slow black hole

The Urth list — 1 messages, 1 voices, 05 Jul 1998

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m.driussi — 05 Jul 1998, 19:55

prion,

You saw-bird, you: a slow black hole could be used to "stellificate" a jovian world like Jupiter.

Secretly we'll call this the "2010: Odyssey Two" scenario, but in public we reference Martyn J. Fogg's TERRAFORMING (1995) and the notes therein from his 1989 paper, "Stellifying Jupiter: A First Step to Terraforming the Galilean Satellites," published in JBIS.

"Identifying three principal assumptions crucial to its feasibility:

"1. Primordial black holes exist, are detectable and occur in a range of masses in the Solar System.

"2. It will become possible to maneuver low-mass black holes and embed them within planets.

"3. Accretion onto the hole occurs at the Eddington limit, with a relatively high rest mass to energy conversion efficiency in the infalling material.

"I examined all three of these assumptions in detail in my original paper. Suffice it to say here that it is thought possible that primordial black holes, of a wide range of masses, could have been formed in the Big Bang. None have yet been detected and so their existence has yet to be proved, or non-existence disproved. Although the smallest of them (up to an initial mass of ~10^12 kg) would have evaporated by now due to the emission of Hawking radiation, holes useful for the purpose of stellification would be about a million times more massive than this and would have undergone very little change since the origin of the universe . . . .

"Assumption 3 is particularly important, as the hole must not eat up the planet it has stellified too quickly and should convert as much of the accreted mass as possible into energy that escapes in the form of radiation. The Eddington limit applies when the accretion rate is very great. The luminosity produced by the accretion process exerts a pressure on the infalling plasma and tends to retard the flow. The photon force acts almost entirely on electrons but gravity works equally well on electrons and protons. Hence electrons move outward in relation to protons creating and electric field that trasfers the photon force from electrons to protons. The luminosity ultimately approaches a critical value known as the Eddington limit:

"L<edd> = {4(Pi)(G)(M<H>)(m<p>)(c)}/sigma<es> ~ 6.35 (M<H>)

where M<H> is the mass of the hole, m<p> is the proton mass, and sigma<es> is the total electron scattering cross-section (6.57 x 10^-29 m^2). When the accretion luminosity rises above L<edd>, the radiation pressure becomes large enough to prevent any further inflow. Accretion is thus self-regulated" (TERRAFORMING, p. 463).

[mantis note: I'm using "< >" brackets to denote subscript.]

"Potentially therefore, a small black hole could provide a power source for the interior of a stellified planet such as Jupiter that operates more efficiently than the processes in the core of the Sun. It is emphasized, however, that the accretion process is still clouded by a great deal of uncertainty, especially where accretion onto microscopic black holes is concerned. It is possible that the radiation released by accretion from such a dense medium as the interior of a planet may itself be swallowed by the hole, as the diffusive velocity of the radiation relativeto the matter may be exceeded by the matter's infall velocity. In this extreme case, accretion is unimpeded by any `back reaction' and calculations suggest that Jupiter would vanish =in less than a human lifetime=!" (TERRAFORMING, p. 464).

[mantis note: gratuitous italics at the very end is my own addition. "Less than a human lifetime" is assumed to mean something greater than "less than a mayfly's lifetime"; human lifetime having an outer edge of what, 70 or 100 years.]

Interesting enough, in the section on "Asteroengineering," which involves modifying our sun to avoid the disasterous red-giant phase, the focus is on papers (1990 and 1993) by Martin Beech, looking at five techniques, including my favorite "Accretion onto a central black hole" with the application "Luminosity determined by controlled accretion onto a small black hole at the stellar core" (TERRAFORMING, p. 458).

These starry-eyed engineers! Where =do= they get their fantastical ideas?!

=mantis=