^{3}He polarized target for FAIR

Radiation of Radiation Damage effects in HCAL plastic scintillators

Cooling Strategies and Analysis Capabilities for Li-Ion Battery and ets.

^3He polarized target for FAIR

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National Science Center
Kharkov Institute of Physics and Technology

KIPT polarized target group

Development of polarized hydrogen, ^{3}He targets , and ets.

Development of high homogeneity magnetic field systems.

Investigation of polarized characteristics for γ **p**, γ **n**, γ **d**, γ ^{3}**He** reactions

Development of new polarized target materials

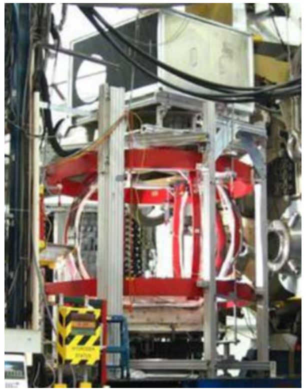
Collaboration with other laboratories

JOINT INSTITUTE FOR NUCLEAR RESEARCH

Movable polarized target

Jefferson Lab

^{3}He polarized target

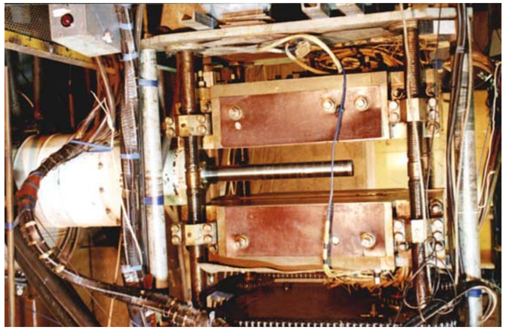


Institute for High Energy Physics

State Research Center of Russian Federation

Federal Agency on Atomic Energy

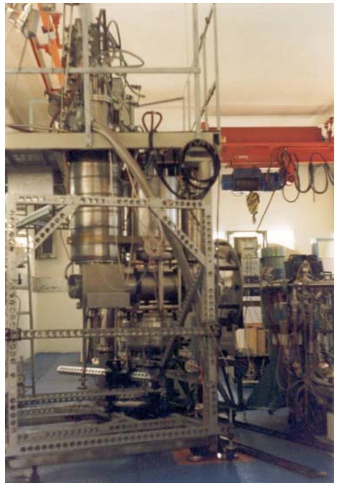
Proton and deuteron frozen spin polarized target



Universitas Carolina

Charles University in Prague

Deuteron frozen spin polarized target



KIPT polarized target

KIPT polarized target group

Spin Physics @ FAIR

Polarized experiments possible at FAIR

$\bar{p}_{beam} + 3He_{target}\uparrow$ Suggested in PANDA program

$p_{beam}\Uparrow + p_{target}$

Possible with add. effort at PANDA

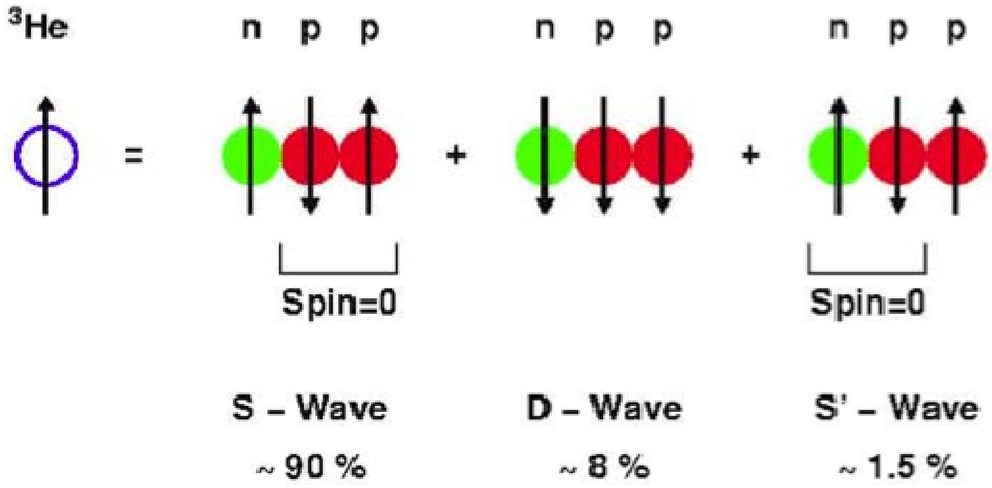
$p_{beam}\Uparrow + 3He_{target}\uparrow$

$\dots$

$\bar{p}_{beam}\Uparrow + p_{target}\uparrow$ Requires succes of pbar pol. + resolving problems at PANDA and/or add. detector (PAX)

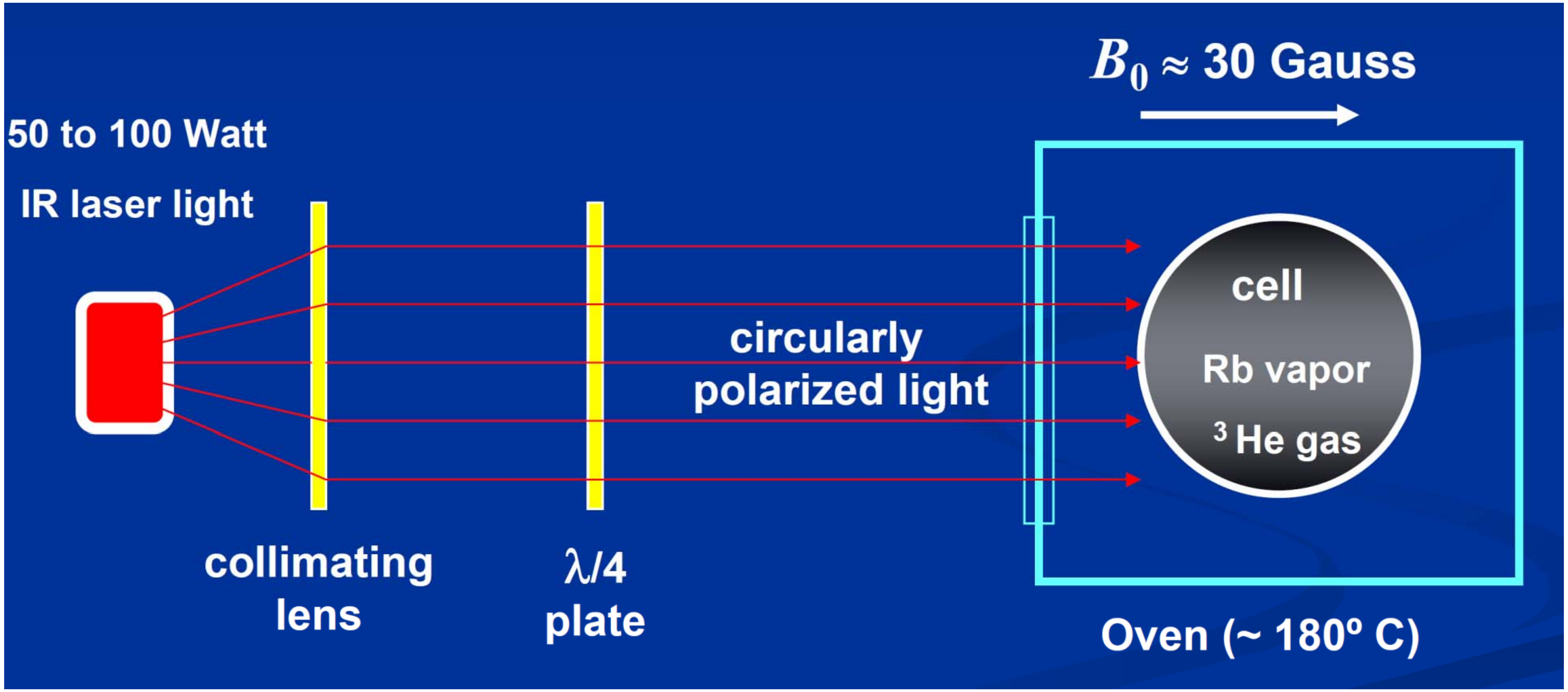
$\bar{p}_{beam}\Uparrow + p_{beam}\Uparrow$ Collider experiment. (PAX) +add. accel. (COSY-type)

$p_{beam}\Uparrow + e_{beam}\Uparrow$ Pol e collider. (add. e- acc.+storage ring) But: Improvement witrh respect to exisiting experiments (COMPASS/HERMES) requires high Luminosity → new project ()

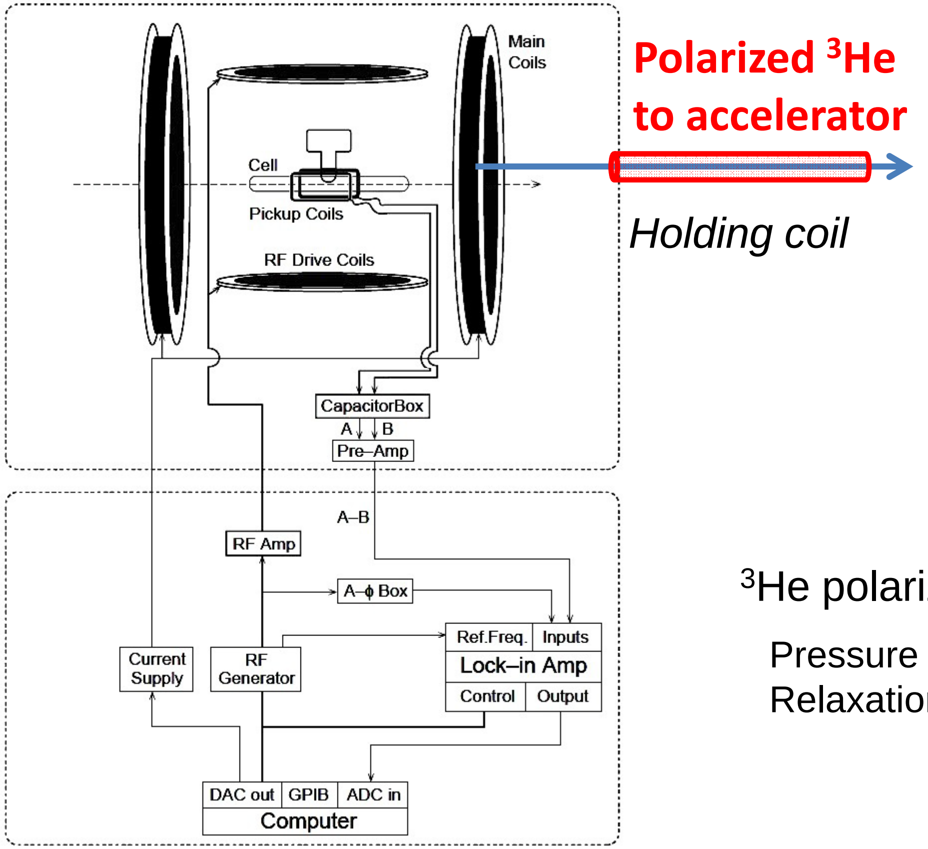


Neutron polarization ~ 86%

Schematic drawing of method

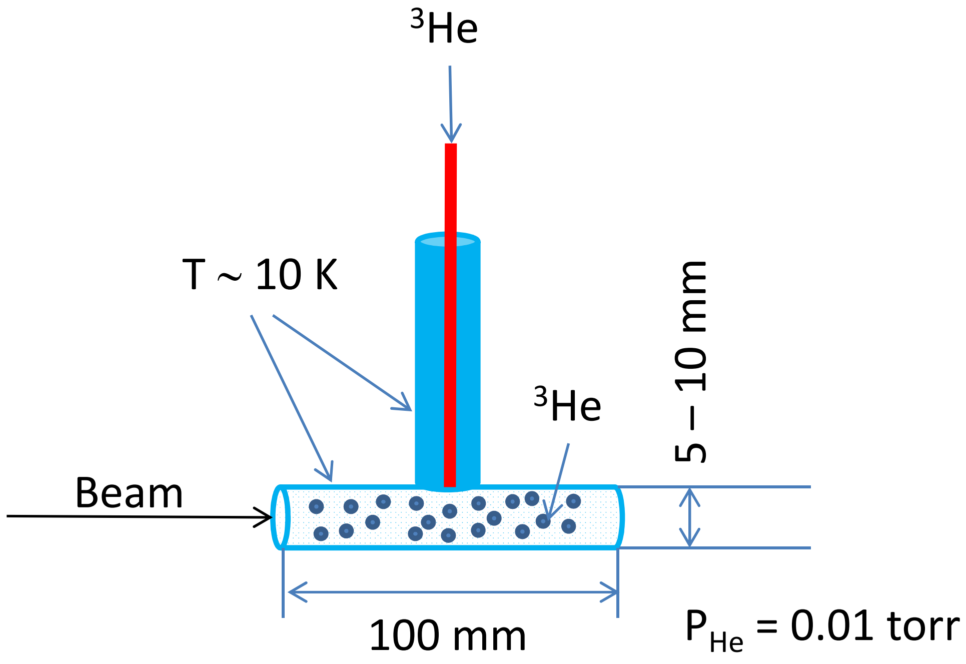


Polarized 3He target



^{3}He polarizations 40% - 50%

Pressure - 10 atm.
Relaxation time - 75 hours.



Effective target density - 4^{15} cm^{-2}

High luminosity - ~ 1 mm^3/sec (P_{He} = 1bar)

(luminosity of 2 x 10^{32} $cm^{-2}s^{-1}$ for 10^{10} $\overline{p}$)

The Summary:

We can design and build new type of ^3He target for PANDA.

RadDam studies at KIPT (Kharkov)

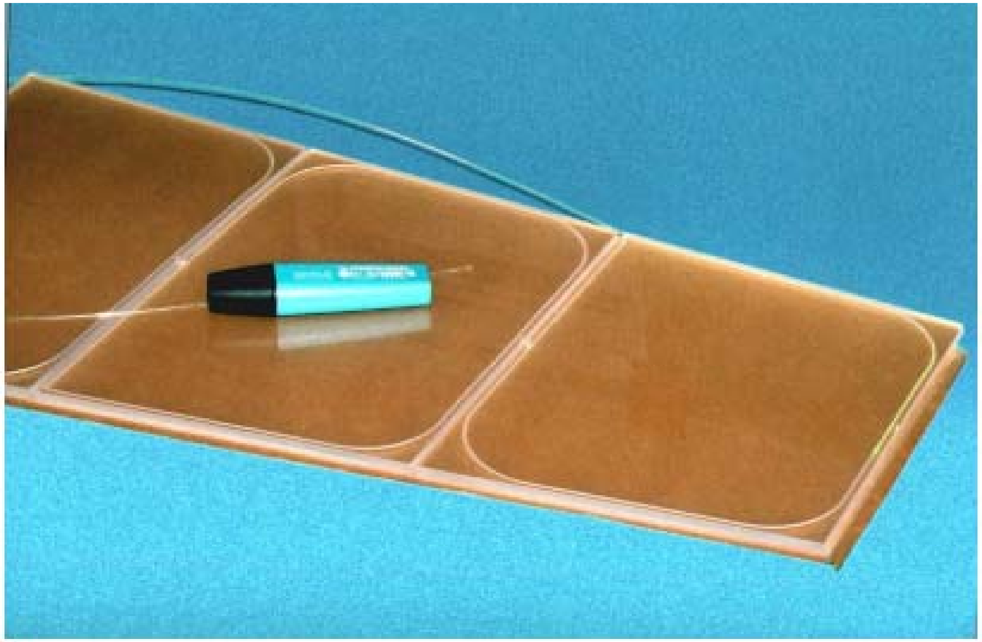
Leonid Levchuk, Alexander Lukhanin, Viktor Popov, Pavel Sorokin
Kharkov Institute of Physics and Technology (KIPT), Kharkov, Ukraine

Motivation

➢ HL-LHC sets new very hard radiation conditions on CMS forward calorimetry ⇒

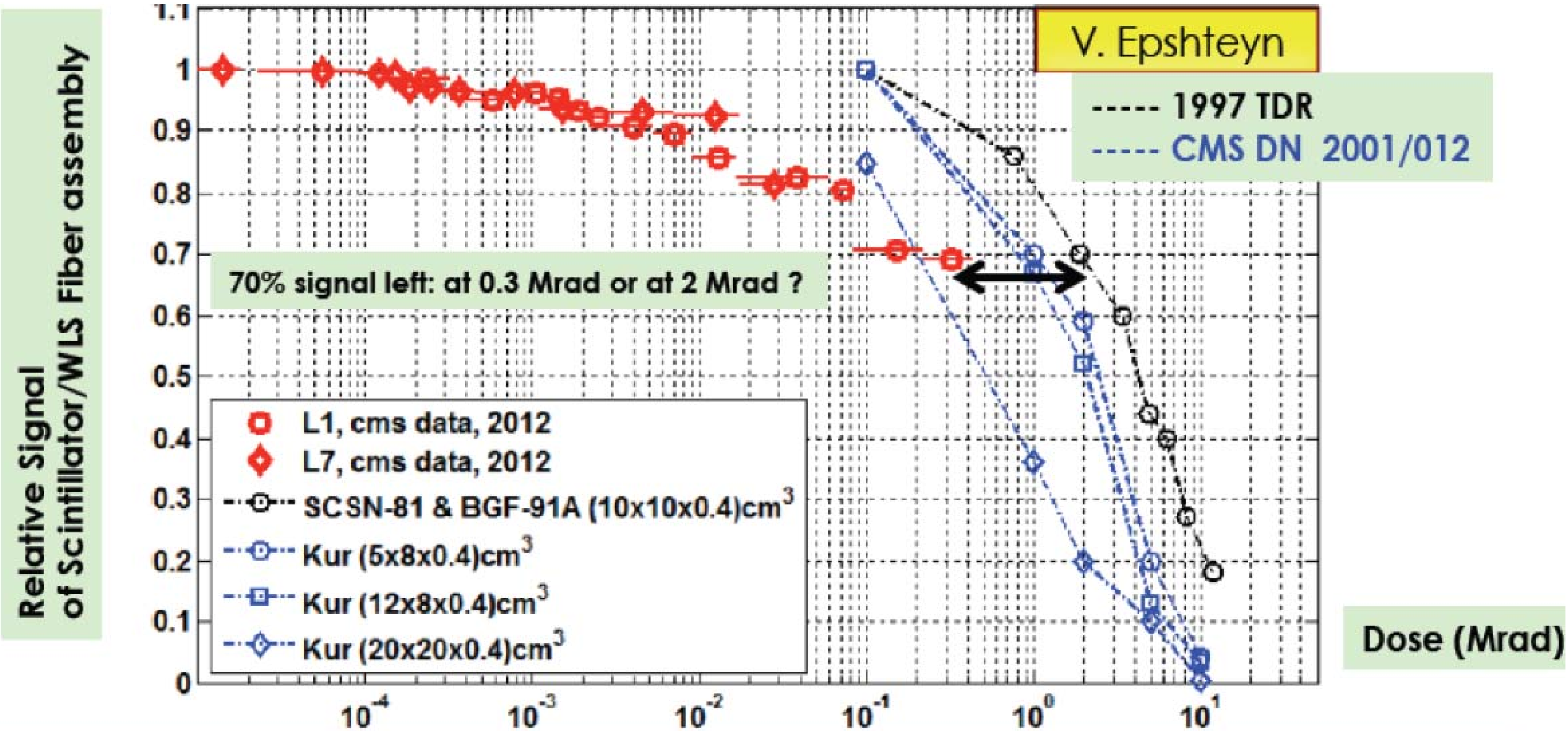
Can any new appropriate (and "cheap") radiation-resistant scintillators be found to replace the present SCSN-81 tiles for the HE rebuild option?

Scintillator tiles for CMS HE



~22000 tiles of SCSN-81 (Kuraray) – produced at ISMA (Kharkov) with quality control at KIPT (Kharkov) (done by 2002)

RadDam in HE after Run I

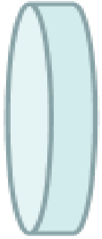


For CMS data at 22 fb^{-1} (Red points), dose is calculated using FLUKA simulation (M. Guthoff)

Measurements indicate considerable disagreement with estimates made prior to LHC startup (during HCAL TDR preparation)

Scintillator samples and irradiation facility

SCSN-81
32×32 mm^2, thickness 4 mm
Dose 1.7 Mrad & 4.3 Mrad
Dose rate 0.02, 0.12, 0.2 Mrad/h



SCSN-81
$\varnothing$30 mm, thickness 4 mm
Dose 10 Mrad
[similar to E.Biagtan e.a., NIM B93 (1994) 296]
Dose rate 730, 0.23, 0.018 Mrad/h

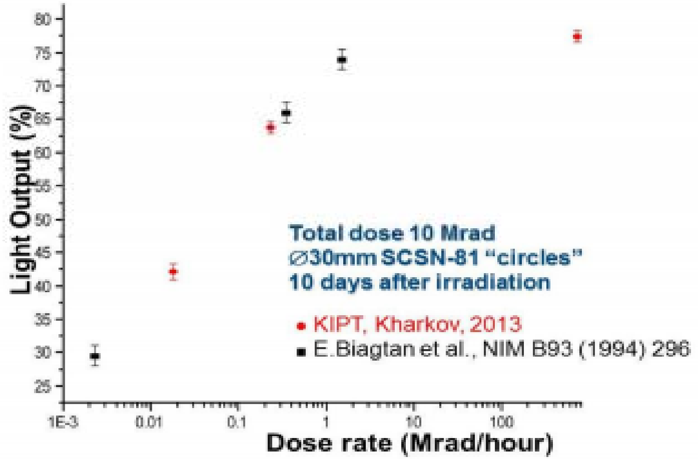
Samples were irradiated at KIPT 10 MeV linac (bremsstrahlung photons)

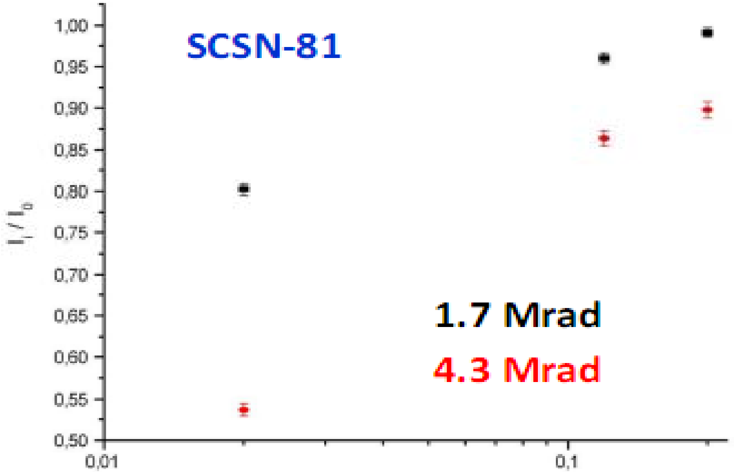
exact beam energy (from 9.1 to 9.4 MeV) – under control

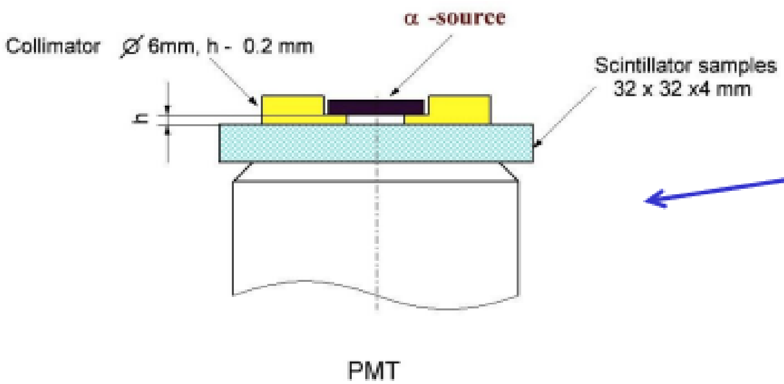
average beam current – 820 μA

accumulated doze – measured by Harwell Red 4034 dosimeters

Dose rate effect (KIPT, 2013)







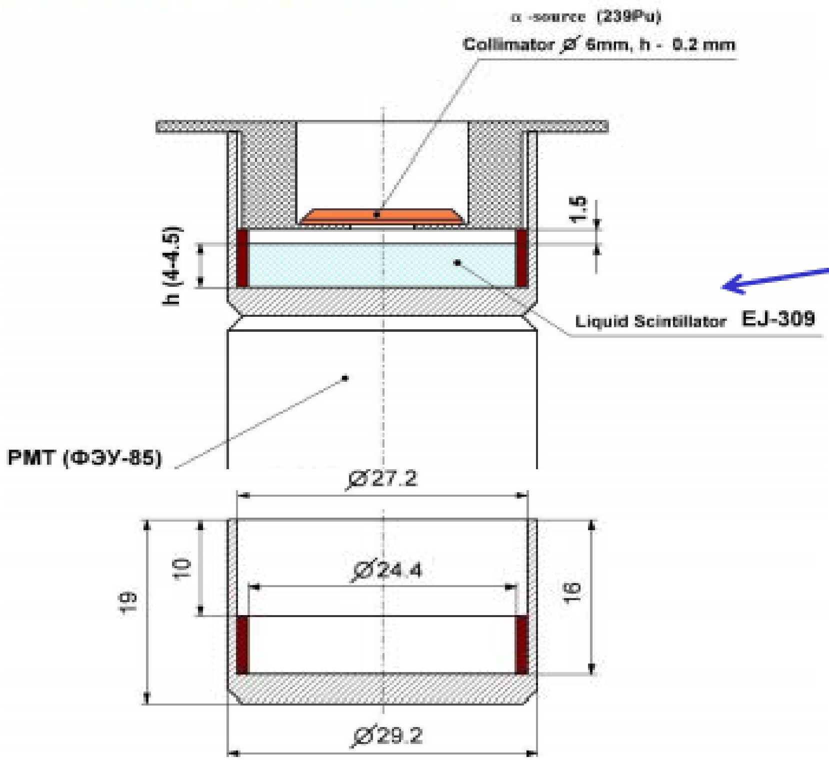
Light-yield measurement
Samples attached "directly" to PMT (no fiber);
α-peak position is measured

Can oxygen-free medium (N_2, Ar, etc.) suppress (or mitigate) the effect as suggested, e.g., in *E.Biagtan et al., NIM B 93 (1994) 296*

Rad resistance of liquid EJ-309

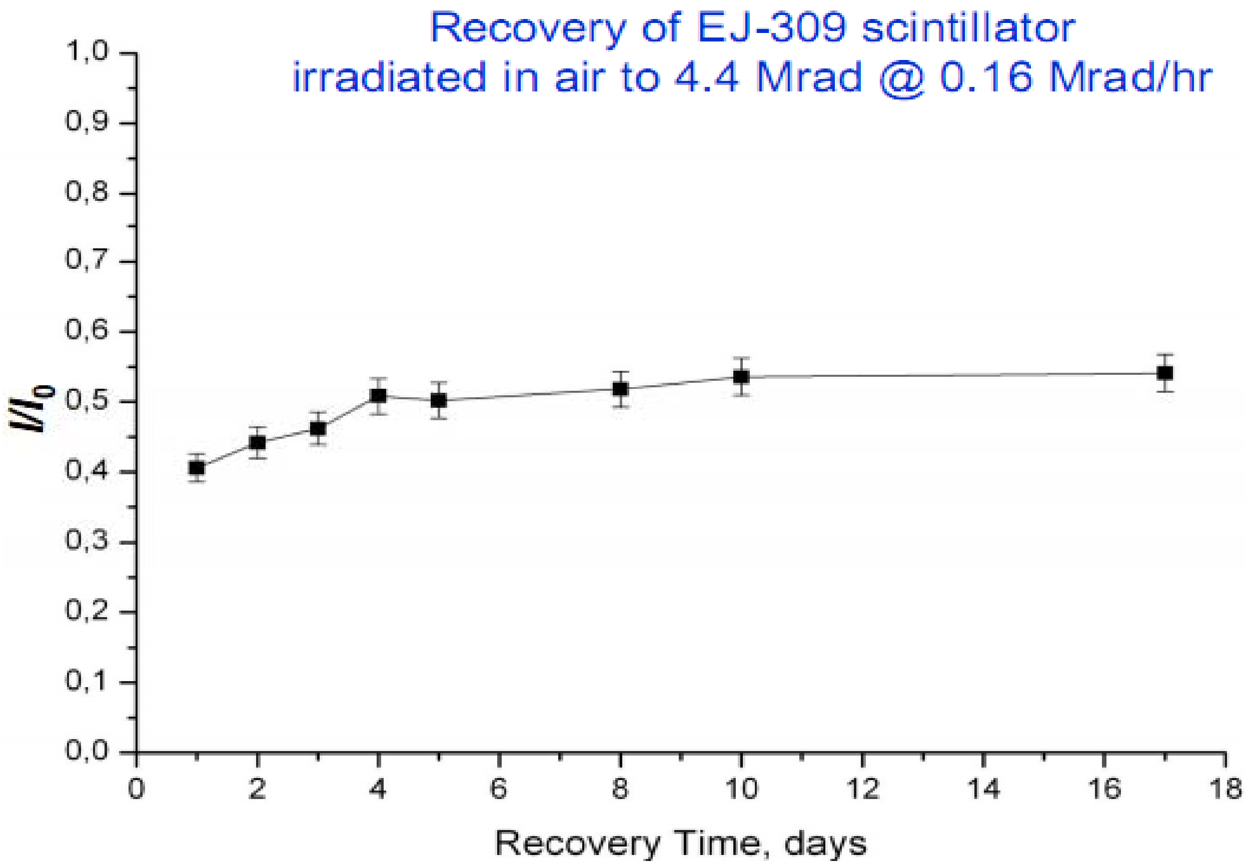
EJ-309 scintillator portion was irradiated inside glass bottle (wall thickness ~1.5 mm) by bremsstrahlung photons (energy up to ~10 MeV) to 4.40±0,05 Mrad @ 0.16 Mrad/hr

For light-yield measurements (before and after irradiation) it was poured into cylindrical vessel (scintillator size Ǿ30×4 mm; 1.5 mm gap between source collimator and EJ-309 surface) – see below



Light-yield measurement
Samples attached "directly" to PMT (no fiber);
α-peak position is measured

Rad resistance of liquid EJ-309



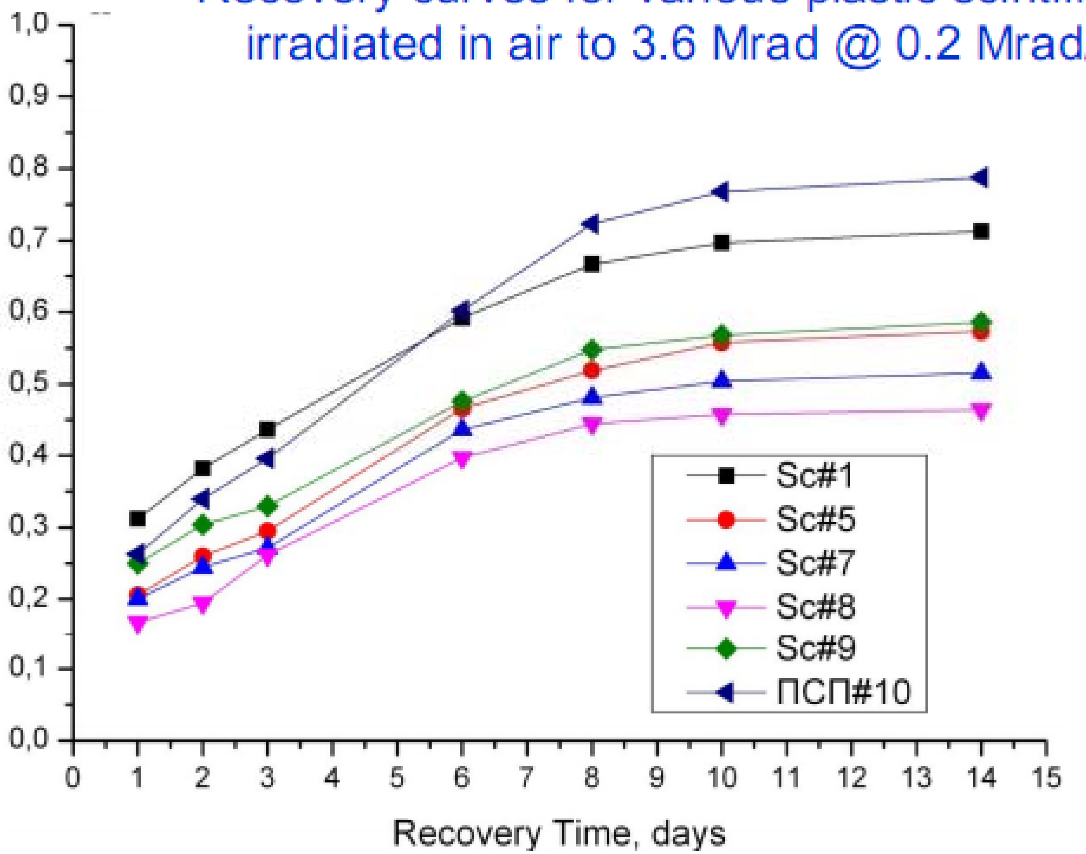
- **Recovery (if any) is very weak for EJ-309**
- **For 4.4 Mrad @ 0.16 Mrad/hr, LY from EJ-309 degrades by ~50 %**

EJ-309 was irradiated and recover in O_2 environment.

New “rad-hard” plastic scintillators

Intensive and extensive study of various new plastic scintillators developed at ISMA (Kharkov) is being carried out at KIPT.
~20 different samples are being studied right now

Recovery curves for various plastic scintillators irradiated in air to 3.6 Mrad @ 0.2 Mrad/hr



There is some progress, but no plastic scintillator has been found so far that could be surely recommended for HE @ HL-LHC conditions

The summary:

We can do light yield degradation test of your scintillation materials in different gases environments (such as O_2, N, Ar, ets.) and irradiate them with different doses and dose rates .

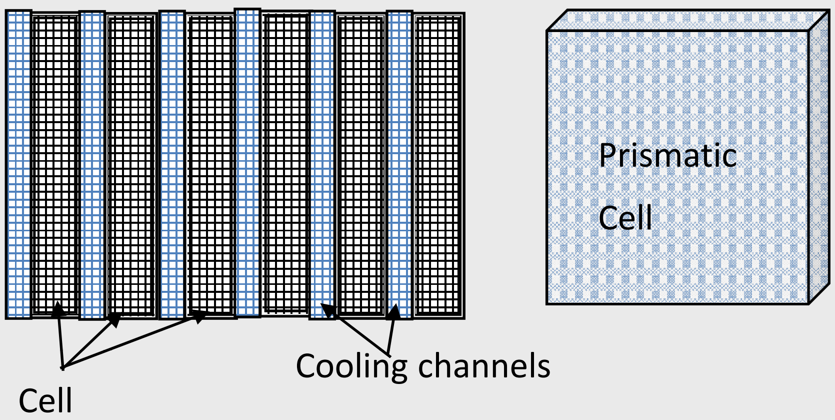
Cooling Strategies and Analysis Capabilities for Li-Ion Battery and ets.

Andrey Belyaev, Dmitriy Fedorchenko, Manap Khazhmuradov, Alexey Lukhanin,Oleksandr Lukhanin, Yegor Rudychev

Kharkov institute of physics and technology, Ukraine

Li-Ion Battery Cooling Strategies and Analysis Capabilities

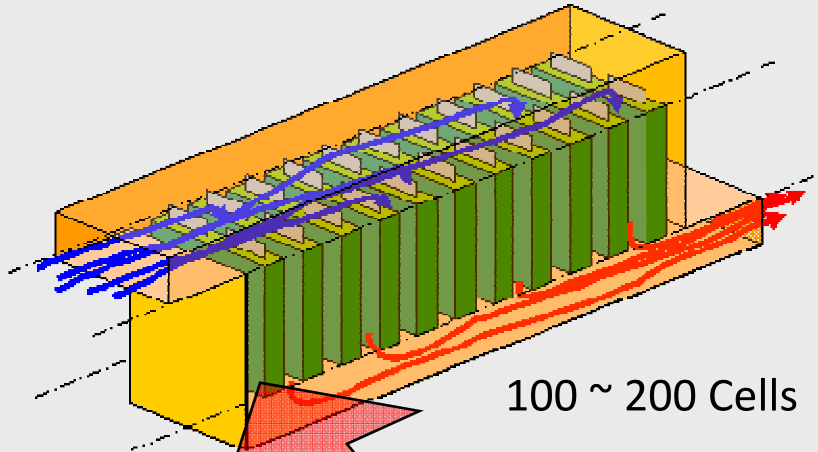
Detailed cell Level Airflow/Thermal Analysis



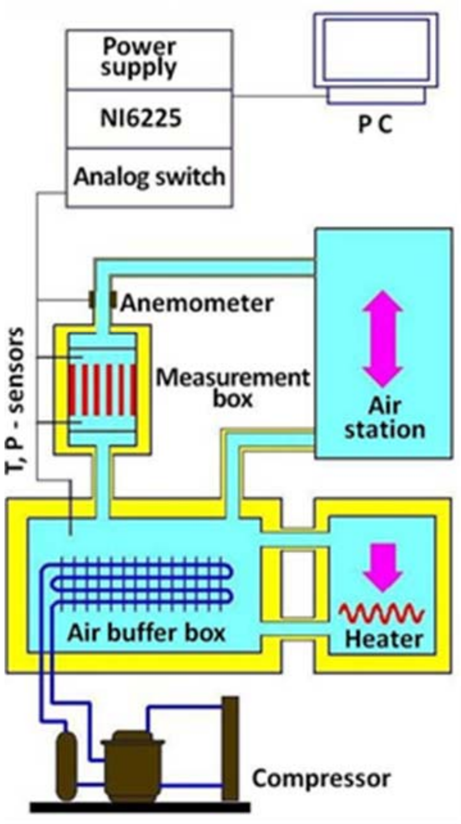
Cell Dimension

Height= 150~200 mm
Width= 100~150 mm
Thickness = 5 ~ 15 mm

Pack Level (Cells + manifold) Airflow/Thermal Analysis

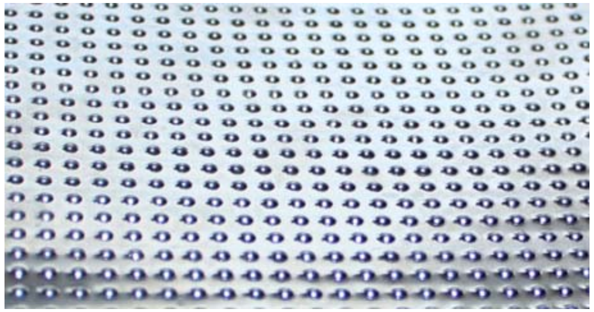


Experimental setup for the preset air flow temperature

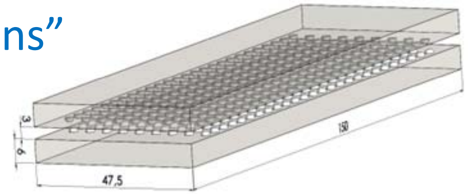


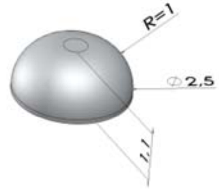
- Air flow temperature at the experimental chamber outlet ---------------- -20 - +50°C.
- Air flow volume -- 20 l/sec
- Output air flow temperature stability -- 0.2 °C.
- Output air flow volume stability of -- 1 %.
- The maximum cooling capacity of refrigeration unit ---------------------- 1500 Watt.

We did several experimental runs with different complex surfaces, such as:
“Filleted pins”, “Twisted Al ribbons” and ''One side open pyramids'‘.

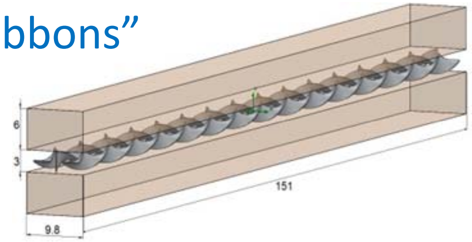


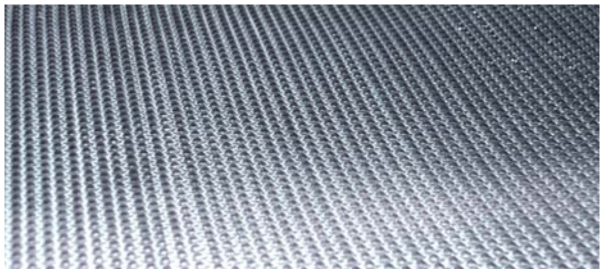
“Filleted pins”



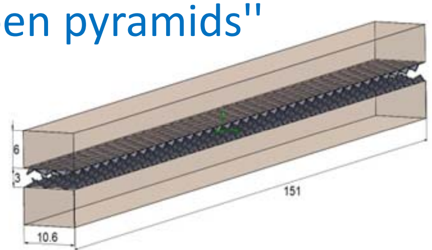


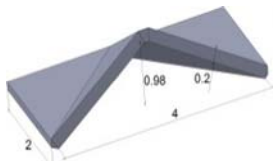
“Twisted Al ribbons”





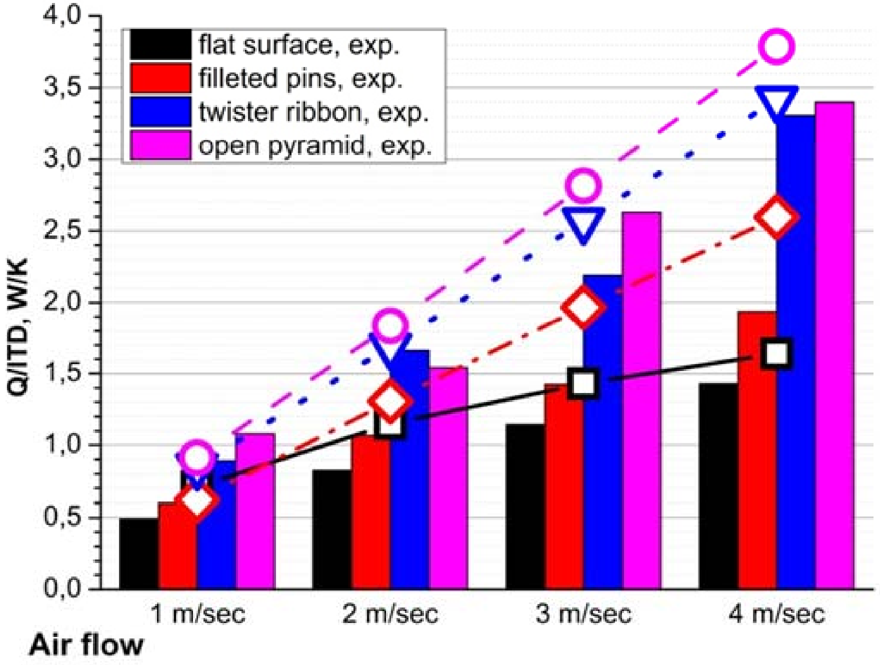
''One side open pyramids''



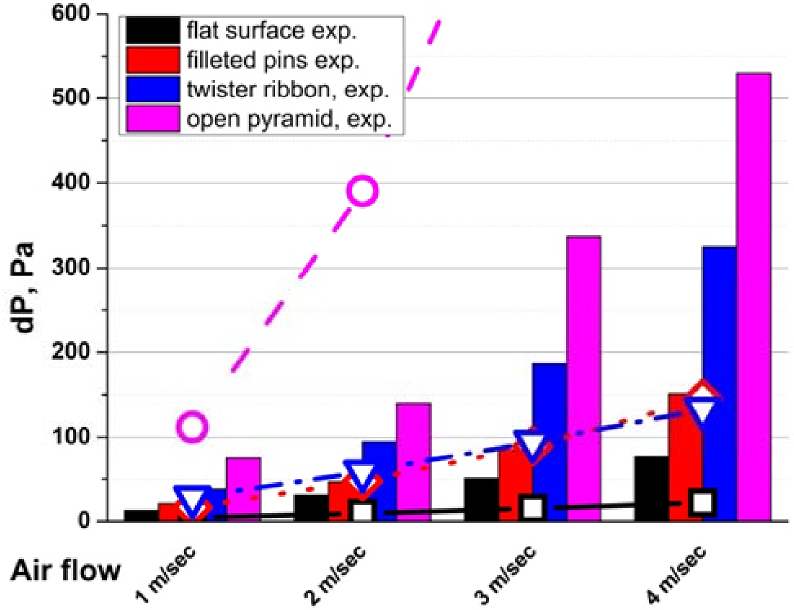


CAD model surfaces

EXPERIMENTAL RESULTS



The average cooling efficiency of different type of surfaces.



Pressure drop of air, as it passes through the assembly of simulators.

The lines with round dots show numerical simulation values.

□ - *“Flat surface”;*

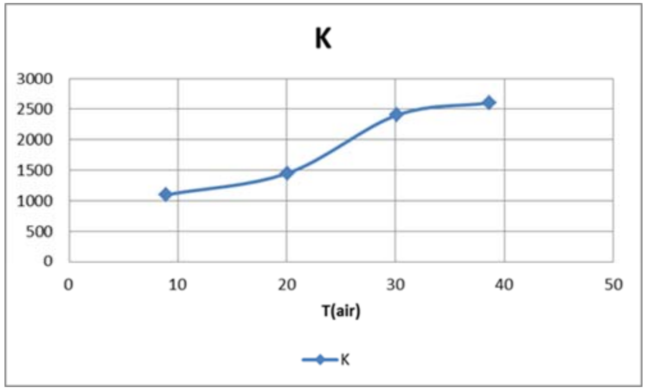
◊ - *“Filleted pins” surface;*

Δ - *“Twisted ribbons” surface;*

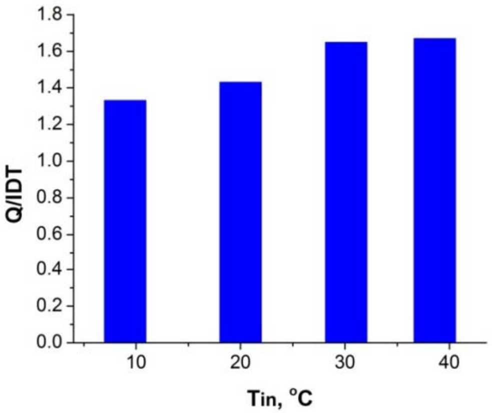
O - *“Open pyramid” surface.*

HEAT PIPE

The actual heat pipe photo.



Thermal conductivity heat pipe (W / m×K).



The cooling efficiency for heat pipe.

The summary:

We can design and build large varieties of environment managing systems for electronics and do electronic “crash test” in large varieties of temperatures (from -20C to + 50C) and air velocities.