# Exclusive reactions as a nuclear manometer

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## Context

As unexpected as it may seem, recent years revealed that it is possible to ascribe a well-defined meaning to the notion of proton internal pressure, to identify several associated observables that can be measured in contemporary experiments and from them to extract this internal pressure in a theoretically controlled manner. The conceptual breakthrough originates from the definition of several objects describing the three-dimensional structure of quantum relativistic bound states. In particular generalized parton distributions provide a direct connection between (matrix elements of) the energy-momentum tensor and exclusive processes measurements accessible at facilities colliding leptons and hadrons.

The first extractions of pressure distributions from exclusives processes demonstrated the actual feasibility of this whole endeavor. Although insufficiently accurate, they already highlight where experimental efforts would be most desirable and delineate what can realistically be learnt from actual data.

## Organization

The lectures will tentatively be organized as follows :

1. **Energy-momentum tensor** in quantum field theory and in relativistic hydrodynamics.
2. Definition of **generalized parton distributions** and their connection to the energy-momentum tensor in Quantum Chromodynamics.
3. Experimental access to generalized parton distributions from the **factorization of exclusive processes** into large-distance (universal) and short-distance (process-dependent) contributions.
4. Principles of **extraction** of pressure distributions from experimental data.

## References

The field lacks of texts aimed at a non-specialized audience, a gap which this series of lectures aims at filling. However the following list of texts (not exhaustive) provide some useful references.

— M. Polyakov, Phys. Lett. B **555** (2003), 57 [arXiv :hep-ph/0210165 [hep-ph]].
— M. Diehl, Phys. Rept. **388** (2003), 41 [arXiv :hep-ph/0307382 [hep-ph]].
— M. Polyakov and P. Schweitzer, Int. J. Mod. Phys. A **33** (2018) 1830025 [arXiv :1805.06596 [hep-ph]].
— H. Dutrieux *et al.*, Eur. Phys. J. C **81** (2021) 300 [arXiv :2101.03855 [hep-ph]].