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## Theoretical model of post acceleration and focalization of protons produced with TNSA

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The concept of the Travelling Wave Tube (TWT) was conceived in 1947, followed by analytical models in the 1950s. The growing interest of this system takes source with the domain of high power and high frequency microwave devices such as the gyrotrons, the relativistic travelling wave tubes or the free-electron lasers. On the other hand, Target Normal Sheath Acceleration (TNSA) is currently one of the most dynamic research domains due to its compactness and numerous applications such as isochoric heating, isotope or neutron production, plasma radiography, and nuclear fusion in a fast ignition scheme. The concept involves interacting a high-intensity laser beam with a solid target. However, the angular divergence of TNSA is still too high, and the energy distribution of protons is poorly controlled, limiting the application possibilities.

In this context, the idea to implement a system coupled to TNSA was conceived to post-accelerate and focus the proton beam, termed the helical coil. The concept involves retrieving a discharge current, created by the laser-plasma interaction, using a helix. The physics of current propagation in this helix is analogous to TWT. However this concept is not optimize. This is why, we propose a new analytical model with an implementation of a tube and a variation on the helical coil geometry to permit applications. During this presentation, we will introduce our theoretical model and present some significant results of proton spectra get by simulations and some possible applicationd sich as radioisotope production or isochoric heating.

### Working group

WG2 : Laser-driven plasma acceleration of ions

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