Synergies between astroparticle, particle and nuclear physics

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Inputs and discussion:

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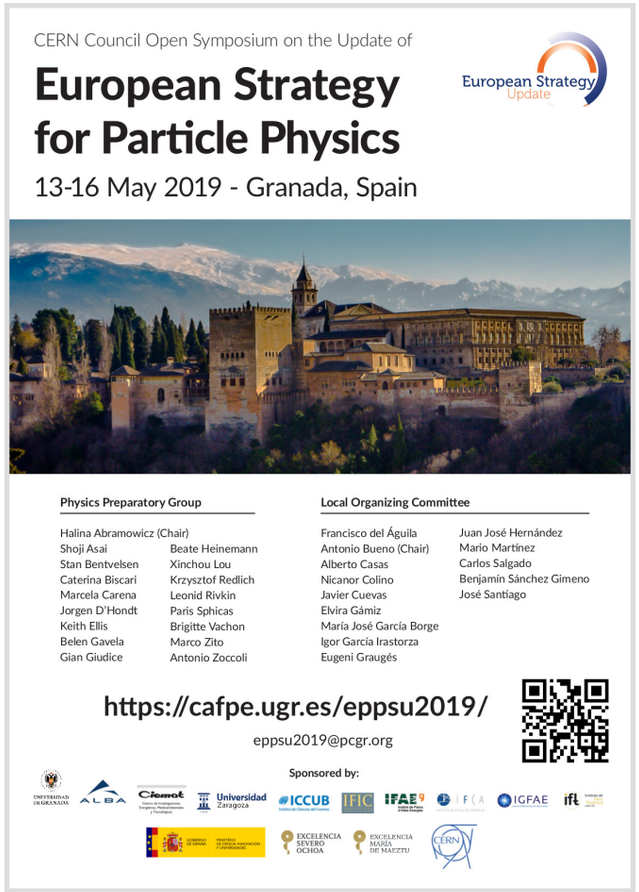
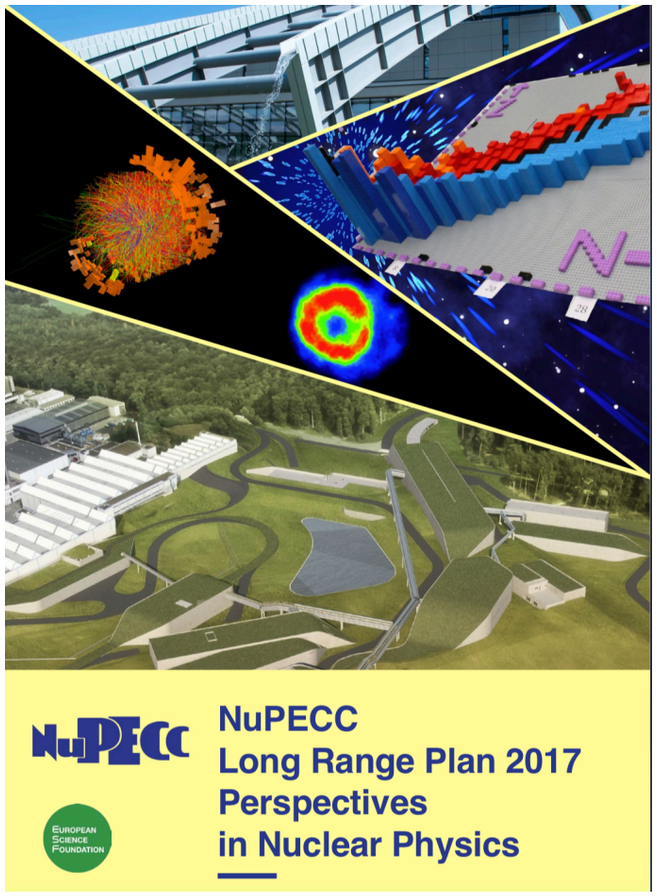
Visions: APPEC, ECFA, NuPECC

Astroparticle (APPEC)

Particle (ECFA)



Nuclear physics (NuPECC)



Astroparticle, particle and nuclear physics in Europe have **strategies and plans** that **recognize the importance of synergies** between the different fields

European Research Council
Established by the European Commission

ATLAS EXPERIMENT

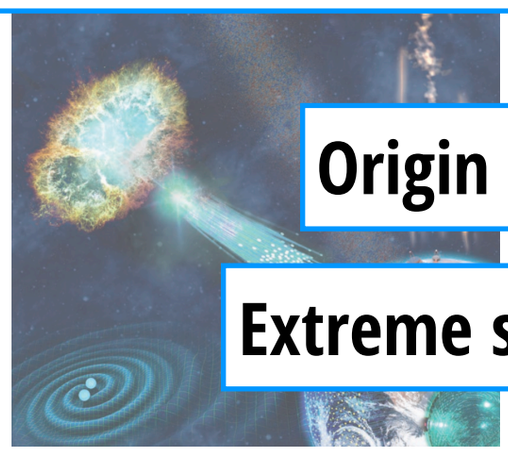
Visions: APPEC, ECFA, NuPECC

Some of the **common scientific goals** in the strategy documents:

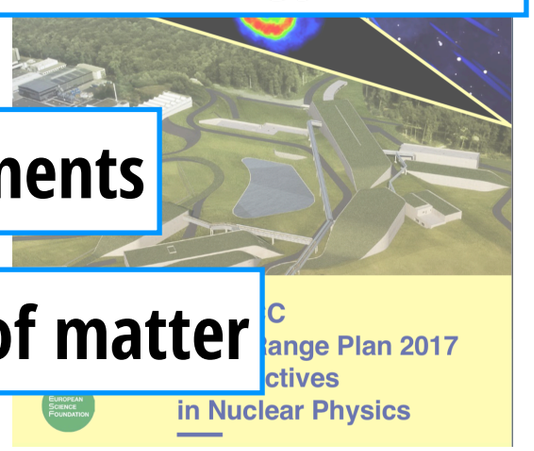
Nature of dark matter and dark energy

Fundamental forces & symmetries

Properties of neutrinos at all energy scales



Origin of elements

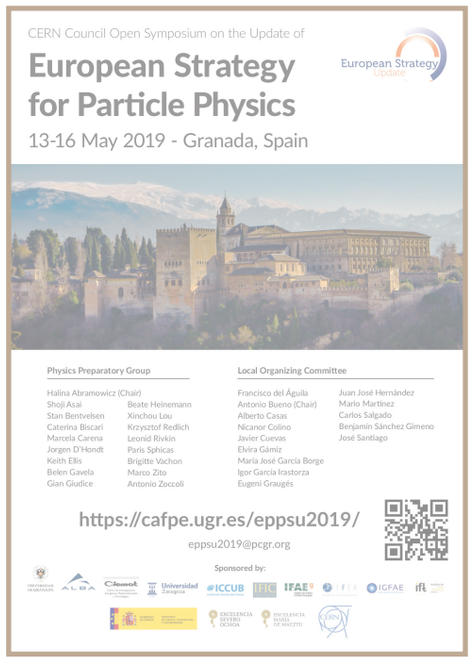


Extreme states of matter

More synergies: ”foundations” for common challenges

Astroparticle

Particle



Nuclear

Common theory ground

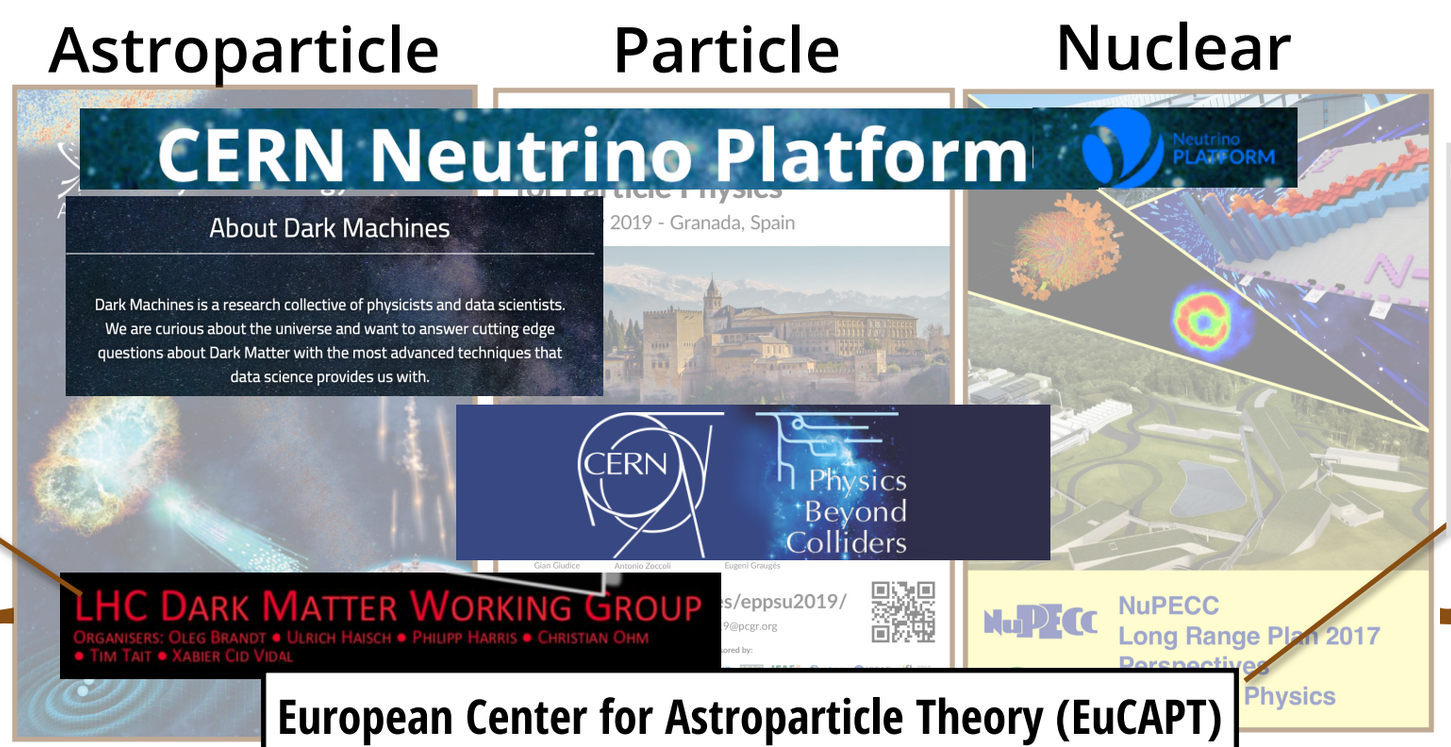
instrumentation
(accelerators, beams, detectors, vacuum & cryogenics, control & automation…)

data acquisition, computing, data sharing & open science

A constellation of activities and initiatives

APPEC news,
after Granada '19:
wish to enhance collaboration
and discussion between
LHC DMWG and DD/ID

Direct Detection
collaborations
input to EPPSU:
strenghten
common
efforts



APPEC input to EPPSU:
taking off in 2019 with CERN
as first 5-year host

European Center for Astroparticle Theory (EuCAPT)

Common theory ground

instrumentation
(accelerators, beams, detectors, vacuum & cryogenics, control & automation…)

data acquisition, computing, data sharing & open science

HSF
HEP Software Foundation

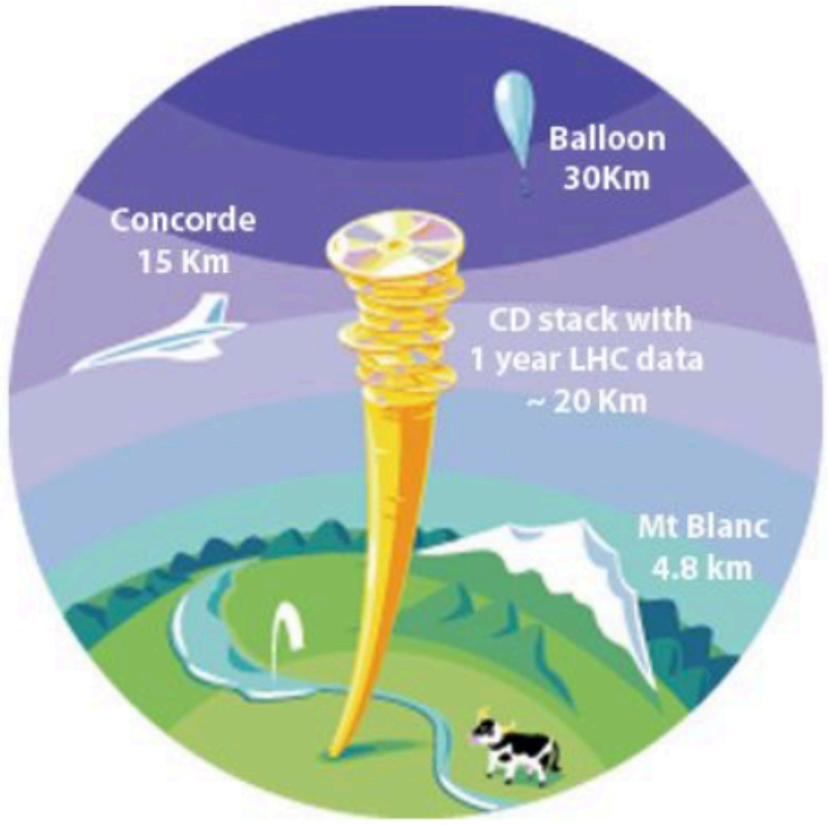
European Research Council
Established by the European Commission

ATLAS EXPERIMENT

Enabling discoveries in particle physics

- **Many different theories** can explain **particle physics** shortcomings
  - None of these theories is yet favored by data
  - Very different signatures in the detector

A key challenge: within millions p-p collisions/second, select/analyze the interesting ones **in real time**

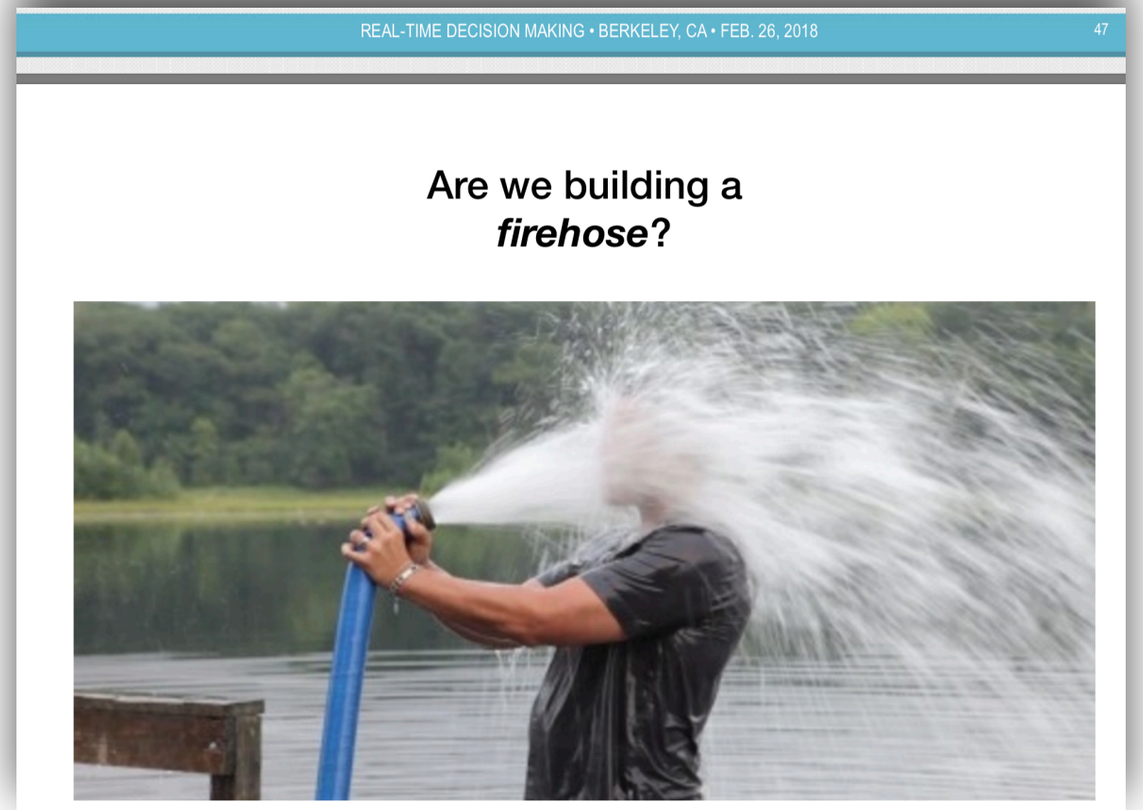


LHC data volumes after selection of ”interesting” data

Extremely large datasets, in different contexts

C. Fitzpatrick, **LHCb**

E. Bellm, **Large Synoptic Survey Telescope**



The LHC and modern astrophysics surveys are **data firehoses**

Can benefit from **common techniques and tools for data taking & data reduction**
(e.g. on-detector / **real-time data analysis**, machine learning)
with applications beyond physics research

Conclusions and outlook

- Answering fundamental physics questions requires **concerted work** from **particle, astroparticle and nuclear physics**
  - Examples: dark matter, neutrino physics…
  - Common challenges in terms of foundations (detector, computing…)
- A number of **synergistic initiatives** exist, many **hosted by CERN**
  - What is the best way forward? Discussion started at Granada meeting
- More discussion at the **APPEC-ECFA-NuPECC meeting** in Orsay this October

- As input to that, come and put a **post**-it on my **post**er!

Thank you for your attention!