

Experimental characterisation of nanoelectronic devices at cryogenic temperatures

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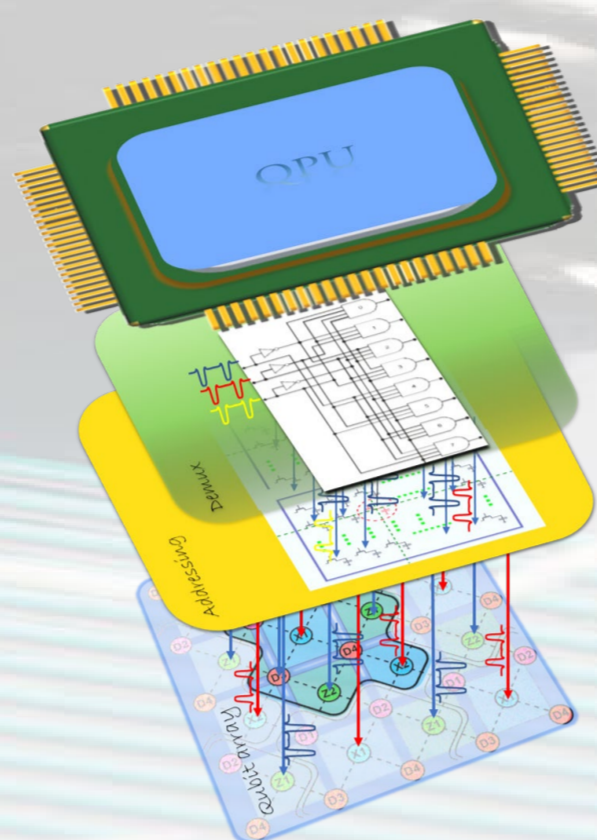
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Introduction

Quantum bits (“qubits”):

- Implementation in silicon
- Qubit and control system at the same IC
- Cryogenic temperatures needed



- Operation models have to be developed
- From room temperature down to the deep cryogenic range (a few K)

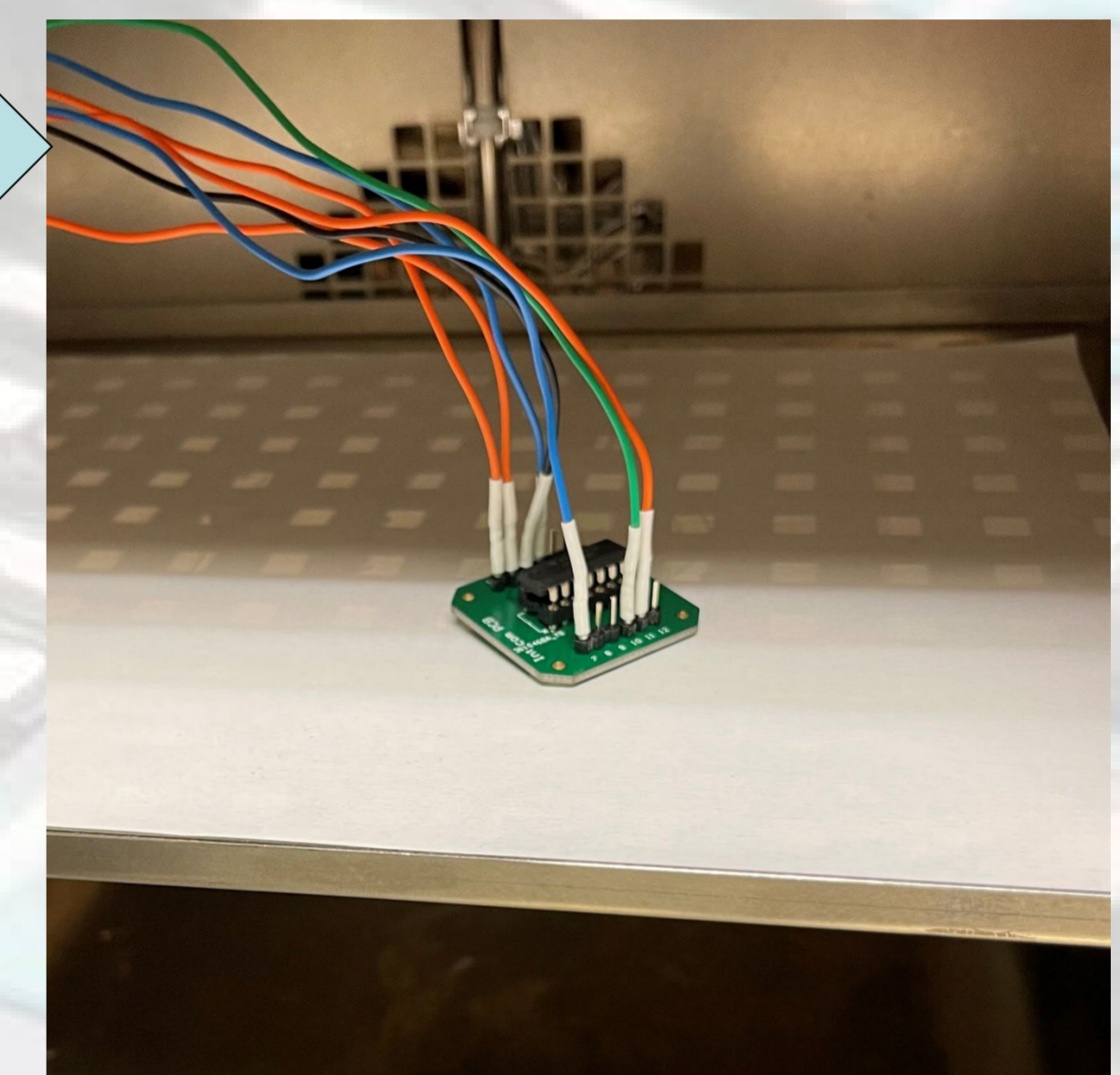
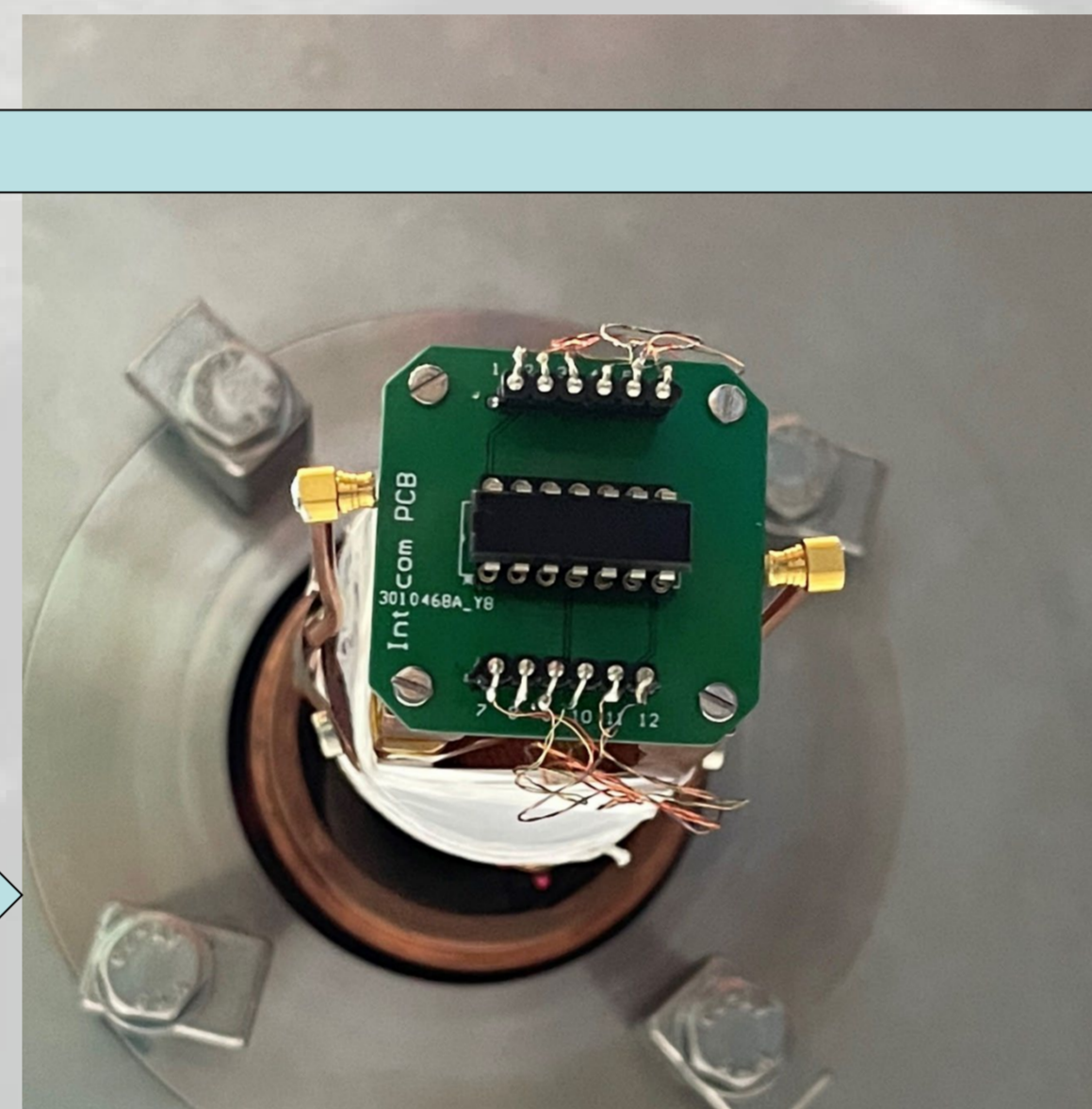
Measurements

Usual range of operation:

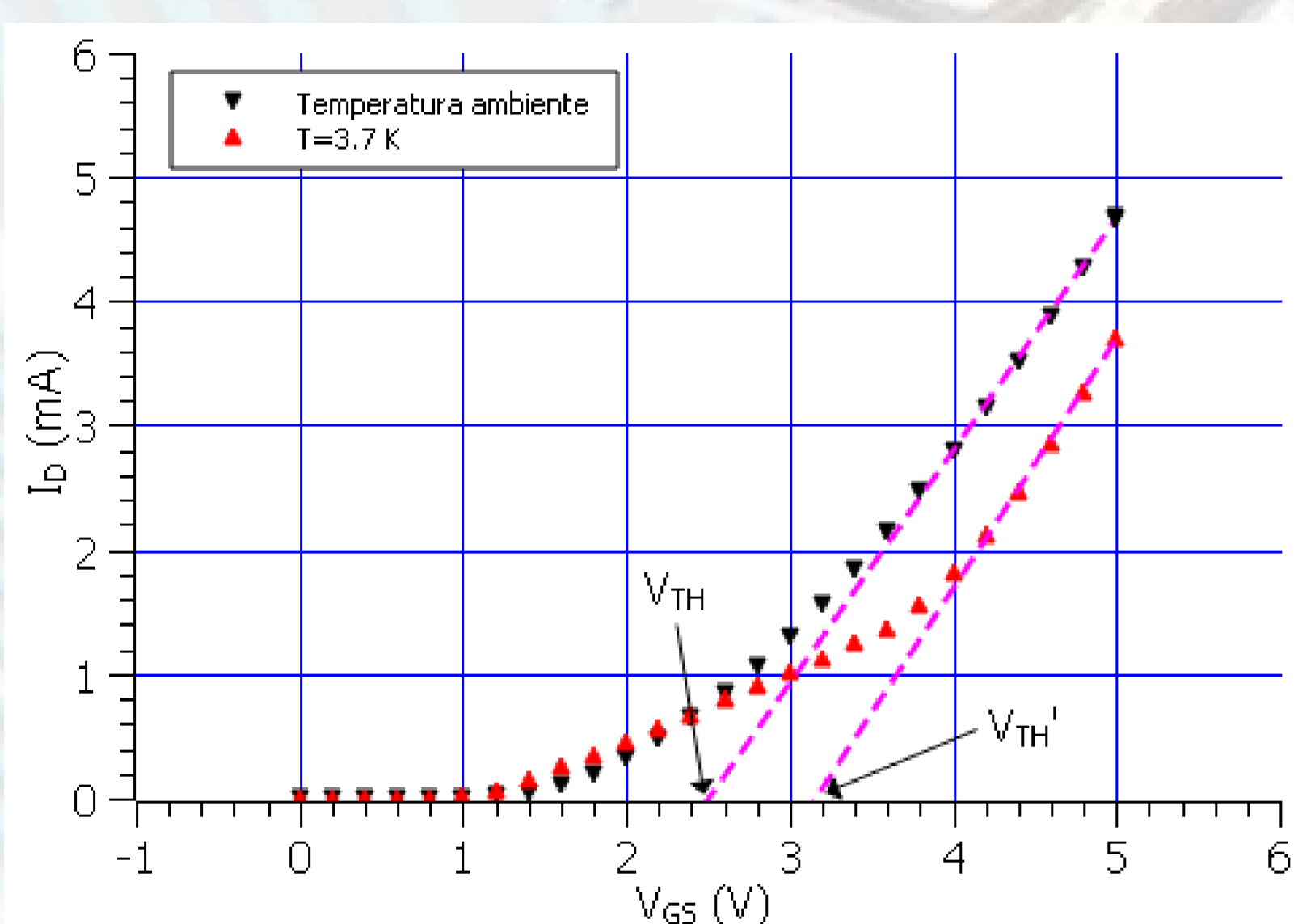
- From -40°C to +80°C
- Measured with a climatic chamber

Cryogenic range:

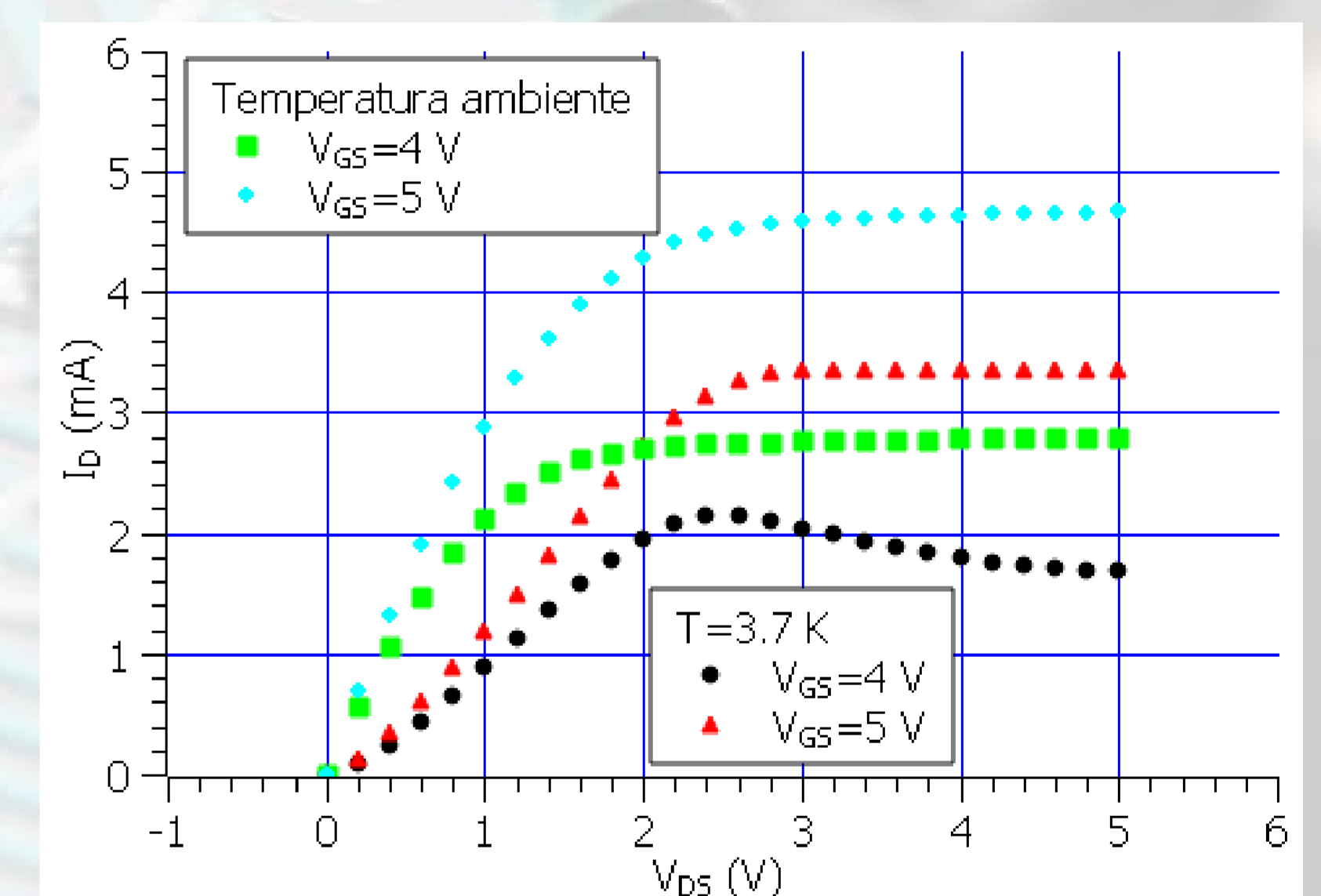
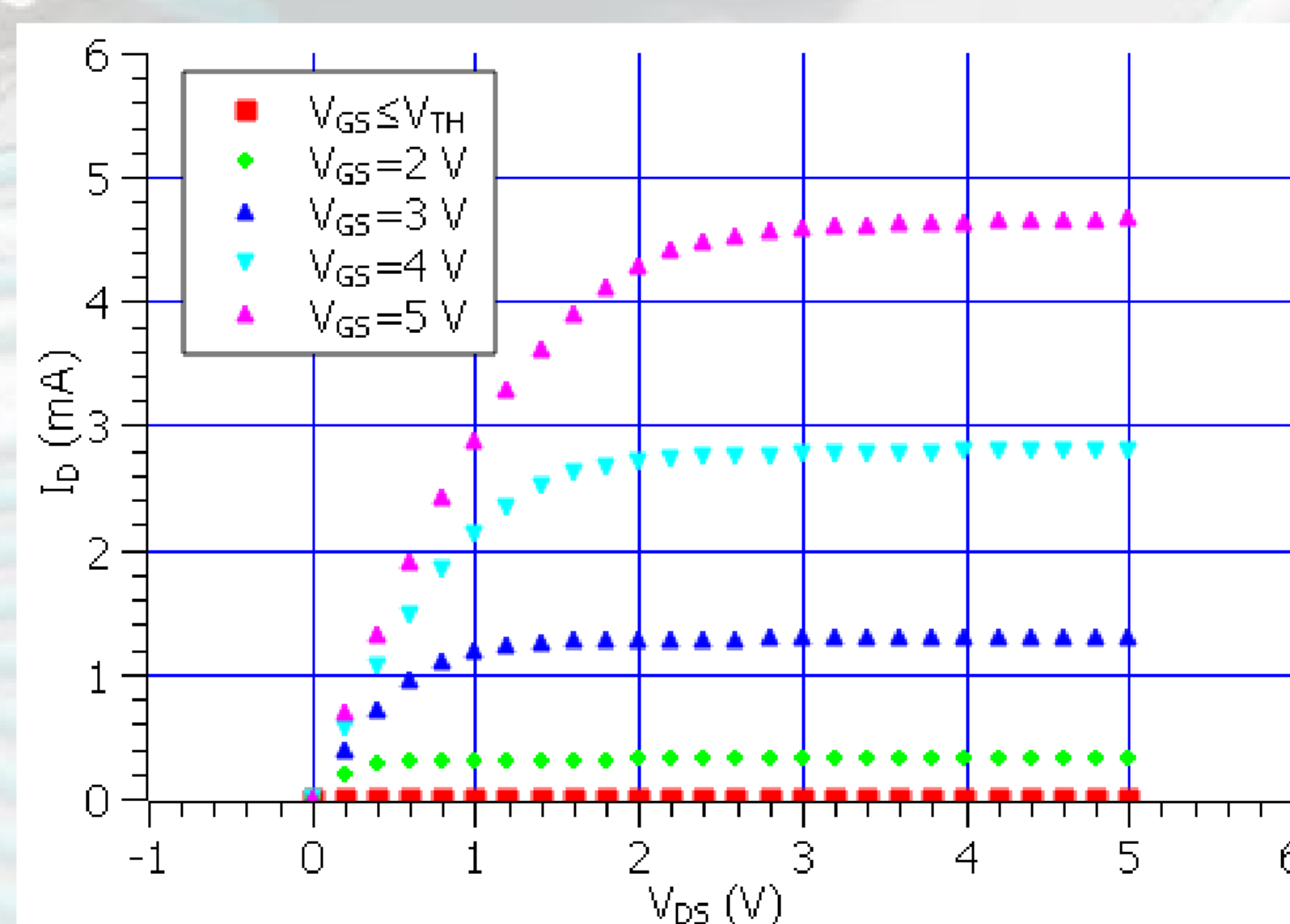
- Down to 4K
- Measured in a cryogenic refrigerator



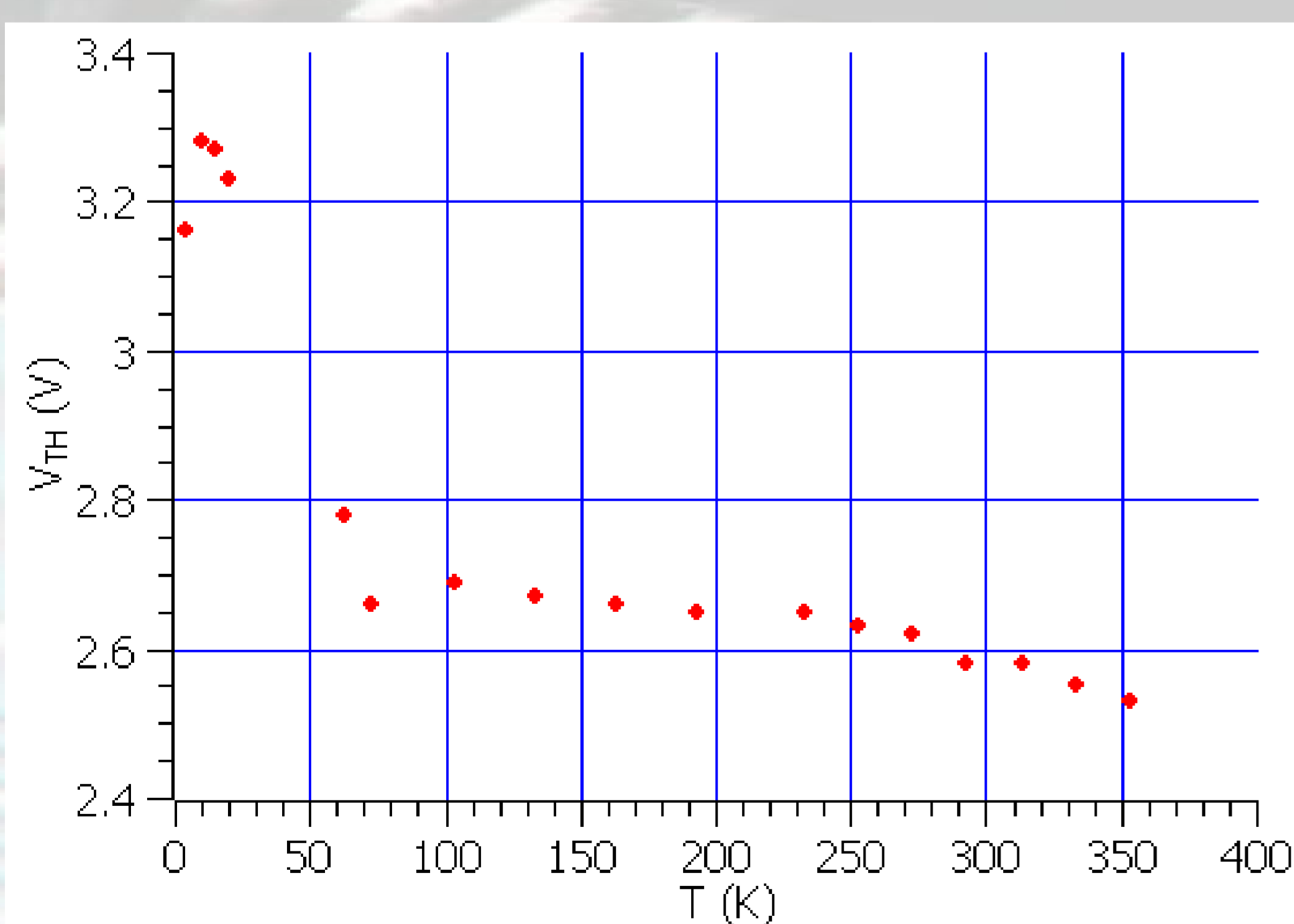
$$I_D - V_{GS} \rightarrow V_{TH}$$



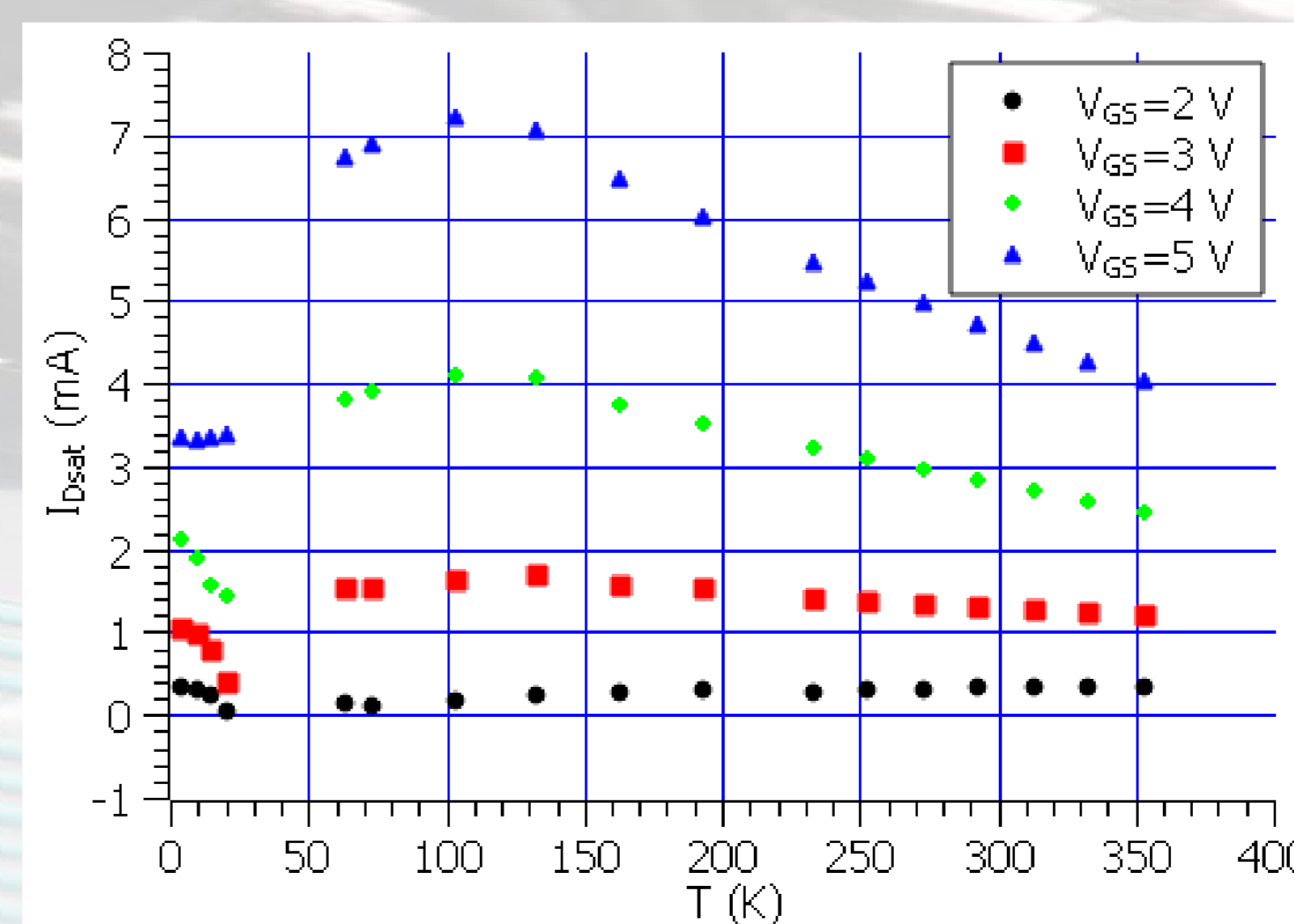
$$I_D - V_{DS} \rightarrow I_{Dsat}$$



Results



- For temperatures above 50K, V_{TH} has a homogeneous value
- At the cryogenic range, there is a stepped increase



- I_{Dsat} has a behaviour similar to V_{TH}
- There is a maximum around 100K

Conclusions

- Previous characterization to the performed on a 65nm CMOS integrated circuit
- With this models, designers will be able to create control and read/write interfaces that could be used at the deep cryogenic range