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2007-2008 Monthly Seminar Series on Space Research

18 October, 15 November, 17 January, 21 February, **17 April**, 15 May
3rd Thursday 4:00-5:00 pm

THE CHALLENGES AND OPPORTUNITIES AFFORDED BY CLOSE ENCOUNTERS WITH ASTEROID APOPHIS

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Date: **17 April 2008 Thursday** Time: **4:10-5:00 pm (*Refreshments will be provided at 4:00 p.m.*)** Location: **1062 Bainer**

ABSTRACT

Hosted by: ***Professor Nesrin Sarigul-Klijn***

Apophis is one of >2000 known near–Earth asteroids, and each year more are discovered. Apophis will pass Earth inside the GEO orbit on April 13, 2029 with the presently remaining uncertainty in the ~5.6 Earth diameter miss distance being about one Earth diameter. Within the current uncertainty region at closest approach, there lies a small 600 *m* region (called the *keyhole*). If the center of Apophis flies through this keyhole at closest approach in 2029, then a resonant encounter condition will be established and Earth impact seven years later is near certain (April 13, 2036). The probability of this event remains small (~ 10^{-5}), but since this impact by a ~300 *m* asteroid would dwarf the largest explosion in recorded history, we must take the 2029 close encounter and possible impact in 2036 very seriously and consider all aspects. Knowledge is power and refining the orbit uncertainty is the first priority and maximizing our understanding of Apophis geology is also vital. Mother Nature has afforded two large time windows between now and 2025 for low-cost mission opportunities and these are overviewed, along with some new approaches to address the probability of collision issue and preliminary ideas for low cost, low risk mitigation. While the probability of any impact remains small, we are reminded by the Shoemaker-Levy comet (23 objects impacted Jupiter in 1994) and other modern impacts that while probability of particular objects to impact Earth are small, occurrences are sufficiently frequent on the time scale of a human lifetime - that we need methodology established before we need to use it. The close approaches of Apophis provide excellent opportunities. The first low energy launch window (2011 +/- 2 yrs) to reach Apophis is a good opportunity to send a discovery mission to put a transponder and appropriate instruments on the asteroid to refine the orbit estimates and study the structural/material properties. The transponder would enable a high precision orbit to be determined within one year. The second window (2020 +/- 2 years) would be another good opportunity to characterize Apophis or to initiate mitigation, if warranted. The 2029 close encounter may be the best opportunity to mitigate if Apophis is found to be within a keyhole corresponding to subsequent collisions, e.g., in 2036. We summarize our work to date on preliminary mission design studies to reach Apophis, probability of collision analysis, and discuss possible "action vectors" for the near future.

ABOUT THE SPEAKER

John L. Junkins *received his MS and Ph.D. from the UCLA, in 1967 and 1969, respectively, and his B.A.E. from Auburn University in 1965. At Texas A&M, he holds the Royce E. Wisenbaker Chair in Engineering. He has also been designated Regent's Professor at Texas A&M and is the founding Director of the Center for Mechanics and Control. He recently led the creation of the Consortium for Autonomous Space Systems which marries a dozen senior* researchers at Texas A&M and the University of Texas. This consortium is funded by the US Air Force to advance the technologies underlying the next generation of small, agile, highly autonomous spacecraft. Prior to joining Texas A&M in 1985, he held academic appointments at the Univ. of Virginia and at Virginia Tech. Before entering academia, he held positions at McDonnell Douglas Astronautics Company and NASA MSFC. He is a member of the National Academy of Engineering and the International Academy of Astronautics. He is a Fellow of AIAA and AAS. Dr. Junkins' technical interests include dynamical modeling and estimation theory, as applied to navigation, guidance, and control of spacecraft, aircraft and robots. He has patented and commercialized several new sensors with application to navigation. His work has been successfully implemented in over a dozen space missions. He is the author of over 350 publications, including 6 textbooks. He is a prolific mentor, having directed the research of over 100 graduate students and post-doctoral researchers. Over a third of his 40 PhD students are on leading faculties worldwide and have given rise to three descendant generations of PhDs. His former students constitute a significant school of thought in the aerospace industry and in academia.

For more information about
SpaceED (Space Engineering Research and Graduate Program) or the seminars please contact
Professor Nesrin Sarigul-Klijn at (530)-752-0682 or nsarigulklijn@ucdavis.edu

Members of the campus community and visitors from the region are welcome to attend the seminar series.
Sign-in is required at the event. SpaceED seminar will replace MAE297 seminar on 3rd Thursdays.

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