Inside View
Beyond graphene

Meet the new Board
~~(In)~~capable as always

Gossip Rubric
Walkie & Talkie

Francken Vrij

28.3 Expansion

Francken Vrij

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Editorial
Unlike the Almanac, this Francken Vrij is on time. With our ever-expanding capabilities, we managed to rapid-fire this edition in two months after our previous layout weekend. I'm very proud of the three magazines our committee produced this year, and I want to thank all the professors, PHDers, and students for having written all the marvellous pieces throughout this year. Now that our work for this year is finished, we'll finally truly be Francken 'Vrij'. Enjoy reading our final edition!

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Chair's preface

By Ciska van Elsberg

Dear Francken members, It's almost time for my incredible year on the board to come to an end. In this very same year, I expanded not just my knowledge but also my family. Without my amazing board members, who have always supported me and one another, it wouldn't have been the same. As president and general board member, I gained a great deal of experience. But since everything happens in little steps, I didn't realise how much I learned until I transferred everything to my candidate. Every previous board member has undoubtedly gone through this: you finally realise what has to be done and how to do it better, but the moment has come to hand over the responsibilities to someone else. It's time for Francken to expand again with a new candidate board!

In order to wrap off this year, I decided to revisit a few of the highlights. This year's Buixie trip saw 36 participants, shattering the previous record for the most! As the majority of you are already aware, this year marks the Commissioner of Educational

Affairs' first time as a solo position. Professor visits to the room and coffee hours have increased, and this year's attendance at the Francken Friday Lectures was outstanding. We also purchased the coffee machine rather than yearly rentals. Not to mention, this year's acquisition was excellent, making the second active member activity free again and forcing the treasurer to find other uses for the money that remains.

As one can see it was an amazing year that I will never forget, love you Freefall!

News of the Association

By Hannelys Posthumus

This is already the last time I am writing the News of the Association, and it honestly makes me a little bit sad and nostalgic at the same time. Looking back at my board year, there was always something that needed work or improvement, which made my board year fly by like crazy. A message for the candidate board: Don't take the exceptional things you do for granted in the upcoming year, because you will look back at all the fun and enjoyment you had with a big smile and maybe a little tear.

The past few weeks the history of the association expanded itself with all the fun activities there have been and all the memories we have made with our amazing members. The end of the academic year is coming up as well as the board year of board Freefall. But next year and many years after we will keep on expanding the history (or the future) of the association and keep on having fun and learn a lot. Have fun reading this column and looking back at all the past events!

Cocktails in Pajamas

The (second) last event of the Borrelcie, but the last borrel of this academic year! During this borrel members enjoyed some cocktails in pajamas while expanding their knowledge with some hot gossip! If you missed out on all the juicy gossip, don't worry; you can read the gossip rubric later in this Francken Vrij ;).

Tata Steel excursion

Participants of the Tata Steel excursion will probably tell you that this was one of the

coolest excursions of the year; the employees of Tata Steel showed their factory and in the meantime gave an honest talk about how steel is produced in all sizes and forms, which is a necessary material in a lot of branches.

What would you bid on this hand?

Klaverjastournament
The yearly klaverjastournament attracted a lot of ouwe lullen again, but they didn't win! Marcel and Adriana won the klaverjastournament with a little bit of wisdom and a lot of luck. But of course it is not about winning, but participating. Personally, I didn't have a lot of wisdom nor luck, so after the first two games me and my partner already had to crawl under the table. Hopefully, I will have better luck next year.

Sympcie announcement borrel
And the theme is… The announcement of the Symposium theme was hilarious. First, the secretary of the Symposium committee, Giulia, presented a quiz where she let the participants guess who said what during their committee meetings, and I can tell you, a loooot of weird stuff has been said and I am happy to see they have grown so close together. Then Noah gave a presentation with hints and finally announced their theme, which is… Photovoltaics! If you are reading this, sign up for the symposium!

Buixie
From the 13th to the 21st of April 36 Francken members traveled all the way to Sweden to expand their knowledge about universities in Sweden, as well as Swedish companies, such as IKEA… Just kidding. The cities we visited are Malmö, Stockholm and Göteborg. We continued the tradition of visiting a particle accelerator and we went to Volvo and SKF, as well as five Swedish universities, and the best activity of all was the pubcrawl from former Chairman Melav. The activities, traveling and learning was great fun and next year will surely also be great.

"I like your mustache. I like it a lot."

Candidate board announcement borrel
Broek uit, op je hoofd, broek uit op je hoofd. The very well attended candidate

board announcement was a great success. All the board members announced their candidates individually with a nice speech, afterwards they had to tie their tie (which didn't go so well) and everyone could congratulate the candidates. They will do a great job next board year!

Kandis failing to tie their kandi tie

FFL: Cédric Cordero Silis

Hopefully you read the piece in the previous Francken Vrij before this Francken Friday Lecture. The speaker already wrote a bit on what he was going to talk about during the lecture and during the lecture attendees expanded their knowledge about this topic and asked a lot of questions. During this Francken Friday Lecture Cédric talked about Two-Dimensional Boterham Devices and it was very interesting and interactive.

Board auction

A crazy amount of money was binnengehengeld during the Board Auction which will all go to KWF, a charity which funds money to research for fighting cancer. Among other things a lot of anytimers were sold, a special place on the stripe system, Francken Vrij bottles, a Pokémon hairstyle, liters and a lot of other attributes and services, but all for a good goal. In total, a little less than a thousand euros was spent!

Red & Blue gala

One of the bigger events took place on the first of May, and coincidentally, the theme was Red & Blue, which are the same colors as International Workers Day, which is also on the first of May, as one of my committee members from Fraccie told me. The theme turned out to be pretty nice, because everyone wore something red and/or blue and the place was beautifully decorated with those colors. Hopefully next year the evening will be as memorable as this one!

Meet the new board

Chair

Hey all, If you don't know me my name is Adriana, more commonly known as Adri, and I have been chosen to be the 40th Kandi Chair of Francken. I am so excited for the coming year and am so grateful to have an amazing Kandi board by my side. You may have gotten to know me throughout the last two and a half years chilling in the Francken room, but if not let me tell you a bit about myself. I started at Francken as yet but a humble Sjaars scavenging for the free toasties during Kick-off week as many of you may have done yourselves. Over the next few months I could be seen solemnly grabbing a cup of free coffee until one fateful night when I attended my first ever Borrelcie borrel… the cocktail borrel! At this borrel I was instructed to perform my first rietadt to join the borrelcie, a com-

mittee I knew absolutely nothing about. If I had to give any advice, if someone tells you to chug a beer, don't question it, it'll probably lead to some of the best experiences of your life. I would say after that the rest is history…now I'm in my 3rd year (hopefully) solidifying the Borrelcie chair to Francken chair pipeline. Over the next year, I hope to get to know all of you a little bit better, and with some help from everyone, I hope to have the best year that Francken has ever seen! Aside from being Chair, I hope to complete some extra courses out of my own interest, maybe in biophysics, maybe astronomy, or maybe I'll extend my thesis, who knows what the future has in store for me? Anyways I'll see y'all around, XOXO Adri

Secretary

Hi mooie members, I am Gerrit and I am in my third year of the Physics bachelor. Most of you know me as the number one on the top of your list of funny Frisians, but hopefully, you can also add me to your chronological list of francken secretaries soon. Next year, next to looking at many emails and overleaf documents, I will also look a lot at sheet music, as I play the piano and want to begin taking organ lessons. But these are not the only skills that I intend to hone during my board year: as you may know, my predecessor has set the bar quite high for her liter times. I will strive to reach (and hopefully surpass) this bar. Will it be possible? I don't know, but I have one liter more than her to set a record, so statistically, it is looking good. I hope you are all looking forward to next year (a lustrum year!) as much as I am.

Treasurer

Hello Francken, I am Camiel, a fourth-year bachelor in Physics. Before I share my position, I would like to buy some of your time to sell myself as a suitable candidate for the next board. I have spent my fair share of hours stocking the fridge for the Borrelcie and I credit this committee for raising my interest in the Francken association. I want

to repay the kindness I have been shown by the people of Francken and contribute to a prosperous year. I might not be the most outgoing person, and sometimes people feel quite taxing, however, I truly feel indebted to have been given a function on board. I'm sure you already know, but I am your candidate treasurer! Cuz what is a King without his treasury? I may have expended most of my function-related puns, bud-get this, I have a few more words to say: Don't be afraid to talk to me. I can be a bit of a goofy person if you do get to know me, so be prepared. Clumsy is also my second name, so don't check my balance! I expect to have a great year with all of you!
Yours monetarily, Camiel Koning

Intern

Hello Francken, I'm Rebecca and at the moment I'm the kandi Intern. I have been around Francken for two years now. But technically I'm still a sjaars (sadly enough). However, I like having the mixup from being called "kutsjaars!" for two years to now being called "kutkandi!" (It is very refreshing). At the moment I am retaking my first year in physics and working hard on getting my BSA. Most of the time I'll be hanging out in Francken playing klaverjas, eating or convincing myself again that I can study in the francken room. I am Dutch, but also Mexican so don't be confused if you hear me speak Spanish. As a hobby, I do figure skating which I have been doing since I was 7 and also teach it. I do have competitions but they are not as often as I would like. Currently, I am learning how to crochet. I have been working on making a blanket for a few months. I even took it with me on the Buixie trip to work on it in the car. I am very excited to (hopefully) be the next Intern and see all of you in the beautiful Francken committees we have.
x - Rebecca Bult:)

Extern

Hey gorgeous Francken people! I'm sure you've seen me hanging around the Francken room before, as I spend way too much of my time there, but I'll introduce myself anyway. I'm Eline, 20 years old, a second-year Applied Physics student and currently kandi extern :). I enjoy cooking, watching movies, travelling, taking pictures (big love for Fotocie) and of course, pretending to study in the Franckenroom. I am extremely excited about the coming year, but also quite scared. Right now I really feel like the incapable kandi that I am, but also I'm sure that in a couple of months, I will have learned so much I won't even remember this uncertainty ;). About two years ago I chose to study Applied Physics here in Groningen, which has been a great decision, despite the unfortunate fact that my brother Melvin, who some of you might know, also studies here. He introduced me to Francken even before I started my studies, and immediately I was sold. Since then, I attended as many Francken events as possible, played a lot of klaverjas and joined many committees. I am intensely grateful to him (and you) for welcoming me into this pretty crazy friend group, as now I am also part of this amazing community. Dreadfully and happily, I am following in his footsteps once more, by (hopefully) being a part of the Francken board next year. I am really excited and curious about what this year will bring, but I'm certain that I'll have the time of my life <3. Big love, Eline

Educational

Hello, readers of the Francken Vrij, my name is Dennis and I am a third-year Applied Physics student. I am excited to say that I am also a candidate board member for the position of Commissioner of Educational Affairs for the 40th Board of T.F.V. 'Professor Francken'. I grew up in Leeuwarden (which is not located in Friesland) and decided to run for board after a fantastic experience with the association. Even though I was not that active in my first year, I became a lot more active in my second and especially my third year of studying here in Groningen. I am also very lucky that Francken is the best association of the FSE in my opinion, because otherwise I would have had a tough time with my last name. You might have seen me around the Francken room, playing games like jas, enjoying a good beer, or encouraging you to sign up for the symposium. For those who don't

know me well, some of my daily activities include going to the gym, playing guitar, gaming, and brewing the best beer in Groningen. If you haven't tried a Gebouw 13 beer yet, you should definitely give it a try. I am thrilled to be working with my fellow board members this year and I'm looking forward to celebrating the upcoming lustrum year together with the entire association.

THE NEW BOARD!!!

From graphene to the great beyond

By Antonija Grubisic-Cabo & Marcos H. D. Guimarães

In our previous FranckenVrij text we have talked about different methods to obtain two-dimensional (2D) materials from van der Waals crystals and via different synthesis methods. We also mentioned how big this family of materials is and how important they are to the solid-state physics community. In this piece we are going to have a trip down memory lane, going through some of the most important 2D materials and introducing the new physics and applications they lead to. We're gonna skip graphene though, because we assume you're sick and tired of hearing about it. After all, it has been 20 years since its isolation, all the way back in 2004! We guess that many of you weren't even born yet!

From soot to glitter - The perfect insulator

Van der Waals materials have been around for literally milenia. We have used graphite to mark sheep since humanity started herding animals. In fact, van der Waals crystals in general have the weirdest applications. Today, we will cover the most important ones for physicists.

The second main van der Waals material to be widely used in devices - after graphite/graphene - is hexagonal boron nitride, or hBN. Its lattice structure is exactly like graphene, but instead of only carbon, we have boron and nitrogen atoms in a beautiful honeycomb lattice. Funnily enough, hBN has been used for ages in makeup. Have you ever seen that white-ish powder that is kind of glittery? Yeah, that's hBN!

Good insulators are key to electronics. They provide the dielectric spacing between capacitor plates, the main component of a field-effect transistor. Additionally, a good and thin dielectric gives us the perfect tunnel barrier for tunneling transistors, one of the best alternatives for low-power

electronics. It turns out that hBN, this glittery powder, is currently the best insulator for van der Waals heterostructures. When used to isolate graphene from environmental effects, it provides the best conditions for graphene to excel and show its true potential for electronics. By sandwiching graphene with hBN - known as hBN encapsulation - we have shown record electronic mobilities even at room temperature [1]. Thanks to hBN encapsulation, graphene now shows the best electronic transport properties at room temperature and one of the best at low temperatures. This exceptional electronic quality gave us access to exotic phenomena which are still not completely understood, such as the fractional quantum Hall effect [2].

It turns out that hBN provides the best encapsulation environment and is the best dielectric spacer for all sorts of 2D materials. Due to its hexagonal lattice, similar to graphene, when the two are brought in contact it leads to a super-periodic potential with some very interesting effects, but you have to read until the end of this text to find out what we're talking about.

From lubricants to cool semiconductors

Graphene and hBN are nice and all, but our current technology is not based on insulators and (semi)metals. We need materials with a decent band gap, i.e. around 1 eV. Transition metal dichalcogenides, or

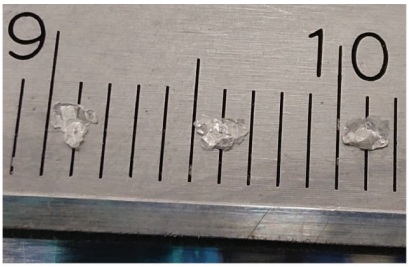

Figure 1. hBN crystals on a ruler. (Credit: Rohill Ramcharan)

TMDCs for short, are, after graphene and hBN, probably the most well known class of 2D materials. TMDCs are actually a fairly large family of materials with the general formula MX2, where M stands for transition metal (such as Mo, W and Te) and X stands for a chalcogen element (S, Se, Te). Out of the about 100-ish known TMDCs, approximately 40 have a hexagonal, layered structure, just as graphene and hBN do. There is, however, one large difference - in the case of TMDCs, a single layer actually consists of 3 atomic layers - a transition metal layer sandwiched between two layers of chalcogen atoms (see Fig. 2). Of course, there are other differences as well: as there are many different TMDCs, they also have very different properties [3]. We can find insulating, semiconducting and metallic TMDCs, as well as ones showing properties such as superconductivity, but the most important ones in the 2D world are TMDC semiconductors. Why is that so?

Idea of making electronic devices out of 2D materials has been around since the discovery of graphene in 2004. As graphene has extremely high carrier mobility, devices made of graphene should be more than 100 times faster than devices made the standard way using silicon [4]. At this point you are probably quite familiar with graphene and know that graphene is not a normal semiconductor – it is actually a semimetal (or a zero bandgap semiconductor, depending on who you ask), and as such, it is not possible to make transistors out of it. In simple terms, electrons and holes always flow in graphene, so it is not possible to switch the transistor off, a necessary condition to produce the 1's and 0's of a computer's binary language. For this, we need a band gap, and to create a nice, stable gap in graphene, without losing graphene's amazing properties is not so simple. This is where TMDCs come in! A lot of TMDCs are semiconductors, and when thinned down to a single layer, they remain so! It is a really simple and elegant solution – why spend a lot of time processing graphene and trying to open a band gap if you can simply use a different 2D material that is already a semiconductor (there are still reasons for this and Antonija is a graphene fan, so feel free to ask her about this!)? And, that's not all! Even more exciting is the fact that while a lot of bulk

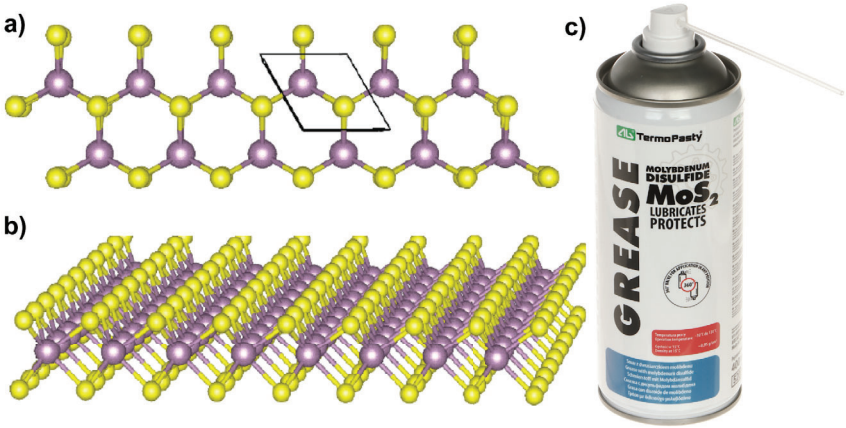

Figure 2. MoS2 as an example of TMDCs. a) Top view of MoS2 showing hexagonal structure and b) side view of MoS2 showing Mo atoms (purple) sandwiched between two chalcogen layers (yellow). c) MoS2 is often used as dry lubricant, https://shopdelta.eu

TMDCs have an indirect gap, when thinned down to a single layer, they undergo a transition to a direct gap semiconductor, which means they can also be used in optical and optoelectronic applications. Actually, 2D TMDCs are also proposed for spintronic and vallyetronic devices which rely on spin and valley degrees of freedom and can be more energy efficient [5]. From a scientific perspective, spintronic and valleytronic properties are really exciting, as this is not something that was studied before, and there is a lot of new and exciting physics hiding in it! But what about the applications? Well, a lot of groups here at our dear Zernike Institute already make devices from 2D TMDCs (feel free to talk to Marcos or Justin Ye and their students), although on a small scale, and this is something that we would also like to see implemented in real, operational devices such as cellphones and computers. These 2D materials could allow us to further miniaturize chips, create devices that consume less energy and are also faster. However, in order to do that we need to overcome several challenges, such as how to create new devices relying on 2D materials, how to use and control spin- and valleytronic properties, and even how to grow uniform, high quality TMDCs on an industrial scale - something we talked about in the previous FranckenVrij piece. These 2D semiconductors are gathering quite some momentum with big players in the semiconductor industry, like Samsung and TSMC and they're investing big bucks (several hundred million euros!) on the development of devices based on TMDCs. While the future is obviously bright for semiconducting TMDCs, there is still a lot of work left and this is where(maybe) you are coming in as future scientists and engineers!

(2D) Magnets! How do they work? - Insane Clown Posse

Ok, so we have metals and semimetals, semiconductors, insulators, superconductors and all that jazz, but for a long time there was a very important missing member of the family of 2D materials - a 2D magnet! FInally, in 2017 the first 2D magnets were first isolated [6,7]. This was perhaps somewhat surprising to a few physicists because a thermodynamic theorem, known as the Mermin-Wagner theorem [8], predicts that long-range magnetic ordering in two dimensions cannot exist at finite temperatures. But Nature is a crafty lady and gave us all the caveats we needed to actually have thermodynamically-stable 2D magnets. Because of their finite size and strong magnetic anisotropy, the Mermin-Wagner theorem breaks down for real-world 2D magnets, and these materials are actually allowed to have a nonzero long-range magnetic ordering at decently high temperatures.

Since the first observations around 6 years ago, the field of 2D magnetism has been booming. Now we can actually store data in the magnetization of atomically-thin layers:

magnetization up means bit "1" and down bit "0". By using 2D magnets in van der Waals heterostructures, combining it with other materials like 2D semiconductors or graphene, we can actually induce magnetism in these non-magnetic materials. It also opened the door to combine in a single system two of the most important highly-correlated physical phenomena: magnetism and superconductivity.

In addition to their applications and interesting combinations we can make, 2D magnets also open the door to explore the physics of true low-dimensional magnetism. As you probably remember from your courses, the behavior of electrons really changes when you go from a three-dimensional to a two-dimensional world. In particular, particles can interact more when we go to lower dimensions. For magnets, the relevant quasi-particles are known as magnons. These are the quantized version of spin waves, or the oscillations of the magnetization, similar to how phonons are the quasi-particles for oscillations of the crystal lattice. Turns out that these magnons, like the photons in the optical fiber of your internet cables, are also great for transferring information, but now instead of optical glass fibers we use a magnetic material. This is one of the key directions of the field known as magnonics. (Yeah, electronics, spintronics, valleytronics, magnonics… Physicists are not great with coming up with names for things…)

One of the most interesting things about 2D magnets is that we can easily tune them using electric fields. This means that using a similar architecture as a field-effect transistor, we can now turn the magnetization on or off using a voltage source, like a battery. This would allow us to make magnetic memory devices that also work as transistors, so we can have what is called computing-in-memory devices, where (parts of) the CPU are embedded in the memory part of your computer (like your RAM or SSD/HDD). It would also allow us to selectively turn-off the magnetization at certain regions, forbidding magnons to propagate there. If you do this just right, we can then guide the magnons along voltage-defined wires, like waveguides. A true magnetic analogue of the optical fiber, and all in an atomically-thin material

Let's do the twist!

One of the unique features of 2D materials comes from the fact that they make weak van der Waals interlayer bonds. This unique characteristic allows us to easily stack flakes of different 2D materials to create heterostructures. By doing so, we can generate materials that don't naturally occur in nature, exhibiting properties vastly different from their individual parent compounds (single layers). Taking it a step further, altering the twist angle between these layers enables the creation of twisted homo- and heterostructures. Twisted 2D materials are a new super-hot topic in physics and

material science because controlling the twist angle can lead to the emergence of exotic phases in the material due to what are called correlated states (although, these states do appear at only some very specific angles). So, how do we get these correlated states and emergent phases? When we twist two or more layers of 2D materials to specific angles, the interaction between these layers becomes so strong that it leads to an emergence of so-called strong correlations: basically, the system interacts so strongly that particles cannot be treated separately, but instead you need to describe their collective behavior - think along the lines of Borg from Star Trek! This can result in phenomena such as superconductivity, magnetism, and the appearance of Mott insulating states in materials like graphene, which under normal conditions exhibit none of these properties. First material that was studied in the twisted form was, of course, graphene. Researchers found that when graphene is twisted at approximately 1.1 degrees, it can exhibit both superconducting and Mott insulating states, depending on the carrier concentration [9]. This specific angle was termed "magic angle graphene" and sparked the field of twistronics. So, what is so special about magic angle graphene? Not only does it show signs of strong correlations and behave as a superconductor (and Mott insulator), but its phase diagram closely resembles that of high-temperature superconductors, featuring superconducting regions surrounded by correlated insulating states. This means that we can use magic angle graphene to investigate the nature of high temperature superconductors, and this is much easier to do than by using high temperature superconductors. But how can this be? By making a device out of magic angle graphene we can easily transition between insulating and superconducting phases by applying gate voltage to adjust the carrier concentration. This is quite simple to do (once you have a device, which is not so easy…) as all you have to do is change the amount of voltage you apply,and, voilà! You can map a whole phase diagram in excruciating details! In contrast, if we were to try and do the same type of phase diagram mapping using high temperature superconductors, we would need to synthesize basically an infinite amount of crystals of different do-

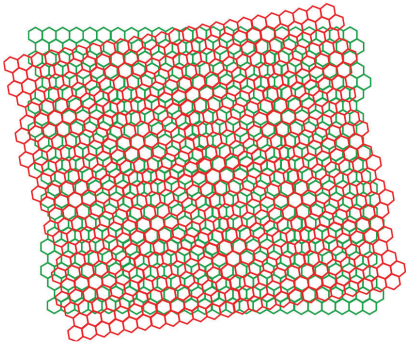

Figure 3. Moiré (superstructure) pattern formed when two hexagonal lattices (shown in red and green) are rotated 10 degrees with respect to one another.

ping, and then make a device using each of these crystals - a very tedious task even for a robot! Of course, graphene is not the only 2D material we can use to make twisted structures, we can also twist TMDCs and even superconductors. On top of it all, we don't really understand the exact nature of correlations in magic angle graphene (or TMDCs, superconductors…), but despite our current limited understanding of the exact nature of correlations in magic angle materials we do know that the field of twistronics holds exciting potential for future applications and the study of unique physical phenomena!

What's up next?

As you can see, graphene was just a beginning, sort of a material that opened the door to the 2D world. It is hard to exactly predict what awaits us in the future as we don't have a crystal magic ball, but some things are clear. First and foremost, 2D materials are here to stay, and they will be a topic of research for years to come – either in their pure, 2D form, as heterostructures or twisted materials. They will also likely find a place in applications, and some already have – graphene has already been tested in batteries and touch screens, and for sure there are applications that we did not even dream of yet!

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Move to Feringa
A Research Group's Perspective

By Malo Blömker

"If you move into the building as the first one you will get all the problems that are still there, but also you have a lot of people around that can still fix it"

Ronnie Hoekstra and Mart Salverda were generous enough to sit down with us to discuss the move of the research group "Quantum Interactions and Structural Dynamics" to the new Feringa building. The research group has been around for over 20 years and studies the interaction of ions with matter on a quantum level. Ions are fired at matter and from the resultant collision properties such as energy transfer and electron transitions can be studied. Driven by Physical applications, the research group used to do work related to fusion. Their interest has shifted over the years and now research is directly relevant to ASML's development of lithography systems. This line of research will continue for the foreseeable future.

Mart is a research technician in the group and was responsible for overseeing the move. "We were already planning [the move] for years since we knew the lab would be built".

The first mention of the move was made over a decade ago when the group was moving from the old KVI location to Nijenborgh. Schematics of the labs were made

in 2016 but since then requirements for the group have changed. Looking to get a stronger power supply and different gas lines led to difficulties, but eventually, on the 6th of March, the relocation of the equipment could start. The next four working days saw boxes being carried out of NB and into Feringa. Ronnie: "There was one day I walked almost 30,000 steps ... that's not normal".
That being said, it's important to note that the moving was overseen by the group but the execution was done by two different moving companies. This caused worries since the size and weight of the equipment mask its fragility.

What about the time leading up to the move?

Mart: "In the past year or so I started collecting boxes and foam and any packing material that I could use to already start packing small things in boxes". However, packing could not start in full swing since experiments were still happening. The packing procedure was meticulously planned since students were still scheduled to work with the equipment. "Two weeks before the move the beamline was still operational" and packing was happening all around the functioning machines.

What changes has the move brought to the research group?

Well, they now have a lab for themselves which was not the case in NB, but that has never been an issue. A significantly bigger change is the new crane that can be found in the new hall. In the old location, the crane had a maximum load capacity of 500kg which may sound like a lot, but since components could weigh up to 1.5 - 2 tonnes, the old crane drastically limited the group's ability to rearrange the equipment. With the introduction of the new crane, this problem should hopefully be overcome.

Taking apart the equipment not only yielded the opportunity to clean and paint difficult surfaces, but it is also a good opportunity to evaluate and redesign the experiments. Plans for experiment modifications are still in the air and we will be sure to check up after the summer to see the changes.

RONNIE'S OFFICE

Nijenborgh



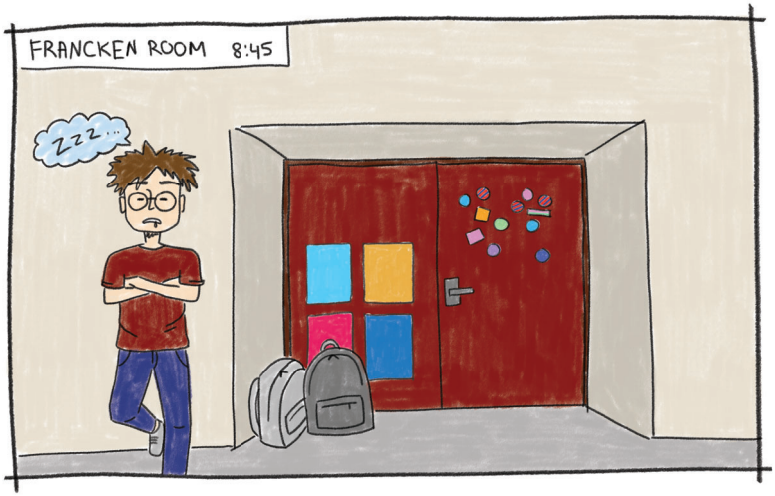

Feringa

So... Nijenborgh or Feringa?

Definitely Feringa, the new building "feels fresh" due to its modern architecture and abundant use of glass. Nothing like good old NB 13. However, the building is still in a transitional state, which doesn't seem to bother many until you are left in the bathroom with the lights off... turns out lights are activated by motion sensors at the door.

Comic

By Tania Ovramenko

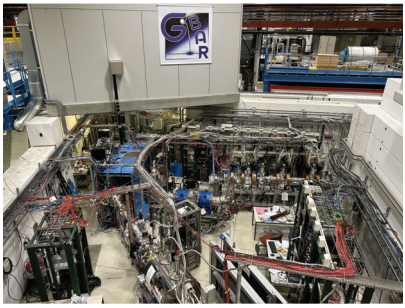


Francken abroad

By Emma Giovinazzo

Bonjour everyone! It has now been about a year and a half since I packed up all my stuff and moved from Groningen to Geneva, to pursue a PhD in Astronomy at the Observatory of Geneva. Some of you may remember me as the Commissioner of Internal Relations of the 2020-2021 board, the first and only full female board and unfortunately also the COVID one. Already while working on my Master's thesis I knew I wanted to continue in research and work on a PhD, and while looking through possible places to apply I saw an open position at the Observatory of Geneva, which we had visited just months prior with SLEF, and given that the visit we had during our tour was super interesting, I decided to apply, so I guess I have SLEF to thank for this PhD position.

If you have never been to Geneva, I would recommend to only go to CERN and leave right after as that is pretty much the only interesting thing to do here, although in summer it's possible to enjoy the nice weather from the Lac Leman, the lake of Geneva. Geneva is both a city and a canton and finds itself nestled in a corner of both Switzerland, completely surrounded by France, where many people, including me, opt to



live, as it is cheaper. The borders of the city thus feel like they extend past the borders of the country. All of these factors, from what I understand from Switzerland in general, make Geneva pretty peculiar place, where the culture feels both very Swiss and Calvinist but also influenced by France. For example, lunchtime at the observatory is strictly at noon, but this also makes it a very social experience, as everyone ends up eating in the cafeteria at the same time and ends up lasting for about an hour each day. Aperòs, the french equivalent of borrels, are also a big part of our life here, as any excuse seems good to drink some wine and have some cheese, even if the aperò has to be held at 11:15 am because of the director's schedule. Talking about cheese, how to forget fondue, a big pot of molten cheese which you eat by dipping bread into it. It has quickly become one of my new favourite foods, especially that of Bains de Paquis, a charming and busy restaurant on the Lac Leman.

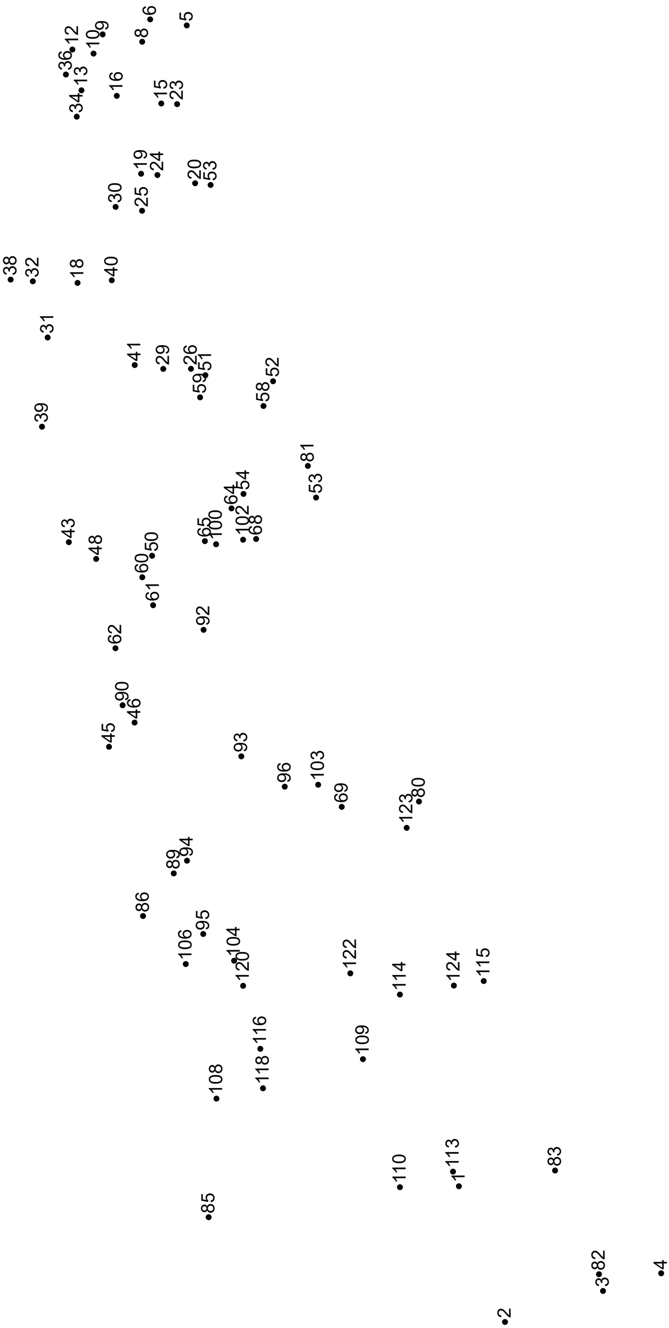
Although living in France while working in Switzerland is a sensible financial choice, especially on a PhD salary, it has expected but unpleasant side effect of double bureaucracy. The Swiss are known for their efficiency but this does not seem to apply to bureaucracy in Romandie, French Switzerland, where it feels cryptic at times, and completely nonsensical other times. For example, although you need an AVS number to do anything, no information get actually linked to this number and I therefore had to prove to multiple cantonal institutions the I did indeed have an insurance, which I could not have gotten without said number. To prove this, and not be fined, I had to send a copy of my health insurance card about five times, both digitally and by snail mail, as they seem to be big fans of paper documents.

I currently work at the Observatory of Geneva, which, unlike what the name may suggest, is located in the woods outside of the proper city, in the town of Versoix. Indeed, the observatory is in a corner of the canton of Geneva, about 50 meters from the border with the next canton, which actually goes through our parking lot, and about 500 meters from the border with France. The position of the observatory is great if you want to have a walk to clear your head when your code is not working, but it makes the commute not trivial, especially with public transport. It takes about 1 hour and multiple means of transport from Geneva proper and 45 minutes from the French

town I live in, although it's faster by bike. By far the best thing about my commute is the walk across the border and to the bus stop, which goes through a beautiful vineyard (there is a lot of white wine produced in this region), with a view on the Mont Blanc and the alps, when it's a clear day.

The personal biggest perk of semi-living in Switzerland is that Italian is one of the official languages of Switzerland and therefore all official documents, at least at a federal level have to be available in Italian. Also, since French is much easier to learn from Italian than German, there are many Italian speaking people here in Geneva, both from Italy and from Ticino, the Italian speaking canton. My favourite discovery of the year was the Italian Theatre Atelier of the University, led by one of the professors of Italian literature here, where I got to meet plenty of people. At the time of writing, we just performed the play we were working on this year.

Overall, I still have most of my PhD to go, about two and a half years more, so it's probably too early to draw conclusions of this experience. However, for now I can say that moving to a different country for work and settling in is much more difficult than it is for studies, but with all its challenges shaping to be a rewarding experience. Luckily, I still get to visit Groningen quite often, so you might still spot me in the Francken room every now and then. But until then, Au Revoir!



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Where should you study?

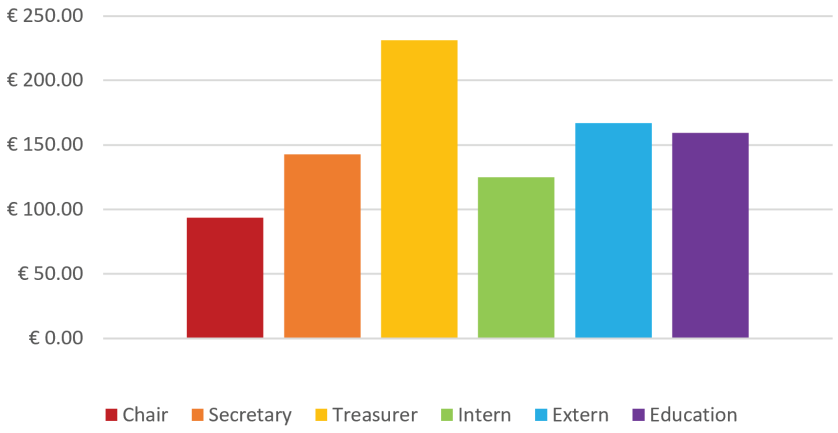
By Eline Mijnlieff

Positional expenses

By Siem Kuijpers

We all know the age-old custom of board members having an unhinged striping spree! But, have you ever wondered which function in our beloved association is the reigning champion of striping? Well, wonder no more, for I've delved deep into the numbers of our striping archives in search of the truth.

After thoroughly examining the striped foods and drinks of the past seven incassos of our active (old) board, I've averaged them out per person and added the results per function. And lo and behold, as anticipated, the function that tends to attract the most furniturey souls has indeed emerged victorious in the striping tournament. Here are the striping statistics of our association's functions!



Member's input

By Solène van der Schot

"Join Francken, it will be fun !" – they said (and they were right)

Dear reader, I am a half French half Dutch first-year physics student. Some like to say my average nationality is thus Belgian (I am not sure if that's a compliment). You may not know me; however, you would have spotted me at most events: a little bit shy, trying to converse in Dutch, and probably a beer in hand.

Sadly, I did not discover Francken during the beginning of the year events like most other first years. I randomly followed a friend a few months after to go to the movie night where we watched 5 hours of Pirates of the Caribbean. Even though I did not know anyone in the association except for 2 friends, I decided to sign up for the member's weekend in December and ended up in the middle of a cantus with people screaming in Latin, and I thought to myself "how on earth did I end up here ?".

Shortly after that, I ended up being part of the sjaars team for the Tour de Francken, which has nothing in common with the tour

de France except for the fact that it is one hell of a ride. I would like to highlight the fact that the sjaars came out with the 4th position in this tournament (without cheating of course). After this near-death experience, I thought it would be a good idea to start attending Francken events more often, and that's exactly what I did.

Even though I have only been here a few months, I can already see how much this association can bring to a person. It broadens your outlook on everything in general, expands your academic knowledge and general (scientific) culture, creates strong friendships, makes you gain matu-

rity, teaches you about the professional adult world ahead, and much more. It just expands your intellect on many different levels.

Francken can even expand your sporting level (in theory)! Members have put into place the habit of going swimming on Tuesday mornings before class. My friend and I have come a grand total of 3 times, but I'm not sure that would even qualify as 'swimming' as we basically try not to drown whilst gossiping in the slowest line and get overtaken by people 5 times our age. Practice sessions for the biggest relay run in Europe are also organized and are surely going to result in a great performance on the day of the race!

One thing Francken will definitely not expand: your free time. Being part of a committee or board will take some/a lot of that away from you, but people still want the job so it must be worth it. That is personally not my case (sjaarcie is not what I would

call time-consuming), I have just spent a little too much time in the Francken room for my own good lately; either eating, drinking (only coffee of course), having a chat, playing klaverjas (terribly), constructing an aqueduct, or literally anything else to postpone studying as much as I can. There are also of course all the great events that the association organizes that you want to attend as much as possible, but know when your cue to leave is or you might end up getting home in the early morning once too many times (speaking for a friend).

I would like to thank everyone for making this a great year so far, with a special thanks to the board for managing this crazy association. I am very much looking forward to making many more memories with all of you and I can't wait to see what else Francken has in store for us!

À bientôt, Solène

PS : Should you ever decide to go hitch-hiking in Germany, avoid expanding your trip to Bunde at all costs

BROUWCIE

Are you the next brewmeister?

Walkie & Talkie: Gossip on the Go

By Marc & Charlotte

We don't really know how it all started, but one day Marc and I decided that going for a walk (read: going to AH To Go to get a snack) and updating each other on the latest gossip would be a great way to spend our time not studying.

Why not just gossip in the Franckenroom? Well, you see, the great thing about gossiping is that you share exclusive information and learn a lot about group dynamics, relationships and individuals along the way. This can simply not be done in the presence of other Francken members who might not appreciate this art form. To be quite frank, our main motivation to join the Francken Vrij was to write the gossip rubric together, so here we are going on another little adventure.

Just like any other ordinary day on campus, I entered the Francken room on Thursday to attempt to study, but alas, Marc was "working on his thesis" at the big table so we simply had to go for a little snack and catch-up session around campus.

Here are the words that we heard and captivated our interest about the life of our infamous members.

Whispers are swirling through our circles, hinting at a budding romance between a certain math prodigy and a star-gazing sjaars. Apparently, sparks flew at the Sirius A gala. Meanwhile, the veil has been lifted on the back then candidate board, stepping into the spotlight. But amidst the intrigue, there's a tale of forbidden love—rumour has it **that a demissionairy board member and an ex are entangled in a clandestine affair.**

And then there's a half french half dutch person, the subject of murmurs suggesting they should let go of their French side. Oh, and let's not forget the adventurous souls of Buixie, who ventured all the way to Sweden this year, **chasing after more than just Ikea meatballs,** I hear.

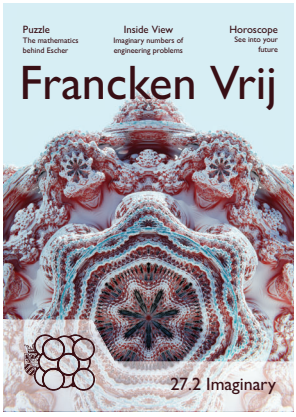
The love was also in the air in our Gala, so here's the tea from the Francken Gala. Rumour has it that our education wanted to manage some events of Buixie. Talk about crossing party lines! But wait, there's more drama. It seems that at the candidate board reveal, two former board members couldn't resist each other's charms and **ended up getting cozy...** in more ways than one. Looks like sparks have been flying all over the place!

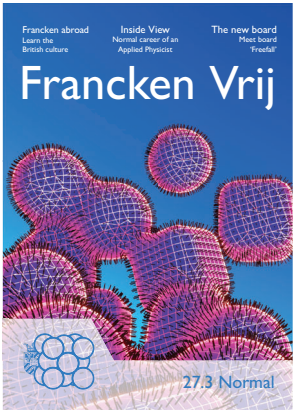
With the sandwiches eaten and the gossip discussed, we thought it best to head back to the Francken room and really start studying this time. But of course, we got distracted by a peculiar-looking banner outside of the Energy Academy and we decided to check it out. It turned out that the banner belonged to a career event being held to promote the energy sector in the North. Having convinced the ladies at the front door that we would just "take a look", Charlotte quickly started scanning the room for stands that had cool freebies. One stand had two hydrogen gas tanks on display, so she touched them and the guy belonging to the stand approached us. He explained that they produced hydrogen tanks for airplanes, to which Charlotte explained that Marc would be studying Aerospace Engineering next year. The guy offeredMarc an internship and we left to hit up the photobooth. Sadly, it had not yet opened, but we did manage to take a selfie to showcase our presence at the energy fair.

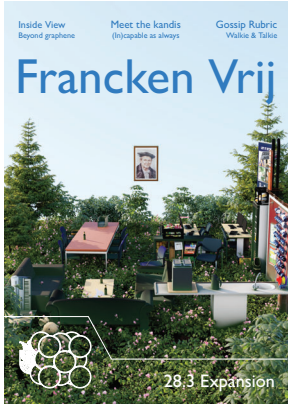
You know you love this rubric, so see you next time!

XOXO Gossip Girlies

Bradley's Francken Vrij Covers







Taylor Swift's New Album Just Dropped!

By Hannelys Posthumus

This article is not sponsored
Disclaimer: This article is written by an undergraduate

A few hours ago pop artist Taylor Swift dropped her newest album: Taylor expansion, which has a double meaning. In an interview with the Francken Vrij committee, she said this album has a few intentions, but the main takeaway is that Swift wishes to expand her world and mind with new ideas, concepts and inspiration. One of those is the concept of applied physics. Having visited the Francken room a few times, she quickly concluded that Francken members are extremely cool and thus applied physics is as well.

Before the album got released, Taylor Swift introduced the album and hyped up her fans by releasing a song called Taylor Swift: an expansion. Here she introduced the concept of and the reason why we use Taylor expansions. After having listened to this song, you know the general concept and can go into more detail by listening to her whole album.

The new album consists of a few things related to the concept of Taylor expansion, the first song being Maclaurin. Maclaurin expansion is another word for a special case of the Taylor expansion (so we can call the artist Maclaurin Swift as well). The Taylor expansion was named after Brook Taylor, who constructed the Taylor expansion, whereas the Maclaurin expansion was named after Colin Maclaurin, who published the special

case of a Taylor expansion, where 0 is the point where the derivatives are analysed. In the song, Taylor sings emotionally about the history of the expansion.

The second song is called Residual, and this is a synonym of Remainder. The residual is the error that occurs when you approximate a Taylor expansion. It is denoted by $R_n(x)$. For example, if you take a Taylor expansion from $n=0$ to $n=10$, the residual is the sum from $n=10$ to $n=\infty$.

The third song in Maclaurin Swift's album is called Exponential. This is because there is an exponential in the sum that goes like x_n, which is in the numerator. This means the exponential is way more dominant at higher n, which doesn't make sense, because you would think that the higher the n, the smaller the function at that n. The latter is what brings me to the next song.

The next song is called Factorial. What is the definition of a factorial, you may ask? It is denoted as n!, where $n=1,2,3,...$, and its definition is $n!=1\times2\times3\times...\times n$. $n!$ is in the denominator of the Taylor expansion, and increases quicker than an exponential. This is why the nth order is smaller in magnitude than the $(n\text{-}1)\text{th}$ order.

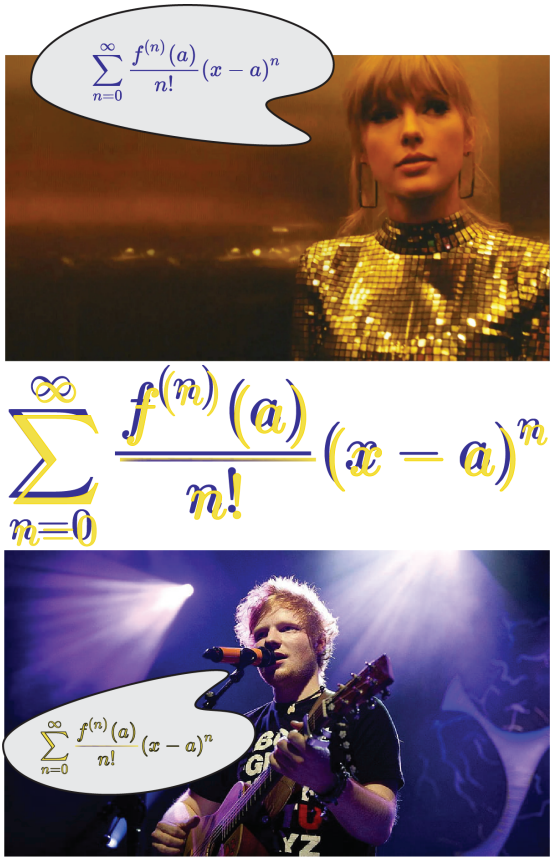
The fifth song is called Derivative. This is since the Taylor expansion also consists of a derivative, how surprising! The order of degree (the next song is called Order of Degree!) of the derivative is dependent on n. If $n=0$, it is the function itself, $n=1$ gives the first derivative, $n=2$ gives the second derivative and so on.

The sixth song is called Order of Degree. How many degrees are you? Send an email to franckenvrij@gmail.com.

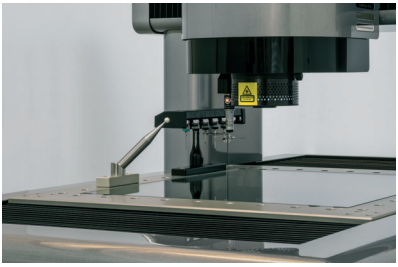
Polynomial is the last but not least of the songs from this album. The Taylor expansion is a polynomial. A polynomial is the definition of a series of exponentials. If you take a look at the Taylor expansion, you can see that this is the case.

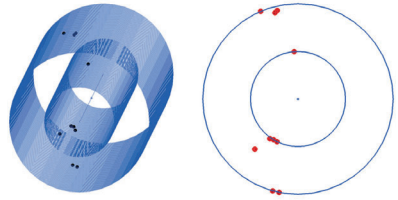
"Applied Physics is extremely cool" - Taylor Swift

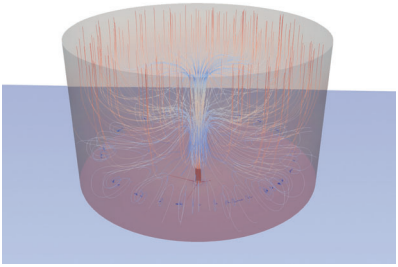
These were all the songs! Taylor Swift mentioned during her interview that she will also do a world tour. During the tour she will solve a lot of maths problems that are related to Taylor expansions, and she will learn a lot. She will take Ed Sheeran with her, since this album is an expansion of his album covers.

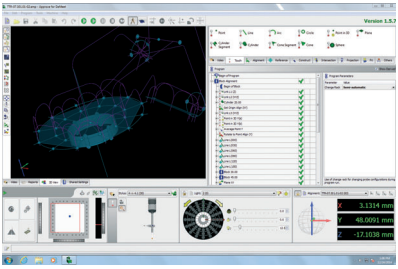


Album Cover of Taylor Expansion.









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