Developing a CAREER Research Proposal

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Disclaimer

• Content is based on my personal experiences of writing a CAREER proposal and other NSF proposals as well as reviewing of NSF proposals.

• It reflects only my thoughts on what is required for a good and successful proposal
My Background

1999  PhD in Condensed Matter Physics  
      University of Cambridge, UK

2001  Postdoctoral Fellow, Physics and Nano  
      University of Texas at Austin

2003  Assistant Director, Nano Center  
      University of Texas at Austin

2005  Assistant Professor, Nano and Physics  
      University of Central Florida
My first few years at UCF

• 25 April, 2005: Accepted offer from UCF
• 29 Jun 2005: I was asked to submit a CAREER proposal. I looked at the program solicitation and decided that I am not ready!!
• 8 July 2005: Came to UCF
• October 2005: Submitted my first proposal as a Co-PI
• Until May 2007: Submitted many proposals, all rejected
• May 2007: Went to NSF panel review
• June 2007: Heard news about my first successful proposal as a Co-PI (sub contract from DOE)
• July 2007: Submitted NSF CAREER proposal
• January 2008: CAREER funded
• March 2008: Got news that my 2nd NSF will be funded which I submitted in October 2007
• June 2008: Got news that my third NSF grant will be funded which I submitted in February 2008.
Comments received from failed proposals

• The reviewer only finds a compilation of several widely known ideas in the proposal.
• It is also to be noted that experiments concerning the aspects of Coulomb blockade and SET behavior in CNT’s have been widely reported in the literature.
• The problem of reproducibility in terms of controlled placement of the barriers, and defect engineering and control are issues which have not been addressed in the proposal. For instance, what experiments are proposed to distinguish gate electrode induced SETs from “unintentional” SETs
• The back gate may be used for additional control of the device, such as tuning the transparency of the unintentional dots have to be clarified.
CAREER Award Program

Excerpts from the Program Solicitation:

– The Faculty Early Career Development (CAREER) Program is the National Science Foundation's most prestigious awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research within the context of the mission of their organizations.

– Such activities should build a firm foundation for a lifetime of leadership in integrating education and research.
CAREER Proposal - overview

Overall Career Goals

Innovative & Credible Research Plan
Solid Educational Plan

Presented in a convincing, concise, clear proposal

Commit time and energy to the proposal

Taken from: Brigid Mullany, UNC Charlotte
Title: CAREER: Engineering and parallel fabrication of single electron transistor devices using carbon nanotubes

NSF Division: ECCS
Submitted: 07/2007

December 13, 2007:

Dear Prof. Khondaker,
The above referenced CAREER proposal submitted to the ECS Division is being considered for recommendation of an award. The maximum award for CAREER proposals in the ENG Directorate is $400K for 5 years. You will have to adjust your budget to $400K for 5 years approximately at the rate of $80K per year.

January 15, 2008: Final award notification came to President Hitt

Receiving a CAREER award is a life changing experience
Preparing a Competitive Proposal

1. Begin thinking about potential CAREER award topics well in advance of the submission date.

2. Select an area to study that builds upon your expertise and skills but is not a direct continuation of your PhD or postdoctoral work.

3. Review NSF’s strategic goals
   Does your proposed area of research fit within these goals?
   If not, is NSF the appropriate venue for this proposal?
Dilemmas of proposal submission

• I have several ideas: Which one to submit?
• Which program to submit?
• How much should I promise?
• How much space for research and how much for education?
Coming up with a Research Idea

- What do you want to do?
- Does it address important questions in your field?
- Is it novel and cutting-edge?
  - Is it transformative rather than an incremental improvement?
  - Why there is a need for the proposed activity?
  - Will the world be a better place if the proposed work is done?
- Do you have the background and resources to accomplish your goals?
  - If you are moving into a new but related area, be sure you discuss collaborations with researchers who will fill any gaps
- Will it contribute to your career goals?
- Will it contribute to your department’s goals?
Research idea

- The research plan should aim to be:
  - Innovative, fundamental science—Basic NSF requirements. NSF supports fundamental research and education
  - Transformative—I get 5 years to do it—Ambitious (non incremental) but realistic
  - Reasonably feasible with respect to my skills sets and my college’s infrastructure?
  - Something I am excited about—if successful you will have to do it (5 years is a long time)
  - Fits with my long term career goals (what you want to do in 5, 10, 20yrs)?
  - Open up other research avenues
Which program to submit?

- You have an idea, where does it fit?
- Become familiar with the different NSF Programs and isolate the one that best fits your work.
- In the ‘best fit’ program, find out exactly what qualifies for funding:
Homework

- Target 2/3 programs
- Use the funded programs database to find out what has been funded recently - http://www.nsf.gov/awardsearch/index.jsp
- This will give an idea where your proposal belongs
- If possible, visit NSF and talk to the program manager (PM)
- Pitch the idea to the PM
- Read the body language. Is he/she really excited? Or he/she just said, interesting, please submit.
- Volunteer to serve as a reviewer on a panel (the most valuable experience I got was from panel review).
- Try to find out: why proposals get rejected. Why awarded?
- Identify Good mentor who are successful
Homework

• Collect some successful proposals (I got two from two colleagues)
• Websites of previous winners in my area identified through NSF award databases
• Gave me confidence that the winners are not very different than me. Yes, I can!!!!!!!
• Volunteer to serve as a reviewer on a panel (the most valuable experience I got was from panel review). Learnt why proposals get rejected. Why awarded?
• Identify Good mentor who are successful
So I identified a good idea which is transformative, will lead to new direction, and I am excited about it.

Now, how can I convince the reviewers that my idea will work?

Narrate to the reviewer that you really have an important idea and that there is a need to execute your idea.

Articulate the problem and your idea.

Convince them why you are sure that your idea will succeed?

Show your evidence that you will succeed. Please don’t ask to trust you!!!

Please also explain that you understand the difficulties in succeeding and have alternative strategies.
Strategy

• Writing a good proposal is not the aim as many other will also write a good one
• Write a proposal that will “stand out”
• Success is pyramid. Only ~10-12% success rate
• Remember you are trying to market your idea
• Understand the review process: who are the reviewers?
• Impress the reviewer – I am a complete package, you got to invest in me
• Don’t make reviewer dig for an answer. Make it easy for the reviewer to evaluate your proposal.
• If the proposal does not flow well, not a coherent description of problems and solutions, and lack important details, you just made it easy for the reviewer to reject it.
Writing the proposal

How to convince the reviewer- an example:

• Identify one or two possible question that will test the feasibility of the proposed research and show preliminary data to successfully demonstrate that the proposed research has a high degree of likeliness to succeed. This is how I put it
• In order to test the feasibility of the proposed research …
• Although experimental conditions will require further optimization, our preliminary study has answered two crucial questions concerning the feasibility of this proposed research, First…, second…
• With these two crucial questions answered, we conclude that the proposed research discussed below has great potential to succeed
• Put yourself in reviewers shoe. As you are writing, please think whether you will fund this if you were the reviewer.
Writing the proposal

• Articulate the background: why the selected research area is important – write in a way that can be easily understood by non-expert reviewer.
• Convince the reviewer that if you complete the work, the world would be a better place!
• Give reason for the reviewers to excite about
• Establish a logical, chronological plan of activities that will lead to your research objective
• Identify clear success matrix
• Identify major questions that must be answered
Project Description

Components of the Project Description

- Proposed research project
  - Discussion of current state of the field
  - Preliminary supporting data
  - Specific objectives
  - Methods and procedures
  - Expected significance of results

- Proposed educational activities and plans to evaluate their impact

- Discussion of how research and educational activities are integrated

- Clearly defined sections addressing Intellectual Merits and Broader Impacts

- Results from Prior NSF support

These can either be fully integrated or presented in two separate sections
What are the intellectual merits?

- How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
- What new knowledge will be created and why is that important.
- To what extent does the proposed activity suggest & explore creative & original concepts?
- How well conceived and organized is the proposed activity?
What are the broader impacts?

• How well does the activity advance discovery & understanding promoting teaching, training, & learning?
• How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
• To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
• Will the results be disseminated broadly to enhance scientific and technological understanding?
• What may be the benefits of the proposed activity to society?
Education component

- Cover all aspects of education. Must have clear plan for integration of research and education
- Identify at least one innovative education component
- Leverage existing NSF funded infrastructures for education and outreach
- Recruitment plans: Not enough to say I will do this. Better to show that you have identified a process..give names..or support letters
Project Summary

- A single page that provides a self-contained description of the integrated research and education activities that are planned.
- Clearly define your research hypothesis/hypotheses and how it/they will be tested.
- Include a statement of objectives and methods.
- MUST address in separate statements:
  - Intellectual Merit
  - Broader Impacts

This may be the only page a reviewer reads if it is not impeccable!
I divided the summary page into several small paragraphs, making it easier for the reviewer to follow:

**Objective:** The primary objective of this proposal is ....

**Background:** If the current trend of miniaturization of Si-Metal Oxide Semiconductor Field Effect Transistor (Si-MOSFET) has to continue ..... 

**Proposed research:**

**Intellectual Merit**

**Broader Impact**

- Technical impact:
- Education and outreach:

Make it easy for the reviewers to understand and identify the novelty

Saiful I. Khondaker
Common mistakes

- Not following the program solicitation. If I invest one month in writing, I should invest few hours checking the latest solicitation. There are new surprises!!!
- Taking too long to state, what is this proposal about?
- Lack of clarity
- Lack of alternative strategy
- Not legible captions/number/writings in figures and tables
- Too little space for education component. Not writing about outreach and broadening participation.
- Not telling why the proposed research is transformative
- Letting the reviewer dig for information
Why proposals get rejected?

Why do so many proposals centered around good ideas get poor ratings?

A few comments that I have seen:

- How the technical aim of this proposal is different from those that the PI has investigated?
- It is not clear what new is proposed
- Did not provide alternative strategy
- Anticipated problems and way to overcome them was not mentioned
- No clearly stated goals.
- Figures and table captions not legible
Why proposals get rejected?

Why do so many proposals centered around good ideas get poor ratings?

A few comments that I have seen:

• Weak in education plan/mentoring, minority recruiting
• Weak in minority recruitment, societal impact/ no detail research plan
• Integration of education and research, education and outreach is not addressed.
• No preliminary result, no minority plan
• What will be accomplished from this research?
• Lack measurable goals, not enough details
Before submitting

• Have some one to proof read
• Give to few colleagues that you can trust and ask for feedback.
• If they did not clearly understand and got excited, then you did not write well