

Report on the LVD Experiment

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on behalf of the LVD Collaboration



1000 tons liquid
scintillator
neutrino
observatory
@
INFN
Laboratori
Nazionali
del Gran Sasso
(Italy)

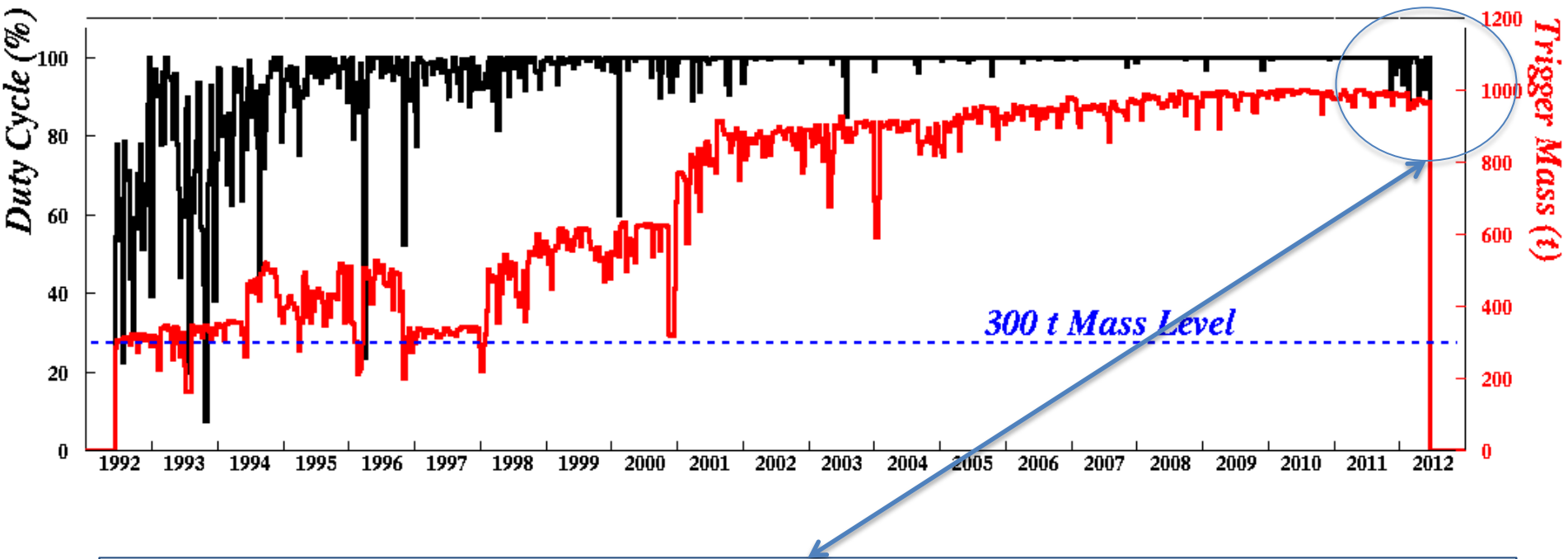


In operation since
June 1992
20 years on line

Designed to look
for ν bursts from
gravitational stellar
collapses in our
Galaxy

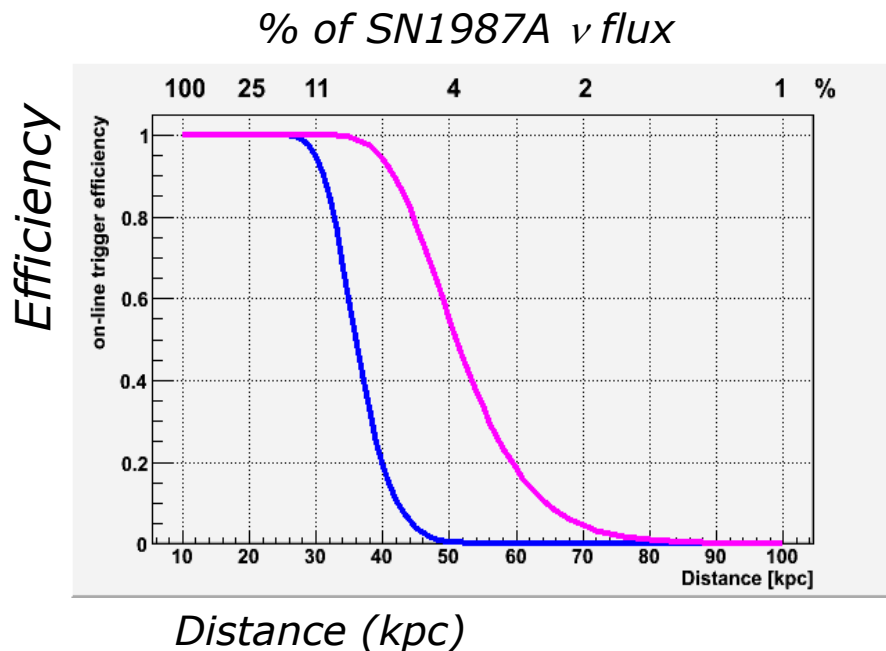
Feb-May 2012
Hardware upgrades
to measure the ν
speed in the CNGS
beam

EFFECTIVE DUTY CYCLE & ACTIVE MASS



Hardware upgrades for neutrino velocity measurement & Tests

SENSITIVITY TO NEUTRINO BURSTS



Triggers above 7 MeV

Triggers above 10 MeV

Full efficiency for supernova neutrino burst detection up to 30 kpc @ M=1 kton

Full efficiency for Milky Way SN Monitoring @ M>300 ton

For details see Ref.. *AstroParticle Physics* 28 (2008) 516-522

PUBLISHED RESULTS

| RUN | Since: | To: | Uptime [days] | Duty Cycle | Mass [tonn] | PUBLISHED |
|---------------|-------------------------------|-------------------------------|--------------------------|-----------------------|------------------------|----------------------------------|
| RUN 1 | Jun 6st 92 | May 31st 93 | 285 | 60% | 310 | 23rd ICRC 1993 |
| RUN 2 | Aug 4th 93 | Mar 11st 93 | 397 | 74% | 390 | 24th ICRC 1995 |
| RUN 3 | Mar 11th 95 | Apr 30th 97 | 627 | 90% | 400 | 25th ICRC 1997 |
| RUN 4 | Apr 30th 97 | Mar 15st 99 | 685 | 94% | 415 | 26th ICRC 1999 |
| RUN 5 | Mar 16st 99 | Dec 11th 00 | 592 | 95% | 580 | 27th ICRC 2001 |
| RUN 6 | Dec 12st 00 | Mar 24th 03 | 821 | 98% | 842 | 28th ICRC 2003 |
| RUN 7 | Mar 25st 03 | Feb 4th 05 | 666 | >99% | 881 | 29th ICRC 2005 |
| RUN 8 | Feb 5th 05 | May 31st 07 | 846 | >99% | 936 | 30th ICRC 2007 |
| RUN 9 | Jun 1st 07 | Apr 30th 09 | 699 | >99% | 967 | 31st ICRC 2009 |
| RUN 10 | May 1st 09 | Mar 27th 11 | 696 | >99% | 981 | 32nd ICRC 2011 |
| Σ | Jun 6 1992 | Mar 27 2011 | 6314 | | 721 | All Data |

**90% C.L. Upper Limit to gravitational stellar collapses in the
Galaxy is
0.13 /year**

**Whole data set reprocessing & refined analysis on going
a summary paper of LVD results in SN monitoring**

MEASURING THE NEUTRINO TOF WITH LVD

On the ΔS CERN-LNGS EXP.Ts Distance

New independent measurement in cooperation with Borexino & Icarus groups

On the ΔT measurements

Absolute Timing

- Upgrade of LVD present system (New 40 MHz oscillator / New Synchronism)
- A new system (at LNGS site) developed in collaboration with Borexino & Icarus Experiments fully independent from OPERA one
- White Rabbit System -> Finally installed @ LNGS in May 2012

Transit Time & Fluctuation

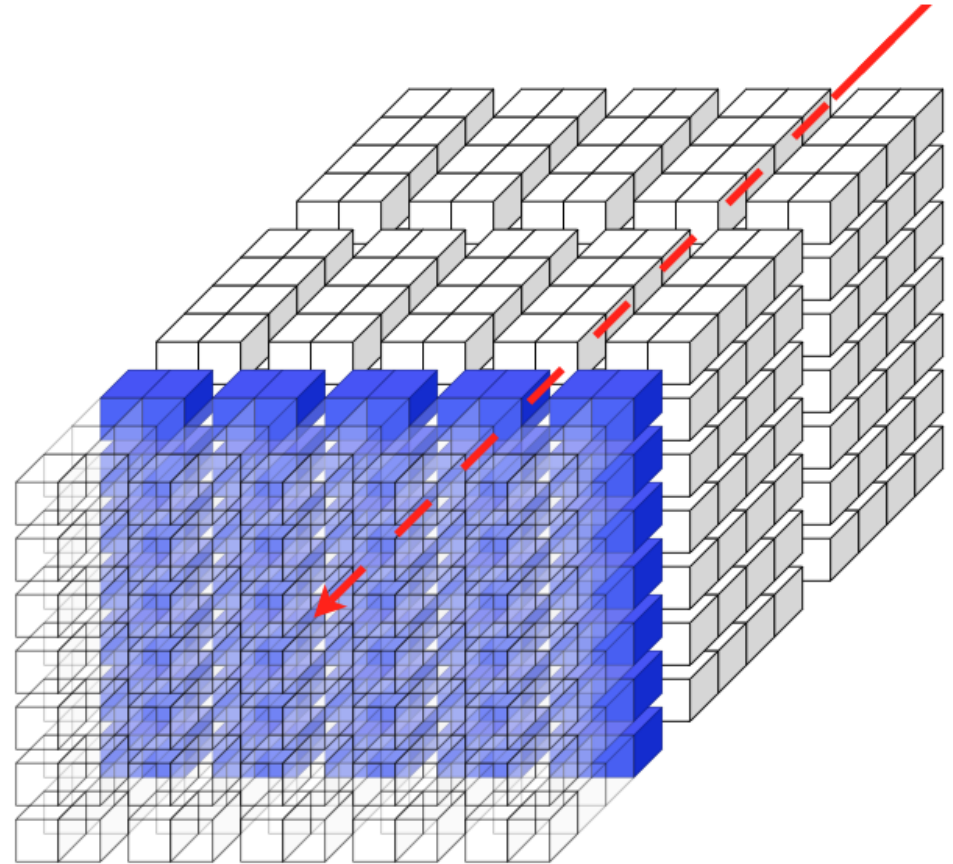
- Upgrade of LVD present system (counter transit time by atmospheric & CNGS muon analysis)
- The LVD SUPER-SET

THE LVD SUPERSET

- 58 Counters equipped with a calibrated fast LED / Almost a full wall in Tower 3
- Delayed Central PMTs (+20 m cable) to generate the 3-fold coincidence
- A new trigger has been realized in parallel with the standard one
- Better time performance → External TIC (Time Interval Counter)
- Direct measurement of the transit time and its dependence on the amplitude of the signal
- Partially independent and faster electronics

7% of the whole array

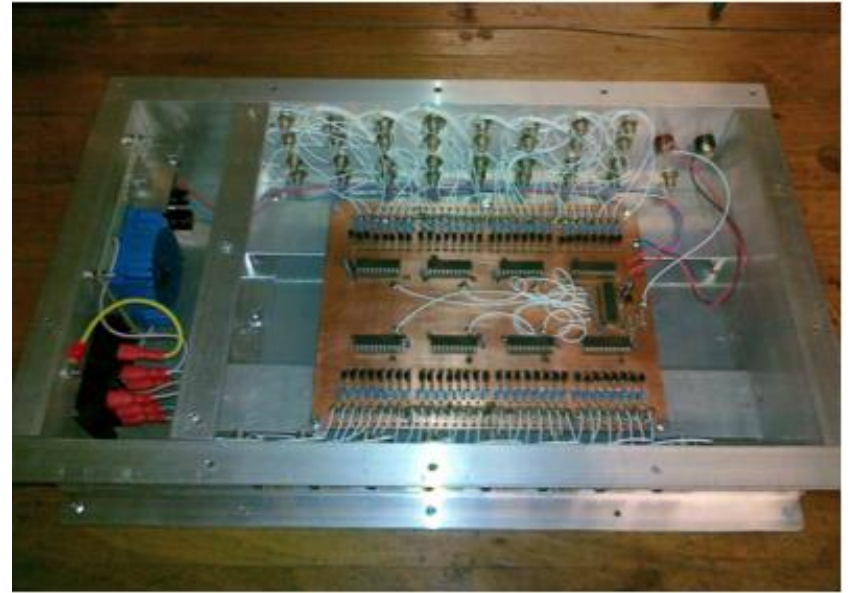
40% geometrical efficiency on CNGS muon



THE LED SYSTEM

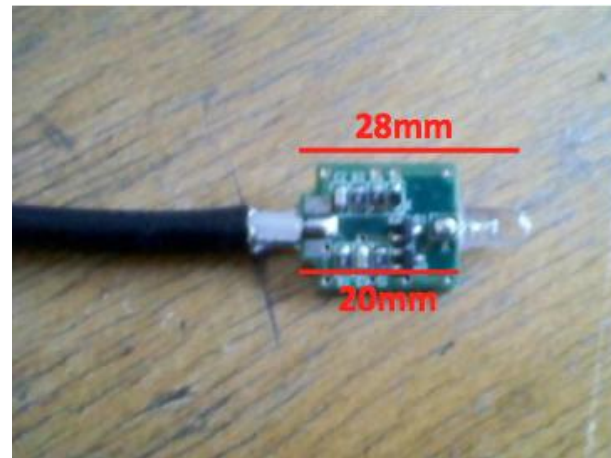


LED Cable Distribution

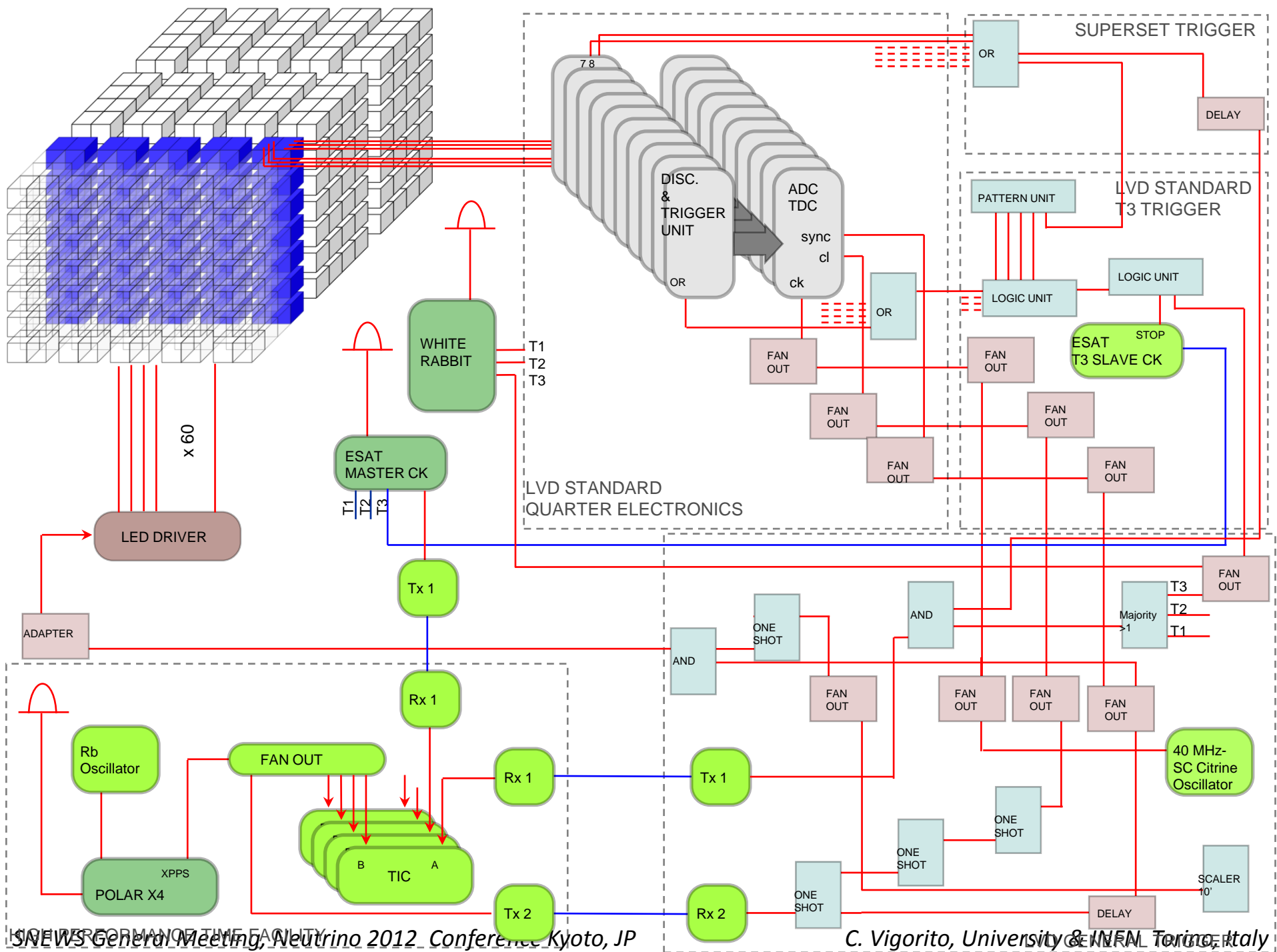


LED Driver Box

Timing Spread of 64 flasher channels $\sim 500\text{ps}$

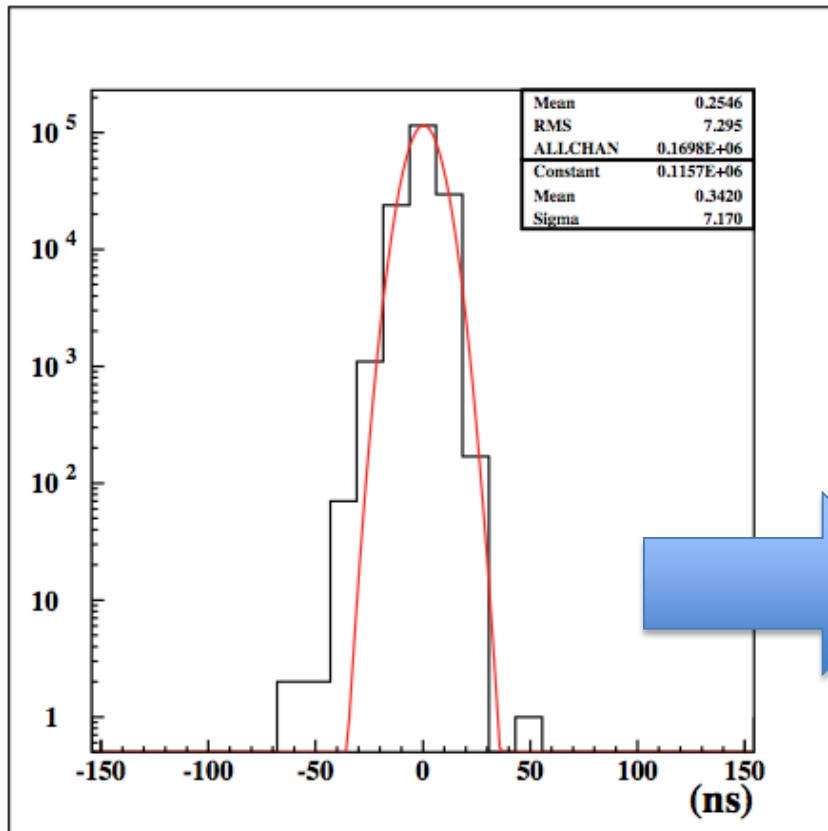


Measured Trigger-Light Emission Delay $\leq 2\text{ ns}$

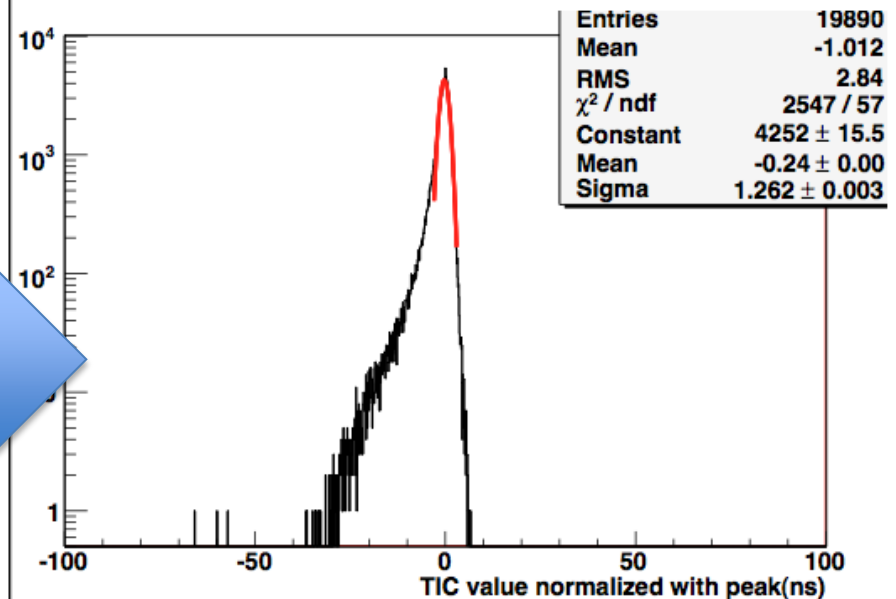


SUPERSET-RELATIVE TIME RESOLUTION

Subset response (LED,58 Counters) by
LVD standard electronics
Relative Resolution r.m.s. ~ 7 ns

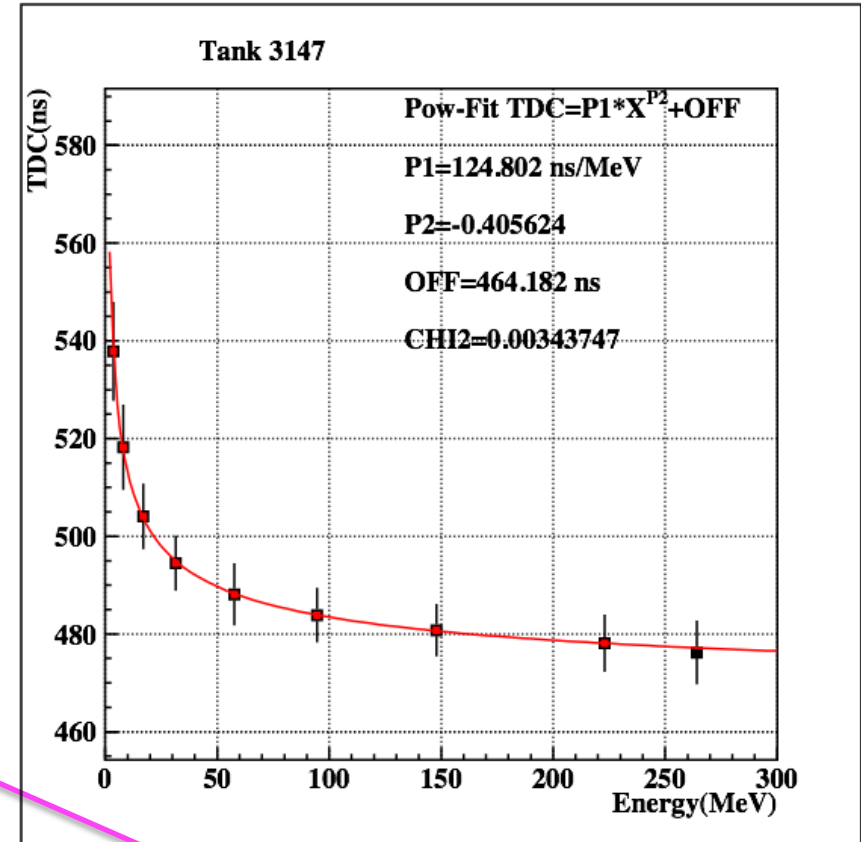
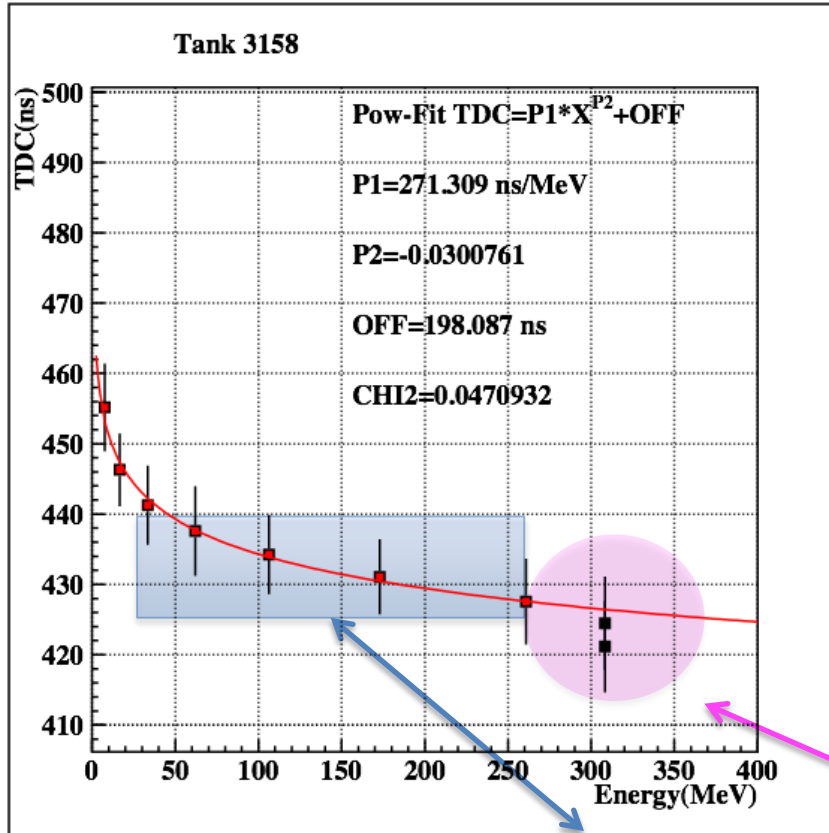


Subset response (LED,58 Counters) by
TIC
Relative Resolution r.m.s. < 3 ns



SUPERSET - SINGLE COUNTER TRANSIT TIME

Transit time as a function of the released energy.

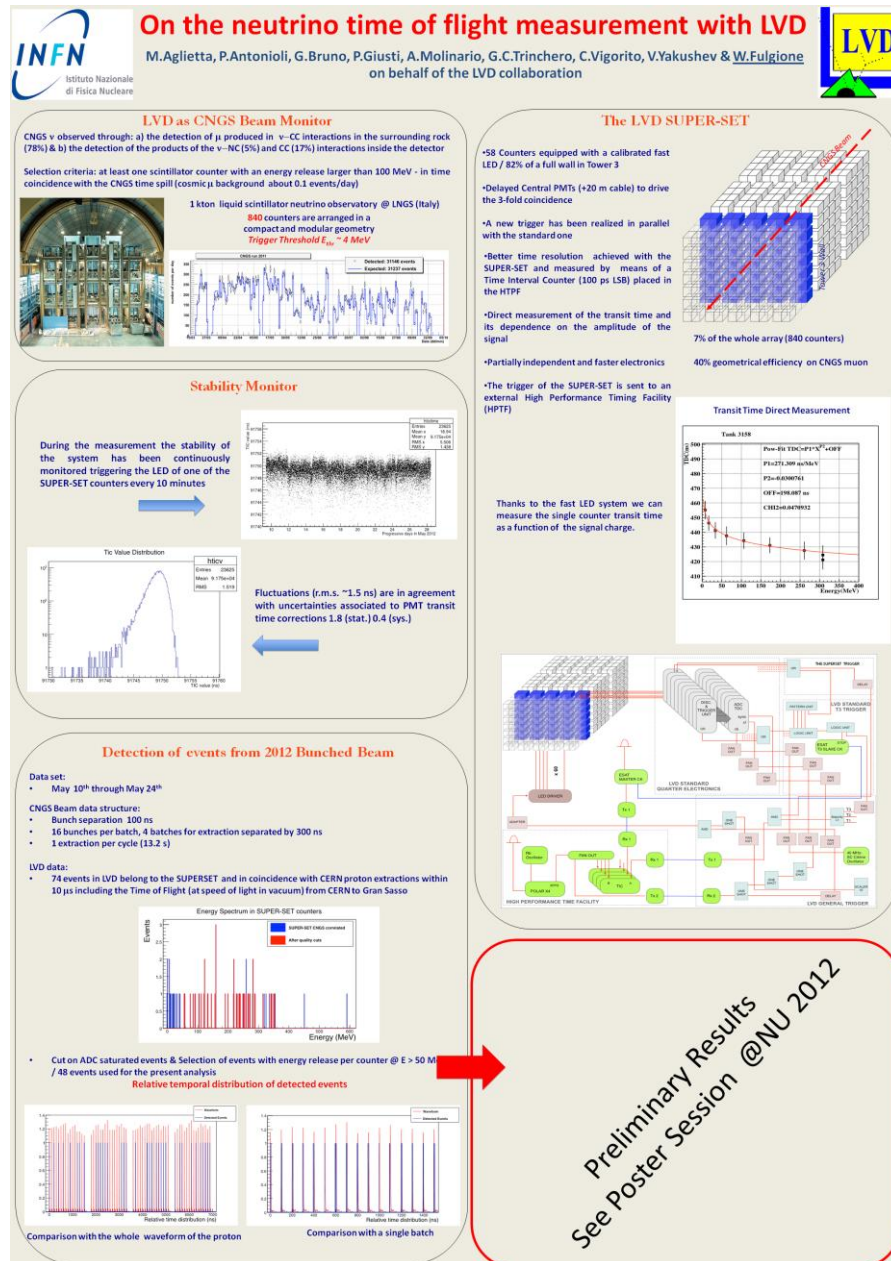


Typical CNGS muon range (100-200 MeV energy release)

ADC saturation effect

PRELIMINARY RESULTS SEE POSTER

Poster Session 3
ID 159



THAT'S ALL!

THANKS