

# AMS Special Session on Experimental and Computer Assisted Mathematics

Joint Mathematics Meetings 2020, Denver CO

I love the Joint Mathematics Meetings. I was fortunate to be invited for these meetings 5 times so far and I get to be there for 4 of these events. For me it is a meeting point to come together with friends and (mathematics) family. I cannot count the number of times that I have seen an inspirational talk or accidentally have run into someone that I was longing to see in these meetings. I can characterize these meetings as huge, disorienting, and sometimes too much but over all this is an event I wouldn't want to miss.

In a conversation much earlier than JMM 2020, Chris Jennings-Shaffer (Univ. Denver) mentioned how he was applying for a special session at this event. He was already at the conference location and it was making much sense. He suggested that I should also think about applying for one too. It was a well timed suggestion. I wanted to organize something for more than a year but I was always second guessing myself about whether I will be invited to give a talk, take the over Atlantic trip, etc. By this time, I also had some experience in organizing conferences and workshops therefore applying for a special session, where I only need to find speakers didn't sound bad. We figured that there will be a q-series/partition theory session and a number theory session. If Chris could get his session, that would make it a second q-series/number theory session. I just wanted to advertise a seemingly non-overlapping topic.

From the get-go, I know I wanted to have a different session, one that has a mix of combinatorics and q-series researchers. These two fields have too much in common but somehow don't get to mingle in general. This was the case in Turkey. This was the case in University of Florida. This was the case in the conferences I have attended. One exception to this informal segregation was RISC/RICAM, Linz Austria, where I was doing my postdoc. I know I learned a lot from the diverse research environment. The Austrian Science Fund's (FWF) special research project (SFB F50) consists of 12 mixed projects, where combinatorics, q-series, number theory and symbolic computation are mixed and encouraged to come up with solutions together. I joined this group with a pinhole view of what my research area was, and learned that it was touching much more. That was the goal for the special session too. I wanted people to see some related "unrelated" research.

I settled on experimental mathematics as my session subject early on as its definition is open to interpretation. The next big thing was to find a co-organizer that I would like to work with. Thankfully there are many names. Honestly, I figured that applying with someone from an American university would raise the chances. I had no connection with AMS at the moment after all. Shashank Kanade (Univ. Denver) and Matthew Russell (Rutgers Univ.) was a natural duo to approach. They are dear friends before anything, and great researchers that are known for their experimental mathematics publications on top of all the other things they accomplished. Mind you, these are busy people that are also in high demand. Shashank already was organizing/applying for another session and speaking in another, Matthew was busy with his institutional duties. Thankfully it didn't take much convincing to organize a session together.

We submitted our request to AMS JMM board after a short discussion about the scope and

the vision of what our session should be. It must have been a nightmare for the JMM board to decide who gets what because they took about an extra month and a half to decide on the schedule and the special sessions. We got our session. It was official scheduled for 5 uninterrupted hours on the second half of the last day of the conference. It was great news regardless. Not surprisingly all our earlier guesses with Chris was realized too. He got his session. Shashank also got his other session. There were partition theory and number theory sessions too. It was great news all around, there were going to be so much to learn and so many people to see. Just the way I hoped for.

By then, it was clear that Matthew was going to be quite busy and he was not going to be able to join JMM. Shashank and I sent out our invitations and build up a nice mixture of everything. It was certainly much better than I initially planned. From number theory to machine learning and from automated/computerized provers to combinatorics, we had everything. The funny thing is, although many people turned down our invitation in the process, the session filled really quickly and it now feels like we could have easily filled another 5 hours with just as great speakers<sup>1</sup>. Maybe in another JMM in future.

The session averaged 30 people per talk. In a conference which attracts more than 5000 mathematicians a year, this may sound like a small number. In perspective, the special session was actually a hit. The mathematician swarm of downtown Denver was releasing that day, conference attendees were vacating their hotels and heading towards the airport. Even under these circumstances there were 42 other conference events scheduled at the last afternoon of the conference. Still including some really nice research sessions with overlapping research topics with our experimental mathematics session. Our session was one of them. Shashank's other session was one of these too. He needed to juggle and, I can only imagine, got some decent exercise between two seminar rooms.

Kate Stange, technically a local, opened our session with the demonstration of the project Numberscope<sup>2</sup>, where we were bombarded with many nice visualisations of Diophantine equations related questions. Then Zafeirakis Zafeirakopoulos and William Severa presented machine learning approaches to nowadays problems and a glimpse of DOE's research in lowering the energy consumption of high performance calculations. Petr Vojtěchovský, this time definitely a local, talked about his research on universal algebras and the automated prover implementation Prover9 and its strengths in finding and writing out proofs with certificates for some algebra problems. The session followed with number theory. Jakob Ablinger and Michael Mossinghoff presented new computer generated and proven identities involving Riemann zeta value and experimental observations about divisor sums related constants and problems, respectively. Then we saw an elementary constructive approach to finding extremal values of the statistics related to hypercube orientations as directed graphs with maximal or minimal number of special nodes. We then reached my comfort zone,  $q$ -series portion of the session. Drew Sills presented his postdoc project `RRtools` package that he implemented in Maple and finite Rogers–Ramanujan type identities. He suggested some future research directions, which I am working on to this day. Then Chris Jennings-Shaffer, another local to the conference, presented the proofs of Kanade–Russell (do these names look familiar?) mod 12 conjectures he found with Kathrin Bringmann and Karl Mahlburg. It still amazes me how a simple guess and prove approach and heavy computer use cracked these conjectures. We closed the session with Frank Garvan, and his new results on the mod powers of 5 and 7 congruences for the rank and crank functions.

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<sup>1</sup>I have to admit, I remember us being slightly worried about being able to fill the session back then

<sup>2</sup><https://math.katestange.net/numberscope/>

Exchanging pleasantries and goodbyes with the participants at the end of the conference always takes some extra time. The conference room kept being filled with nice friendly chat and occasional laughter until a convention center employee politely kicked us out. Carrying our conversations to the convention center aisles was nothing new to us of course. This just meant it was closing to dinner time with friends before saying our final goodbyes of the conference. We ended up going to a local diner. It was the first chance from the beginning of this 4 day, 5 day conference I had with Shashank to do some actual catching up. Maybe this was the only downcast of the conference for me. It was a cheerful reunion with not enough time to catch up with everyone I want to. Oh well... I bet it was not just me.