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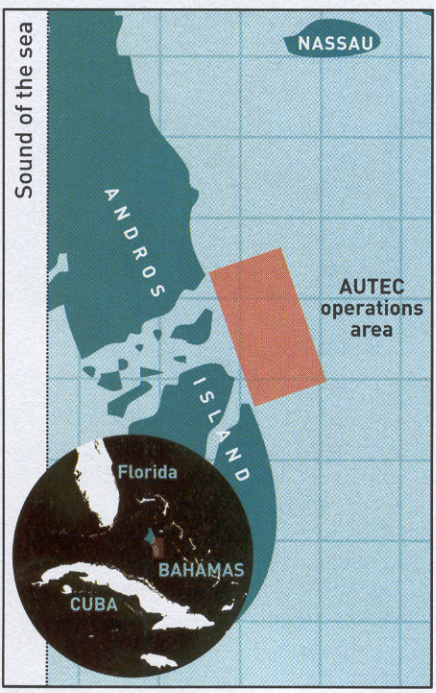
Pop goes the neutrino

If you want to listen out for extraterrestrial visitors, call in the Navy

THIS summer, a team of physicists from California will enlist the help of the US Navy to search the sea off the Bahamas for energetic visitors from space—unless the whales and snapping shrimp spoil the show.

The team is trying to solve the mystery of extremely energetic cosmic rays that hit our atmosphere, sparking showers of other particles. Physicists have no idea what the rays are, where they come from, or how they travel so fast. One possibility is that they are neutrinos, in which case some would make it into the ocean. If they then interact with atoms in the water, the researchers reckon they'll be able to hear them.

A neutrino with an energy of 10^{20} electronvolts hitting an atomic nucleus in the sea would create more than 10 billion particles, which would dump their energy as heat. "We're talking about the energy equivalent of a book falling off a desk," says Giorgio Gratta of Stanford University. "It's easy enough to generate a sound pulse."



Such a pulse would span a range from audible frequencies to near-ultrasound. "If you were snorkelling nearby, you could hear a neutrino," says Gratta. But you might have a long wait. "Only one such neutrino strikes each square kilometre of sea each century."

To increase the chances of detecting such a rare event, you need to listen to a large volume of sea. Gratta and his colleagues from Stanford and the Scripps Institution of Oceanography in La Jolla, California, propose using a large array of underwater microphones, or "hydrophones".

The biggest challenge is distinguishing the sound of a neutrino from background signals such as the electronic "noise" in the detectors and the ordinary noise of marine creatures. "Snapping shrimps are a real problem, but you can avoid them by going deeper than 1000 metres," says Gratta. "The main worry is sperm whales, which use sound to locate their prey."

The team hopes to quantify the noise problem this summer using the US Navy's AUTEC hydrophone array off the Bahamas. Covering an area of 250 square kilometres at a depth of 1500 metres, the array tracks ships and submarines during naval exercises. "The Navy is extremely excited and is giving us a couple of months," says Gratta. "Not enough to stand a chance of detecting a neutrino, but enough to test the technique."

"This is an exciting development," says Peter Gorham of NASA's Jet Propulsion Laboratory in Pasadena. "An existing system—already paid for by taxpayers—has the potential to produce a big scientific payoff."

If the technique can be shown to work, the team hopes that physicists building two optical cosmic ray detectors on the Mediterranean seabed will be persuaded to include hydrophones as well. **Marcus Chown**

More at: http://xxx.lanl.gov/abs/astro-ph/0104033