HASPIDE WP2: Electronics and DAQ Kick-off meeting

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HASPIDE WP2 Target and Tasks

Two targets:

- Clinical dosimetry and radiation flux measurement
  - Current signal from the detector, to be converted in frequency, then digitized (counting pulses) and acquired by an FPGA-based DAQ board
- Single particles and neutron detection
  - Single charge pulse read-out solution (based on a previosly designed chip); data acquisition by an FPGA-based board

Tasks:

T2.1: Design of the front-end chip for clinical dosimetry

T2.2: Design and test of the data acquisition board for neutron detection

T2.3: Design and test of the data acquisition board for clinical dosimetry

HASPIDE WP2 People

Participant institutions and people (as listed in the proposal):

- **Milano**:
  - Valentino Liberali (WP2 Responsible)
  - Alberto Stabile
  - Luca Frontini
- **Torino**:
  - Gianni Mazza
  - Edoardo Bianco
  - Richard Wheadon
- **Perugia**:
  - Pisana Placidi
- **LNS**:
  - Pietro Paolo Falciglia

+ 1 AdR (Torino)

Expertise in chip design; excellent co-operation between Milano and Torino (and Cagliari) in the TimeSPOT project.

Milestones

First year (2022) milestones:

M2.1: Design of the first miniAsic (M8)

M2.2: Test board for the first miniAsic (M12)

Second year (2023) milestones:

M2.3: Characterization of the first miniAsic (M15)

M2.4: Design of the second miniAsic (M18)

M2.5: Test board for the second miniAsic (M22)

M2.8: Design and fabrication of the data acquisition board for neutron detection (M24)

The miniAsic to be designed is the front-end chip for clinical dosimetry.
In our plans, the second version should be the final one, and therefore is should include all the interfaces with the DAQ board
$\longrightarrow$ chip-to-board interfaces MUST be well defined before the miniAsic design!

The miniAsic (1)

Technology: TSMC CMOS 28 nm HPC+

- mature technology
- available through Europractice
- excellent radiation hardness
- already used in previous designs (TimeSPOT, HTT)
- performance limited by parasitics; complete layout design and parasitic extraction required for meaningful simulation results
- dedicated NDA required before exchanging design information between different teams (to be checked)

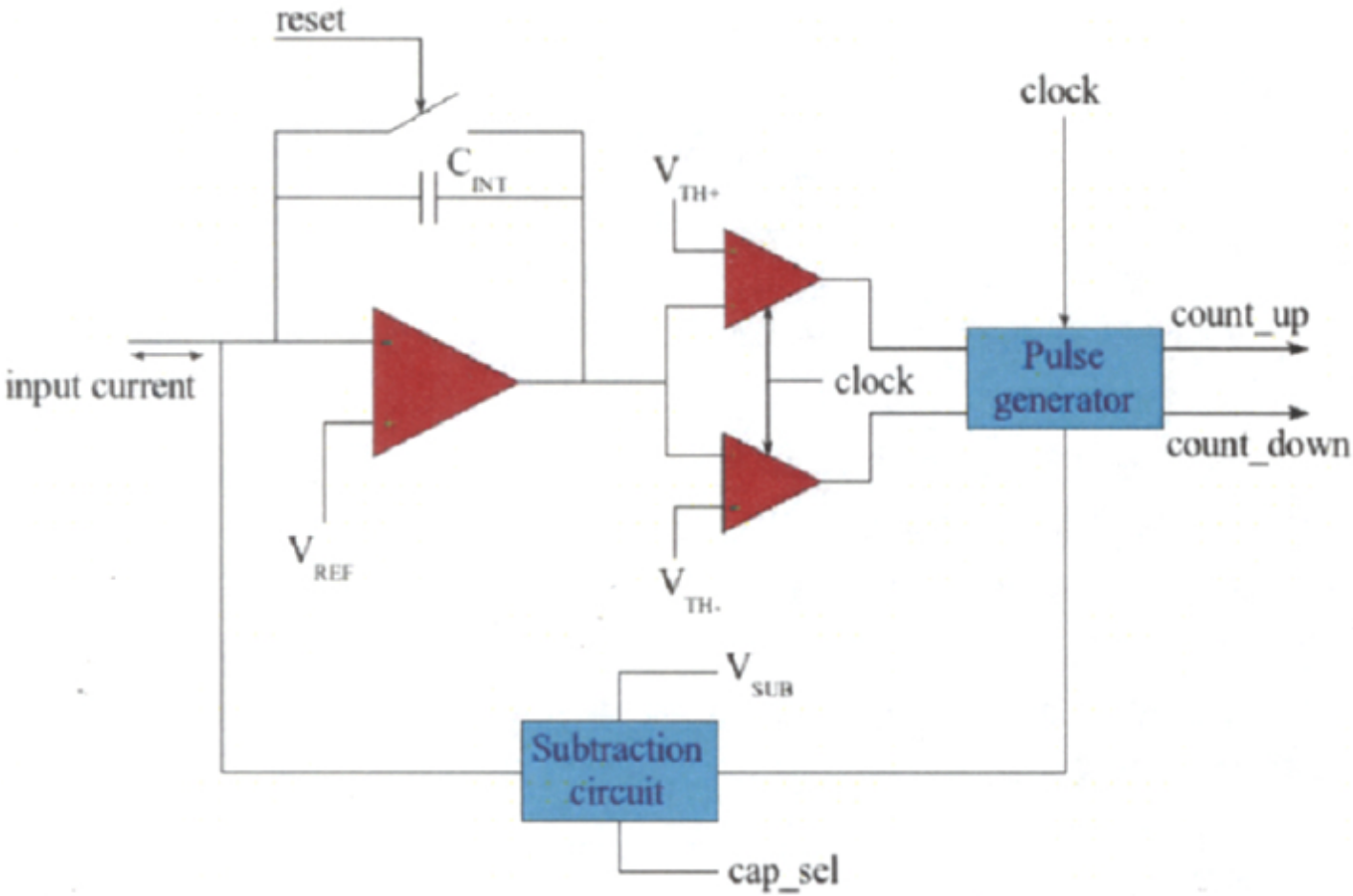
Other drawbacks:

- "Chip crisis": possible delays in MPW fabrication
- Limited number of miniAsic submissions; advance reservation required (3 months before submission)
- "Chip crisis": certain delays (and cost increase) in packaging

Do we need chip packaging?

The miniAsic (2)

i-f (current-to frequency) conversion for clinical dosimetry:
integrator with threshold detector and charge injection
$\rightarrow$ the number of output pulses depends on the input current and on the injected charge (programmable)



The miniAsic (3)

The front-end circuit has been successfully designed by Torino group in different technologies (not yet in 28 nm)

2008 IEEE Nuclear Science Symposium Conference Record **N02-289**

A Large Dynamic Range Charge Measurement ASIC Family for Beam Monitoring in Radiotherapy Applications

G. Mazza, *Member, IEEE,* A. La Rosa, A. Attili, F.Bourhaleb, R. Cirio, M. Donetti, A. Garella, N. Givechi, S. Giordanengo, F. Marchetto, V. Monaco, J. Pardo, A. Pecka, C. Peroni, G. Russo, R. Sacchi

Actions

- Update WP2 participant list (+ mailing list)
- Regular WP2 meetings in 2022
- Define the complete architecture (detector + read-out chip + acquisition board) of the two deliverables as soon as possible
- Check deadlines and costs for miniAsic submissions (and book in advance!)
- Joint meetings with WP1 on detector / read-out interfacing (for clinical dosimetry)
- Check the availability of the front-end chip designed by INFN Torino in 0.11 µm CMOS technology (for neutron detection)

THANK YOU !