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Origin and Evolution of Titan's Nitrogen Atmosphere – A Cassini-Huygens Perspective

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Prior to Cassini-Huygens, it was debated how Titan acquired its earth-like atmosphere of nitrogen [1]. This talk will review the history of Titan's atmosphere, models, and the unique role of Cassini-Huygens in understanding the origin and evolution of an atmosphere of nitrogen on Titan. After hydrogen and helium, nitrogen is the fourth most abundant element in the solar system. In the colder outer solar system beyond 5 AU, nitrogen is bound to hydrogen in the giant planets. Thus ammonia (NH_3), not N_2, is the dominant reservoir of nitrogen in these objects. The satellites that form in the relatively warm and dense subnebula of the gas giant planets, Jupiter and Saturn, may acquire nitrogen as NH_3 during their accretion [2], although some models had proposed N_2, not NH_3, as the stable form of nitrogen in the subnebulae. The latter is reflected in the atmosphere of Triton, which almost certainly accreted nitrogen directly as N_2, since N_2 can be the stable form of nitrogen in the very cold environment of Neptune. Before Cassini-Huygens, it was debated whether Titan, the largest moon of Saturn, also acquired its nitrogen directly as N_2, putting it in the same class as Neptune's moon Triton half its size, or the nitrogen on Titan was secondary atmosphere, produced from a nitrogen bearing molecule, putting Titan in the class with terrestrial planets. The evidence from Cassini-Huygens to be discussed in this talk leaves no doubt that Titan's nitrogen atmosphere is secondary [3]. Probable scenarios of the sustenance, evolution and reduction or demise of this atmosphere will also be explored. References: [1]Owen T. (2000), Planet. Space Sci. 48, 747-752. [2]Prinn R.G., Fegley B. (1981), Astrophys J. 249, 308-317. [3]Atreya S.K., Lorenz R.D., Waite J.H. (2009), pp 177-199, in *Titan* (R.H. Brown et al., eds.) Springer.