

## P4.1072 A real case of complex network controllability: the NIO1 ion beam source

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See full abstract here

<http://ocs.ciemat.es/EPS2019ABS/pdf/P4.1072.pdf>

A negative ion beam source is a key component of a neutral beam injector such as that under development for ITER. Its efficient and reliable operation depends on a network of processes affecting generation, extraction and acceleration of the negative ions. Such processes interact with each other in a complex fashion. Controllability of complex networks [1] can offer interesting new tools to both identify the most crucial processes in the negative ion beam source NIO1 [2] [3] and to verify its controllability. In this contribution a model based on this theory has been developed and tested. NIO1 processes have been mapped into a network of 40 nodes and 292 links to highlight the most important processes (the driver nodes). Predictions obtained with the model have then been compared with the observed behaviour of NIO1. The test has been performed by numerically perturbing the model with input signals that mimic the ones used in NIO1 experimental campaigns. Experimental data and outputs from the model have then been compared. Preliminary results show a good agreement between model predictions and experimental behaviour of the source so that a subset of processes which in principle allow the system to be driven towards any state has been identified. As an outcome of the analysis the most crucial processes have been identified and discussed in terms of emerging diagnostic and modelling necessities required to improve the understanding of the physics behind them.

References

- [1] Y.-Y. Liu, J.-J. Slotine and A.-L. Barabasi, "Controllability of complex networks," *Nature*, vol. 473, 2011. [2] M. Cavenago et al., "Design of a versatile multiaperture negative ion source," *Review of Scientific Instruments*, no. 81, 2010. [3] M. Cavenago et al., "First experiments with the negative ion source NIO1," *Review of Scientific Instruments*, no. 87, 2016.

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