

# NINO development

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# Status

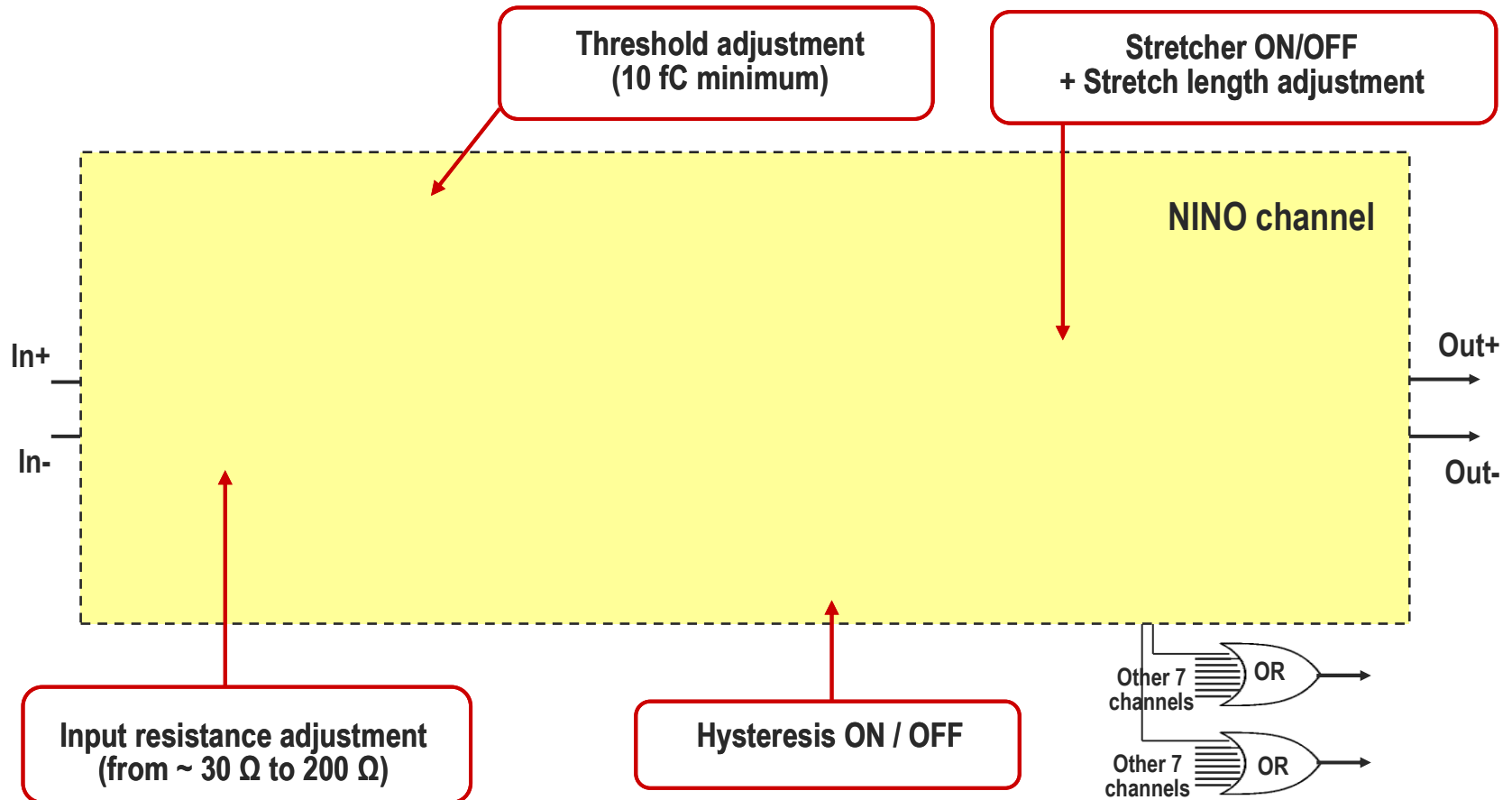
- NINO status
  - Used successfully connected to HPTDC in ALICE TOF
  - Jitter limit
    - 2-3 ps rms (Crispin)
  - Used for PET TOF (Endotofpet-us EU project) with 220 ps FWHM coincidence
    - with SiPM coupled to LSO crystal, 70 ps rms limited by Poisson statistics, so far the best results
  - a version 32 channel has been developed
  - A prototype in 130 nm has been developed

# Interest for a new development

- Arguments to continue the development of NINO
  - So far it is the best amplifier-discriminator optimized for low jitter and low threshold
    - Is ESE is interested to keep this technology alive?
  - With a new HPTDC in 130 nm (90 nm) to be developed a front end interfacing a detector is essential.
  - Why?
    - Because an integrated ASIC has many advantages
      - Simplification of the readout system, lower cost, lower power
      - It has been verified (Crispin) that the physical connection between NINO and HPTDC increases the jitter,
      - not an issue for 30 ps time resolution
      - But critical for 10 ps time resolution
- Design effort estimate
  - One year of prototype development and design
  - ½ year of characterization
  - ½ year of contingency, resubmission
  - Plus time of design for integration with HPTDC

# Appendix

## NINO schematic



# Time jitter limit from Crispin NINO 25

- 4 different values of injected charge and 4 different values of threshold
- Typical jitter between **2 and 3 ps** With LeCroy oscilloscope
  - Input signal is 25-100 fC, for lower signal jitter dominated by electronic noise

Jitter of single channel:

Front-end card not  
connected to anything

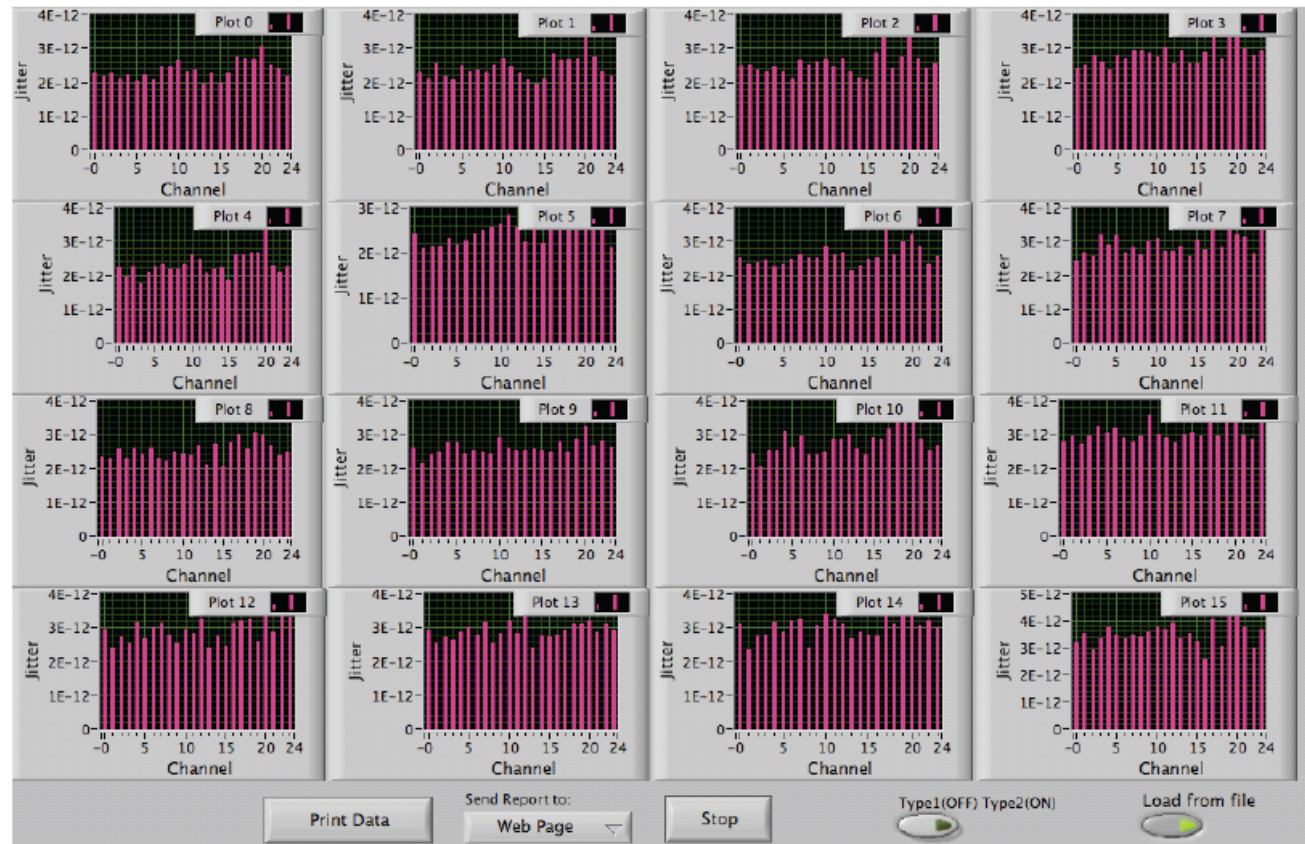
**7 ps**

Front end card plugged  
into interface card

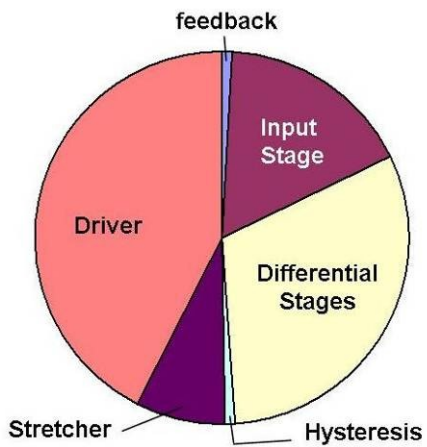
**14 ps**

Front end cards  
plugged into interface  
card that is connected  
to mrpc strip

**21 ps**



# Power



	Input stage	Feedback	Differential stage	Hysteresis	Stretcher	Driver
Channel Rin = 50 Ω	1 mA × 2 <b><u>2 mA</u></b>	<b><u>100 μA</u></b>	920 μA × 4 <b><u>3.68 mA</u></b>	<b><u>92 μA</u></b>	<b><u>Off: 920 μA</u></b> <b><u>On: 950 μA</u></b>	<b><u>5 mA</u></b>
Channel Rin = 30 Ω	1.8 mA × 2 <b><u>3.6 mA</u></b>	<b><u>100 μA</u></b>	920 μA × 4 <b><u>3.68 mA</u></b>	<b><u>92 μA</u></b>	<b><u>Off: 920 μA</u></b> <b><u>On: 950 μA</u></b>	<b><u>5 mA</u></b>
Bias Cell Rin = 30 Ω Rin = 50 Ω	N1/N2/N3/P1 <b><u>2 mA</u></b> <b><u>3.6 mA</u></b>	N4/P2 <b><u>140 μA</u></b> <b><u>140 μA</u></b>	N5 <b><u>910 μA</u></b> <b><u>910 μA</u></b>	N7 <b><u>230 μA</u></b> <b><u>230 μA</u></b>	N8 <b><u>230 μA</u></b> <b><u>230 μA</u></b>	N6 <b><u>5 mA</u></b> <b><u>5 mA</u></b>

# NINO 130 nm proto not yet fully optimized

NINO13 CHIP in 130 nm CMOS technology		
Performance	LCO	HCO
Power consumption	250 $\mu$ W / channel	4 mW / channel
Discriminator threshold	1.5 to 5 fC	10 to 100 fC
Peaking time	800 ps	600 ps
Input resistance	2 k $\Omega$	30 to 100 $\Omega$
Front edge jitter	175 to 50 ps rms	25 to 6 ps rms
Detectors readout	Time-resolved hybrid pixel detectors	MRPC, Vacuum tubes (MCP-PMT), Solid-state photodetectors (SiPM...)
Applications	High Energy Physics (NA62)	HEP, Biotechnologies, Medical Imaging

