

# Discussing Prof. Miller's intervention

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There is every reason to cheer the presence of Profs. Dougherty and Miller here! Because QFT is almost as old as quantum mechanics itself: one can argue that papers by Jordan, Wigner, Dirac that in the present twenties will be one hundred years old, belong in QFT.

But, whereas quantum mechanics has been a favourite subject for philosophers for many years, **only now they (and we) start to come to terms with the strangeness of QFT.**

## Don't put it in by hand

Because QFT, as mentioned in my own talk, is **much weirder** than ordinary quantum mechanics. Prof. Miller is 100% right in understanding the establishment of the Epstein—Glaser (EG) view of renormalization theory as a **philosophical** (as much as mathematical and physical) enterprise.

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Von Stückelberg, with the help de Rivier et Peterman, put the foundations of EG theory in the early fifties.

Bogoliubov read French and even before his article in *Acta Mathematica* with Parasiuk, on interpreting the divergences of QFT as unresolved products of generalized functions, he had absorbed the ideas of von Stückelberg.

Bogoliubov's great contribution (cf. his famous book with Shirkov, 1957) is the **functional scattering matrix**.

# Prerequisites for an argument

The paradigm-changer paper by Epstein and Glaser appears in the [Annales HP of 1973](#). It seems to have sprouted like Minerva herself from the head of Jupiter. But this was not the case!

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It was preceded by many discussions and drafts, starting at the ICTP of Trieste (1969), the [R.C.P. of Strasbourg](#) (1970-72), work at CERN on the necessary adiabatic limit in Bogoliubov's matrix... Only after such long preparations a truly mature paper can be born.

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Neither Glaser, busy at CERN (where he chain-smoked to his death ten years later) nor Epstein (still with us) came back to the subject. The torch was picked up almost at once by **Raymond Stora** (with e.g. his "geometrical lemma"), main authority in Epstein—Glaser theory till his lamented disappearance (2015).



## Clearing up possible misunderstandings

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This is not a “boutade”. It does reflect the present situation, with so many contending (but not contradictory) approaches: constructive field theory, stochastic quantization, algebraic field theory based on von Neumann algebras, modular theory, resurgence theory methods, Hopf-algebraic methods, Mund-Schroer-Yngvason string-local fields...

## Still a work in progress...

In fact, in spite of the scope and strength of the EG-73 paper, much half-done business was left, besides the adiabatic limit for couplings with massless fields. For instance, the integral formulae given in EG73 are insufficient when zero-mass particles are emitted: a nasty little surprise to us in a paper we finished just last year about the **di-photon decay** of the higgs.

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To finish the story: the flame was kept first by Scharf's [Zurich School](#). Then by the [Hamburg School](#) – which in the person of Kasia lectured us brightly last week: an ambitious program for a background-independent, off-shell, functional Epstein-Glaser framework, with roots in classical field theory thru Moyal quantization.

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Michael Dütsch's trajectory handily represents **both schools**. As well, the flame was kept by R. Stora, I. Todorov, a powerful Moscow school around Tkachov...