Russia Meteor Renews Focus on Asteroid Threats

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A week after a meteor exploded over Russia on the same day that an asteroid swung closely past Earth, experts discuss how the potential threats posed by near-Earth objects should be addressed. Astronomers Donald Yeomans and John Tonry weigh in on how to keep the planet safe.

IRA FLATOW, HOST:

This is SCIENCE FRIDAY. I'm Ira Flatow. A week ago, a meteor exploded over Russia, injuring more than a thousand people, shattering windows, raining meteorite fragments over a Siberian town. On that same day, an asteroid half the size of a football field gave us a close shave as it flew closely by Earth, coming closer to our planet than the satellites in orbit that work your cell phones.

Astronomers say the two incidents are unrelated. But should this cosmic coincidence be a wakeup call? Are we doing enough to protect our planet from wayward space rocks? What needs to be

done to discover and track these near-Earth objects, and who's going to pay for it? Yeah.

Let me introduce my guests. Donald Yeomans is a senior research scientist and manager of NASA's Near-Earth Object Program, that's at JPL, the Jet Propulsion Laboratory in Pasadena. He's also author of the new book "Near-Earth Objects: Finding Them Before They Find Us." Welcome to the program.

DONALD YEOMANS: Thank you very much.

FLATOW: Your book came out just at the right time, it looks like.

YEOMANS: Excellent timing, yeah.

(LAUGHTER)

FLATOW: John Tonry is a professor at the Institute for Astronomy at the University of Hawaii in Honolulu. Welcome to SCIENCE FRIDAY.

JOHN TONRY: Good afternoon, Ira. How are you?

FLATOW: Fine, how are you? Don, let's start by talking about and possibly clearing up something. Was the Russian meteor at all connected to the asteroid fly-by?

YEOMANS: No, definitely not. It's compositionally disparate, the two objects, and their orbits are completely different. The fireball was in an orbit that had a period of about 2.2 years, and the other asteroid, 2012 DA14, was in a one-year orbit.

FLATOW: So it isn't possible that the asteroid came by before, in another circle around the sun, let loose something from it, and they sort of went into different orbits and came back together?

YEOMANS: No, there's not a real easy dynamical way to do that. In fact, it's very tough. So I think they're completely different.

FLATOW: OK, let's talk - it's been a week since the fireball over Russia. What do we know more about it today than we knew literally exactly one week ago at this moment?

YEOMANS: Well, we know its approximate size. It was about 20 meters in diameter. It came out of the sun, which explains why we didn't see it ahead of time. It would have been tough to see even if it

were in the nighttime sky because it's so faint, it was - didn't get down below 24th magnitude until two hours prior to closest approach.

We know from the fragments that are being collected in Russia that it's made of what we call ordinary chondritic material, which is the most common type of asteroid in the inner belt. So that makes sense. It just took us by surprise by coming out of the sun.

FLATOW: What do you mean coming out of the sun? Why could we not see it during the day, because we -

YEOMANS: Well, most...

FLATOW: The telescopes looking at it are all visual telescopes?

YEOMANS: That's correct. The NASA-supported Near-Earth Object Survey telescopes are operating in the U.S. Southwest and Hawaii. They're all optical telescopes, and of course they need the nighttime sky to do their observations.

FLATOW: Now John Tonry, you're working on a project that would basically add as a last-minute asteroid warning system at a time that it would be too late to divert an asteroid if we saw it, but we would possibly know where it's going to hit us.

TONRY: Yeah, that's exactly right. The NASA NEO program is supporting a variety of efforts, and this ATLAS thing is a bit complementary to the other ones. It's a little bit less sensitive, but it basically surveys the whole sky a couple times a night, and so it has a better chance of catching something just before it hits us.

FLATOW: And so how much warning would it give us?

TONRY: Well, it depends on the size of the asteroid. So something like the 2012 DA14, maybe five days or something like that. But it sort of depends on a bunch of factors, like it better not be coming out of the nighttime - the daytime sky. 2012 DA14 happened to be coming up from the south, and you can't see that from Hawaii.

And of course it's always possible to be cloudy.

FLATOW: And so you would make a prediction pretty accurately about where it might hit on the Earth?

TONRY: Oh, it's really astonishing how accurate we can be. There was this impact in 2008 where it was discovered basically a day before impact, and all sorts of people jumped on it, sent off the information to JPL, and the prediction of where and when it hit was just unbelievably accurate, like one mile and one second.

FLATOW: So you could - you're saying, then, you'd alert people to evacuate that spot, a big city perhaps, you have 24 hours to get out?

TONRY: That's exactly right, yeah.

FLATOW: Don...

(LAUGHTER)

FLATOW: I've seen the movies, right, we've all seen those movies about it's coming, and no one's going to be able to escape in time. There's got to be a better way than this, doesn't there?

YEOMANS: Well, yeah, NASA's goal, of course, is to find these objects early enough that we could use our existing technologies to deflect them. So that's the goal. And we've actually discovered more than 95 percent of the large near-Earth objects, larger than a kilometer, and none of them represent a threat in the next 100 years.

And so we're now working on the 140-meter-sized objects and larger, and we've discovered 40 percent of that population, and none of those represent a threat. So we're looking for the big ones first because they could cause global problems rather than regional problems.

But as pointed out by John, we need to, we need to expand our capabilities and start aggressively looking for these small objects. And John's ATLAS system is one way to do that quite effectively.

FLATOW: But you're saying that we can't see them if they come out of the sun. You're talking now about expanding it to something a little more useful than hopefully not just the daytime.

YEOMANS: Well, yeah, these objects typically are in Earth-like orbits because those are the most dangerous, also the easiest to reach in terms of human exploration. But they typically make several close-Earth approaches before a final impacting approach. And so it would be during these previous close-Earth approaches that a system like

John's would pick them up, and then we would predict when it might be a problem in the future.

FLATOW: Is this an orbiting satellite, an orbiting telescope, or how would it work? Or is it all ground-based telescopes?

TONRY: Well, you know, there are sort of two issues. The first is if the thing is literally coming out of the sun, and it's never seen before, as was this one over Chelyabinsk, you basically need an orbiting satellite, one that can look very, very close to the sun to have a chance of catching it.

But as Don was saying, the hope is that actually this 2012 DA14 made a number of previous close passages, like it was found in 2012. And so if you can catch it up there, there's a chance that you'll see it in the nighttime sky even though the final approach happens during the daytime. So in that way you'd be able to predict the daytime impact.

And also if you can find it early enough, then you actually have the time to mount a mission to possibly nudge it.

FLATOW: Let's talk about the asteroid DA14 that came by last week. If ATLAS had been up, if your project had been up and running, could we have found it sooner?

TONRY: I think probably yes. If I look at the actual discovery by the Spanish, I think probably ATLAS would have picked it up maybe several weeks earlier, and it's fantastic that they were able to find it, actually. They had an upgraded system, and they were - they happened to be looking in a funny direction, and they happened to pick it up.

It's a little bit luck in that case, whereas ATLAS is much more thorough. It basically - there's very little that can sneak by, at least in the portion of the sky that ATLAS can look at.

FLATOW: But is ATLAS just something on the drawing board now?

TONRY: ATLAS is a little bit more than drawing board. NASA has funded the construction. We're a month and a half in now, and we're just now deciding on what the telescope design will look like, and then that's the first critical decision. So we're hoping that we can

actually be online sometime next year and fully operational by the end of 2015.

FLATOW: Is there any way to expand it from its early stage to get more...?

TONRY: Well, we could accelerate it a little bit if we had the funding, but I don't think that that's really critical. What's much more interesting is the possibility of putting multiple ATLAS units all around the planet because any given one is subject to weather, it's subject to daytime, nighttime. All those factors cut down the efficiency. And if we could replicate it and put it in, let's say, six places around the planet instead of one, then we'd have much more thorough coverage of the sky.

FLATOW: And who's going to pay for that?

TONRY: Well, that's to be determined. But I think it's appropriate to get the first one going and demonstrate that we can actually be as effective as we say we're going to be.

FLATOW: 1-800-989-8255. Let's go to the phones, to Gary(ph) in St. Louis. Hi Gary.

GARY: Hi. We're - you were talking about how accurate we can be in predicting, and yet last week, everybody was predicting that the closest point that DA14 was going to be to Earth was about 2:25 Eastern. And it ended up on your show being about four minutes earlier than that, which - four minutes seems like a pretty big gap.

YEOMANS: Well, the uncertainties of the object are by far the most in the long-track direction, and as this one was coming from the south to the north, so the distance off-track or perpendicular to the motion of the object was the most important. And that was good to a kilometer or so. It's true that the motion of the object a long track, the longest orbital track is the least well-known. And that you pointed out that the - there was a couple of several hundred kilometer uncertainty there. But that really wasn't the most important component.

FLATOW: Thanks for the call. How long before this meteor frenzy, asteroid frenzy fades and we start this all over again?

(LAUGHTER)

YEOMANS: Well, who's to say? I mean the event over Russia, the fireball event is for an object of that size, you'd expect something like that to hit about every hundred years on average. On the other hand, basketball-sized objects hit the Earth's atmosphere every day. Volkswagen objects hit the Earth's atmosphere every couple of weeks. They just cause fireball events. They don't cause any ground damage. But this type of thing happens all the time. Mother Nature...

FLATOW: So what I'm asking was, is this - was this a game-changer? Will people really pay attention? Will governments invest money? Will the satellites be put up? Or is it just, you know, we talk about it and then it becomes something of the past. We move on to the next new cycle.

YEOMANS: Well...

TONRY: Well, I think that's real hard to say, but NASA has had a significant program in place for more than 10 years and has been steadily chipping away on finding things, starting from the biggest and most dangerous ones and working down. So it's conceivable that this will actually spur some congressional hearings, and NASA will get a pat on the back and maybe some more money. And conceivably, private individuals will step forward and fund some of this stuff. But regardless of the new cycle, NASA is steadily working on this.

YEOMANS: Yeah. That's a good point. It's important to point out that NASA's budget actually increased threefold in 2012. So NASA is aggressively pursuing this phenomenon.

FLATOW: And we had a gentleman on last week from B612 project, I think it was called, in which that's a privately funded satellite they want to put into orbit to look at asteroids.

YEOMANS: That's true. If you want the most efficient way to find these objects is in the infrared, which means you have to have satellites in Earth orbit or perhaps in space, like the B612 concept. So these objects radiate primarily in the infrared, and they're mostly easily found there. But it's also the most expensive way, of course.

FLATOW: I'm Ira Flatow. This is SCIENCE FRIDAY from NPR. Talking with Donald Yeomans and John Tonry. I guess what I'm saying is, do people feel that this is really a threat to national security? Of that ilk? If you have something like that asteroid that -

like the meteor shower that hit Russia, if it had actually landed and not broken up on a major city and created like the Arizona crater, would that have gotten more attention?

(LAUGHTER)

YEOMANS: Oh, yes.

TONRY: There's no question, yes.

YEOMANS: Yeah.

FLATOW: But it's a real possibility?

TONRY: It's a possibility...

YEOMANS: It is.

TONRY: ...and there are, as Don had been saying, there's a wide variety of sizes. The little ones, the little explosions are far more common and far less dangerous. And the integrated risk from this thing is not really high. It's not something for people to seriously worry about, but it's not negligible either. And we simply don't know. It's conceivable that New York will be destroyed tomorrow. It is literally possible that New York will be destroyed tomorrow. But the chances of it are just really, really small.

However, it seems as though now that we have the technology to actually do something about it actually find the things and conceivably even move them out of the way, we ought to do it. It's just an insurance policy.

FLATOW: And what about creating the technology to push one or to move the asteroid itself instead of moving all the people?

YEOMANS: Well, NASA is actively studying the deflection concepts that make the most sense, as is the European Space Agency and some of our international partners. The easiest, cheapest and fastest technique, to my mind, is simply to run into an object with a massive spacecraft and change its orbital period a little bit so that in 10 or 20 years when it was predicted to hit the Earth, it would miss by a wide margin. And we've demonstrated that technology with the Deep Impact mission back in July of 2005 when we purposely ran into Comet Tempel 1.

FLATOW: And did we move its orbit?

YEOMANS: Well, that was a large comet. It was a six-kilometer comet. We moved its orbit but only by about 100 meters, which is undetectable.

FLATOW: But we don't have any ready standby capability to do something like that.

YEOMANS: Well, I don't think we actually need a standby capability. What we do need to do is find them early enough so that we can develop the mission concept to go up and run into it. So you need to find them early. That's the key, and that's exactly what NASA is planning to do.

FLATOW: And if they found one early, what would they do?

YEOMANS: Well, they would design a mission to intercept it to perhaps run into it with a spacecraft so that you would either slow it down or speed it up, change its orbital period so that it - when it was predicted to hit the Earth 10, 20 years down the road, it wouldn't.

FLATOW: And we have the money to do that?

YEOMANS: Well, I would guess we would find the money if...

(LAUGHTER)

YEOMANS: ...that were a real threat.

FLATOW: Well, we're not spending any money on things these days. So where would we take it from? I'm sort of being facetious about this. I understand though there's not a real answer to it, but it's a real question that I - just as a layman watching this over the last 30 years, never see anybody have answer to. It's always 30 years away and someone else's problem.

TONRY: Well, you know, Ira, there really are a lot of launches. People aren't aware of it too much, but communication satellites wear out all the time. There are launches to replace them. It's not as though there aren't a lot of launches that happen all the time. And purposing a launch to go after a comet or an incoming asteroid would involve a payload that would actually have its own propulsion and its own mass and all that sort of stuff. But it's not crazy to think that,

basically, the human race could spin on a dime and get something going within a year or two.

But the real trick is that this nudges are just tiny, tiny, tiny compared to the velocity of these dangerous asteroids. And so, therefore, time is the key. You really want to be able to do it way ahead of time so that the little nudge can accumulate so that it misses the Earth.

FLATOW: OK. We enjoyed the conversation. We'll - this is something that we've been following for many years and will continue to follow and, actually, talk to some people who have ideas on how to do the nudge. So thank you both, Donald Yeomans and John Tonry, for taking time to talk with us today.

TONRY: You're very welcome.

FLATOW: Have a good weekend.

YEOMANS: My pleasure.

FLATOW: You're welcome. We're going to take a break. When we come back, we'll take a look at what's causing severe air pollution in the interior of Alaska, pollution worse that what we see in Beijing. So stay with us. We'll be right back after this break.