

DEPARTMENT OF MATHEMATICS

# VIGRE Funding Report

(due 30 days after semester of support)

Semester/Summer and Year:

Fall 2007

Name: Robert Jenkins

List the graduate courses you have taken this semester (including independent studies), your grades, and the instructors:

Course	Title	Grade	Instructor
920	Dissertation	K	McLaughlin

List the title, date and location of any talks you have given, either here or elsewhere:

[Empty box for listing talks]

If you are working on your dissertation, include a one paragraph description of your research progress. If you have not yet begun dissertation research, describe your progress toward finding a dissertation topic and advisor and beginning that research.

During the fall semester I found a complete solution to the Riemann Hilbert problem associated with the focusing nonlinear Schrodinger equation in its small dispersion limit at the initial time. This included finding a factorization of the jump matrices that would lead to small norms in the small dispersion limit and studying the local problems that remain. The local problems were completed by comparing them with similar problems from the literature and adapting methods we found there to our own problems. With what little time remained in the semester we started examining how our method must be adapted to deal with solving the Riemann Hilbert problem at positive times.

List publications, if any.

Check all activities you completed during the funded period:

Academics:

- Independent Study
- Oral Comprehensive Exam
- Commence Thesis Research
- Conference attendance
- Conference participation
- Complete PhD

Professional development and outreach:

- AP Calculus Visit
- High School Workshops
- Undergraduate Research Project
- Undergraduate Research Seminar
- Super TA
- Mentoring junior graduate students for the qualifying exams
- RTG (help organize)
- Research Seminar (help organize)

Other (please specify)

As I overloaded my summer of support with professional development and outreach activities, I had none this fall.

Attach a brief statment about your academic progress and professional development during the period of support.

I was a VIGRE recipient during the fall of 2007. I used the freedom afforded to me by that financial support to focus on my thesis research. As was outlined in my proposal, my research focuses on using asymptotic methods to solve the small dispersion limit of the focusing nonlinear Schrödinger equation (NLS),

$$i\epsilon q_t + \frac{\epsilon^2}{2} q_{xx} + q|q|^2 = 0, \quad q(x, t = 0) = q_0(x),$$

given compactly supported initial data. Prior to the beginning of the semester Ken McLaughlin, my advisor, and I had worked out the preliminary calculations and decided that the next step was to find the correct factorizations necessary to solve the initial time Riemann-Hilbert problem (RHP) associated with the inverse scattering transform of NLS. This started as guess work, we had to find a factorization of the jump matrices that left the RHP in the so-called small norm form. After completing that work I had to analyze several local parametrices that we had used to reach a small-norm problem. Mostly, this involved reading a series of papers authored by my advisor, Peter Miller, and Arno Kuijlaars, who among others who had studied similar problems. I then adapting their ideas to solve my problem. By early December we had completed all of the analysis for a complete solution of the initial time problem and began to think about how to adapt our methods to solving the RHP for positive time. We didn't make many inroads into solving the positive time problem but we believe that its solution should be a smooth deformation of the  $t = 0$  problem.

Pursuant to the professional development requirements of the VIGRE grant, I attended a SIAM conference on analysis of PDEs December 10-12. During the conference I met with and listened to talks by Peter Miller, Sephanos Venakides, and Alexander Tovbis. After the conference I had time to meet with Dr. Miller to discuss my research. He made several useful suggestions to improve the strength of my research. It was great to meet with the people whose papers I have studying over the past few years and I'm sure that the contacts I made will come in handy when I eventually move from thesis research to job search.