

INTEROFFICE MEMO

ELLIOTT CUTTING

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TO R. V. Morris (E. Cutting) SEC. 39

FROM W. Stavro EXT. 7015 SEC. 392

SUBJECT Origin of "Gravity Assist" Trajectories

In the AA article published in September 1970 which I co-authored with Divita, Draper, and Frewing, one of my responsibilities was to present a chronological order of the research done on multiple planet swing-by trajectories. At that time I attempted to be as correct as possible in order to give the proper credits.

Recently, I have been looking back again at the origin of the "gravity assist" idea. In the AA article, I made the statement: "The concept of using the gravity of a planet to change the trajectory of a space vehicle was initially advanced by Hohmann in his analysis of an Earth-Mars-Venus-Earth trajectory." The reference quoted for that was a German paper written by Hohmann in 1925. I just recently obtained a translation to this memo and have discovered that my statement was incorrect! Hohmann did not use the gravity of a planet to change the trajectory, he used on-board rocket propulsion to obtain the required  $\Delta V$ . So crediting Hohmann for the basic idea of "gravity assist" was incorrect. Actually, this credit to Hohmann was first advanced by Flandro in a paper called "The Mechanics and Applications of the Planetary Swing-by Maneuver in Interplanetary Mission Design" (AAS, Denver, Colorado, July 1968).

Digging further into this, I discovered a Section TM written by M. Minovich (TM 312-130) dated August 23, 1961! As far as I can tell this is the original idea and theory behind all gravity assist trajectories. I read that memo with keen interest and I truly believe it provides the technological breakthrough in trajectory design since it essentially solves in a practical way the N-body trajectory problem! In that memo Minovich not only proposed the solution to an Earth-Venus-Earth trajectory, using gravity assist, but also proposed the following mission: Earth-Venus-Mars-Earth-Saturn-Pluto-Jupiter-Earth!! I guess if anybody is to be accredited with the original idea of "celestial billiards" it has to be Minovich!

I would like to set the record straight and correct my erroneous statement in the AA article, however, I'm not sure what the best way is. I would like your advice in this matter.



Bill Stavro

WS:mcl

cc: A. M. Goldman, Jr.