# LAr ionization with UV laser

Report on the on-going activity

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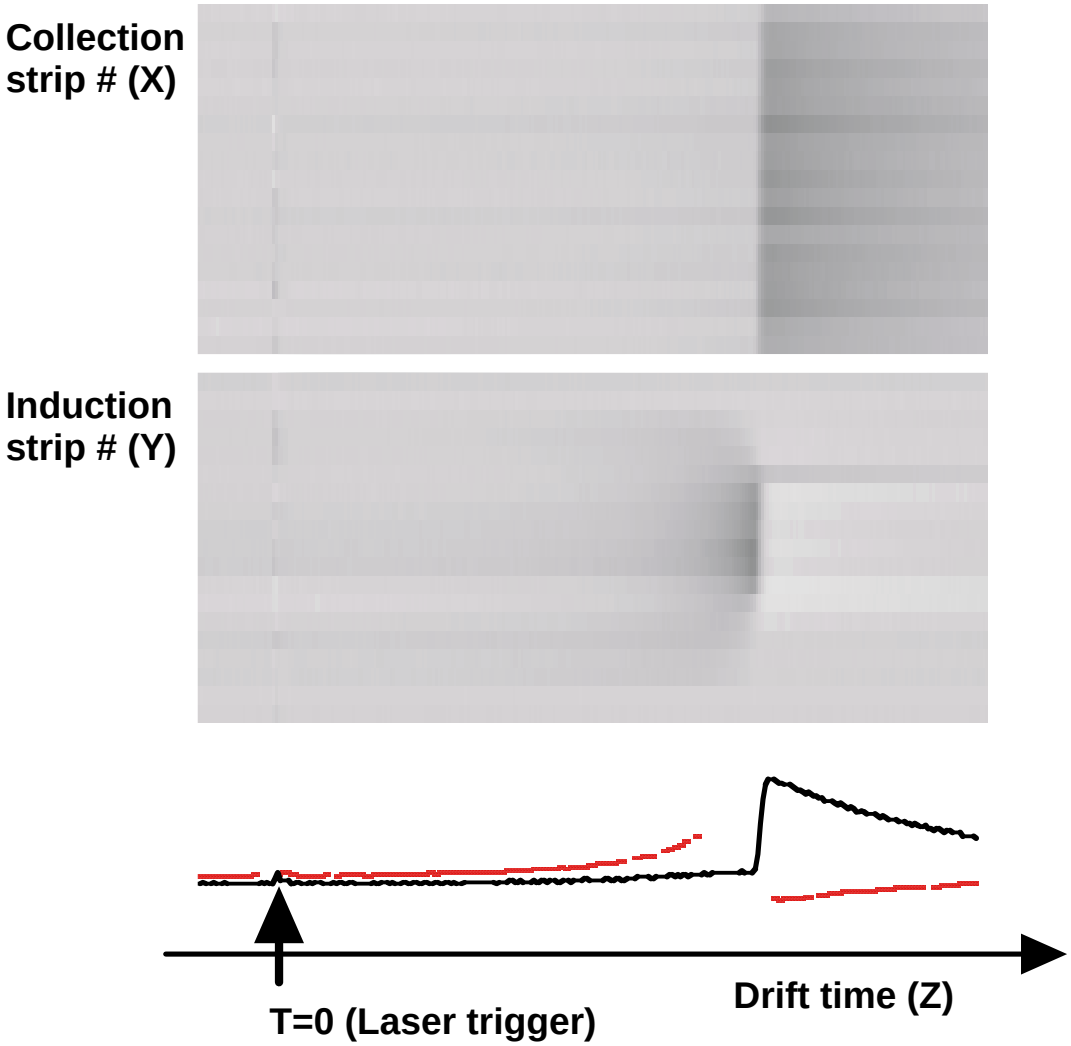
• R&D study to realize a UV-laser system for ICARUS T1200

• Goal: detector calibration and monitoring of LAr purity through generation of long straight tracks (known $T_0$ and position)

• Starting point: interpretation of existing data from early studies within ICARUS: J. Sun et al., NIM A **370**, 372 (1996)

# Laser produced ionization tracks

Nd-YAG laser 4$^{th}$ harmonic ($\lambda$=266 nm)




Useful to measure:

- electron drift velocity and diffusion
  (well known t=0)
- electron-ion recombination
  (isolated pairs)
- detector intrinsic energy resolution
  (no landau fluctuation)
- space resolution
  (no multiple scattering)

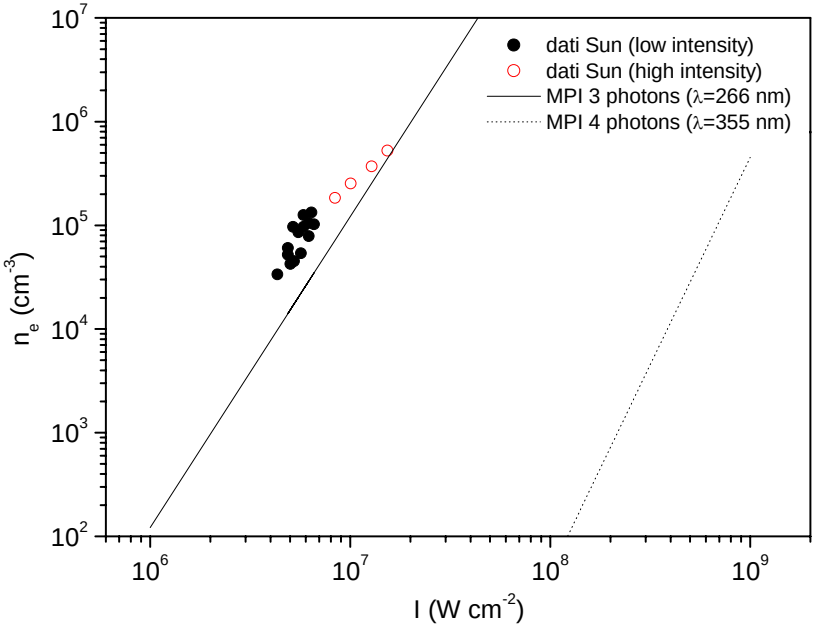
Production mechanism:

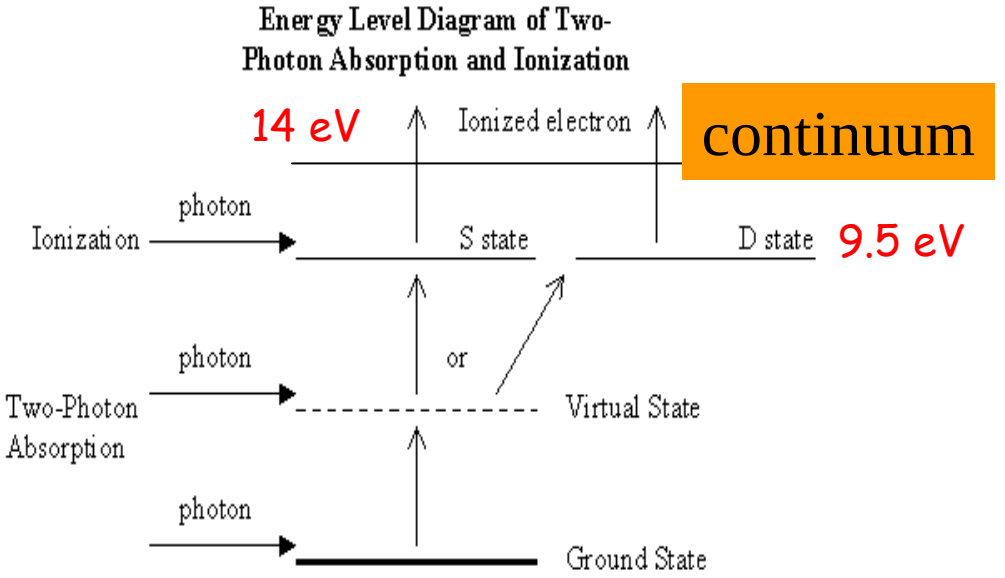
photon energy = 4.67 eV,

LAr ionization potential $\cong$ 14 eV

- coherent photo-absorption?

# Interpretation:
## multiple photon absorption



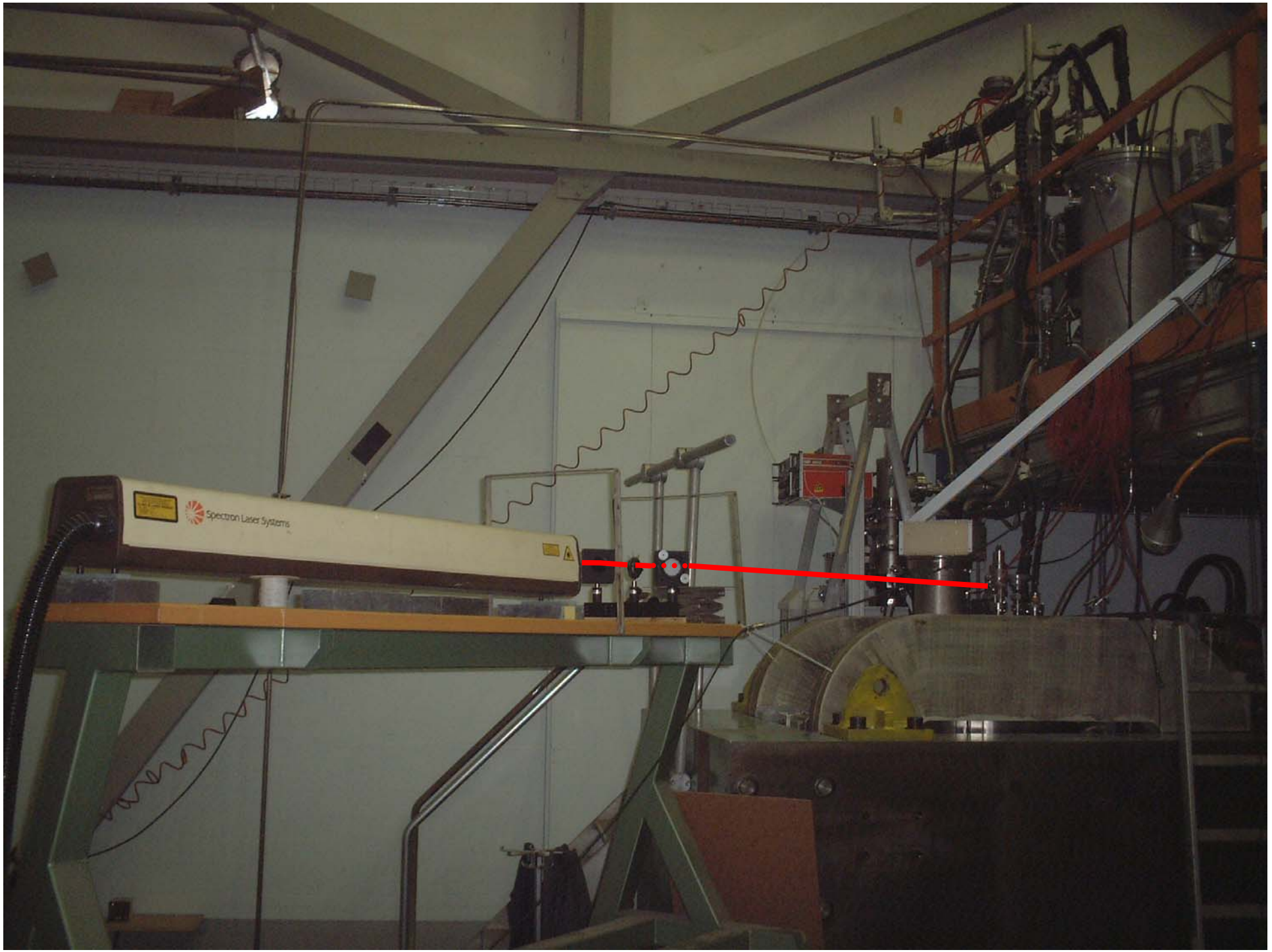

Classical formula: $$W(\mathrm{s}^{-1}) = 1.88\times10^{15}\,\lambda_{[\mu m]}^{2n_{\mathrm{ph}}-1}\,n_{\mathrm{ph}}^{3/2}\left[\frac{6.35\times10^{-14}\,I\left[\frac{\mathrm{W}}{\mathrm{cm}^2}\right]}{\mathrm{J_i}\left[\mathrm{eV}\right]}\right]^{n_{\mathrm{ph}}}$$

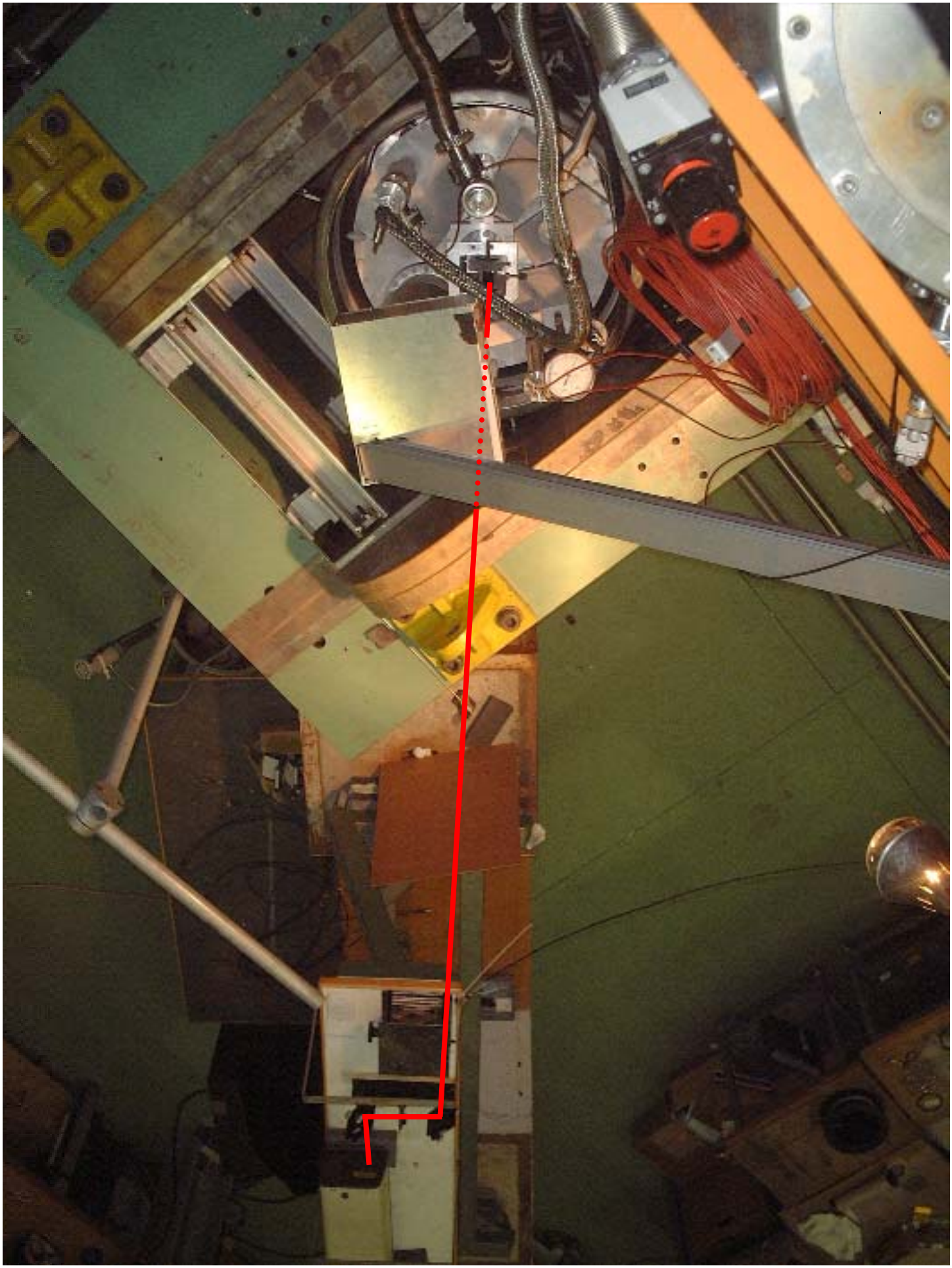
# New activity

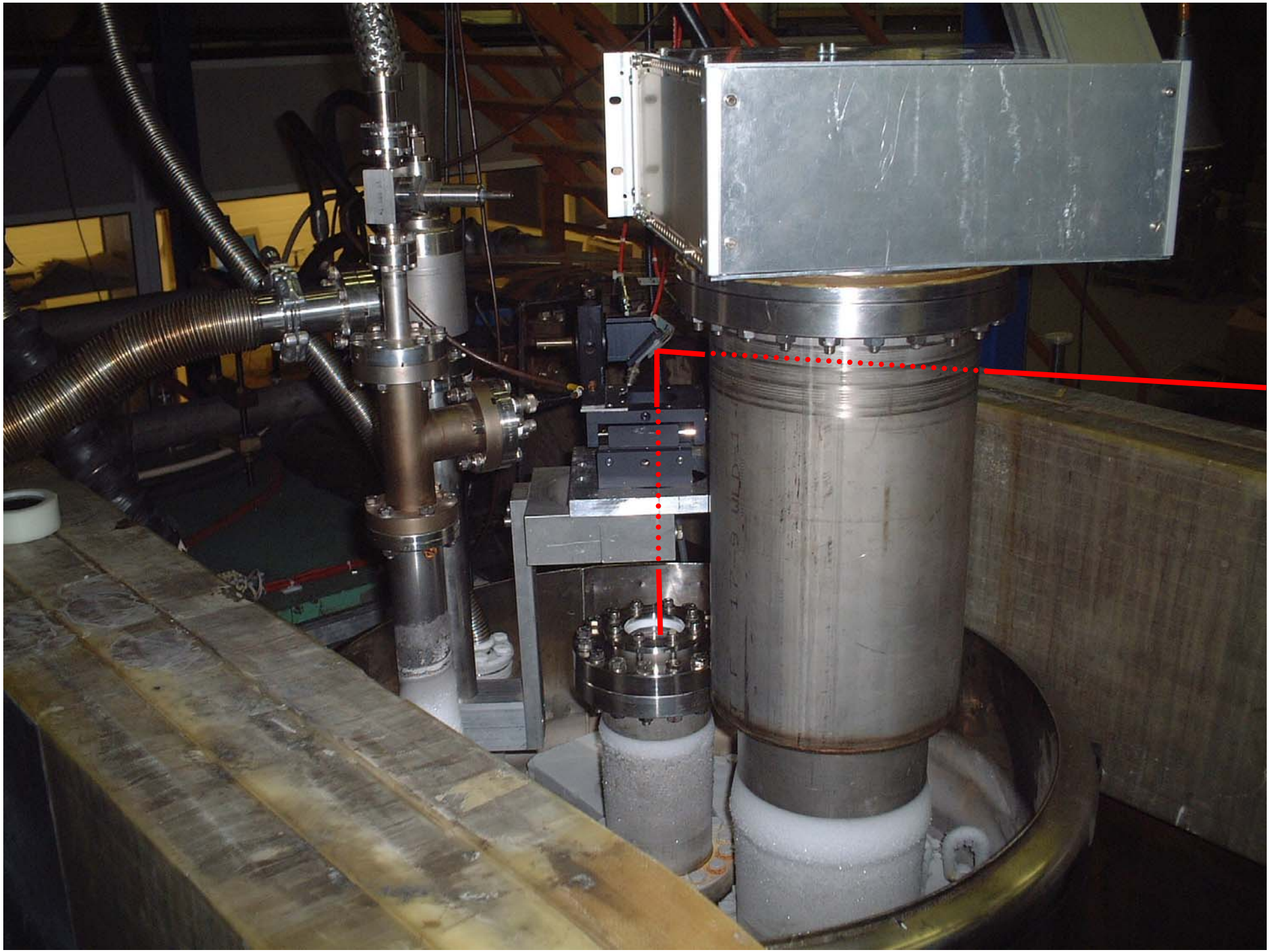
- Measurements with prototype detectors:
  - Assess the feasibility of the technique
  - Characterization of the laser beam propagation in LAr
  - Electron density measurements vs distance
  - Role of laser intensity and energy profile fluctuations

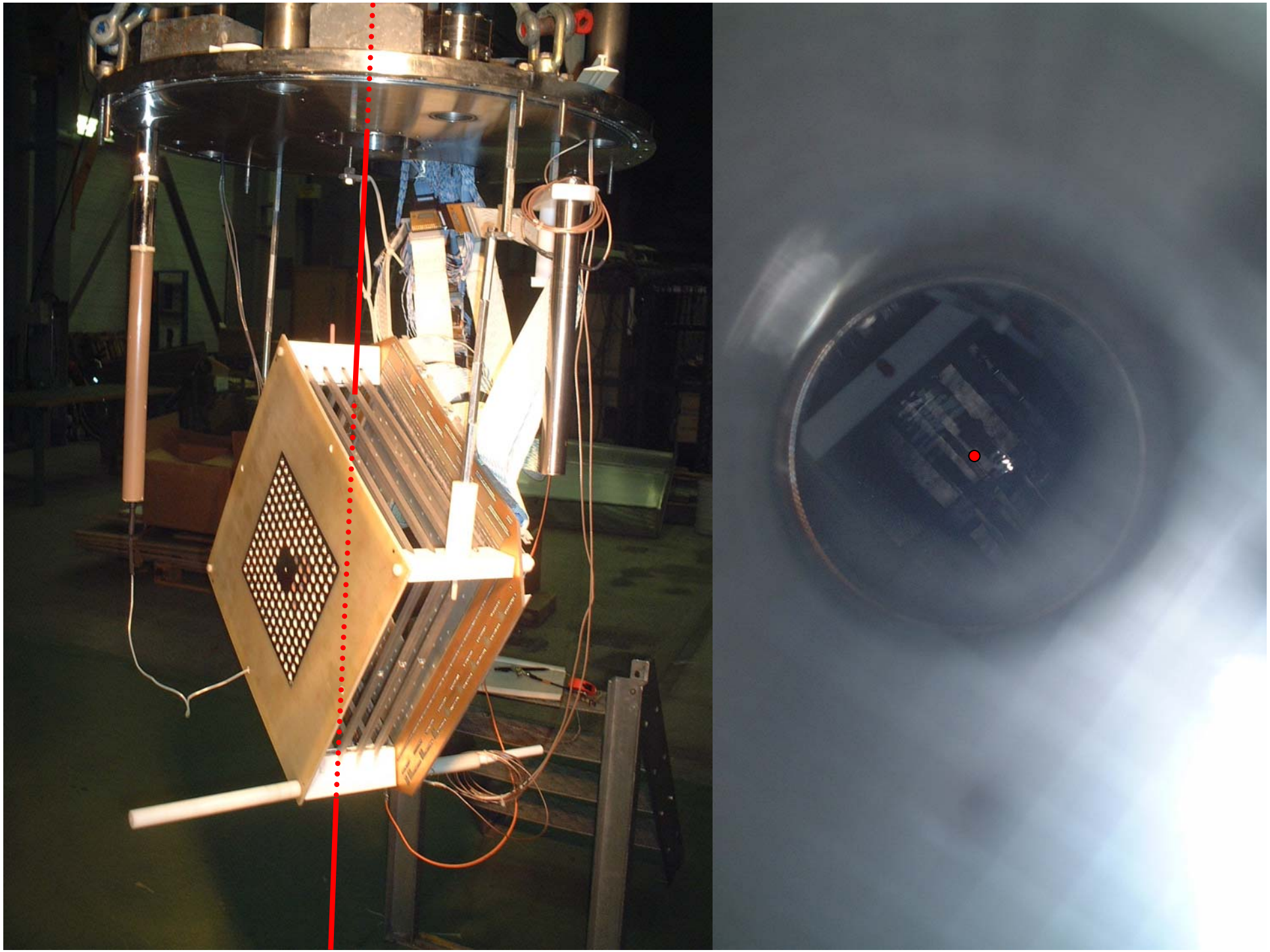
- First step:
  - Exploit the 50 liter LAr TPC and the
    Nd:Yag laser ($W_{max}$ = 4mJ / 5ns @ 266 nm)
    existing at CERN.

Presently under test


Spectron Laser Systems

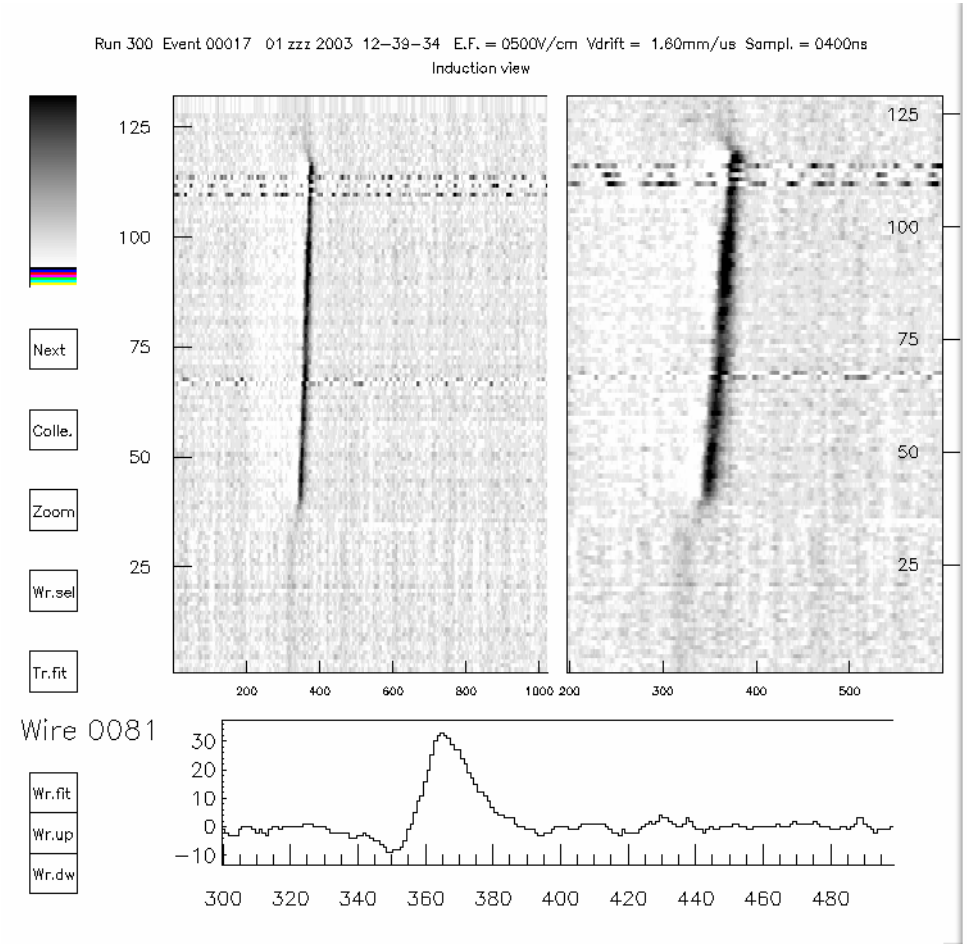


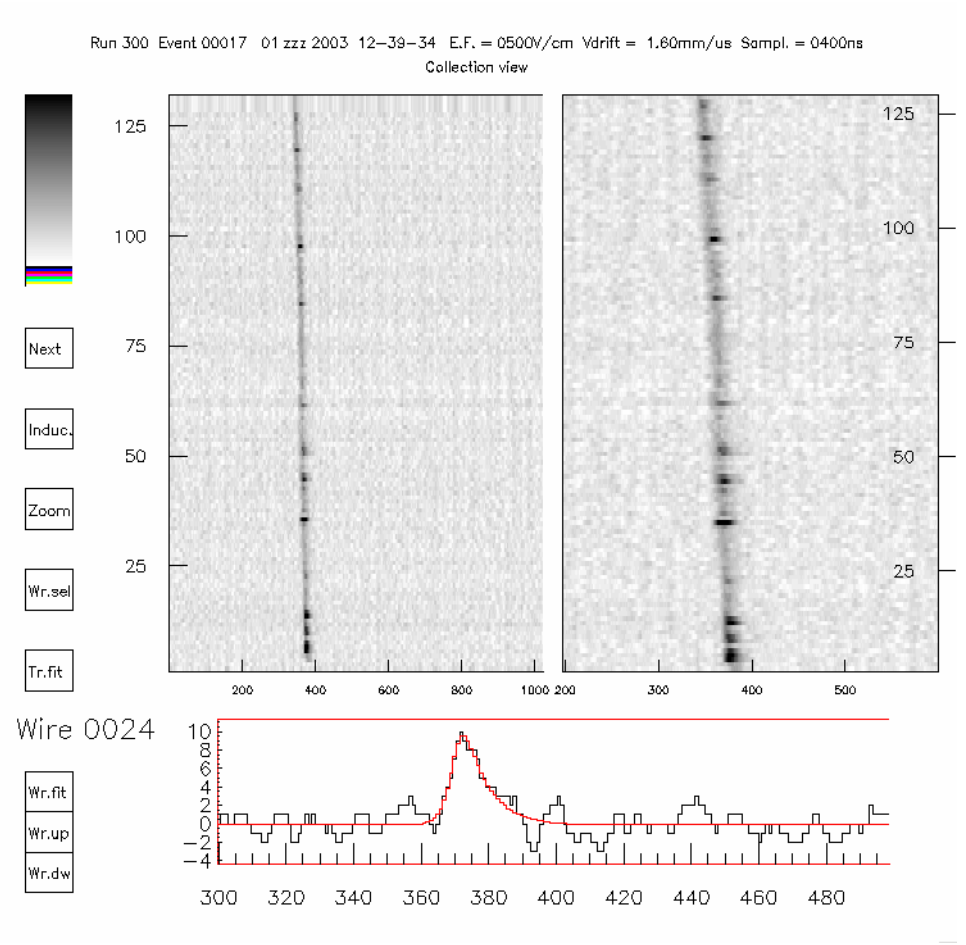




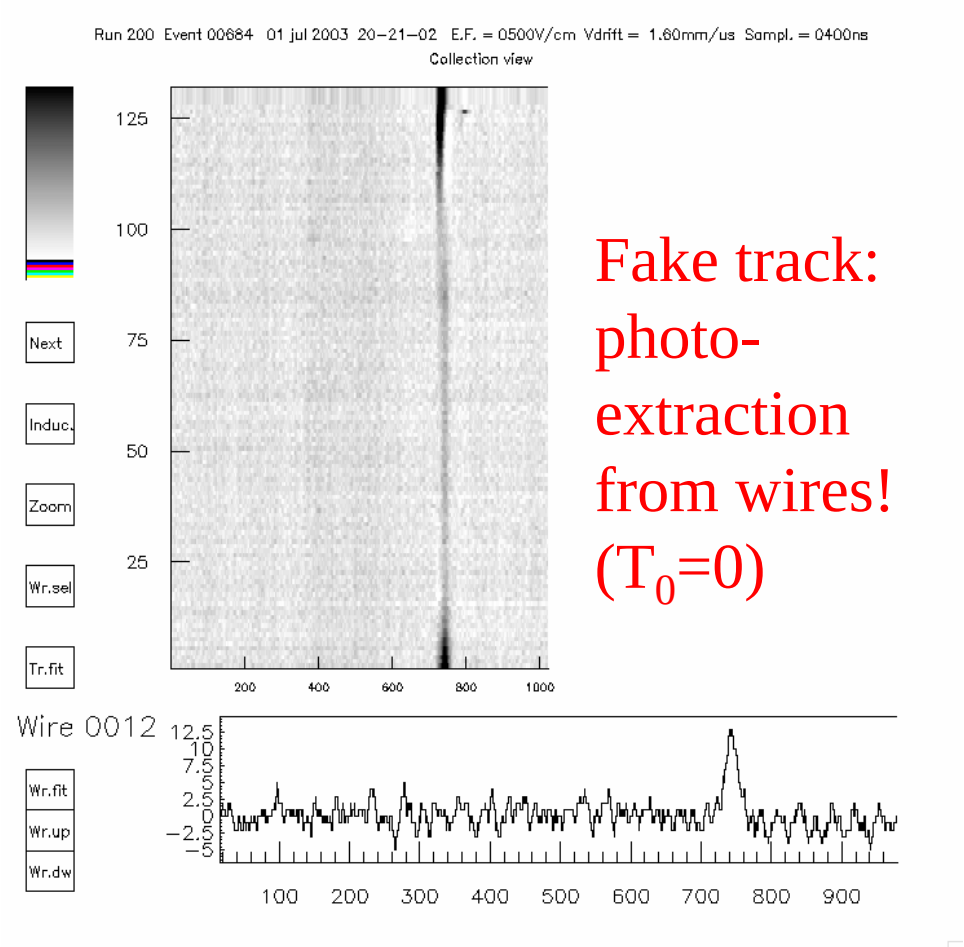
# A vertical muon track

## (simulating a Laser induced track…)



# Present status of the test

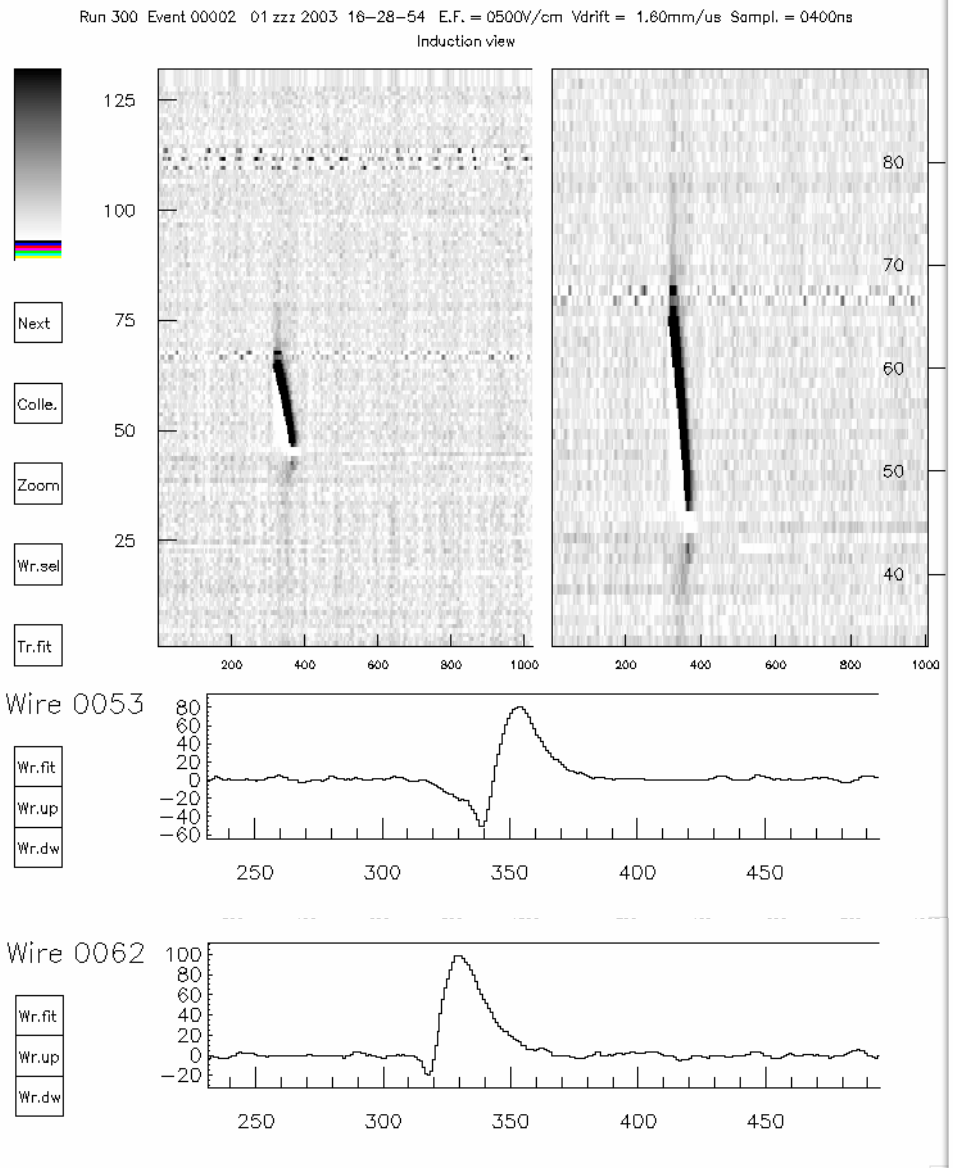


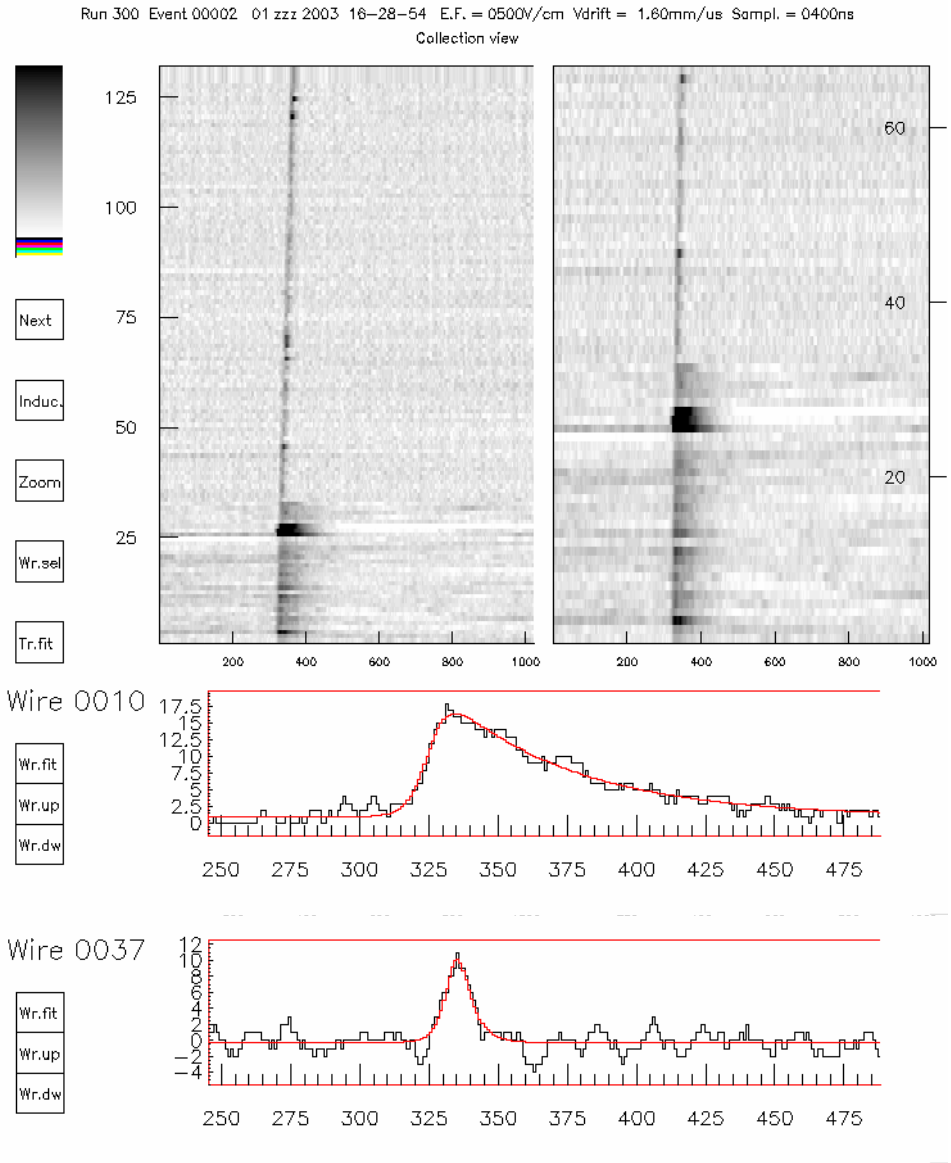

Fake track: photo-extraction from wires! ($T_0$=0)

- Alignment of laser and optics successful:
  - Laser beam crosses the chamber
- No LAr ionization track yet:
  - Laser energy too weak (<0.2mJ) due to damaged mirror (only 5% reflection)
- Repairs underway

# Ionization measurement:

## V791C vs V791Q



# A new signal flange

## (mounted and tested on the 50 liter TPC)