



14.12.1936 – 24.05.2012

**Dieter Möhl**  
**35 Years of Friendship**  
**and**  
**Scientific Partnership**

*COOL'2013*

*By Igor Meshkov*



# Prologue: CERN 1977

1972 – 1977 the years of

*The Initial Cooling Experiment (ICE)*

for studies of both stochastic and electron cooling.



**My recollection:** In March 1977 I came for the first time to CERN. Three fellows from Novosibirsk – Yaroslav (Slava) Derbenev, Vladimir Smakhtin (“detector man”) and myself. It was very first scientific trip abroad for all of us. That was Dieter who took all care of us providing very friendly and hospitable atmosphere at so not simple (from political point of view) circumstances “around”.



Most often we worked three together: Dieter, Slava and myself discussing again and again details of ICE – Initial Cooling Experiment setting up (that was under design and beginning of construction just that time).

# Prologue: CERN 1977

It was wonderful time! Many new friends –  
– since that time and forever!



At “Schloss von Möhl”,  
as I call this house:  
Lisa, Karin, Andrea and Dieter



Going to Zermatt:  
Slava, Lars Thorndahl  
and Dieter



Hello, Valise Alps!

# Chapter I. Childhood and Youth

## The Boy of The Second World War

The story he told me once:

He was living with mother in a little village in Sauerland (North Rhine-Westphalia). One day 1944 he was with mother in a forest for brushwood collecting when by “carpet bombardment” the village was destroyed to the ground... By a lucky chance they avoided the bitter fate...



# Chapter I. Childhood and Youth

## The Highschool

1948



1956



1956



1951



1959 Last examination



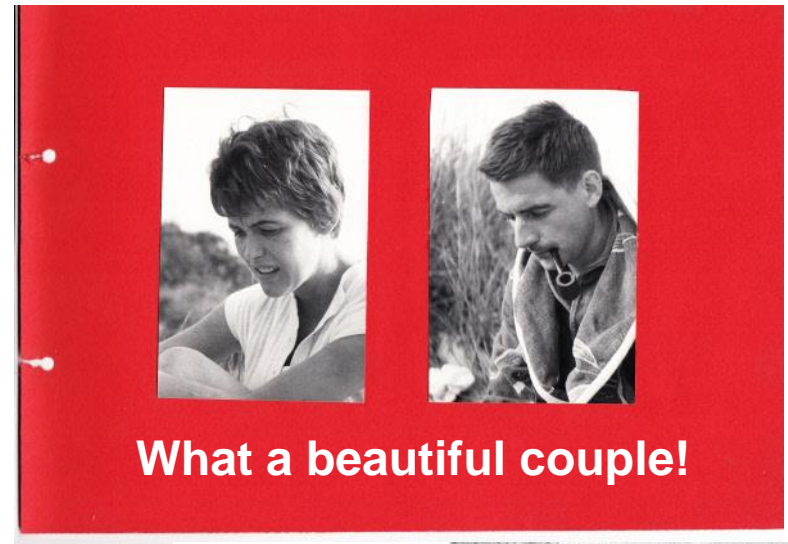
# Chapter II. University and Soon After



1962 West  
Berlin



To fast!  
(alcohol test)



What a beautiful couple!



1965  
Holiday  
in Nice

1966  
Wedding  
Day

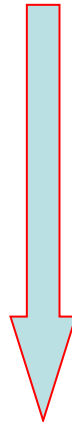


# Chapter II. University and Soon After

## University

1959 – 1964

1964 - Graduated from  
**Freie Universität Berlin**  
(FUB - Free University of Berlin)



**1964 – 1966** – work at FUB



Otto-Hahn-Building  
(FUB Institute for Chemistry), where the nuclear fission was discovered.



# Chapter III. CERN – Since Then and Forever



**1967 Robinzon Crusoe  
on “The Island of Science”**





## Chapter III. CERN – Since Then and Forever

**1966 – 1970** – Entry into particle beam physics and accelerator technology,

- first works as theoretician in this field,
- studying of both electron cooling (proposed in 1966 by G.Budker) and stochastic cooling (proposed in 1968 by S. van der Meer).

*"...After developing **a primitive theory (1968)** I therefore did not pursue this subject. However, **the work was taken up by others** and in **1974 the first experiments were done in the ISR.**"*

*S. van-der-Meer,  
Autobiography of Nobel Laureat*



S. Van der Meer,  
1977



## **Chapter IV. At CERN and “Around”**

**1971**

**“Sabbatical” year at University of California, Berkeley**



**Theoretical works under leadership of Andrew M. Sessler, director of LBNL that time.**



**Andrew M. Sessler, the 1970<sup>th</sup>**

**Andy Sessler recalls:**

**“In Berkeley our group, led by Dennis Keefe (no longer alive) was working on the collective accelerator, the Electron Ring Accelerator (ERA). This activity was started by Sarantsev's group in Dubna and activity was in Maryland, Munich, some other places in the Soviet Union, as well as Berkeley. We had a significant experimental program. Dieter became very much involved with this work and made important theoretical contributions to this very complicated concept.**

**Independent of this ERA work he was involved in the first consideration of PEP, the Positron , Electron, Proton Accelerator that was to be built at SLAC. This was the first time one considered colliding beams between different kinds of particles (Always before that  $e^- - e^-$ ,  $e^+ - e^-$  or p-p). In the event, there was not enough money and the proton part was not built, but only the Positron-Electron Project (same name but everything else different!)...”**

**“...DESY went on and did it. But Dieter was involved with the very first theoretical studies of colliding electrons with protons.**

**In both of the above I enjoyed working closely with Dieter. We had only a few theorists: Lloyd Smith, Jackson Laslett, and myself. I believe Dieter enjoyed working with us, as well as with Andris Faltens , an engineer, but pretty close to a physicist, and many of the experimental physicists like Dennis Keefe and many distinguished others. Later, Faltens spent a year at CERN (perhaps thanks to Dieter) and became good friends wit Dieter.”**



## Chapter IV. At CERN and “Around” *Years and Projects*

Dieter was initiator, promoter and an active developer of many accelerator projects...

... at CERN:

- SuperLEAR (**not approved** after many years of consideration)
- Antiproton Decelerator (**in operation and steady development**)
- Extra- Low ENergy Antiproton ring (ELENA) – **approved recently**
- Low Energy Ion Ring (LEIR) – reconstructed LEAR, **in operation** for LHC

... in Japan: MUSES at RIKEN (**not approved** after many years of development)

... in Germany: FAIR (**design stage**)

... in Russia: NICA at JINR (**design stage**)

*“His theoretical work was unique for the understanding, improvement and extension of the beam cooling techniques to many accelerators and storage rings.”* (Stephan Maury, CERN Weekly Bulletin, May



## Chapter IV. At CERN and “Around”

ISR  $\Rightarrow$  ICE  $\Rightarrow$  Sp̄pS  $\Rightarrow$  LEAR

1974  $\Rightarrow$  1979  $\Rightarrow$  1983  $\Rightarrow$  1988

Then came

### The Era of LEAR.

And again Dieter played at LEAR a crucial role.

#### Accelerator issues at LEAR:

- ✓ Creation of an efficient stochastic cooling system
- ✓ Electron cooling – design and construction of the cooling system that became a routine operation tool at LEAR
- ✓ First electron cooling of antiprotons
- ✓ Development of ultra-slow beam extraction system:

*Stephan Maury* (CERN Weekly Bulletin, May 2012):

“...He was a leading member of the team initiating and designing the Low Energy Antiproton Ring (LEAR) where the first ultra-slow beam extraction extending over hours to the experiments was performed.”



## Chapter IV. At CERN and “Around”

**Geneva  $\Rightarrow$  Novosibirsk  $\Rightarrow$  Alma-Ata  
September 1977**



**Dieter’s visit to Institute of Nuclear Physics:  
experiments at NAP-M – his first touch to electron cooling “alive”.**



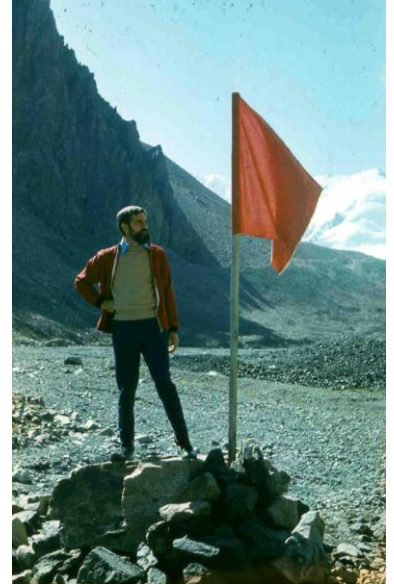
**“Sancta sanctorum” of  
electron cooling - NAP-M :  
“Antiproton Storage Ring -  
Model” 1974 - 1984**



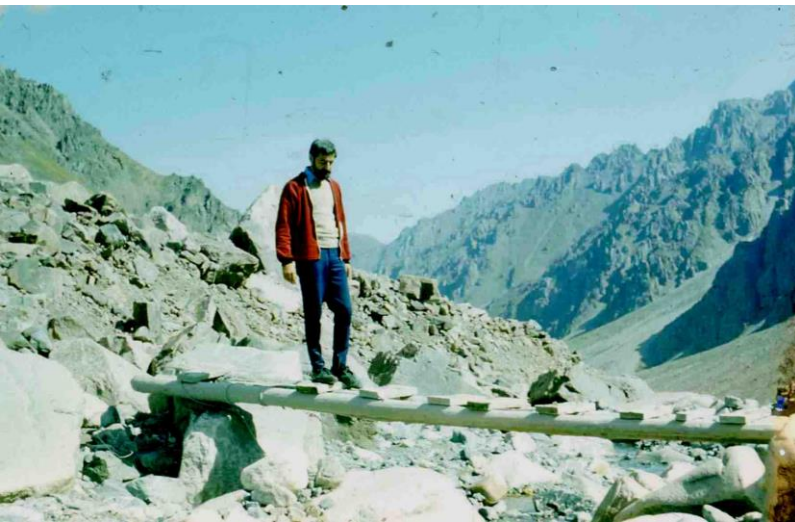
## Chapter IV. At CERN and “Around”

**Geneva ⇒ Novosibirsk ⇒ Alma-Ata  
September 1977**

**Mushrooming (near Novosibirsk)...**



**...and mountaineering (near Alma-Ata, Tian-Shan)**







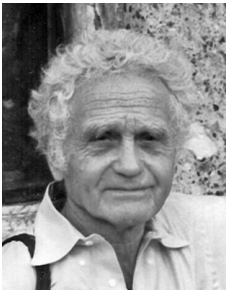
## Chapter IV. At CERN and “Around”



### *Not Only Accelerators...*

*“Dieter was not only a famous Accelerator Physicist but played also an important role in Human Rights issues, in particular in the framework of **the Orlov Committee** created at CERN with him as one of the founding fathers to provide efficient help to Soviet dissidents in the 1970/80th.”*

(Stephan Maury, CERN Weekly Bulletin, May 2012)



Yuri Orlov  
~1987,  
CERN

I wish to add that in a “century of iron curtain” Dieter was among those who were breaking this “curtain” keeping contact with colleagues in USSR. That I know from my own experience. His friendship helped me at different circumstances.

# Chapter V. Zermatt !



**Self-service,  
Hotel "Bahnhof"**

**Dieter was an enthusiast of skiing. Zermatt became our favorite "Ski Paradise"...**



**Skiing from Theodul pass**



**Spaghetti à la Takeshi**



# Chapter V. Zermatt !



*Physicists are joking (from my talk at COOL'2005 Workshop, Galena, IL, USA)*



## Chapter V. Zermatt !

... where three together - Dieter, Takeshi Katayama and myself had many times "MiniWorkshops" sharing time between physics and skiing.



Discussion  
and  
results



Considering LEPTA project

# Chapter VI. "My House is My Fortress"



2011



2007 First mountaineering



2011



2008 Christmas

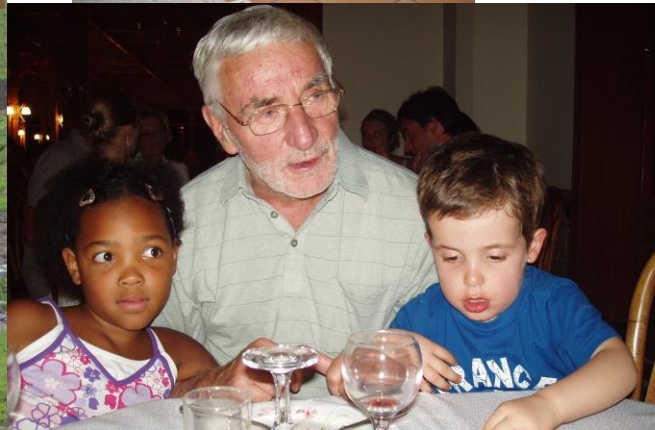


2010



2011

Walking and talking stories WO worries...



2011 Always telling stories...



2008 Christmas

# Chapter VII. Scientific Heritage

Lecture Notes in Physics 866

Dieter Möhl

## Stochastic Cooling of Particle Beams



Available online at [www.sciencedirect.com](http://www.sciencedirect.com)



Nuclear Instruments and Methods in Physics Research A ■■■■■■■■■■

**NUCLEAR  
INSTRUMENTS  
& METHODS  
IN PHYSICS  
RESEARCH**  
Section A

[www.elsevier.com/locate/nima](http://www.elsevier.com/locate/nima)

## Numerical simulation of crystalline ion beams in storage ring

I. Meshkov<sup>a</sup>, D. Möhl<sup>b</sup>, T. Katayama<sup>c,\*</sup>, A. Sidorin<sup>a</sup>, A. Smirnov<sup>a</sup>, E. Syresin<sup>a</sup>,  
G. Trubnikov<sup>a</sup>, H. Tsutsui<sup>c</sup>

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Research (CERN), CH 1211 G  
<sup>c</sup>S, The University of Tokyo, Hir

PHYSICAL REVIEW E **69**, 066504 (2004)

### One-dimensional ordering of ultra-low-density ion beams in a storage ring

H. Okamoto, K. Okabe, and Y. Yuri

Graduate School of Advanced Sciences of Matter, Hiroshima University, 1-3-1 Kagamiyama, Higashi-Hiroshima 739-8530, Japan

D. Möhl

CERN, CH-1211 Geneva, Switzerland

A. M. Sessler

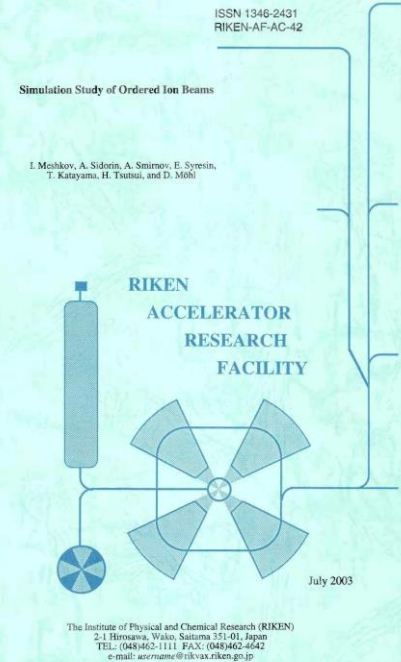
Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, California 94720, USA

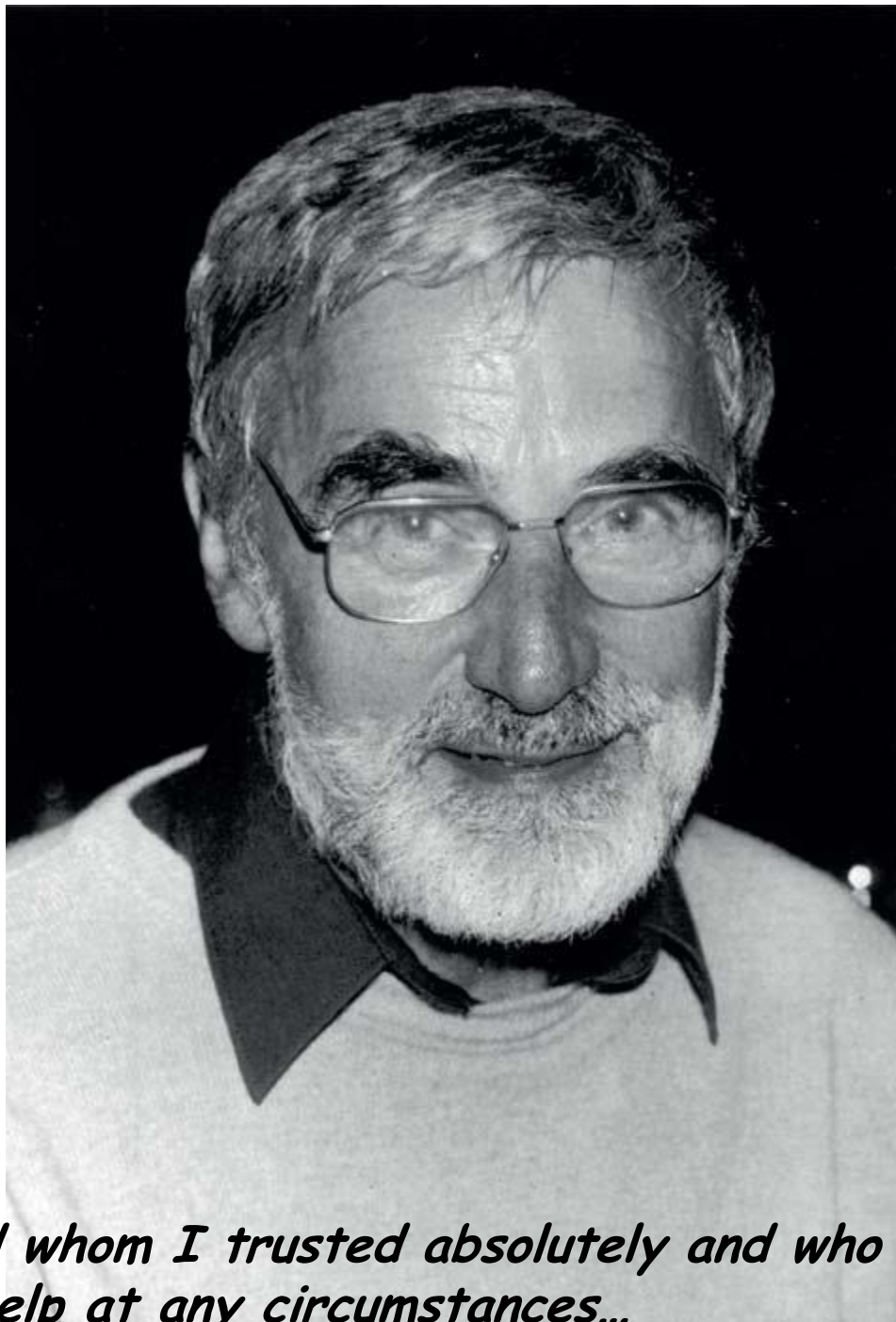
(Received 9 October 2003; revised manuscript received 16 April 2004; published 23 June 2004)

The two-particle model, first introduced by Hasse, is employed to predict the beam temperature at which a one-dimensional ordered state of ions will be established in a cooler storage ring. The proposed state does not have the ions (in the beam frame) at rest, but simply has them not passing each other, i.e., remaining in the same (ordered) sequence. The model is applicable to an ultra-low-density beam where collective Coulomb interactions are negligible. It is pointed out that the nature of the anomalous beam behavior observed in electron-cooling experiments at GSI (Darmstadt) and MSL (Stockholm) is approximately free from such parameters as the lattice design, ion species, beam density, and energy. On the basis of the model, which is put in Hamiltonian form, scaled, and numerically studied, a universal criterion of one-dimensional beam ordering at low line density is derived. Analytic work is employed to explain the numerical results and derives an approximate criterion.

DOI: 10.1103/PhysRevE.69.066504

PACS number(s): 29.20.Dh, 29.27.Fh, 41.75.-i





*The Friend whom I trusted absolutely and who always was ready to help at any circumstances...*

## Backup

### Our Shelter Hotel "Bahnhof" (Continued...)

#### **Two Stories of Stringed Instruments without Orchestra**

##### **Story I.**

Once famous Russian violinist Vladimir Spivakov was on starring in France at Nice, and has met outstanding violinist legudi Menukhin, whom he admired since childhood. And he asked legudi Menukhin to play together at a concert by duet for limited group of people. legudi refused absolutely arguing he finished to perform concerts. "And, he said, I have no violin with me". But Vladimir Spivakov insisted and finally succeeded to get legudi's agreement. However, legudi asked they should train before. A violin was rented (or borrowed), decent one, and they came to the hotel, where Vladimir stayed, and he suggested to start the play. "No, answered legudi, I need a hidden place where people would not hear my abominable play!" They began to look for such a place, however legudi did not like all that Vladimir offered. Finally he has found only place satisfying his requirement. It was toilet! They seated together and began to play. At last legudi was pleased...

The concert they performed next day had a great success.



## Backup

### Our Shelter Hotel "Bahnhof" (Continued...)

## Two Stories of Stringed Instruments without Orchestra

### Story II.

Once famous CERN physicist Dieter Moehl was going for skiing in Zermatt. And he got know that the outstanding physicist Takeshi Katayama, whom he admired since long time ago, stays at GSI. He invited Takeshi Katayama to ski together during limited number of days. Takeshi refused absolutely arguing he had no practice since long time. "And, he said, I have no ski and ski equipment with me". But Dieter Moehl insisted and finally succeeded to get Takeshi's agreement. However, Takeshi asked they should have a celebration after skiing. Ski equipment was rented, modern and decent one, and they went for skiing. After three days of perfect skiing, Dieter invited Takeshi for promised celebration. They came to the hotel, where Dieter stayed, and he suggested to begin the party. "No, - answered Takeshi, - I need a larger place where people would not hear our abominable jokes!" They began to look for such a place, however Takeshi did not like all that Dieter offered. Finally he has found only place satisfying his requirement. It was toilet! They seated together and began to drink. At last Takeshi was pleased...

The celebration party they preformed had a great success.

## Backup

### Our Shelter Hotel "Bahnhof" (Continued...)

#### Two Stories of Stringed Instruments without Orchestra Story II (Continued)

One should add, Takeshi is an outstanding cello player as well. However, he could not use legudi Menukhin's experience that time due to absence of cello.

Described by Igor Meshkov, who listened from Vladimir Spivakov The Story I (in TV program) and joined Takeshi and Dieter for The Story II.  
Zermatt, 13-15 March 2005.

