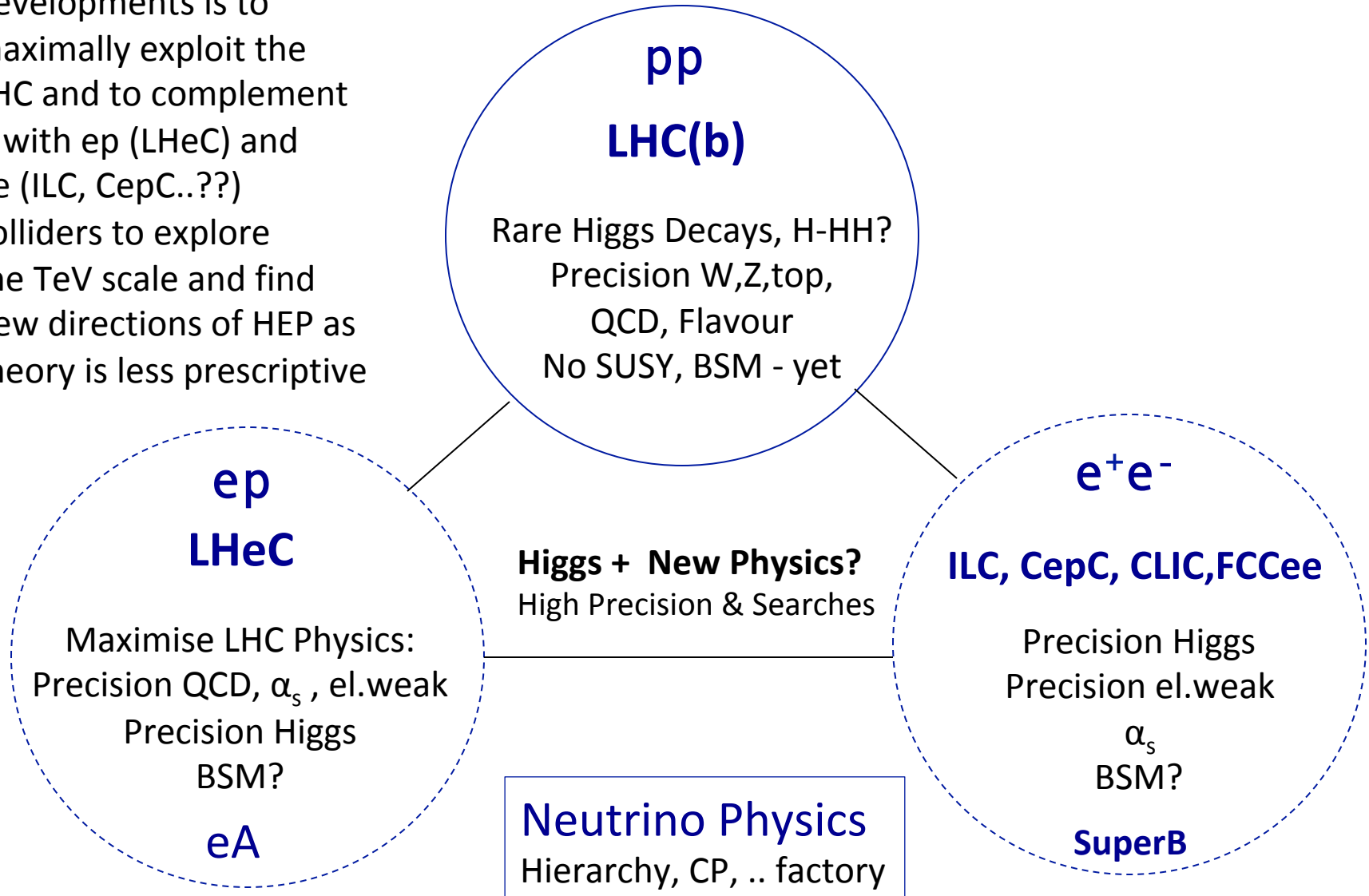
HL LHC (CMS, S1) & LHeC, CLIC350 [1608.07358], ILC [1710.07621]

← For ECFA Higgs WG

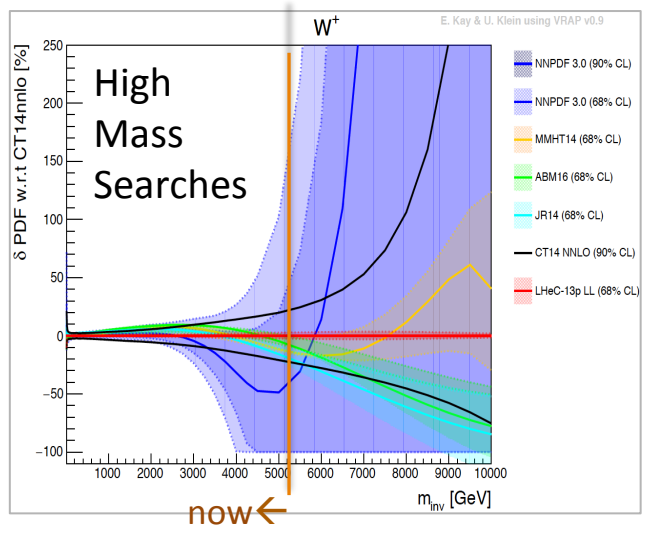
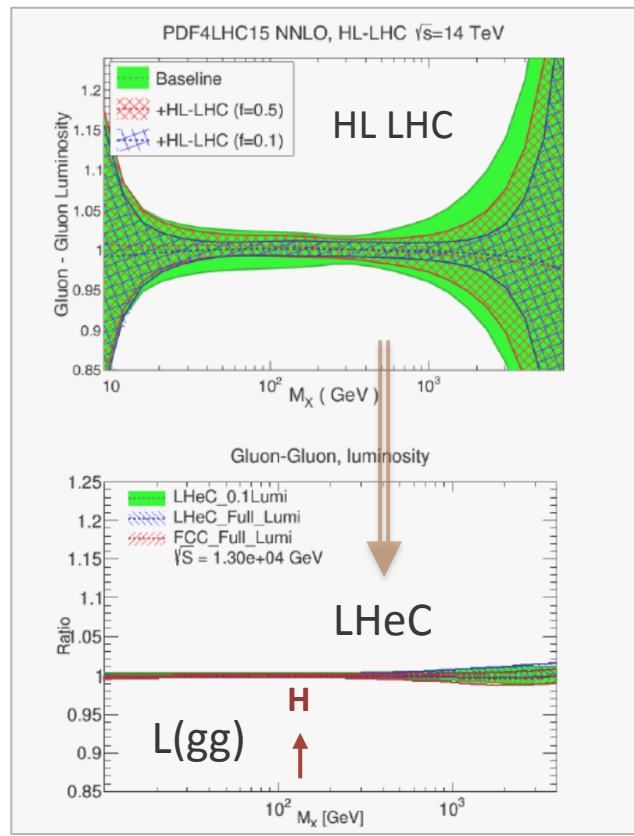
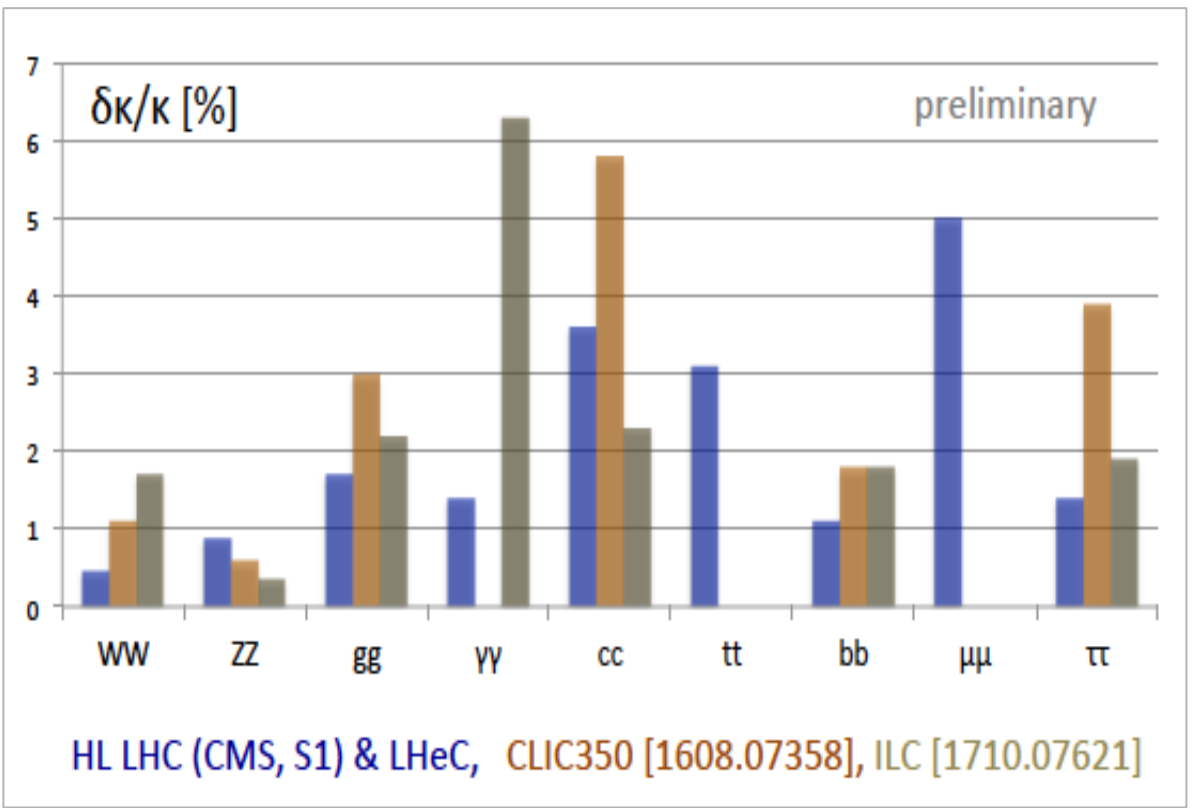
Particle Physics at O(1) TeV ~2010-2050

Four Decades

The goal of current developments is to maximally exploit the LHC and to complement it with ep (LHeC) and ee (ILC, CepC..??) colliders to explore the TeV scale and find new directions of HEP as theory is less prescriptive



backup



Physics

1802.04317

α_s to 0.1%
 V_{tb} to 1%...
 $\sin^2\theta_W$ better than LEP
 M_W [pp+ep]: 0.004%
 ...
 HIGH precision leads to Discovery BSM

