Congratulations on this 80th anniversary of an accelerator laboratory at Notre Dame from Ingo, Kirby, Mark, Paul, Sergio and Sam –The FSU Friends

How did ND get to its current prominence? – Recent history (1977-present)

In mid 1970s DOE and NSF decided there were too many nuclear physics accelerator facilities and rumors started that there would be a culling of labs and only those with "Outstanding Science" would survive

ND Lab leadership was worried about future research at ND as they had heard the rumors (Browne, Chagnon, Darden,Funk, Mihelich)

response- Kolata hire 1977

Jim brought heavy-ion physics to Indiana through Heavy-Ion Resonances

PHYSICAL REVIEW C VOLUME 21, NUMBER 2 FEBRUAR Y 1980

Inclusive alpha-particle production in the $^{12}C + ^{12}C$ reaction

J. J. Kolata, R. E. Malmin, P. A. DeYoung, S. Davis, and R. Luhn

Uniuersity of Notre Dame, Notre Dame, Indiana 46556

(Received 17 September 1979)

To cull labs the NSF started a series of “shootouts”

1979 11 labs reviewed 2 lost funding afterwards

After shoot out in 1979 Garg hired in 1982

1982 Mail review of 7 labs which we never got to see the results. Cal Tech and Stony Brook had been declared world class and were not reviewed. Wisconsin was dropped by DOE and added to NSF

Hires after this review were Wiescher in 1986, Aprahamian in 1989 and the rest is history

1993 8 labs reviewed: result was Cal Tech and Stony Brook still world class with FSU and ND lauded

1996 another review and FSU, ND and Stony Brook were kept

Report of the NSF Special Emphasis Panel on the NSF Low Energy Nuclear Physics Laboratories Feb 1993

The Panel noted with pleasure that the much younger than Cal Tech astrophysics program at Notre Dame has reached the level of international leadership, and promises to continue on this trajectory. –**Another component of the astrophysics effort at ND involves the excellent work with radioactive beams of ^{8}Li and ^{6}He. The experimental work is complemented by an active theoretical effort by Wiescher in collaboration with a number of the world's leading nuclear astrophysics theorists.**

Overall evaluation of individual laboratories

Caltech and Stony Brook clearly represent a world class effort on a broad scale. The overall effort and future potential in terms of a 'bloc" program is considered excellent at Florida State and Notre Dame. The other four laboratories, Penn, Princeton, Rochester and Wisconsin represent very good science with unique potential and world class efforts in selected areas.

How CASPAR saved my career!

The importance of heavy-ion reactions in nuclear physics

NSAC was formed in 1977 and in 1979 formed a subcommittee to investigate the possible physics of heavy-ion reactions and what fraction of the overall nuclear physics budget should go into this area of nuclear physics.

At the time leaders of nuclear physics thought heavy-ion interactions were too complex to provide useful information.

Some experimental developments completely changed the field. The sputter ion source made heavy ion beams easily available at tandems as did the ECR source for cyclotrons. In addition the fear of damaging Ge gamma ray detectors by using them with beams rather than with decay products eased and so new information with long runs of beam on target and the greatly improved gamma ray energy resolution completely changed our physics emphasis.

Some takeaways from the 1979 Heavy-Ion report were that multiparticle transfer could be carried out, the possible production of “high spin” states, knowledge from Coulomb excitation and possible fragmentation processes were all reasons to have a heavy-ion physics program in the US

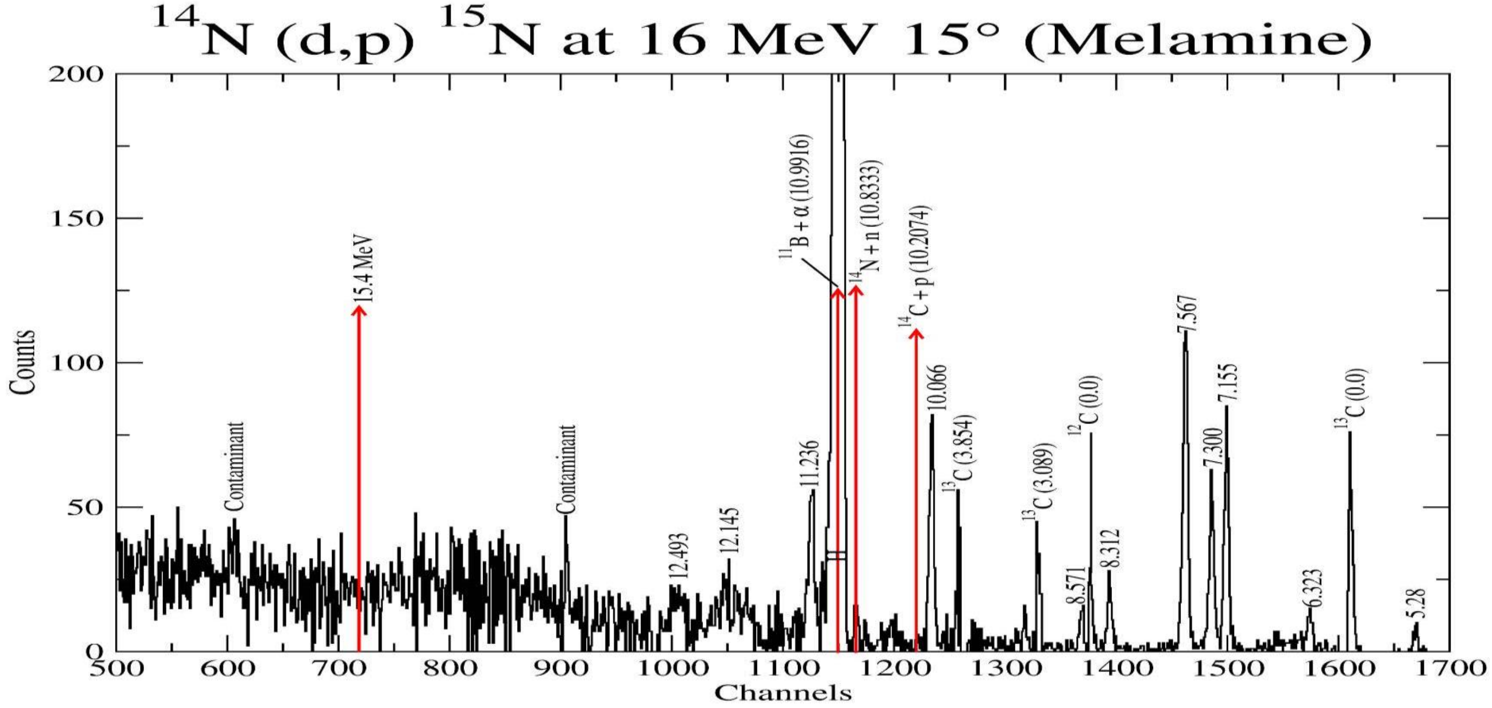
In 1978 one third of all papers published in the Physical Review involved heavy ions-

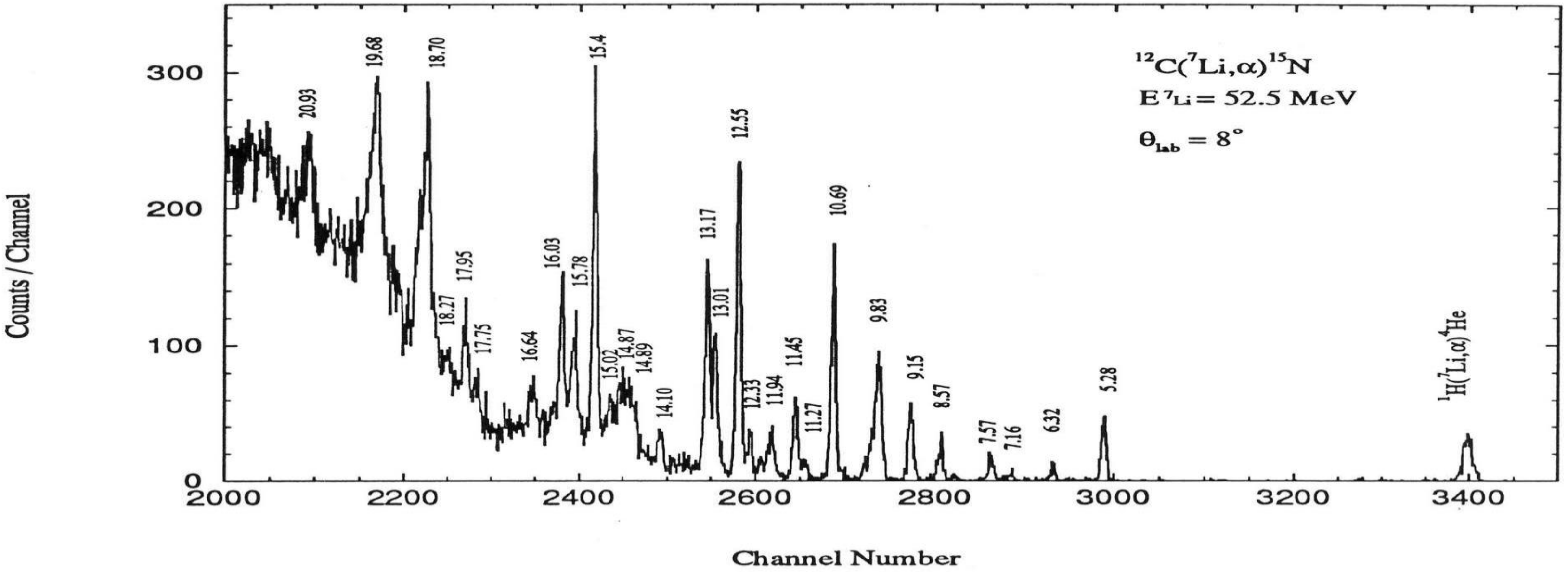
The sticking point was that in this report they envisioned moving from local facilities to national facilities because of the cost of heavy ion detection systems.

How could the agencies help with this transition?

The report states that because of the complexity of the data, more co-authors might appear on papers and the survey showed that the number of co-authors on heavy ion papers averaged 7 but that one paper had 11 co-authors

It was agreed with the agencies that one third of the nuclear physics budget would go to heavy-ion physics
(Their definition of a heavy ion was one with A>4)





Low lying levels are "single particle" but as you can see there is a rich spectrum all the way up to 20 MeV in excitation

By doing $^{12}C(^{6}Li,t/^{3}He)$ mirror states in the two products ^{15}N,^{15}O could be easily identified.

However, with this reaction you have what became known as angular momentum mis-match and so high spin states should be favored. Peak at 10.7 MeV in ^{15}N should have high spin

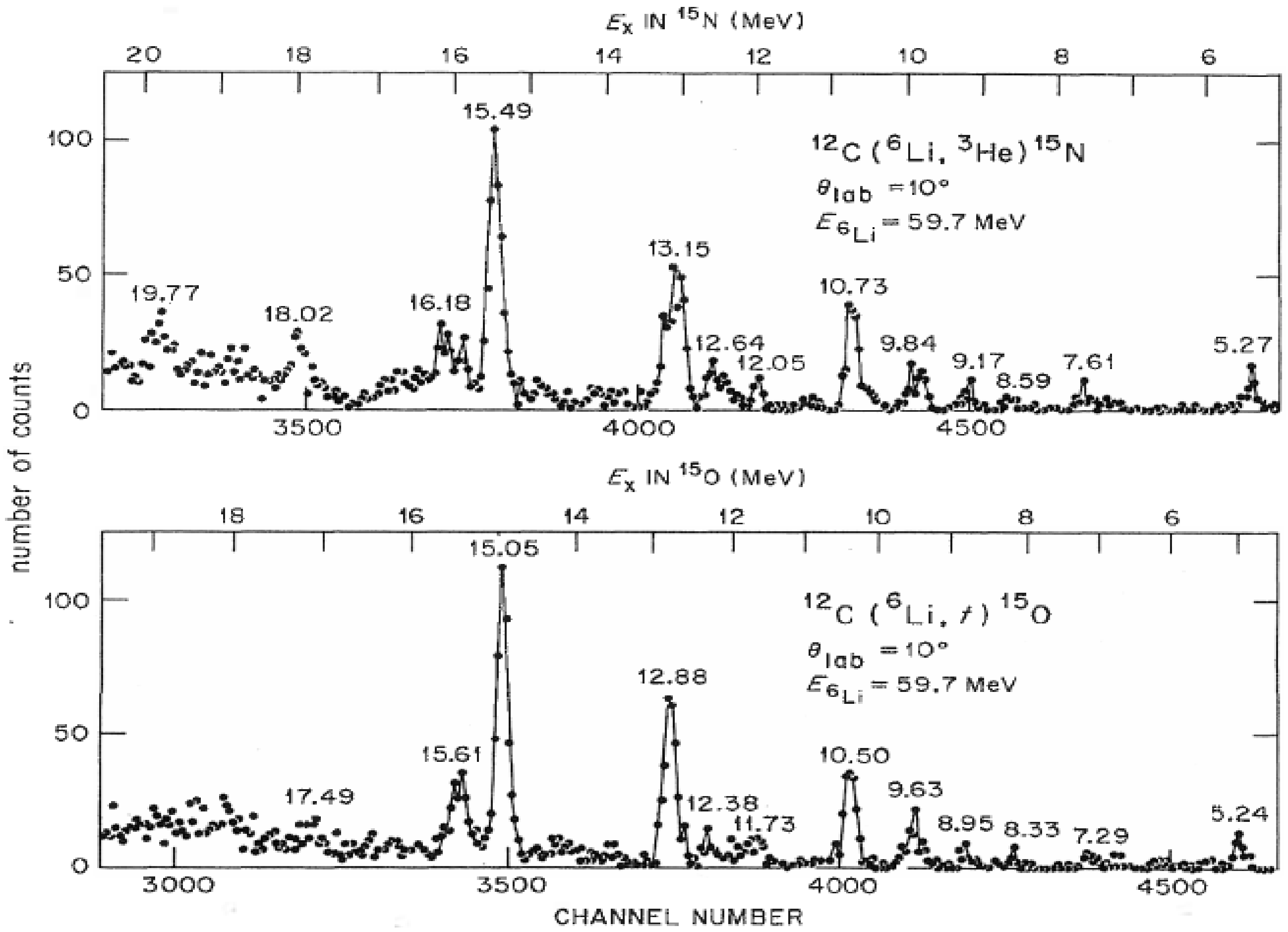


FIG. 2. Energy spectra from the $^{12}C(^{6}Li, ^{3}He)$ and $^{12}C(^{6}Li, t)$ reactions taken simultaneously. The energy scales were inferred from the energies of known low-lying states.

Known Energy Levels in ^{15}N in 1974

Ex	Jπ;
9.9250	3/ 2 –
10.0660	3/ 2 +
10.4497	5/ 2 −
10.5333	5/ 2 +
10.7019	3 /2 −
10.804	3/ 2 +

Note that at 10.7 MeV there is only a 3/2- state known.
We are stuck since heavy ions can't be understood

Physics Letters B

Volume 56, Issue 3, 28 April 1975, Pages 253-254

Discovery of a 9/2+ state in ^{15}N☆

R.P.Beukens[1] T.E.Drake[1] A.E.Litherland[1]

https://doi.org/10.1016/0370-2693(75)90388-3Get rights and content

Abstract

A new resonance has been discovered in the $^{14}C(p, \gamma)^{15}N$ reaction at E_p = 519 keV (E_x = 10.693 MeV) with Γ > 40 meV and $\omega\gamma$ = 2.4 ± 0.5 meV. This state is assigned Jπ=9/2+ and is identified with a predicted Jπ=9/2+ 3p−4h state. The E3 ground-state decay of the 7/2+(7.56 MeV) level was also observed and the branching ratio was determined to be (1.3 ± 0.6)%.

Known Energy Levels in ^{15}N in 1975

Ex	Jπ;
9.9250	3/ 2 –
10.0660	3/ 2 +
10.4497	5/ 2 −
10.5333	5/ 2 +
10.6932	9/ 2 +
10.7019	3 /2 −
10.804	3/ 2 +

We were saved by the CASPAR JN Van de Graff

So again Notre Dame nuclear physics group, congratulations on making this important milestone of 80 years

NSF Labs in 1979
Cal Tech
FSU
Maryland
Notre Dame
Pennsylvania
Pittsburgh
Princeton
Rochester
Rutgers
Stanford
Stony Brook

NSF Lab reviews 1982
FSU
Notre Dame
Pennsylvania
Pittsburgh
Princeton
Rochester
Rutgers
Wisconsin

Cal Tech Stony Brook world class not reviewed

NSF Low Energy Lab review 1993
Cal Tech
FSU
Notre Dame
Pennsylvania
Princeton
Rochester
Stony Brook
Wisconsin

Polarization Studies at ND

ND was known for having an excellent beam of polarized protons and deuterons and under Darden led to many assignments of spins and parities of nuclei through the (d,p) reaction.

Polarized Spin-One Particles

S. E. Darden

Citation: American Journal of Physics 35, 727 (1967);
View online: https://doi.org/10.1119/1.1974228
View Table of Contents: http://aapt.scitation.org/toc/ajp/35/8
Published by the American Association of Physics Teachers

Abstract

A simplified treatment of polarization effects in scattering of spin-one particles is presented. The analogy between spin moments and electric multipole moments is exploited. Elementary physical arguments illustrating the mechanism of polarization are given for two specific interactions.

gestions; to Professor R. E. Peierls and the Department of Theoretical Physics at Oxford for generous hospitality and the appropriate atmosphere for doing the work represented by the foregoing; to Miss Margaret Bradfield for an excellent job of difficult typing; to my wife for valuable proofreading assistance; and to the late Professors Darwin and Fowler for providing the only approach to quantum statistical mechanics that I have ever been able to understand.

Polarized Spin-One Particles*

S. E. Darden
Department of Physics, University of Notre Dame, Notre Dame, Indiana
(Received 2 January 1967)

A simplified treatment of polarization effects in scattering of spin-one particles is presented. The analogy between spin moments and electric multipole moments is exploited. Elementary physical arguments illustrating the mechanism of polarization are given for two specific interactions.

INTRODUCTION

THERE exists, at the present time, a vast amount of literature covering both theoretical and experimental aspects of spin polarization in nuclear scattering and reactions. Although most of this literature pertains to nucleon polarization, a significant amount of it is devoted to the consideration of spin-one particles. Since these treatments are generally at a fairly advanced level, it seems worthwhile to present an elementary treatment of spin-one polarization, similar to the discussion[1] of nucleon polarization which appeared recently in this Journal. Owing to the greater complexity of spin-one phenomena, a somewhat more detailed presentation than for nucleons is required. None of the results given here are new, but an attempt has been made to explain the most important results in as simple and physical a way as possible.

I. DESCRIPTION OF BEAMS OF SPIN-ONE PARTICLES

Some aspects of spin-one polarization are better understood if a comparison with spin-½ polarization is made. Accordingly, some results for spin-½ polarization are reviewed briefly here. It is important, at the outset, to distinguish between pure spin states and mixed spin states. The distinction between these two types of states can be better understood by comparison with the familiar case of plane-polarized light. If a light beam is represented by a single electromagnetic wave having **E** and **H** fields

$$\begin{aligned} \mathbf{E}(\mathbf{r},t) &= \mathbf{E}_o \exp[i(\mathbf{k}\cdot\mathbf{r}-\omega t)], \\ \mathbf{H}(\mathbf{r},t) &= \mathbf{H}_o \exp[i(\mathbf{k}\cdot\mathbf{r}-\omega t)], \end{aligned} \tag{1}$$

it is 100% plane polarized, with the plane of polarization given by $\mathbf{E}_o$. This is an example of a pure state. In order to describe an unpolarized or partially plane-polarized light beam, an incoherent mixture of waves of the type (1), polarized in perpendicular directions, can be used. In such cases, the beam is said to be in a mixed state. The degree of polarization is conventionally expressed as

$$P=(I_{\perp}-I_{\parallel})/(I_{\perp}+I_{\parallel}), \tag{2}$$

where $I_{\perp}$ and $I_{\parallel}$ denote the intensities of the two plane-polarized beams making up the mixture. The counterpart in a system of spin-½ particles of a 100%-polarized light wave is a completely polarized beam, which is again said to be in a pure state. The particle spins are all quantized along the direction of polarization,

* Work supported in part by U. S. Office of Naval Research under Contract No. Nonr-1623(05).

[1] H. H. Barschall, Am. J. Phys. 35, 119 (1967).

Enter the era of radioactive beam physics-a brilliant move

PHYSICAL REVIEW C VOLUME 40, NUMBER 3 September 1989
Measurements of discrete nuclear reactions induced by a radioactive 8Li beam
F. D. Becchetti, W. Z. Liu, D. A. Roberts, and J. W. Janecke
Department of Physics, The University of Michigan, Ann Arbor, Michigan 48109
J. J. Kolata, A. Morsad, X. J. Kong, and R. E. Warner
Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556
(Received 24 May 1989)

PHYSICAL REVIEW C VOLUME 43, NUMBER 2 FEBRUARY 1991
Scattering of ^{6}He from ^{197}Au, ^{nat}Ti, Al, ^{nat}C, and ^{9}Be at E =8—9 MeV
R. J. Smith, J. J. Kolata, K. Lamkin, and A. Morsad
Physics Department, University of Notre Dame, Notre Dame, Indiana 46556
K. Ashktorab, F. D. Becchetti, J. A. Brown, J. W. Janecke, W. Z. Liu, and D. A. Roberts
Physics Department, University of Michigan, Ann Arbor, Michigan 48I09
(Received 3 October 1990)


Westcott Building, Florida State University, Tallahassee.
Kirby Kemper