Understanding reconnection one of the greatest challenges in modern science. I will present my view of one of the central themes in space science: the process of magnetic energy release via magnetic field rearrangement, known under the label of magnetic reconnection.

Borrowing the famous statement of Winston Churchill, the problem has proven to be a great riddle whose solution requires us to address one of the most mysterious aspects of plasma physics: the processes coupling large and small scales.

Reconnection is but one example of this larger mystery, affecting practically every energy transformation in space plasmas, from turbulence to dynamo processes, to shocks and particle acceleration: how do macroscopic processes derive their properties from the self-organization of microscopic processes?

The final enigma in this grand challenge is than: what can we do to arrive at a comprehensive ability to encompass all scales in a single view? What observational effort and what theoretical insight should we focus on to crack this problem?

The talk will cover our recent effort in relation to the Magnetospheric Multiscale (MMS) mission of NASA. Here we report on the new work where the role of the third dimension is investigated. We start from the typical 2D case and add the effects of the 3rd dimension in three steps.

First, we simply add the z-direction to a 2D run loading an initial system that simply replicates the same initial 2D state invariant of z, with the same initial perturbation also independent of z. This case is already extremely interesting showing the presence of key processes absent in 2D. Several regions of intense free energy are present (velocity shears, strong flows, density gradients) and elad to numerous instabilties. We will explain the relevance to existing observations and to the future MMS mission [2,3].

Next, we allow reconnection to develop freely an initially uncorrelated in the z dimension. Here we do not presc ribe any perturbation and allow each z-plane to develop with only the spontaneous correlations natiurally evolving in the system. In this case reconnection is vastly different from the 2D case leading to numerous reconnection sites that start to interact to form coherent structure: flox ropes and extended electron and ion diffusion regions.

Last, we initiate the system with configurations that are fully 3D and include to beging with a 3D topology with prescribed null lines and null points where the magnetic field is zero. The evolution is drastically different at null points and null lines.

In all three cases, we report on the evolution of the system focusing especially on

1) the presence of instabilities,

2) the existence of non-MHD effects where electrons and ions display their kinetic nature and decouple from the forzen in condition.

3) the energetics of the process, investigating where and how energy is released.