Swarms of dust-sized particles would explore planets

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EnÂ-giÂ-neers are deÂ-signÂ-ing a new breed of planÂ-eÂ-tary exÂ-plorÂ-ers: tiÂ-ny, shape-shiftÂ-ing deÂ-vices that ride the wind like dust parÂ-tÂ-iÂ-cles and alÂ-so to comÂ-muÂ-niÂ-cate, fly in forÂ-maÂ-tion and take sciÂ-enÂ-tifÂ-ic meaÂ-sureÂ-ments.The specks might even be the first exÂ-plorÂ-ers from Earth to visÂ-it planÂ-ets outÂ-side our soÂ-lar sysÂ-tem, the deÂ-signÂ-ers claim.

A â€œsmartâ€• dust parÂ-tÂ-iÂ-cle would conÂ-sist of a comÂ-putÂ-er chip about a millimeter wide enÂ-cased in a polÂ-yÂ-mer maÂ-teÂ-riÂ-al that wrinÂ-kles or smoothâ€™s out when elecÂ-triÂ-calÂ-ly acÂ-tiÂ-vatÂ-ed. WrinklÂ-ing the surÂ-face would inÂ-crease air drag on the parÂ-tÂ-iÂ-cle, makÂ-ing it float highÂ-er. SmoothÂ-ing would cause it to sink. Swarms of so-called nano-nauts might be the first exÂ-plorÂ-ers from Earth on planÂ-eÂ-tary sysÂ-tems outÂ-side our own, reÂ-searchÂ-ers say. DeÂ-signÂ-ers of the parÂ-tÂ-iÂ-cles say they might be deÂ-livÂ-ered to the alÂ-ien worlds via spaceÂ-crafts that use ion proÂ-puÂ-sion, a powÂ-erÂ-ing sysÂ-tem that alÂ-lows for slow but steady accelerati Â-on and efÂ-fiÂ-cient enÂ-erÂ-gy use. (ImÂ-age courÂ-teÂ-sy CalÂ-tech)
SimÂ-uÂ-laÂ-tions show that by switchÂ-ing beÂ-tween rough and smooth modes, the parÂ-tÂ-iÂ-cles can gradÂ-uÂ-alÂ-ly hop toÂ-wards a tarÂ-get, even in swirling winds, reÂ-searchÂ-ers say.

â€œThe conÂ-cept of usÂ-ing smart dust swarms for planÂ-eÂ-tary exÂ-ploÂ-raÂ-tion has been talked about for some time, but this is the first time anÂ-yÂ-one has looked at how it could acÂ-tuÂ-alÂ-ly be achieved,â€• said John BarkÂ-er of the UniÂ-verÂ-siÂ-ty of GlasÂ-gow, ScotÂ-land. He deÂ-scribed posÂ-siÂ-ble apÂ-pliÂ-caÂ-tions of smart dust at the U.K. RoyÂ-al AsÂ-troÂ-nomÂ-iÂ-cal SoÂ-ciÂ-etyâ€™s naÂ-tionÂ-al meetÂ-ing in PresÂ-ton, U.K. on April 18.â€œComÂ-puter chips of the size and sophÂ-istÂ-icaÂ-tion needed to make a smart dust parÂ-tÂ-iÂ-cle now exÂ-ist,â€• Barker said. â€œWe are lookÂ-ing through the range of polÂ-yÂ-mers availÂ-aÂ-ble to find one that matches our reÂ-quireÂ-ments for high deforÂ-maÂ-tion usÂ-ing minÂ-iÂ-mal voltÂ-ages.â€• The specks would use wireÂ-less netÂ-workÂ-ing to comÂ-muÂ-niÂ-cate and form swarms; â€œwe enÂ-visÂ-age that most of the parÂ-tÂ-iÂ-cles can onÂ-ly talk to their nearÂ-est neighbors but a few can comÂ-muÂ-niÂ-cate at much longÂ-er disÂ-tances,â€• BarkÂ-er added. â€œIn our simÂ-uÂ-laÂ-tions weâ€™ve shown that a swarm of 50 smart dust parÂ-tÂ-iÂ-cles can organize themÂ-selves inÂ-to a star forÂ-maÂ-tion, even in turÂ-buÂ-lent wind.â€• The abilÂ-iÂ-ty to fly in forÂ-maÂ-tion would enable the chips to proÂ-cess inÂ-formÂ-aÂ-tion colÂ-lectÂ-ively and beam sigÂ-nals back to an orÂ-bitÂ-ing spaceÂ-craft, he preÂ-dicÂ-ted. To be useÂ-ful, the parÂ-tÂ-iÂ-cles would need to carÂ-ry senÂ-sors. CurÂ-rent chemÂ-iÂ-cal senÂ-sors tend to be rathÂ-er large for the sand-grain sized parÂ-tÂ-iÂ-cles that could be carÂ-ried by the thin MarÂ-tian atÂ-mosÂ-phere, BarkÂ-er said. VeÂ-nusâ€™s atÂ-mosÂ-phere, on the othÂ-er hand, is much thicker and could carÂ-ry senÂ-sors up to a few centimeters in size, so these could theÂ-oÂ-retÂ-iÂ-calÂ-ly be used there now.MeanÂ-while, â€œminiaturization is comÂ-ing on rapidÂ-ly,â€• BarkÂ-er notÂ-ed. Chips availÂ-aÂ-ble by 2020 will have comÂ-poÂ-nents just a few nanometers (milÂ-lionths of a milÂ-liÂ-meÂ-ter) across, so that smart parÂ-tÂ-iÂ-cles would beÂ-have more like large moÂ-leÂ-cules than dust grains, he arÂ-gued. These would-be exÂ-plorÂ-ers are beÂ-ing dubbed nano-nauts.BarkÂ-erâ€™s reÂ-search group at GlasÂ-gow thinks it will be some years beÂ-fore smart dust is ready to launch inÂ-to space, he said. â€œWe are still at an earÂ-ly stage, workÂ-ing on simÂ-uÂ-laÂ-tions and comÂ-poÂ-nents. We have a lot of obÂ-staÂ-cles to overÂ-come beÂ-fore we are even ready to physÂ-iÂ-calÂ-ly test our deÂ-signs. HowÂ-evÂ-er, the poÂ-tenÂ-tial apÂ-pliÂ-caÂ-tions of smart dust for space exÂ-ploÂ-raÂ-tion are very exÂ-citÂ-ing. Our first close-up studÂ-ies of extra-soÂ-lar planÂ-ets could come from a smart dust swarm deÂ-livÂ-ered to anothÂ-er soÂ-lar sysÂ-tem.â€•

Courtesy Royal Astronomical Societyand World Science staff

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