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Tenth LAMPF Users Meeting

November 7-9, 1976

by

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ABSTRACT

The following talk was given before the Tenth LAMPF Users Meeting to report on the progress made at the Clinton P. Anderson Meson Physics Facility.

We meet at a happy time for LAMPF, perhaps the happiest time yet since the start of these meetings. And the reason for the happy time is shown in Table I.

TABLE I

MILESTONES

Official Ground Breaking	2/15/68
Major Construction Funds Released	10/12/68
5 MeV Beam Achieved	6/10/70
100 MeV Beam Achieved	6/21/71
211 MeV Beam Achieved	8/27/71
800 MeV Beam Achieved	6/9/72
Dedication to Clinton P. Anderson	9/29/72
First Simultaneous H^+ and H^- Beams	5/4/73
First Experiment (#56) Received Beam (Area B)	8/24/73
Beam to Area A, First Mesons Identified	8/26/73
Beam to Area A-East	2/6/74
Usable 100 μA Beam to Switchyard	9/5/74
First Radiotherapy Treatment Trial	10/21/74
Start of Great Shutdown, 79 Experiments Run, 13 Completed	12/24/74
Acceptable Simultaneous 100 μA H^+ and 3 μA H^- Beams to Switchyard	9/14/75
First Pions Through EPICS Channel	3/18/76
Production Beam in Area A and Area A-East, End of Great Shutdown	4/5/76
100 μA Production Beam	8/15/76
200 μA Beam to Beam Stop	10/23/76
HRS Achieved 100 keV Resolution	11/1/76

This year is the 14th anniversary of the first official memorandum proposing that a meson factory be built at LASL. And here in this table you see the milestones, all of which we have behind us and you see the progression of goals as they were attained. Outstanding of course, is the fact that real funds for LAMPF construction were not released until October 1968. And not quite four years from that time we had full energy beam. And since then we have enjoyed one success after another. Since we last met, just in one year, a number of very important milestones have occurred. As Harold Agnew, Director of LASL, has told you, the Great Shutdown appears to have been a great success. We have, since that Great Shutdown, gone into production at 100 μA . We have also provided to ERDA, the first time, a schedule for final achievement of design intensity of the facility. In order to meet that schedule we must continually upgrade the intensity, which means improving our understanding of the performance of the accelerator. The problems ahead of us involve going from 100- μA production to 1-mA. We see none that appear insurmountable. One of the reasons why I am happier than usual at this particular time is that some people may recall that 12-14 years ago many experts told us that no way can we control 100 μA , much less 1 mA, with beam loss of less than 1%. Now these were people we respected and I would not be telling the truth if I didn't admit that I was worried about it. In fact, I was worried enough that I started to drink coffee.

Not very frequently, but on occasion. However, as of this point in time, I am tapering off on my coffee as I am not as worried as I once was. We are going to meet our objectives and it looks like we will even surpass the promises we made 10-12 years ago as to the capabilities which this facility will provide.

Figure 1 shows you a very recent achievement. Chairman Lind has told you that at this point in time all of the secondary beam lines are complete and all of them, with the exception of the WNR beam line, are in operation and doing experiments of one kind or another. And the WNR beam line will be in operation within the next 3-4 months.

Now, one of the biggest achievements in terms of secondary beam line capabilities is in fact the HRS spectrometer. I should remind you that this is the one facility which we did not have in our original plans for immediate implementation at LAMPF. We considered that as an add-on which we would start constructing about now. However, you, the Users Group, especially George Igo, Harry Palevsky, Norton Hantz—I cannot remember all who were involved—decided that you could not wait until now to start building the HRS. You wanted an HRS working by now (in fact, before now!) and so you went to Rogosa and said, "We must have two and one-half million dollars for a high-resolution spectrometer. This is an extremely important field for nuclear science." The Division of Physical Research decided to strike a bargain. McDaniel told me, "O.K., we will put up the \$2.5M if you will find \$1M from your construction funds to construct the building that will house HRS." I agreed to do this and provided the building while DPR provided the \$2.5M (actually it went somewhat beyond that before it was finished). HRS is now complete and working, and this is the first spectrum which was obtained a few days ago, shown in Fig. 2. The point here is that the resolution we promised you was 100 keV. It is now 85 keV, which I am told is a world record.

I mentioned to you that ERDA is very anxious to understand, in real time, how the intensity to be obtained will proceed as a function of time. Of course any of these time scales, any schedule we make, is predicated on development of construction that goes along with it. I am sure all of you understand that. But with the budget that we

Fig. 1. Final configuration of the HRS in Area C.

Fig. 2. Energy resolution obtained at 85 keV (FWHM) for $p + {}^{208}\text{Bi}$ elastic scattering at 25° laboratory scattering angle.

actually proposed 10 years ago (we have not deviated from those Operations Budgets), we have arrived, sometime ago, at this schedule and timetable. I convened a committee with Darragh Nagle as chairman, and including many of our senior people, who worked very hard for a number of months to document how we could safely, reliably, and in an orderly way, without terrible disruption to the really large experimental program which is already under way, get to our design performance. Now I realize that more than 75% of the 300 and more proposals we have received can be done, and done very well, with 100 μA of beam. However, the other 25% contains some of the gems in both practical applications and in basic research for which LAMPF was constructed.

Figure 3 shows the schedule which we gave to ERDA. We were scheduled to get to 100 μ A November 1. We actually beat that by some months, perhaps two. We will now stay at 100 μ A in production while we try to develop beams which will take us to the next level at 300 μ A. Now at that level, at Phase III level, even the biomedical people who have the biggest appetite for beam, perhaps with the exception of the neutrino people, will be reasonably happy. And the neutrino people, at this level, can essentially start seeing neutrinos in a very respectable way.

So this is the schedule that we hope to follow for the next three years.

Now that we have achieved 100 μ A and that we have 8 to 12 experiments running simultaneously at any given time, we must change our priorities a bit. Up until now we were worried enough about the accelerator that it essentially got everything it wanted. And if there was a question as to where our resources had to go, the accelerator won out. Now we must see a change in the level of support in various areas. We must better balance the support we give to the experimental areas, the beam-stop areas, the switchyard and the research effort. We are in the process of starting to do that. This has entailed some organizational changes. We have established an Associate Division Leader for Experimental Areas, and he is Lewis Agnew. He still remains head of the experimental area group, MP-7. In addition we have established a physics group on secondary beam lines. We are very fortunate to have Bob Macek as head of that group. It is that group that is going to have to understand the switchyard, the primary beam lines, the secondary beam lines, and have enough redundancy in their control to avoid a catastrophe as we operate at 100 μ A and increase the beam to higher and higher intensities.

Now, in addition, you know that we have the Program Advisory Committee (PAC). That body we appoint mainly from nominations which you, the Users, make. Those members have 3-year appointments. One-third of the members are replaced every year. This has worked very well. In addition, as we focus more on research, we have established a number of supplementary committees. Darragh Nagle heads up, and has the main responsibility, for coordinating the research overall for this facility. He heads up a Research Review Committee, an internal one, and tries

Fig. 3. Schedule for LAMPF current upgrading (fiscal year).

to maintain surveillance, understanding and guidance of the research programs, especially those in-house, to try to make certain that we have a balanced program and that we are moving in the directions which we have agreed upon.

In addition, with Ed Knapp we have had a Committee on Practical Applications. Now Ed, as Harold Agnew told you, is moving to P Division. As I told MP Division just a few days ago, we view this not as losing a son but as gaining a daughter, and she is not all that bad-looking either. And she comes from a well-to-do family, so we are going to make use of the fact that Ed is in P Division and he will have supervision over WNR and, as I told Harold, if he doesn't look too closely he will not be able to tell the difference between the two divisions, we are going to work together so closely. WNR is a very important part of our activities.

I might mention to you that the Russians have decided to build a meson factory. They had a delegation here at Los Alamos which ERDA approved and they studied here and worked with us for some weeks.

There is a very important and interesting point here. Two or three years ago when Harold was visited by the Regents of the University of California he invited me to give a talk. Edward Teller was among them. As I talked I told them about all the programs we are doing and I told them about WNR. I reminded them that ten years ago, I argued to the Joint Committee that they should provide funds for this add-on for a reason not all of them liked. The reason I gave them was that sooner or later, whether we like it or not, there is going to be a comprehensive test ban. When that occurs they are going to

desperately wish for a means to maintain a high level of accomplishment in national defense activities based on nuclear weapons. As I said this I could see Edward Teller was not completely convinced, and finally when I had finished he said, "It is a very interesting concept but it will never happen. There will never be a test ban in our lifetime." Well, I think Edward may be wrong. Especially with the change in administration, I think it is not completely out of the question that such a test ban will occur and this will make the WNR add-on to this facility of prime importance for the national safety of this country. The point is that I believe our U.S.S.R. colleagues have perceived this and that they may also be looking to their meson factory as a means for maintaining parity with us in the event of a test ban which could represent a great savings to both countries.

So, if you are lucky, you do not have to be smart. It looks like we did the right things a decade ago. That we focused on the right goals and that we built the right facility for the next 10 or 20 or how many years.

Additional changes along with Ed Knapp's moving had to be made, and Jim Bradbury will now take over the Practical Applications Group. I think we are very fortunate to have Jim to undertake that very difficult assignment. In addition, we are setting up within MF Division a new group, MP-14. This group will address PIGMI. This is the pion generator research and development which NCI has asked us to undertake in order to be ready three years from now to start building pion therapy facilities if the clinical trials under way here are as successful as many of us think they will be. Just the other day when I was in Washington talking to OMB, they kept impressing upon me that they understand the intellectual value of physics; even nuclear science they understand, but the Congress, "Boy, you gotta sell it to them." What they appreciate are the applications. They are not going to stop you from doing basic research, from extending the knowledge in nuclear science, but you have to give them something they can sell to their constituency. So, again I think we have done just the right thing by devoting a substantial fraction of our resources to the practical applications of nuclear science and the technology which emerged from the pursuit of nuclear

science. This is very very important.

Now we come to the major part of my talk. It has to do with money, and in Fig. 4 you can see the budgetary history of LAMPF. It is true that, as of a year ago, if you extrapolated it wouldn't look too good. It would have looked like we will need the federal budget to operate LAMPF 20 years from now. But this is now bending over (faster than I would like). However, we are almost at the level of people we need for safe and proper operation of this facility. Last fiscal year we discovered, as we thought we would, and as Harold alluded, that the President's budget would have been a disaster. We mobilized the nuclear science community and we went back to the Congress and we went back to OMB and got an agreement to increase those funds to what is a reasonable level. If we achieve that we will be able to operate this fiscal year with a two-month's budgetary shutdown.

Now since there is no authorization I was faced with a dilemma. What do we do? Do we focus on the President's budget and try to arrange our schedules for the year in terms of that, or do we assume that Congress will authorize the appropriations they have already made? I talked with Bob Hirsch and the OMB people and became convinced that, at not too great a

Fig. 4. Budgetary history of LAMPF.

risk, we should assume we are going to get the funds as appropriated by Congress and therefore we have constructed our budget for this fiscal year to reflect the appropriated budget.

Now why could we run last fiscal year with only a few weeks shutdown and this fiscal year two months? Table II tells you the answer to that question. I presented this slide to the OMB and they were startled because it shows that the true inflation for a high technology endeavor is far beyond what the Bureau of Labor Statistics say is the inflation in the country. If you do the arithmetic that is indicated here you learn that instead of the 5.5% which I was told by Hugh Loweth they have been assuming for the past 12 months, instead of that we see 14% to 17%. That is why the field of nuclear science is going to die and so will other high technology basic sciences if it is not recognized that there is a big discrepancy between buying bread and buying high technology.

I think I have conveyed to you the main points of what I had to say. One other committee which was established is to look at the research environment here. Feshbach, Lomon, and Frauenfelder are on that

committee. They came here, not for one day or two days, but they spent two weeks looking at how we carry out research here. Especially our in-house research. This is a supplement to the PAC. The PAC is very busy when they meet here. They have to hear the different proposals. Even though they spend four or five days here they cannot really talk to a lot of people and get the flavor of the research activities here. This new committee will do just that. They have written their first report. I think we have a lot of things to do in order to come up to all of our expectations and we are going to try to do them. One thing they focused on very strongly is the fact that the theoreticians who support this research are not based here. They live elsewhere. I have asked Harold to consider giving us a little more space in the new building which is being built for WNR so we can move some of our people there and let the theoretical people move in here among all of us so that we can have a stronger coupling between experimentalists and theoreticians than is presently the case.

I want to leave a few minutes for questions.

TABLE II
ONE-YEAR CHANGE IN TYPICAL COSTS INCURRED AT LAMPF
(Listed in Order of Budgetary Significance)

Item	July 1, 1975	July 1, 1976	% Increase
LASL Staff Salaries, Including Lab Overhead and Fringe Benefits	This increase represents the difference between FY 1976 and FY 1977		19*
Electrical Power			55
Hourly Base Pay for Electricians	\$11.79	\$13.23	12
Hourly Base Pay for Ironworkers	9.92	11.90	12
LASL Machine Shop Charges (Including Overhead)	18.60/h	18.60/h	0
7835 Triod Amplifiers	55,800	65,204	17
805 MHz Klystrons (Over a 3-Year Period)	22,000	31,000	41
Analog to Digital Converters (Typical of Most Electronics)			14
Magnet Coils	Average Increase		15
Reject Steel	Average Increase		0
Vacuum Ion Pumps (500 l/s)	3,950	4,200	11
Coax Connectors	Average Increase		20

From above it can be estimated that LAMPF costs, due to inflation, will increase by 14-17% in FY 1977, over what we experienced the previous 12 months.

* Staff salaries increased by less than 10% per year.