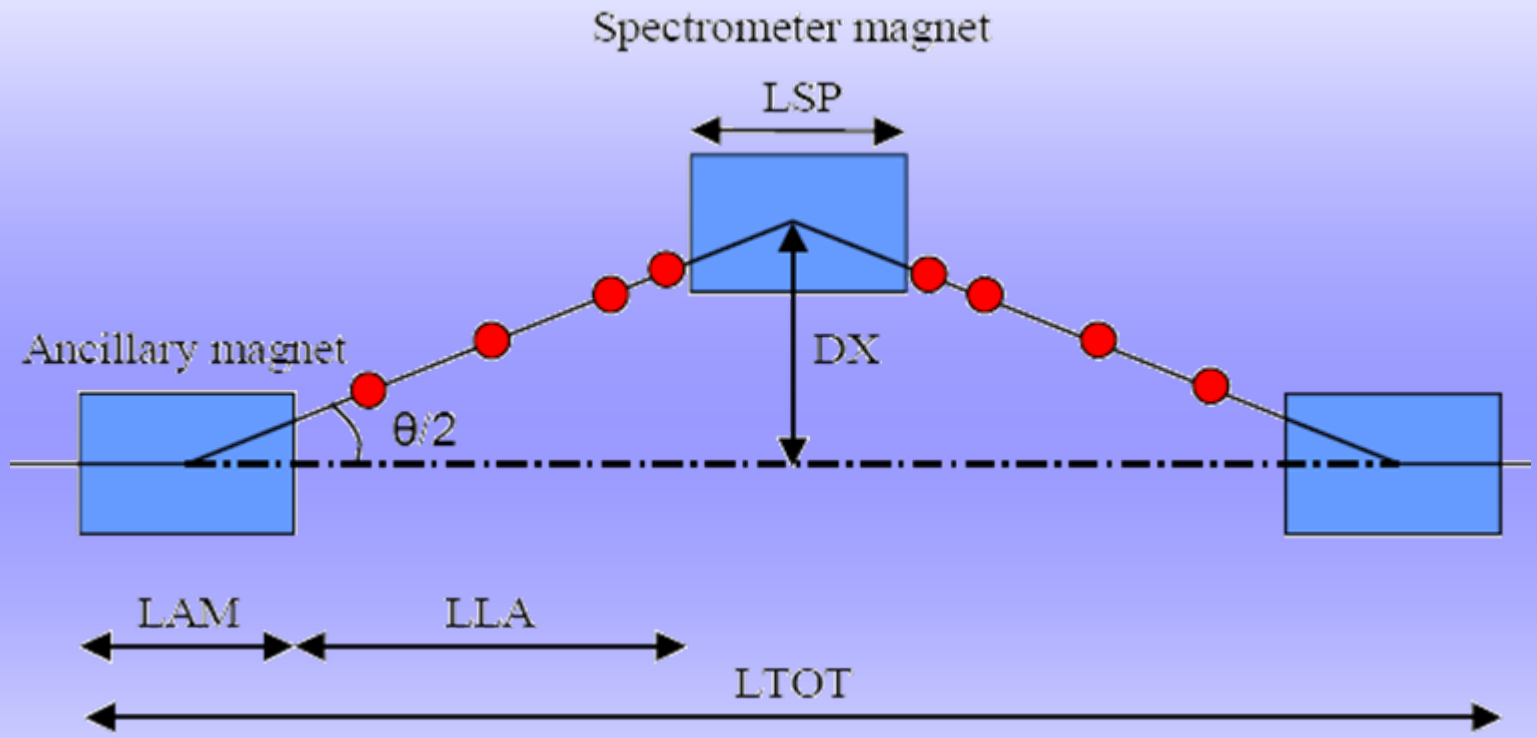
CONSTRUCTION OF SYNCHROTRON RADIATION MONITOR AND SIMULATION OF SYNCHROTRON RADIATION FROM MAGNETIC SPECTROMETER

B. Zalikhanov, R. Makarov, E.Syresin, DLNP-JINR

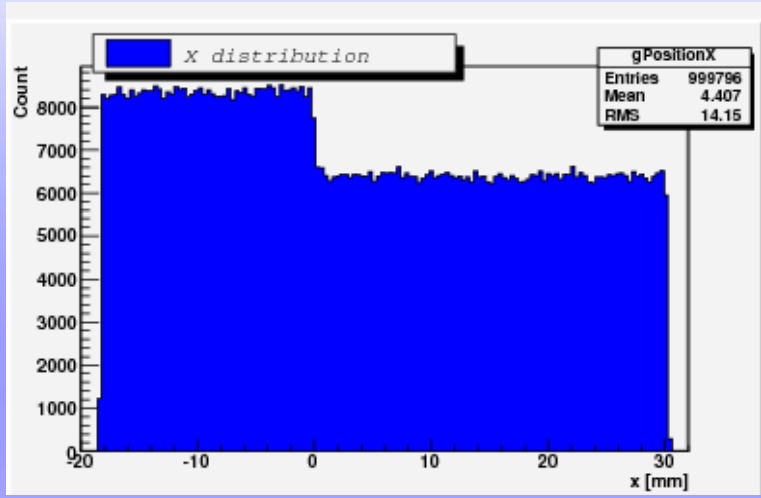
SCHEME OF MAGNET SPECTROMETER

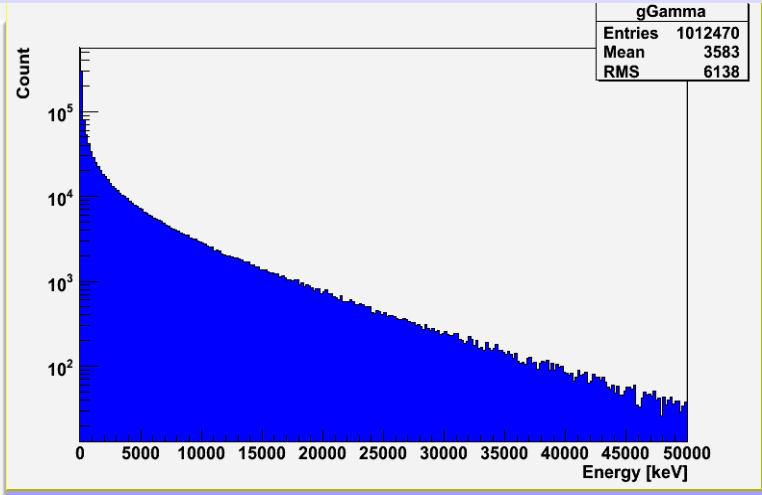


Scheme of magnetic spectrometer applied for ILC beam energy measurement.

GEANT IV SIMULATION

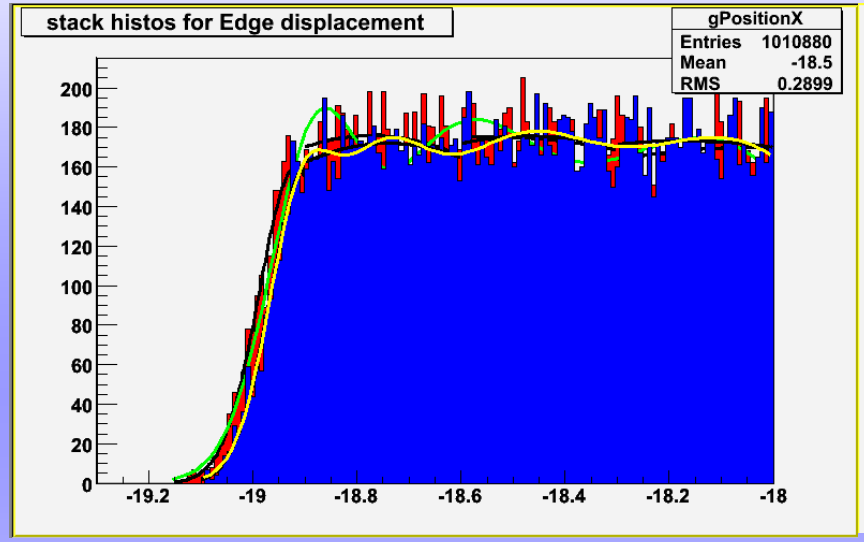
R. Makarov

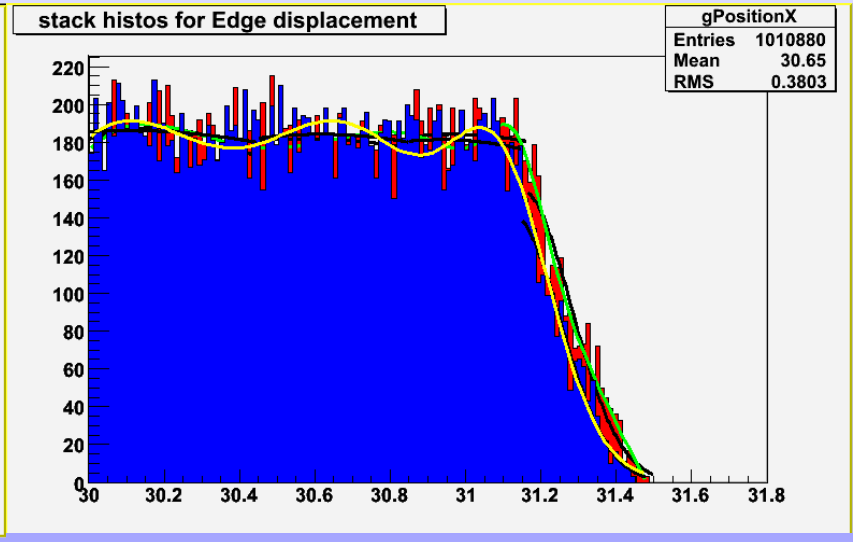




Transverse distributions and energy spectrum of SR on distance of 50 m from middle of spectrometer magnet at electron energy of 250 GeV.

SR edges displacement



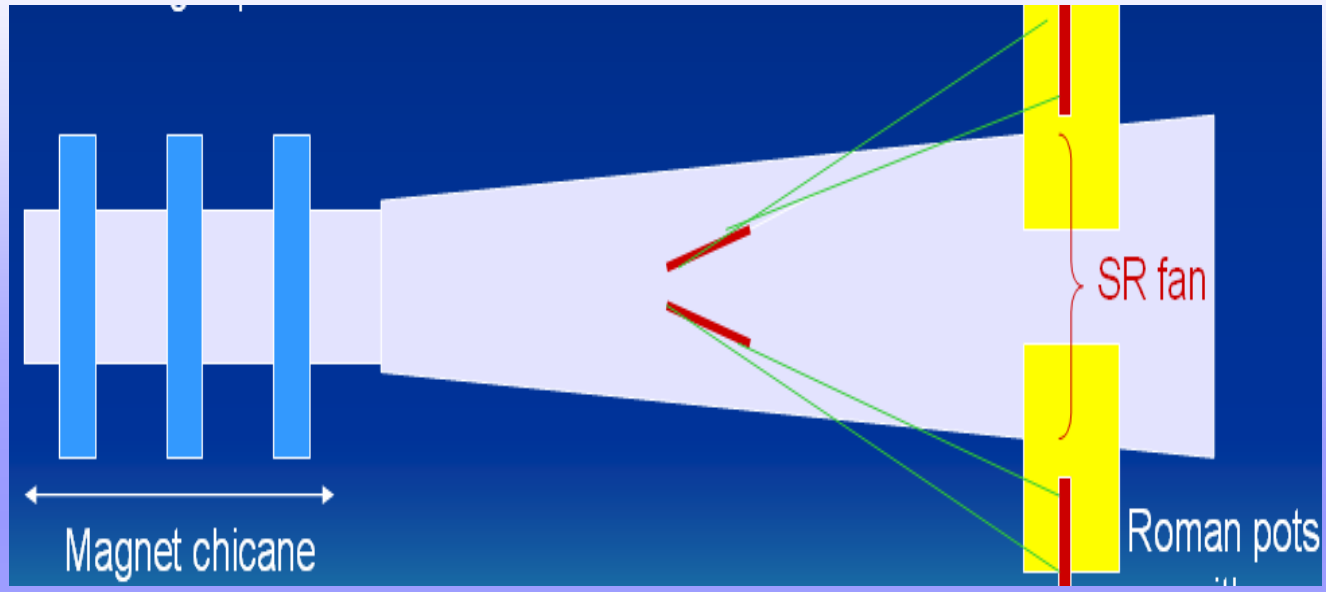


E = 250 GeV blue histogram

E = 250 GeV – 300 MeV red histogram

SR fan left edge displacement	**$\Delta x_{left} \approx 42\text{-}48$ μm**
SR fan right displacement	**$\Delta x_{right} \approx 30\text{-}36$ μm**
Simulated energy resolution	**75 μm/300 MeV**
Required resolution	**30 μm + 30 μm /300 MeV**

REFLECTION MIRRORS FOR SOFT SR



The application of mirrors permits to avoid the problems related to SR radiation protection however the installation of mirrors reduces the energy resolution at fixed coordinate resolution and detector position.

L_{am}=40 m

mirror-spectrometer magnet distance

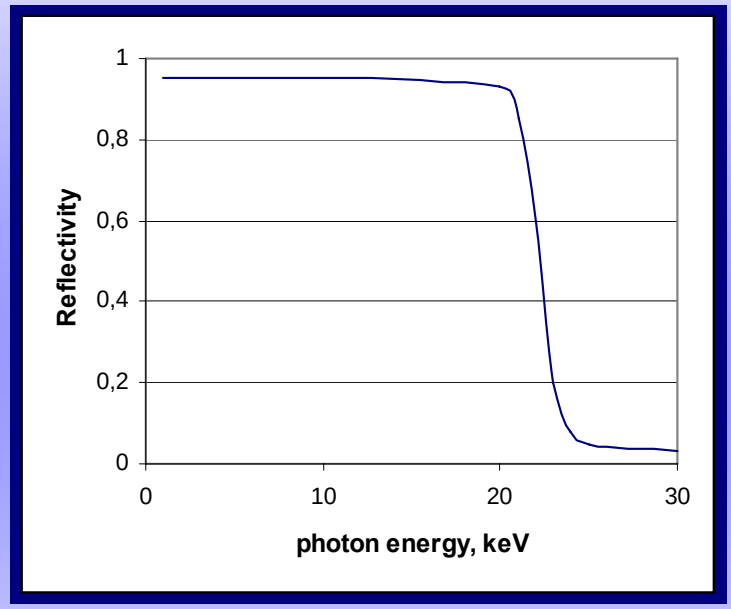
$L_{m\text{-}d}$=10 m

mirror-detector distance

REFLECTION OF SOFT SR RADIATION BY MIRROR

φ_{max} *(rad)* ≈ 0.08/E_γ *(keV)*=4 mrad

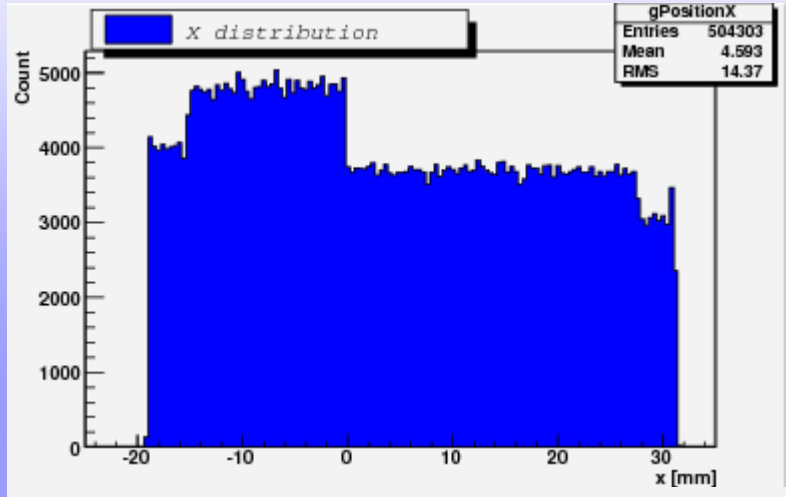
mirror critical angle at large atomic number Z and electron energy of 20 keV



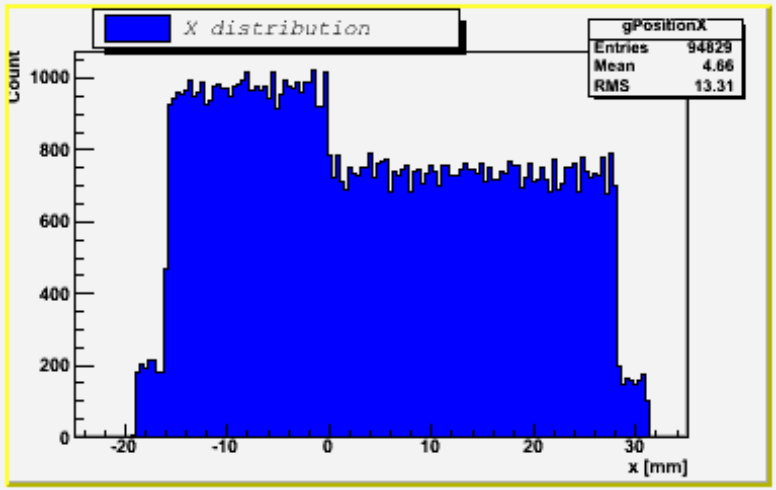
Dependence of Rh mirror reflectivity on photon energy.

The mirror reflected surface is placed at angle of φ=3 mrad to beam axis.

SR interaction with mirrors



Horizontal distribution of SR with enabled reflection of soft radiation on mirrors



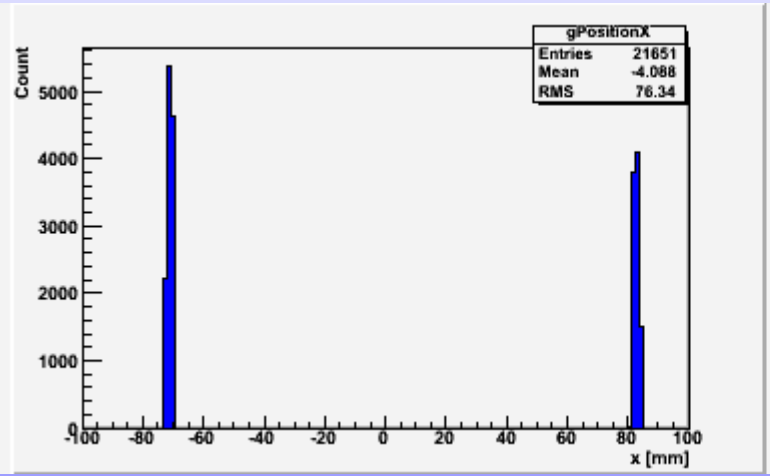
Horizontal distribution of SR with enabled reflection and absorption of soft radiation on mirrors

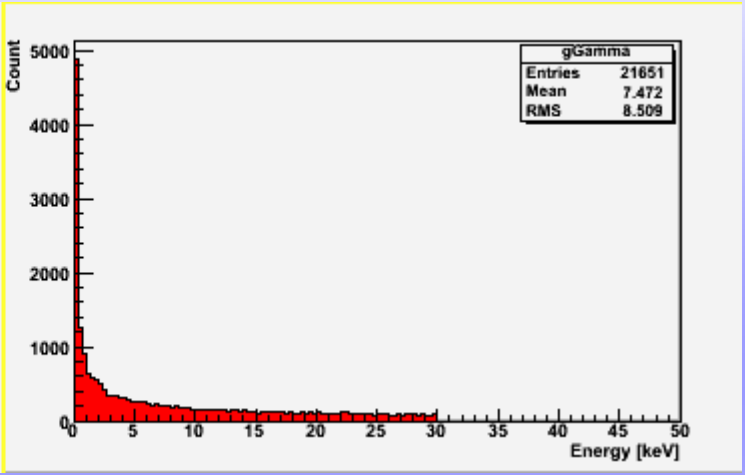
Total energy losses in mirror per electron corresponds to $\Delta Q\gamma$ =210 keV.

Total energy losses in mirror per bunch is of

$$Q_\gamma \approx N_e \cdot (2I_{mir}\varphi/L_{am}\theta) \cdot \Delta Q_\gamma \approx 45\ \mu J$$

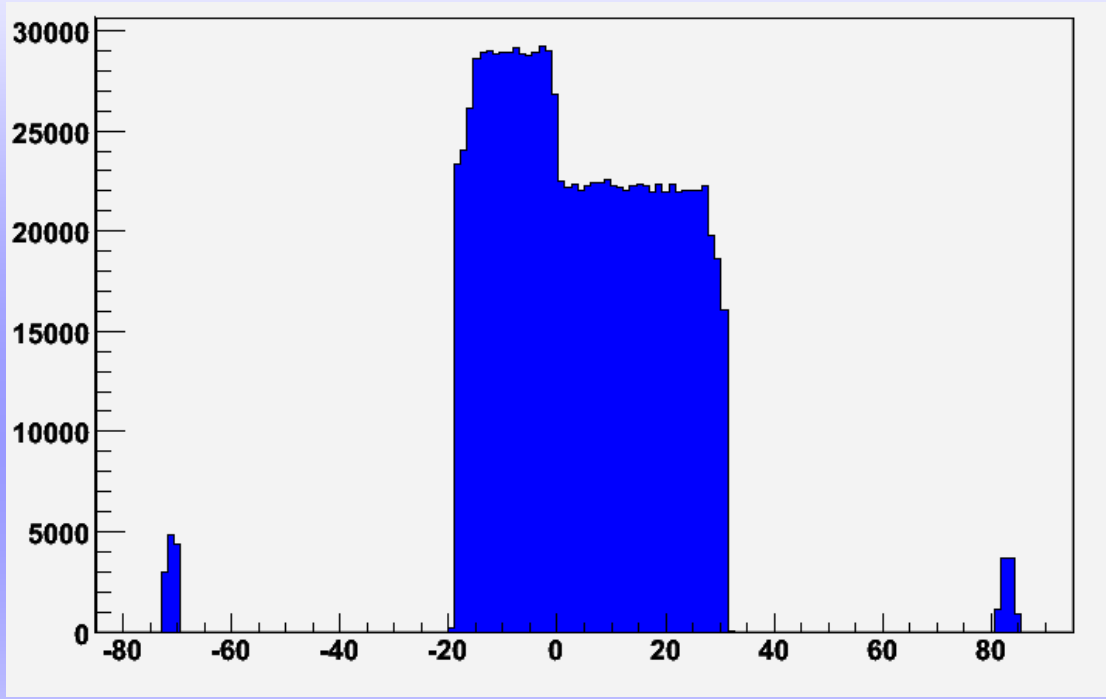
Soft radiation reflected from mirrors





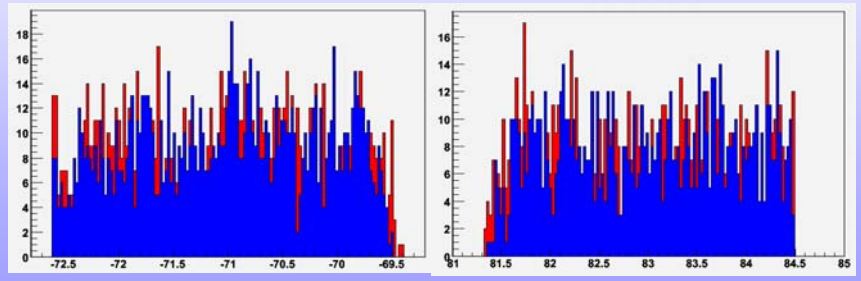
Horizontal distribution of soft radiation reflected from mirrors and energy spectrum

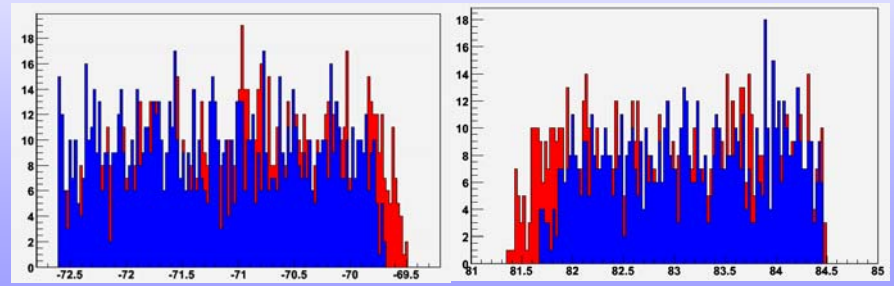
Distribution of SR at 50 m from the center of spectrometer magnet



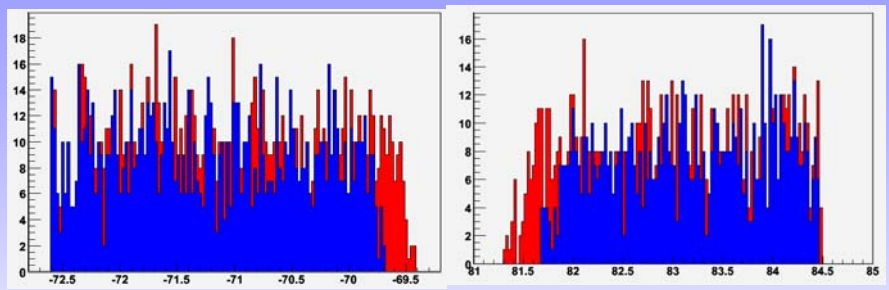
Horizontal distribution of SR at 50 m from the center of spectrometer magnet

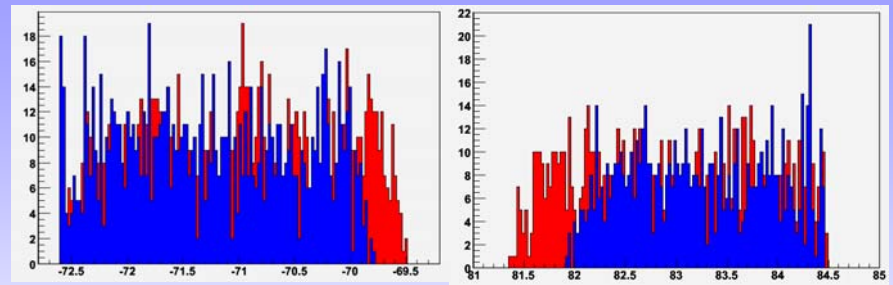
Dependencies of displacement of soft radiation fan edges versus energy variation





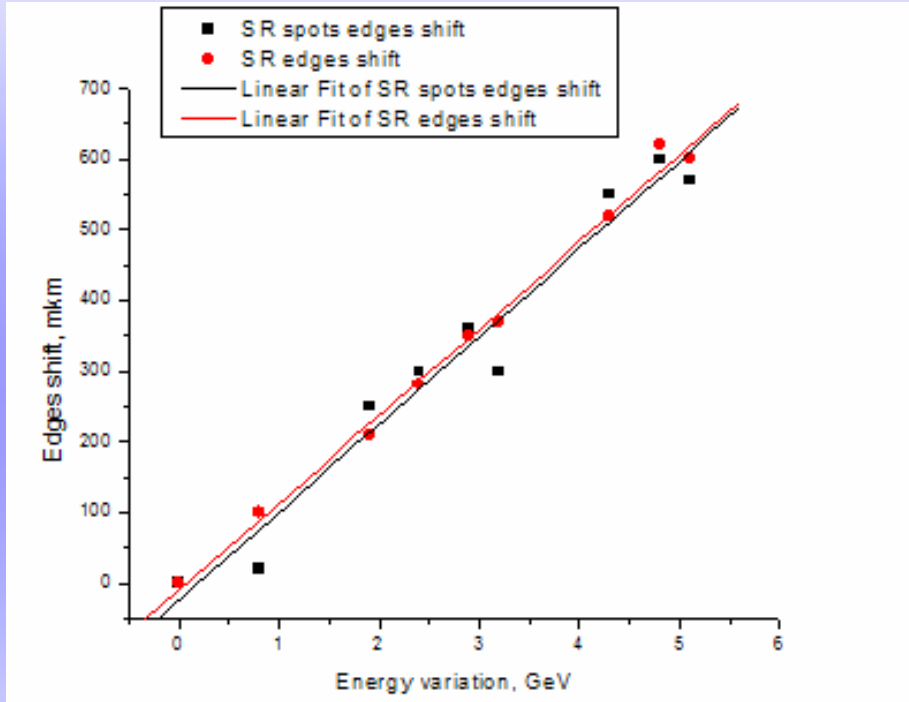
Horizontal distributions of soft radiation reflected on mirrors for 0.8 GeV and 2.4 GeV variations of energy





Horizontal distributions of soft radiation reflected on mirrors for 2.9 GeV and 4.3 GeV variations of energy

Dependence SR fan edges displacement versus energy variation



Red line for SR fan edges displacement, black one for soft radiation reflected on mirrors

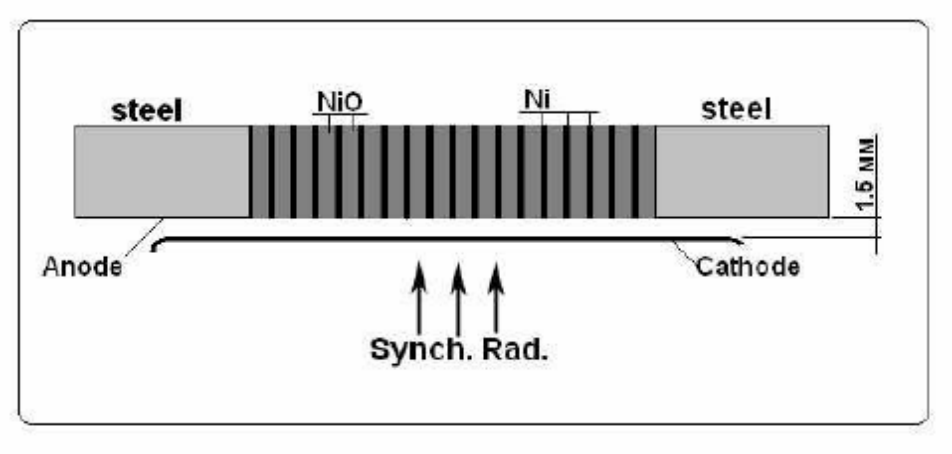
Linear Regression for SpotsShift
Y = A + B * X

Parameter	Value	Error	
A	-22,35225	31,19995	
B	124,06182	9,54306	
R	**SD**	**N**	**P**
0,97991	47,25073	9	<0.0001

Linear Regression for xDistShift
Y = A + B * X

Parameter	Value	Error	
A	-8,10732	12,44364	
B	122,95141	3,80611	
R	**SD**	**N**	**P**
0,99666	18,84525	9	<0.0001

GAS AMPLIFICATION DETECTOR



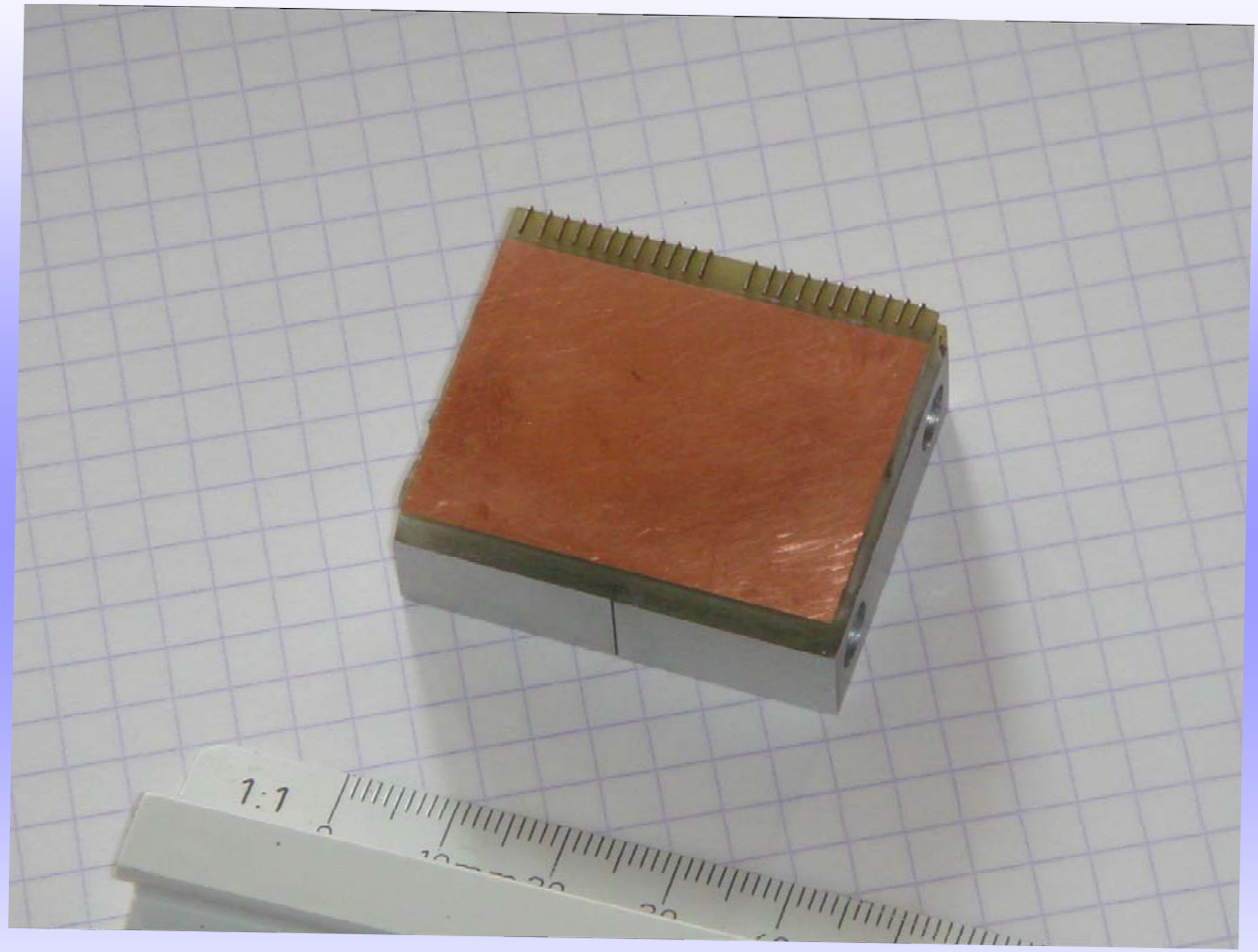
$N=N_0 \exp(\alpha d_{c-a})$

P=60 Atm at t=16 C- critical pressure for liquid Xe
liquid Xe density is of 3.05 g/cm^3

720 Ni layers at a thickness of 1 mkm
strip pitch is 3 mkm

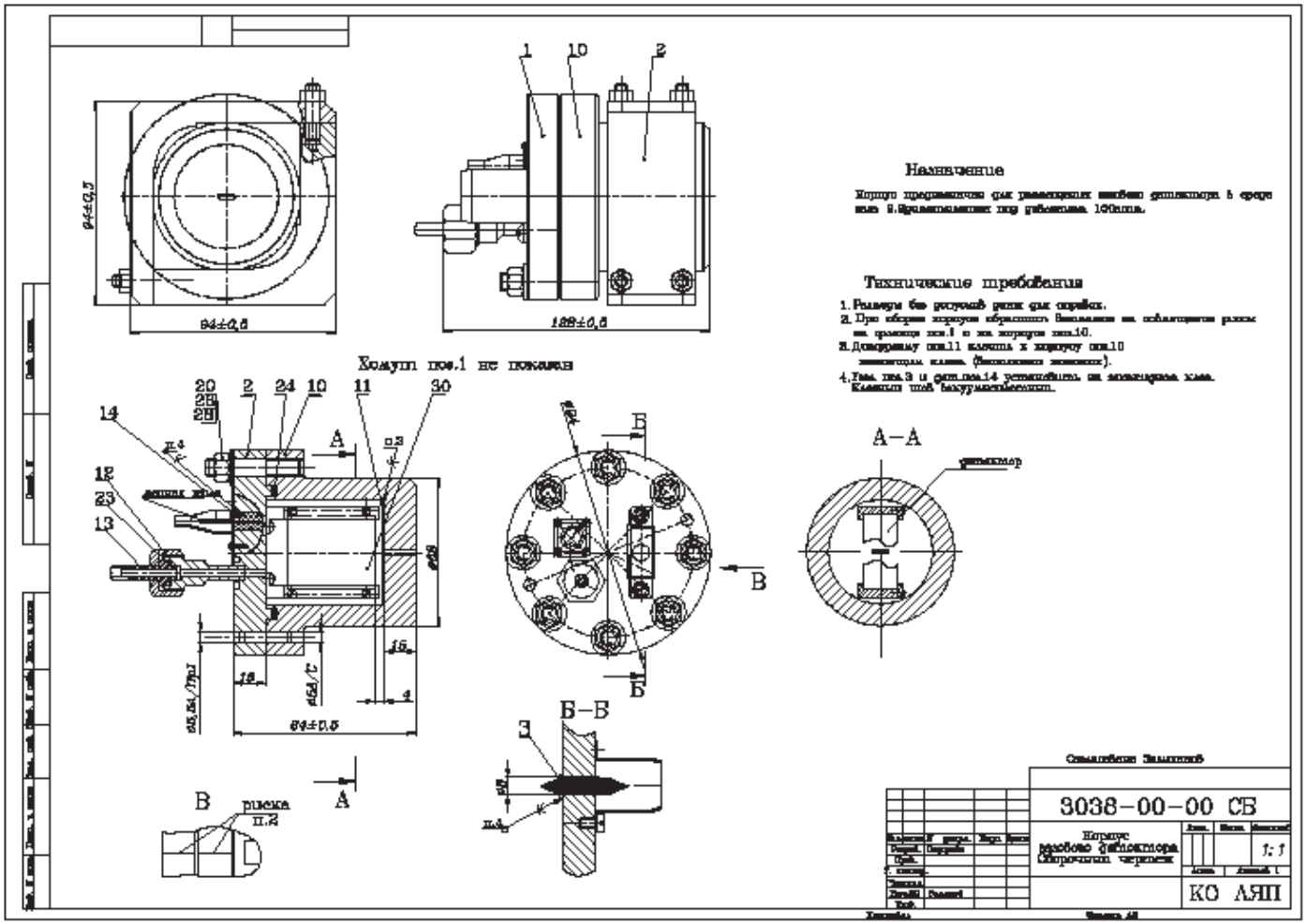
Number of soft photons at E≈10 keV per strip	$N_\gamma \approx 10^6$
Number of secondary electrons per strip	$N_e \approx 10^8$
After amplification at K=10	$N_e \approx 10^9$
The signal at amplifier conversion of 5 V/1 nC	V≈1.5 V

Prototype of Gas Amplification Detector constructed in 2006



48 channels
Strips from Al foil of 0.75 μm
Detector window is placed on forward surface

GAS amplification detector high pressure chamber

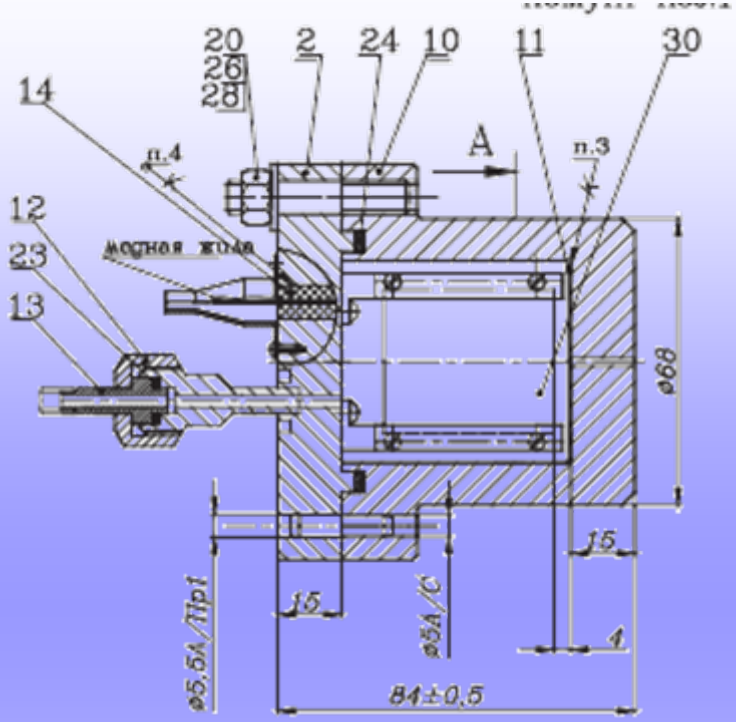


Pressure is of 150 atm

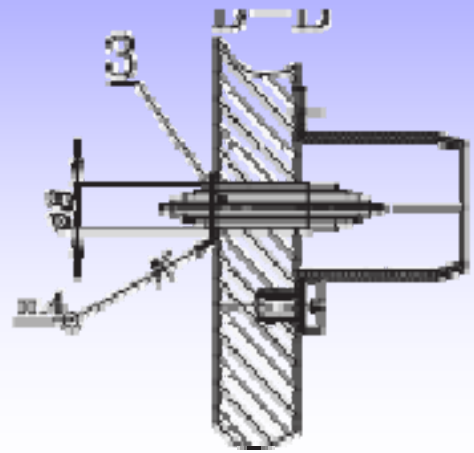
Chamber window width is of 2 mm

Be foil thickness for window is of 0.5 mm

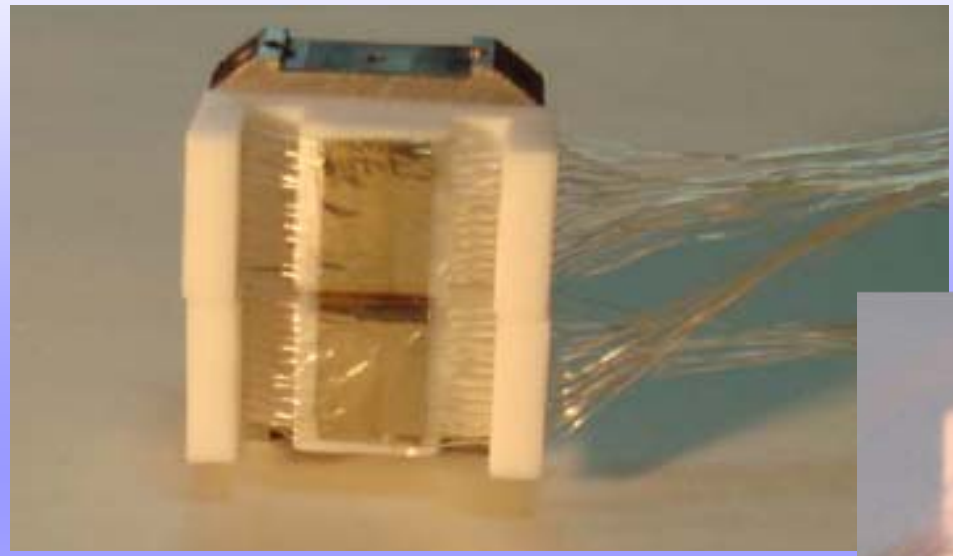
Corpus of high pressure chamber of SR gas amplification detector

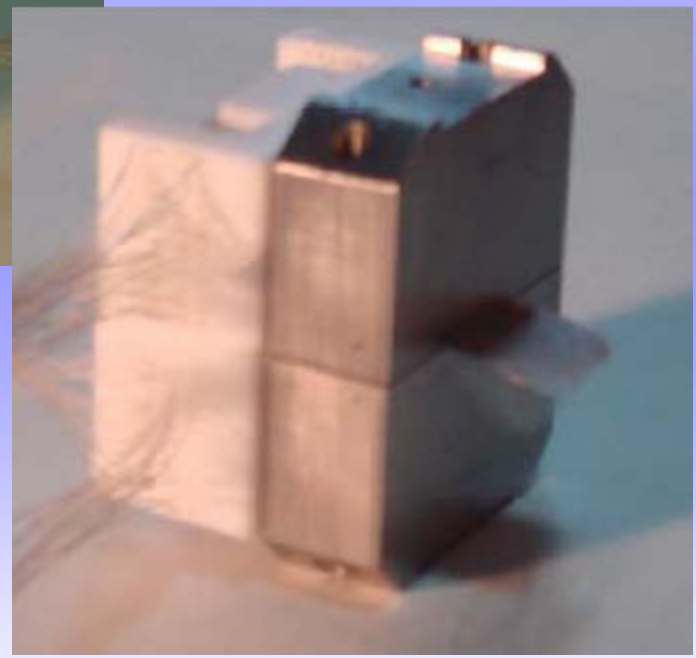


Connector consists from covered capton foil with thickness of 100 mkm



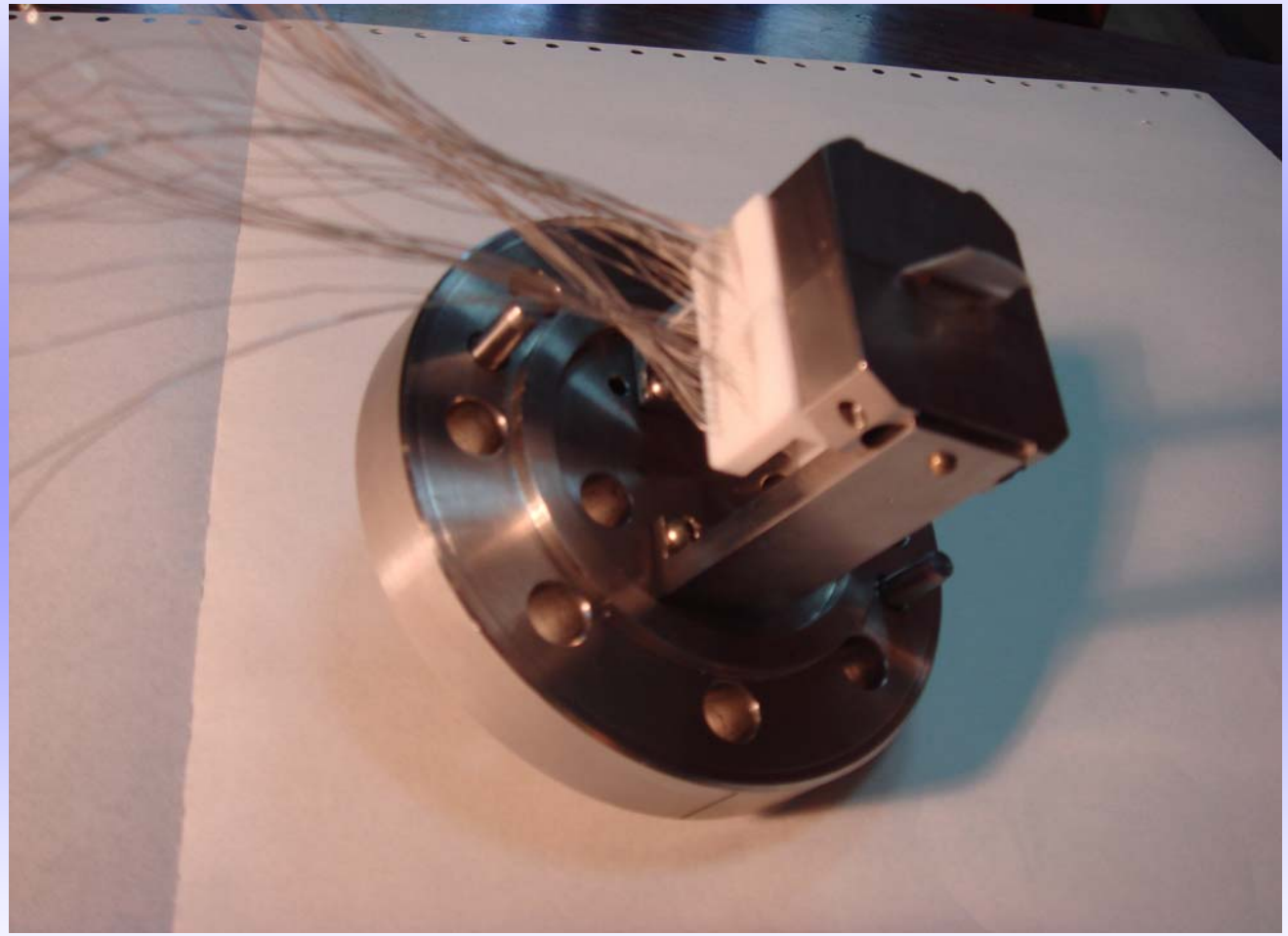
New prototype of SR Gas Amplification Detector





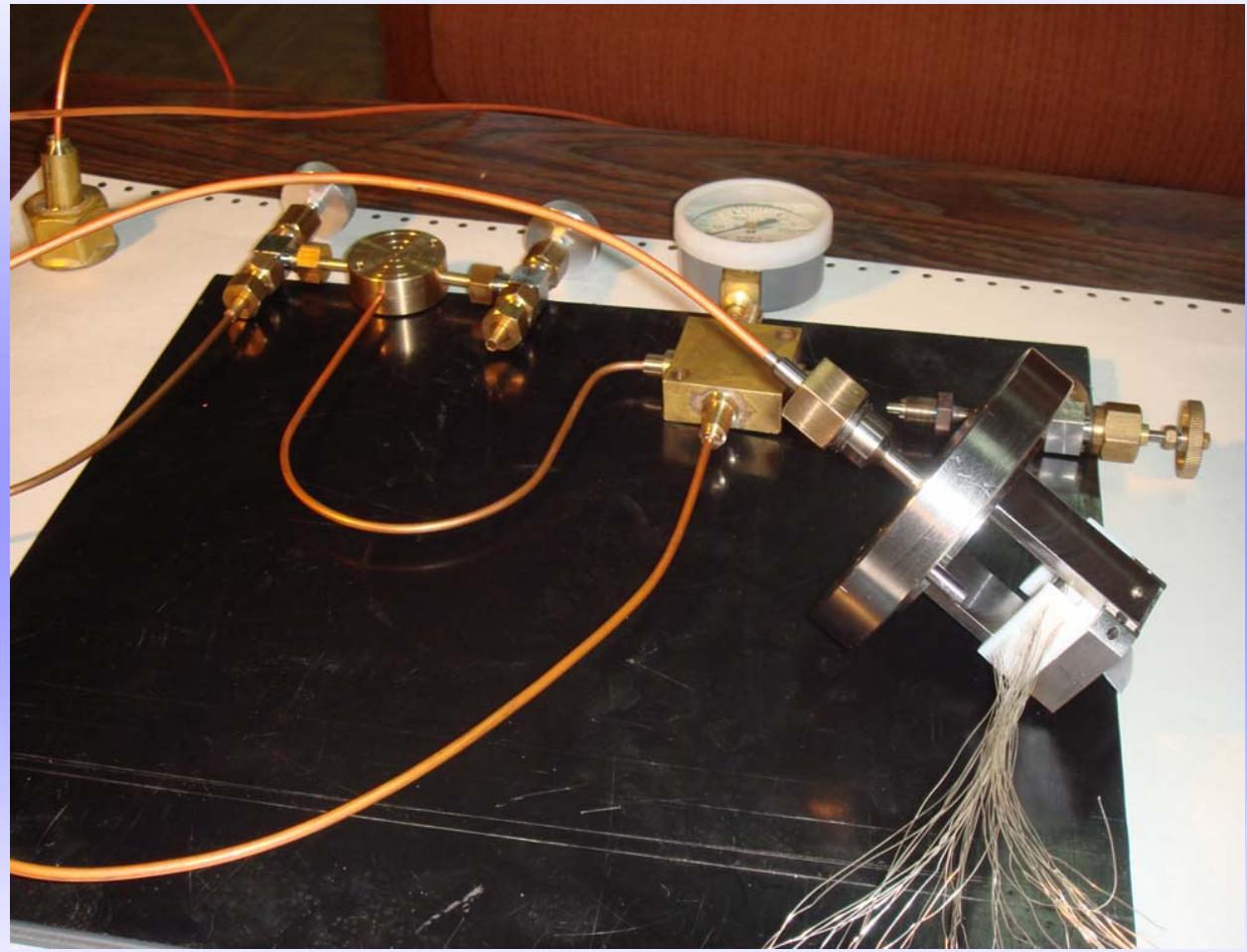
48 channels
Strips from Al foil of 0.75 μm

SR Gas amplification detector



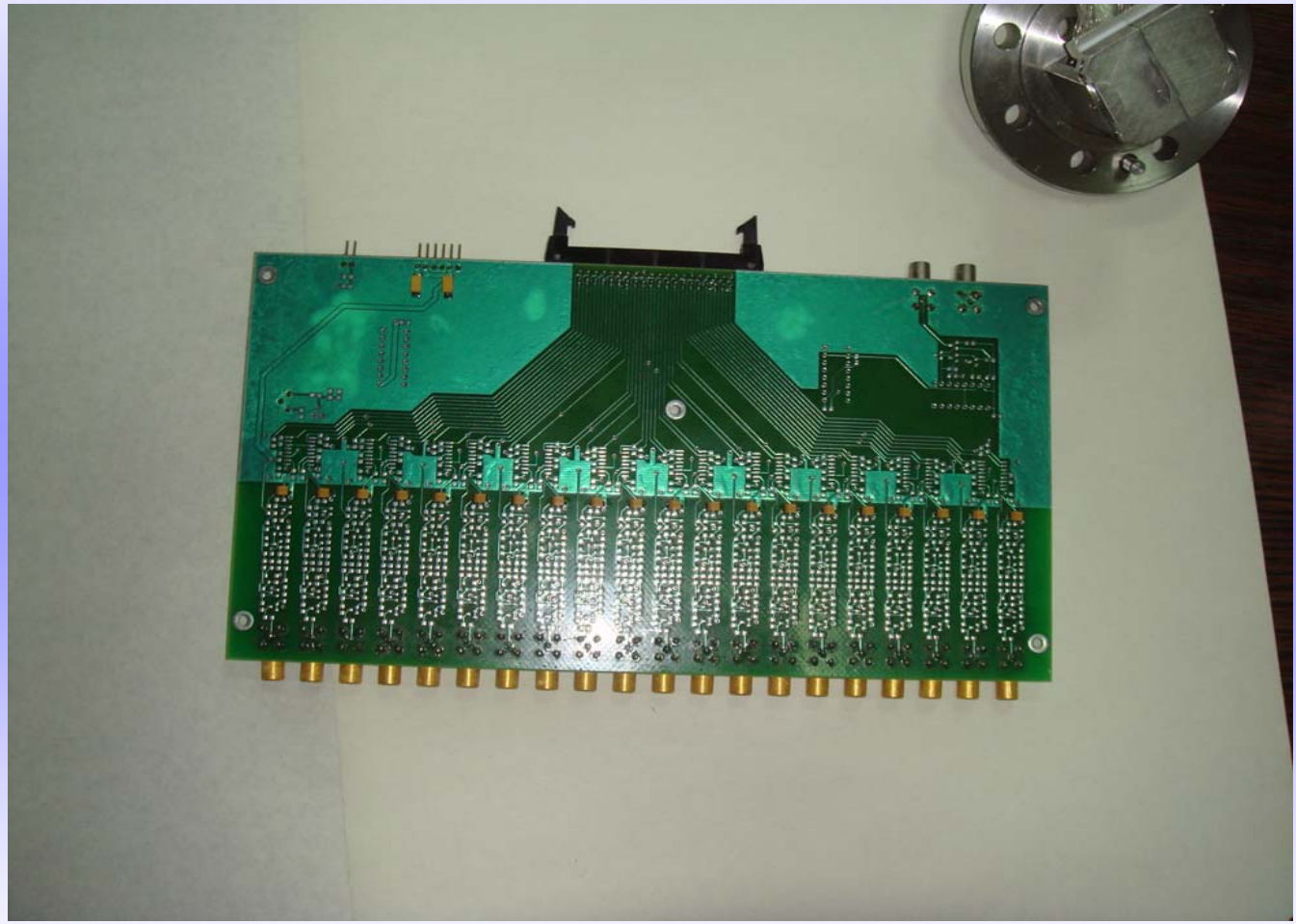
High pressure chamber with beryllium window of SR detector

High pressure system for SR Gas amplification detector



A prototype of a gas amplification strip detector with 48 channels and resolution of 3 μm was constructed. The construction of high pressure (150 atm) chamber for a gas amplification strip detector was performed. The assembling of SR is planed in near future.

Prototype of Electronics for SR gas amplification monitor



Prototype of 20 channel electronic

Future plans

- Assembling of SR gas amplification detector
- Creation of electronic system
- Test experiments with isotope produced X-ray radiation of several tenth keV

Required resources

Required resources in 2007 for prototype of SR coordinate detector: 13.5 k$

Activity planed in 2007

1. Participation in GEANT simulations of SR produced in energy spectrometer.

2. GEANT simulation of conversion efficiency of γ-quanta in photo electrons in gas amplification detector.

3. Development and construction of electronics for a prototype of gas amplification detector with resolution of 3 μm.

4. Assembling and calibration of prototype of SR gas amplification detector.