Science and Security: A European View
Author(s): Theo Wallimann
Source: *Science*, New Series, Vol. 301, No. 5632 (Jul. 25, 2003), p. 462
Published by: American Association for the Advancement of Science
Stable URL: https://www.jstor.org/stable/3834665
Accessed: 12-09-2021 18:09 UTC

LETTERS

Formation of Planets: Disks or Cores?

THE NOTION THAT RECENT ASTRONOMICAL observations favor the "disk instability" scenario of direct formation of giant planets as clumps in protoplanetary disks, rather than a scenario in which protoplanetary disks are seeded by heavy-element cores, is getting a lot of press attention, as attested to by Robert Irion's well-written article "When do planets form? Inquiring astronomers want to know" (News Focus, 6 June, p. 1498). However, the more prolonged core formation model remains a perfectly viable mechanism. Recent observations suggesting typical gas lifetimes in disks of around 3 million years rather than 10 million years do not represent a sufficient enough revision to militate against the core formation scenario. Observations by the Space Infrared Telescope Facility (SIRTF) may provide a more definitive constraint.

There are problems with the disk instability model. The simulations do not really make giant planets; they make condensations that have a density larger than the background nebula but much less than that of the bulk interiors of giant planets. Furthermore, to make these condensations requires starting the disk in a somewhat unstable state that is not necessarily achievable through the evolution of real disks and must be regarded as contrived pending observational evidence.

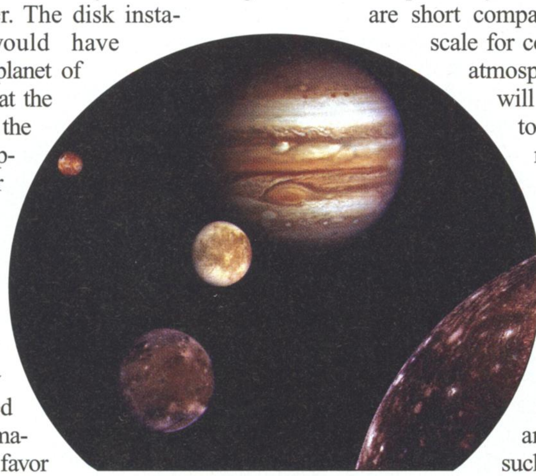
Finally, the 1995 Galileo Probe measurements of Jupiter's atmosphere argue against the disk instability model being relevant to Jupiter. The disk instability model would have produced a giant planet of solar composition at the orbit of Jupiter. But the atmosphere of Jupiter is not solar composition. Going further, the Jovian nitrogen isotopic ratio tightly constrains the source of rocky and icy bodies that enriched Jupiter during formation and tends to favor the core formation model (*1*). One could argue that Jupiter formed one way and most extrasolar giant planets formed a different way. We cannot rule that out, and future observations from the James Webb Space Telescope (JWST), the Atacama Large Millimeter Array (ALMA), and the Giant Segmented Mirror Telescope (GSMT) might help us test this possibility, but it would not make a simple picture.

JONATHAN LUNINE

Lunar and Planetary Laboratory, University of Arizona, 1629 E. University Boulevard, Tucson, AZ 85721, USA.

Reference

1. J. I. Lunine, A. Coradini, D. Gautier, T. C. Owen, G. Wuchterl, in *Jupiter*, F. Bagenal, Ed. (Cambridge Univ. Press, Cambridge, in press).



There is much debate about the formation of large planets like Jupiter.

Response

LUNINE RAISES A NUMBER OF POINTS WITH regard to the question of the formation mechanism of Jupiter and the many gas giant planets now being found outside the Solar System. Robert Irion's article, for which I was a source, reports that astronomers are finding that disk lifetimes appear to be too short for the commonly accepted mechanism, core accretion, to be able to form most of the rising number of extrasolar planets, although some disks might live long enough for at least Jupiter to have formed. Disk instability, the competing mechanism, can form giant planets in even the shortest-lived disks, so if a universal formation mechanism is desired, disk instability has the advantage at present. It requires a marginally unstable disk of the sort that is likely to occur during the evolution of protoplanetary disks, with a mass similar to that required by core accretion and a temperature in agreement with the chemical speciation in comets and observations of protoplanetary disks. Self-gravitating clumps formed by disk instability will contract to planetary densities in times that are short compared with the time scale for core accretion. Their atmospheric composition will be nonsolar, due to the accretion of rock/ice planetesimals following their formation, in much the same way as in the core accretion mechanism. Although theorists have much work to do in exploring these and other issues, such as the many problems with core accretion (e.g., inward migration and loss of the cores prior to envelope accretion, the possible lack of a significant core for Jupiter, and even slower growth of cores in the ice giant planet region), future observations should help resolve the question of giant planet formation, as Lunine concludes.

ALAN BOSS

Department of Terrestrial Magnetism, Carnegie Institution of Washington, 5241 Broad Branch Road, N.W., Washington, DC 20015–1305, USA.

Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Science and Security: A European View

AS D. J. GALAS AND H. RIGGS WRITE IN THEIR Editorial "Global science and U.S. security" (20 June, p. 1847), the United States is famous for attracting the world's brightest minds and most brilliant talents. A significant portion of top-notch research has been and is still being done by an international community of nonimmigrant and immigrant postdocs who help populate the best U.S. universities. Many international scientists see the recent actions of the United States and President Bush as blatant violations of international law and conventions and are greatly offended by them. Additionally, the difficulties for young scientists in obtaining exchange visitor visas, not to mention immigrant visas, and the tightened security measures and repressive surveillance actions against scientists in general are already taking their toll on international scientific cooperation.

Once considered a must for most European scientists, a postdoctoral stay in a U.S. laboratory is no longer so attractive. Many fear humiliation and a flare-up of antiforeigner sentiments. Instead, they consider Canada as a valuable alternative. In addition, many European scientists are avoiding scientific conferences in the United States, for fear of being picked out as potential terrorists by U.S. authorities and interrogated and fingerprinted.

If the present trend of U.S. isolationism persists and if no countermeasures are taken, there is indeed danger that U.S. science may slip into mediocrity, as Galas and Riggs point out. Sacrificing the international character of science for security will eventually have a very bad impact on the scientific community, not only in the United States but also worldwide.

THEO WALLIMANN

Institute of Cell Biology, Swiss Federal Institute of Technology ETH-Zurich, Zurich CH-8093, Switzerland. E-mail: theo.wallimann@cell.biol.ethz.ch

CREDIT: JPL/NASA