

UNDERGRADUATE MATHEMATICS SEMINAR

The next seminar of the winter term will be:

DATE: MONDAY, February 23rd

Time & 4:15pm – Refreshments in the Math Common Room, Bailey 204

Location: 4:30pm – Seminar in Bailey 207

In this seminar, **Professor Rebecca Surman** of **Union College's Department of Physics and Astronomy** will visit Bailey Hall to tell us about:

TITLE: The Mathematics (and Physics) of Heavy Element Synthesis

ABSTRACT: About half of the elements heavier than iron found in the Solar System were created via rapid neutron capture in a process called r-process nucleosynthesis. The basic mechanism of the r-process was understood over forty years ago, but where in the Universe it takes place and the details of how it proceeds have yet to be fully worked out. To address these questions, nuclear astrophysicists run nuclear network calculations that simulate the r-process in various astrophysical environments. Here we will describe the mathematics of these simulations and discuss the aspects of heavy element synthesis that are currently under investigation here at Union College.

Pieces of Theses: A View from Andy Mackenzie, '09

Thesis is a battlefield. It is a terrible and violent war waged at the crux of the human soul and how yours unfolds defines your destiny thereafter; you must never succumb to or surrender at the hands of the forces conspiring against you, for if you can resist and overcome, then the brilliant glory of your triumph shall cast out the shadows of doubt and your torch shall lead you and those few that would follow you to the better world you always knew in your heart was out there, somewhere.

I am a veteran of this tragic cycle of carnage and I have been asked at the behest of one Prof. Friedman to come stand before you on this cold winter's day and recount to you with what breath still rattles these bones the experiences I've been trying so desperately to forget. I have agreed not because I am motivated by your success, nor by the chance to make inner peace with my volatile past, but because of a strong yet unfounded hope that my cooperation will have a dramatic positive influence on my grade in Probability this term.

It all began so many moons ago on that cool spring day – oh, I remember it like it was yesterday. I was so naïve then...I remember awakening to the joyful melody of chirping songbirds as warm sunlight flooded through my window blinds, striped and sparkling with fluttering dust; I remember the crisp, sweet smell of a recent rainfall flaring up through my nostrils. I couldn't help but feel a smile spread across my face – it was so exciting to be alive. But little did I know that just beyond the horizon, a dark cloud was brewing. A cloud of the cumulonimbus variety. A cloud called thesis.

I knew something was off when I entered Bailey Hall. "Something isn't quite right," I thought as I contemplated using the staircase or the elevator. "Something feels different," I mused as I waited for the elevator to come meet me at the first floor. "Something bad is going to happen," I whispered to myself as the elevator's doors opened on the second floor.

I went into the office of Prof. Zwicker and proposed that we collaborate on a summer research project; he was interested in voting theory and I was interested in everything, so it was a perfect match...and that's when the word first slithered into my ears: thesis. "Why not extend the summer research into a fall thesis?" he suggested. I'd have to do one anyway, and this would give me a head-start. It sounded reasonable at the time. What I now understand is that I should have then and there left that office, dropped out of college, and joined my second cousin's struggling door-to-door carpet repair business.

But I was foolish and agreed. The topic was an abstract voting property called one-way monotonicity and I was to study it in the context of a spatially-inspired perversion of the straightforward Borda count. It sounded straightforward enough – code both a program that would draw the four-dimensional permutohedron in 3D and a program that would check every possible voting situation to see if a violation of our property could be produced from it, then describe the theoretical implications of the results. But it turned out not to be straightforward at all.

For one, I soon realized that this would require

programming. I managed to accomplish this feat, but only after searching the seven seas for two that could help me...it was only with assistance from Prof. Aaron Cass in the CS department and a previous research student of Prof. Zwicker's named Ari Morse at Skidmore that I managed to tell my computer to do my work for me.

I then had to study the theoretical implications. This involved all sorts of math and proofs. Fortunately, during my training at college I had acquired just this skill set, and long story short, after a few months I had submitted a final draft. But I highly recommend against trying to write a math thesis if you don't know about things like math and proofs. You want to be something of a mathemagician going into this.

I suppose the first thing you need to know about thesis is try do one or less of them. I'm doing a second one right now because once upon a time in my naïve youth I thought being a double major sounded elegant and would seriously attract the ladies, and now the inevitable question I'm confronted with every time I look myself in the mirror is, "What are you trying to prove? What void in your life are you trying to make up for?"

The second thing you need to know about thesis is that it is pervasive of all types of conflict known to mankind. Don't believe me? I'll play Dante and give you the tour of the eighth ring:

MAN VERSUS MAN. I would submit a draft of a chapter to my thesis advisor. I thought his role was to tell me, "Good Job, A+". I couldn't have been more wrong. Every time he got a draft, he would pour enormous care into reading it and returning it with unbelievably detailed comments about how it could be improved...and yet somehow, he'd manage to get these comments back to me very, very quickly. To beat him at his own game, I'd have to submit a draft that he couldn't mark with red ink anywhere. It wasn't easy, especially because he had the ability to notice when I was using too many pronouns. But after all was said and done and the smoke had cleared, it was revealed in a very theatrical fashion that I had prevailed.

MAN VERSUS NATURE. "Is it going to rain? I'd have to walk through the rain to get to the library. I hate walking through the rain. Actually, I kind of like the rain and walking through it, but I'm not averse to using it as an excuse to avoid going to the library. But I have to go to the library, because if I don't leave my apartment I'm never going to stop playing Guitar Hero." Every time there was even a slight hint of cloud in the sky, I'd have this conversation with myself for around an hour and half.

MAN VERSUS GOD. "God, are you making it rain? Is this a sign? Am I working too hard? You must think I'm working too hard. Thanks for the advice, God – I trust your judgment." This is generally how those conversations would end.

MAN VERSUS SELF. Over the course of this process, you must sculpt yourself into a thesis writer, and that means embracing the cold machinery that will transform you into such. If you're like me, that means you need to make the library your office. And if when you go there, if you find that someone's sitting in the spot that you designated as your office, you will have to not make a scene and find somewhere else to work. Apparently. If working with a huge document puts a burden on your shoulders with a magnitude befitting Atlas, make a bunch of separate documents, one for each chapter, so you can feed upon and digest your accomplishments for psychological nourishment instead of feeling like you just put another brick in a very large wall. If you are putting off getting started with excuses like you're not sure what sort of tone you should write in or what the formatting should be like, go to the math common room and look at previous theses...this advice won't hold if you're writing the first thesis for our department, but that shouldn't be the case. Or just simply go with ridiculous tone first comes to mind – this isn't an English department, you can probably get something published with any ridiculous sort of narrative.

However! If you have the discipline to see this thing through to the light at the end of the tunnel, rejoice. It wasn't actually that bad. And hey! You're pretty proud of what you did, too. So proud that you'll try to get all your friends and family to read it, and they'll read like two pages and turn it back to you and say, "But I can tell it's really good." So give yourself a pat on the back! Because when it really comes down to it, thesis is happiness, and so by transitivity, thesis is a warm gun.

Problem of the Newsletter: February 20th, 2009

Congratulations to **Wei Jia Bao**, **Andy Mackenzie**, and **Steven Neier** for correctly solving (and **Schuyler Smith** for posing) last week's Problem of the Newsletter. A solution has been posted on the bulletin boards in Bailey Hall.

Here is this week's problem: Showing all steps, integrate

$$\int \frac{\sqrt{1+x} + \sqrt{1-x}}{\sqrt{1+x} - \sqrt{1-x}} dx.$$

Professor Friedman will accept solutions to this problem until 12:00 noon Thursday, February 26th. Email your solution to him (friedmap@union.edu) or put it in his mailbox in the Math Department's office on the second floor of Bailey Hall.