

---

## PhD applications

---

Taras Kolomatski <tkolomatski@gmail.com>  
To: Matt Kennedy <matt.kennedy@uwaterloo.ca>

Tue, Mar 13, 2018 at 5:25 PM

I typed up a long set of interview summative comments in this email that has existed as a draft since early February. I have now resolved every application. Here follows my narrative with tightly TMI.

### Offers:

**Toronto with CGS-M:** 36,750 covering the first 12 consecutive months, 19,250 annually subsequently covering 8 months (I think...) of each year. Four years.

**Stony Brook:** 22,500 USD with health insurance annually covering 9 months of each year. Six years.

**Berlin Mathematical School:** On the funding waitlist, have not ascertained likelihood. Four years.

### Interview notes:

Copenhagen and Berlin were antithetical. Stony Brook was non-technical.

#### **Copenhagen:**

I spent four days in Denmark and went to all of the things organised for the interviewees. They (CSymD) invited ten people, generally they end up hiring three or so, but this is not funding constrained.

The remaining nine candidates did geometry and topology. They were interviewed by four people. I went last with Prof. Rordam joining in for that interview.

The presentation delivery went smoothly and I there were a few questions asked for clarification and about Weaver's paper.

I was then asked if I knew what a trace on a  $C^*$  algebra was and I said no and that my knowledge of purely  $C^*$  theory was the content covered in 810.

I was then asked to give examples of  $C^*$  algebras. I said  $C(X)$  and  $B(H)$ , and provided the disc algebra as a non-example.

I then correctly gave the maximal ideal space of the disc algebra after clarifying what was meant by spectrum of an algebra.

Then I made a large error in that I was asked to give and discuss a specific non-commutative example, which after 20s of thought I said I was currently balking on (I should have said compact operators).

The rest of the questions were on other subjects.

First, I had to show how to compute the homology of a spheres, which I did in singular homology. I was then asked what result I used, which I correctly identified as excision.

Next, I was asked to state the fundamental theorem of Riemannian geometry after explaining what was covered in my DG course.

Finally, I was asked to give the Krull dimension of several rings. I made good remarks about  $\mathbb{Z}[x_1, \dots, x_n]$  to the order of showing that it's exactly  $n$  is tricky and the proof I knew of used combinatorial GK-dimension.

Between this were questions asking what I had covered in several subjects, and I was asked what I wanted to work on at Copenhagen.

So at this point I'm generally happy and have a meeting with Prof. Rordam the following day.

The next day he said that he invited me with the expectation that I had a much stronger  $C^*$  algebras background and that in the confines of a three year PhD there is no room for a year of requisite reading.

He then suggests that otherwise I showed mathematical competence and that he thinks that my background would make me a strong candidate for another centre at Copenhagen... quantum information.

He offered me to arrange interviews with them. I said that I had no interest in studying QIT. He then asked me to explain why this was the case, which I did.

Refusing further interviews from that end got me 45 min to further describe my background and e.g. send him Vern's 810 problems.

I was then told that he would look over this in a way that meant that I should go out and find another supervisor in the next 3h. He also invited me to the operator algebras seminar that evening.

I generally would have had quite a bit of spare energy and set out knocking on doors with some efficiency, but I was pretty defeated at this point.

I spoke with Prof. Jesper Grodal asking for feedback sort of as a lead into asking about geometry/topology research (which is basically what I am otherwise doing).

He said that I presented myself as a competent analysis candidate and asked me to explain why I wouldn't like to consider QIT (this was internally communicated), which I did again.

He said then that there was an unfortunate matter of fit. I sulked about around the university, had lunch, went to the seminar, spoke with Prof. Rordam once more and then headed to the airport.

I arrived with little rush and took a train back to Cambridge after I landed (although on the way there I first took the wrong underground line and subsequently the wrong bus from the airport in Amsterdam where I had a layover).

### **Cambridge:**

I was interviewed by Prof. Rand-Williams and Prof. Rasmussen.

We worked out, in a series of guiding steps, the cohomology ring of quaternion projective space.

The first thing that I did upon arriving at the interview was say that I was behind on AT and that I did not know Ch. 3 of Hatcher, but that I knew well the De Rham Cohomology as in Spivak I.11.

They said that they could work with this and we began with the homology of  $CP^n$ .

I defined the cellular homology chain groups and wrote out the homology of the space.

I then said that I knew that I should next apply the universal coefficient theorem, but that I did not know it.

They defined what the cochain complex was and I was then able to give the cohomology groups.

They then asked me to work out the ring structure, and Prof. Rand-Williams asked if he had heard me mention Poincaré duality a moment ago.

I had in fact not mentioned Poincaré duality, but having read Spivak I was eager to whip out the statement for De Rham, which gave me the structure for  $CP^n$ .

I was then asked to consider the induced map on cohomology from the inclusion of  $CP^n$  into  $HP^n$ .

Unfortunately, to finish the problem, the De Rham specific statement of Poincaré duality does not suffice, so I was told to, on faith, find two embeddings of  $CP^n$  in  $HP^n$  with finite intersection number.

I did this after a few false starts, recalling mid-way through that  $H$  was not commutative.

This was a 30 min interview and I had the ring structure at the end.

I learned more AT in the seven hours prior to the interview than I had in the two weeks preceding it, having read the construction of the cellular chain complex and reminded myself of Poincaré duality about three hours prior.

Unfortunately, I, like, took Prof. Rasmussen's AT course last term, so relative to the other geometry and topology applicants, I had less background than I should have had.

Ivan Smith later sent me an email of consolation saying that the geometry and topology group had an unusually large number of applicants. :(

### **Berlin:**

I spent 30h in Berlin and went to one of the two days of scheduled applicant events, to say nothing of the three day student run conference they invited applicants to. ~35 people were interviewed. They have budget for a set number of hires.

I applied for Phase II, which is a three year PhD program without a lead-in master's. I indicated on my application that I want to work with Prof. Holger Reich, who does algebraic K-theory.

He does not have a personal webpage and I did not contact him prior to applying.

I received my interview invitation while I was in Copenhagen. For Copenhagen I immediately began scheduling the trip after I received the invitation.

However the second day of the interview process in Berlin conflicted with an appointment that I had scheduled quite some time back in Cambridge and I needed to sort that out.

Also I needed to contact Prof. Reich because was I seriously going to otherwise travel internationally to an interview for a specialised PhD with a professor who does not have a homepage describing his work, or who I had not heard of prior to applying? (Moreover so because of what happened in Copenhagen.)

Yes I was. Eight days later I was told that the deadline for accepting the interview was the prior day, so I hastily replied and confirmed that I intended to interview. This was two weeks prior to the interview.

I found a survey article written by Prof. Reich and intended to read some of it prior to contacting him. I get through some of this and send him a message him six days prior to the interview saying that I had hoped to read more of this.

I asked what the 'non-negotiable expected background' he expected and described my background. He replied that I should relax and that if I got an offer, then I could do one year of Phase I prior to starting a PhD.

My second interviewer was Prof Tibor Szabo, who does combinatorial graph theory.

The interview was scheduled to be 30 min.

At the interview, after describing what I am doing this year, Prof. Szabo asked if I would be comfortable with 'combinatorics questions', and then asks me to show infinite  $\Rightarrow$  finite Ramsey. Yes please.

I was probably not very clear, because I wrote down isolated collections of symbols and not a linear proof, and had to repeat parts of the argument and definitions of notation several times, but I definitely knew what I was doing (and addressed the technicalities e.g. ordering the vertices).

After that, we moved on to alg top. I said that the last thing that I had read in Hatcher was the universal coefficient theorem, so we began there. I stated that and then was in progress on deriving the homology of  $T^2$  when Prof. Reich had to attend another interview (this was about 40 min in).

I then spent 30 min going over our paper with Prof. Szabo, and after he asked me about C&O at Waterloo.

Eventually he also had to attend another interview, but Prof. Reich was finishing up with his, so we continued with more alg top, although we stopped due to time after I was asked about definitions going into some sequences.

I then asked him to describe his research, which he did for about 25 min. This was interesting.

Both he and Prof. Szabo individually asked me about Canadian funding because there is a student receiving provincial support from Quebec at BMS (neither CGS nor OGS are tenable internationally).

We also spent some time chatting about Berlin and Germany.

I was satisfied with how this interview went and so enjoyed the rest of the talks and reception before heading to the airport. I comfortably got onto the plane and flew into Heathrow at about 10pm.

I then outdid every transportation organisational failure in my life and missed several trains and used notes jotted down on my notepad prior to my phone dying to navigate to the East end of London to catch the last possible bus at 1:10 am that would otherwise result in my being stranded in London till 6am. I ran around searching for where this bus would depart.

Fortunately somebody kindly walked with me until I saw the bus 1 min prior to the scheduled departure time. I ran and waived, got to the bus, and then realised that I did not have money. I arrived in the Cambridge city centre at about 2:40 am after begging the bus driver to let me on.

**The interview that I had to return for on the following day: *Methylphenidate*. Lifetime.**

### **Stony Brook:**

This was a non-technical Skype interview. I was contacted on March 1st suggesting that I was a very likely candidate for an offer and that I was to talk about my interests and their department.

I arranged to speak with Prof. Grushevsky on March 5th, he is an algebraic geometer.

I gave a somewhat unsatisfying answer to the question of what type of mathematics I like...

(What I am studying this year is quite different from what I studied last year and I don't have a strong specialisation preference in geometry/topology, but I would have studied operator algebras had I been a PhD student 20 or so years ago.)

Then I described what my experience was this summer. When I mentioned the 'virtually unreadable' initial write up, Prof. Grushevsky asked me: '*And how did that make you feel - to have your work called unreadable?*' :P

(I explained exactly how terrible the series of transplanted patches that Dani and I made in writing up the initial argument was.)

All in all, he said that this played out as collaborative research typically does.

He then spoke about their department, the Simons centre, and what areas of geometry were represented.

I got my offer a few hours ago and then finished these reports.

I am currently waiting for an ECG to verify that I don't have something silly like long QT syndrome.

In the meanwhile I am 'palate-cleansing' which means that I'm not taking things that are otherwise soft stimulants and hence have not been able to do any mathematics in the last three days, hence time existing to complete this.

I then have 79 days remaining to my first exam and look forward to the ability to structure work independently of deadlines as was a clear problem re the Cambridge interview.

### Conclusion:

If I plan on studying geometry/topology, Stony Brook looks like the clear choice? Please advise.

Thank you,

Taras Kolomatski

[Quoted text hidden]