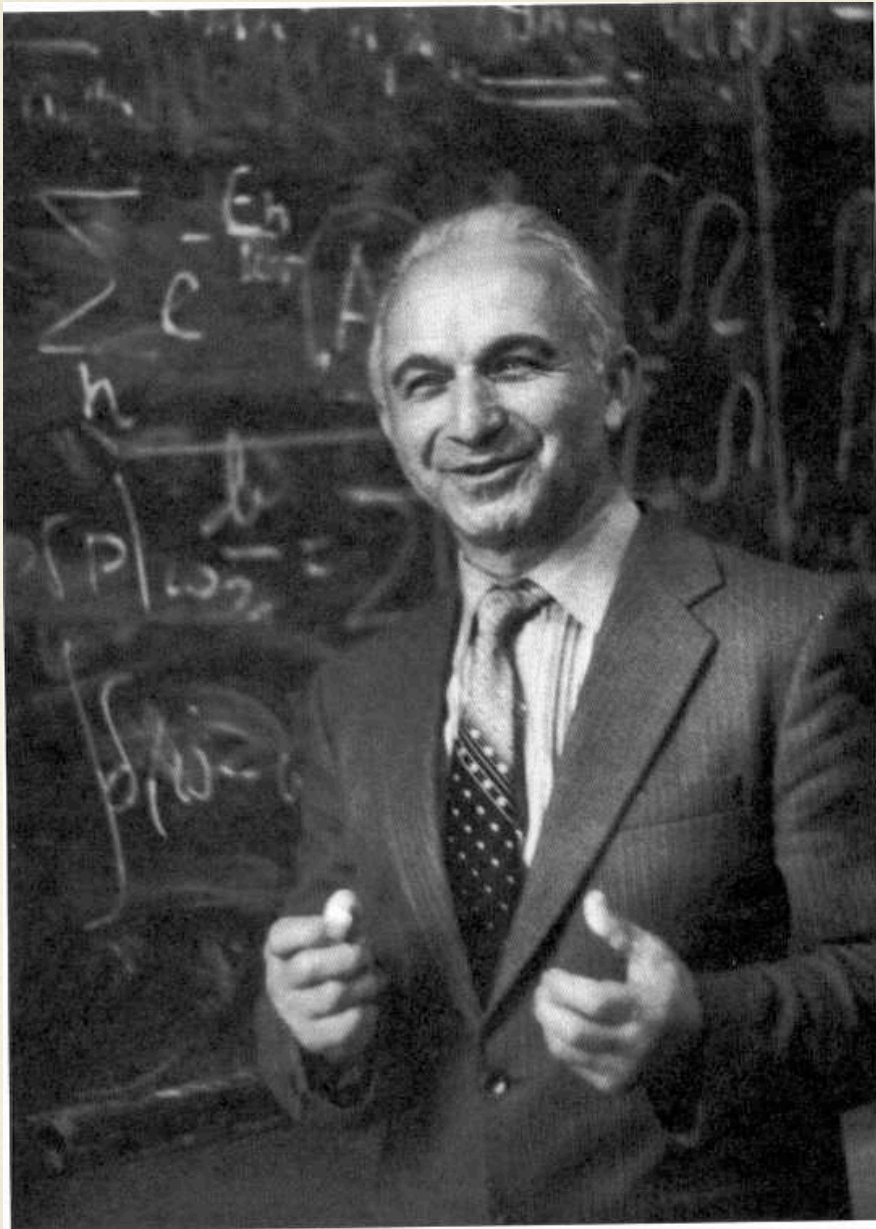


Efim Samoilovich Fradkin
A lieutenant in war and
a general in physics



Lars Brink
Moscow 2009



I first heard of him when people came back from a meeting in Alushta in mid-70's.

Fradkin had talked about **H**amiltonian dynamics.

Even though Dirac had pioneered it we knew little in the West. We grew up with Lagrangians and Feynman rules.

It was clear that Russians were ahead of us in formal treatments of gauge invariant systems.

Led among other things to **BRST**.

Next time I heard about Efim was in the late 70's when Peter van Nieuwenhuizen came back from a small meeting in Moscow about extended supergravity.

“He knows it all” (papers with Misha Vasiliev about auxiliary fields)

This was a young man's field, but as Gelfand said about Efim:

“He always seemed to be the youngest in the crowd”

In 1981 we had the first Landau-Nordita meeting.

Efim was one of the most active participants.

Meeting remembered because of Sasha Polyakov's papers. A few months later a paper from Efim about $N=2$. He was interested in strings from the beginning!

However, he had been interested in the quantum properties of supergravity as well as model building from the beginning.

(papers with Tseytlin on $N=4$)

In the beginning of the string revolution when the rest of us thought about covariant actions for the Superstring or compactifications Efim and Arkady published a paper about the effective action for the Superstring. (Also pioneered by Lovelace)

Conformal invariance leads to equations of motion for the supergravity fields.

Superstring crowd at the time: 25-year olds or 40-year olds and Efim in his early 60's.

In 1986 a series of papers with Misha about higher-spin gauge field theories.

Connected again to work of mine on such theories in the light-cone gauge.

Corner stone in his future thinking together with quantization of constrained systems (Fradkin, Batalin, Vilkovisky), conformal invariance and string theory.

He spent the rest of his life thinking deeply about these issues trying to synthesise these ideas.

But he had a long life in physics before I encountered him.

John Schwarz once asked him what he did in the trenches in Stalingrad between the fightings.

“I thought about higher-spin gauge field theories”

Indeed his first paper after the war was about spin-5/2 generalizing work on spin-3/2 by Ginzburg.

In the 50's he developed

- ✓ The functional path integral formulation
- ✓ Obtained the completely renormalized set of Schwinger-Dyson equations
- ✓ Invented the thermal diagram calculus for quantum statistics.
- ✓ The Ward-Takakhashi-Fradkin-Slavnov identities
- ✓ Landau pole
- ✓ Euclidean formulation of quantum field theories
- ✓ ...

Simultaneously with the other people involved in these discoveries (and he was involved in the hydrogen bomb project)

In the 60's and 70's he studied conformal field theory and made the preliminary steps to understand asymptotic freedom.

Still his fame in the West comes from the work from the 70's on.

Why was he not more known in the West earlier?

SPIRES

Renowned papers(500+ cites):	4
Famous papers (250-499 cites) :	3
Very well-known papers (100-249) :	13
Well-known papers (50-99) :	13
Known papers (10-49) :	45
Less known papers (1-9) :	49
Unknown papers (0) :	18
Total eligible papers analyzed:	145
Total number of citations:	7475
Average citations per paper:	52

All from later times.

He never spoke his mother tongue.

He spoke very fast.

His speech was impeded by his war injury.

But when he was given ample time he was a very deep speaker with wonderful understanding of physics. He was incredibly fast to understand and make connections.

Efim Fradkin, the warrior.

He was a fighter who stood up for the good cause.

He supported Andrei Sakharov, even though it hurt him.

He would give everything to solve a problem.

He almost died when giving his speech at the 1997 Sakharov Meeting.

Efim Fradkin, the general

He was a born leader.

He led a huge and very successful group.

He shared everything with his group, worked with everybody and did his share.

He was always in the center of a discussion.

Efim Fradkin the devoted scientist.

In 1991 I visited him the day he had returned from the hospital after his heart attack. (He wrote two papers in the hospital.)

The first comment he said when I came in was:

“Isn’t the paper by so and so wrong?”

I happened to know it and could say yes.

His Christmas cards were wonderful, one page with greetings and one with physical formulae starting with “I have a wonderful idea....”

He was a true scientist.

We miss him a lot!

