

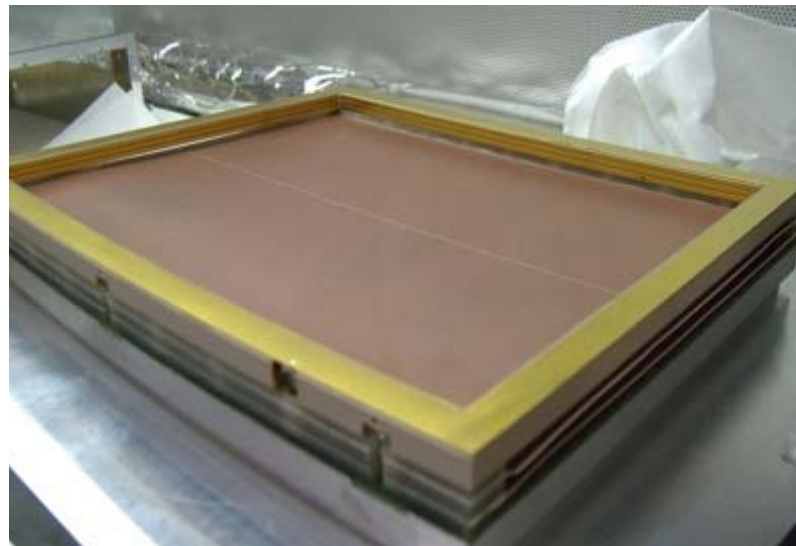
BEAM TEST in Nov. 2016.

The Main Objective of Beam Test and Rough Schedule.

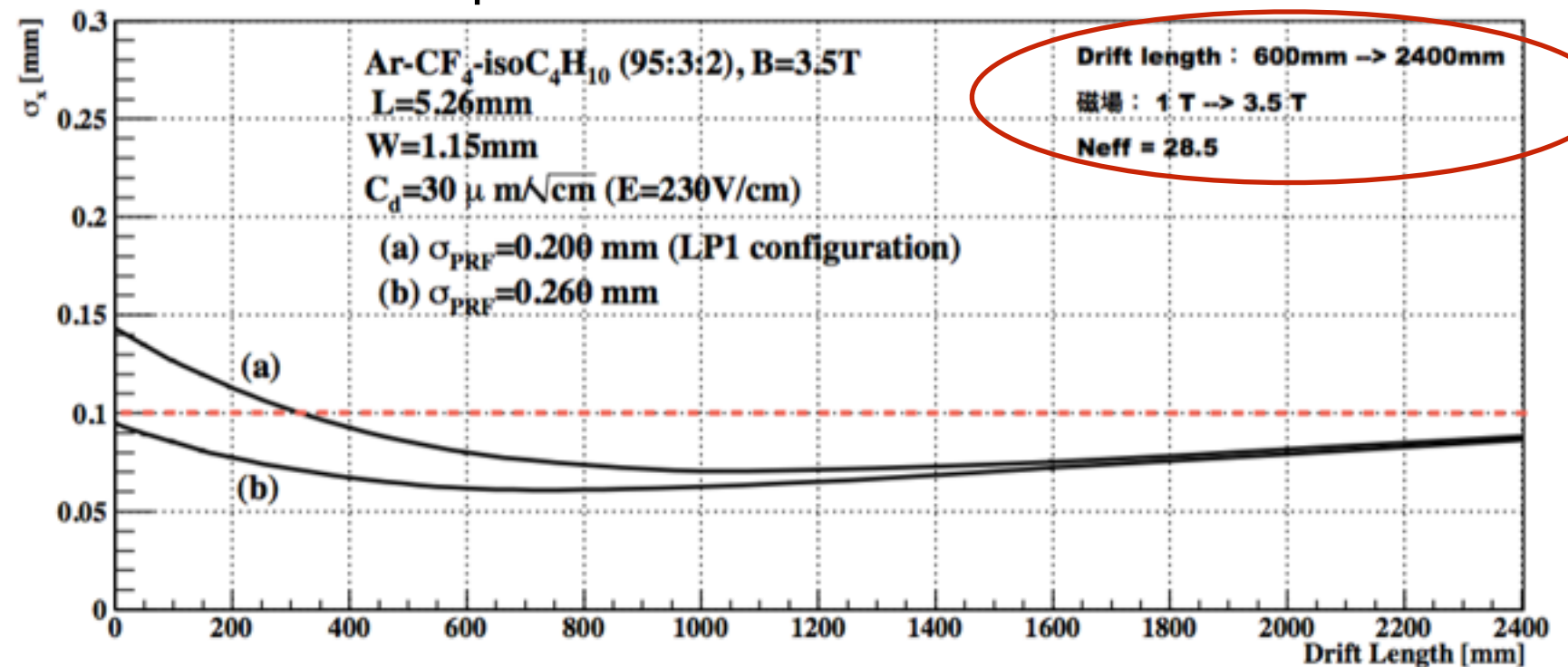
LCTPC-Asia/Japan group
Tomohisa Ogawa

Look Throw The Activities: Asian-GEM.

- >. In 2010 and 2012 Asia group carried out beam test in order to confirm that the Asian GEM design have good performance on position resolution “ $\sigma_{r\phi}$ ”.
- >. The extrapolated result based on beam test data satisfied the demand that “ $\sigma_{r\phi}$ ” should be less than 100um at 2.2m. ($\sigma_{r\phi} \sim 85\mu\text{m}$).



The extrapolated result based on beam test



- >. Ion back flow also needs to be stopped.

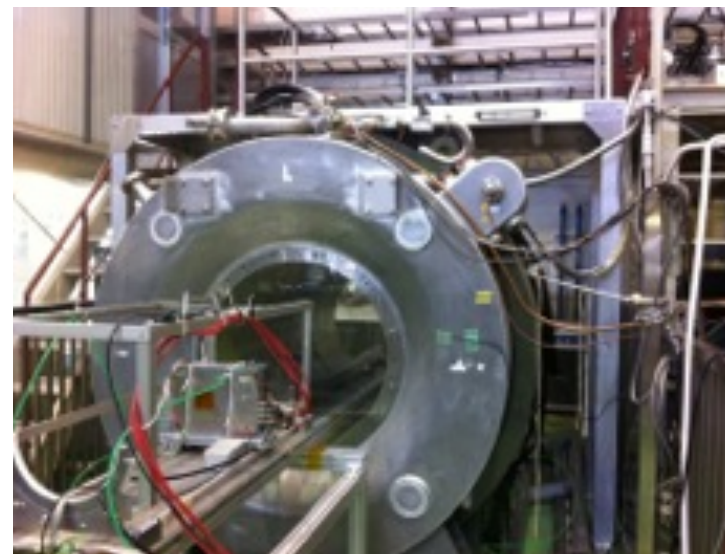
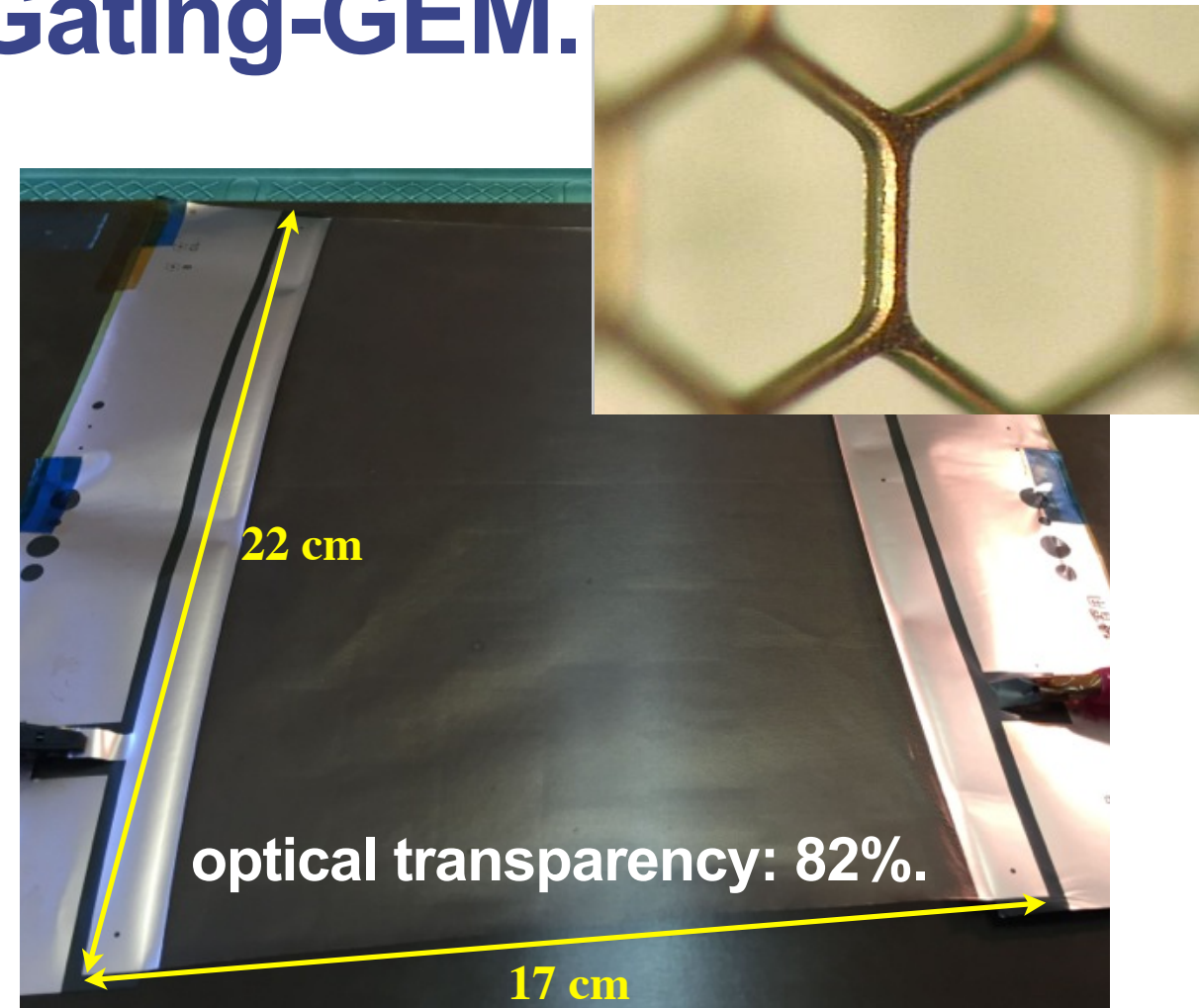
>. If the electron transmission rate is more than 80%,

“ $\sigma_{r\phi}$ ” will be still less than 100 um because $\sigma_{r\phi}$ should be proportional to $1/\sqrt{N_{\text{eff}}}$.

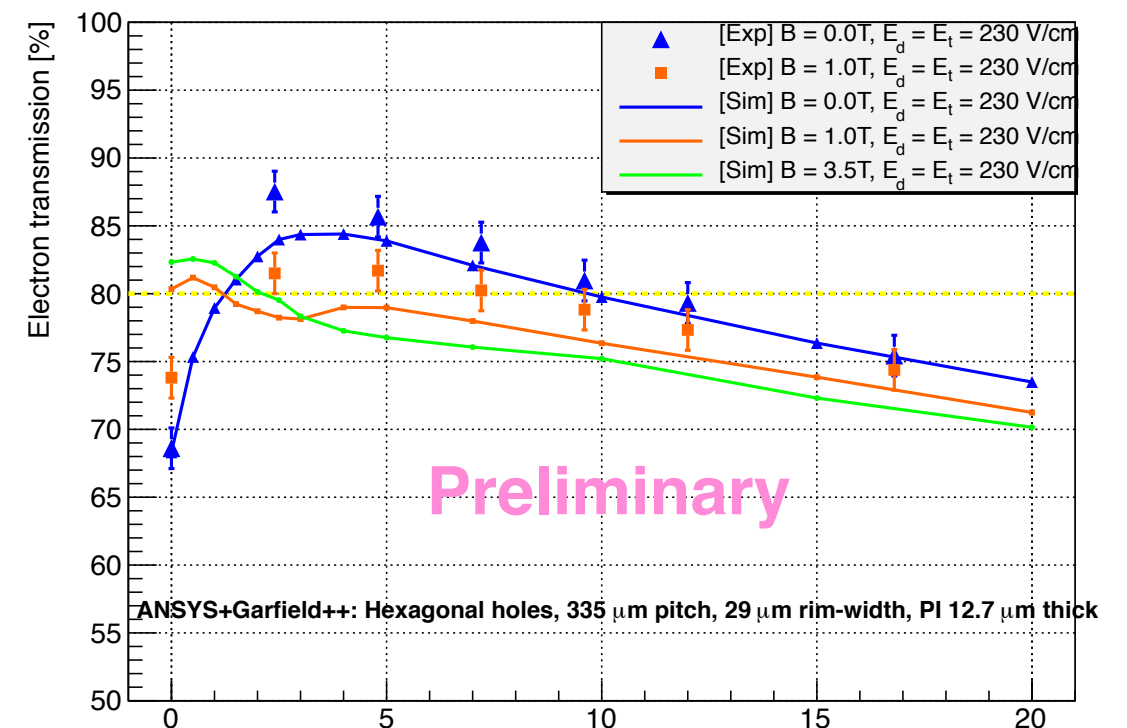
$$(85 * 1/\sqrt{0.8}) \sim 95$$

Look Throw The Activities: Gating-GEM.

- >. Asian group started to develop a high transparency gating GEM in cooperation with FIJIKURA company.
 - >. optical transparency: 82%.
- >. Saga group have also measured the elec. transmission rate with Sauli's way using small/large samples.
- >. The transmission rate achieved the good value which was more than ~80% with 1 T.
- >. Need precise simulation to estimate it with 3.5 T.



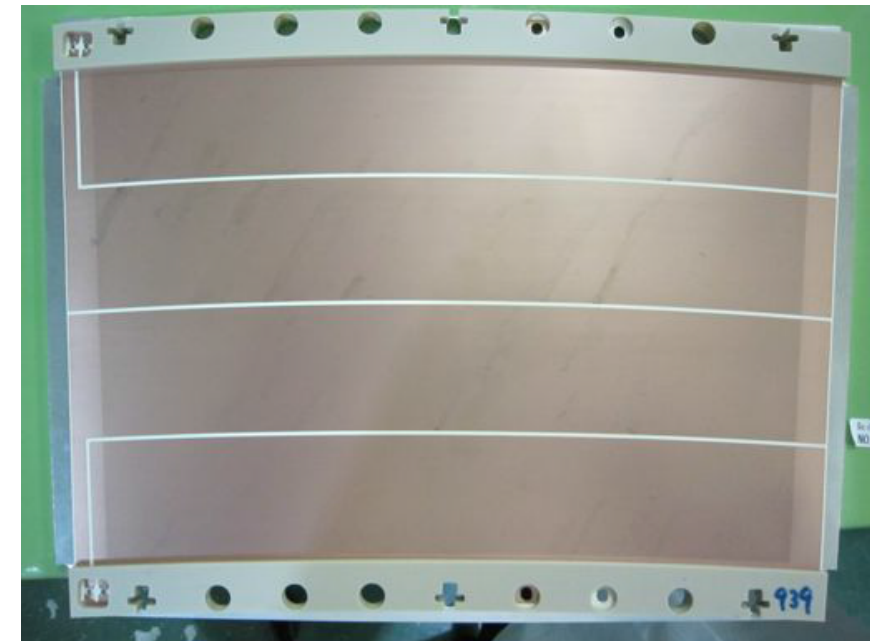
Under 1T Magnet.



The Main Objective Of Beam Test 2016.

- >. **Get a proof of position resolution “ $\sigma_{r\phi}$ ” with a gating-GEM.**
 - >. Can we really achieve the required “ $\sigma_{r\phi}$ ” for ILD-TPC?
- >. **Comparison of “ $\sigma_{r\phi}$ ” using a module equipped with a field-shaper and a gating-GEM.**
 - >. Confirm that the degradation of “ $\sigma_{r\phi}$ ” is proportional to $1/\sqrt{\text{transmission}}$.

-
- >. **Check distortions of track with new Asian-GEMs.**
 - One side is flat, another side is divided into 4 electrically.**
 - >. Distortion may be less small than that of 2010/2012 data.
 - >. **Try to construct Z resolution formula like Yonamine’s position resolution formula.**
 - >. Nobody knows.



$$\sigma_x^2(z; w, L \tan \phi, C_d, N_{eff}, \hat{N}_{eff}, [f]) = [A] + \frac{1}{N_{eff}} [B] + [C] + \frac{1}{\hat{N}_{eff}} [D]$$

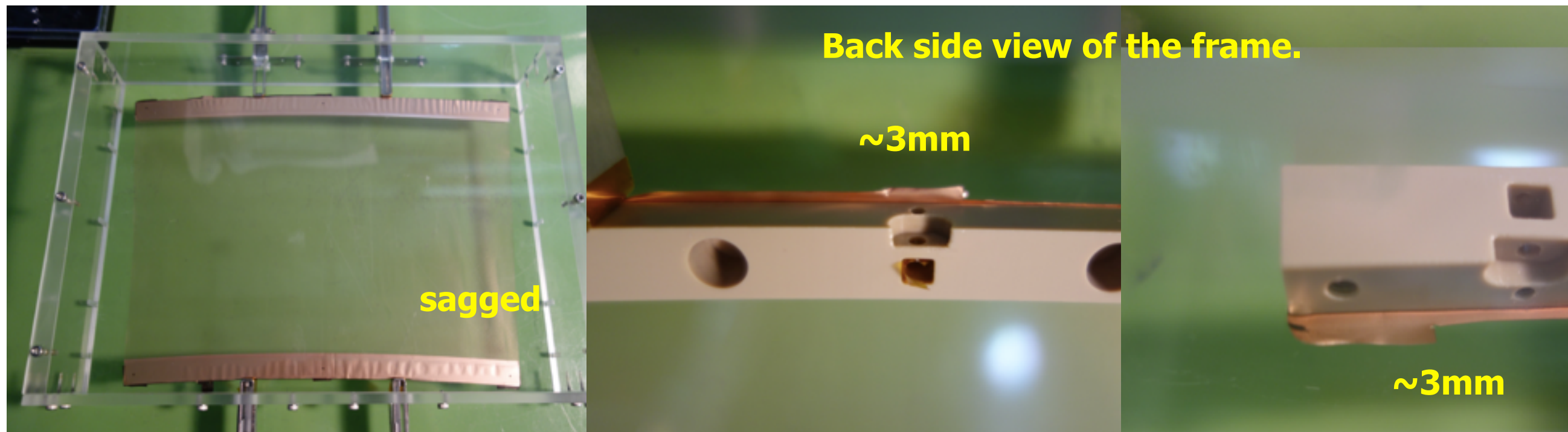
Full Frame Gating GEM.

>. A few problems on gating GEM (half frame gating GEM).

These problems are come from not precise framing.

>. A sag & protrusions.

>. After we bend protrusions and tape it, we plan to apply H.V. (Lab. test).



>. **We want to use the best gating GEM! which has no sag and no protrusions.**

>. Another gating GEM is ordered to the company.

>. This gating GEM has a square frame (full frame) to avoid a sag.

>. It will be delivered in early Sep.

Plan During Beam Time (1st Week).

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
10/30	10/31	11/ 1	2	3 文化の日	4	5
Move to the test area.	Tuning the system Noise reduction etc...		Start to Take Pede/Phys data with 1T.			
6	7	8	9	10	11	12
		Mini WS?				

- >. We need to operate electronics stably at least once in order to take data.
- >. What we are worried about is the situation that electronics is broken during operation.
 - >. The possible process we might get troubles is the time that we Un/Mount the modules. Before this step (2nd week to replace the modules), we should have minimal data set to compare " $\sigma_{r\phi}$ ". So we plan to install 2 modules which have a field shaper & a gate.
 - >. If we start operation with 2 modules, We can get minimal data set with only one-time stable operation and compare " $\sigma_{r\phi}$ ".
 - Of course same module should be used to compare performance. Above way is a kind of insurance.
 - **This is minimal line for our objective of beam test in Nov.**

Plan During Beam Time (1st Week).

>. During 1st week we plan to take enough data set for the objective.

Start with 1 [T].

>. A set of data points along Z. (9~12points)
[mm] 25, 50, 100, 150, 200, (250), 300, (350),
400, (450), 500, 550.

T = 0T, **1T(has priority)**,

$\varphi = 0^\circ, +20^\circ, -20^\circ, +10^\circ, -10^\circ$

G = nominal (3000~3500)

**Even if we finish here,
minimal data set will be taken.
The objective will be achieved.**

>. **Additional data set.**

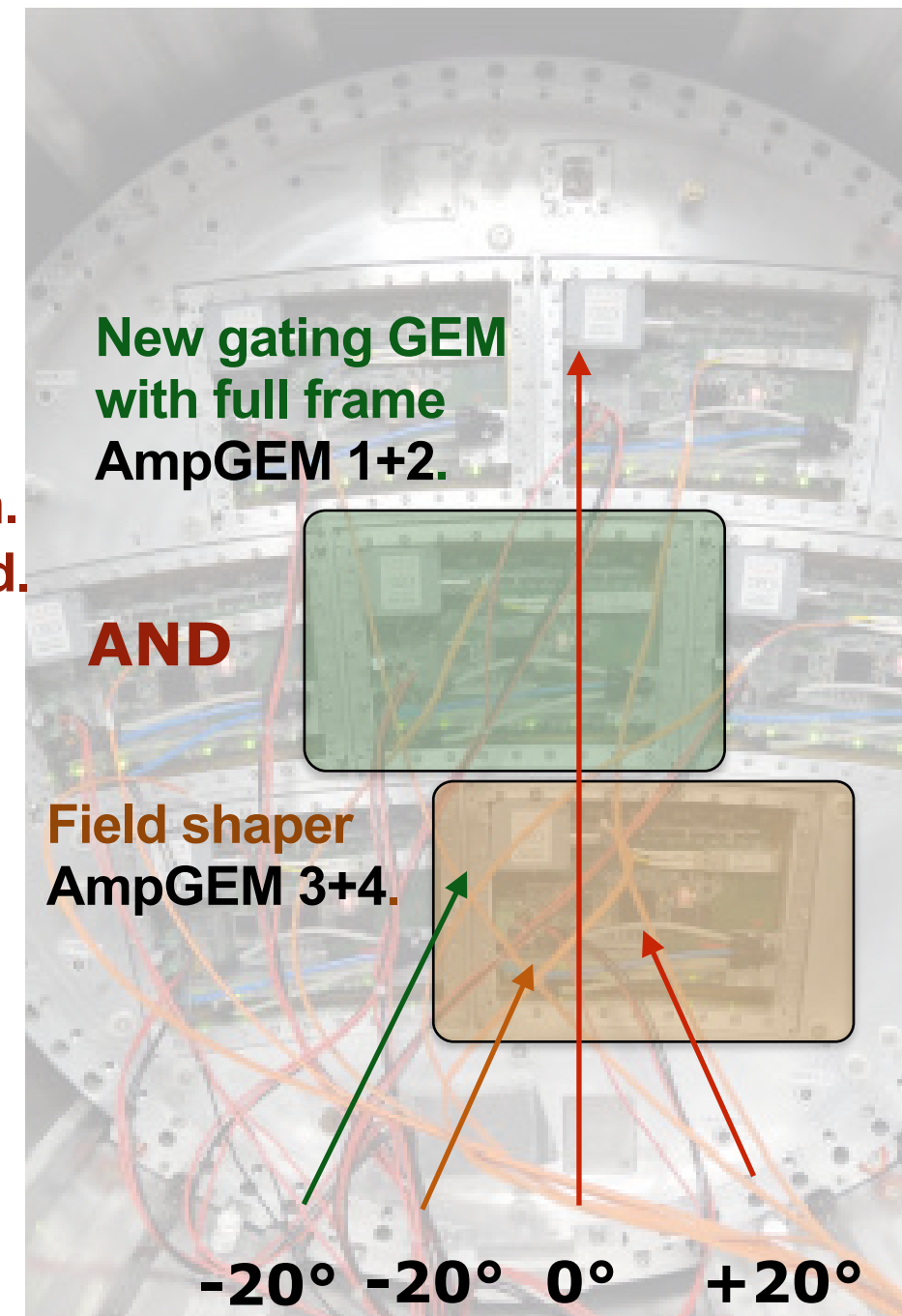
>. For Z resolution: $\theta = +30^\circ, -30^\circ, \dots$
(at $\varphi = 0^\circ$ G = nominal)

>. For Lower Gain: T=1T, $\varphi=0^\circ$, $\theta=0^\circ$.

>. $E_d \sim 110$ V/cm.

→15min/run * 9~12points
* (10set + additional run)
~ 35~45hours (4days).

>. **We should rethink replacement of modules
before/after 11/8. (including a plan of data set)**



Plan During Beam Time (2nd Week).

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
10/30	10/31	11/ 1	2	3 文化の日	4	5
Move to the test area.	Tuning the system Noise reduction etc...		Start to Take Pede/Phys data with 1T.			
6	7	8	9	10	11	12
		Mini WS?	Start 2nd operation with 1T.			

>. The purpose is to take data under the same conditions.
Just replace upper devices.

(Same AmpGEMs, position, electronics)

>. Another module is applied H.V but
no ALTRO connection?

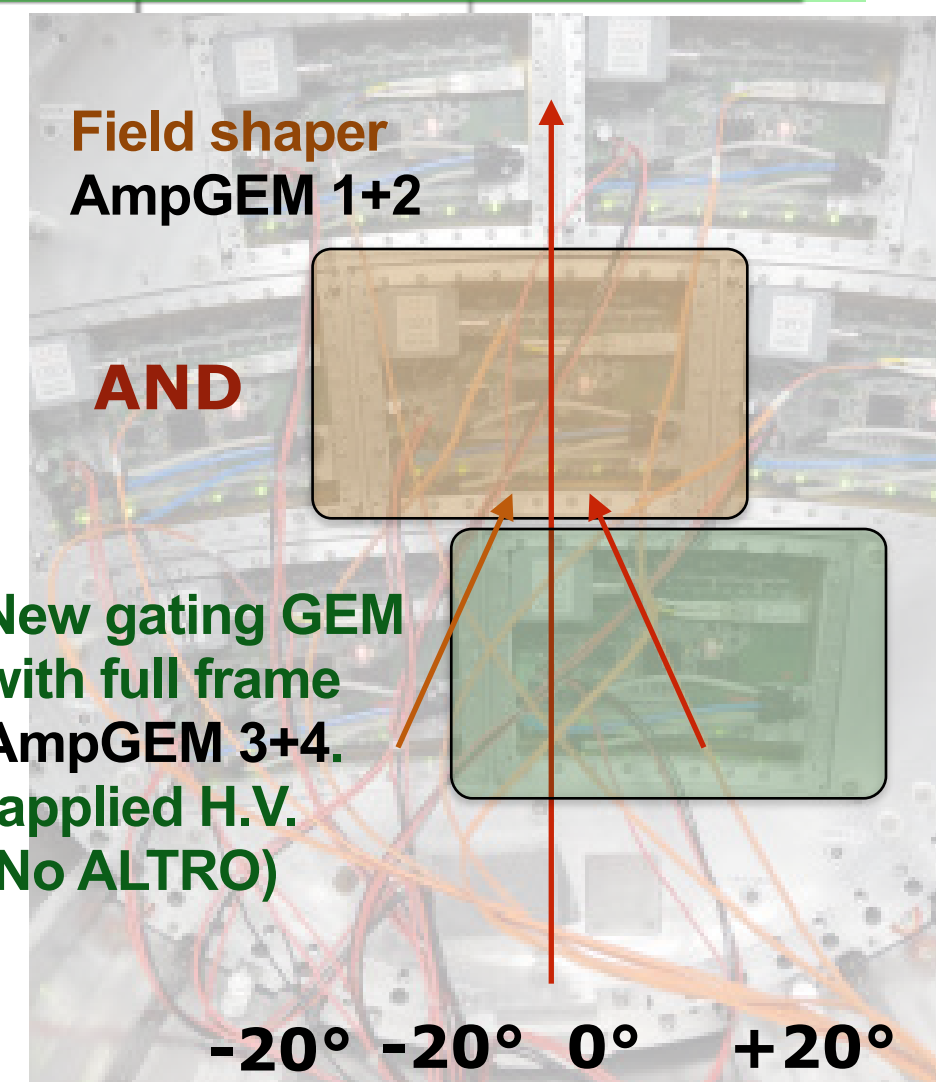
>. A set of data points along Z. (9~12points)
[mm] 25, 50, 100, 150, 200, (250), 300, (350),
400, (450), 500, 550.

T = 0T, **1T(has priority)**,

$\varphi = 0^\circ, +20^\circ, -20^\circ, +10^\circ, -10^\circ$

G = nominal (3000~3500)

>. **Additional data set.**



Summary.

- >. We are planning to carry out beam test in this Nov.
- >. The main objective is to take data with gating GEM in order to proof that it has still good performance on position resolution “ $\sigma_{r\phi}$ ”.

Memo

(0) It would be good if you can discuss the measurement errors of the effective numbers of electrons from the past beam tests and try to convert them into that of the electron transmission of the gate GEM to be measured this time.

$N_{\text{eff}} \sim 35.86 \pm 1.82$ (2010 data)

Err 2.078 %

20% electron loss

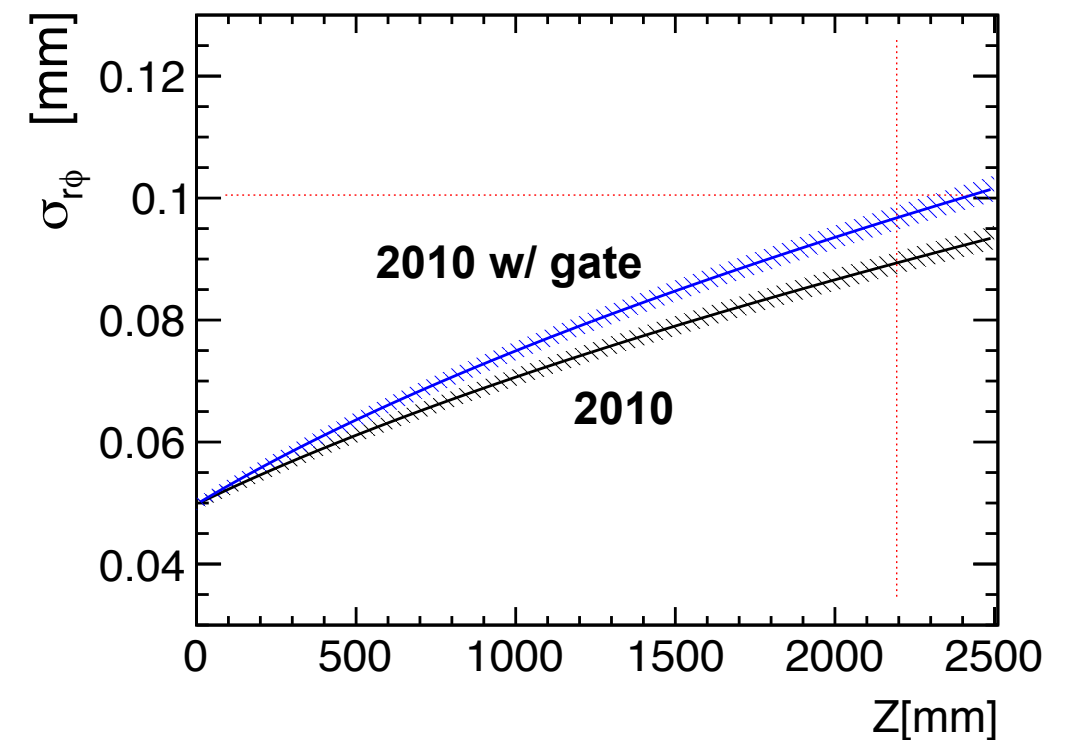
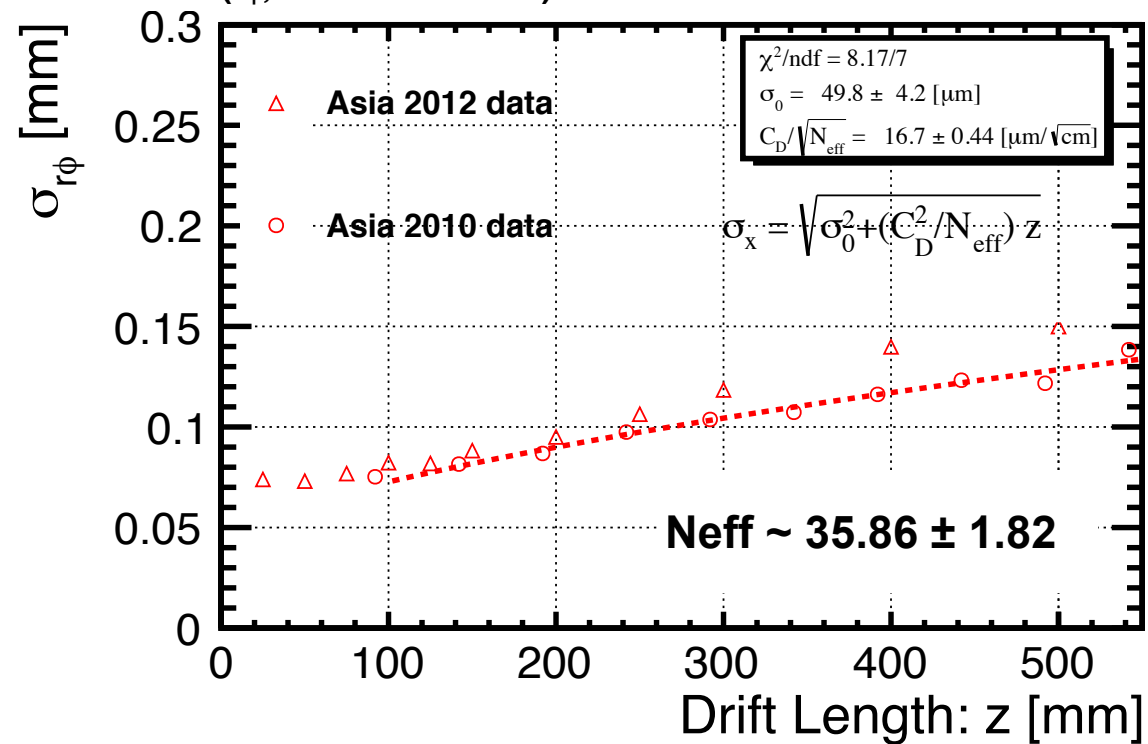
resolution curve along Z with 3.5T.

No Use Yonamine formula.

$C_d \sim 100 \text{ } \mu\text{m}/\sqrt{\text{cm}} @ 1.0\text{T}$

$C_d \sim 30 \text{ } \mu\text{m}/\sqrt{\text{cm}} @ 3.5\text{T}$

GM Resolutin (r_ϕ , Module3 Row16)



Memo

(0) It would be good if you can discuss the measurement errors of the effctice numbers of electrons from the past beam tests and try to convert them into that of the electron transmission of the gate GEM to be measured this time.

Neff ~ 35.86 ± 1.82 (2010 data)

Err 2.078 %

20% electron loss

resolution curve along Z with 3.5T.

No Use Yonamine formula.

(2) It would be more clear if you could add some operation parameters of the Asian modules (amp. GEM voltages, the gain, etc) for the people who will join the test from other groups.

Gain 3000~4000 Electron loss ~ 20% due to a gating GEM.

3000 is a bit small according to Yonamine's opinion.

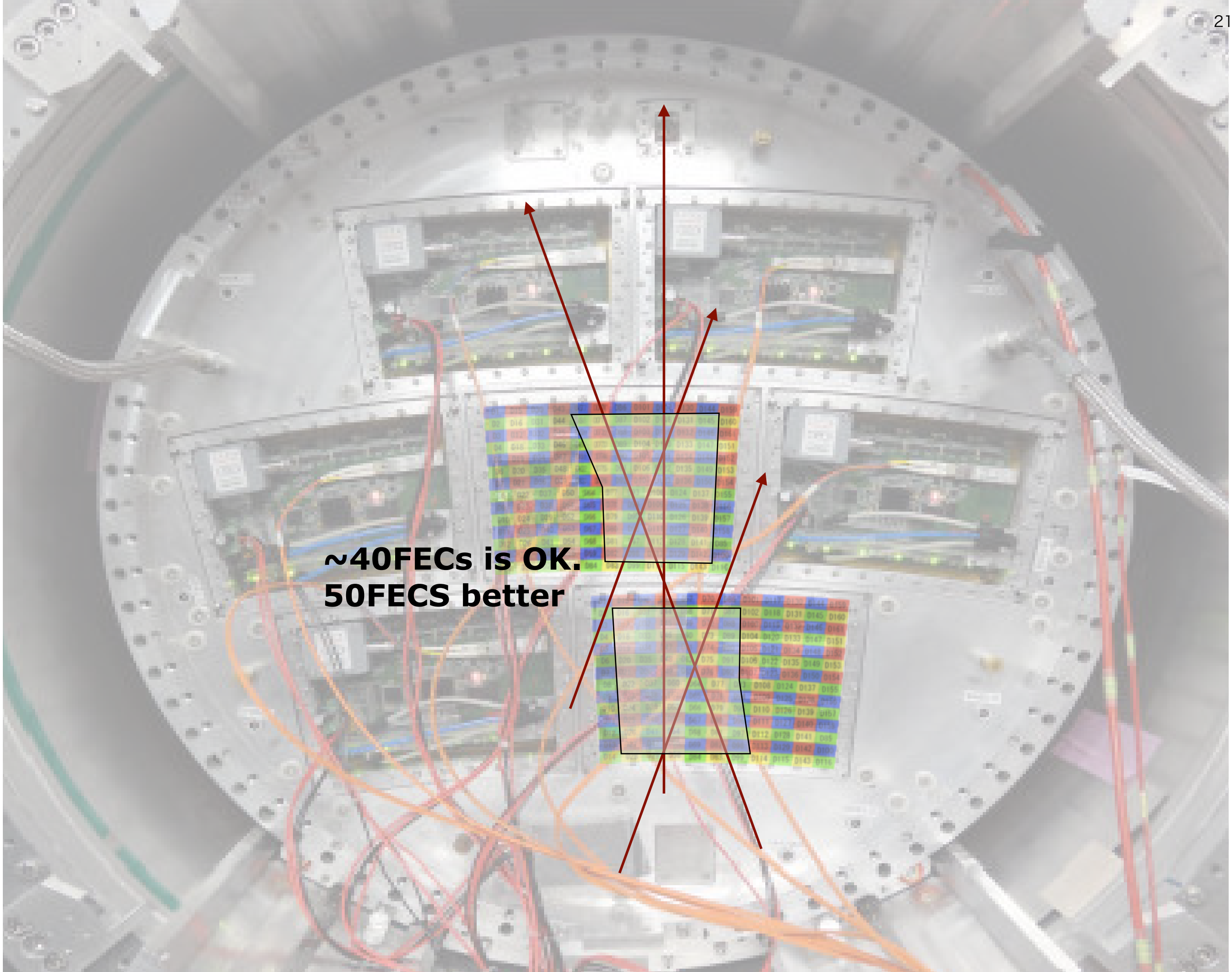
H.V for lower : 315 if 320 → discharge increase on the current GEM.

H.V for upper : 345 ~ 355

(4) In the LCTPC WP meeting tonight, it might be helpful to explain the gain non-uniformity and its possible cause of the Scienergy GEM (since they do not know about them), and ask about the gain uniformities of the other two modules, in particular the DESY module.

Another topic.

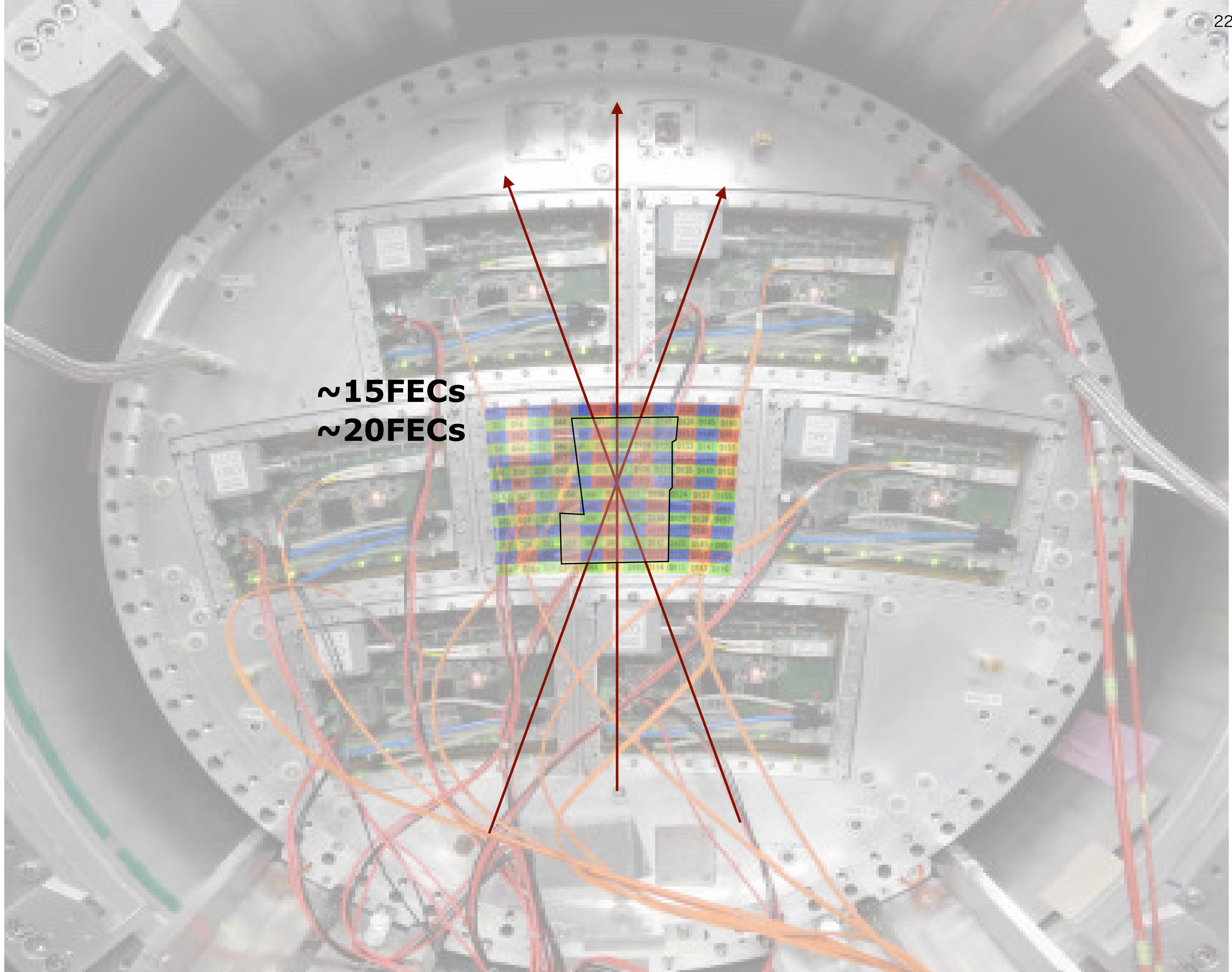
BACK UP.



**~40FECs is OK.
50FECs better**

D100	D101	D102	D103	D104	D105	D106	D107	D108	D109
D110	D111	D112	D113	D114	D115	D116	D117	D118	D119
D120	D121	D122	D123	D124	D125	D126	D127	D128	D129
D130	D131	D132	D133	D134	D135	D136	D137	D138	D139
D140	D141	D142	D143	D144	D145	D146	D147	D148	D149
D150	D151	D152	D153	D154	D155	D156	D157	D158	D159
D160	D161	D162	D163	D164	D165	D166	D167	D168	D169
D170	D171	D172	D173	D174	D175	D176	D177	D178	D179
D180	D181	D182	D183	D184	D185	D186	D187	D188	D189
D190	D191	D192	D193	D194	D195	D196	D197	D198	D199

D200	D201	D202	D203	D204	D205	D206	D207	D208	D209
D210	D211	D212	D213	D214	D215	D216	D217	D218	D219
D220	D221	D222	D223	D224	D225	D226	D227	D228	D229
D230	D231	D232	D233	D234	D235	D236	D237	D238	D239
D240	D241	D242	D243	D244	D245	D246	D247	D248	D249
D250	D251	D252	D253	D254	D255	D256	D257	D258	D259
D260	D261	D262	D263	D264	D265	D266	D267	D268	D269
D270	D271	D272	D273	D274	D275	D276	D277	D278	D279
D280	D281	D282	D283	D284	D285	D286	D287	D288	D289
D290	D291	D292	D293	D294	D295	D296	D297	D298	D299



~15 FECs

~20 FECs

01	015	005	043	01009	010	0173	0130	0144	0159
02	016	033	044	01010	011	0174	0131	0145	0160
03	017	034	045	01011	012	0175	0132	0146	0161
04	018	035	046	01012	013	0176	0133	0147	0162
05	019	036	047	01013	014	0177	0134	0148	0163
06	020	037	048	01014	015	0178	0135	0149	0164
07	021	038	049	01015	016	0179	0136	0150	0165
08	022	039	050	01016	017	0180	0137	0151	0166
09	023	040	051	01017	018	0181	0138	0152	0167
10	024	041	052	01018	019	0182	0139	0153	0168
11	025	042	053	01019	020	0183	0140	0154	0169
12	026	043	054	01020	021	0184	0141	0155	0170
13	027	044	055	01021	022	0185	0142	0156	0171
14	028	045	056	01022	023	0186	0143	0157	0172
15	029	046	057	01023	024	0187	0144	0158	0173
16	030	047	058	01024	025	0188	0145	0159	0174
17	031	048	059	01025	026	0189	0146	0160	0175
18	032	049	060	01026	027	0190	0147	0161	0176
19	033	050	061	01027	028	0191	0148	0162	0177
20	034	051	062	01028	029	0192	0149	0163	0178
21	035	052	063	01029	030	0193	0150	0164	0179
22	036	053	064	01030	031	0194	0151	0165	0180
23	037	054	065	01031	032	0195	0152	0166	0181
24	038	055	066	01032	033	0196	0153	0167	0182
25	039	056	067	01033	034	0197	0154	0168	0183
26	040	057	068	01034	035	0198	0155	0169	0184
27	041	058	069	01035	036	0199	0156	0170	0185
28	042	059	070	01036	037	0200	0157	0171	0186
29	043	060	071	01037	038	0201	0158	0172	0187
30	044	061	072	01038	039	0202	0159	0173	0188
31	045	062	073	01039	040	0203	0160	0174	0189
32	046	063	074	01040	041	0204	0161	0175	0190
33	047	064	075	01041	042	0205	0162	0176	0191
34	048	065	076	01042	043	0206	0163	0177	0192
35	049	066	077	01043	044	0207	0164	0178	0193
36	050	067	078	01044	045	0208	0165	0179	0194
37	051	068	079	01045	046	0209	0166	0180	0195
38	052	069	080	01046	047	0210	0167	0181	0196
39	053	070	081	01047	048	0211	0168	0182	0197
40	054	071	082	01048	049	0212	0169	0183	0198
41	055	072	083	01049	050	0213	0170	0184	0199
42	056	073	084	01050	051	0214	0171	0185	0200
43	057	074	085	01051	052	0215	0172	0186	0201
44	058	075	086	01052	053	0216	0173	0187	0202
45	059	076	087	01053	054	0217	0174	0188	0203
46	060	077	088	01054	055	0218	0175	0189	0204
47	061	078	089	01055	056	0219	0176	0190	0205
48	062	079	090	01056	057	0220	0177	0191	0206
49	063	080	091	01057	058	0221	0178	0192	0207
50	064	081	092	01058	059	0222	0179	0193	0208
51	065	082	093	01059	060	0223	0180	0194	0209
52	066	083	094	01060	061	0224	0181	0195	0210
53	067	084	095	01061	062	0225	0182	0196	0211
54	068	085	096	01062	063	0226	0183	0197	0212
55	069	086	097	01063	064	0227	0184	0198	0213
56	070	087	098	01064	065	0228	0185	0199	0214
57	071	088	099	01065	066	0229	0186	0200	0215
58	072	089	100	01066	067	0230	0187	0201	0216
59	073	090	101	01067	068	0231	0188	0202	0217
60	074	091	102	01068	069	0232	0189	0203	0218
61	075	092	103	01069	070	0233	0190	0204	0219
62	076	093	104	01070	071	0234	0191	0205	0220
63	077	094	105	01071	072	0235	0192	0206	0221
64	078	095	106	01072	073	0236	0193	0207	0222
65	079	096	107	01073	074	0237	0194	0208	0223
66	080	097	108	01074	075	0238	0195	0209	0224
67	081	098	109	01075	076	0239	0196	0210	0225
68	082	099	110	01076	077	0240	0197	0211	0226
69	083	100	111	01077	078	0241	0198	0212	0227
70	084	101	112	01078	079	0242	0199	0213	0228
71	085	102	113	01079	080	0243	0200	0214	0229
72	086	103	114	01080	081	0244	0201	0215	0230
73	087	104	115	01081	082	0245	0202	0216	0231
74	088	105	116	01082	083	0246	0203	0217	0232
75	089	106	117	01083	084	0247	0204	0218	0233
76	090	107	118	01084	085	0248	0205	0219	0234
77	091	108	119	01085	086	0249	0206	0220	0235
78	092	109	120	01086	087	0250	0207	0221	0236
79	093	110	121	01087	088	0251	0208	0222	0237
80	094	111	122	01088	089	0252	0209	0223	0238
81	095	112	123	01089	090	0253	0210	0224	0239
82	096	113	124	01090	091	0254	0211	0225	0240
83	097	114	125	01091	092	0255	0212	0226	0241
84	098	115	126	01092	093	0256	0213	0227	0242
85	099	116	127	01093	094	0257	0214	0228	0243
86	100	117	128	01094	095	0258	0215	0229	0244
87	101	118	129	01095	096	0259	0216	0230	0245
88	102	119	130	01096	097	0260	0217	0231	0246
89	103	120	131	01097	098	0261	0218	0232	0247
90	104	121	132	01098	099	0262	0219	0233	0248
91	105	122	133	01099	100	0263	0220	0234	0249
92	106	123	134	01100	101	0264	0221	0235	0250
93	107	124	135	01101	102	0265	0222	0236	0251
94	108	125	136	01102	103	0266	0223	0237	0252
95	109	126	137	01103	104	0267	0224	0238	0253
96	110	127	138	01104	105	0268	0225	0239	0254
97	111	128	139	01105	106	0269	0226	0240	0255
98	112	129	140	01106	107	0270	0227	0241	0256
99	113	130	141	01107	108	0271	0228	0242	0257
100	114	131	142	01108	109	0272	0229	0243	0258
101	115	132	143	01109	110	0273	0230	0244	0259
102	116	133	144	01110	111	0274	0231	0245	0260
103	117	134	145	01111	112	0275	0232	0246	0261
104	118	135	146	01112	113	0276	0233	0247	0262
105	119	136	147	01113	114	0277	0234	0248	0263
106	120	137	148	01114	115	0278	0235	0249	0264
107	121	138	149	01115	116	0279	0236	0250	0265
108	122	139	150	01116	117	0280	0237	0251	0266
109	123	140	151	01117	118	0281	0238	0252	0267
110	124	141	152	01118	119	0282	0239	0253	0268
111	125	142	153	01119	120	0283	0240	0254	0269
112	126	143	154	01120	121	0284	0241	0255	0270
113	127	144	155	01121	122	0285	0242	0256	0271
114	128	145	156	01122	123	0286	0243	0257	0272
115	129	146	157	01123	124	0287	0244	0258	0273
116	130	147	158	01124	125	0288	0245	0259	0274
117	131	148	159	01125	126	0289	0246	0260	0275
118	132	149	160	01126	127	0290	0247	0261	0276
119	133	150	161	01127	128	0291	0248	0262	0277
120	134	151	162	01128	129	0292	0249	0263	0278
121	135	152	163	01129	130	0293	0250	0264	0279
122	136	153	164	01130	131	0294	0251	0265	0280
123	137	154	165	01131	132	0295	0252	0266	0281
124	138	155	166	01132	133	0296	0253	0267	0282
125	139	156	167	01133	134	0297	0254	0268	0283
126	140	157	168	01134	135	0298	0255	0269	0284
127	141	158	169	01135	136	0299	0256	0270	0285
128	142	159	170	01136	137	0300	0257	0271	0286
129	143	160	171	01137	138	0301	0258	0272	0287
130	144	161	172	01138	139	0302	0259	0273	0288
131	145	162	173	01139	140	0303	0260	0274	0289
132	146	163	174	01140	141	0304	0261	0275	0290
133	147	164	175	01141	142	0305	0262	0276	0291
134	148	165	176	01142	143	0306	0263	0277	0292
135	149	166	177	01143	144	0307	0264	0278	0293
136	150	167	178						