A Case for EIC

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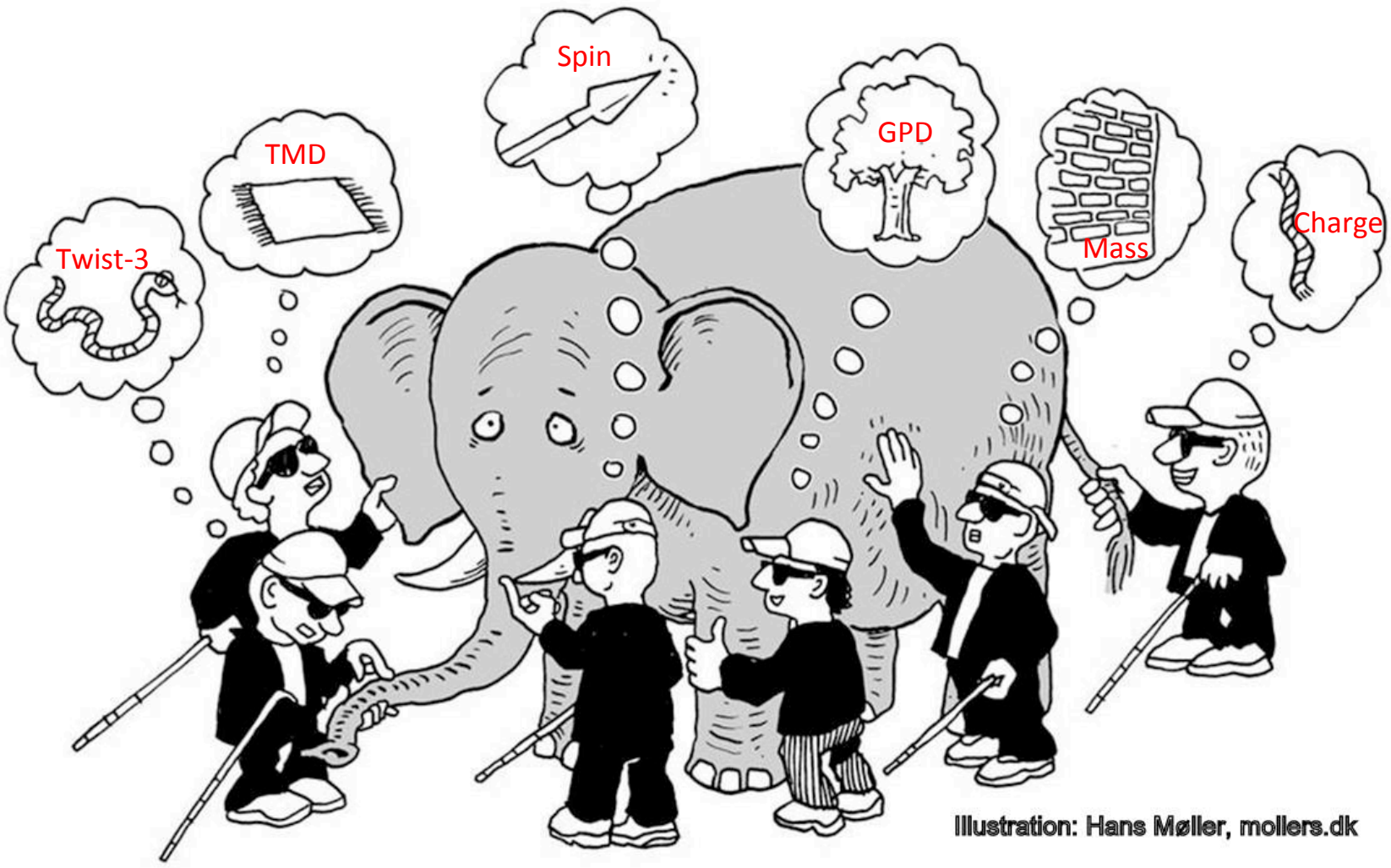


The Big Picture

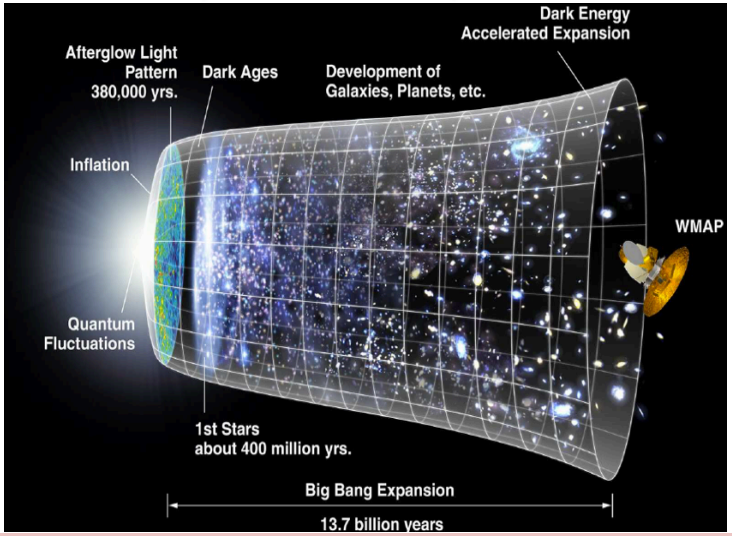
Why Should We Continue to Support High Energy Nuclear Physics?

- Understanding the visible Universe, physics of "How and Why"
  - Origin and Evolution
  - Nucleons dominate
  - How nucleons formed from quarks and gluons?

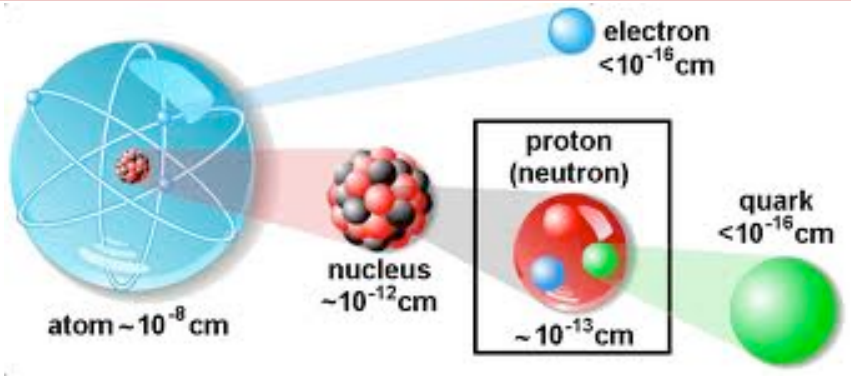
- @Largest scale: Gravity + X…
  - Structures of the (in)visible Universe
  - Black holes, Stars, Microwave Background …
  - Dark Matter, Dark Energy

- @Smallest scale: QCD and Electroweak + X…
  - Structures of the nucleons and nucleus
  - Strongly interacting quarks and gluons
  - No free quarks and gluons, color confinement
  - Novel phenomena

- Many outstanding questions remain on "How and Why" on nucleon structures
  - Strongly interacting quark and gluon system
  - Novel distributions and dynamics of quarks and gluons



Multiple probes, for e.g.
- Distribution of CMB polarization in the Universe
- Distribution of Gluon polarization inside the Nucleon



Our View on the New Future Facility

EIC – A Precision Machine for Discoveries

- A new facility is desired to advance our understanding of nucleon, a strongly interacting system
  - Explore the key uncharted regions that sensitive to gluons
  - Precision study to test predictions and improve our knowledge

- Driven by recent discoveries and theoretical breakthroughs in QCD at the two major US NP facilities, RHIC and JLab, as well as other facilities from worldwide,
  - Large Spin/TMD effects in polarized SIDIS and p+p reactions – Sivers and Collins asymmetries
  - Quark and gluon interactions/correlations inside the nucleon and nucleus – shadowing, saturations
  - Quark, gluon and QGP, novel properties – prefect liquid QGP

- Complementary to the current RHIC and JLab (and other worldwide) programs
  - A broad physics program with e+p and e+A driven by the desire for the next breakthroughs
    - Novel QCD process-dependent parton distribution functions in p+p at RHIC vs e+p in EIC
    - EIC on sea-quark and gluon polarizations vs Jlab-12's focus on valence quark polarization

- How do we go from here to there?
  - Bottom-Up approach
  - Get other NP and Public Support and Make it a National Priority

Scientific Impacts of EIC

- The Frist Polarized High Energy e+p Collider
  - High center of mass energy (an order of magnitude higher than polarized fixed-target experiments)
  - High luminosity, >1000x of previous unpolarized e+p collider
- Open up a new domain for precision measurements of emerging novel strong interaction phenomena at the fundamental level of quarks and gluons
  - Spin, Charge, TMD, GPD as tools
- Controlled access to selected physics processes
  - Spin, quark flavor
  - Large kinematics coverage
  - Controlled size of probe
  - Universality of QCD descriptions

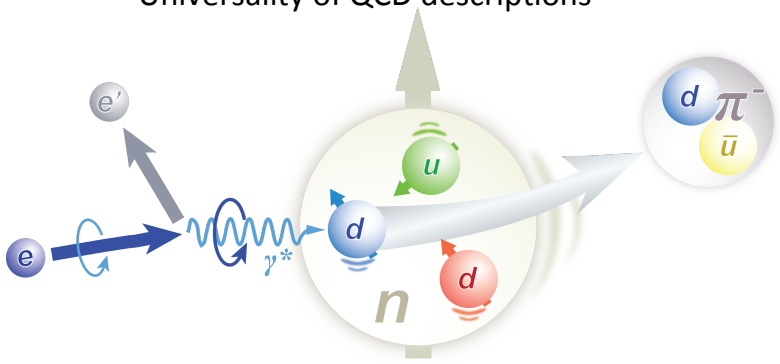


Illustration of E06-010 Double Spin Asymmetry
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- The First (Polarized) e+A Collider
  - High energy to access the quark and gluon degree of freedom inside the nucleus
  - How quark and gluon distributions differs between nucleon and nucleus?
    - Shadowing, saturation
    - EMC, correlation
  - Quark-gluon correlation inside the nucleus, color transparency
  - How quarks and gluons interact with color field and neutralize into physics particles?