Astronomy Cast Episode 235 for Monday, October 17, 2011: Einstein

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Fraser: Welcome to Astronomy Cast, our weekly facts-based journey through the Cosmos, where we help you understand not only what we know, but how we know what we know. My name is Fraser Cain, I'm the publisher of *Universe Today*, and with me is Dr. Pamela Gay, a professor at Southern Illinois University – Edwardsville. Hi, Pamela. How are you doing?

Pamela: I'm doing well. How are you doing, Fraser?

Fraser: Good, you're in a sort of momentary break from in between France and China.

Pamela: Yes. This would be called travel insanity. Thursday evening I flew from Nonce to Paris, left Paris Friday morning, flew Paris-London-Chicago-St. Louis…I'm now spending about 15 hours in St. Louis before flying St. Louis-Chicago, Chicago-Beijing, and I'm going there for a meeting there about communicating Astronomy to the public to find out how people all around the world do the types of things you and I do.

Fraser: People sometimes don't believe us that you have this insane travel schedule, but this is the…you always tell me, as I've said, "Oh no, I'm going to be around for the next three months, we'll have lots of time to record," and then it all gets filled up with all kinds of speaking engagements, and trips and meetings and whatever, so…and again, we are recording this episode as a Google plus hang-out, so we've got eight of our best friends listening to this while we record. Everybody wave (that won't make it into the podcast)…but if you want to join us on future episodes, you just have to join Google plus, and then circle me or Pamela, and then you'll see we usually try to give people a bit of a warning when we're going to record, and then we will announce the hang-out, and then it's kind of first come first served, but it's pretty cool, and hopefully when they do hang-outs on air we'll be able to be a part of that.

Pamela: We *really* want to hang out on air – we're just going to keep saying this.

Fraser: I saw one…I saw one for the first time and it was really cool. It was kind of like Youtube, but it was live and people were chatting it was really neat, so…and it let everybody watch it, so that would be really cool. That was like the Dalai Lama or something.

Pamela: We're not that [laughing].

Fraser: We're not there yet. Alright, well let's get on with the show, then. So what can we say about Einstein? Albert f---ing Einstein…lots actually. In this show we're going to talk about the most revolutionary physicist ever. He completely changed our understanding of time and space and energy and gravity. He made predictions about the nature of the universe that we're still testing out. Alright, Pamela…and I know you have fiendish plans to talk about his love life, too.

Pamela: [laughing] Well, it was one of these things that as I was reading through the biographies for him, I realized the dates with which it listed him as with various women and married and divorced to various women overlapped in the most fascinating of ways, and I actually had to resort to a spreadsheet to keep track of Einstein's love life.

Fraser: Is this a first? Is this the first episode of AstronomyCast where you've had to prepare a spreadsheet to perform some kind of pivot data analysis on a scientist's love life? That is amazing!

Pamela: Well, it just made no sense -- the listing of cities and everything else, and then I realized, no, he actually left this chick here, went there, was with this other chick…it was just sort of like, "Wow! This is like *All My Children: Scientists' Edition*."

Fraser: So how do you want to do this? Do you want to the first do the part of the episode where we just talk about, you know, the stuff you might see on the Discovery Channel? You know, the "explained this, taught that," and then feed in the love life parts? Or have a whole separate addendum where we just cover the timeline of his affairs and marriages?

Pamela: Well, if you just take him in order – so beginning to end is probably the easiest way. His love life will play its way in.

Fraser: I think when most people think of Einstein, they think of that picture with him sticking his tongue out, and he was kind of wild and crazy, white hair, but that was really him sort of at the end of his life, but he did a lot of his work when he was quite a young man, so how did it all get started? Where did he come from?

Pamela: Well, he's a man of Europe, for lack of a better way to put it. He was born in Wittenberg Kingdom in Germany before it was the German nation that we're used to. This was back in 1879 when we're still looking at monarchies, but very quickly his family moved to Munich. He stayed in Munich until he was 17 when he moved first, briefly, to Italy and then to Zurich, rather to Areuse, Switzerland and then to Zurich the next year, and this movement was, in large part, to try to keep him in good schools. When he was five… he was from a non-practicing Jewish family, and they sent him to a Catholic elementary school from age 5 to 8 to start him off on a good educational foundation, and at 8 he was able to get into the Leuthold Gymnasium, which was a much more advanced school, and he stayed there for most of his life, but when he was a teenager his parents moved to Italy. They left him in Munich to try and finish out his education in the Gymnasium, but when he was 16 he basically said, "No, I'm going to go spend time with my parents." And his parents said "We've not got a good school for you here," because he didn't get into the one that was local, and then he moved to Switzerland where he met his first girlfriend.

Fraser: So how like old was he at this point?

Pamela: So at age 16 he leaves, he drops out of Leuthold Gymnasium, he moves to Pavia, Italy, didn't get into the school there, he gets sent to Areuse, Switzerland where he's living with one of the professor's families, meets Marie Winteler (I believe is how you pronounce her last name), and actually his sister married her brother, but he didn't actually end up staying with Marie. He spent a little over a year there, finished off his schooling, then got accepted into a four-year program at the Polytechnic University of Zurich at age 17 and moved to Zurich.

Fraser: So this all so far kind of sounds like your life, right? You know, finishing high school, doing well, getting accepted to a University, going straight on to university…right? This is all fairly normal.

Pamela: Yeah, except he had a bit more of a private school education where you have to test into getting into the Gymnasium. I went to Westford Academy, which sounds fancy, but is just a public school in New England that happened to be really old.

Fraser: No, but so far this is all fairly standard, you know: went to high school, went to university…but things went a little weird from that point on, right?

Pamela: Right. So he was doing perfectly well studying math and physics in Zurich, while he was there he met the Serbian, Mileva Maric. The two of them spend a number of years together. He graduated in 1900 had a teaching diploma from Zurich Polytechnic. Unfortunately, Mileva failed her exams and wasn't able to get one. They stayed together; everything was doing OK. He published his first paper with his equivalent basically of a bachelor's degree, his four-year degree. His first paper was on capillary forces and straws. I love how he starts with something just so mundane as, "Well, how do straws work?" That was his very first paper, and then he spend two years trying to get a job, and this is the part that gets left out of all the stories because here he is, he's graduated, he actually had a kid out of wedlock during this period…

Fraser: OK. Right.

Pamela: [laughing] …and so after struggling to find a job, failing to get a job, having a kid out of wedlock at the turn of the 1900s, he moves to Bern, Switzerland and ends up getting a job in the patent office, and once he has the job in the patent office, he and Mileva end up getting married. And while all of this was going on he was also working on a PhD remotely at the University of Zurich and so he had…it was just a crazy life. You can imagine he's that guy who's trying to hold together the kid out of wedlock, trying to finish school, needing a to have job to pay all of the bills, and trying to do everything all at once, and it sort of makes sense that he wasn't fully on his game for anything -- and he struggled to get a job.

Fraser: Yeah, I can just imagine we have all of these modern conveniences like telephones, and computers and internet, you know, and they had none of that back at the turn of the …

Pamela: They had the postal service.

Fraser: [laughing] Postal service, yeah, so you can imagine when he's doing a PhD by mail, right? And you know, everything was just so much harder. I would have loved to have the internet back then…So right, but I mean, the thing is everyone talks about the fact that it was "when he was an ordinary patent clerk" and yet, he was…crazy ideas coming into his mind at that point.

Pamela: And so he'd always shown that this might be happening. As a kid he growing up he got a compass, and he was extremely disturbed by "how does this compass thing work?" He spent a lot of his childhood trying to figure out how to build things. His dad and his uncle actually had an electronics business, which is what was able to keep him in Munich for a number of years, and it was when that business failed that his family moved to Italy, and he tried to transfer schools, and it was just kind of a mess. He didn't actually graduate Gymnasium. He took standardized exams where he didn't do so well. That's…long story short, he didn't go to the Universities he wanted because he did the equivalent of a GED, and he just managed to keep pulling himself out of these strange life situations. So in 1905, he finished (basically, via mail) a PhD at the University of Zurich, and at the same time, published his group of papers on the Photoelectric Effect, on Brownian Motion, on Special Relativity, and on the Equivalency of Energy in Mass (the famous E=mc2 equation), so he managed to somehow pull everything out, and in one fell sweep proved, "Yeah, I can do it. I can do all of it, all at once," which was kind of overwhelming.

Fraser: So was he releasing these papers as he was doing his PhD, or after he finished his PhD?

Pamela: It was all in one year: he finished the PhD, published all of the papers, and presumably he'd been working on all of those ideas simultaneously. The thing is when he was in the patent office, the patents that he was working on were all ones that had to do with time, so he was constantly thinking about all these ideas. So the ideas that he was thinking about while reading patents during the day played into the stuff that he was doing as a PhD candidate, and it culminated in all these different papers that all came out at the same time while he was still in his mid-20s.

Fraser: I wonder what effect being in a patent office would have for your creativity. I mean, you would be looking at all of these patents, all of these

ideas coming through, and for me, I can just imagine if I was looking at all these patents, I would have lots and lots of ideas, not necessarily stealing the ideas, but just…it would just make me think of other ideas, so I'm sure it was a place for a lot of creativity.

Pamela: And it also gets you thinking about "Wow, this person is so wrong, but here's this little seed of possibility in what they said." It's like anytime you're listening to someone give a talk and you just finish reading a related paper and your brain starts building these connections between things that the author of the paper and the person you're hearing speak right now never imagined. It's just the confluence of everything being in the right place at the right time.

Fraser: Yeah, and I think that's really important. I know in my own life, being able to (as I'm comparing myself to Einstein)…that I love to read, you know, sort of cross-disciplinary stuff, you know, I'm reading about technology and reading about advances in science and I'm always thinking about how that stuff all applies back to my business, and it's been really useful to me making just advances in my own… in publishing *Universe Today*, you know? It just keeps the…so I think it's really important for many people that you can, you know, expand outside what you're doing and look at other stuff. That's where you really get the great ideas and that's…and then you can feed that back into what you're working on. So he releases all of these amazing papers over the course of a year, and what was the reception?

Pamela: [laughing] Well, he kept working as a patent officer for a few more years, but overall, he started very slowly and thoroughly revolutionizing everything. He started being invited to travel and give talks. Finally, in 1908, he was still working at the patent office, but he was able to get a position as a lecturer at the University of Bern, this was the same year that he published his paper on wave particle duality of light, so he's traveling and giving the lectures. His day job to pay for himself and his wife and their kids is at the patent office, but now he's started teaching, so you can almost imagine this is the adjunct professor position. He's still continuing to publish groundbreaking papers, and finally in 1909, he was able to work for the first time as a full-time academic. He got a position that means something different than it does in English; he was appointed as a docent at the University of Zurich, which is really a mid-level academic position. We don't really have the equivalent, maybe research scientist is somewhat close,

but he had that position for two years, and he was able to just focus purely on his research and collaboration. And he is someone that really points out over and over and over again the importance of writing letters, the importance of traveling and giving talks, the importance of being part of a community of science because, like you just said, you can't have ideas in a vacuum.

Fraser: Right and so but this was, I mean, for essentially one of the most prestigious, most influential physicists of all time, it's interesting that he got a job as kind of a mid-level person, you know, I mean, we've heard….

Pamela: Well, he was still only 30 at this point.

Fraser: Well, I guess, I guess, but you can see that the ramifications of his ideas still hadn't quite percolated in the brains of all the people he was supposed to influence because I know there's some stories…I'm trying to remember, I listened to Radiolab, and there was this great story about a statistician, I think, and he came up with this formula for…and brought it to his professor and said, "Is this new?" and the professor looked at it, and immediately he was given a tenured position on the faculty because – yes, it was new, and very important so, you know, still Einstein -- people didn't take him super seriously. I mean, they'd give him a job…

Pamela: But, the thing to remember though is the example you just gave is really the exception to the rule. Academia is one of those places where you are expected to go through certain sets of things: you're expected to spend six years on the tenure track, you're expected to do two post-docs…there are all of these things, where at a certain age you do certain things, and exceptions are made, but they're very rare, and he's at very prestigious universities where, as you pointed out, when he came to America, he deeply appreciated the meritocracy system we have because it was very different from the system he was coming from, and because he was still a young academic, he was given the positions a young academic gets…which kind of sucks, but...

Fraser: Right, but he still got them. Right, so he was working as an adjunct…wait, no, you said docent?

Pamela: Docent. He was a docent at the University of Zurich for two years, and then got offered…he finally got offered a full professorship at the Karl

Ferdinand University , I believe, of Prague, moved to Prague, left Mileva behind…so here he is leaving behind wife #1.

Fraser: Yeah…

Pamela: Moving to Prague...

Fraser: And out-of-child-wedlock #1, right? [sic]

Pamela: And so he had a child with Mileva before he married her. They did get married. No one knows what happened to the kid who was born out of wedlock, but they went on to have more kids *in* wedlock, he then left Mileva behind moved to Prague, took a professorship and very quickly started having a relationship with a new woman. And so this would be Elsa Lowenthal, who went on to become his second wife who he stayed with most of the rest of his life until she passed away, but it was right after he moved that he wrote his paper on how light can be bent from gravity that would then end up being proved at 1919 during a solar eclipse. So he continued doing amazing science and everything else.

Fraser: Right, now which one, then, is the big relativity? Which is the one…is it the E=mc2 one? Which is the one?

Pamela: Well, so it was a combination. He did special relativity in E=mc2 in 1905, and then he went on to do general relativity in 1915, so it was over a course of 10 years that he fully developed the theories of relativity, including wave particle duality, light being bent by gravity, he took a sideline into quantum mechanics, and in 1913, wrote on the zero point of energy, and then he pulled in cosmology in 1917, and he used relativity to talk about, basically, the evolution of our Universe and how the cosmological constant can play in. When he employed the cosmological constant, it's because he was trying to create a steady-state universe.

Fraser: So, he's in Prague and becoming a pretty big deal at this point. I mean, I know at this point people are taking his ideas quite seriously and attempting to test them out, and so on. So how long did he stay in Prague?

Pamela: He was in Prague until 1914 where he was offered the directorship of the Kaiser Institute of Physics, as well as being offered a position at the Humboldt University in Berlin, and he managed to get the professorship

worded such that he had hardly any teaching at all. So for the beginning of this period he was still married to Mileva, but Elsa moved with him to Berlin and he's continuing to do all of these amazing relativity, cosmological constant, like getting that gravity work, and then finally in 1919 he divorces Mileva, marries Elsa, and in 1921 finally seems to start to settle his whole life, gets the Nobel prize, is with the woman he's going to spend the rest of his life with, has this amazing directorship, has this amazing professorship, everything is going right except for the country he's in is going entirely wrong.

Fraser: Germany.

Pamela: Germany.

Fraser: And he knew it, and he didn't like it.

Pamela: No, not at all, and in fact, he started looking in the early 1930s, realizing he was about to be in a very bad place to be, he started looking for positions in the U. S. He was a visiting professor at Cal Tech for a while; he ended up having to go back to Europe, spent some time in England… Finally in 1934, landed a position at Princeton as a full professor. That's where he would spend the rest of his life. But it was while he was a visiting professor at Cal Tech that Hitler came into power and he basically said, "I'm not going back to my position in Berlin anymore." So he stepped aside, and we talked about this in a previous episode, it was actually his replacement who tried to rescue a lot of German Jews by helping them find positions in America simply by encouraging the people who were there who weren't Jews to stay put and weather the storm, so he escaped. It was a complicated time.

Fraser: Right, and you can see though, I mean, you can, again, you can just imagine what it must have like to have been in Germany at that time, and he must have just felt -- you can just see the way the direction things are going, and wouldn't have wanted to stick around and he was really fortunate that he had an alternate back-up, I mean, he had this professorship that he was working on over at Princeton at the same time, so he could just sort of stop going home and just stay in the United States, which, unfortunately, I mean so many people didn't have that kind of mobility and those kinds of options and they would have taken it, so that's quite amazing to think about that. So

he's in Princeton, which…who's with him? Has he got any women with him?

Pamela: He did take Elsa with him, so love of his life, ended up taking her with him. They moved the United States. A few years after they moved to the United States, she actually passed away and he stayed single as far as not married for the rest of his life, but then he got tangled into trying to deal with the war. The guy had a bounty on his head – there was actually a price on his head from the Germans, and he was considered one of the enemies of state. In 1939, Einstein did one of the things that he morally struggled with the most. He received letters from other scientists who were trying to alert President Roosevelt about the possibility of the Germans developing the Nuclear bomb, and most scientists didn't have the President's ear, but Einstein was famous enough that he was able to listen to their concerns, realize this was an honest concern, go to Roosevelt and say, "We need to address this," and it was the power of Einstein's scientific fame that made Roosevelt realize this was an honest threat and eventually led the Manhattan Project, which Einstein wasn't part of but he might be considered the reason behind.

Fraser: He regretted that, too.

Pamela: Right, it's something he struggled with. It was something that he's like "well, I had these reasons that I needed to do it," but he really regretted that the Manhattan project ended up coming of it, and he really rode out against the use of the nuclear bomb.

Fraser: Right, and so he was both a proponent and helping people understand what was possible and what probably the Germans were working on, but at the same time, really deeply regretted that technology had even been…especially that the technology had been used and that the genie was kind of out of the bottle at this point.

Pamela: And so here he was in a position of, "OK, so we've got to prevent them from doing it, and, oh…we did it. Oh, dear."

Fraser: He was used, yeah.

Pamela: And what's interesting is throughout his entire life he was recognized as such a genius, and he was also a great reader, so he was asked to talk not just on physics but on philosophy, which he read constantly. He was always an advocate for peace, and in a lot of his philosophical papers -- I'd encourage people to go and read them -- he talked a lot about humanism and his struggle trying to deal with basically what he'd unleashed through his science, and it's one of those things that's hard to sum up in something as short as a podcast, so go out and read Einstein's non-scientific writings, they're actually quite beautiful.

Fraser: One of the things I really like about Einstein, or maybe it's just the culture of the 40s and the 50s and stuff is he was seen as a rock star.

Pamela: Yeah.

Fraser: To the same level as any of the singers, or like Marilyn Monroe, I mean, there was this real appreciation back then of scientists and science and people really understood the changes that science were making and that, you know, you can imagine, I mean, right now, very few people can actually name a scientist, you know? I think the closest thing that we have is, as we're recording this, we're just a couple of days after Steve Jobs died, and that's like the closest thing that we kind of have, but I mean, he was more of an engineer and created devices that people really use and love, but the fact that they appreciated his intellect, and really appreciated the fact that Steve Jobs, for example, was really injecting new and important ideas into the way we use computers, whether or not you like Apple products or not, but there was the same appreciation for scientists, for Einstein, that people, they may not have understood Relativity, but they knew it was important. They didn't necessarily understand Brownian Motion, and Wave Particle Duality, and all that kind of stuff, but they knew that it was important and could recognize his name and the media did a really good job of bringing these people into the forefront and showing that they were important and making people really appreciate science, so it's really too bad that we're not at that point now, you know, you talk to most people and they can't name a scientist by name. Steven Hawking, maybe…

Pamela: Yeah, Neil Tyson …

Fraser: Neil Tyson, yeah…

Pamela: But he's not actively publishing that much research. I think the big difference here is Einstein, like Feynman to a degree, like Carl Sagan to a different degree – he was out there constantly giving public talks, constantly traveling the entire world, and he talked about things that triggered people to think. He didn't only talk about physics, he talked about culture, he talked about politics, he talked about philosophy and in this way, he was out there engaging people in a pre-television, pre-internet…I mean, they had television but it's not like every single home had a television at this point. He was interacting with people in their communities all around the world on a variety of different things and that really got his name out there. If he just sat at Princeton quietly working in his office doing the exact same science, I don't think we'd have so many pictures of him on posters and every dormitory in the world.

Fraser: Maybe, but I think that there was a hunger for it, like I think there was a desire to bring those people forward and to understand who they were and to showcase them in a way that isn't there now, you know, you get people like, as you said Tyson, Phil Plait, and even yourself. You put a lot of energy into getting science information out there, and I think back then there was a lot more of a demand and a hunger for it and people really appreciated…I don't want to sound like some grumpy old man, "In my day…" but just the fact that I think there was a disconnection of the science to the reality to the way that we live every day, and it would be nice if we could bring that back into the conversation -- so that's what we're doing. So he was struggling with his the theory of everything. I mean he had, in many cases, helped unite the forces and figure out that light and mass were the same thing, but you know, in the end, he was struggling with this sort of final great challenge, right?

Pamela: Right. So toward the end of his life, science was revolutionizing itself in all sorts of new directions. We had quantum mechanics, which he did not like, we had general relativity, special relativity, we had electromagnetic theories, we had technology and computers and everything else taking off and he just wanted to find the single theory that would pull it all together -- that underlying theory that explains how is it that you can unite gravity and electromagnetism, and a strong and weak force, into a single understanding.

Fraser: The theory of everything…

Pamela: And it drove him crazy that he couldn't do it, and all the while he was greatly disturbed that quantum mechanics was showing a statistical understanding of the universe. And what really gets me, is Einstein is someone who was able to accept the fact that this whole quantum theory really fundamentally bothered him -- he didn't want a statistical universe, but in 1924, he worked on the Bose-Einstein statistics that went on to understand, allowed people to understand in the 50s how Bose-Einstein condensates work. So here he is not liking the statistical understanding of the Universe, but helping to define how it actually works.

Fraser: Yeah, and we, of course, depend on it for out very lives now, so…

Pamela: Right.

Fraser: And so…when did he die? How long did he live and when did he die?

Pamela: Well, he died in his mid-70s in 1955. One of the most amazing things that he didn't do toward the end of his life was in 1952, when the first president of Israel (and the presidency was a largely honorary position)…when the first president of Israel passed away, he was actually offered the presidency of Israel, and he turned it down. He left that for other people to do, and he continued on as a professor at Princeton doing research up until the very end, and he passed away in 1955.

Fraser: Wow. Well, and we have been, sort of, going past some of his research. So we've done whole episodes…we've done episodes on general relativity, and on special relativity, we've done a whole episode on the theory of everything, so if you want sort of more details on those topics, we've got whole shows on them and that's sort of why we've sort of skipped past the actual specifics and focused more on his life. Well, that was great, Pamela. Thank you so much.

Pamela: Well, it was my pleasure and we'll be recording when I'm back from Beijing.

Fraser: Alright, have a great trip to China.

Pamela: OK, thanks and I'll talk to you later. Bye-bye.

Fraser: Bye-bye.