VTX, CAL, その他

'94-Nov-30 @

2nd JLC meeting

Y. Fujii

1. VTX Status Report
2. CAL Status Report
3. Muon, Solenoid 省略
4. H1 SPACAL 時間が余ったら.

SOLENOID

- 2 Tesla ← CDC, BG OK
- 9mφ ← CAL OK
- 3分割 ← CAL OK

Engineeringly No Problem.

MUON

TOTALY OPEN.

Vertex Detector R&D Status

• Goal of present R&D

-> Develop CCD detector which can be operated at room temperature (>0°c)

• Noise due to dark current becomes serious at high temperature
(SLD operation at -90°c)

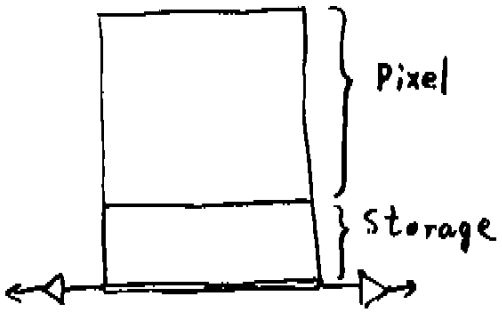
• How to solve this problem?

1) Increase Signal
   • Use Si wafer with high resistivity
   -> Depletion thickness≈30μm
   Signal≈2400 e/h

2) Decrease Noise
   Noise $\sqrt{i_d * t}$
   ->1) Quick readout
   2) Small i_d

• Things done so far

- Obtained CCD samples
  a) Hamamatsu
     -Thick depletion region
     -Slow read out (4 sec/frame)
  b) EEV
     -Quick readout (max 5 msec/frame)
     -Frame transfer type



- [redacted] for the Hamamatsu CCD

Preliminary

FFT CCD Image Sensors(S5466 series)

write 1992/05/01
rewrite 1992/10/23

HAMAMATSU PHOTONICS has developed full frame transfer type CCD. This CCD is useful for the application of scientific, space, medical, and spectroscopy etc.

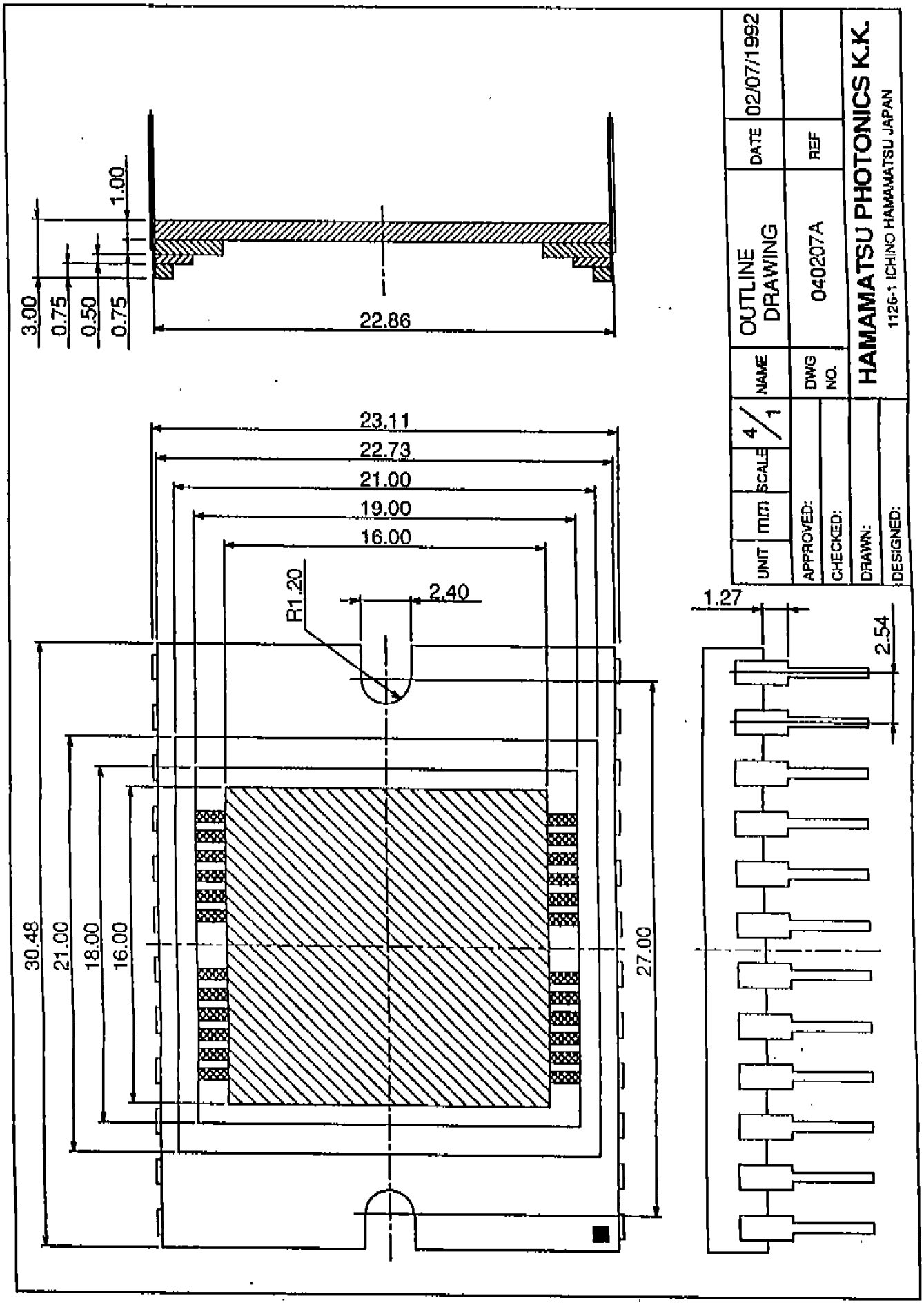
*Advantages

-Low Dark Current	Normal	:	4.4 electron/sec/pixel (at -40 degree)
	MPP	:	0.22 electron/sec/pixel (at -40 degree)
-High Sensitivity		:	more than 1.2 uV/electron
-Large Capacity		:	more than 300,000 electron per pixel
-Transfer Efficiency		:	more than 0.99995
-UV high sensitive (option)		:	phosphor coat is available

*Specifications

-CCD configuration	:	Full Frame Transfer Type
-Effective Pixels	:	512 (H) X 512 (V)
-Pixel Size	:	24 um (H) X 24 um (V) (aspect ratio 1:1)
-Vertical Clock Phase	:	2 Phase
-Horizontal Clock Phase	:	2 Phase
-Effective Photo Sensitive Area	:	12.288 mm (H) X 12.288 mm (V)
-Chip Size	:	13.6 mm (H) X 14.4 mm (V)
-Output	:	1 Stage MOSFET source follower
-Package	:	24 DIP with 900 mil width

Solid State Division HAMAMATSU PHOTONICS K.K.
Phone 81(JAPAN)-53-434-3311 Fax 81-53-434-5184 (product div. 81-53-433-8575)


1.00
3.00
0.75
0.50
0.75
22.86
23.11
22.73
21.00
19.00
16.00
R1.20
2.40
30.48
21.00
18.00
16.00
27.00
1.27
2.54
UNIT
mm
SCALE
4/1
APPROVED:
CHECKED:
DRAWN:
DESIGNED:
NAME
OUTLINE DRAWING
DWG NO.
040207A
DATE
02/07/1992
REF
HAMAMATSU PHOTONICS K.K.
1126-1 ICHINO HAMAMATSU JAPAN

EEV

CCD17 PRELIMINARY DATA

FEATURES

- 512 x 512 1:1 Image Format
- Frame Transfer Operation
- Electronic Exposure control
- 15 µm Square Pixels
- 5 ms minimum Readout Time

ARCHITECTURE

IMAGE AREA	7.7 mm x 7.7 mm
Horizontal pixels (active)	512
Vertical pixels (active)	512
Pixel size	15 µm x 15 µm
STORAGE AREA	7.7 mm x 6.1 mm
Horizontal pixels	512
Vertical pixels	512

Additional pixels are provided in both the Image and Storage Areas for dark reference and over-scanning purposes.

Gated Anti-Blooming for highlight handling and electronic exposure control is provided. Alternatively the CCD can be supplied without anti-blooming structures for maximum sensitivity under controlled illumination conditions.

PERFORMANCE

Number of Output Amplifiers	2
Maximum Readout Frequency	>30 MHz per amplifier
Output Responsivity	2.2 uV / electron
Peak Signal	220 mV
Peak Charge Storage	10^5 electrons
Dynamic Range	>1000:1 (frequency dependent)
Binning capacity in Readout Register	4x

Minimum Readout Time:

Whole array through 1 amplifier	10 ms
Whole array through 2 amplifiers	5 ms

PACKAGE 36 pin PGA

EEV
Waterhouse Lane, Chelmsford, Essex CM1 2QU, England
Telephone: (0245) 493493 Telex: 99103 Fax: (0245) 492492
Subsidiary of the General Electric Company, p.l.c. of England

Provisional March 1992

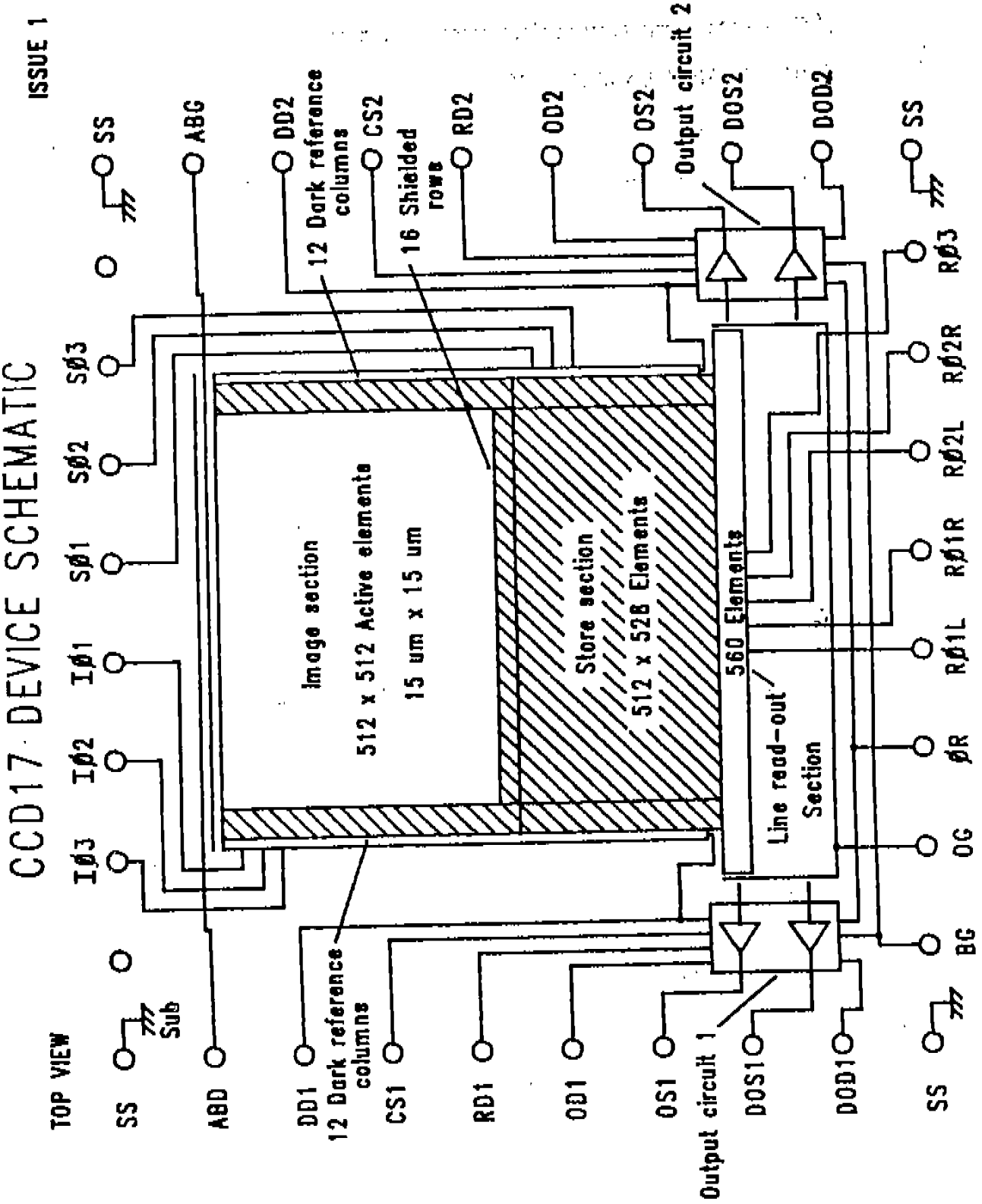
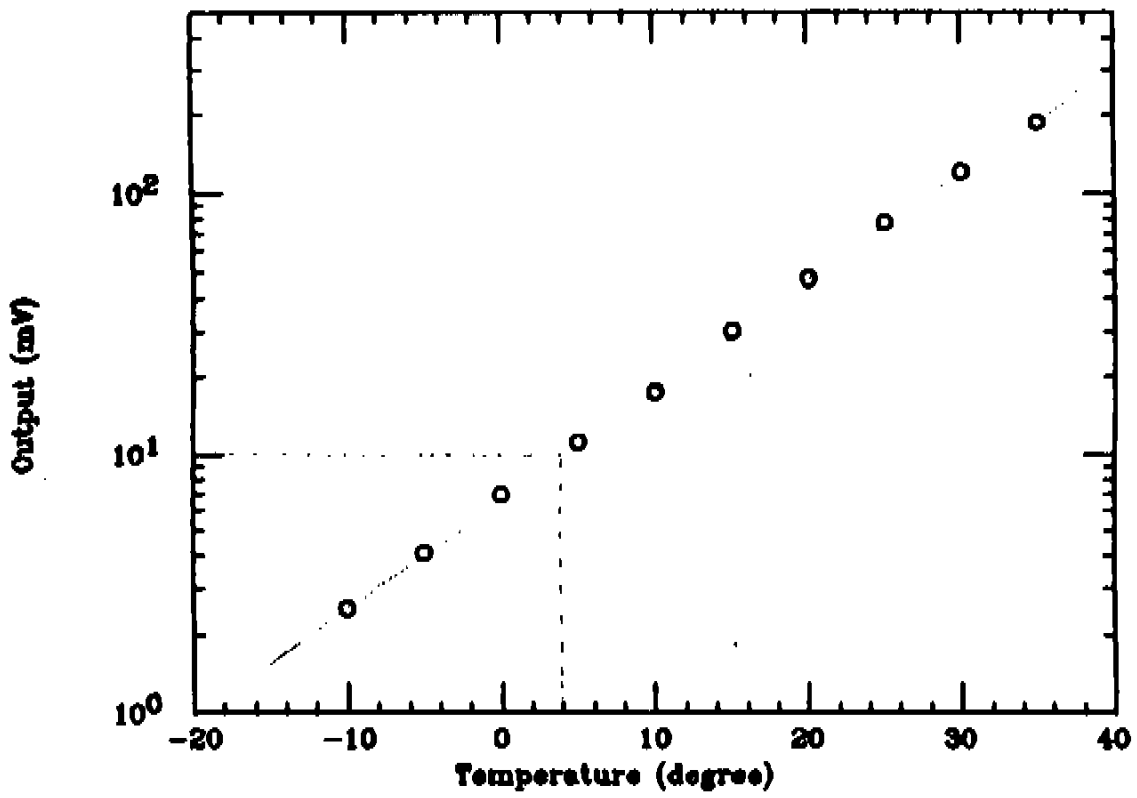

CCD17 DEVICE SCHEMATIC
ISSUE 1
TOP VIEW
SS
Sub
ABD
DD1
12 Dark reference columns
CS1
RD1
OD1
OS1
Output circuit 1
DOS1
DOD1
SS
BG
ØR
RØ1L
RØ1R
RØ2L
RØ2R
RØ3
OG
SS
ABG
DD2
12 Dark reference columns
CS2
16 Shielded rows
RD2
OD2
OS2
Output circuit 2
DOS2
DOD2
SS
SØ3
SØ2
SØ1
IØ1
IØ2
IØ3
Image section
512 x 512 Active elements
15 um x 15 um
Store section
512 x 528 Elements
560 Elements
Line read-out Section

FIGURE 1

- Thermal noise of HAMAMATSU CCD



Gain: ~ 6μV/e ⇔ ~ 170e/mV

@ 4°C: 1700 e ⇒ Noise = $\sqrt{1700}$ ~ 40 e !
(with 4S readout)

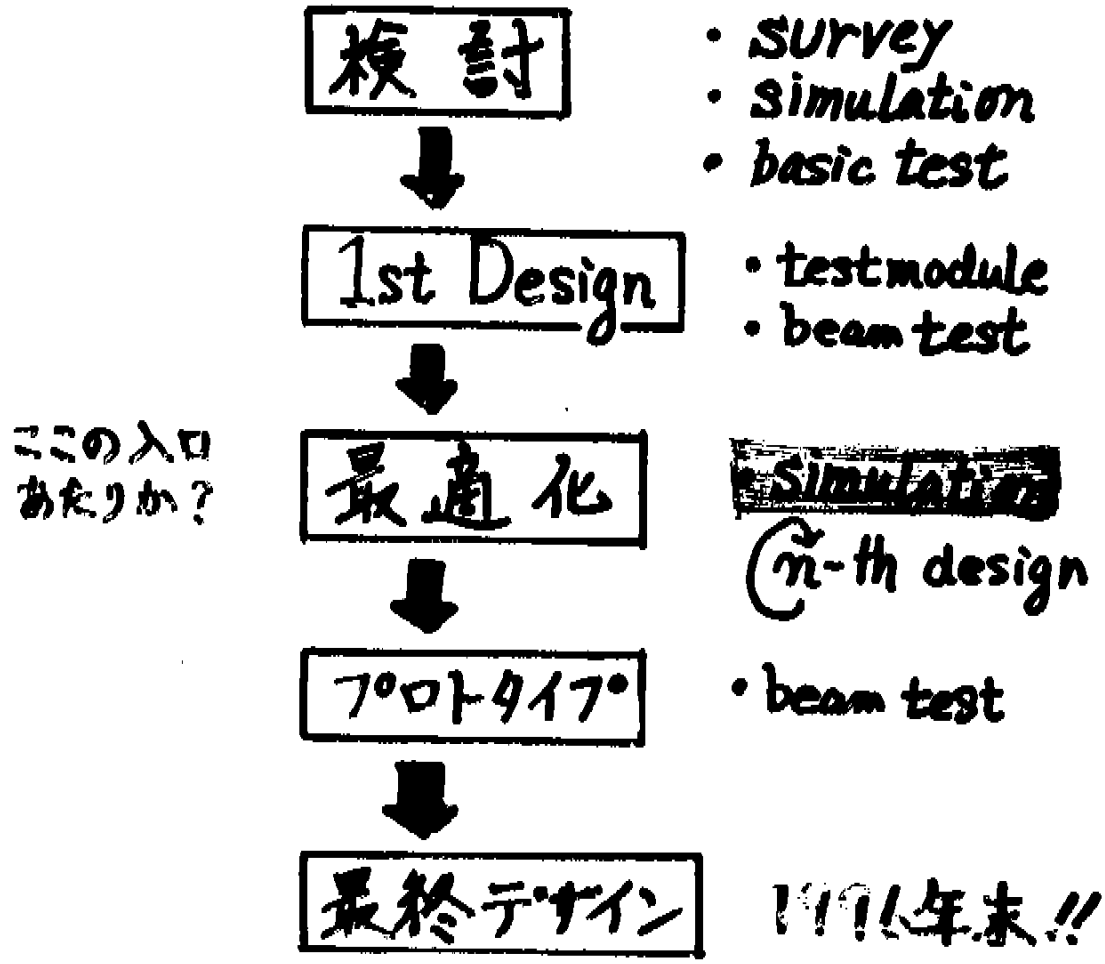
Very Low Noise !

• Items to be considered

- Radiation damage
- Power consumption (cooling)
- Optimization of detector configuration
  -Tracking efficiency
  -More than 2 layers?
  -R_{in} and R_{out}
- Thinner wafer to minimize multiple scattering

Calorimeter Group Report

今我々はどこにいるか？



Y. Fujii (KEK) &

神戸・甲南・信州・KEK Collaboration

現在のカロリメータ案

鉛/シンチサンプリングを

クリスタルは → No. → almost estab.
Sandwich or SciFi → yet open

コンペンセーションさせて

必要はあるか → Yes. → almost estab.
本当にできるのか → ?

2Tの磁場中においてできるのか → Yes. READOUT DEVICE

必要か → Yet OPEN

15%/√E & 40%/√Eを得る.

達成可能か → EM Test needed.
Constant term!!
Beam test done.
Further test needed.

Si-Pad + PreShower で性能向上をはかる.

Pb/シンチはコンペンセイトするか？

- Wigmansによる計算 → 4:1示唆

- ZEUS T-36 ビームテスト
  SW (Pb10mm:シンチ2.5mm) Pb 81cm厚
  raw $e/\pi = 1.15$ @ 5GeV
  1.09 after 横リーク補正

- SPACAL
  SciFi (1mmφ) Pb 160cm厚相当
  raw $e/\pi = 1.10$ @ 5GeV
  1.10 after ±10%補正

- INS - ZEUS
  SW (Pb 8.5mm, シンチ 2.0, 2.5) Pb 84cm厚
  raw $e/\pi = 1.28$ @ 4GeV

- JLC-T305
  SW (Pb10, シンチ2.5) Pb 80cm厚
  raw $e/\pi = 1.09$ @ 4GeV
  need WLS 減衰補正, 横リーク(5%)
  SciFi (1mmφ) Pb 104cm厚相当
  raw $e/\pi = 1.19$
  need 横リーク補正 (5%)

結果を批判的に検討すると...

ZEUS-T36

- EM部とHad部のRelative Calibrationがuniqueでない.
- 横リーク補正が推定値.

SPACAL

- 補正項が大きい。Cancelの信頼度??

INS-ZEUS

- Pb:シンチ比のちがい
- WLS減衰補正は必要ないか? e/π↓下げる

JLC-T305

- WLS減衰補正 不可欠 e/π↑上げる
- Fiber 〃 〃 〃

Compensationを疑わせはしないか

4:1でよいかどうか

は確認の必要あり.

Characteristics of the devices

Device	Active Area	Rise Time	Quantum Efficiency	GAIN			with 30photon input at 0T	
				0T	1T	2T	S/N	resolution
FMPMT	$10cm^2$	2ns	20%	10^6	10^5	?	3000	49%
MCP	$2.5cm^2$	0.2ns	20%	10^6	?	?	6000	110%
APD	$2cm^2$	5ns	80%	300	300	?	0.4	18%
HPD	$5cm^2$	11ns	20%	2000	2000	?	1.0	36%
VAPD	$2cm^2$	5ns	20%	10^5	10^5	?	80	36%

References

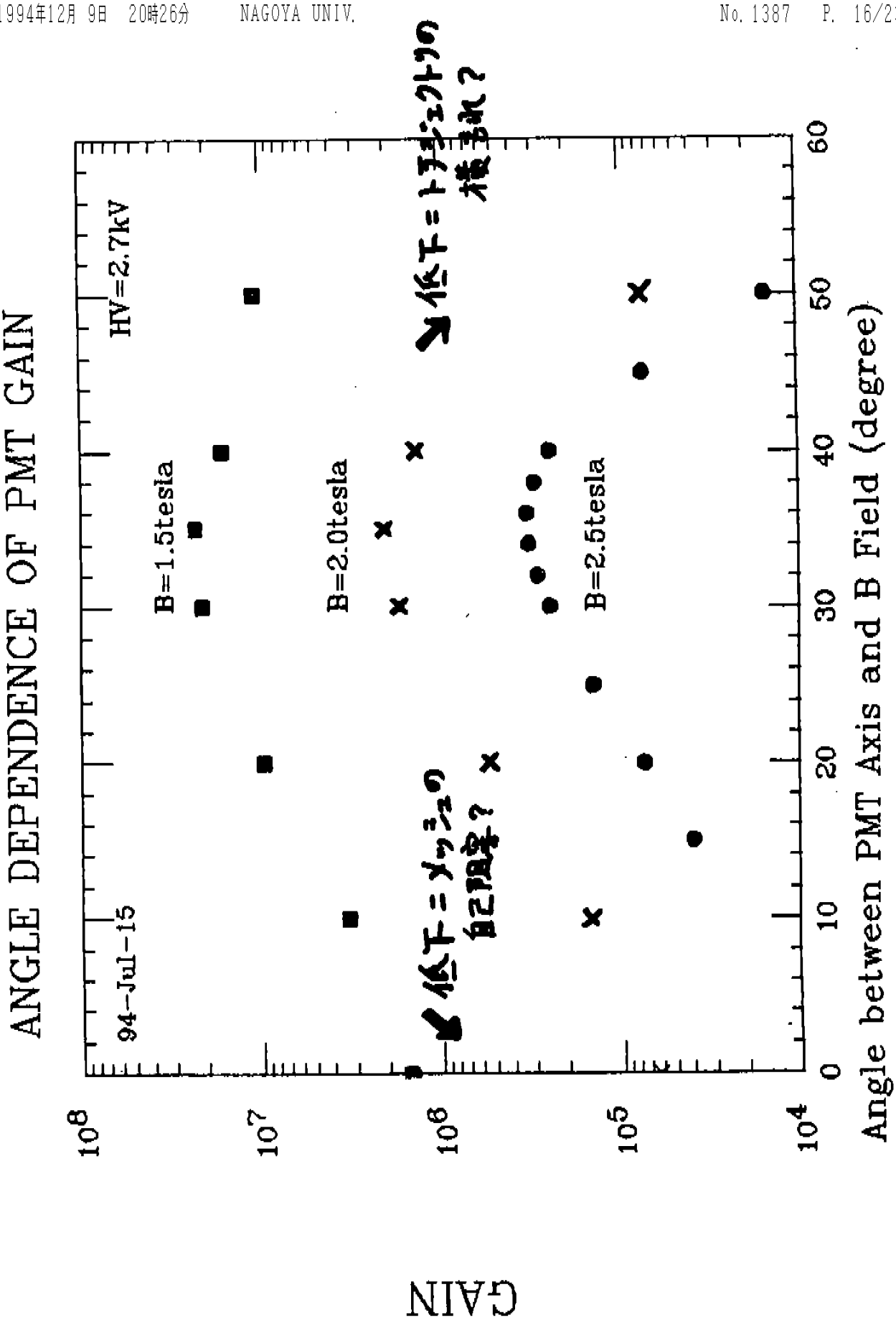
FMPMT ; 1) Hamamatsu Photonics, R2490-05 Technical data, Oct.1992
2) H.Kichimi et.al., KEK preprint 92-57, July 1992

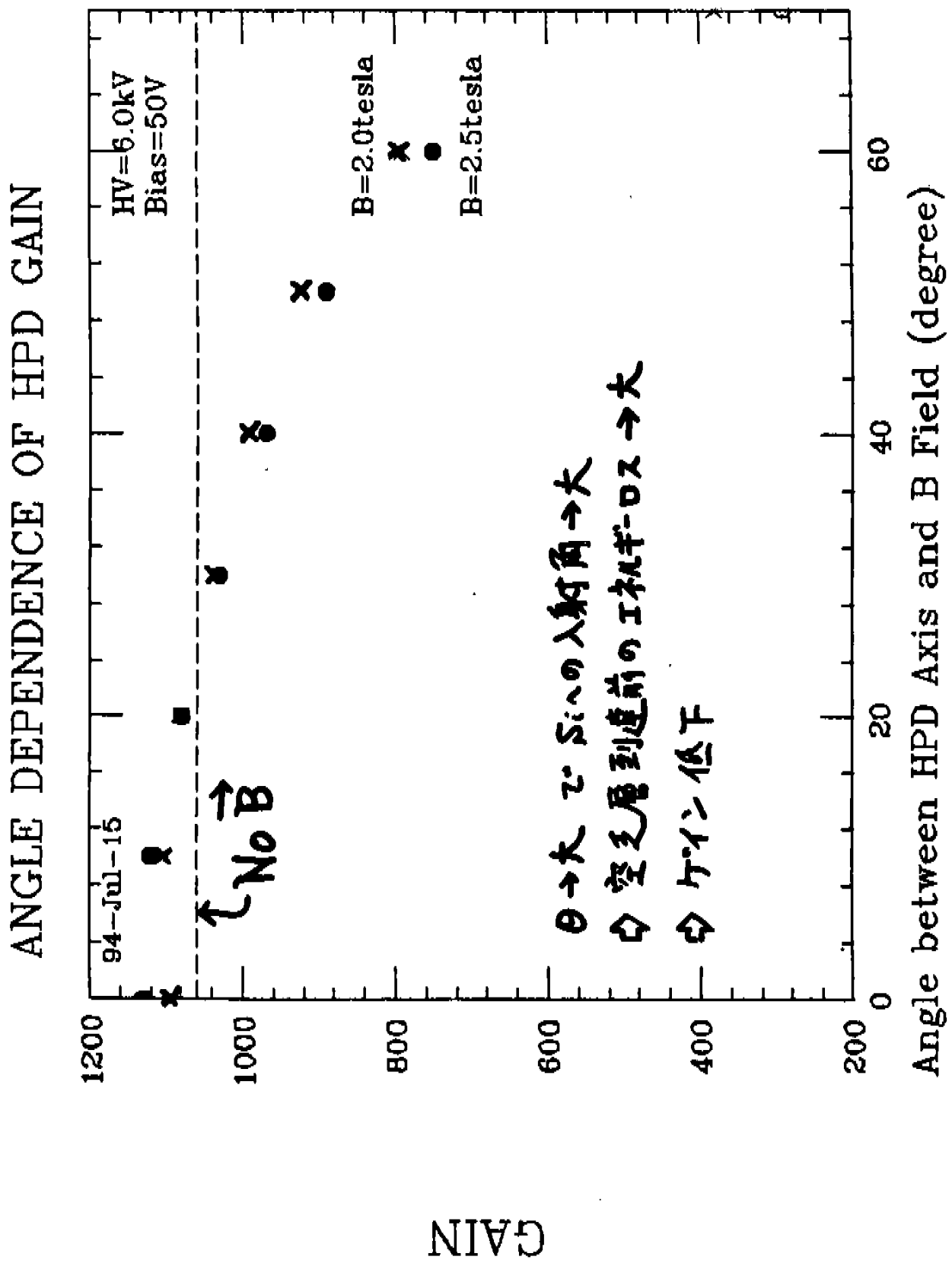
APD ; 3) Matussada Precision Inc., The Avalanche Photodiode Catalogue

HPD ; 4) Delft Electronische Producten, HPMT PP350B Technical Data
5) L.Boskma, "Overview of electro-optical systems for scintillating fiber readout" (DEP Scientific)
6) H.Arnaudon et.al., CERN-LAA/HC/93-16
7) H.Arnaudon et.al., "The Characterization and Evaluation of a Proximity Fucussed Hybrid Photo Diode", Technical Information (DEP Scientific)
8) S.Basa et.al., Nucl.Instr.Meth.A330(1993)93

VAPD ; 9) S.J.Fagen (Advanced Photonix Inc.) Seminor at KEK, Nov.1993
10) P.Cushman and R.Rusak, Nucl.Instr.Meth. A333(1993)381
11) S.J.Fagen, "Vacuum avalanche photodiodes can count single photons", Laser Focus World, Nov.1993 (PennWell Pub.Co.)

1994年12月 9日 20時25分 NAGOYA UNIV.
No.1387 P.15/23


ANGLE DEPENDENCE OF PMT GAIN
HV=2.7kV
94-Jul-15
B=1.5tesla
B=2.0tesla
B=2.5tesla
GAIN
Angle between PMT Axis and B Field (degree)


ANGLE DEPENDENCE OF HPD GAIN
HV=6.0kV
Bias=50V
B=2.0tesla
B=2.5tesla
94-Jul-15
No B
θ→大 で Si への入射角→大
⇨ 空乏層到達前のエネルギーロス→大
⇨ ゲイン低下
GAIN
Angle between HPD Axis and B Field (degree)
1200
1000
800
600
400
200
0
20
40
60

ZT中での光読出

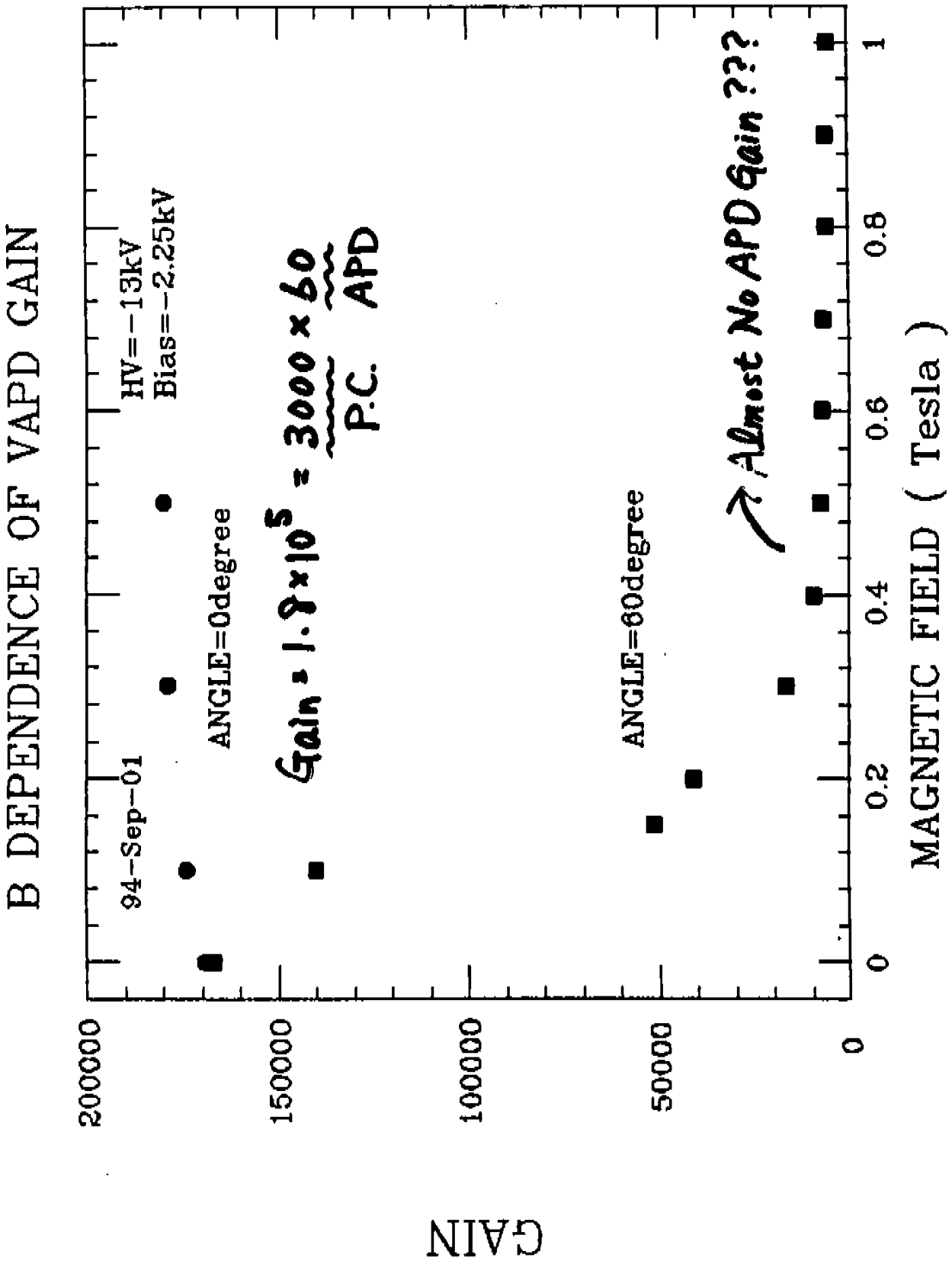
デバイステスト DONE in 7月末

High Gain HPD ~OK.

FMPMT ~OK but 取扱面倒

VAPD ~もう少し煮つめ必要

- COST (1コ~30万) が問題
- HPD用 低ノイズ プリアンプ が必要 ≲1000e⁻
- HPDのGainをぎりぎり試す.
  tested upto ~1600
  高ゲイン管 ~3300 → 5000まで


B DEPENDENCE OF VAPD GAIN
94-Sep-01
HV=-13kV
Bias=-2.25kV
ANGLE=0degree
ANGLE=60degree
Gain = 1.8×10^5 = 3000 × 60
P.C. APD
Almost No APD Gain ???
GAIN
MAGNETIC FIELD (Tesla)
200000
150000
100000
50000
0
0
0.2
0.4
0.6
0.8
1

15%/√E & 40%/√E を得る.

- Pb4mm+シンチ1mm で15%いくかどうか はビームテストが必要
- この分解能で十分/不十分のシミュレーションをさらに進める.

Si-Pad + PreShower

- ビームテスト done … Noise 大

◎Noise対策を考えた Version.2 作った.

⇒ ビームテストを予定.

- PreShowerを薄くとnon-compensated

⇒ Needs Simulation

SIMULATION

本年度重点項目の1つ

JIM

測定器シミュレータにCALを組込んだ.
(前回報告済)

⬇

パラメータ最適化 ... まで致らず.

シャワーシミュレーション

ビームテストデータ等を用いて

GEANT をチューニングする.

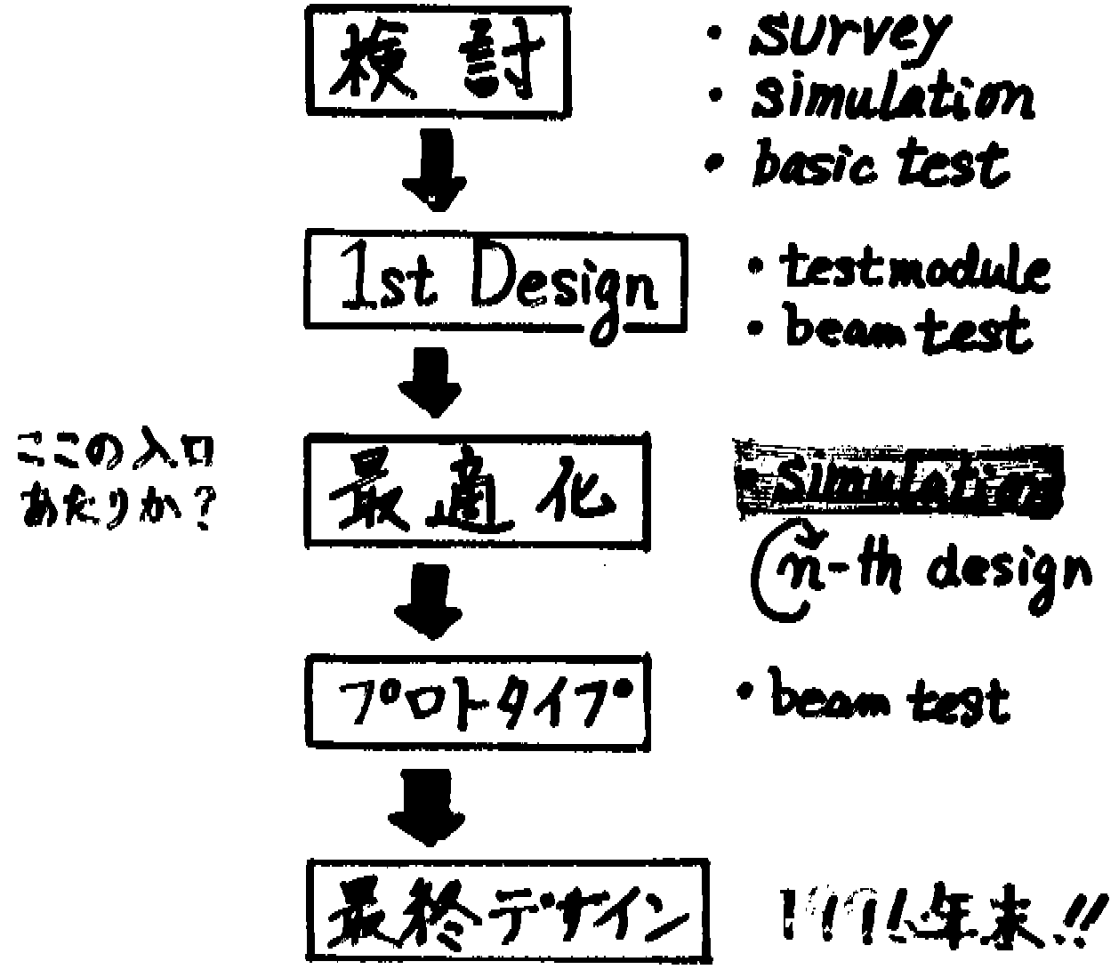
未だ再現性不十分

まとめ & 星取表 & Time Chart

'93年度	'94年度	'95年度	'96
テストモジュール製作&ビームテスト ⇨	解析 ⇨ 補正検討 e/π=1 可? ⇨	e/π テスト? EM 15% 位確認	
	⇩ Rev. Si-Pad Pre Shower ⇨	ビームテスト	
		→ SciFi コストダウンの可否 survey	
光読み出し Survey ⇨	磁場中テスト 結果良好 ⇨	さらに高性能/コストダウン	
シミュレーション & 最適化 ⇨	さらに継続 重点項目であったが ⇨	さらに継続 ひき続き重点項目	

Calorimeter Group Report

今我々はどこにいるか？



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