European roadmap & high lumi (high energy nuclear physics)

Ionut Arsene (Oslo), Konrad Tywoniuk (Bergen)

ECFA roadmap (physics and detector) calendar

[ECFA detector and R&D roadmap]

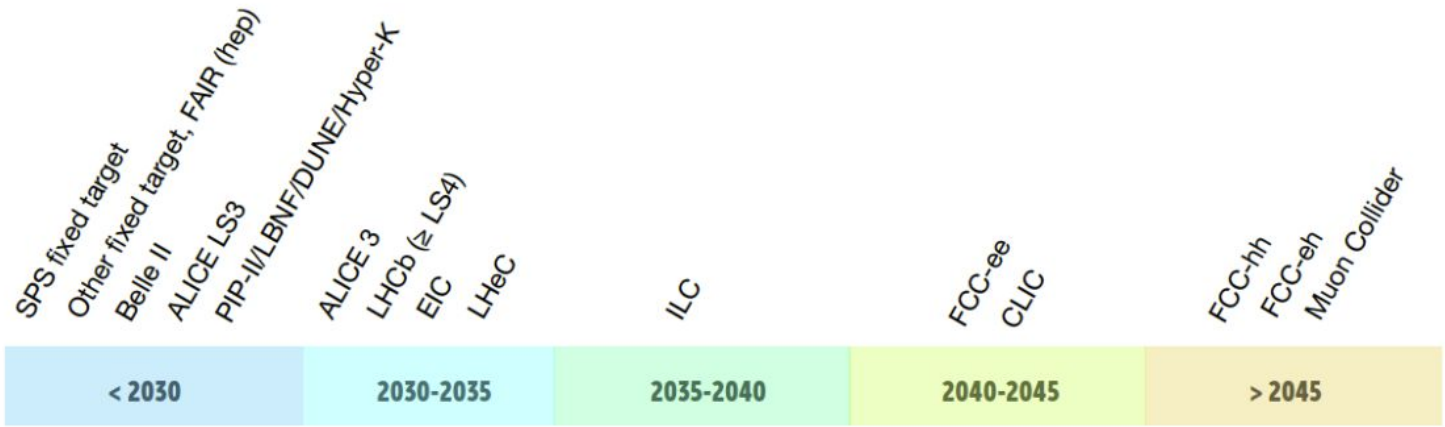
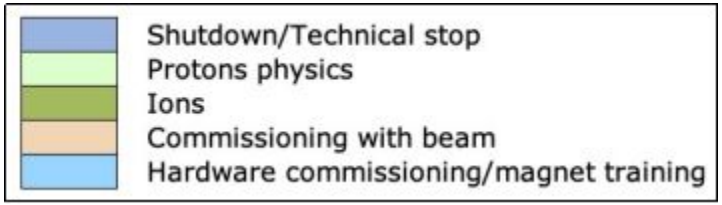


Figure 3: Large Accelerator Based Facility/Experiment Earliest Feasible Start Dates.

The 2020's



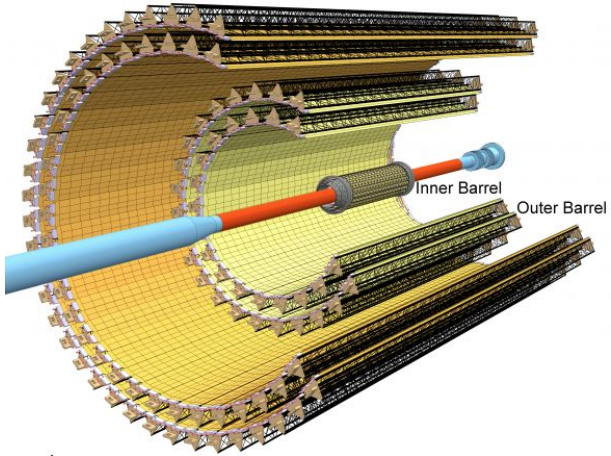
Tentative Run-3 heavy-ions schedule:

- PbPb in 2022, 23 and 25
- p-Pb in 2024
- O-O in 2024 ?

Involvement in activities for the preparations of Run3 and Run4 is fixed:

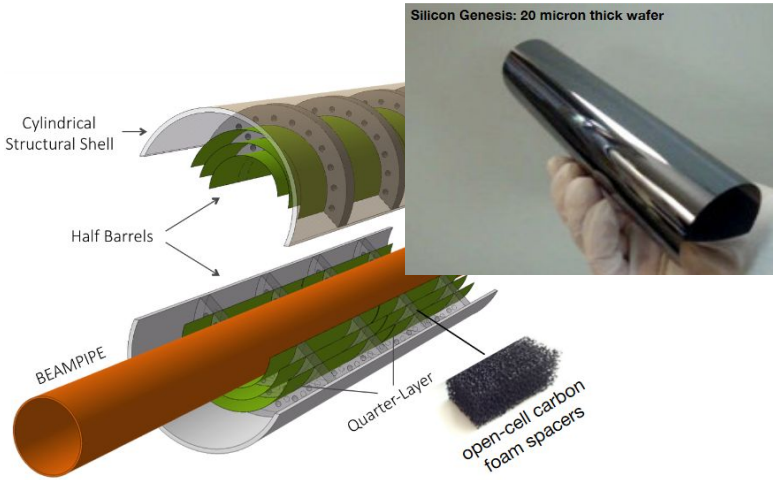
- Major ALICE LS2 detector and software upgrade
- ALICE LS3 upgrade

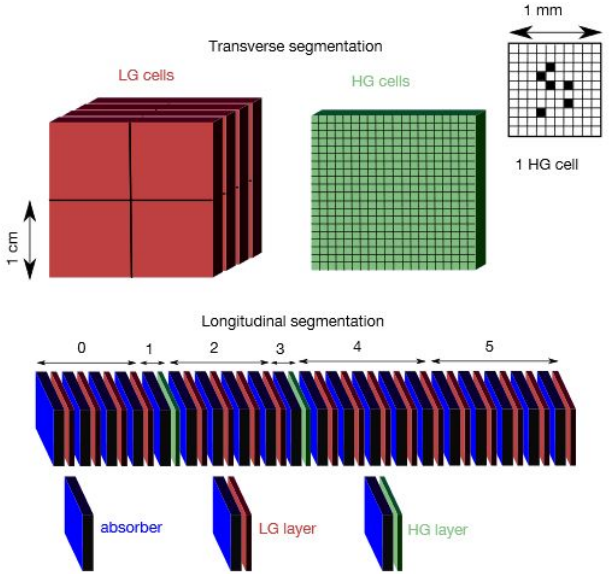
LHC Run3



- Involvement in both hardware, software and computing developments
  - ITS2 and TPC upgrades
  - Online & Offline (O^2) software upgrade: core developments, analysis framework
  - Grid developments

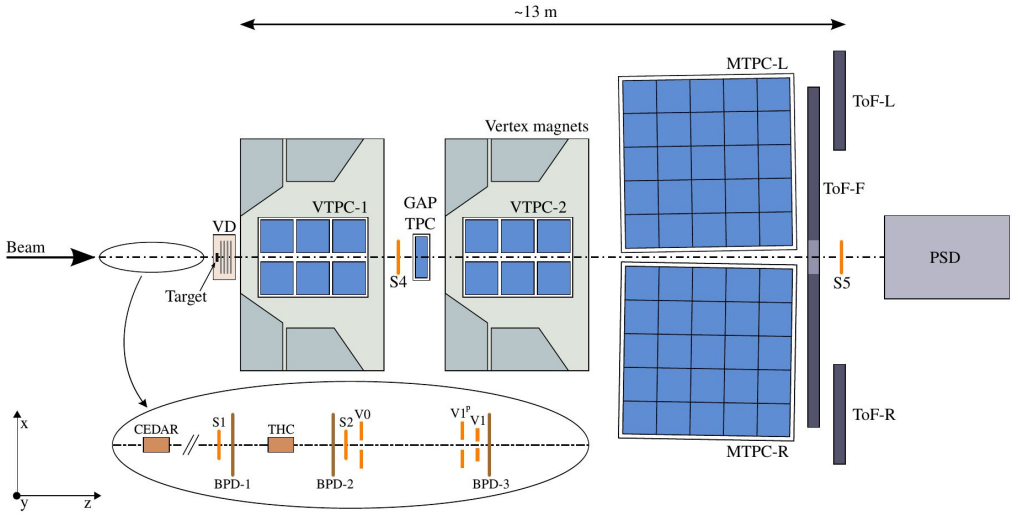
LHC Run4





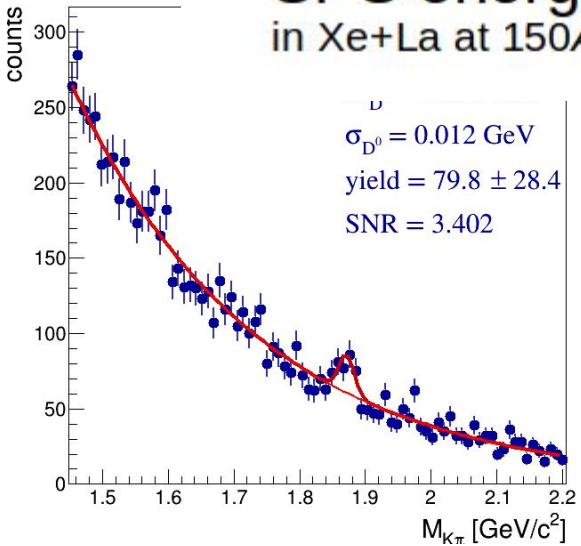
- Second upgrade of the Inner Tracking System: wafer size bent ALPIDE chips
  - High spatial resolution, low material
  - Boost for heavy flavor and jet physics
- FOCAL: forward calorimeter
  - High granularity calorimeter
  - Gluon saturation at small-x, photo-production in ultra-peripheral collisions

NA61/SHINE



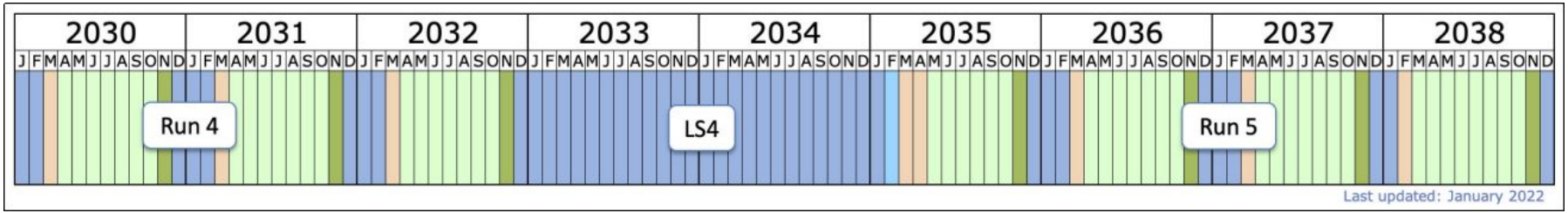
First open charm observation at SPS energies!

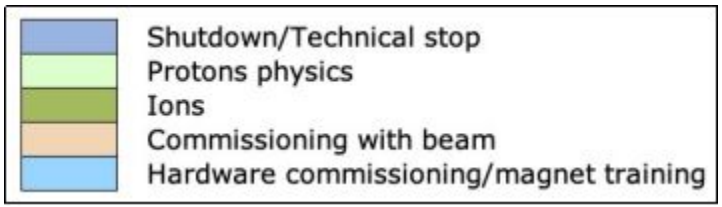
in Xe+La at 150*A* GeV/*c*



- Vertex detector upgrade: MIMOSA sensors -> ALPIDE sensors
- TPC readout electronics
- Faster trigger rate -> first open charm observation in heavy-ion collisions at the SPS energies!
- Norwegian-Polish project funded via the NFR - GRIEG call

The 2030's

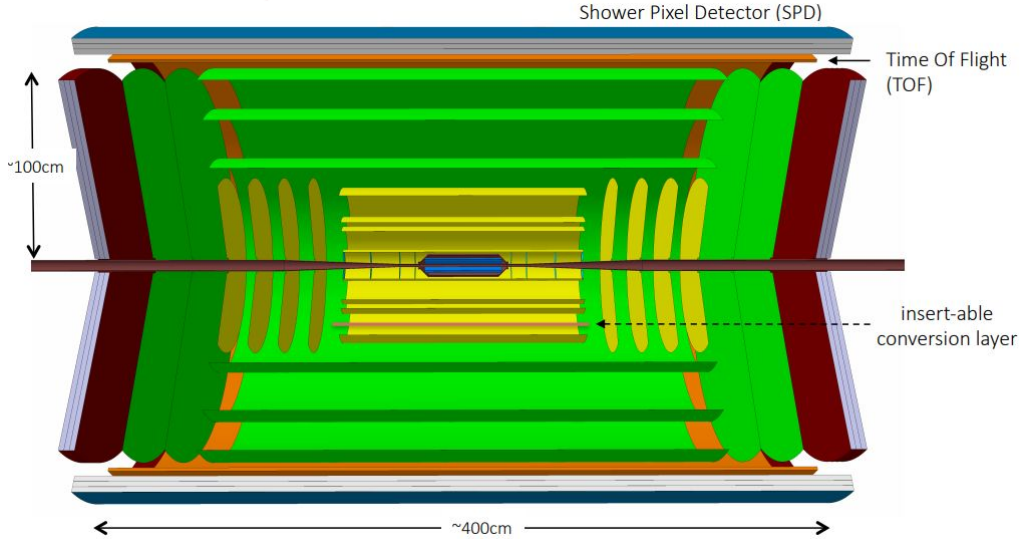


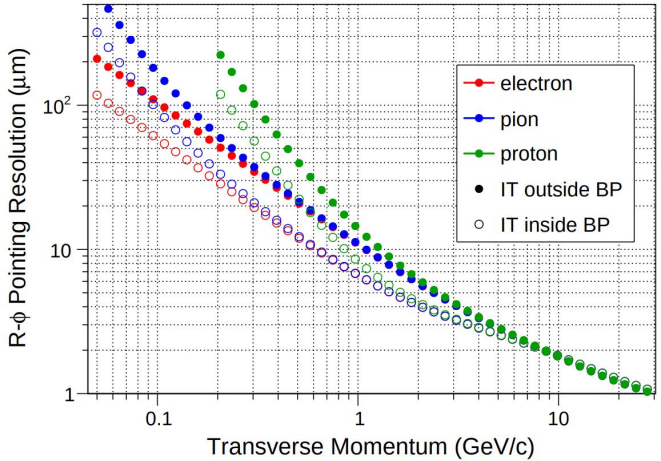


A few possibilities, at the LHC and the EIC

ALICE3 (Run5)

Adamova et al., arXiv:1902.01211





- Compact barrel detector based on curved thin sensors with MAPS technology
- Low material budget (~0.05% X_0 per layer)
- Boost in integrated luminosity by factor 50-100x wrt Run3&4
- High precision vertexing

Key physics points

- Heavy flavor and jets
- Low mass dileptons
- Rare quarkonia and exotic states
- Multiple heavy flavor baryons
- New physics (dark photons, long lived particles,etc)

EIC (BNL)

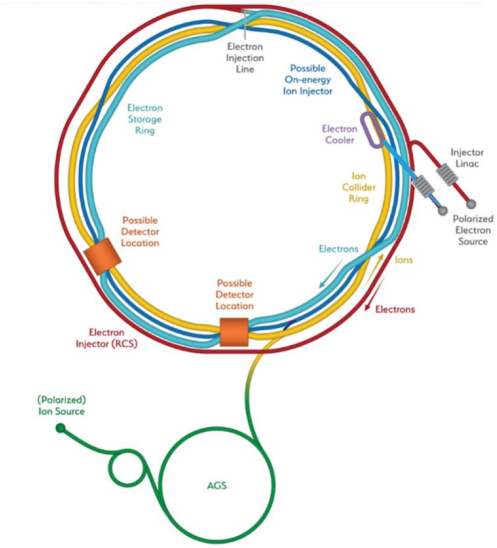
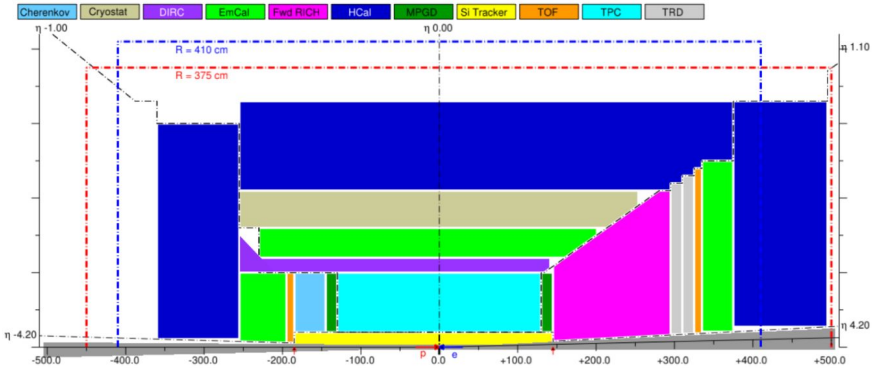


Figure 1.1: Schematic layout of the planned EIC accelerator based on the existing RHIC complex at Brookhaven National Laboratory.

EIC detector concept

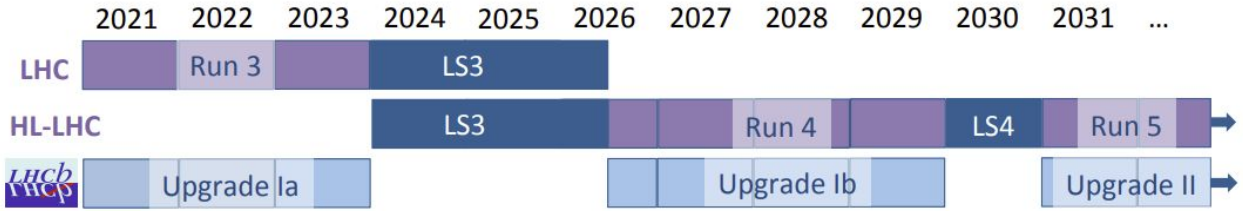


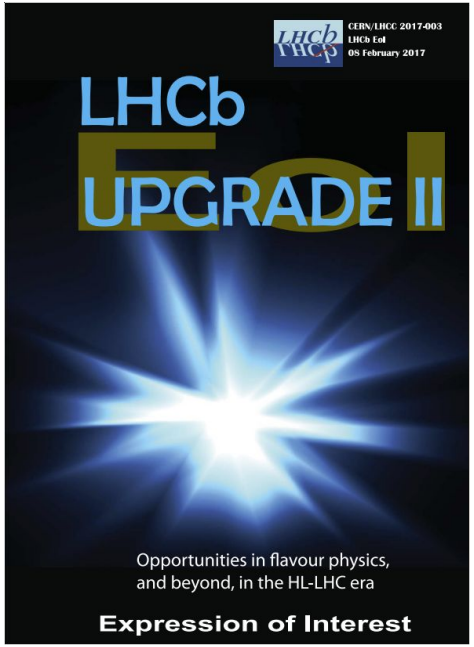
- Highest priority facility established in the 2015 US Nuclear Physics Long Range Plan
- Polarized electron and nucleon beams
- Ion beams from deuterium to heavy nuclei
- CMS energy in the range 20-140 GeV

Main physics objectives:
How do the nucleon mass and spin emerge from partons and their underlying interactions?
Parton distributions inside the nucleon, in both momentum and position space
Gluon saturation inside nuclei and nucleons

Project application to this year's NFR call for contributing to the design of a far-forward detector

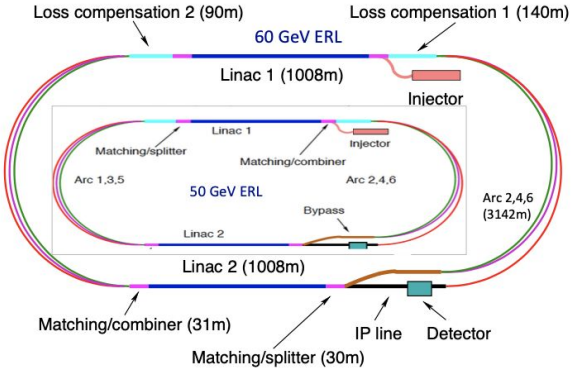
LHCb upgrade II (LS4)

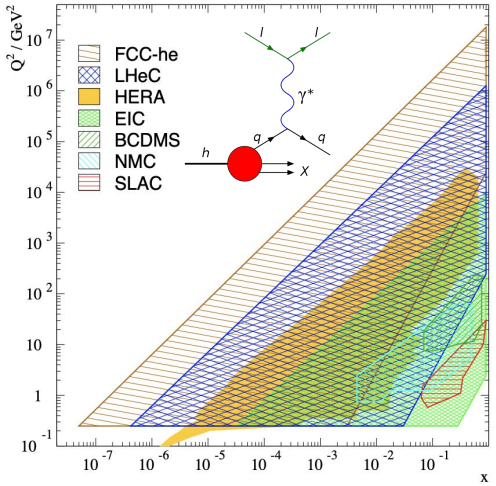




- Upgrade of the VELO with pixels with high spatial and timing resolution
- Upgrade of the tracking system using silicon pixels and strips
- Access the full centrality range of Pb-Pb collisions
- High precision detector for heavy-ion physics
  - Special emphasis: low-x physics, gluon saturation
- Complementary to the ALICE3 project

LHeC (2032-)





Key design & physics points:

- 50 GeV electron beam to scatter off LHC hadron accelerator with both ep and ePb options
- dedicated LHeC detector
- HERA kinematic range extended by a factor of >15
  - much better coverage at both small-x and large-Q2 and high-x
- achieves 100 fold higher luminosity
- **high-resolution microscope** for exploring dynamics inside nuclear matter
  - 3D structure of proton
  - small-x: high parton density regime
  - high-Q2: tests of EW SM sector, top
  - origin of “cold nuclear matter” effects
  - study Higgs, exotics