SOUNDBITES

"If your baby has a fever, you go to the doctor. If the doctor says you need to intervene, you don't say, 'I read a science fiction novel that says it's not a problem.'"

Al Gore, testifying to the US Congress on the need for a bold agenda to tackle climate change (*San Jose Mercury News*, 22 March)

"It makes me wonder whether the current classification of twins is an oversimplification."

Vivienne Souter of the Banner Good Samaritan Medical Center in Phoenix, Arizona, on a rare case of "semi-identical" twins in which an egg was fertilised by two sperm, split and formed twins who are identical – but only on the maternal side (BBC online, 27 March)

"They probably won't even be able to tell it's from panda poop."

Liao Jun, a researcher at the Chengdu Giant Panda Breeding Base in Sichuan province, China, which plans to recycle panda droppings by turning them into paper (Associated Press, 26 March)

"If I can take off my left arm and connect it to my right arm, I can [write on the whiteboard] without standing up or leaving my chair."

Wei-Min Shen, director of the Polymorphic Robotics Laboratory at the University of Southern California, Los Angeles, on how robotics researchers think and why copying nature can be limiting when designing robots (*The New York Times*, 27 March)

"This isn't a gay issue. It's in society's interest to give couples a safe method of reproduction."

State senator **Carole Migden** on a bill being debated in California to permit the use of washed sperm from an HIV-positive donor to impregnate a consenting woman (*San Francisco Chronicle*, 27 March)

Equinox challenge to Newton's law

ZEEYA MERALI

IF, FOR some reason, you managed to make an egg stand on its end during the recent equinox, experimental physicists could do with your help. An exquisitely sensitive experiment that can only be performed during equinoxes could test some of the theories that offer an alternative to dark matter.

Stars on the outskirts of galaxies are moving much faster than can be explained by the gravity of visible matter. To account for the extra gravity, astronomers have proposed the existence of dark matter. In the 1980s, Mordechai Milgrom, then at Princeton University, suggested that the observations could also be explained by tweaking Newton's law of gravity. Milgrom's theory of modified Newtonian dynamics (MOND) has since evolved into two forms: gravitational MOND, which modifies the inverse-square law of gravity, and inertial MOND, which modifies Newton's second law of motion.

In both cases, when objects are moving with an acceleration above a certain threshold, a_0, the well-known laws hold true. When the acceleration falls below a_0, the laws are modified slightly to explain, for example, the speed of stars at the edges of galaxies. The value of a_0 is about a billionth of the acceleration due to Earth's gravity, so the effects of MOND cannot ordinarily be seen on Earth. This means astronomers have had to rely on observations of galaxies and galaxy clusters to test MOND. Now, Alex Ignatiev, at the Theoretical Physics Research Institute in Melbourne, Australia, is proposing a way to test inertial MOND on Earth.

The key is to find a time and place when the acceleration felt by a test object would be zero. Not an easy task, since besides Earth's gravity, our planet's rotation and its motion around the sun also set up forces that accelerate objects beyond the MOND limit. However, Ignatiev's calculations show that along latitudes of about 80° north or south, passing through northern Greenland and Antarctica, at two precise times of year, these forces cancel each other out.

The window of opportunity to do any tests is extremely narrow, though. The forces only negate each other for about a millisecond on two days close to the vernal and autumnal equinoxes. At those precise times and places, if Newton's second law of motion is correct at all accelerations, a mass should feel no force. But if inertial MOND is correct, Ignatiev's calculations show that there will be a slight residual force, causing the mass to jerk by about 10^{-12} metres (*Physical Review Letters*, vol 98, p 101101).

Picking up such a small movement seems daunting, but Ignatiev points out that experimentalists have already constructed gravitational-wave detectors that can measure even smaller movements. He suggests using a similar detector for the experiment. "It won't be simple," says Ignatiev, "but it can be feasible."

"A positive result would have such tremendous implications for dark matter," says HongSheng Zhao, an astronomer at the University of St Andrews in the UK, who works on MOND. "We should do this experiment in the near future."

A negative result would rule out inertial MOND, but would still leave open the possibility that gravitational MOND is correct.

"On two days of the year, the acceleration of Earth's gravity, rotation and its motion around the sun cancel each other out"

To test this, Zhao says, similar experiments should be carried out on a spacecraft at a point between the Earth and the moon where the gravitational pull of each is equal.

While theoretical physicists such as Ignatiev and Zhao are enthusiastic about the test, Eric Adelberger of the University of Washington in Seattle, who works on high-precision tests of gravity, is less convinced. "The idea is great in theory, but in practice it will be tough," he says. "It'll be difficult to persuade anyone to hike around Greenland to measure it." ●