(part of) WP-2 : Atomic, Nuclear and Molecular Systems in Traps & Beams

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WP-2 : Atomic, Nuclear and Molecular Systems in Traps & Beams

Current structure:

- 2a : **Exotic systems in traps and beams**
- 2b : Atom Interferometry
- 2c : Clocks: development, distribution, networking (Steven Worm)

Does this structure make sense?

WP-2a: Exotic systems in traps and beams

- 2a_a: Extension and improved manipulation of exotic systems (experiment)
- 2a_b: Bound state calculations (theory)
- 2a_c: Extraction of constants in presence of New physics (phenomenology)

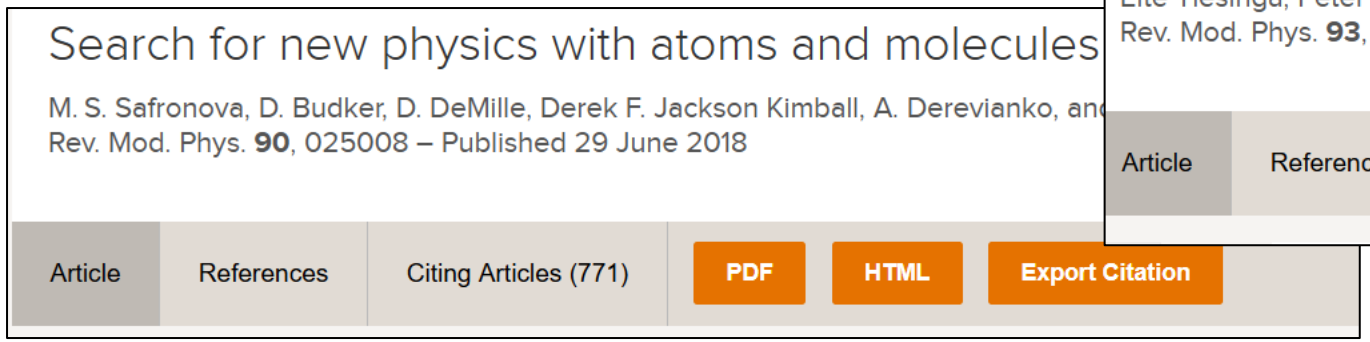
Fundamental physics at the precision frontier

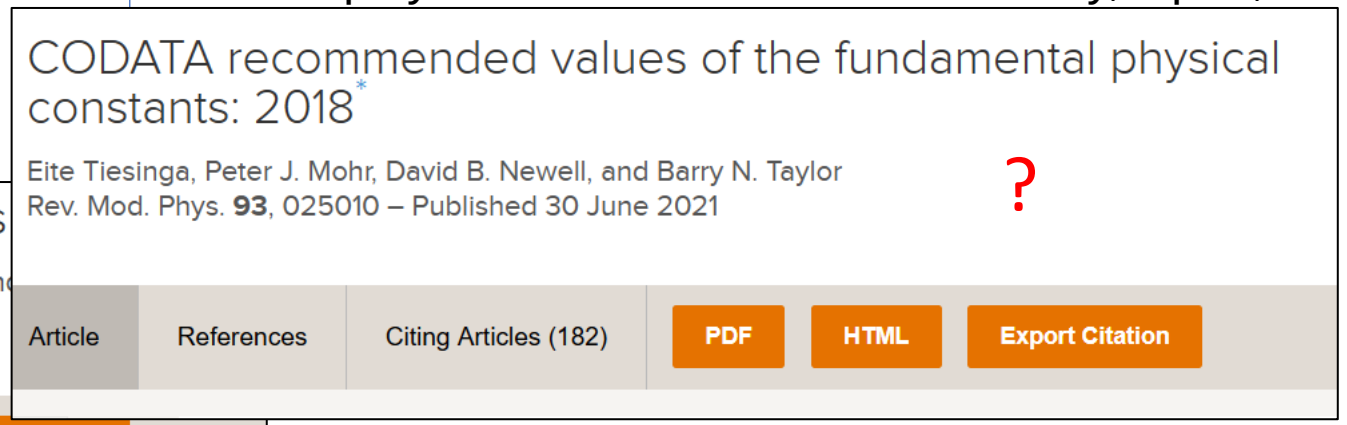
Sensitivity:

- Choose the “best behaved” systems (cold, controllable, narrow transitions)
- Choose “unique” system, e.g. antimatter
- Measure “Zero” with the highest sensitivity
- Look for differences/variations e.g. in time, space, and etc.

Accuracy:

- Compare experiment and theory *digit by digit*
- Single particles, simple atoms and molecules
- Usually best suited for searching for new interactions mediated by heavy particles.
- Interplay with fundamental constants: Ry, alpha,





WP-2 : Atomic, Nuclear and Molecular Systems in Traps & Beams

Physics drivers

WP-2a :
Exotic systems
in traps and beams

BSM physics @ Precision frontier: Sensitivity & accuracy

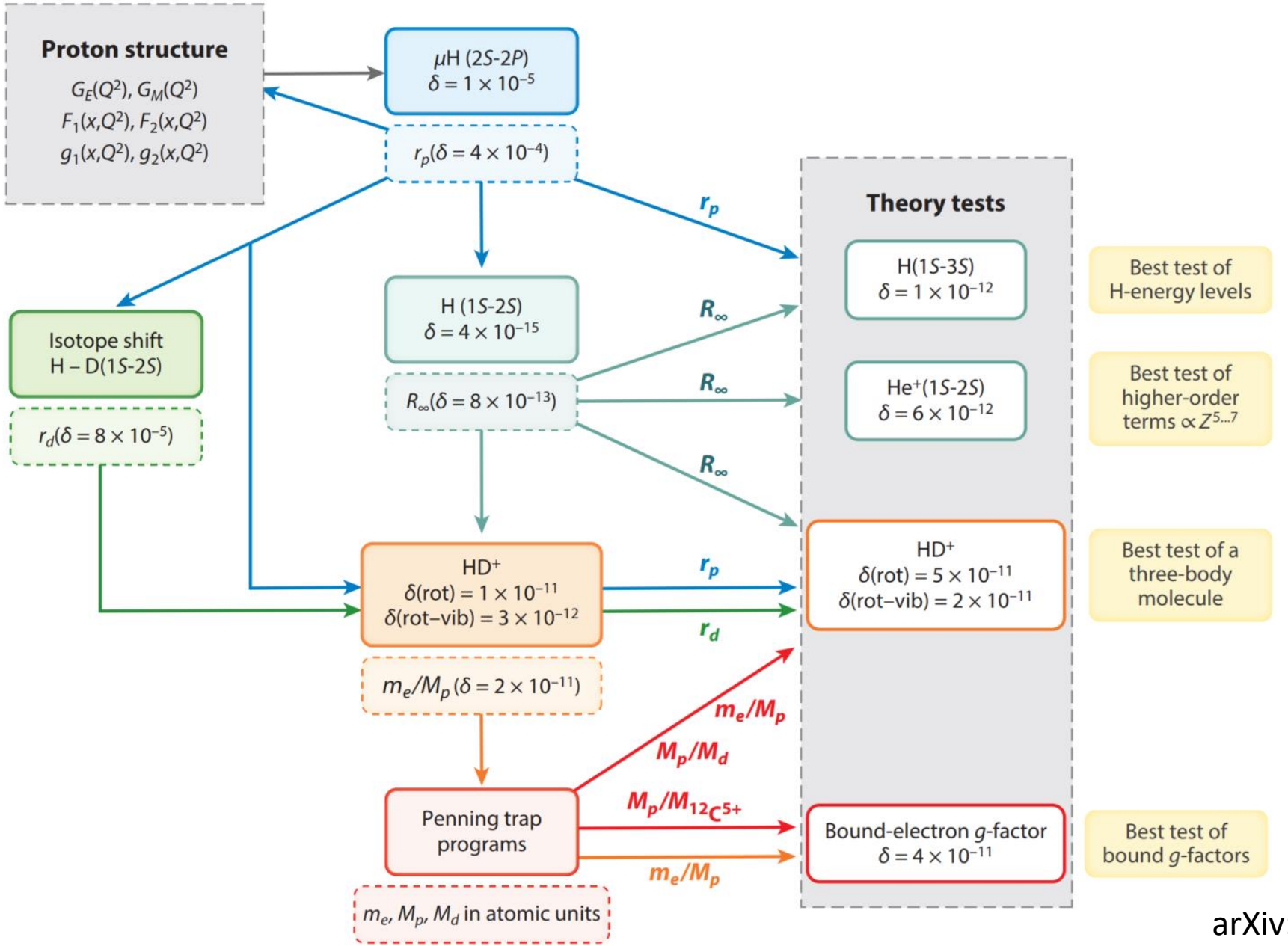
SM: QED development

SM: Determination of fundamental constants

AMO as quantum detectors: gravitational wave detection, …

- Missing physics drivers?

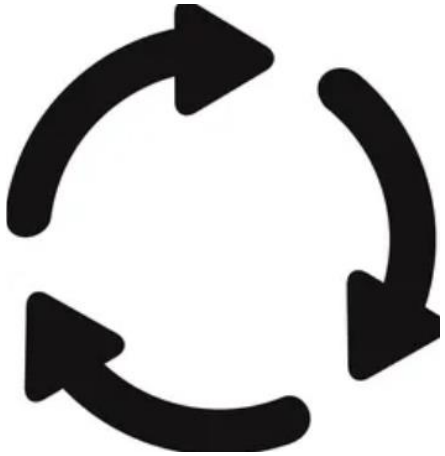
Canonical example of accuracy frontier



arXiv:2210.16929

Theory: Bound-state calculations.
Perturbative and all order QED calculations, as well as low energy nuclear structure

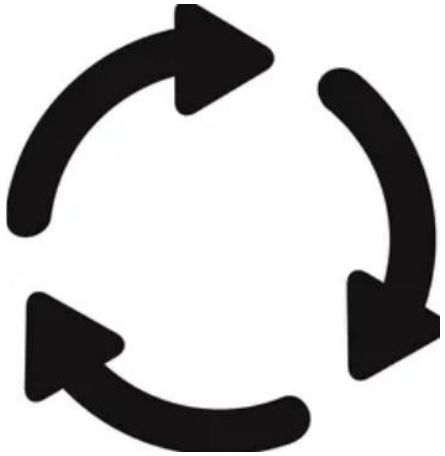
Experiments: Precision measurements in simple atomic systems – we emphasized a global effort on exotic bound systems



Phenomenology: Global analysis of fundamental constants In presence of new physics

- Vision: consolidate through open, dynamic web platform

Theory: Bound-state calculations.
Perturbative and all order QED calculations, as well as low energy nuclear structure



Experiments: Precision measurements in simple atomic systems – we emphasized a global effort on exotic bound systems

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Self-Consistent Extraction of Spectroscopic Bounds on Light New Physics

Cédric Delaunay,[1,2,*] Jean-Philippe Karr,[3,4,†] Teppei Kitahara,[5,6,7,‡] Jeroen C. J. Koelemeij,[8,§] Yotam Soreq,[9,‖] and Jure Zupan[10,¶]

- Vision: consolidate through open, dynamic web platform

WP-2a_a: Extension and improved manipulation of exotic systems:

- Exploration of novel production mechanisms (e.g. using antiprotons)
- Novel species (e.g. polyatomic, laser-coolable molecular systems)
- Extension of techniques (e.g. laser cooling negatively charged systems)
- Exotic nuclei (e.g. for radioactive molecules) – “beam to beaker to beam”

- …