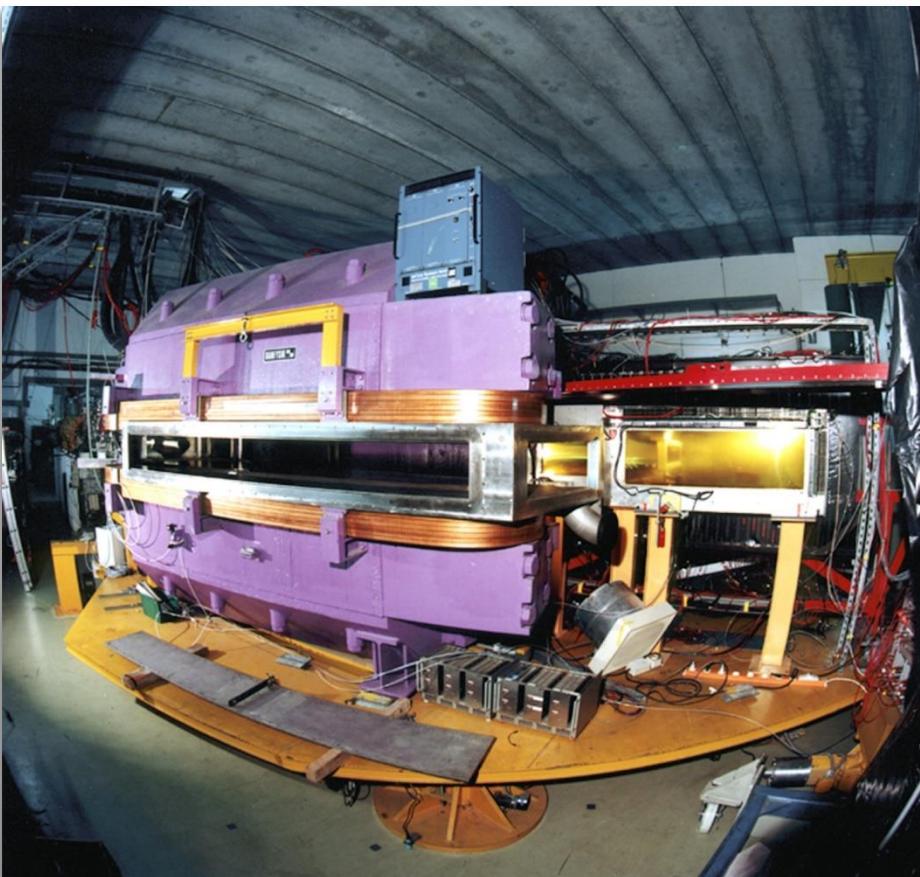


Time period covered: 15 years,  $\approx$  1989 – 2004



## Menu

### Appetizer

- ..., KaoS

### Entree

- Technical contributions

### Main course

- Physics contributions

### Dessert

- What to take away



# Disclaimer

- A very personal - not necessarily Helmut's - view
- By far not complete
- It's not a KaoS review
- And....  
KaoS: A truly collaborative endeavor!



# The Appetizer

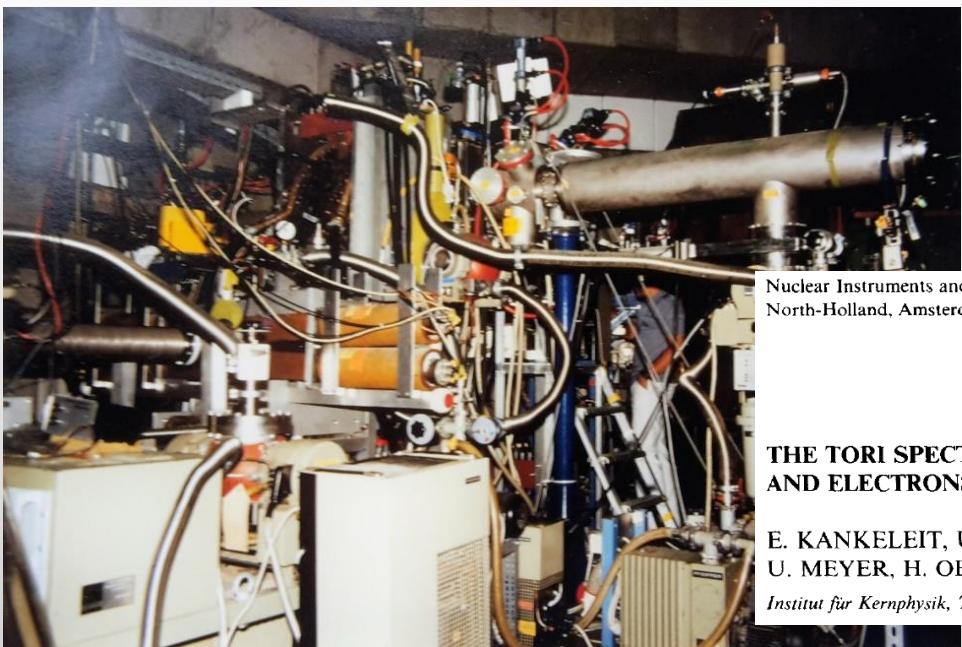
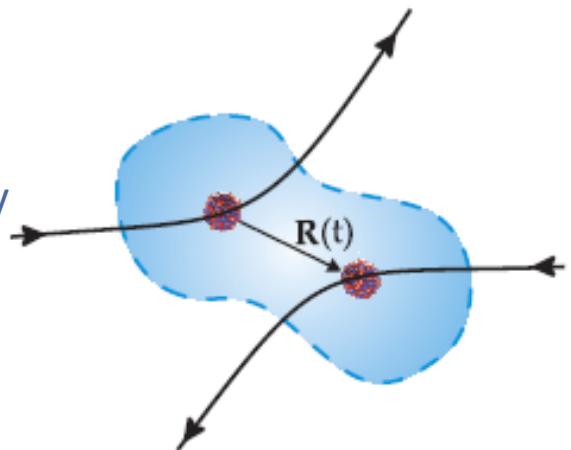


# TORI

Dissipative HIC

Tool:  $e^-/e^+$  spectroscopy

- Fast stopping
- Long contact times



Nuclear Instruments and Methods in Physics Research A234 (1985) 81–90  
North-Holland, Amsterdam

THE TORI SPECTROMETER, A MAGNETIC TRANSPORT SYSTEM SEPARATING POSITRONS AND ELECTRONS EMITTED IN HEAVY ION COLLISIONS

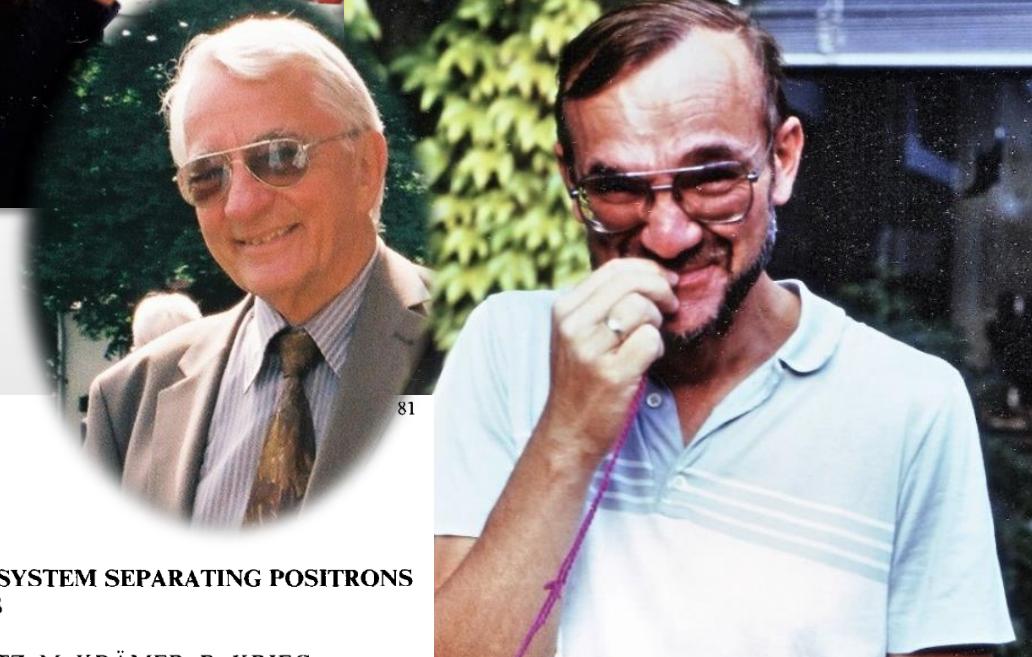
E. KANKELEIT, U. GOLLERTHAN, G. KLOTZ, M. KOLLATZ, M. KRÄMER, R. KRIEG,  
U. MEYER, H. OESCHLER and P. SENGER

Institut für Kernphysik, Technische Hochschule Darmstadt, Germany



1986...88

Institut für Kernphysik  
Technische Hochschule Darmstadt  

81

# KaoS Proposal

## PROPOSAL FOR A QD-MAGNETIC KAON SPECTROMETER AT SIS

E. Grosse (co-spokesperson), R. Bock, H. Bokemeyer, R. Brockmann, H. Grein,  
W. Henning, T. Humanic, A. Sandoval, D. Schüll, P. Senger, H. Stelzer, H. Ströbele  
(GSI Darmstadt)

H. Oeschler (Technische Hochschule Darmstadt)



R. Stock (co-spokesperson), W. Heck, R. Renfordt, K. Stiebing, S. Wenig  
(University of Frankfurt)

J.W. Harris, S. Chase (Lawrence Berkeley Laboratory)

B. Kohlmeier, F. Pühlhofer, H. Stege (University of Marburg)

tic spectrometers in energetic particle physics. In order to meet the requirements of the experiment (> 30 msr), the spectrometer will have to have a large acceptance (1 GeV/c ( $< 30^{\circ}$  with respect to the beam axis) and the efficient detection of charged particles.



detectors necessary for particle identification and raytracing, involving wire chambers, time-of-flight scintillators, aerogel and water Cerenkov detectors and segmented calorimeters for particle decay. While the primary purpose for the construction of the spectrometer is the measurement of kaons, it can as well be considered a general purpose magnetic spectrometer for other hadrons and for leptons. Its large solid angle also allows the study of two-particle correlations.

# KaoS

- A new, dedicated QD magnet combination
- A 2<sup>nd</sup> generation experiment (after LBL BEVALAC)
- Focus: Subthreshold kaon spectroscopy

- Proposal 1987...?

- Forming a Collaboration:

Univ. Frankfurt: R. Stock, H. Ströbele, ...

Univ. Marburg: B. Kohlmeyer, F. Pühlhofer, ...

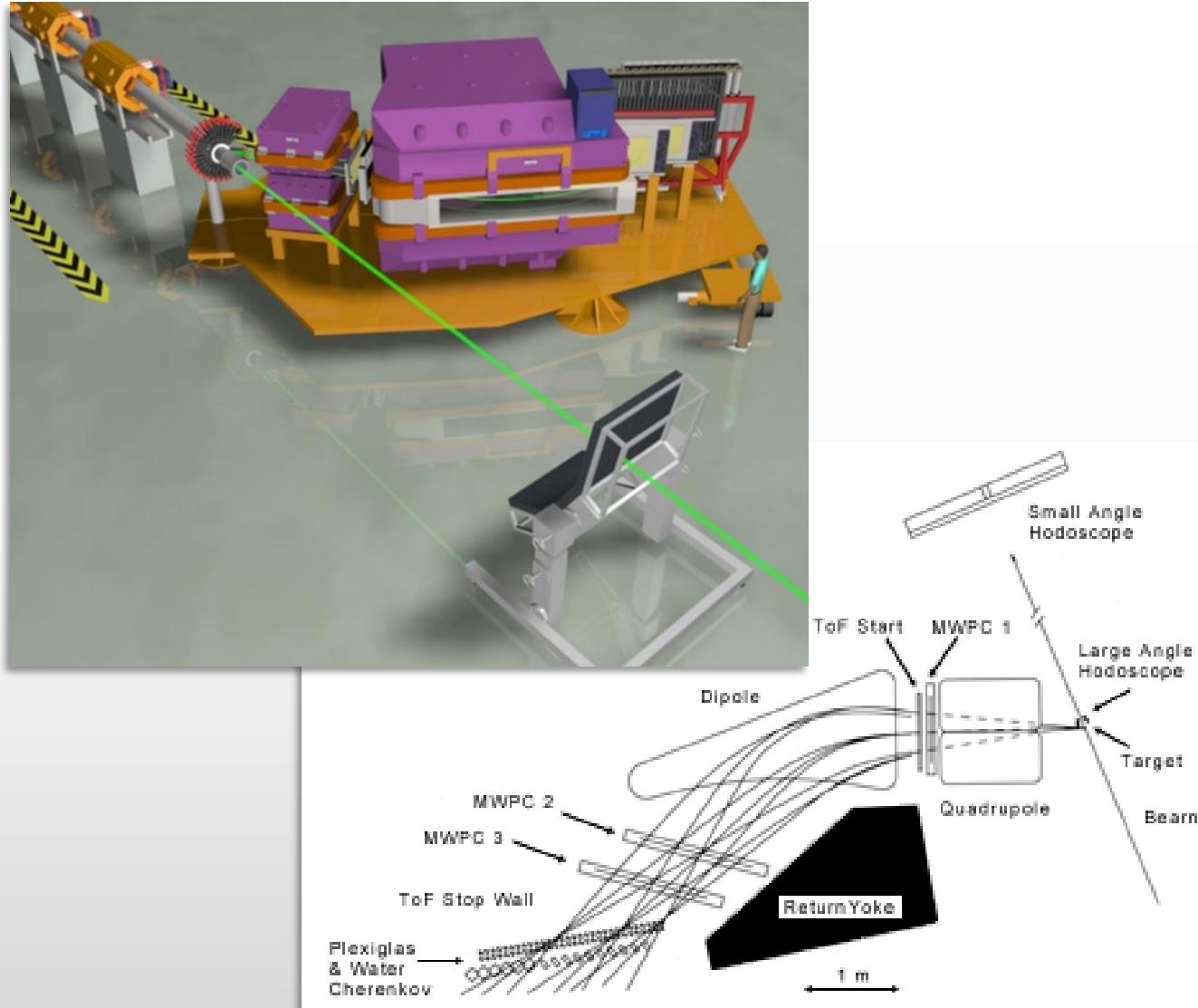
TU Darmstadt: **H. Oeschler**, ....

Jag. Univ. Krakow: W. Walus, ...

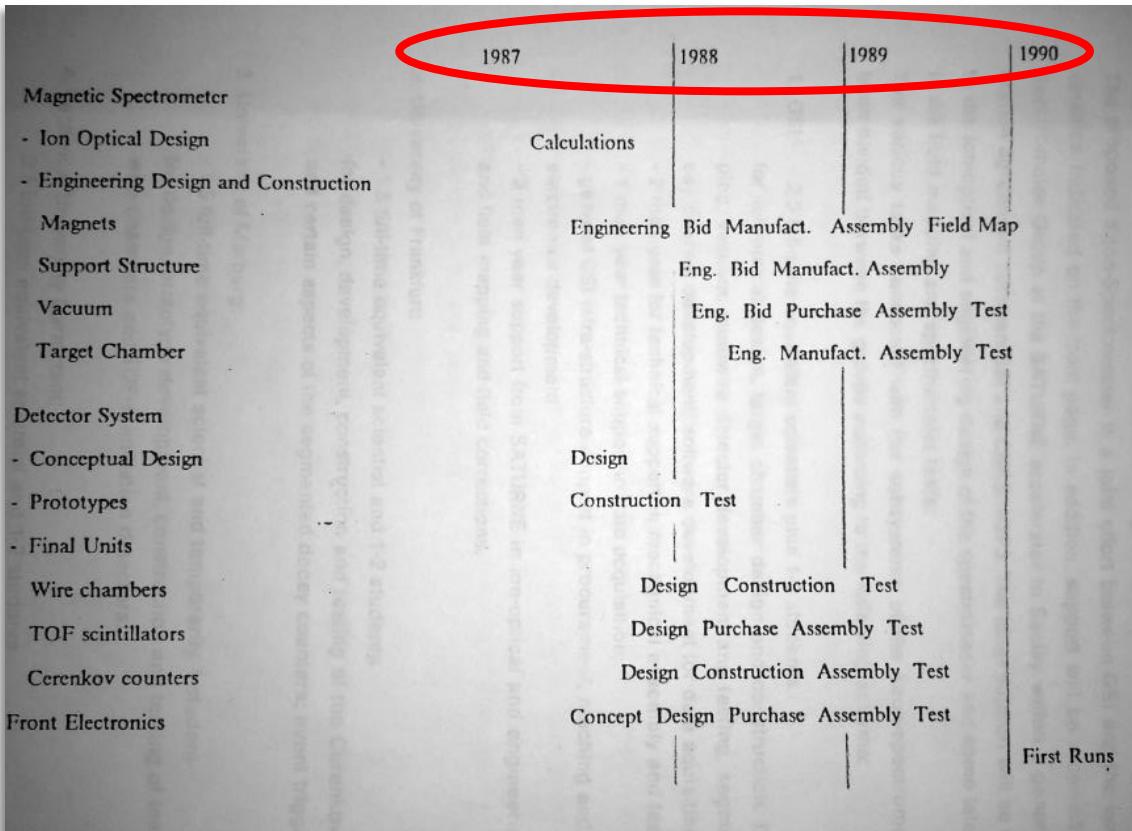
GSI: H. Grosse, W. Henning, P.  
Kozcon, P. Senger, ...

$\Omega = 30 \text{ msr}$

Cost estimate: 5 Mio DM



# Project Plan



**9/89:** The following recommendation was made in connection with your request for beamtime (S027, "Commissioning the Kaon Spectrometer"), with which I concur:

Commissioning of KaoS should be given beamtime. The EA notes, however, that no p- and  $\alpha$ -beams will be available for commissioning. The experiment has been assigned to category #1 and has been allocated 5 days of beamtime.

Sincerely yours,

*P. Kieule*

## PROPOSAL FOR AN EXPERIMENT AT GSI, DARMSTADT

2. Title of Proposal: Commissioning the Kaon Spectrometer

New proposal

Continuation of previous experiment

3. Spokesperson: Peter Senger Address: GSI Telephone: 652 Computer Mail:

4. Participants: The KaoS-Collaboration: W. Ahner, H. Bokemeyer, R. Brockmann, H. Grein, E. Grosse, W. Henning, D. Miskowiec, A. Sandoval, P. Senger, W. Walus (GSI); P. Baltes, H. Jäger, Ch. Müntz, H. Oeschler (TH Darmstadt); R. Renfordt, H. Ströbele, K. Stiebing, R. Stock (Univ. Frankfurt); B. Kohlmeyer, H. Pöpl, F. Pühlhofer (Univ. Marburg); W. Benenson (Michigan State Univ.)

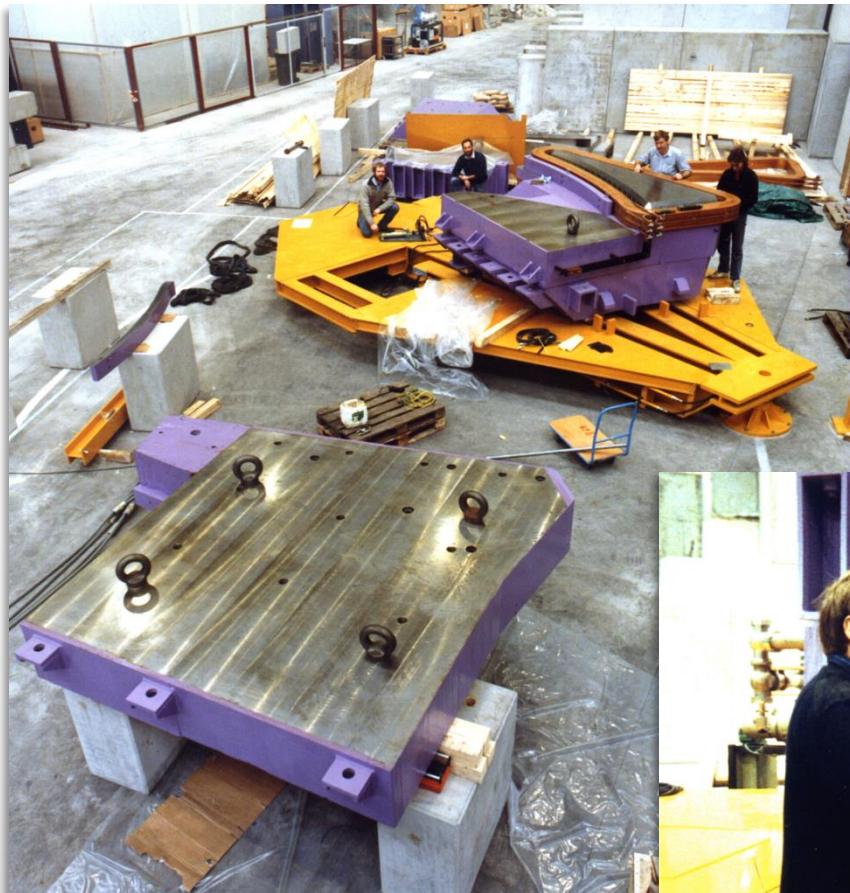
8. Requested Beam Time (in shifts of 8 hours each)

20

Total: \_\_\_\_\_ Number of runs: 3

Preferred dates: after 15.3.90 Dates when you cannot run: \_\_\_\_\_

# Construction & Completion, late 80s



E. Grosse ... ... ... P. Senger



## The kaon spectrometer at SIS

P. Senger <sup>a</sup>, W. Ahner <sup>a</sup>, P. Baltes <sup>b</sup>, P. Beckerle <sup>c</sup>, Ch. Bormann <sup>c</sup>, D. Brill <sup>c</sup>, M. Cieślak <sup>a</sup>, E. Grosse <sup>a</sup>, W. Henning <sup>a,1</sup>, P. Koczoń <sup>a</sup>, B. Kohlmeyer <sup>d</sup>, W. Konrad <sup>d</sup>, D. Miśkowicz <sup>a</sup>, Ch. Müntz <sup>b</sup>, H. Oeschler <sup>b</sup>, H. Pöppel <sup>d</sup>, W. Prokopowicz <sup>e</sup>, F. Pühlhofer <sup>d</sup>, S. Sartorius <sup>b</sup>, R. Schicker <sup>a</sup>, B. Schlei <sup>d</sup>, E. Schwab <sup>a,c</sup>, Y. Shin <sup>c</sup>, J. Speer <sup>d</sup>, J. Stein <sup>c</sup>, K. Stiebering <sup>c</sup>, R. Stock <sup>c</sup>, H. Ströbele <sup>c</sup>, Ch. Sturm <sup>b</sup>, K. Völkel <sup>d</sup>, A. Wagner <sup>b</sup> and W. Waluś <sup>e</sup>

<sup>a</sup> Gesellschaft für Schwerionenforschung m.b.H. Darmstadt, FRG

<sup>b</sup> Institut für Kernphysik, Technische Hochschule Darmstadt, FRG

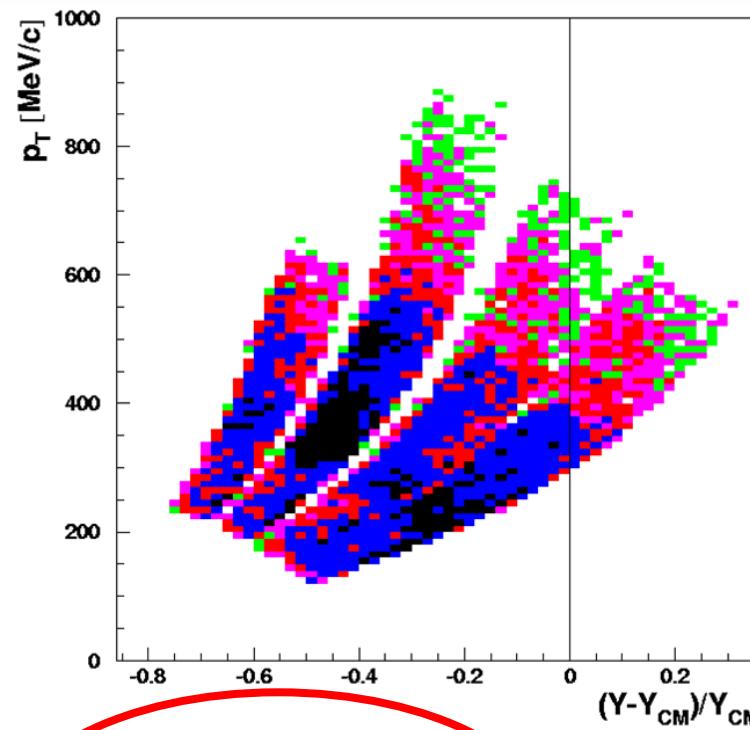
<sup>c</sup> Institut für Kernphysik, Johann-Wolfgang-v.-Goethe-Universität, Frankfurt am Main, FRG

<sup>d</sup> Fachbereich Physik, Philipps Universität, D-3550 Marburg, FRG

<sup>e</sup> Institute of Physics, Jagiellonian University, PL-30004 Kraków, Poland

# KaoS Nutshell

## Acceptance

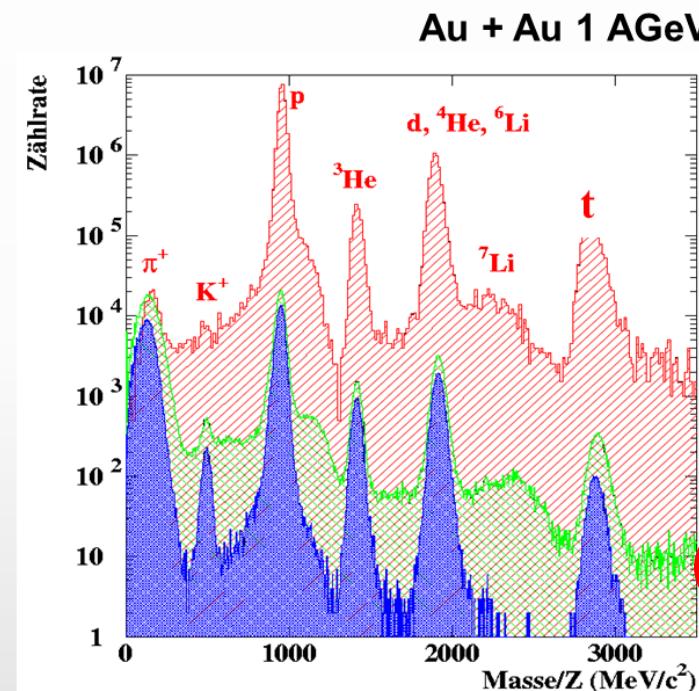


$\theta_{\text{lab}} = 32, 40, 50, 60^\circ$

$B = 0.6, 0.9, 1.4 \text{ Tesla}$

Polarity

## Particle identification



1. Minimum bias trigger
2. Kaon trigger (TOF & Cherenkov)
3. Kaon trigger & tracking & 2xTOF

- $\Delta\Omega = 15 - 35 \text{ msr}$
  - $\Delta p/p \approx 2$
  - $\theta_{\text{lab}}: 0^\circ - 115^\circ$
- 
- compact size: path length 5 – 7.5 m
  - Kaon Trigger (ToF + Cherenkov)
  - efficient background reduction by 2xToF measurement

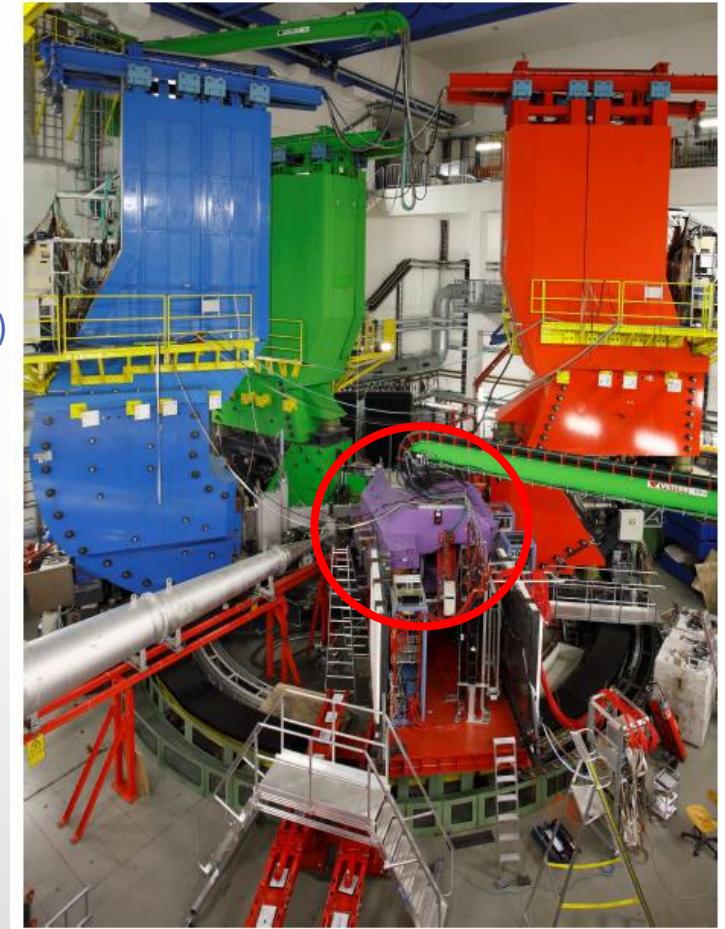
# Dismantling of KaoS in 2003

- A new life @ **MAMI**
- Setup: 2003 → 2008/9

(© P. Achenbach)



Figure 2.3.: Photographs of magnet pieces from the KAOS spectrometer taken during the transport in June 2003.



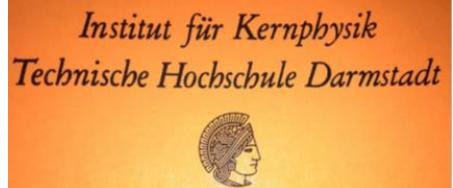
2.6.: Photograph of the spectrometer hall operated by the A1 Collaboration as of 2008. The KAOS spectrometer at the near-target position is surrounded by the high-resolution spectrometers (SpekA, SpekB, and SpekC). Significant parts of the shielding walls were removed to get maintenance access to the detectors. The kaon electro-production experiments that started in 2008 were performed using this set-up.

# The Entree



# Technical Contributions

KaoS Proposal: ...



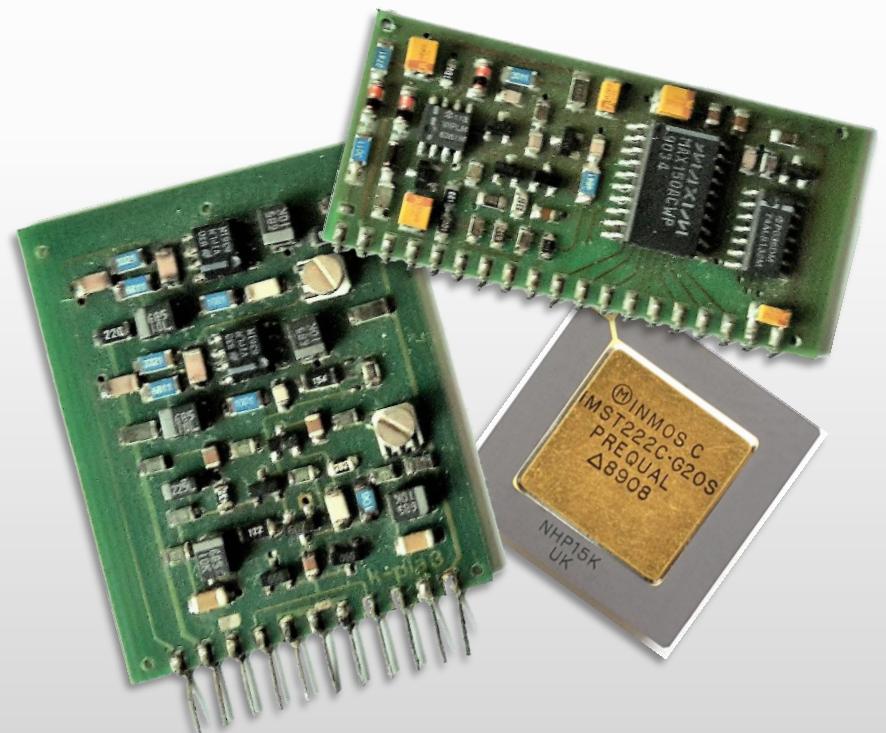
## 4. Technical University Darmstadt:

0.5 full-time equivalent scientist and 1-2 students  
for focal-plane wire chamber development, construction and testing; front-end electronics and data aquisition

- **MWPC** together with GSI, H. Stelzer/ H. Daues
- **FEE/DAQ:**
  - Charge sensitive Pre-Amp
  - 8-bit ADC
  - Transputer network



J. Foh, Electronics  
Workshop, IKDA '93



# MWPC & R/O, DAQ

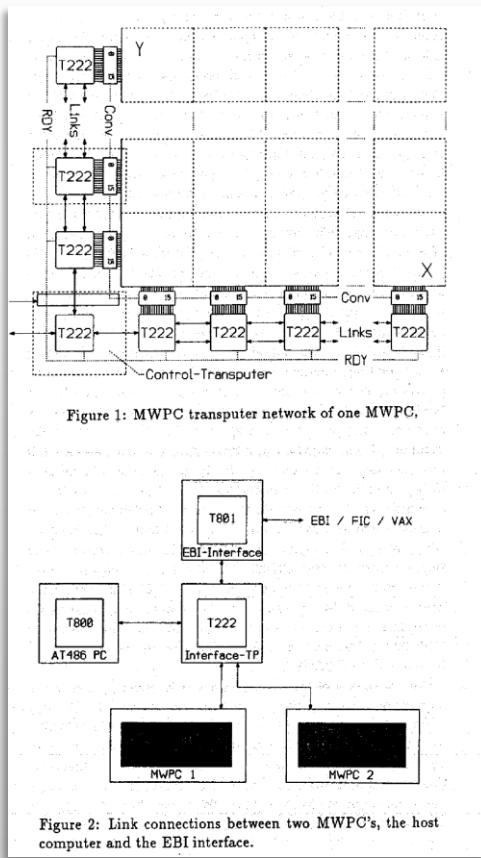
## The Transputer-Based Data Acquisition System for Multiwire Proportional Chambers<sup>B,G</sup>

P. Baltes, J. Foh, E. Kankeleit, Ch. Müntz,

H. Oeschler, S. Sartorius, A. Wagner (TH Darmstadt)

and the KaoS Collaboration

GSI 1991

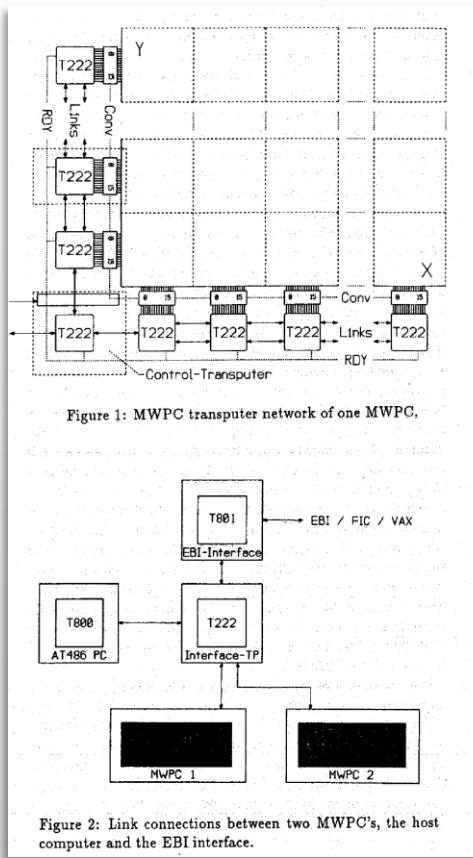


# MWPC & R/O, DAQ

## The Transputer-Based Data Acquisition System for Multiwire Proportional Chambers<sup>B,G</sup>

P. Baltes, J. Foh, E. Kankeleit, Ch. Müntz,  
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and the KaoS Collaboration

GSI 1991



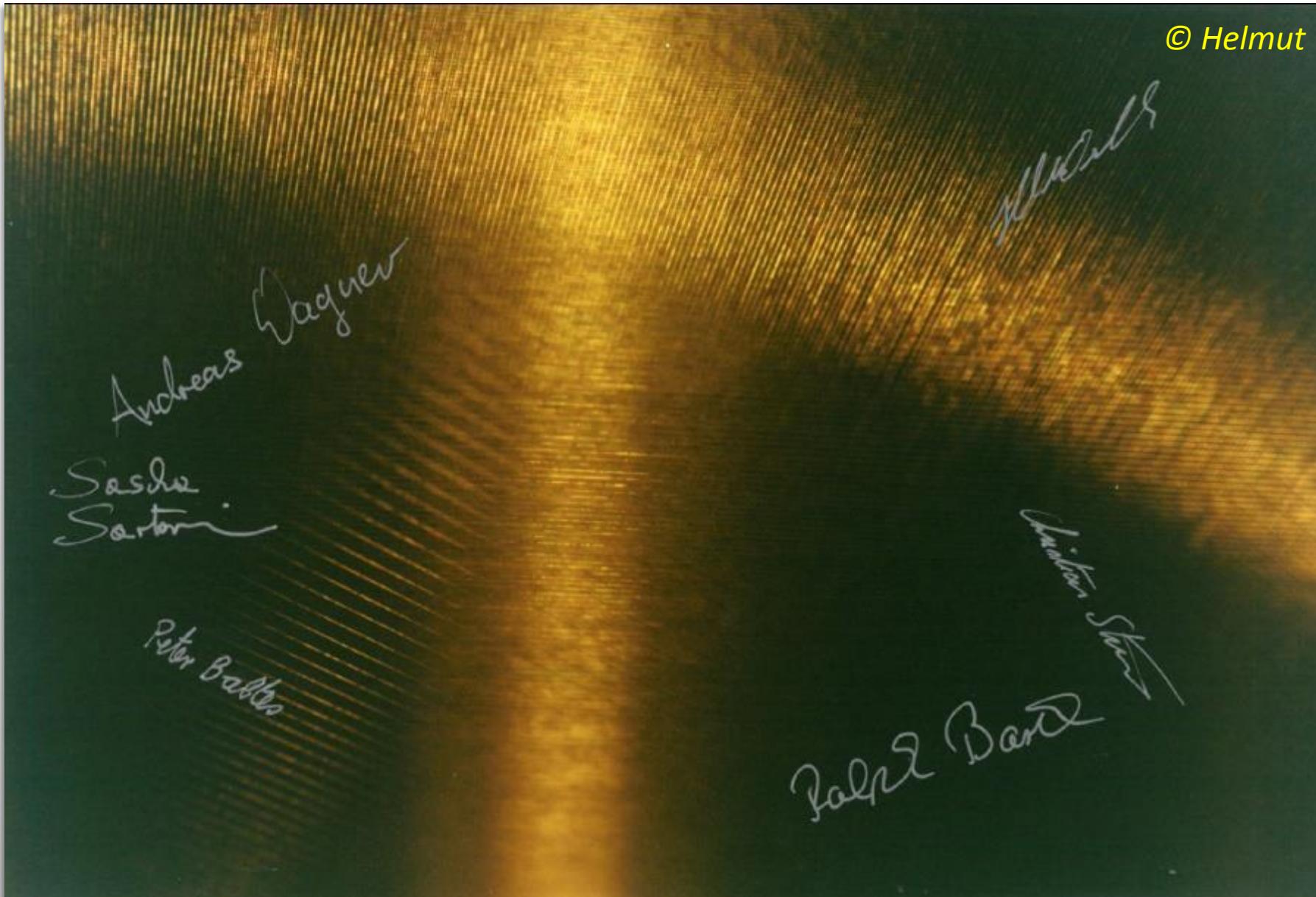
## Properties of large MWPC's at the Kaon Spectrometer<sup>B,G</sup>

P. Baltes, Ch. Müntz, H. Oeschler, S. Sartorius,  
A. Wagner (TH Darmstadt), H. Stelzer (GSI)  
and the KaoS Collaboration

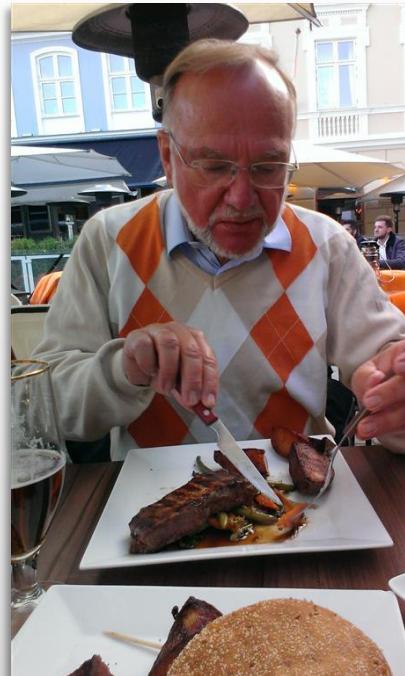
GSI 1988



# Helmut's View on Detectors



# The Main Course



# The Stage: ... High-Density - EOS - Kaons

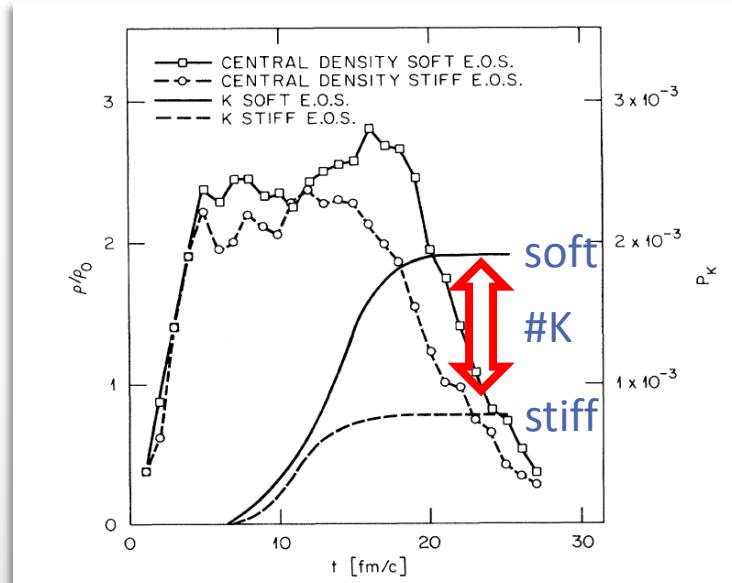
VOLUME 55, NUMBER 24

PHYSICAL REVIEW LETTERS

9 DECEMBER 1985

## Subthreshold Kaon Production as a Probe of the Nuclear Equation of State

J. Aichelin and Che Ming Ko<sup>(a)</sup>



In summary, we have carried out microscopic calculations of kaon production at subthreshold energies using the Boltzmann-Uehling-Uhlenbeck equation. We find that kaon production is sensitive to the nuclear equation of state. For central collisions between heavy systems, the number of produced kaons can differ by a factor of  $\sim 3$ , depending on the equation of state. All the kaons are created at the stage of maximum compressions and are therefore sensitive to the equation of state at high densities. The sensitivity dimin-

# The Stage: ... High-Density - EOS - Kaons

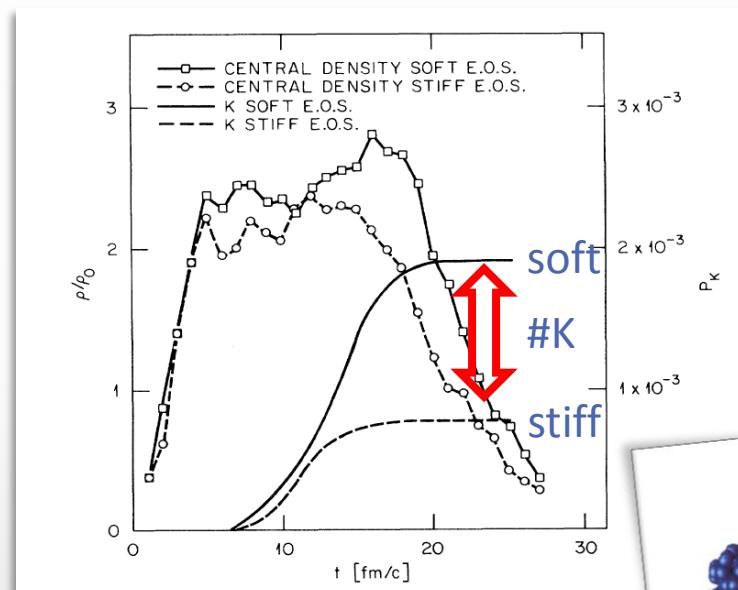
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VOLUME 49, NUMBER 19

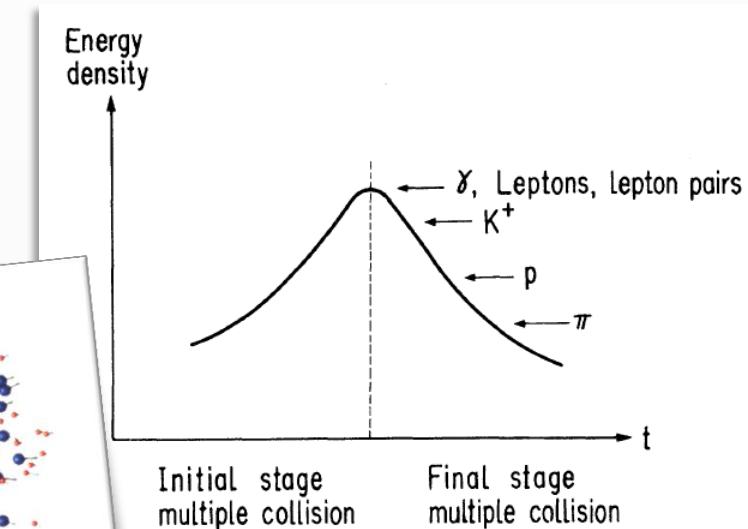
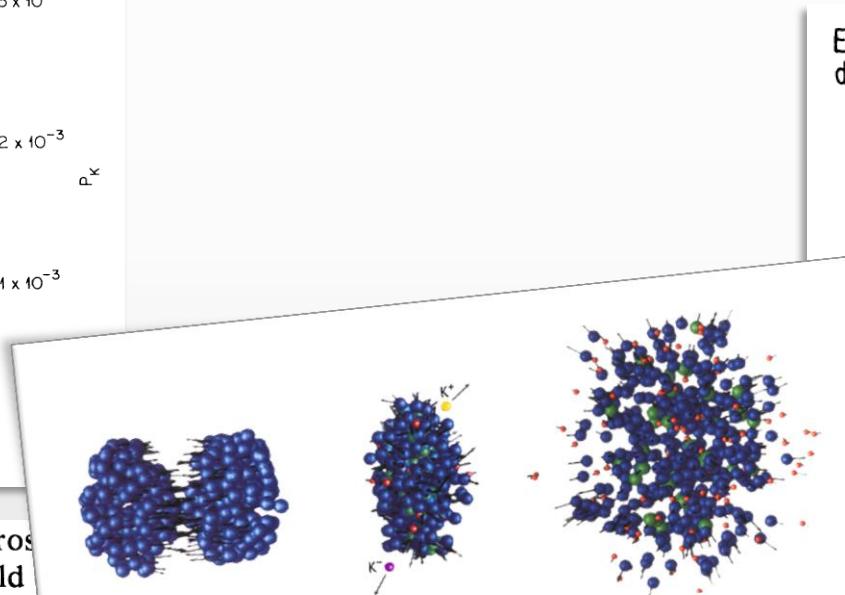
PHYSICAL REVIEW LETTERS

8 NOVEMBER 1982

## Role of Mean Free Paths of Product Particles in High-Energy Nucleus-Nucleus Collisions

Shoji Nagamiya

Intuitive arguments, @ BEVALAC energy range



spectra suggests that mean free paths of these product particles seem to play the major role in determining such a difference. It also implies that  $K^+$  probes most sensitively the highest energy-density phase of the collision. The data of

# The Stage

PHYSICAL REVIEW C

VOLUME 40, NUMBER 2

AUGUST 1989

## Inclusive production of $K^+$ mesons in 2.1-GeV/nucleon nuclear collisions

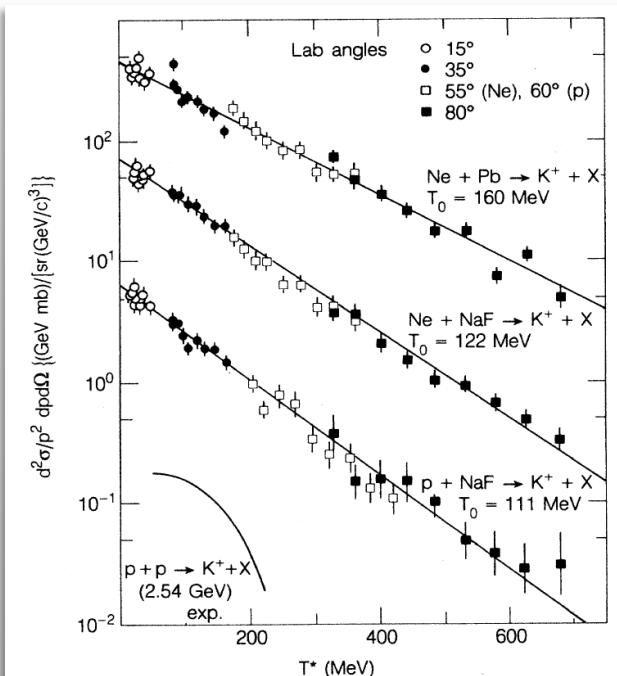
S. Schnetzer,\* R. M. Lombard,<sup>†</sup> M.-C. Lemaire,<sup>†</sup> E. Moeller,<sup>‡</sup> S. Nagamiya,<sup>§</sup> G. Shapiro,<sup>\*\*</sup>  
H. Steiner,<sup>\*\*</sup> and I. Tanihata<sup>†</sup>

Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, Berkeley, California 94720

(Received 17 February 1989)

$K^+$  meson production by 2.1-GeV/nucleon Ne,  $d$ , and  $p$  projectiles on NaF and Pb targets has been measured. The cross sections depend exponentially upon the kaon energy in the nucleon-nucleon c.m. frame, with an inverse slope  $T_0$  larger than the values obtained from comparable proton and  $\pi^-$  spectra. The angular distribution in this frame is approximately isotropic. The  $A$  dependence of the kaon yield has been determined. Data are compared with theoretical predictions.

@ LBL  
BEVALAC:  
(above NN  
threshold)



# The Stage: KaoS, a 2<sup>nd</sup> Generation Kaon Experiment

PHYSICAL REVIEW C

VOLUME 40, NUMBER 2

AUGUST 1989

## Inclusive production of $K^+$ mesons in 2.1-GeV/nucleon nuclear collisions

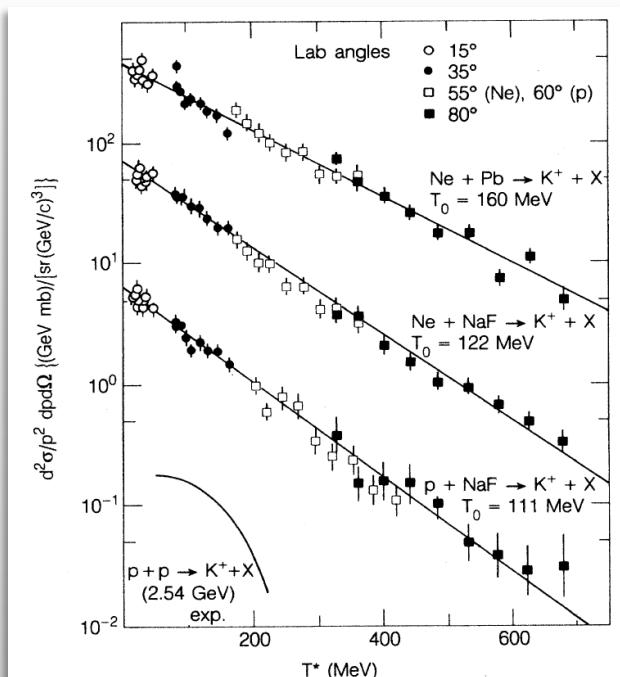
S. Schnetzer,<sup>\*</sup> R. M. Lombard,<sup>†</sup> M.-C. Lemaire,<sup>†</sup> E. Moeller,<sup>‡</sup> S. Nagamiya,<sup>§</sup> G. Shapiro,<sup>\*\*</sup>  
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@ LBL  
BEVALAC:  
(above NN  
threshold)



Christian Müntz (Goethe University Frankfurt), SQM 2017

# Physics News In 1998

A Supplement to APS News

Public Information Division, American Institute of Physics physicsnews@aiph.org

Edited by Phillip F. Schewe and Ben P. Stein

KAONS BEHAVE STRANGELY in dense nuclear matter. Recently, experi-

## APS NEWS



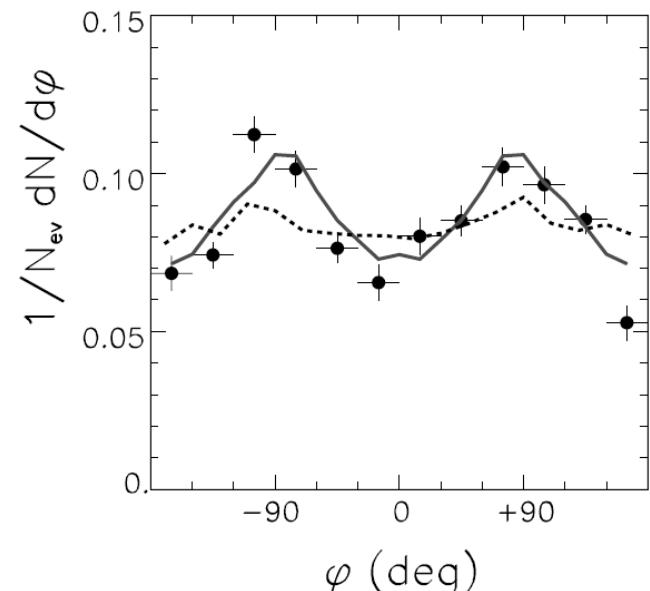
VOLUME 81, NUMBER 8

PHYSICAL REVIEW LETTERS

24 AUGUST 1998

### Enhanced Out-of-Plane Emission of $K^+$ Mesons Observed in Au + Au Collisions at 1A GeV

Y. Shin,<sup>3</sup> W. Ahner,<sup>1</sup> R. Barth,<sup>1</sup> P. Beckerle,<sup>3</sup> D. Brill,<sup>3</sup> M. Cieślak,<sup>5</sup> M. Dębowksi,<sup>5</sup> E. Grosse,<sup>6</sup> P. Koczon,<sup>1</sup> B. Kohlmeier,<sup>4</sup> M. Mang,<sup>1</sup> D. Miśkowiec,<sup>1</sup> C. Müntz,<sup>2</sup> H. Oeschler,<sup>2</sup> F. Pühlhofer,<sup>4</sup> E. Schwab,<sup>1</sup> R. Schicker,<sup>1</sup> P. Senger,<sup>1</sup> J. Speer,<sup>4</sup> H. Ströbele,<sup>3</sup> C. Sturm,<sup>2</sup> K. Völkel,<sup>4</sup> A. Wagner,<sup>2,\*</sup> and W. Walus<sup>5</sup>  
(KaoS Collaboration)



# Pions

@ LBL BEVALAC:

VOLUME 53, NUMBER 21

PHYSICAL REVIEW LETTERS

19 NOVEMBER 1984

## Pion and Proton "Temperatures" in Relativistic Heavy-Ion Reactions

R. Brockmann, J. W. Harris, A. Sandoval, R. Stock, and H. Ströbele  
Gesellschaft für Schwerionenforschung, D-6100 Darmstadt, West Germany

and

G. Odyniec, H. G. Pugh, and L. S. Schroeder  
Nuclear Science Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720

and

R. E. Renfordt and D. Schall  
Institut für Hochenergiephysik, Universität Heidelberg, D-6900 Heidelberg, West Germany

and

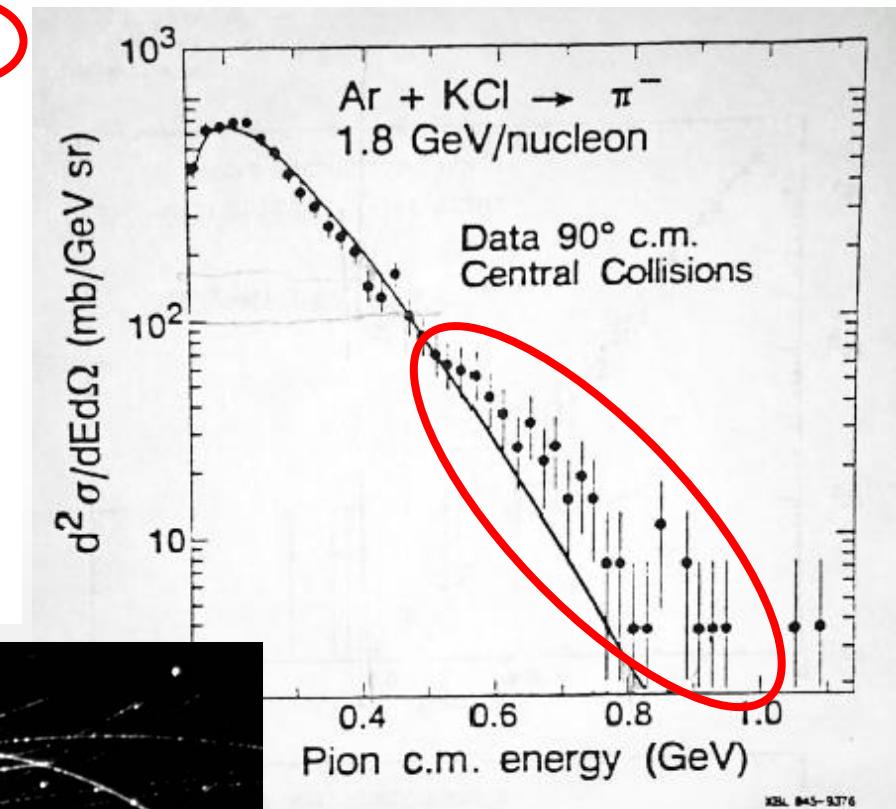
D. Bangert and W. Rauch  
Fachbereich Physik, Universität Marburg, D-3550 Marburg, West Germany

and

K. L. Wolf  
Cyclotron Laboratory, Texas A&M University, College Station, Texas 77843



© LBL streamer chamber



# Helmut, with H. Ströbele: Proposal(s) on High-Energetic Pions

**PROPOSAL FOR AN EXPERIMENT AT GSI, DARMSTADT**

2. Title of Proposal: High-Energetic Pions from Relativistic Heavy Ion Collisions

New proposal       Continuation of previous experiment

3. Spokesperson: H. Oeschler H. Ströbele  
Address: TH Darmstadt Univ. Frankfurt Telephone: GSI 612 GSI 667 Computer Mail: Z171 DDAGSISI3

4. Participants: Address: Telephone: Computer Mail:

<sup>1</sup>The KaoS Collaboration: W. Ahner, R. Brockmann, E. Grosse, W. Henning, P. Kocsor, D. Miskowiec, A. Sandoval, R. Schicker, P. Seeger (GSI Darmstadt); P. Baltes, Ch. Müntz, H. Oeschler, S. Sartorius, A. Wagner (TH Darmstadt); Ch. Bornmann, D. Brill, R. Renfordt, Y. Shin, J. Stein, H. Ströbele, K. Stiebing, R. Stock (Univ. Frankfurt); B. Kohlmeyer, W. Konrad, H. Poppl, F. Pühlhofer, K. Völkel (Univ. Marburg); M. Cieslak, W. Walus (Univ. Krakow); M. Berg, L. Carlen, G. Ericsson, B. Jakobsson, O. Oskarsson (Univ. Lund); T.F. Thorstein, K. Nybo (Univ. Bergen); J. Julien (CEN Saclay)

5. GSI Contact Person: E. Grosse

6. UNILAC:  SIS:  ESR:

7. Requested Beam Properties and Experimental Equipment:

a. Ion species (charge state if needed): Ca, Ar, Ni / Au (Xe)

b. Intensity (particle nA): > 10<sup>7</sup> / 2 · 10<sup>5</sup> ions/spill

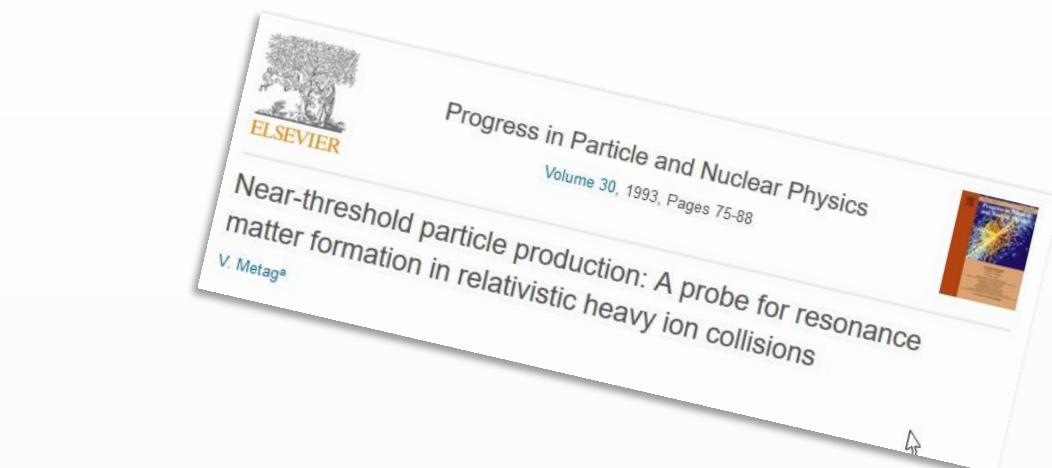
c. Energy (MeV/u): 500, 800, 1500

8. Requested Beam Time (in shifts of 8 hours each)

Total: 10 (in addition to S029) Number of runs: 2

Preferred dates: 1991 Dates when you cannot run: \_\_\_\_\_

1990



**PROPOSAL FOR AN EXPERIMENT AT GSI, DARMSTADT**

2. Title of Proposal: Dynamics of Δ Production and Δ Decay

New proposal       Continuation of previous experiment

3. Spokesperson: H. Oeschler H. Ströbele  
Address: TH Darmstadt Univ. Frankfurt Telephone: GSI 612 TH 16 2321 Computer Mail: Z171 069-798-4259

**SUPPLEMENTARY FORM FOR SAFETY ASPECTS OF YOUR PROPOSAL**

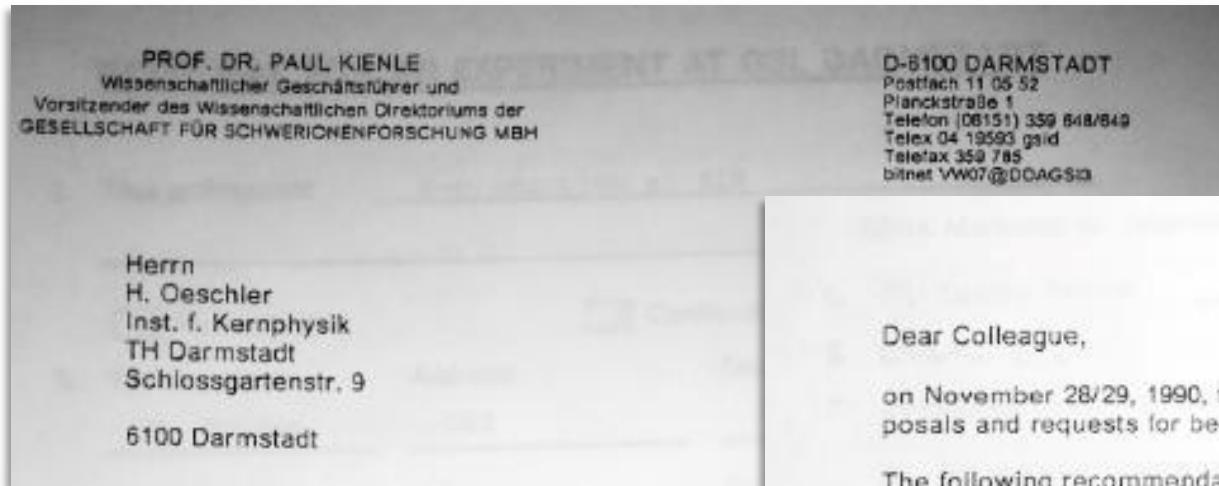
Title: Dynamics of Δ Production and Δ Decay

Spokesperson: H. Oeschler / H. Ströbele

GSI-Contact Person: E. Grosse

© Helmut's hand writing

# No Systematic Pion Studies, yet!



Darmstadt, December 17th, 1990

Dear Colleague,

on November 28/29, 1990, the Experimentausschuß met at GSI to discuss proposals and requests for beam time submitted to GSI until October 19, 1990.

The following recommendation was given concerning your experiment:

S030  
Hard Energetic Pions from Relativistic Heavy Ion Collisions

No!

with which I concur:

The committee was pleased to see the progress made during the short initial commissioning period, and is eagerly waiting for the expeditious completion of these experiments in the 15+15 shifts already approved.

The committee advises the collaboration to focus on the unique opportunity given by the SIS facility, namely measuring the subthreshold  $K^+$ -production with the Au beams and the excitation function to be measured with Ar beams.

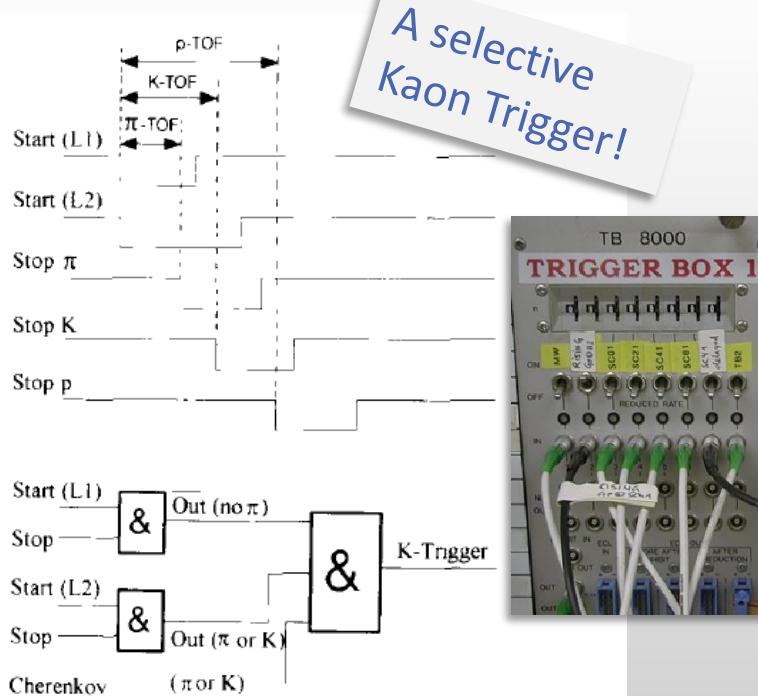
Such a measurement will yield simultaneously a large sample of interesting multiplicity triggered proton and pion ( $\pi^+$ ) spectra.

Sincerely yours,

?

P. Kienle

P. Kienle



# Nethertheless ...



- “find a oeschler and a senger and date > 1989”: 33 papers ( 28 citable, 11 PRL)

(Ref: “find cn kaos”: 45, 25 citable)

33 papers found, 28 of them citable (published or arXiv)

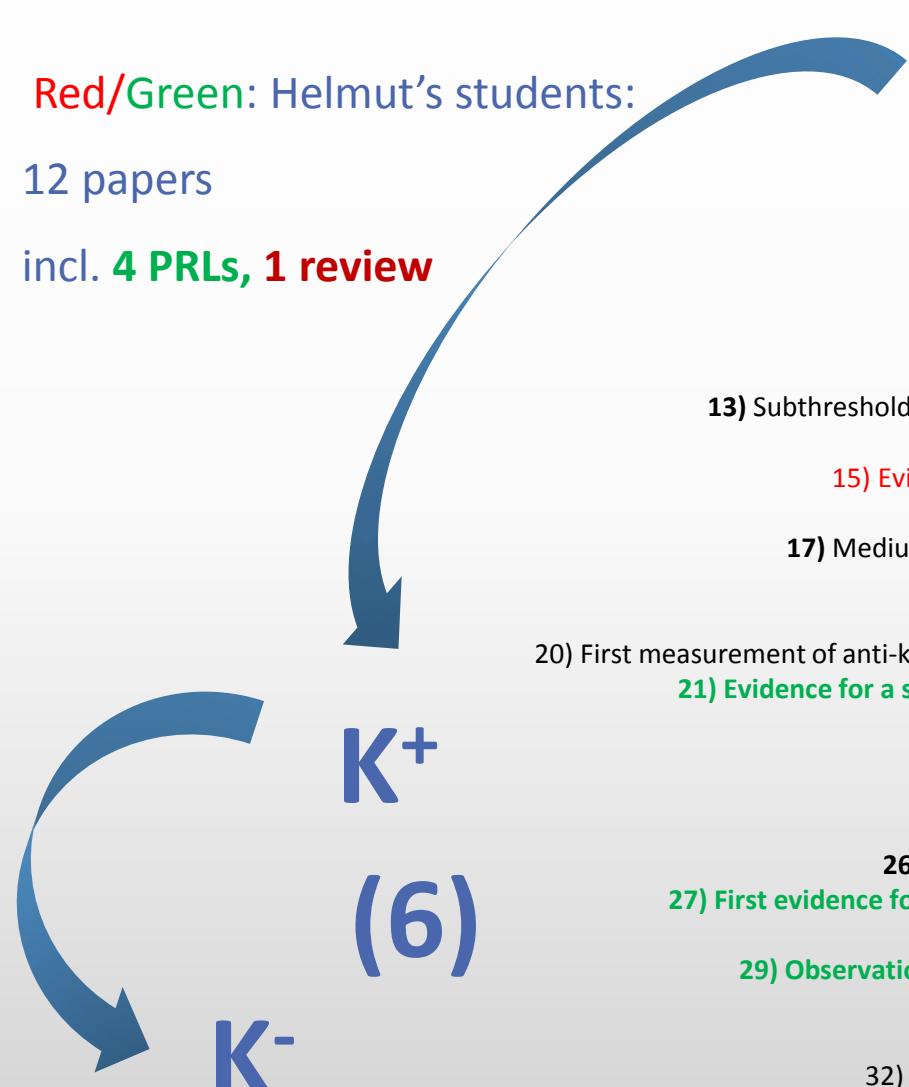
Citation summary results	Citeable papers
Total number of papers analyzed:	<u>28</u>
Gesamtzahl Zitationen:	1,568
Durchschnittliche Zitierung pro Artikel:	56.0
Breakdown of papers by citations:	
Renowned papers (500+)	<u>0</u>
Famous papers (250-499)	<u>0</u>
Very well-known papers (100-249)	<u>4</u>
Well-known papers (50-99)	<u>7</u>
Known papers (10-49)	<u>12</u>
Less known papers (1-9)	<u>3</u>
Unknown papers (0)	<u>2</u>
$h_{\text{HEP}}$ index <a href="#">[2]</a>	20

# Publications – A Focus of Helmut's Work!

- 1) Planned kaon experiments at SIS By KaoS Collaboration (P. Senger et al.).
- 2) Subthreshold kaon production in Au on Au collisions at 1-GeV/u By W. Ahner et al.
- 3) Particle production at SIS energies and the nuclear equation of state By W. Ahner et al.
- 4) The KAON spectrometer at SIS By P. Senger et al.
- 5) Azimuthally anisotropic emission of pions in symmetric heavy ion collisions By D. Brill et al..
- 6) Observation of enhanced subthreshold K+ production in central collisions between heavy nuclei By D. Miskowiec et al..
- 7) Properties of high-energy pions emitted from heavy ion collisions at 1-GeV/nucleon By C. Müntz et al..
- 8) Charged pion production in heavy ion collision at SIS energiesBy KaoS Collaboration (C. Müntz et al.).
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- 10) Kaon production in relativistic nucleus nucleus collisions By KaoS Collaboration (P. Senger et al.).
- 11) On the size of the pion emitting source in heavy ion collisions at 1-A-GeV By A. Wagner et al..
- 12) Pion and kaon emission from the fireball formed in Ne + NaF collisions at 1-GeV/nucleon to 2-GeV/nucleon By W. Ahner et al..
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- 14) Studies of the out-of-plane emission of pions in symmetric heavy ion collisions By D. Brill et al..
- 15) Evidence for different freezeout radii of high-energy and low-energy pions emitted in Au + Au collisions at 1-A/GeV By A. Wagner et al..
- 16) Enhanced out-of-plane emission of K+ mesons observed in Au + Au collisions at 1-A/GeV By KaoS Collaboration (Y. Shin et al.).
- 17) Medium effects in kaon and anti-kaon production in nuclear collisions at subthreshold beam energies By KaoS Collaboration (F. Laue et al.).
- 18) A Measurement of the Coulomb dissociation of B-8 at 254-MeV / nucleon and the B-8 solar neutrino flux By N. Iwasa et al..
- 19) The Emission pattern of high-energy pions: A New probe for the early phase of heavy ion collisions By A. Wagner et al..
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- 28) K+ and K- production in heavy ion collisions at SIS energiesBy KaoS Collaboration (A. Forster et al.).
- 29) Observation of different azimuthal emission patterns for K+ and of K- mesons in heavy ion collisions at 1-A-Gev to 2-A-Gev By F. Uhlig et al..
- 30) Review of the results of the KaoS collaborationBy KaoS Collaboration (A. Forster et al.).
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- 33) Production of K+ and of K- Mesons in Heavy-Ion Collisions from 0.6 to 2.0-A-GeV Incident Energy By A. Forster et al..

# Publications – A Focus of Helmut's Work!

- 33 papers w/ KaoS
- Red/Green: Helmut's students:
- 12 papers
- incl. 4 PRLs, 1 review



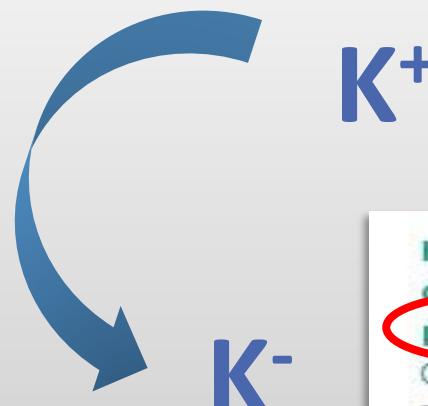
## Pions (5)

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# Reviewing KaoS Results: Reports & Talks



## Pions



### Timing of Heavy Ion Collisions at SIS Energies

Oeschler, Helmut

Darmstadt : Institut für Kernphysik der Technischen Universität Darmstadt, 2000

### Strange particle production from SIS to LHC

Oeschler, Helmut

Darmstadt : Techn. Univ., 2001

Kaon production in heavy ion collisions : which observable is best suited to observe in-medium potentials? : presented at the workshop on...

Oeschler, Helmut

Darmstadt : Inst. für Kernphysik, 2005

### Pion and Kaon Production as a Probe for Hot and Dense Nuclear Matter

Cape Town 1998

Helmut Oeschler<sup>1</sup>

Institut für Kernphysik, Technische Universität Darmstadt,  
D - 64289 Darmstadt, Germany  
for the KaoS Collaboration\*

**Abstract.** The study of particle production in heavy ion reactions represents a valuable tool to extract information on the properties of hot and dense nuclear matter. Pions, kaons and protons were detected in mass-symmetric heavy ion reactions from C+C to Au+Au at incident energies between 0.6 and 2.0 A·GeV with the magnetic spectrometer KaoS installed at SIS, GIS. The study of  $K^+$  mesons is

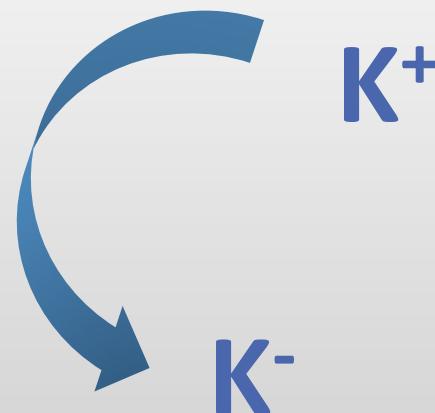
### Interests:

- Systematics & the global picture:
  - Particles
  - Beam energy
- Collision phases
- $T, \mu$

...See the following talks!

## 8 Diploma

- A. Wagner
- A. Sartorius
- P. Baltes
- C. Sturm
- A. Förster
- F. Uhlig
- S. Lang
- A. Schmah



## Pions

## 5 PhDs

- C. Müntz (1993): Origin of **high-energy pions**, Z. Phys. A 352, 1995, A 357, 1997,  
now at Goethe-Univ. Frankfurt
- A. Wagner (1996): Emission pattern of high-energy pions, „**pion clock**“, Coulomb, Phys. Lett. B 420  
1998., Phys. Rev. Lett. 85 (2000),  
now at HZDR Rossendorf
- C. Sturm (2001):  $K^+$  - **EOS/incompressibility of nuclear matter**, Phys. Rev. Lett. 86 (2001),  
now at GSI/FAIR
- A. Förster (2003):  $K^+K^-$  - **Emission times & strangeness exchange** (Au+Au 1.5  
AGeV), Phys. Rev. Lett. 91, 152301 (2003),  
now at ESO Garching
- F. Uhlig (2003):  $\pi K^+K^-$  - **Azimuthal emission patterns** (Ni+Ni), Phys. Rev. Lett. 95, 012301 (2005),  
now at GSI/FAIR

# The Dessert

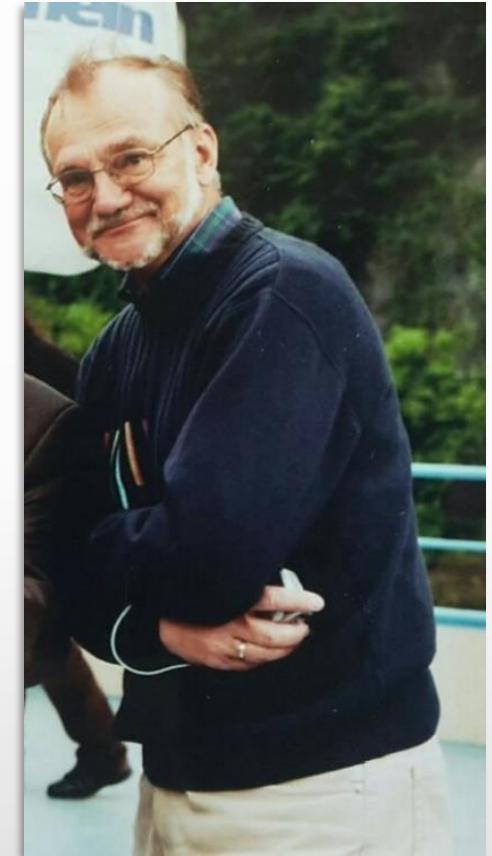


# What KaoS People Wrote & To Take Away...

A collection of quotations taken from **theses credits** of his students:

“Many thanks to Helmut Oeschler for ...

- ... backing me up, and never let me realize who really is **sitting in the drivers seat**
  - ... trustfully **granting freedom and responsibility**
  - ... perfect supervision in all phases, and selecting research subjects with **foresight**
  - ... always be around for help, discussions and **motivation & inspirations**
  - ... **mentoring in science and beyond** questions
- 
- ... your cheerful and **open-hearted nature”**



## Thank You!