August 13, 1997

To the HEPAP Subpanel:

We were asked to make presentations to this subpanel about the views of graduate students on the future of High Energy Physics. In preparing for this task, we decided to survey the graduate students and post–docs at Fermilab. The answers we received were, for the most part, well thought out and very interesting. We decided to extract these responses and present them directly to the subpanel. The specific responses of seven individuals (one summer student, four graduate students, and two post–docs) are reproduced below. We have also gathered other responses together into a more general section at the end. These responses have been edited for clarity and to preserve the anonymity of the respondants.

Respectfully,

Michael Begel Tacy Joffe–Minor

Survey:

1) Which experiment are you on?
2) Are you a graduate student or post–doc?
   a) How many years have you spent or did you spend in graduate school?
3) Do you feel that you had adequate prep in your classes prior to being sent to Fermilab?
   a) Did you take a field theory course before you came to Fermilab?
   b) Have you attended any of the physics courses offered at Fermilab?
   c) Have you attended a non-Fermilab HEP summer school?
4) What do you think is the future of HEP? Where is that future?
5) Do you think about the long term future of the field? Why or why not?
6) Do you plan on staying in the field? Why or why not?
   a) If not, did you attend any of the jobs programs (seminars, resume classes, computer classes, etc) offered by the GSA?
7) Why do you think people are leaving the field?

Response of a Fermilab summer student (undergraduate)

What do you think is the future of HEP? Where is that future?

I think that HEP will exist for several more years, however the number of researchers will steadily decrease until it reaches the point where good HEP is no longer feasable.

Do you think about the long term future of the field?

No. Because I will not be in the field for much longer.

Why do you think people are leaving the field?

Poor economic outlook, decreasing support for research. Lack of public and governmental interest.

Response of a third year graduate student

What do you think is the future of HEP? Where is that future?

In my opinion, the future of HEP lies in: the commitment of those who do it, their willingness to learn and change with new technologies, the involvement of physicists in the education of the general public, the number of faculty jobs available, and the involvement of the US in the LHC. I think the biggest hurdle to a bright future of HEP is the third item.

Do you plan on staying in the field?

Too early to think about that. It will become a pressing issue once I get a good portion of my thesis work done and will depend upon whether or not I'm still seeing postdoc's leaving the field.

Why do you think people are leaving the field?

Job availability, salary level, and, most importantly, the lack of fun of doing particle physics when there is as much politics as in the world outside; the tenacious dependence of the old important people on the outdated technologies and their superegotism when facing the experts from other field such as computer science and engineering.

Response of a fifth year graduate student

What do you think is the future of HEP? Where is that future?

HEP does have a future, but I think it's at CERN. However, if we do a much better job in popularizing fundamental physics research, and keep the projects under control, I think we can pull it off.

Do you think about the long term future of the field?

I do, but mostly in terms of having to permanently settle in the neighborhood of CERN one day.

Why do you think people are leaving the field?

It's natural that people leave the field, since it can't always expand. In order for every student to get a permanent job within HEP, each professor would have to advise only one or two students in his/her whole career. That would mean the death of HEP, since there is no way our goals could have been achieved with one tenth of the person-power. Grad students are essentially cheap labor—rewarded by their PhD's, experience, and the fun they have doing physics!

The way I see it, the grad schools should keep the current level of admission to HEP slots, only it should be made clear that only a fraction of the students will be able to get a permanent position within the field. However, there should be a concentrated effort of the grad schools, the APS, and the government (it too, since the goal of the good government is to provide for the welfare of the nation) to smooth the transition into the 'real world'. For instance, physics students should take courses in management, public policy, and even finance, and routinely take internships in companies and firms not connected to HEP... In general, the field could only benefit if there is a freer flow of people to and from industry.

But, overall, I think there is still hope for the field, and I'm going to stick around and see what happens, while doing my best to keep it afloat.

Response of a seventh year graduate student

What do you think is the future of HEP? Where is that future?

So much of the field is focusing on an ever-smaller number of ever-larger experiments, and it's getting harder and harder to push the energy and intensity limits. There is a lot of excitement now and will be for at least the next 10-20 years, but I suspect that either the LHC or the NLC will be the last big accelerator to be built. It just gets too difficult beyond that.

Do you think about the long term future of the field?

I do think about it. I have to decide whether it interests me enough to embark on a career in it, given the long hours, modest salaries, and my fear that the range of experiments which can feasibly be done will be exhausted during my peak years.

Do you plan on staying in the field?

I'm not entirely sure. I have been fortunate to play a central role in an experiment of moderate size, from the planning stages through data collection and first results. The thought of going on next to join a big experiment well along in its evolution, and in which I would probably play a fairly small role, has limited appeal. I know my talents would be useful in other endeavors as well, and that's basically what I want out of a career.

Response of a graduate student who is starting to look for a job

Do you plan on staying in the field?

I will probably apply for a job in the industrial/technological sector. The prospect of a university tenure track job (much less one that pays well) is hopeless. A job at a federal lab is still reasonable in the long run, but frankly, starting salaries are not competitive. The primary reason is that the experience gained in industry in the 3-6 years of otherwise filling a postdoc position (after which the future is very muddy) is invaluable. In other words, if you don't get the university permanent position after the 3-6 years, and then go into industry because that's the other choice, the amount of experience (not to mention raises, monetary savings) lost during that time is too much. Of course you might get layed off but you still have gained some experience and will find another job (probably easier).

Response of a post–doc

Do you think about the long term future of the field?

At some level yes. More often, I am concerned with my own personal survival. The global future takes second place.

Why do you think people are leaving the field?

Getting traditional jobs (not including post–docs) is borderline impossible. The young people see their immediate peers washing out in droves. It doesn't take a lot of imagination to project yourself forward a few years and see yourself in the same position. I would not advise any young person to get into HEP with any expectation of being able to grow old doing it.

And the attitude 'a Ph.D. in HEP is fine training for any career you want' is pure bullshit. There are MANY fields for which the transition from academia to (for instance) industry is much easier. An intelligent student who is not internally compelled to be a HEP guy/gal is going to choose a field where their options are richer...for instance an engineering Ph.D.

I liken the whole situation to a bunch of fish swimming up an otherwise tranquil river which happens to contain a nasty and dangerous waterfall. In the beginning (as a student) you swim along, and the swimming is easy. Eventually you come to a point where the water is flowing a little faster and has a bit of turbulence (just a little downstream from the falls) (Note this is a student which is thinking about graduating and their first postdoc position). As they swim further, the water gets dangerous and they start watching the bodies of the fish in front of them floating upside down downstream. They realize something is very wrong. When they try to swim up the waterfall (trying to get a permanent post), they are beaten by the current, crushed on the rocks and eventually die. However a few, very rare, fish try to swim upstream, get tossed back, bounce off a rock and end up at the top of the falls where the water is calmer and they swim away from the waterfall (just got an assistant prof level position). The current is strong, but they are able to, with reasonable effort, pull away. Eventually they end up in the calm water again (get tenure). From then on, they swim in nice calm water...typically forgetting that the waterfall was bad.

The story is silly, but it points out the fact that there is an artificial barrier that needs to be crossed, which requires heroic efforts. On either side of the barrier, substantial (but achievable) effort is needed. But for many, crossing the barrier is a matter of luck. A problem is that the senior types don't seem to realize just how tough it is. More times than not I've heard things of the order '...they weren't good enough or they didn't want it badly enough.' This is completely bullshit. They wanted it, but realized that in many respects it didn't matter what they did. Being intelligent and competent people, they chose to improve their odds and went to do something else. The senior people are sheltered from this process and have little invested in it. They will only feel any impact when their (until recently) never-ending supply of cheap labor starts to dry up. But by that time, it's too late.

Response of a post–doc

What do you think is the future of HEP? Where is that future?

I am very concerned about the future of HEP. The current leadership seems to be taking a very short term view, neglecting the longer term. For various reasons, prospects for younger physicists continue to be bleak resulting in low morale among post–docs and junior faculty. This necessarily feeds down to the graduate students as the younger professionals are the ones that have the most direct contact with the students. The centralization of HEP into the various labs makes it very difficult for university-based physicists to contribute to the field. There is the impression that input from university groups in unwelcome. Talented people are leaving the field, some in disgust, not for what the field was or could be, but because of what it is becoming. I remember being lured into physics by a call for the best and the brightest. Now I associate it with bureaucracy, politics, and old ideas.

Do you plan on staying in the field?

I will attempt to obtain a permanent position this year. Failing this, I will leave the field. I have personally seen too many tragedies of people remaining in the field too long, being forced to leave, and then having a difficult time finding an alternative career. I'm fortunate as I don't have a family to worry about.

Other Interesting Responses

What do you think is the future of HEP? Where is that future?

- Smaller experiments, because the funding for large scale colliders and detectors is dwindling.
- The future of HEP, at least as it appears today, is outside of accelerator physics. Governments are increasingly less willing to fund any study which doesn't result in immediate technological reward, which HEP just cannot provide. There is a VERY short sighted vision within our government in particular, and as such, basic research such as we do at Fermilab has little, if any, value to those who vote for our funding allocation. If any HEP research is to be done in the early part of the 21st century, it will have to be non-accelerator based programs—i.e. cosmic ray physics. The hope of funding new projects is just too dim.
- Future exists but will be somewhat curtailed from what we all envisioned a few years ago. Possible best future might be Europe/Japan???
- The future of HEP is problematic. As the size of the experiments grow it appears that the amount of money being spent on materials is growing relative to the amount being used to employ physicists. Hence, there is a growing lack of manpower to actually run the experiments. As labs like Fermilab reduce the number of people they hire it also reduces the type of senior people we have working in the field. It appears to me that Universities hire a particular type of person and if you cannot fit into that box you won't get a job. I would hope that jobs at labs or University research positions would allow a larger cross-section of people to stay in the field.
- LHC, NLC, and $\mu^+\mu^-$ collider (maybe). Mostly in Europe and also probably Japan.
- I think the future will be the LHC and beyond that the next big project. That will continue to drive things. I think you almost have to focus on the places where there is support and exposure in order to advance a career. That is easier done at a large, high profile experiment.
- The future of HEP will lie in the very large experiments. HEP is in need of a "revolution" which will most probably come from LHC (and larger) type machines.

Do you think about the long term future of the field?

- I think about it a lot. I just don't do anything about it because there has been no indication that the people with the decision making power do any more then listen to young people, then do what they were going to do in the first place.
- Not much. The future is uncertain and there's no use thinking too long term when the funding policy changes from year to year.
- Yes, I think that the field is in much greater trouble than the senior physicists

would have us believe: I think that the field will shrink considerably in the future (30-50%).

Do you plan on staying in the field?

- Probably not; my personal interest in science has withered away, while my interest in money has bloomed.
- Yes, I plan on staying in the field. This is the most exciting time in particle physics and I want to be in on it. There will always be problems and you don't usually get more than one shot at doing something worthwhile.
- I will stay as long as it is viable—I enjoy too much what I am doing to let the present funding situation discourage me too much. Probably after a second post–doc, if it is not possible to find permanent employment, I'll ditch. But I'm certainly planning to make an effort to stay in.
- Yes. I would like to remain in HEP, but I don't know if HEP will remain a realistic career in the near future.
- No, I have already accepted a position in industry. I am not willing to gamble for a future in HEP: I am getting out while I still can.

Why do you think people are leaving the field?

- This is a tough field. There are too many programs, people spend too long in graduate school, too long as post–docs and are underpaid. Too many people spend too much time worrying. After awhile, one becomes disillusioned and leaves.
- Not enough positions. And it's very interesting that (for the most part) people want to stay in the field so much that they only go to high paying industry jobs as a last resort. The government and taxpayers should realize that they are getting a real bargain with these people.
- Disillusionment. Frustration. Lack of positions and length of time spent trying to find one. Realistic expectations. Stability needed for self and families. etc. etc...
- Because they cannot stay in the field. There are not enough permanent jobs in HEP! Some do leave because they do not enjoy the job, or are not willing to work long hours for miniscule pay. However, it is almost impossible to get a permanent job at the moment. Also, I feel that Universities tend to keep students around to long as a cheap labour pool. A graduate degree should not take 5-6 years. The average should be 4 to 4.5 years, not the lower limit.
- Because the prospects for the future look bleak. It's very difficult to move up from a postdoc when so few positions are open in the universities. Additionally, the future for any physicist looks bright in industry.
- Destruction of the American University system by a gang of power-hungry

administrators who are castrating the faculty and replacing tenure-track hires with temporary, part-time, or short-term instructors subservient to the every whim of administrative depravity; 16 tenure track hires for every 124 new Ph.D.s.

It was the self-governing nature of academia that attracted good people despite low pay. But Americans no longer want genuine universities. They want paper certificate machines: put in $ 100,000 at one end, out the other end comes - Ding! - a certificate "So-and-so has demonstrated the spending power to be admitted as a probationary member of the new American upper class." And then the administrators build another layer of administration, or maybe an Olympic-sized swimming pool.

- There appears to be a need for post docs but not for tenured professors. Hence, many are looking for opportunities in industry where they will be rewarded for their contribution in money as well as position.
- Ultimately, I feel that they do not find enough satisfaction in doing the physics to counteract the financial uncertainty of staying in the field. Quite apart from this, it is a simple fact that the money outside the field is quite good for those trained as we are, so the attractiveness of salaries outside is quite hard to resist.
- Partially because there is sufficient competition now that people are not able to just coast into the next (postdoc, tenure track) phase like we all coasted into grad school because that was the next step that everyone just takes. And once that happened, people began to think of the field as less of a calling and more of a career—which caused them to think about alternatives, and question why they should commit their career to a field which is increasingly less likely to offer them security. Those who would do physics at any cost will stay—that's good for the field. Those who reach their limit will leave, and probably be better compensated and secure. Perhaps that is also good for the field—"natural selection."