

Martin Bizzarro looks at the martian meteorite NWA 7533 that contains the oldest material from this planet, dating back to about 4.48 billion year ago.  
Photo: Lise Brix.



## KAPITEL 24

# Professor Martin Bizzarro

Martin Bizzarro's research center is called the Center for Star and Planet Formation, or STARPLAN. That already gives you an impression of the scope of his ideas and goals, and hence, those of the center. That said, the day I meet him, a cold January morning in the Geological Museum in Copenhagen where his center is located, he is somewhat challenged. His wife is traveling and the logistics of being a temporary single parent and running a research center are a bit much even if you are used to dealing with planets. Nonetheless he is enthusiastic and very present as he starts explaining what STARPLAN is about.

### What facilitates formation of planets like Earth

While all the centers funded by The Danish National Research Foundation are interdisciplinary, Martin Bizzarro's center is taking that to the extreme, and in fact, as he says, this is more than just important.

“My main objective is to understand how the solar system formed and if it is special relative to all the other planetary systems in the galaxy. In other words, are there special circumstances which promote the formation of planets like Earth? To me this is an extremely relevant question for mankind in general, not only for the next 5 years but for the next 20 to 50 years. We want to lay the foundation, the first bricks, for answering that question (Facts box). This requires that we work in a truly multidisciplinary manner. If we don't interact with each other, everything breaks apart and we don't make progress. So, engaging in this sort of synergy is required to get success.”

Martin Bizzarro answers my next question – namely, what are you most proud of and why? – with a question to which we will return later in our conversation.

“It's a difficult question because it comes back to the bigger question: what makes the legacy of a center? People get excited when you have Nature and Science papers. That is very nice, but what I am proud of, is a study which will be cited for the next 50 to 100 years. I think that during the lifetime of the center, there can be very few – maybe

### The research of STARPLAN **FACTS BOX**

STARPLAN was established as a DNRF centre of excellence from 2009 to 2019 and now maintain its status as a research centre in the newly formed Globe Institute at the University of Copenhagen. The main focus of the research at STARPLAN is to explore the origin and evolution of planetary systems from a dynamic perspective by integrating the disciplines of cosmochemistry, astronomy and astrophysics. This innovative and multidisciplinary approach places the centre in a unique position amongst research groups in the field of planetary sciences. This provides a framework to understand the circumstances that allowed for the formation of the terrestrial planets in our solar system, including the preservation of water worlds like Earth, where life has been thriving for nearly 4 billion years. The ultimate goal of the research centre is to determine whether planetary systems hosting habitable worlds are common in our galaxy.

Image: NASA.



two or three – such papers. We have two published now which I think have the potential to become legacy papers. I will take an example of one of them, which was published a few months ago [91]. We originally submitted it to *Science* and *Nature*, but because it is so provocative in its thinking, it was difficult to get it accepted in these journals, so it was published in *Science Advances* which is a sister journal of *Science*. The technical details are not important here, but it discusses which materials are required to form planets efficiently in a planetary system. And it puts forward for the first time the idea that when our solar system formed, all the key ingredients for planet formation were more or less in place. So, this paper allows us to provide a new framework for understanding how planets form efficiently in a planetary system. But I can tell you, out of 7 referees, 6 recommended rejection and only one recommended publication. This is an example of something that is extremely difficult, not only to achieve in the lab – it was 3 or 4 years of intense work – but also very difficult to publish. But it is also an example of one of the things I am most proud of, namely pushing the boundary. And although the paper was difficult to get published, I think in 20-30 years, this will be one of the legacy papers.”

### To some extent we have the same purpose as a museum

I ask Martin Bizzarro what the ingredients in research are, that enable such a legacy paper. And by extension, what are the characteristics of work that he admires from his colleagues?

“Again, it has to have this flavor of pushing the envelope, in the thinking process, in the approach, and in the analysis. I am keen on spending a lot of time and resources developing new techniques in the lab, because it allows you to ask new questions. The work that I most respect from my colleagues or competitors would be that which has all these different flavors to it: being

thought provoking, based on new ideas, using new methods and taking them to the extreme limit.”

Somewhat provocatively, Martin Bizzarro thinks that about half the papers out there should not even have been published, because they are essentially duplication of something or just an incremental step forward. He also feels that funding agencies and others evaluating science tend to focus on quantity over quality. He would rather publish much less but with higher impact – research that has the potential to really change our current views. That is also how he sees his research in a societal context.

“Being in basic science, I don’t deal with problems which are directly relevant to mankind in the sense of, for instance, finding the cure to cancer or anything like that. But like art, I think our discoveries make life more interesting for people. To some extent we have the same purpose as a museum – trying to get people excited about things from the past or questions that may arise in the future. Another ethics-related question is how we pick our research topics. I would always go for what I think is more scientifically exciting, rather than something I think sells better to journals like *Nature* and *Science*. It’s fully question-driven. And if one of my colleagues or competitors is working in an area, would I go in that direction and try to beat them? If I think it’s eventually positive for my group to be in this area and win, then certainly I will push for it. It’s about what’s in the best interest of the research group.”

STARPLAN has a very unusual and, as one might expect, ambitious and interdisciplinary approach to brainstorming and idea generation: The staff members – all 45 of them – go away together for a week. The program includes lectures, but that is essentially just to get people warmed up for the discussions that are the key activity. At a typical retreat, there will be long discussion-sessions morning, afternoon, and evening. And there will be lots of free time during which people can mingle and do things together.

“We rarely know what is going to come out of a retreat. We prepare for it and try to stimulate people, and the outcome is basically dictated by their participation. But many of the ideas for papers from the center were cemented during these retreats. To the best of my knowledge this is one of the few, maybe the only, center in planetary science which is so integrated. When the center was going through its midterm review, one of the reviewers commented that until they visited the center, they did not think it was possible to do what we are doing. It is unique. We mingle and integrate and share postdocs and students from disciplines which traditionally don’t speak to each other and would never go to the same meetings.”

So it’s not just the retreats but also the daily work in the center that is highly interdisciplinary. How do Martin Bizzarro and the other principal investigators in STARPLAN ensure this level of synergy between extremely different fields of research?

“First of all, we all sit together in one building, and we have a lot of shared activities. We have multidisciplinary journal clubs, where the younger people will present a paper outside of their discipline, but they are assigned a mentor the week before to help them understand the paper. We also have PhD days: once a year, all the students have a full day during which they present their research to all the groups as well, so it has to be done in a way that everyone can understand them. This is normally followed up by a second day with lots of talks and presentations by visiting researchers. And we have an annual science day focused on the postdocs. For the projects that have been established at our retreats, we of course have follow-up meetings during the year by the people who are working on the paper. This could be something like 10 people working together on a project, who will meet every month to report on their progress. And at one point you don’t have to do anything to organize it, these become natural things for people to do.”

## In science I get the feeling of winning by achieving excellence

Martin Bizzarro was not interested in a career in science from the beginning. He was interested in sports. Growing up in Canada, he played elite-level ice hockey throughout high school. At one point he realized that he was not big enough to become a professional player. So he quit and started fencing instead. He was on the national fencing team for Canada during the time he did his B.Sc. and M.Sc.

“I didn’t have big ambitions in university, or rather, because I was putting all my time in fencing I was putting less time in university. When I realized that ok, fencing is interesting, going to world cups is interesting but I’m not going to have a career in fencing because there is no money in that, I made a critical decision. I decided to do a PhD, and I quit fencing, and all the energy that I had at that time – I was training 10, 15 hours a week – all this extra energy was put into my PhD. And I realized that I was getting the same sort of satisfaction when I got good results in the lab, as I got from winning in fencing or scoring goals in ice hockey. So, my career in science is an extension of my career in sports – in science I get the feeling of winning by achieving excellence.”

In other words, it did not just start with curiosity. Rather, it was the other way around: being addicted to the feeling of getting results and then realizing that what he discovered was exciting and important. Martin Bizzarro’s path to science, to a very large extent, was also not driven by role models.

“The classical example, a brilliant science teacher in high school or something, that was not part of it. And my PhD advisor was not that good, but I knew what I wanted to do, so it didn’t slow me down. I got inspired by looking at top people in my field, reading their papers and studying what they had done. Although I only met those people

later in my career, I knew of them and the work they were doing, and I respected them immensely. If you take the analogy of sport, every kid wants to be as good a Messi, and it was a similar thing – or at least it showed me that these things are possible.”

## From Canada to Denmark

Not only was he not interested in a research career from the beginning, Martin Bizzarro also did not come to Denmark from Canada out of a burning desire to pursue his research here. He came because he had a Danish girlfriend. He wrote and won a competitive Canadian postdoc grant, allowing him to go anywhere in the world for two years. As soon as he came to Denmark, however, he changed his project, because he discovered a place he would rather be. This attractive place was the Danish Lithosphere Center, DLC, headed by Hans Christian Larsen and part of the first generation of D NRF Centers of Excellence.

“I learned about them, went over there and started talking to people about what I wanted to do. Eventually, I was integrated as a postdoc at the center. I spent three years there, two on my own money and one on money from the foundation. In the third year, the leader left, and I transitioned into getting a starting grant. So this was my first and last postdoc.”

## Breakthroughs and legacy papers

When I ask Martin Bizzarro to describe his most important breakthroughs, we return to the issue of legacy. As he sees it, a breakthrough paper is something you should be writing relatively often in a research group as big as a Center of Excellence, whereas a legacy paper is something that occurs, at most, a few times in the lifetime of a center.

“Breakthrough papers are important, exciting discoveries, which if you play your cards right, you should be getting one a year, at least, with

the kind of resources you have as a center. These are papers in *Nature* and *Science*, *Proceedings of the National Academy of Science*, and other *Letters* type journals. In this category there are some that I am proud of, because they have shifted the way the field is thinking. For instance, one of the early papers from the center, which was published in 2011 [92], tested the core assumption of a key method for studying the chronology of planet formation, and showed that it was incorrect. But imagine that people have been working with this method for the last 30 years, and then you come and tell them it is not correct. So the paper was published in 2011, and I think that now, in 2018, it is finally starting to get accepted.”

Another example is, of course, the legacy paper Martin Bizzarro talked about earlier in our conversation [91]. Up until very recently, it was thought that the precursor material for planets started forming late in the history of our solar system, that is, at least two million years after the formation of our sun. That would mean that if this material is what drives the growth of planets, you cannot start forming planets earlier than that. What the study by Martin Bizzarro and his colleagues showed was that the bulk of the precursor material for planets was already formed in the first million years. Because the so-called protoplanetary disc, from which the material from our solar system formed, only existed for 4 to 5 million years, this represents a major shift in the understanding of the timescales of planet formation, Martin Bizzarro explains.

## The Messi’s, the midfielders and the defensemen

Leaving a legacy, changing the thinking in the field or perhaps even beyond that, is something that all scientists hope to do. What are the conditions making that kind of legacy research possible?

“Firstly, if you don’t have funding, then none of this is possible. So let’s say that you have the funding. Then, being driven, wanting to win, is

really important, as is being ready to work really hard. At the same time, one has to give liberty to the people in the group who have good ideas. Unless you do that, you will never be able to keep a group of successful people around you. You are there to facilitate their work and give them ideas and let them run with those ideas. Once you have someone who has the potential in all of these categories, then my role is helping them aspire to that, giving them projects, which are exciting, and giving them the responsibilities they need in order to develop. I think it all comes naturally as long as you are willing to let people be independent. Otherwise, they won't feel that it is their work."

According to Martin Bizzarro, the key to success of a research group is how people interact. Of course people have to be smart and driven, but having established that, an essential quality for new team members is the ability to be a team player. It is the balance of people with different qualities and skills that makes a group function well.

"I know nothing about football, but as an analogy, you need three different types in a research group. You need people like Messi, the prima donna's, because they will work extremely hard and they will push the envelope. You need the defensemen because without them, you may not be able to push the limits technically speaking. And then you need the midfielders. These are the idea generators. They may not work in the lab very well or write papers very well but they come up with the brilliant ideas. I think that having the right mixture of these people is the only way you can make huge steps forward. Conversely, if someone is not willing to play on a team, then it is never going to work out. I have a few examples where after a year I have had to get rid of people because they have not been willing to play in this sort of environment. That just slows people down, frustrates the others and doesn't work out."

## What can I say? I am stubborn

One would think that for someone to whom winning is so important, it could be very hard to cope when things go wrong. But Martin Bizzarro seems to take that rather calmly.

»Yeah, sometimes you could be working in the lab and not making progress for a year. What can I say? I'm stubborn! You have to give things their time, and sometimes you realize that what you thought would work doesn't. But I think it is common sense: if the reward is so potentially large, then you feel it is worth the effort and then of course you're going to do it. And in the category of high-risk, high-gain science, you don't expect that everything is going to be a win."

Another example in the challenges category, arguably considered one of the most frustrating by many scientists, is being "scooped": you have been working on an exciting new discovery and are getting ready to publish, and another group beats you to the finish line and publishes first, diminishing the impact of your work. But he seems to be relatively Zen even about this scenario.

"Of course, it pisses me off, but you can't expect that your group is going to be number one in every single field. Even if you had the idea first, maybe the idea was driven by a student who was a bit slower or something like that, and another group got there first. It happened to us a couple of times during the life of the center. Big deal. It's natural, it's going to happen. So I think you just have to live with these kinds of failures. It's about also learning from it: why were we scooped? Maybe because we were spread out too thin, for example, and we should have had two projects less and focused more energy on the other projects. When you are a young center leader, you want to win as much as you can, and that can lead to having too many projects. So, these kinds of failures are good because they teach you about

yourself as well. Losing is not entirely bad. It pisses you off and you get frustrated, but then you realise, ok, I can learn from this and get back up.”

On the topic of spreading resources too thin or sometimes being too slow: how does one balance the freedom needed for keeping brilliant people motivated with sometimes having to enforce that everyone works like mad on the same project, to avoid things like being scooped?

“Yes, I push people. I am always pushing, pushing, pushing. Of course people need to have time to reflect. But I think that unless you apply pressure, it’s very difficult to keep the momentum going. Sometimes, like now, we have a number of projects which need to be finished before the application for the ERC Advanced Grant and the Villum application, so I am pushing people really hard. I see it as one of my roles as a center leader. Not being the bad guy but communicating, for example, that Martin really wants this to happen in the next two months and there is no room for error.”

The way he generally deals with such times, Martin Bizzarro says, is to meet with everyone in the center and explain the situation: everyone has to work extra hours, push really hard, for the next 2 to 3 months, but after that, most likely, there will be funding for another 6 years. And he comes in to work on weekends, helps people out, and shows that he is doing the same thing as they are. And he tries to ensure that everyone still feels that their opinion counts and they make a significant contribution.

### There is not a position for everyone

Martin Bizzarro talks to all his postdocs and PhD students every day. I find that amazing, imagining his schedule, but he thinks it is essential.

“Here, problem solving is really a team effort. There are fields where people can work much more individually. Research group leaders in

math, for instance, probably wouldn’t need to know on a day-to-day basis what their postdocs are working on. They would know the overall idea of course, but they would not be talking to them every day. I guess that in such fields, if people don’t succeed, they are on their own. It must be difficult, but that’s the nature of the beast.”

Martin Bizzarro intentionally grooms the next generation of researchers now coming up in his center, and for a few key people, he puts very substantial energy into this. He teaches them to write papers and proposals. He also helps them in making the right choices about where to go next.

“My strategy is that, when they have been with me for some years, I send the best young people in my research group abroad to work with people where I think they can learn more than with me. After a couple of years there, they are in a position to write an ERC Starting Grant and come back to the center, or to my research group once the center has ended. I identified four or five who I think can attract this sort of money, and I am sending them to different places in the world.”

Clearly, this kind of career is only accessible to very few of the students in a research group. The rest of them are going to leave science.

“There is not a position for everyone. And it turns out that a lot of people are happy being part of the center, doing exciting research and after that, moving on to something else. I think that is ok. The center has benefitted from them because of their work and other contributions, and they have benefitted by learning a lot, including work ethic and so forth. So, I think this doesn’t have to be a bad experience – it’s about feeling like you’re part of a team and making a difference.”

### The difficult transition

Although there are funding opportunities today that

did not exist 10 to 15 years ago, such as the big European research funding schemes, Martin Bizzarro thinks that establishing yourself as a young scientist in Denmark today is, in some ways, harder than when he started.

“The opportunities are there, but it’s more competitive. People have better CVs and are writing better grant proposals. It’s a self-created problem in the sense that there are many successful centers in Denmark with very good people coming out of them, who are competing for the same money. I think that for the extremely good people, the chances are more or less the same as before, but in the layer underneath it is very difficult. I think that is sad in a way. The young people in the centers can have additional difficulty getting money because they are part of a center. That means that with the important transition between being on your principal investigator’s grant to being 100 percent on your own, it gets more difficult to obtain money. And if that doesn’t happen, it is difficult to become independent. That parent-child relationship is always going to be there.”

### Extraordinary things can come from almost anyone

It is not surprising therefore, that if Martin Bizzarro could decide how to spend Danish research funding, he would take more chances with young researchers. As he sees it, in that way you will of course have more failures, but if you prioritize the very established researchers, you miss opportunities to fund the potentially best young people.

“Centers will be successful, no doubt, if you pick someone with a track record of excellence. But does that mean the center will have a huge impact for science? Maybe not. I would rely more on external grants for these established scientists, and put more emphasis on the young people. They are the ones that are going to make a difference. And yes, they will also have more failures, but this is a high risk, high gain relationship.”

But if you want to find the very best people who do not yet have a huge track record, how do you recognize them?

“Yes it is difficult. You can recognize some of the people who you feel have the potential to be very good, but there are others you won’t recognize. But that is why you should be taking more chances. Extraordinary things can come from almost anyone. How do you make sure that you don’t miss out on those people? I think it is by having the ability to give more grants, and maybe shorter grants, like three years. That way you will be able to identify more of the talents. Sure you will also have failures, but they are necessary. A big part of the problem is having pre-set criteria on what you imagine the best sort of promising scientist is. If you want to win Nobel prizes, you need to make sure that you get everyone who has the potential on board.”

One could argue that that is more or less the system we have now, in Denmark and in Europe in general? With the low funding rates, you need to be able to sell yourself in order to earn a grant?

“Right. At the ERC for example, both the starting and consolidator grants involve an interview. That is a selling job, and only the people who are good at selling themselves will succeed. All the others, who are equally or maybe even more talented intellectually, who may well have better ideas, are not going to succeed, and I think that is a problem. What you’re doing is screening for the type of scientist who is good at selling their science. It’s different, I think, for grants for big centers for established scientists – of course you want to meet that person before you fund them. But I think that at the initial level you shouldn’t rely on this as an important criterion. Not everyone may be comfortable with that at the start of their career, even though they may later develop into that person.”

In fact, Martin Bizzarro would like to also see the DNRF taking bigger risks.

“Why not only use half of the money for centers in their current form, and use the other half on a higher-risk sort of platform, where you invest in younger people for a shorter time and with less money? Once you have given the right person that money, they will do something fantastic with it and won’t need you anymore. Now they can get money from other sources. That is a way of reaching the younger people who could develop into something fantastic, but unless they have that initial seeding, they won’t.”

### Sparking curiosity in science

Before we end the interview, I ask Martin Bizzaro if he sees a way for the centers to contribute to sparking interest in science in students before they even enter university.

“How do you make sure that young people get excited about science early on in their education, so that they will go on to pick a career in science? It sparks curiosity to be involved in some aspect of real research, right? And from a center perspective, making the extra effort to be part of a public outreach program like this could even be

potentially beneficial. You could have programs, maybe a science summer camp, where the most talented young people from certain schools could come and spend a week and be involved in some projects. It’s one thing to sit in a high school classroom and think something is pretty interesting. But to actually be involved, or to have a real scientist come to your class and tell you about what we do on a day-to-day basis that might get you really excited.”

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#### Professor Martin Bizzaro

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Education: PhD in isotope geochemistry Université du Québec à Montréal (1999-2003)

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