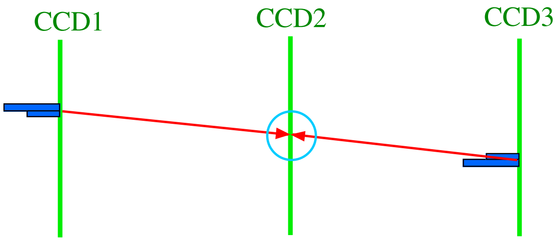
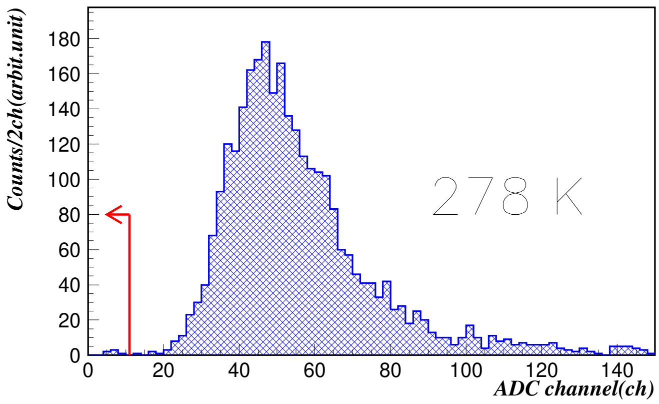
Detection efficiency for MIP

After the alignment, detection efficiency is measured by looking for associated clusters in CCD2 expected from CCD1&CCD3.



Signal of less than S_{thres} is taken as inefficiency.

S_{thres} = **20% of the peak position@+5°C** ($\simeq 2\sigma_{noise}$**@+5°C**)

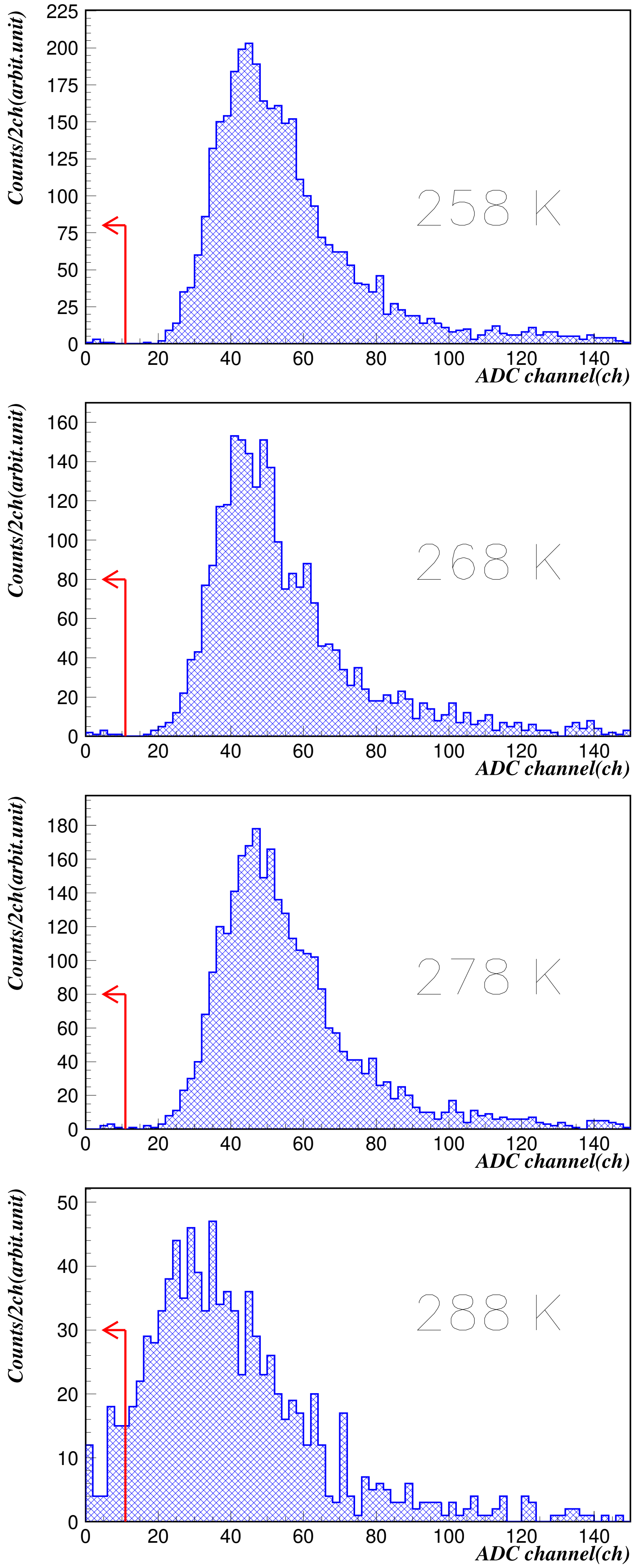


Temp	$-15°$**C**	$-5°$**C**	$+5°$**C**	$+15°$**C**
Ineff†	$< 0.5\%$	$< 0.8\%$	$< 0.7\%$	$< 6.6\%$‡

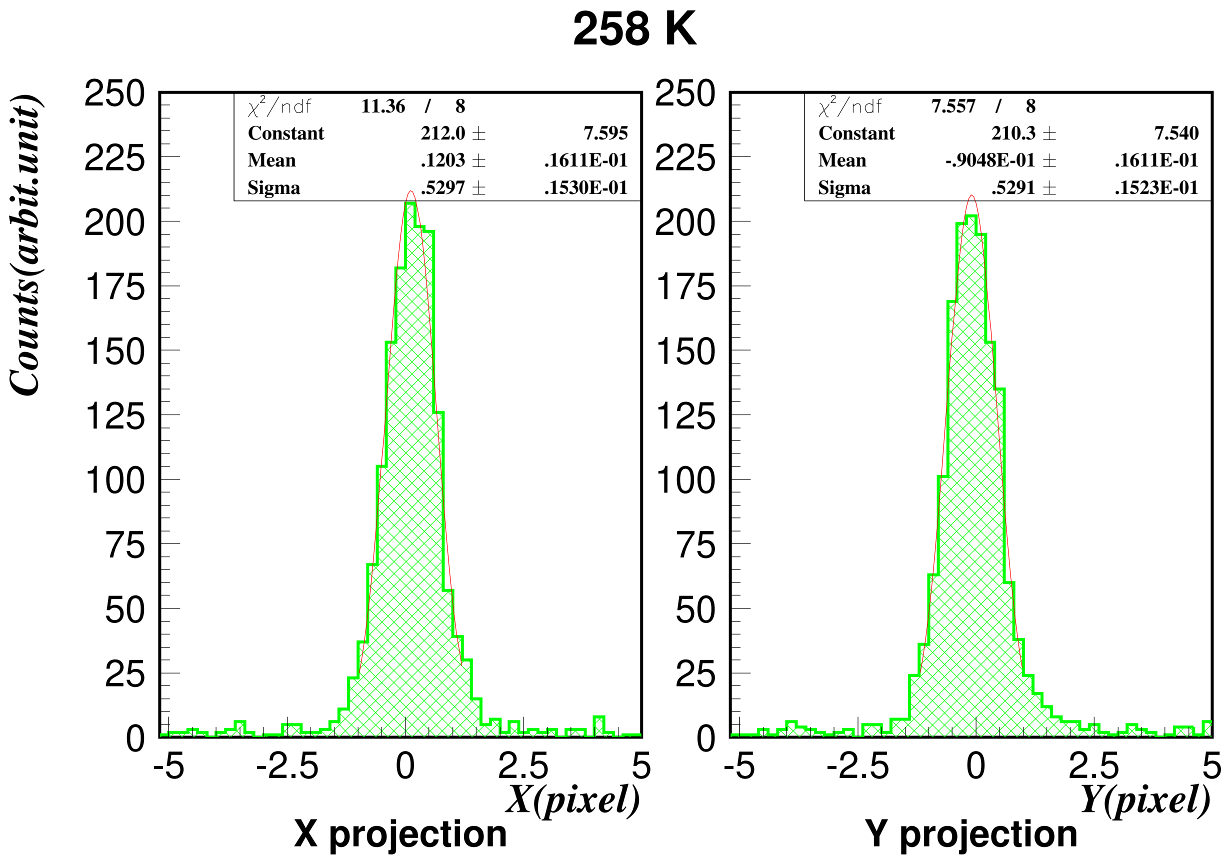
† Due to the multiple hits, we can only quote the upper limits.

‡ Possibly DAQ problem: gain dropped by half

Less than 1% inefficiency for $T \leq +5°$C


258 K
268 K
278 K
288 K
Counts/2ch(arbit.unit)
ADC channel(ch)

Position resolution



Temp	-15°C	-5°C	$+5^\circ$C	$+15^\circ$C
ΔX (μm)	12.7 ± 0.4	13.1 ± 0.4	12.6 ± 0.6	13.6 ± 0.6
ΔY (μm)	12.7 ± 0.4	13.3 ± 0.4	12.7 ± 0.8	14.0 ± 0.7

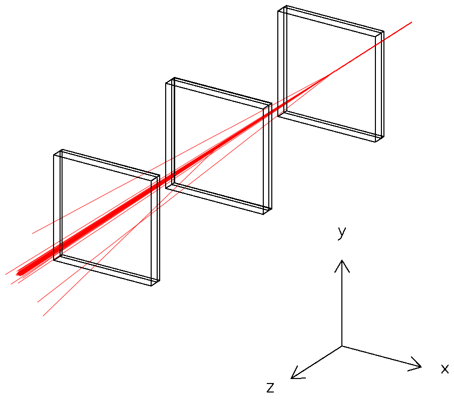
combined resolution: 13.0±0.2μm

NB) We used the standard packages for this exp.

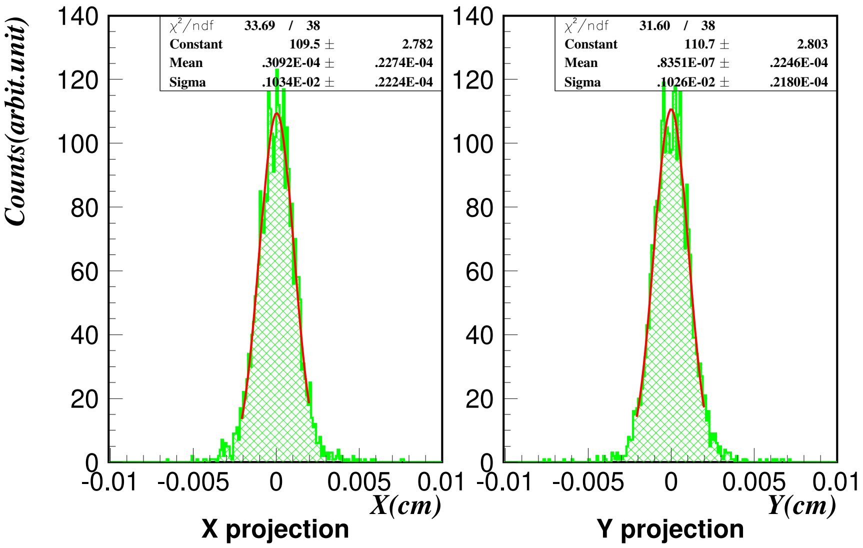
- 1.2mm $A\ell_2O_3$ behind the chip
- thickness of CCD sensor: 510μm
- dominated by multiple scattering

Simulation study

Material effect is estimated by GEANT



Position resolution with all material in



Contribution of material: 10.3±0.2μm

⇒ Intrinsic resolution: 7.9±0.4μm

- Material effect can be reduced to 5.2±0.1μm (GEANT expectation only with the sensors)
- Special made CCD with a hole has arrived
- Beam tests with 4 layers are planned next month

Summary

- **First beam test of HPK CCD's has been done**
- **Behavior of the dark current is carefully analyzed**
  - Fits well to the formula
  - Width measurements of the dark current $\rightarrow$ gain & intrinsic noise
- **MIP's are successfully detected even at room temp.**
  - S/N >10 up to ~0°C
  - N_e generated: 60/μm(peak), 110/μm(mean)
  - Inefficiency: $< 1\%$ for $T \leq +5°C$
  - Position reso.: 13μm(total), 8μm(intrinsic)

Prospects

- **Beam test with reduced material**
  will be done next month
- **Radiation damage**
  affects CTE(Charge Transfer Efficiency)
  - **CTE measurements are on-going**
  - **Irradiation with a strong $^{90}S_r$ will take place in the near future**