Basics of TWT Amplifiers

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Understanding the highly non-linear physics of the Traveling Wave Tube remains a challenging problem. Its complexity develops in a six dimensional phase space, compared, for example, to the usual three dimensions for fluids. At first glance, this huge complexity discourages from finding simplifications. Therefore, the most common approach when studying the TWT is to model it numerically with high performance computer. Although providing crucial results, these mere numerical experiments elude finding few key parameters that govern the looked after characteristics. Computing is not understanding. Au contraire, reducing the system to few meaningful numbers, deriving its characteristics from them with simple relations, identifying the best achievable performances would not only be a gratifying epiphany, it would be of practical importance when undertaking an optimization. In this mini-course, we apply this program to the TWT used in space and more generally to any TWT. Salient missions exploring Mars, Saturn and Pluto, deep-space observatories like the James Webb space telescope, Global Positioning System, and satellite internet services are examples of systems using them as high efficiency and high data rate transponders.