

MEETINGS

Regge-Cut Theory Yields Encouraging Results

The idea that the analytic structure of partial-wave scattering amplitudes as functions of the angular momentum might determine many properties of the complete scattering amplitude has been extremely important in recent studies of high-energy scattering. Tullio Regge, in 1959, originally investigated this idea for potential scattering. In that case the amplitudes have only simple poles (Regge poles) in angular momentum. The positions of these poles are functions of the energy. The resulting Regge trajectories determine both the location and properties of resonances and behavior of scattering amplitudes at large momentum transfers.

The basic ideas of the Regge description of scattering amplitudes have been taken over into high-energy physics. Here the Regge poles determine not only the behavior of resonances in a given channel, say $A + B \rightarrow C + D$ but also the high-energy behavior of scattering amplitude in the crossed channel $A + \bar{C} \rightarrow \bar{B} + D$.

Considerable effort has been devoted over the past nine years to application of simple Regge-pole models to the description of high-energy reactions. The models have been remarkably successful. Among the many successes are:

- Resonances in a given reaction and high-energy behavior in the crossed channel of that reaction are correlated through the trajectory.

- The model generally explains the presence, shape and energy dependence of both forward and backward peaks in a great number of high-energy reactions. In particular, virtually all elastic and inelastic meson-baryon reactions can be described in terms of only a few Regge poles.

- A single trajectory can contribute to several reactions. The contribution of this pole is proportional to its residue, which factors into two pieces. Each piece depends on a given pair of the external particles, and this fact allows correlation of the magnitudes and energy dependencies of the forward and backward peaks in reactions involving the same trajectories and external-particle pairs.

- At certain known values of the trajectory function the contribution of a Regge amplitude vanishes. This disappearance normally leads to dips in the cross section.

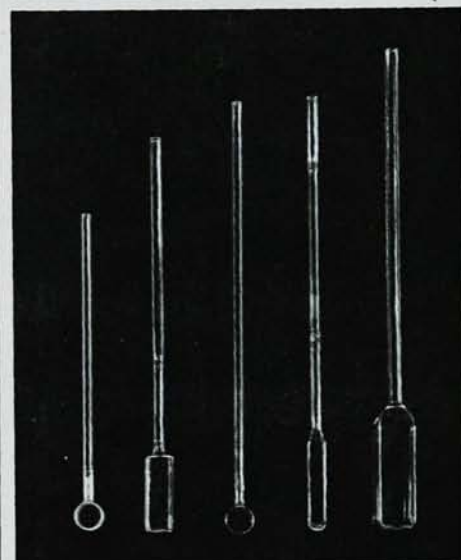
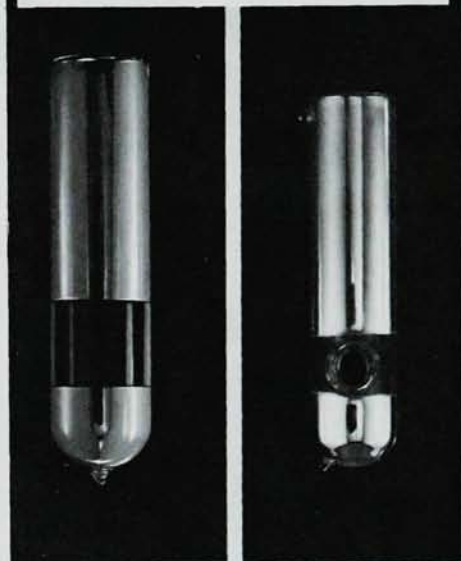
These predictions are borne out in many reactions—for example, in meson-baryon reactions near the backward direction. On the other hand, some features of the high-energy data are difficult to explain with a pure Regge-pole model. In order to understand these features of the data, phenomenologists have incorporated another type of angular-momentum singularity, Regge-cuts, into their analysis.

Regge cuts. That such singularities must exist in a relativistic theory, as opposed to potential theory, has been known for some time. In particular, V. N. Gribov and Isaak Y. Pomeranchuk showed on very general grounds that there must be an essential singularity at $j = -1$. Stanley Mandelstam showed this singularity could be put on a second Riemann sheet of the j plane and made harmless if there exist appropriate j -plane cuts. The properties of such cuts have, therefore, been of much theoretical interest.

Work on Regge cuts in both phenomenology and theory has recently been very active, with encouraging results. To examine the phenomenological and theoretical work on Regge cuts a topical conference was held at the University of Wisconsin at Madison, 23–25 April 1969. The conference was arranged to coincide with the last three days of the 1969 Spring Institute for Theoretical Physics at the University of Wisconsin.

The theory of Regge cuts is not as well developed as one might wish. For phenomenological applications one uses rather simple models, not based on very fundamental theory. On the other hand, theoretical studies that have established the existence and some properties of Regge cuts are based primarily on model field theories, and they do not yield predictions specific enough for phenomenology. As might be expected, the conference divided rather clearly into several parts: phenomenological studies,

FUSED QUARTZ dewars & cells



APPLICATION:

Low Temperature investigations for U.V., Visible, and I.R. Fused Quartz Dewars in round or with flat window configurations are available from stock. All cells and Dewars utilize fused construction throughout. No frit glasses are used. Cell path lengths are available from 0.5 MM up. Diameters available from 10 MM up. Window material may be suprasil, ultrasil, homosil, infrasil or optosil. Special cells and Dewars made to order as well as a complete line of Quartz instrumentation. For information and literature, Write: Worden Quartz Products, Inc.

P.O. Box 36010
Houston, Texas 77036

how about a computer ad with a few specs for a change.

PDP-15 comes in four versions, for four different classes of applications, and at four different prices. Read and believe. It's straight stuff.

PDP-15/10 Basic System hardware contains 4,096 18-bit words of 800 nanosecond core memory. Complete autonomy of central processor, input-output processor, and memory. TTL integrated-circuit construction. 1.6 microsecond add time. System prewired for expansion by plug-in. ASR-33 console teleprinter included. Software is COMPACT system, including assembler, editor, ODT (Octal Debugging Technique), Math Package, basic I-O monitor for 8K configuration, hardware read-in mode punch routine, teletype I-O routines, octal dump routine, memory scan routine, and paper tape handling routines. \$16,500.

PDP-15/20 Advanced Monitor System hardware contains 8,192 18-bit words of 800 nanosecond core memory, the KSR-35 teletype, two DECtape transports and control unit, a high speed paper tape reader and punch, and an extended arithmetic element for high speed arithmetic operations and register manipulation. Software is the ADVANCED MONITOR SYSTEM, including a systems loader, command decoder, IOPS data-handling, device handling, and interrupt routines, real-time clock

here's the PDP-15



handler, error detector program, device assignment tables, FORTRAN IV, FOCAL, macro assembler (MACRO-15), Dynamic Debugging Technique (DDT), Text editor, peripheral Interchange Program (PIP-15), linking loader, and chain and execute. \$36,000.

PDP-15/30 Background/Foreground System hardware has 16,384 18-bit words of 800 nanosecond core memory, the KSR-35 teletype, the extended arithmetic element, an automatic priority interrupt system, a memory protect

system, a high speed paper tape reader and punch, three DECtape transports and control unit, a real-time clock, and a second on-line teletype for background use. The software includes the Background-Foreground Monitor System which combines all the Advanced Monitor functions of the PDP-15/20 with concurrent execution of real-time foreground tasks and program development, or other low priority background computation. \$58,000.

PDP-15/40 Disk-Oriented Background/Foreground System hardware contains 24,576 18-bit words of 800 nanosecond core memory, the KSR-35 teletype, the automatic priority interrupt system, a memory-protect system, high speed paper tape reader & punch, two DECtape transports and control unit, an RF15 DECdisc control and two RS09 random access disk files, a real-time clock, and a second on-line teletype for background use. The software includes a disk oriented version of all the software available for the PDP-15/30, allowing concurrent execution of real-time tasks and background computation, and, of course, all the features of the Advanced Monitor system described as software for the PDP-15/20. \$91,000.

There. You have it. If you want more, write. A brochure describes the systems architecture in detail.

digital
COMPUTERS • MODULES

DIGITAL EQUIPMENT CORPORATION
Maynard, Massachusetts 01754.

model field-theory calculations, and intermediate work that attempts to establish a bridge between the two.

Models. Marc Ross (Michigan) surveyed the commonly used models for Regge cuts and the phenomenological situation. Most theoretical studies employ Feynman-diagram models with crossed lines. Such graphs are nonplanar and require the presence of a third spectral function. These cuts have a definite signature, which is generally believed to be correct and which can correctly shield the Gribov-Pomeranchuk essential singularity. For phenomenological applications, the more commonly used models are based on multiple-scattering theory or absorptive corrections. The theoretical basis for these models is not yet complete. Some of the important features of the data that they must fit are the crossover of particle-particle and particle-antiparticle differential cross-sections, polarization data, loss of exchange degeneracy for residues, and antishrinkage. As we mentioned above, there are striking dips in many differential cross sections in the simple Regge-pole model, because of what are technically known as "nonsense-wrong-signature zeros." Cut-pole interference can also produce dips, and an outstanding task for phenomenology is to distinguish the two mechanisms.

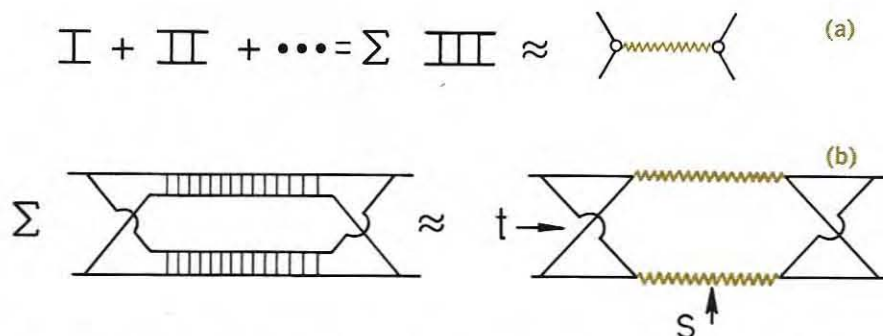
Field theory. In Feynman-graph techniques, surveyed for the conference by Clifford Risk (Michigan), one considers a class of Feynman diagrams, extracts the asymptotic be-

havior from the Feynman integral, and sums all graphs. One of the more common models is the sum of ladder graphs in ϕ^3 theory, shown in part a of the figure. This sum produces a moving pole in the angular-momentum plane, and consequently ladder sums are a conventional approximation to Regge poles in models for cuts, such as that (due to Mandelstam) illustrated in part b of the figure.

John Polkinghorne (Cambridge) described t -channel iterations of the Mandelstam diagram (figure, b). This calculation produces a result compatible with t -channel unitarity and is necessary in order to remove the Gribov-Pomeranchuk essential singularity at $l = -1$. The asymptotic behavior of the integrated sum differs from the original cut contribution only by a factor $(\log \log s)^{-2}$.

For the treatment of certain cut models, as well as for multi-Reggeon exchange amplitudes, it would be useful to have a Feynman-like Reggeon calculus. Ian Drummond (Cambridge) described work on the general vertex function $f(\alpha_1\alpha_2)$ for the coupling of two Reggeons to an elementary particle. These general results were checked in two specific models for the Reggeon lines and their couplings. Related work on the three-Reggeon vertex $F(\alpha_1\alpha_2\alpha_3)$ was described by Peter Landshoff (Cambridge). The result reduces in the appropriate way to $f(\alpha_1\alpha_2)$ and to two-particle-one-Reggeon vertices.

Quantum electrodynamics. These calculations were all limited to spinless-field theories. Calculations in a realistic field theory that incorporates



TWO CLASSES OF FEYNMAN DIAGRAMS in ϕ^3 theory, used as models for a simple Regge pole (in a, above) and a Regge cut (in b, below). In a the sum of all planar diagrams for the exchange of n elementary particles behaves, for large s , as a single t -channel Regge pole. (The Regge pole is represented by the colored wavy line.) Part b of the figure shows a model for a moving Regge cut. Here double Regge-pole exchange is required. To produce a cut the diagram must be nonplanar—hence the crossed particle-exchange lines at the ends. As in part a, the model for the Regge poles is a sum of ladder graphs.

ONE SIEMENS RWO CAN REPLACE TWO EVEN THREE BWO's

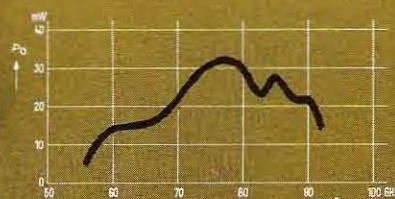
UP TO 30 GHz BANDWIDTHS FOR:

- MICROWAVE SPECTROSCOPY
- PLASMA RESEARCH
- RADIO ASTRONOMY
- PHYSICAL & CHEMICAL RESEARCH



Check These Frequency Ranges:

TYPE	FREQ. RANGE (GHz)	AVG Po
RWO 40	26.5-40	60 MW
RWO 60	40 -60	20 MW
RWO 80	60 -90	5 MW



And These Features:

- Highest power output of any BWO with comparable bandwidth.
- Guaranteed life 2000 hours (Average life 5000 hours)
- Wide Bandwidth—only three tubes cover 26.5—90 GHz
- All tubes can be served by one power supply. (Type RWON-14)

For Complete Information, Contact:

SIEMENS

Components Division
350 Fifth Ave., New York, N. Y. 10001

Meet ALICE.* She's the newest fusion experiment at the Lawrence Radiation Laboratory, Livermore, Calif.⁽¹⁾ Her superconducting magnet provides stable confinement for hydrogen plasma for controlled thermonuclear fusion. It will create a magnetic well and exert force on the electrically charged particles of the plasma. Material containers are just not suitable.

Shaped like a baseball (unladylike, but efficient), her magnet will produce a cusped magnetic field close to 20 kG in the center and up to 75 kG at the conductor.

She's girdled in Supercon super-

conductor that permits the economic achievement of steady-state fields in large coils and a corresponding ease of accessibility to the center of the coil. Alice's $\frac{1}{4}$ -inch square conductor will carry 2400 amperes during operation.

But, Alice is only wearing one style of Supercon superconductor. Supercon has supplied superconductive materials in strips as large as 2" w. x 0.10" th. and in wires as small as .0032" dia. Supercon can make superconductors larger, smaller, or anywhere in between and in lengths that will simplify your winding operation.

Supercon is the world's largest manufacturer of superconductors. We handle its fabrication from ingot to finished conductor. Our research group is constantly refining our product and manufacturing methods. They'd love to get wound up in your next project and suggest the best Supercon conductor for it. For information, contact: Norton Company, Supercon Division, 9 Erie Drive, Natick, Massachusetts 01760

*Adiabatic Low Energy Injection and Containment Experiment.

(1) Operated for Atomic Energy Commission by University of Calif.

ALICE IS ALL WRAPPED UP IN SUPERCON.



Superconductor used to power Alice's magnet



NORTON

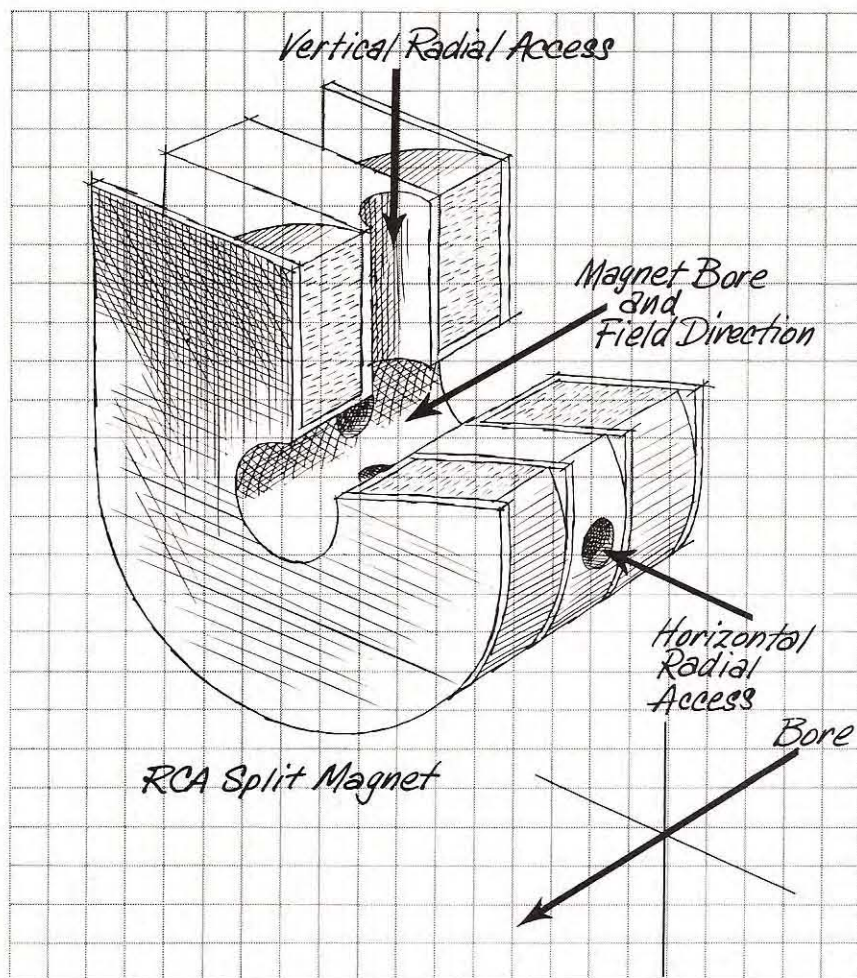
SUPERCON DIVISION

spin, namely, quantum electrodynamics, were described by Tai T. Wu (Harvard). The processes $e^-e^- \rightarrow e^-e^-$, $e^-e^+ \rightarrow e^-e^+$, $\gamma e^- \rightarrow \gamma e^-$, $\gamma\gamma \rightarrow \gamma\gamma$ and the scattering of electrons and gammas by an external field have been examined up to order e^8 . Because internal electron lines carry spin, one gets asymptotic contributions from certain graphs that are of higher order than one would expect from the spinless theories. For each order in e^2 elaborate cancellations occur in the asymptotic limit between graphs with crossed and uncrossed lines, and one must go to high order to find contributions of the type expected to dominate asymptotically.

Keiji Kikkawa (Wisconsin) described a calculation that produces Regge cuts from duality amplitudes. Such amplitudes are the nontree-diagram generalization of the Veneziano model. The planar graphs were previously found to produce corrections to the linear Veneziano trajectory while maintaining crossing symmetry. Certain classes of nonplanar graphs were shown to produce Regge-cut contributions.

Corrections. Field-theory calculations do not usually lead to simple phenomenological predictions. Absorptive corrections, which produce Regge cuts, are more often used. Frank Henyey (Michigan) discussed the derivation of absorptive cuts from Feynman-diagram models. He focused our attention on the box diagram whose sides are Reggeons. To produce a Regge cut, the ladders that serve as models for the Reggeons must include crossed rungs. Considerable effort is required to obtain a relative pole-cut phase that produces destructive interference.

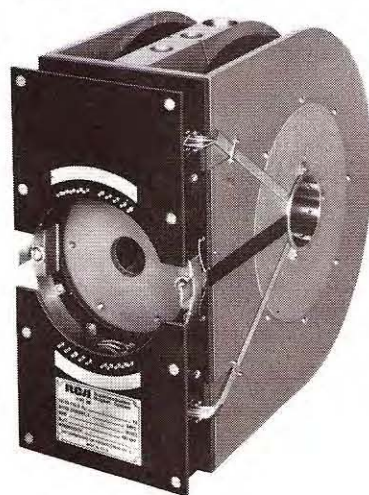
In a related vein, Antonio Pagnamenta (Rutgers) discussed high-energy scattering in multiple-scattering models. In collisions of particles composed of clusters of two, three, four and infinitely many constituents, the Glauber series converges well. These models fit the proton-proton scattering data, but it is not possible to differentiate the models on experimental grounds. David Harrington (Rutgers) compared, in potential theory, the high-energy limit of the multiple-scattering series with Glauber theory. He showed that the two theories agree because of cancellations in the multiple-scattering series. This



Look Into This 100 kG Split-coil Magnet for Research Versatility!

- 2.5" horizontal bore
- Four 1.2" optical access ports at right angles to each other
- Uniform 100 kG field
- Homogeneity to within 0.4% in 1 cm spherical volume

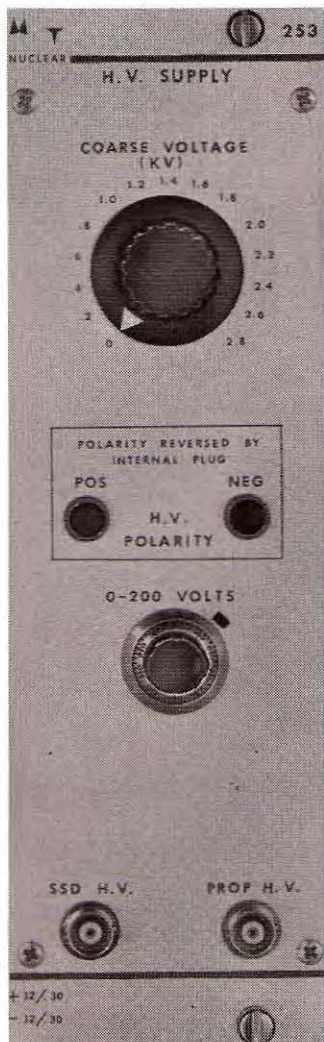
—and the unit can be "tailored" to the exact needs of your project. If your project involves high magnetic fields, your plans should involve RCA. Pick from superconductive magnets with ranges from 20 to 150 kG field, bore sizes from 1" to 20" and homogeneities to within 0.001% / cm. For full information on the range of RCA Superconductive Magnets and matched system components or RCA copper-clad Nb₃Sn ribbons, write: Marketing Manager, RCA Superconductive Products, Section I-159DC, 415 South 5th Street, Harrison, N.J. 07029



RCA



HIGH VOLTAGE POWER SUPPLY



NEW

"Maximized Value Design"

... Model 253 provides operating bias for high resolution Ge(Li) spectrometers. ■ Noise and ripple less than 200 μ V rms (10Hz-2MHz) ■ Voltage control to 3K vdc ■ Front-end protection during bias voltage adjustment ■ Fast delivery ... \$450.00. For more information, write or call collect (312) 344-2212

Mech-Tronics

NUCLEAR

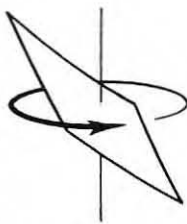
1723 North 25th Avenue • Melrose Park, Illinois 60160



SUPERCONDUCTING

SUPERCONDUCTING MAGNETS

SUPERCONDUCTING MAGNET SYSTEMS



MAGNETIC CORPORATION of AMERICA

67 ROGERS STREET
CAMBRIDGE, MASS. 02142
(617) 868-3300

*Conception, Engineering and Fabrication
All Shapes and Sizes
Inquiries Invited*

MEETINGS

agreement suggests that the Regge cuts predicted by Glauber theory may actually be present, even though they are absent in the complete double-scattering term.

Diffraction models for the high-energy proton-proton differential cross section are able to explain the data fairly successfully in terms of the proton electromagnetic form factor. So it would be desirable to have an expression for the form factor in terms of strong-interaction quantities. An initial step in this direction has been taken by Richard Arnold (Argonne), who described a calculation based on cut dominance and the Fubini-Dashen-Gell-Mann sum rule, which reproduces the relation between the proton-proton cross section and the proton form factor.

Raymond Rivers (Chicago) presented an absorption model based on the inclusion of nonelastic (two-body) intermediate states in the *s*-channel unitarity sum. Absorptive corrections to the Regge amplitude were expressed in terms of certain cross-section ratios. Rudolph Hwa (Stony Brook) described a bootstrap of the Pomeron cut. The model begins with unitarity (saturated by two intermediate-state resonances) and crossing, and it relies on the bootstrap to produce Regge behavior.

Phenomenology. The remainder of the conference was primarily devoted to accounts of fits to data based on Regge-cut models. Because fewer secondary trajectories are used in such models, the number of adjustable parameters may be smaller than in a pure pole model. On the other hand, as the cut contribution is not factorizable, the predictive power of these models may be somewhat weaker.

Arnold gave a survey of fits with Regge cuts and with other models in elastic and charge-exchange scattering. Attention was focused on models that begin with either a fixed or moving *l*-plane pole in the Born term. The full amplitude containing a Regge cut is generated, for example, by an absorptive calculation such as the eikonal model. Arnold discussed the work of a number of groups who use these methods. In addition, he presented a detailed model incorporating exchange-degenerate Regge poles, which fits the forward-elastic and charge-exchange data and the polarization. Cuts in this model are essen-

tially minor corrections to the pure pole model. In particular, dips are still produced by nonsense-wrong-signature zeros in the pole amplitudes.

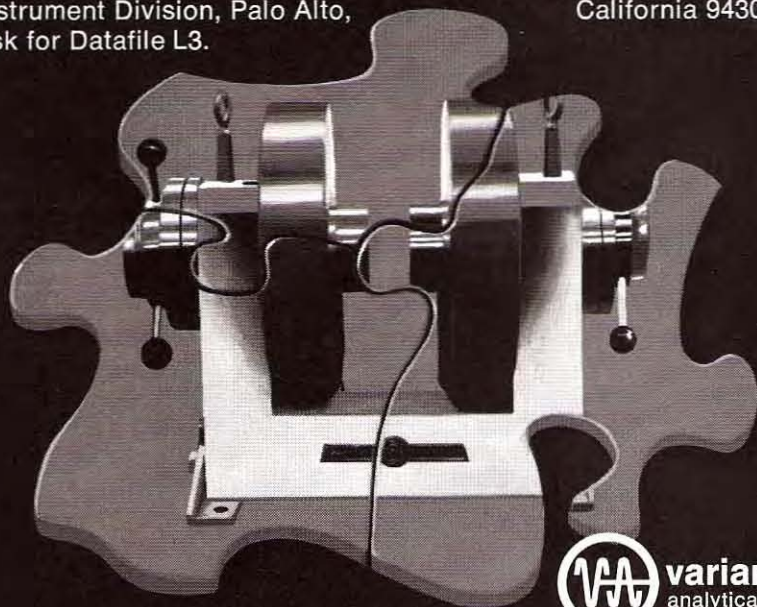
Gordon Kane (Michigan) described the results of extensive calculations for inelastic processes with a Regge-exchange plus absorptive-cut model. The absorptive-cut correction term involves an extra adjustable parameter to account for the effect of inelastic absorptive states. The cut contribution in this model, in contrast to that of Arnold, is of a size comparable to the pole contribution. The pole and cut contributions interfere destructively; this interference can produce dips in the cross section; so the data can be fitted without assuming nonsense-wrong-signature zeros as in the pure Regge-pole model. In addition the cut contribution decreases as spin-flip increases; so the dip position depends upon the helicity. A careful examination of the backward-scattering region should be able to distinguish the pole-cut and the pole model. Christopher Michael (Wisconsin), however, described the practical difficulties in distinguishing the pole-cut model from a pure pole model that incorporates additional secondary trajectories. Each model possesses enough freedom in its parameters to fit most reactions. Processes connected by crossing to exotic channels (those in which no single Regge exchange is allowed) provide a possible means of unambiguously detecting cut contributions through their characteristic energy dependence.

Bernard Margolis (McGill) discussed the predictions of various versions of the eikonal approximation—in particular, the Frautschi-Margolis model for proton-proton scattering. The predictions are: The forward peak will eventually shrink; the elastic differential cross section will continue to fall; the total cross section will eventually rise slightly; the forward real-to-imaginary ratio will change sign, and cuts contribute a definite and substantial amount to forward scattering.

Absorptive corrections to the Regge-exchange term can be introduced through the unitarity relation. Henri Navelet (Saclay) described such a calculation and fits to pion-nucleon, kaon-nucleon and nucleon-nucleon elastic-scattering and charge-exchange reactions. The absorptive correction is essentially a Regge-cut term, and good fits were obtained. Ronald Mickens (Massachusetts Institute of

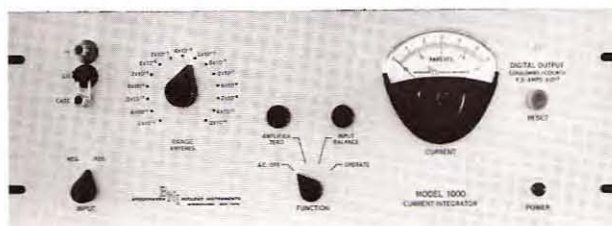
We've got all the pieces for small magnets.

We choose the right system to fit your applications (teaching, applied research) from almost 100 combinations of 4", 6", 6½" magnets plus power supplies. Budget-conscious prices, versatile quality systems, field measuring accessories, and technical backup from the precision-magnet leader. Varian, Analytical Instrument Division, Palo Alto, California 94303. Ask for Datafile L3.



varian
analytical
instrument
division

Model 1000 Current Integrator



- **UNPRECEDENTED ACCURACY** — .02% of full scale.
- **PERMANENT CALIBRATION** — no user adjustment required; accuracy is maintained by the highest long-term stability achievable at the present state of the art.
- **HIGH RESOLUTION** — 100 pps eliminates need for interpolating meters; permits direct connection to automatic data processing systems.
- **EXTREMELY LOW INPUT IMPEDANCE** — .1 microvolt input voltage drop; eliminates errors due to leakage from target to ground; no loss of accuracy with water-cooled targets.
- **WIDE RANGE** — 15 ranges from 2 na to 20 ma F. S.
- **CHOPPER STABILIZATION** — solid-state chopper stabilized input amplifier eliminates drift.
- **VERSATILITY** — accepts inputs of either polarity - pulses or dc.
- **OFFSET ADJUST** — adjustable input balancing current to neutralize thermal emf's and leakage in external circuit; special mode of operation provided to permit very accurate balancing.
- **CURRENT INDICATION** — panel meter provides continuous indication of input current.
- **AUTOMATIC DEAD TIME CORRECTION** — output may be inhibited by dead time signal from pulse height analyzer, etc.
- **ISOLATED GROUND** — common input terminal may be grounded anywhere in experimental system to avoid ground loops.

Our users include Government Laboratories, Universities and leading accelerator manufacturers throughout the world.

BROOKHAVEN INSTRUMENTS CORPORATION

BOX 212

PHONE 516-289-1617

BROOKHAVEN, N. Y. 11719

NIM standard power supply for digital modules



Type IV NUCLEAR INSTRUMENTATION BIN POWER SUPPLY

The Power Designs Model AEC-320-7 conforms to the requirements of a Type IV Bin Power Supply per TID-20893 addendum of September 16, 1968.

It provides three regulated outputs: $\pm 6\text{VDC}$ at 10 amperes from either source and $+12\text{VDC}$ at one ampere, with a maximum supply output rating of 72 VA. Built-in over-voltage crowbar circuits protect modules against damage.

Power input and output routing connectors permit interbin bussing of voltages not available in the power supply.

The Model AEC-320-7 is manufactured to the high quality standards demanded by on-line nuclear instrumentation.

Discounts are available to AEC laboratories, cost contractors, research and educational institutions.

Write or call for technical data.

power designs, inc.

Power Designs Pacific, Inc.
3381 Miranda Avenue, Palo Alto, California 94304
Tel: 415-321-6111 • TWX: 910-373-1251



Power Designs, Inc.
1700 Shames Drive, Westbury, New York 11590
Tel: 516-333-6200 • TWX: 910-373-1251

Technology) suggested that destructive interference between pole and cut is not always necessary. Calculations of the forward real-to-imaginary ratio for both phase choices in Pomeron models were unable to decide which phase is correct.

The current position. In model field theories, the existence of Regge cuts appears to be well established, along with the location of the branch point and the signature. Furthermore, in these models one can find cuts with the properties required to mask the Gribov-Pomeranchuk essential singularity. It is not clear that any other cut properties, in particular the phase relative to the pole, have been rigorously established. In addition, all models consider only limited classes of graphs. Subtle cancellations can occur when one considers larger classes. Much more work is needed to establish firmly the other properties of Regge cuts.

The popular phenomenological Regge-cut models have no outstanding difficulties in fitting data, but the question of whether cuts are required by the present data is somewhat controversial. These models are based in one way or another on absorptive or unitarity corrections. It is certainly clear that such corrections are related to Regge cuts, but none of these models has any rigorous theoretical foundation. In particular, although the absorption models yield a relative pole-cut phase that seems to be verified by experiment, they lack crossing and hence do not produce a signatured contribution. Signature essentially must be put in by hand. Finally, the popular cut models do not even agree on the strength of the cut contribution and have somewhat different physical implications. Firmer theoretical underpinnings would greatly increase the predictive power of these models.

* * *

The 1969 Spring Institute for Theoretical Physics was supported by the Advanced Science Seminar Project of the National Science Foundation, and the Regge Cut Conference, a part of the institute, was sponsored jointly by the University of Michigan and the University of Wisconsin. The proceedings will be available from the department of physics, University of Wisconsin.

PAUL M. FISHBANE
L. M. SIMMONS, JR
University of Wisconsin □

We've got all the pieces for 9" magnets.

We choose the right system to fit your applications (NMR, EPR, optical, Hall-effect, etc.) from more than 200 combinations of standard and high-field 9" magnets plus current- or field-regulated power supplies. High quality, compact modular design, low prices, technical backup from the precision-magnet leader. Varian, Analytical Instrument Division, Palo Alto, California 94303. Ask for Datafile L4.



varian
analytical
instrument
division

Lock in



simplified
retrieval of
noise buried
signals with

Ithaco's 353 Phase-Lock amplifier

- no tuning required
- phase and gain not affected by adjustment or drift in reference frequency
- adapts automatically to virtually any reference input
- ultra stable, highly linear detector—no overload at 1,000 : 1 noise to signal ratio
- 1.0 Hz to 200 KHz operation

- plug-in construction permits addition of new or specialized features—prevents obsolescence

For further information and complete specifications contact:

607 272-7640
ITHACO INC.
413 TAUGHANNOCK BLVD., ITHACA, N.Y. 14850