International Particle
Physics Outreach Group

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WG on Explaining Particle Physics to the Public

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Explain open questions of particle physics to the public

- **Explain** the outstanding physics issues to the general public, lay persons and decision makers
- **Cosmic connection**:
  Macrocosm: Dark energy, Dark matter
  Microcosm: Scalar fields, BSM, neutrinos, …
- **No** clear Nobel **predictions** from Standard Model! But:
- What is the role of **scalar fields** in the Universe?
- **Precisely** investigate the SM with focus on the Higgs.
- new **colliders**: e^+e^-, circular + linear, Higgs factories

realistic effort: priorities

https://docs.google.com/document/d/1XG_QaKNUJKnL9qOYbPixrgoNMsw40jygu5cjHJCPURQ/edit

- do not reinvent the wheel: link to
  - CERN backgrounders
  - IPPOG newsletters, Symmetry articles, ...
- Focus on uncovered topics:
  - scalar era
  - precision in PP
  - ...
- IPPPOG student:
  put links +
  new docs
  to web

IPPOG WG Explaining PP to the Lay Audience: topics + structure

Materials:

- CERN backgrounders
- ATLAS Glossary
- ATLAS Physics Briefings and ATLAS Features
- IPPOG reports and newsletters - resume here

TOPIC	Subtopics	Existing input / source	Person(s)
HIGGS	The SCALAR ERA: Scalar vs vector fields	https://docs.google.com/document/d/1ENtqBly1k_dZQW7Ed_f7g-V7F1lk6OpWTJuSSevjzlw/edit?usp=sharing	Thomas
PRECISION	**Analogies**: Neptune + Uranus prediction, flat vs curved Earth. PP: flavor (CKM), couplings, neutrino (mass), FCC, …	Newsletter 2, page 4	Thomas
Cosmology and PP	DARK ENERGY + MATTER	CERN backgrounders Dark energy and matter: https://home.cern/science/physics/dark-matter + https://www.symmetrymagazine.org/collection/dark-matter-101	

The Scalar Era

Physics for 500 years deals with forces. Forces or interactions like Newton's gravity or electromagnetism are represented by **vector fields** pointing from one point to another. Vectors are described by three coordinates at each space point.

Scalar fields are much simpler. They represent just one number per space point. As can be seen from the figures, weather forecasts, for example, contain the scalar fields of temperature, humidity, and pressure. They are not fundamental, however, since they emerge from averaging over the microscopic properties of the air molecules. Wind maps contain vectors and are not fundamental either.

For the first time in the history of physics we go from studying fundamental vector fields of forces to fundamental **scalar** fields which do not mediate forces. They are **omnipresent background fields** which fill up the vacuum in the Universe. Such fundamental **scalar** fields are:

the **Higgs** field, **Dark Energy**, and the field of **inflation.**