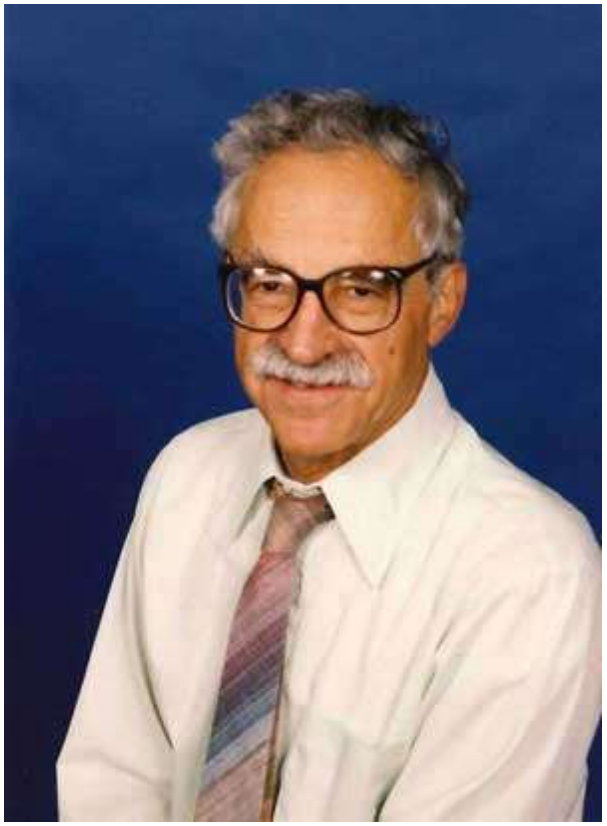
# Symmetry in Subatomic Physics: In Memory of Ernest Henley

Here we focus simply on memories of Ernie (with some symmetry)

As remembered by Steve Ellis

1975 to 2017



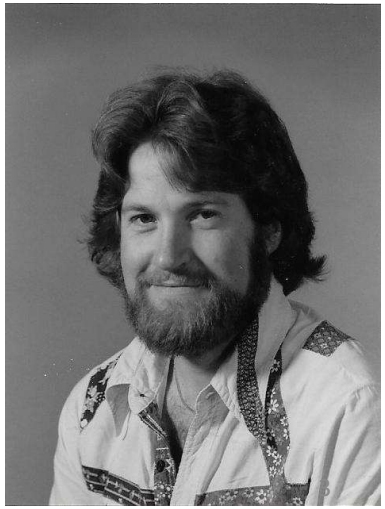
# Summary:

- Ernie was a truly outstanding physicist, instructor, colleague, administrator and human being.
- It was my honor and pleasure to experience Ernie in all of these roles throughout my time at the University of Washington.
- My goal today is to share some of those experiences (a trip down memory lane).

I arrived in Seattle in late summer 1975 to join the THEORY Group

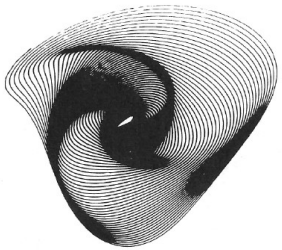
Recall that in those days DoE funding did not distinguish nuclear physics (Medium Energy) from particle physics (High Energy)

The Group = Ernie Henley, Bob Puff, Larry Wilets, Jerry Miller, Lowell Brown, Marshall Baker, David Boulware, Joe Weis, Bob Cahn and Steve Ellis

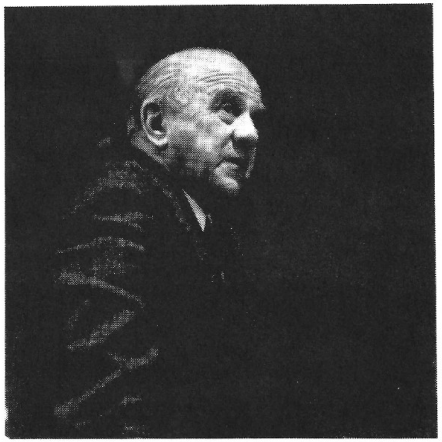


# At this time Ernie was busy serving as the Department Chair (1973 – 1976)

PHYSICS NETWORK*
MAY 11, 1973
Editors: J. Rothberg, L. Brown, E. Watson
NUMBER 1
Editorial Assistant: A. Cronin



## DISTINGUISHED LECTURERS



*Prof. W. Heisenberg* addressed an overflow crowd at a Physics Colloquium in Roethke Auditorium during his recent visit to Seattle. Prof. Heisenberg was introduced by Prof. E. Uehling who had worked with him and recalled many episodes from the early days of quantum theory. Heisenberg's lucid and provocative talk traced the development of some

*Prof. W. Fowler* of Cal. Tech. has addressed the University community at an evening lecture in Kane Hall on Thursday, May 10. He spoke on the Age of the Elements and the Age of the Universe. In addition to his public talk, Prof. Fowler has presented a seminar on the problem of solar neutrinos.

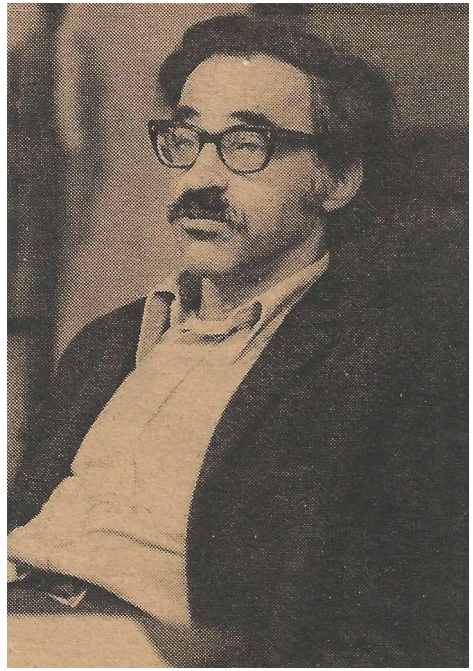
## PROMOTIONS AND NEW ARRIVALS

*Prof. Ernest Henley* has been appointed chairman of the Physics Department.

*Prof. Ronald Geballe* who had served as chairman since 1958 has been appointed to the position of Executive Associate Dean of the College of Arts and Sciences.

*Dr. Kei Moriyasu* has been promoted to Assistant Professor. Dr. Moriyasu will continue to work with the Visual Techniques Laboratory. He received his doctorate at the University of California at Berkeley and then spent a year on an NSF fellowship in Europe. He came to UW in 1971 after having been a research staff member at SLAC from 1968 through 1971.

*Dr. Joseph Weis* has been promoted to Assistant Professor. However,



Later in 1973 in the same “journal”, Ernie showed off his love for his bicycle and his forethought in backing an “energy study”

# PHYSICS NETWORK*

June 8, 1973

*Editors: J. Rothberg, L. Brown, E. Watson*

NUMBER 2 *Editorial Assistant: A. Cronin*


*Chairman proposed energy study (see last page)*

Mikkelsen entered graduate school here in 1971 having done his undergraduate work at Cal. Tech. He is now working on neutron star models with the supervision of Prof. Peters.

Wieman is studying inelastic deuteron scattering at the Nuclear Physics Laboratory. He had spent a considerable amount of time on the engineering and testing of a direct extraction ion source for general use on the Tandem Van de Graaff accelerator. Wieman, who came to UW from Oregon State, expects to finish his dissertation within a year. His thesis adviser is Prof. I. Halpern.

TEACHING AWARDS

*Prof. Michael Schick* has received the 1973 award for "excellence in undergraduate physics teaching." The annual award and plaque were established by the senior class of 1969

## DEPARTMENTAL ACTIVITIES

ENVIRONMENTAL AFFAIRS

Several members of the physics department held an exploratory meeting with Prof. Robert O. Sylvester, chairman of the planning committee for the Institute for Environmental Studies at UW. Although up to this point there has been no formal involvement of the physics faculty with the new Institute, a number of individuals have undertaken projects.

Jack Herbert is working on a thesis problem involving the scattering of light from particulate matter in the atmosphere. This work has application to the measurement of pollutants and is being partially supported by an interdisciplinary grant. Prof. L. Wilets is his thesis adviser.

Since the meeting with Sylvester, three members of the faculty have submitted a proposal to the Institute to support an environmental data project. Professors Brown, Rothberg and Williams hope to assemble data on population, resources, energy usage etc. for various geographical regions and publish these, together with some conversion factors, physical constants and references, in a format similar to the "Particle Properties" booklet.

Prof. Henley has proposed that the I.E.S. set up a committee to study energy problems; members of the physics department would be active participants in such a study.

UW-SFU-UBC CONFERENCE

The 18th annual Northwest Physics Symposium was held on May 11 and 12. The program included several speakers from Simon Fraser University and from the University of British Columbia.

Dr. R. Richardson, UBC, the director of TRIUMF, opened the meeting with a review of progress in constructing the new 500 Mev sector-focussed cyclotron. The Vancouver machine, which is scheduled for completion in about a year, is expected to produce pi-meson intensities nearly competitive with those at LAMPF.

Other speakers included Dr. K. Rieckhoff, SFU; Dr. A. S. Arrott, SFU; and Dr. V. P. Silin from the Lebedev Institute of the Academy of Sciences of the USSR. Informal discussions with UW physicists were held on Saturday morning. Approximately 75 people attended a party at the Long House at the Pacific Science Center on Friday evening. Although plans are not yet firm, the next conference is scheduled to be held at Simon Fraser University.

In that same issue appeared -

## GRADUATE STUDENT NEWS

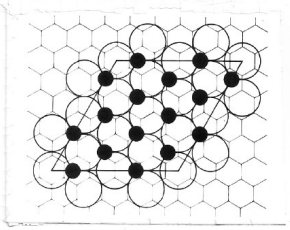
*Larry McLaren* has recently been elected the GPSS Senator from the Physics Department. Pat Cassidy is the alternate.

# The chair baton was passed to Dave Bodansky in late 1976

PHYSICS NETWORK* NOVEMBER 1976

Editors: E.M. Watson & P.C. Peters

NUMBER 4 Editorial Assistant: L. Maddox



Several of them have appeared in numerous debates including radio and TV, and have participated in assorted writing and other endeavors. *Joe Rothberg* was a member of the Seattle 1990 Energy Study Group. All of these activities come under the heading of Public Service.

A face now seen much more frequently around the Physics Department is that of *George Farwell*. He is currently teaching Physics 101 and is expected to teach 102 Winter Quarter.

*Lowell Brown* and *Kenneth Young* attended the XVII International High Energy Conference at Tbilisi, Georgia, Russia this summer. Lowell also travelled a few days to Leningrad and Moscow while Ken journeyed more extensively.

NEW PHYSICS CHAIRMAN

As of December 16, 1976 *David Bodansky* will replace Ernest Henley as the Chairman of this department. This appointment is for 5 years. A warm welcome to our new Chairman.

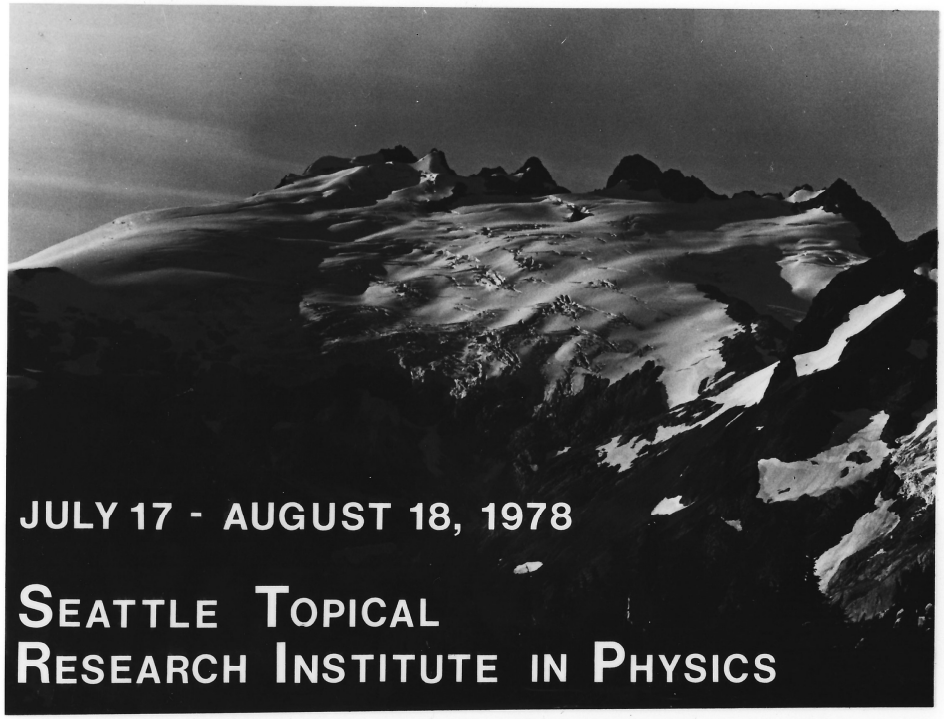
*Vic Cook* has been made Chairman of the Faculty Council for Student Affairs.

The new Vice Provost for Research and Dean of the Graduate School is *Ronald Geballe*.

*David Boulware* has taken on the added

Ernie was regular faculty until agreeing to become Dean of A&S in 1979 (where he stayed until 1987).

# My first collaboration with Ernie – In the late 1970's the Theory Group regularly hosted Summer Institutes (in the days before the ITP and INT)




SUMMER
INSTITUTE
OF
THEORETICAL
PHYSICS
ON
WEAK
INTERACTIONS

Ernie and I hosted this one and this is when I first got to know him.

SUMMER INSTITUTE OF THEORETICAL PHYSICS S Ellis 8/24/78
List of Participants and Dates

| | | | |
|---|---|---|---|
| 1. | Agassi, Dan | University of Rochester | 7/13-8/15 |
| 2. | Carlitz, Robert | University of Pittsburgh | 6/29-9/5 |
| 3. | Close, Frank | University of Virginia | 8/15-8/17 |
| 4. | Costa, Giovanni | University of Padova | 7/15-8/6 |
| 5. | Creamer, Dennis | University of Pittsburgh | 7/15-8/20 |
| 6. | Gunion, J.F. | University of Ca. at Davis | 7/19-9/5 |
| 7. | Haber, Howard | University of Michigan | 7/23-8/20 |
| 8. | Hagiwara, Terry | Ohio State University | 7/16-8/12 |
| 9. | Herczeg, Peter | Los Alamos Scientific Lab. | 7/17-8/4 |
| 10. | Hey, Anthony J.G. | Southampton University | 7/23-8/18 |
| 11. | Hwang, Woei-yann Pauchy | University of Pennsylvania | 7/1- |
| 12. | Kane, Gordon | University of Michigan | 7/16-8/20 |
| 13. | Kayser, Boris | National Science Foundation | 7/23-8/21 |
| 14. | Kelly, Hugh P. | University of Virginia | 7/16-7/21 |
| 15. | Ling-Fong Li | Carnegie-Mellon University | 7/14-8/19 |
| 16. | Londergan, J.T. | Indiana University | 8/9-8/20 |
| 17. | Ma, Ernest | University of Hawaii at Manoa | 7/22-8/18 |
| 18. | Missimer, John | Johannes Gutenberg U. | 7/13-8/18 |
| 19. | Ng, John | University of Alberta | 7/2-8/11 |
| 20. | Ravndal, Finn | University of Oslo | 7/9-8/19 |
| 21. | Sanda, Anthony | Rockefeller University | 7/17-8/4 |
| 22. | Schramm, David N. | University of Chicago | 7/24-8/4 |
| 23. | Serot, Brian D. | Stanford University | 7/13-8/21 |

# Participants provided “testimonials” – Ernie played a central role

SUMMER INSTITUTE OF THEORETICAL PHYSICS
Boris Kayser, National Science Foundation

Note: I think it would be best if my report were not included in any proposal to a funding agency, since I work for one of them.

SUMMER INSTITUTE OF THEORETICAL PHYSICS
P. Hwang, University of Pennsylvania

I am personally involved with the theoretical aspects of parity-violating effects in nuclei. Various communications with E.M. Henley, P. Herczeg, S.Y. Lee, B. Serot, and J. Ng are extremely helpful. An article, of which the abstract is attached, was written during the institute. My collaboration with S.Y. Lee and E.M. Henley on a systematic treatment of the nuclear-physics uncertainties in the study of parity-violating effects has also begun during this period.

I appreciate very much the hospitality of the institute and was inspired a lot by the other participants. My only suggestion is that the organized meetings, which could have stimulated more collaborations among the participants, could be more intensive.

SUMMER INSTITUTE OF THEORETICAL PHYSICS
Howard Haber, University of Michigan

My work here at the summer institute has been in collaboration with Gordy Kane. We set out to study a Higgs system in the context

SUMMER INSTITUTE OF THEORETICAL PHYSICS
John Ng, University of Alberta

I worked on the problem of p converting into $e^+$ in collaboration Dr. Kamal at Rutherford. Discussions with Professor L.F. Li and Dr. P. Herczeg on this problem had been very helpful.

I am also collaborating with Prof. G. Miller on the problem of parity mixing of the deuteron in the polarized electron scattering experiment at SLAC. A third problem I am working on is the effects of the z-boson in $e^+e^- \rightarrow qq \rightarrow$ jets. This project involved Dr. Sanda and Dr. Hagiwara.

The general atmosphere and the social hours are very good. However, the physics library is a total disaster and the preprint library needs a lot of work. It is next to impossible to locate a preprint that is not on the shelf. The SLAC preprint list is not available and most recent published conference proceedings are late in arrival. At least one more telephone should be made available for the Institute. It may be better to have the afternoon coffee hour in the Physics lounge. Same permanent members of the Physics may he more willing to participate. Also the experimentalists should be encouraged to attend this coffee hour.

Thanks for the hospitality, Ernie and Steve.

Another interaction with Ernie in the late 1970's is connected to the question:

Why were there so few physics classes on Thursday in winter quarter?

Ernie was an organizer of a group of senior faculty who regularly spent Thursdays on the slopes. I was lucky and Ernie invited me to participate with the "older" faculty.

– unfortunately I lost the photo with the "gang"

# ASIDE: Ernie as an instructor (again influencing my life!)

In Winter 1977 my wife-to-be Penelope took Physics 122 from Ernie.

Luckily this was a positive enough experience with Physics and Physicists that she was willing to date and then marry me.

# Eventually I did some research with Ernie (1979) – recall the early days of trying to understand QCD!

Volume 89B, number 1 PHYSICS LETTERS 31 December 1979

**PARITY VIOLATION IN HIGH ENERGY LEPTON PAIR PROD**

D.J.E. CALLAWAY, S.D. ELLIS, E.M. HENLEY and W.-Y.P. HW
*University of Washington, Seattle, WA 98195, USA*

Received 13 September 1979

We use the quark–parton model with perturbative QCD corrections in the Weinberg–Salam theory to calculate a parity-violating asymmetry in inclusive lepton pair production. We estimate the asymmetry proportional to the triple correlation $\langle P \cdot l^+ \times l^- \rangle$ of the lepton momenta $l^+$ and $l^-$ and the incident hadron momentum $P$. We find that a nonzero asymmetry requires inclusion of nonperturbative effects.

See parity-violation in this case but depends on non-perturbative structure (phases) – interesting but not predictive.

Among the most fascinating recent developments in elementary particle theory are studies of gauge theories for the weak and strong interactions. The successes of the Weinberg–Salam theory [1] (augmented by the GIM mechanism [2]) are remarkable, and the combination of the quark–parton model [3] with QCD [4] is rapidly becoming a respectable theory. We have used these two theories to study the parity-violating asymmetry $A$ in the cross section for inclusive lepton pair production, in the absence of any polarization, which is proportional to

$$A \sim \langle P \cdot l^+ \times l^- \rangle . \quad (1)$$

Here $P$ is the incident hadron momentum, and $l^+$ and $l^-$ are the momenta of the leptons produced in reactions such as

$$\pi^- + p \to \ell^+ + \ell^- + \cdots , \quad (2a)$$

$$p + p \to \ell^+ + \ell^- + \cdots , \quad (2b)$$

the Drell–Yan process [5]. In this letter we treat $\pi^- p$ collisions, which are dominated by quark–antiquark annihilation between u quarks. Proton–proton collisions will be treated elsewhere.

Relativistically, a nonvanishing asymmetry of eq. (1) requires the presence of a term in the quark–antiquark annihilation cross section proportional to

$$\epsilon^{\mu\nu\omega\rho} \bar{q}_\mu q_\nu l_\omega Q_\rho , \quad (3)$$

where $l \equiv l^+ - l^-$, $Q \equiv l^+ + l^-$, and $q, \bar{q}$ are the quark

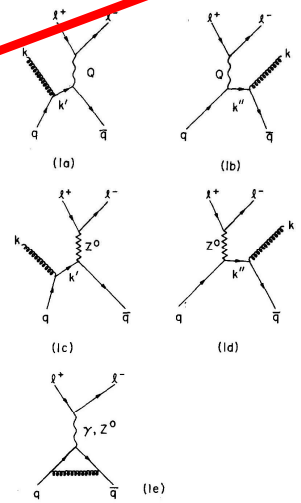



Fig. 1. Diagrams which contribute (except for fig. 1e, see text) to the parity violating asymmetry in the reaction $\pi^- + p \to \ell^+ + \ell^- + \cdots$.

interactions. The theory [1] (aug- 2]) are remarkable, and the combination of the quark–parton model [3] with QCD [4] is rapidly becoming a respectable theory. We have used these two theories to study the par-

In conclusion, we have calculated a polarization-independent parity-violating signal in lepton pair production which is sensitive to the perturbative structure of QCD as well as to a nonperturbative aspect of confinement.

# And then

With polarized beams see interesting structure dependent on polarized quark PDFs, but numerically small effects.

Nuclear Physics B171 (1980) 59–77
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**PARITY AND CHARGE SYMMETRY**
**IN HIGH-ENERGY LEPTON PAIR PR**
**WITH POLARIZED HADRO**

D.J.E. CALLAWAY, S.D. ELLIS, E.M. HENLEY and W-Y.P. HWANG

*Institute for Nuclear Theory*
*and*
*Department of Physics, FM-15, University of Washington, Seattle, Washington 98195, USA*

Received 20 February 1980

With polarized beams or targets the nature of the neutral weak current can be explored in the production of lepton pairs in high-energy hadronic collisions. The production of lepton pair masses of order 10 GeV, if dominated by quark-antiquark annihilation process and described by the Weinberg-Salam theory, will exhibit parity violations of the order of a few tenths of a percent and charge symmetry violations of the order of a few percent due to electro-weak interference terms. Both differential and integrated asymmetries are presented here. The dependence on the polarization of the constituent quarks is discussed with emphasis on how measurements of these asymmetries yield information on the polarized quark distributions.

## 1. Introduction

The production of lepton pairs in hadron-hadron collisions provides us with an excellent laboratory for investigating neutral weak currents. The large dilepton masses which can be produced in such collisions (up to approximately 10 GeV in present experiments) can, in principle, give rise to electromagnetic-weak interference effects of the order of a few percent of the total lepton pair production cross section; the corresponding ratio in deep inelastic electron scattering [1] (with much smaller momentum transfers presently possible) is of order $10^{-4}$. The electromagnetic-weak interference terms in the lepton pair production process give rise to several distinct types of asymmetry. Separate measurements of these asymmetries allow us to probe several aspects of the Weinberg-Salam theory [2] of weak interactions and of our understanding of hadronic structure.

The results presented here rely on the assumption that lepton pair production in hadron-hadron collisions is dominated by quark-antiquark annihilation, the simple Drell-Yan model [3] illustrated in fig. 1. With the inclusion of quark distributions empirically determined to fit the total lepton-pair production cross section [4] in

* Research supported in part by the US Department of Energy.



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polarization of the constituent quarks is discussed with emphasis on how measurements of these
asymmetries yield information on the polarized quark distributions.

In summary, we find that for $Q^2 \approx 100\ \mathrm{GeV}^2$, electro-weak interference in the Weinberg-Salam model leads to a helicity asymmetry of order 0.1%, a charge-helicity asymmetry of order 1% and a charge asymmetry of a few percent. These results are relatively insensitive to the precise form of the polarized quark distributions. However, measurements of the asymmetries, which should soon be possible, with pion (and perhaps antiproton) beams on polarized proton targets will allow the separate measurement of the polarization distribution of u quarks and of d quarks within a polarized proton. Finally we have noted that in proton-proton collisions it may be possible to test the SU(2) symmetry of the sea quarks in a proton by looking for a change in sign of the helicity-dependent asymmetries in the neighborhood of $\tau = Q^2/s \simeq 0.5$.

# Try “Classical” QCD

PHYSICAL REVIEW D VOLUME 22, NUMBER

**Classical chromodynamics of two sources: Charg**

Roger A. Freedman, Lawrence Wilets, Stephen D. El
*Institute for Nuclear Theory and Department of Physics, University of W*

(Received 2 June 1980)

We investigate a system of two static quark sources having both color charges and color magnetic moments. Numerical variational methods are used to find the classical chromodynamical fields generated by these sources. For sufficiently large values of the non-Abelian coupling constant $g$, we observe color screening in this system. It is proposed that this screening effect is related to the instability of color charges found by Mandula.

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## I. INTRODUCTION

Quantum chromodynamics (QCD) is widely regarded as the best candidate for the fundamental field theory of the strong interactic
This status is largely a consequence of the
cess of QCD at describing the short-distar
interaction between quarks. Little is know
however, about the behavior of the theory
large quark separations. Since this state
ignorance is due to the intractability of the
tum field theory problem for QCD in the la
distance regime, much interest has develo
the corresponding problem of the classica
field produced by static quark sources.[1–15]
problem of "classical chromodynamics" re
a nontrivial one since the nonlinearities of the non-Abelian field theory are retained. Studies of classical chromodynamics cannot be expected to resolve the confinement question for QCD, since the confinement mechanism presumably arises at least partially from quantum-mechanical effects which renormalize the (running) coupling constant of the theory. The hope is rather that analysis of the classical problem will provide insight into the structure of the underlying field theory, insight which will be of use for the attack on the full quantum problem.

Several authors have investigated the problems of a single color charge[1–3,5–8,11–14] and of two color charges[4,9,10,15] in classical chromodynamics. In this paper we consider a system of two static sources having both color charges and color magnetic moments. By requiring the magnetic moments to be oriented in color space in a direction which does not commute with that of the color charge, we are able to study a facet of the non-Abelian nature of the static problem not explored previously. Our results indicate that a qualitative change in the nature of the fields generated in this system occurs as the non-Abelian coupling constant $g$ is increased in value. For small values of $g$ the fields behave very much as those in the corresponding electromagnetic problem.

As $g$ is increased beyond a critical value, however, the interaction energy of the two sources decreases more rapidly than the inverse of the separation, indicating that color is screened in

Studied non-linear, non-Abelian field equations numerically, ignoring quantum effects. So confinement insight but interesting results for “electric” versus “magnetic” filed forms.

## II. FIELD THEORY OF THE TWO-SOURCE PROBLEM

We begin with the Lagrangian for QCD,

$$\mathcal{L} = \bar{\psi}(-i\gamma^\mu \partial_\mu - m)\psi - \tfrac{1}{4}F^a_{\mu\nu}F^{\mu\nu a} + g\bar{\psi}\gamma^\mu L^a \psi A^a_\mu \,.$$

Here $\psi$ is th
labeled by t
the gauge gr
$L^a$ are the g
Abelian cou
are

$$F^a_{\mu\nu} = \partial_\mu A^a_\nu - \partial_\nu A^a_\mu - g f^{abc} A^b_\mu A^c_\nu \,,$$

in which $f^{abc}$ is the group structure constant. For SU(2) this is equal to the Levi-Civita tensor $\epsilon^{abc}$. The elements of $F^a_{\mu\nu}$ form the color electric and color magnetic fields $E^a_i$ and $B^a_i$,

$$E^a_i = F^a_{0i} = (-\vec{\nabla}A^a_0 - \partial_0 \vec{A}^a + g f^{abc} A^b_0 \vec{A}^c)_i \,, \qquad (2.3)$$

$$B^a_i = \tfrac{1}{2}\epsilon_{ijk} F^a_{jk} = (\vec{\nabla} \times \vec{A}^a + \tfrac{1}{2} g f^{abc} \vec{A}^b \times \vec{A}^c)_i \,. \qquad (2.4)$$

In order to consider the limit of static quark sources, we discard in Eq. (2.1) the first term (which refers to the dynamics of the quarks) and replace the dynamical quark current $g\bar{\psi}\gamma^\mu L^a \psi$ by

In conclusion, our analysis of the problem of
have considered, the magnetic moments play
an important role in this screening effect. Since
real quarks have magnetic moments, such stud-
substantial
nding of the
r quarks
and antiquarks.

Characteristic of those days results were limited by “restructions on computer time”.

# Update on the junior collaborators – successful careers having benefited from interactions with Ernie

**David J. E. Callaway** is a biological nanophysicist in the New York University School of Medicine, where he is Professor and Laboratory Director. He was was previously an associate professor at the Rockefeller University after positions at CERN and Los Alamos National Laboratory. Callaway's laboratory discovered potential therapeutics for Alzheimer's disease based upon apomorphine· after an earlier paper of his developed models of Alzheimer amyloid formation. Plus he is a serious mountain climber.

**Roger Freedman** is on the faculty at UCSB specializing in Physics Instruction. He shares authorship of four well-known physics texts.

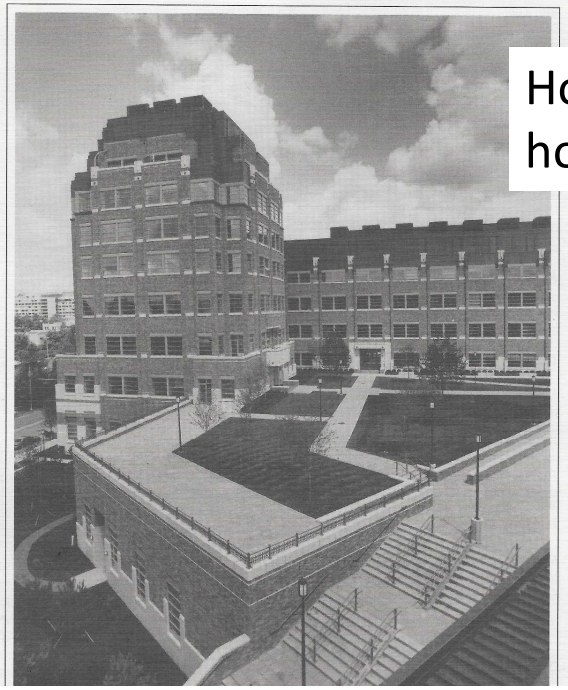
The next impact Ernie had on my life was the inspiration that one can survive being Chair of the Physics Department – I accepted that task in 1994 (-1999)

UNIVERSITY OF WASHINGTON

PHYSICS

VOL. 4, NO. 1
1995

As Ernie had predicted, I did survive and even enjoyed parts of the job!



NEW BUILDING AND FIVE NEW

The new Physics/Astronomy building complex, which opened in 1994, has won favorable responses from architects, city leaders, and—most importantly—

However, the only 2 times I have been in the hospital overnight were during this period!

## MESSAGE FROM THE CHAIR

Steve Ellis

Hello. I am pleased, in this my first report as Chair of the Department of Physics, to look back on a year marked by exciting events: new faces, a new building, new activities and, for me, a new job. The articles in this newsletter focus primarily on the new faculty. In this letter, let me briefly introduce the new building and some new activities.

Two rather extraordinary events helped us inaugurate the

welcome to the rest of the campus community. This evening marked the first time that a regular academic building has served as host to the Dinner. At both of these events, our guests had ample opportunity to experience and

's much-touted beauty (see the ar-

were also impressed by those fea-

dly affect the occupants of the

pports and enhances our work.

ors in both education and research

ilding. The laboratory spaces, for example, are larger and more functional than in the old building. Delicate experiments are no longer periodically disrupted by the vibration of students walking by the labs on their way to lectures; the new laboratories are physically separated from classroom traffic. We finally have an adequate place to build a clean room and keep it clean (a feature essential for several programs including the SNO research effort described in this newsletter). The machine shop has a larger and more modern home, providing space for a new computerized milling machine and an evaporator that allows us to fabricate our own laser diodes. Other design decisions also were made with the needs of research in mind. Stray magnetic fields due to the elevators are minimized by using stainless steel rather than iron (but our new location seems to offer its own challenges: fields from nearby electric bus routes and a power substation).

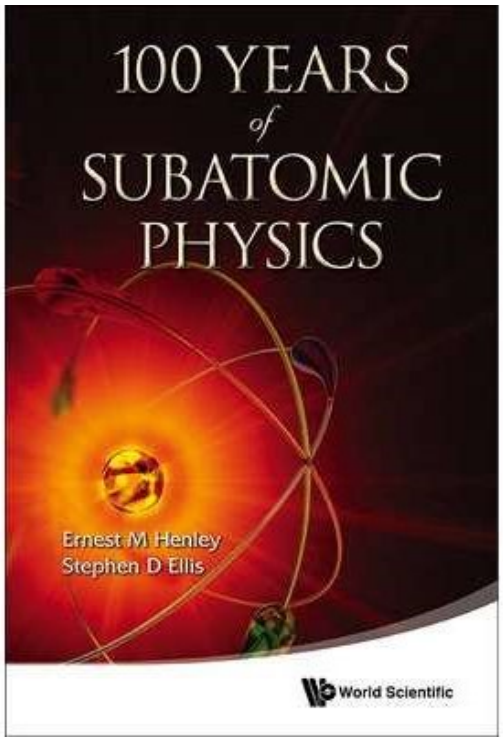
The four new lecture halls have wonderful acoustical properties and marvelous multiple banks of blackboards. Perhaps less apparent but just as important for both education and research are the well designed public spaces that pro-

vide inviting opportunities for interactions among faculty

Steve Ellis

# ASIDE: Ernie (and Jerry) at Marshall Baker fete in 2002:

My final professional interaction with Ernie (2012-13) was when he again "hired" me as his assistant to prepare -




We collaborated to choose contributors. Then he would make the invitation and I was the "muscle" to encourage the submission of the article.

Page 11 – "The Early Years and Beyond", Henley and Garcia

Page 155 – "Parity- and Time-Reversal Tests in Nuclear Physics", Hertzog and Ramsey-Musolf

Page 171 – "High Energy Nuclear Physics'", McLerran

Page 343 – "Jets and QCD", Ellis and Soper

# Summary:

- Ernie was a truly outstanding physicist, instructor, colleague, administrator and human being.

- It was my honor and pleasure to experience Ernie in all of these roles throughout my time at the University of Washington.

- I hope my shared experiences illustrated Ernie's special talents as a physicist and a human being. He had a very positive influence on the lives of many of us and he will not be forgotten.