Accessing Icy Moon's Ocean with Thermonuclear Reactor

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Abstract

Introduction:
The icy moons (e.g. Europa and Enceladus) present some of the promising examples of extended habitable locations in our Solar System. Some of them seem to have potential ocean that could support life.

The primary goal for astrobiology is to find life somewhere else in the Universe. How could we detect biosignatures on icy moons, if we cannot find them on the hostile surface or water plumes? The only solution is to go somehow under the ice and explore the ocean beneath.

Challenges in Accessing the Ocean:

Accessing ocean under ice in remote moon to explore possible biosignatures seems overwhelmingly difficult. We don't even know how thick the icy shells are. It is estimated, that in e.g. Europa the ice is around 15 to 25 km thick [1]. It takes 35 to 52 minutes to send radio signals from Europa to Earth, so any exploration vehicle should be autonomous in all its activities. As these icy moons are in high priority for astrobiology, all vehicles flying-by or landing them should be extremely sterilized in order not to contaminate the target.

Using Thermonuclear Penetrator:

One obvious way to penetrate ice is to melt it. And that would need a lot of energy. On the remote moon, there is only one adequate energy source available today: fission. Thermonuclear reactors are relatively simple nuclear reactors that could be used for providing needed energy to get to ocean. For this purpose, we can do rough estimates about the size of the reactor by using information and estimates about the thickness of the ice cover, diameter of the penetrator (these give us the amount the ice), and the temperature of the ice.

Nuclear reactors have already flown in space. For example, Soviet TOPAZ reactors demonstrated that nuclear reactors could provide steady power for years.

In this presentation, I will present general model of thermonuclear penetrator for accessing oceans beneath icy shells, and also some existing plans and test results of using nuclear energy for ice drilling.

References:

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NASA (2012) Frequently Asked Questions about Europa. http://solarsystem.nasa.gov/europa/faq.