Recent developments with the ILC Accelerator

Progress since AWLC
Selected topics

- XFEL Cavity gradient
- Positron source R&D
- AD&I Activities
- ATF2
- MDI-BDS

K. Yokoya

2014.9.7 ILD Meeting 2014, Oushuu

XFEL Cavity Statistics

- Status as of Jul.31 reported at LINAC2014
- 840 cavities planned, 404 delivered, 382 tested.
- Definition of "usable gradient"
  - < Quench, Q0 >1e10, X-ray < certain limit
- Acceptance criteria changed:
  - Usable gradient 26MV/m → 20MV/m

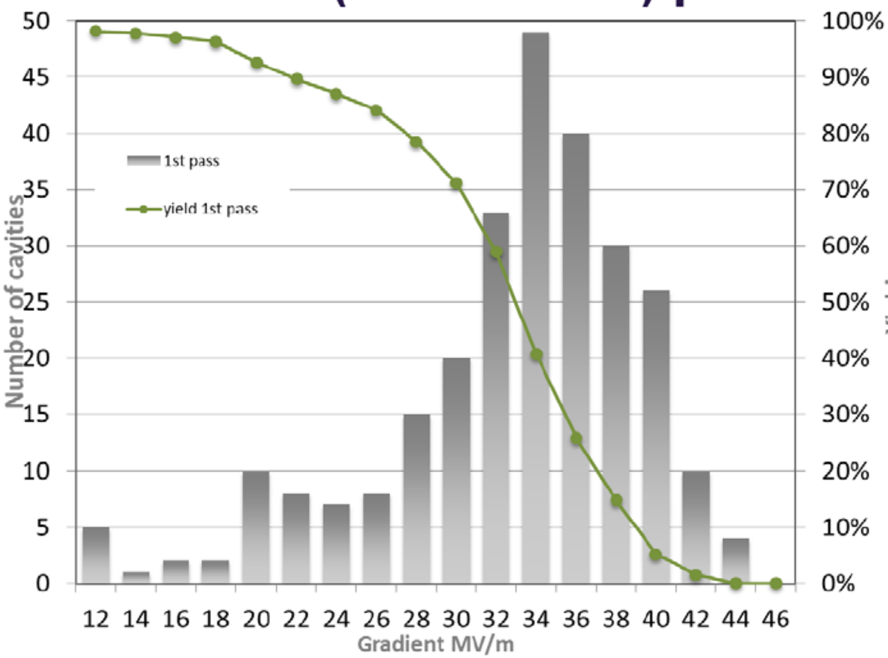
XFEL Status May 6, 2014 (Old criteria, 1st pass)

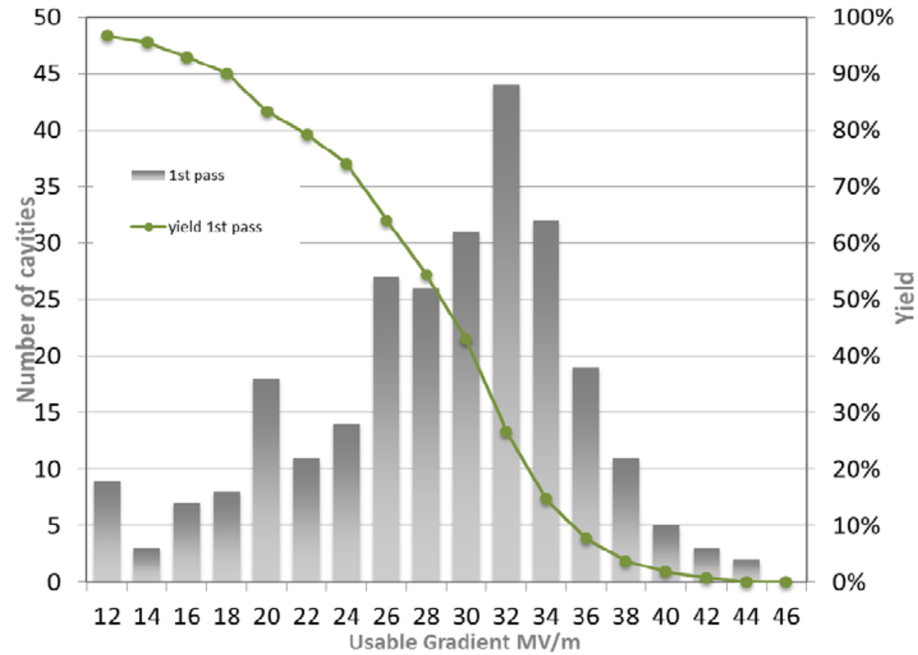
European **XFEL**

Status of XFEL Series Cavity Results

Yield of gradients: As received / 1. Pass

- Yield of usable and maximum gradient of **271 cavities as received => 64 % (174 cavities) passed**





Average **maximum** gradient:

(31.1 ± 6.8) MV/m

EZ: (29.2 ± 6.3) MV/m

RI: (33.6 ± 6.5) MV/m

Average **usable** gradient:

(26.8 ± 7.1) MV/m

EZ: (25.4 ± 6.5) MV/m

RI: (28.8 ± 7.4) MV/m

XFEL Status May 6, 2014 (Old criteria, 2^{nd} pass)

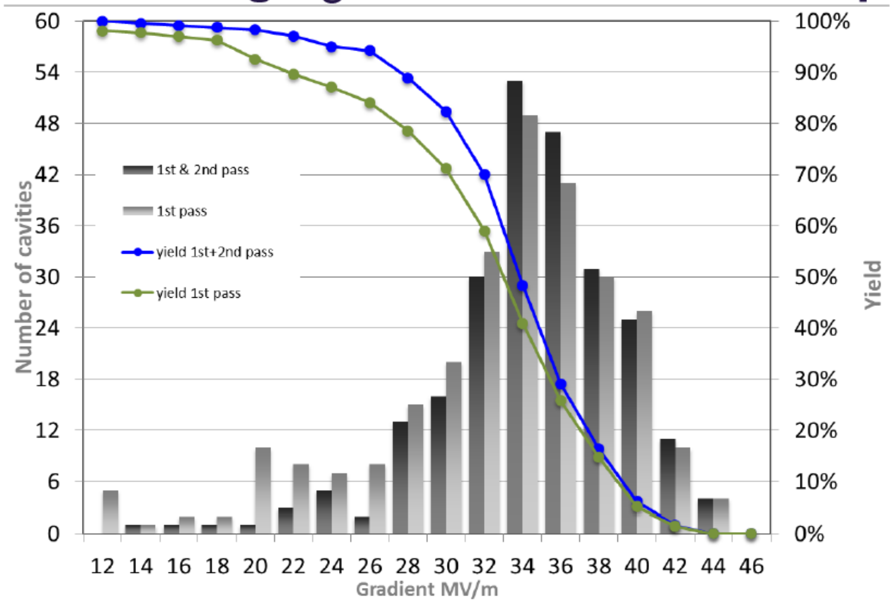
European XFEL

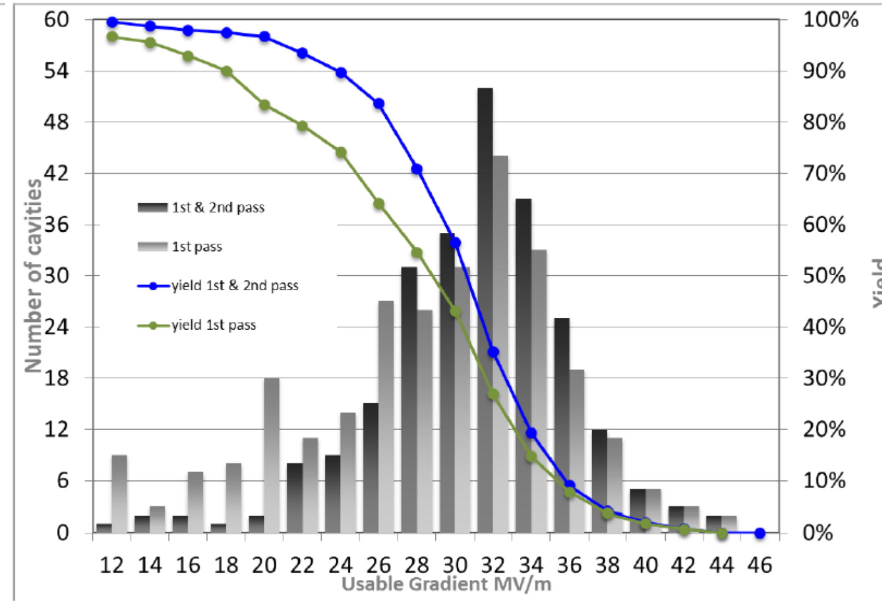
Status of XFEL Series Cavity Results

Yield of gradients: After 1. re-treatment (2. pass)

12

- Yield of usable and maximum gradient of ~244 cavities (2.pass)
  => 84% (204 cavities) => sum of “as received” + 1. re-treatment
- **Average** gradients **increased + spread reduced**



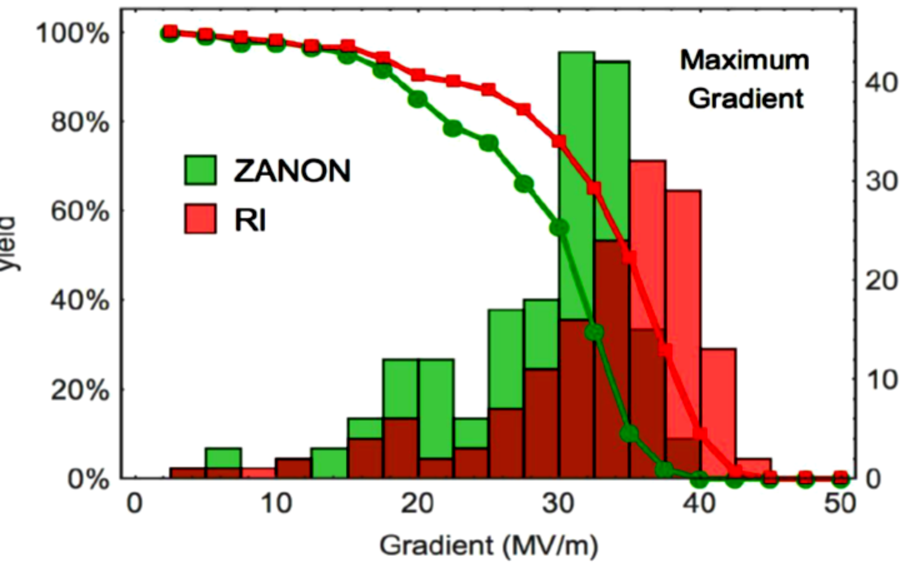


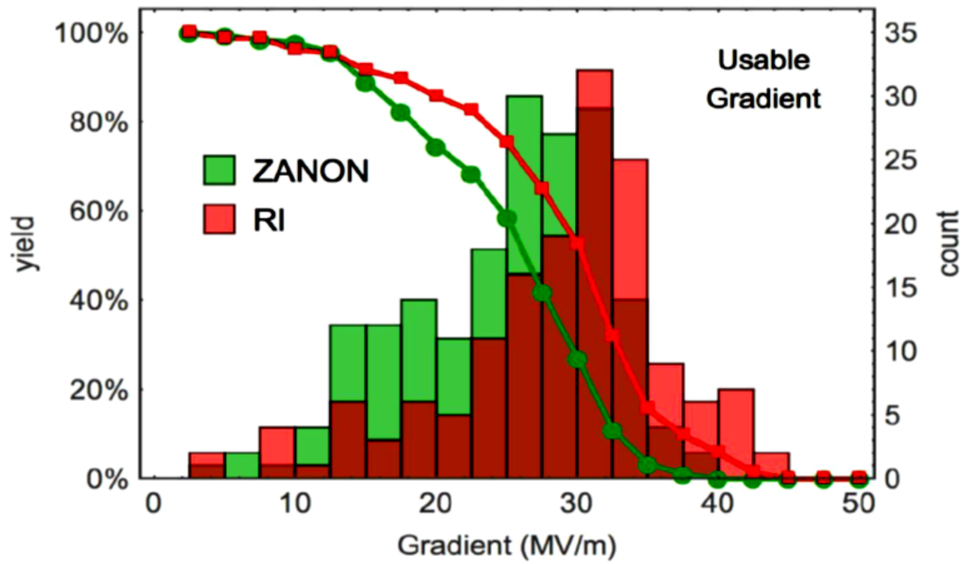
Average **maximum** gradient:
(33.0 ± 4.8) MV/m
EZ: (31.3 ± 4.3) MV/m
RI: (35.0 ± 4.6) MV/m

Average **usable** gradient:
(29.6 ± 5.1) MV/m
EZ: (28.4 ± 4.4) MV/m
RI: (30.9 ± 5.4) MV/m

Yield of gradients: "As received"

- Yield of usable and maximum gradient of **339 cavities "as received"** (EZ: 185; RI:154)





Average **maximum** gradient:

(30.4 ± 7.6) MV/m

EZ: (28.4 ± 7.1) MV/m

RI: (32.4 ± 7.6) MV/m

Average **usable** gradient:

(26.6 ± 7.6) MV/m

EZ: (24.8 ± 7.0) MV/m

RI: (28.6 ± 7.9) MV/m

given errors are standard deviation

Detailed vertical test analysis see **Poster THPP021**

J.Swierblewski, LINSC2014

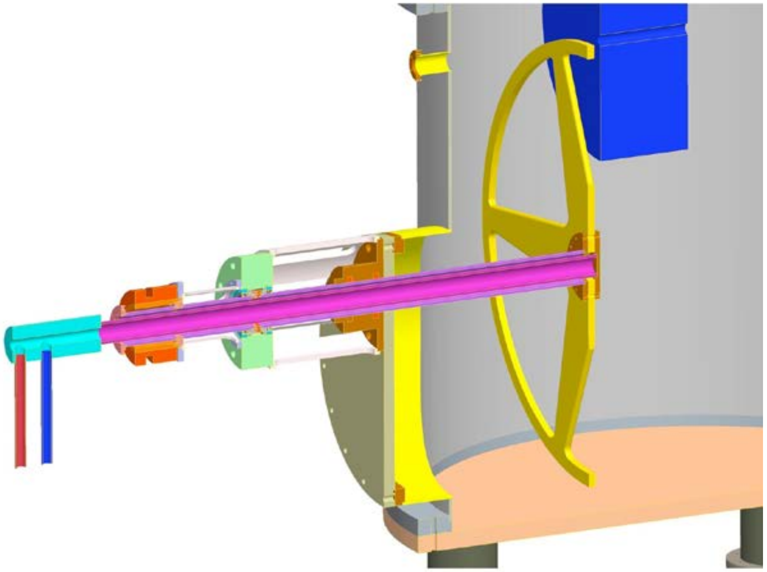
Positron Source

- The only area where real R&D is needed, in particular:
  - Baseline undulator scheme
    - **Target**---- most critical
    - Flux concentrator
  - Backup electron-driven scheme
    - Target R&D
    - Consistency check
- POSIPOL2014 Aug.27-29 @ Ichinoseki Library
  - Make proposal of R&D plan for the next couple of years

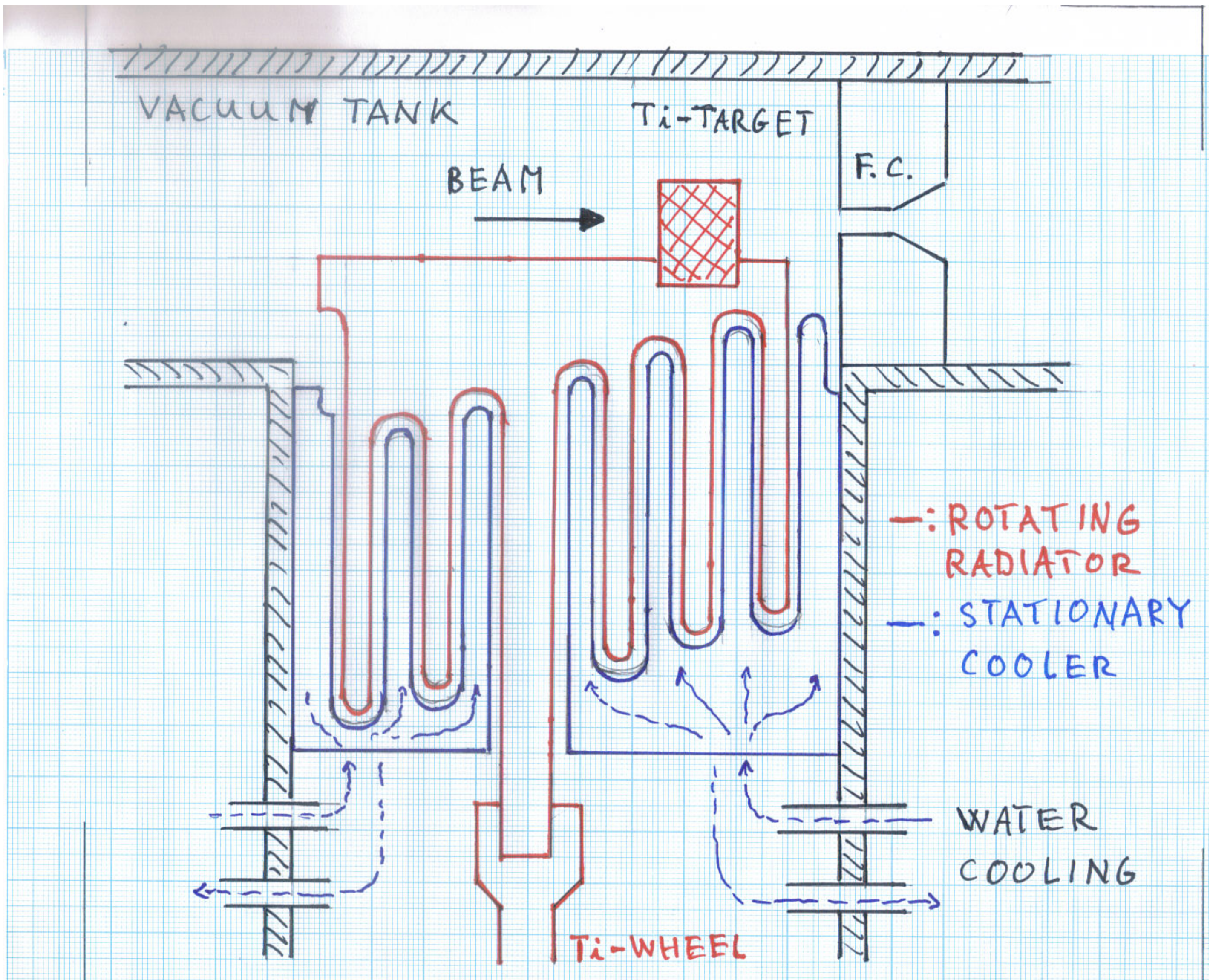
Undulator Scheme

Mission of POSIPOL2014

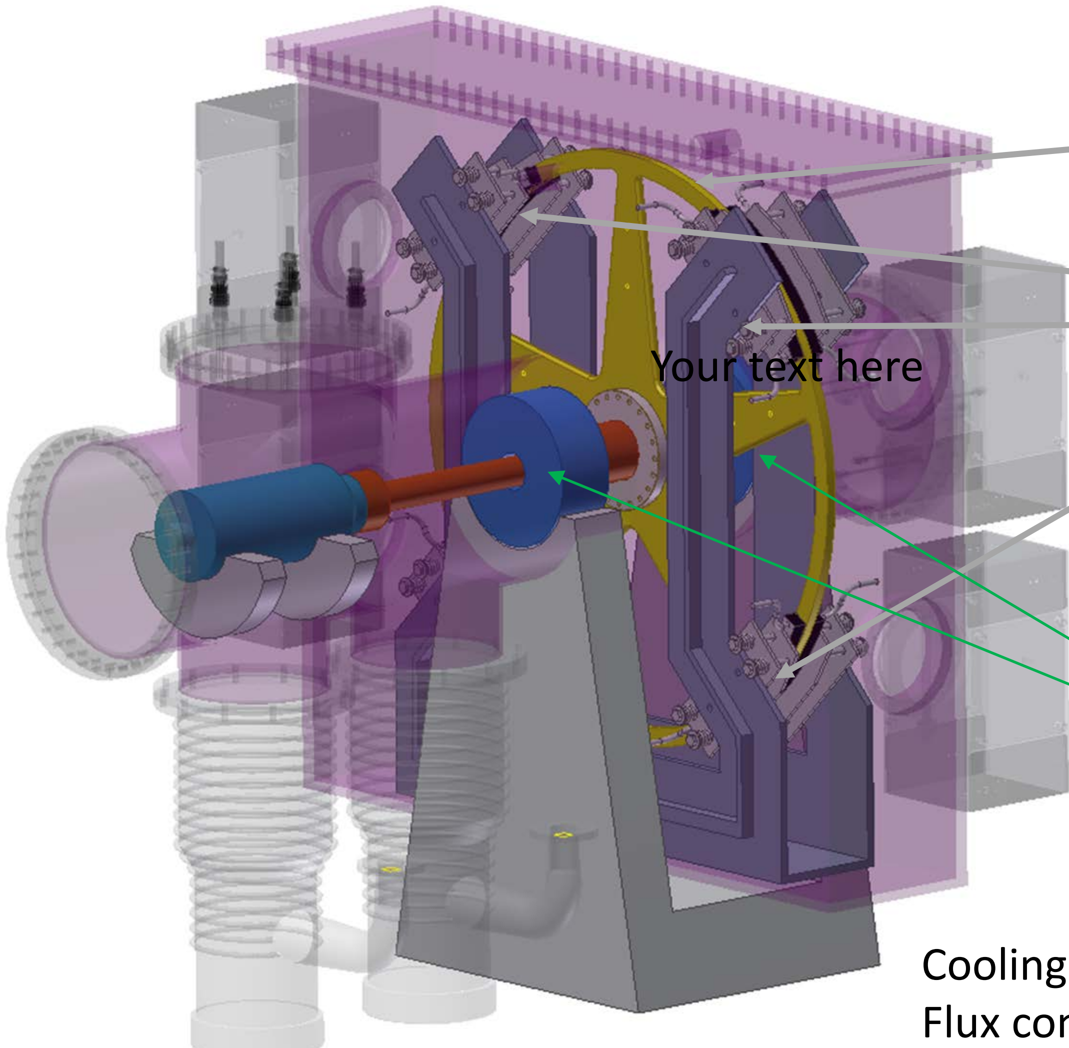
- Highest emphasis is on the TARGET
  - Candidates (as far as I know)?
    - Continuation of LLNL experiment (water-cooled ferro-fluid seal)
    - Radiation cooling
    - Contact cooling
  - What exactly must be demonstrated ?
  - To what level?
  - By when?
  - Who?
  - Must be affordable
  - Criteria of success



One Idea for Radiation Cooling (O.Sievers)



Contact Cooling (idea by Wei Gai)



Target wheel, geometry may be optimized for cooling efficiency and wheel balance

Cooling pads and supporting structures

Magnetic bearing on both sides

Cooling water manifolds are not showing. Flux concentrator and accessories are not included in this conceptual illustration.

Recommendation

From the summary by W.Gai & M.Kuriki to be reported to ILC Technical Board

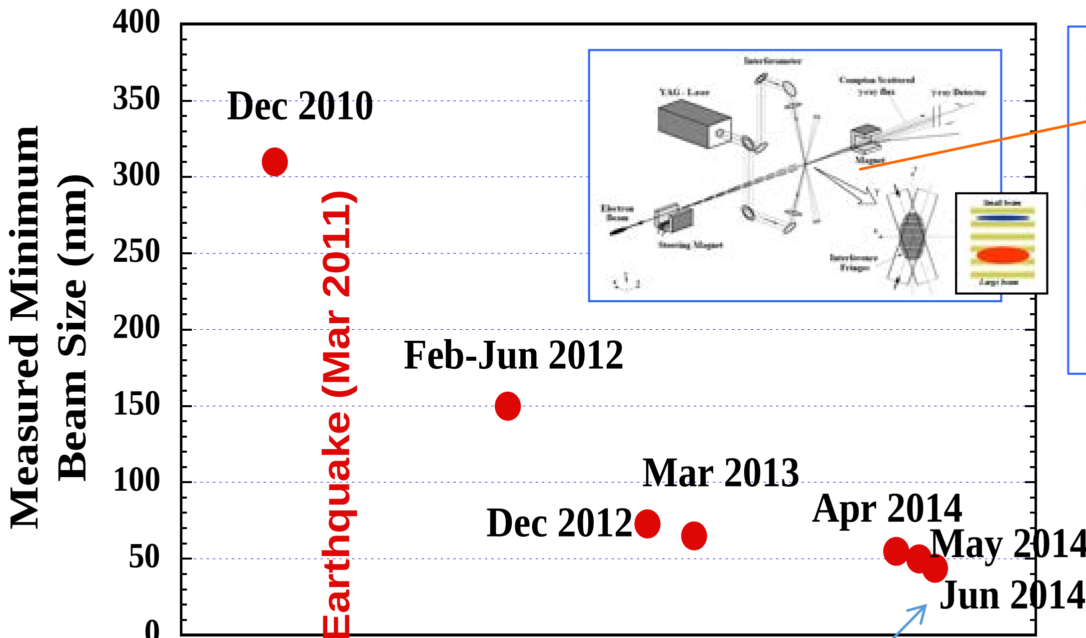
- Water-cooled
  - Highest priority
  - Resume the water-cooled ferro-fluid sealed target test with modifications. (1M USD, 2014-2015)
  - If this is successful, construct the target equivalent to the real machine. (3 M USD, 2015-2017)
  - Endurance test of the target (2017)
- Non-water cooled
  - Investigate several critical aspects to establish the conceptual design of the non-water cooled target. (2014-2015)
  - Some basic tests, e.g. friction with lubricant, material dilution, out gas rate, etc. if it is possible with a limited amount of money. (2014-2015)
  - Construct mock-up (3.1 M Euro + 5.5 Man.year) which is compatible to examine radiation cooling and contact cooling. (2 years)

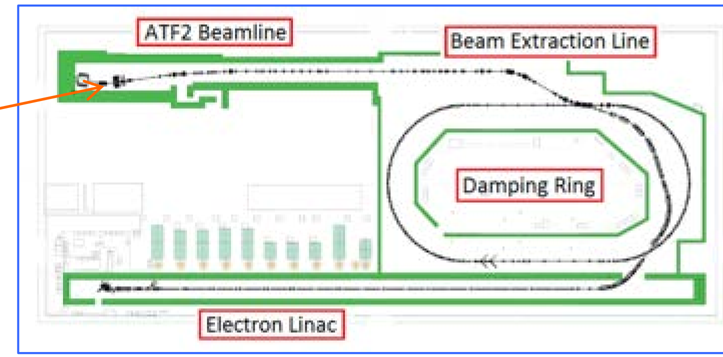
AD&I Activities

- Accelerator Design & Integration team
  - Convener Nick Walker + KY
  - Leaders of accelerator areas (source, DR, RTML, BDS)
  - CFS key persons
- Phone meetings since AWLC
- Topics
  - Radiation safety issue
    - Average beam loss (done)
    - Beam loss in failure mode
    - MPS
  - Path length
    - Task force formed (E.Paterson, D.Rubin, B.List, M.Kuriki)
    - First meeting Sep.10
    - Conclusion by LCWS
  - Commissioning
  - 10Hz operation

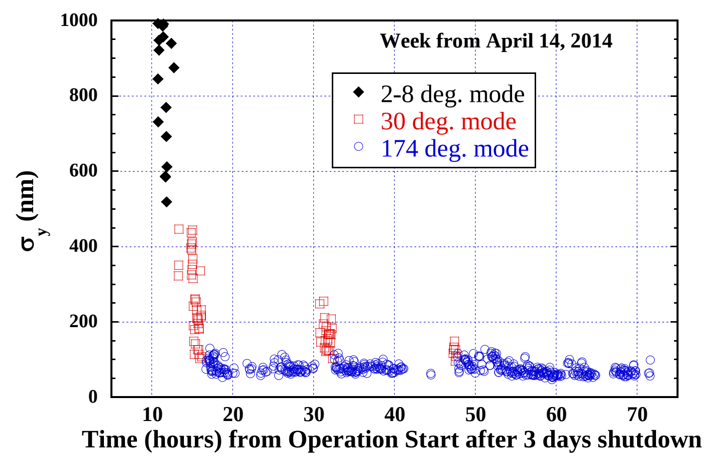
Progress in measured beam size at ATF2

IPAC2014, K. Kubo + ICHEP S.Kuroda





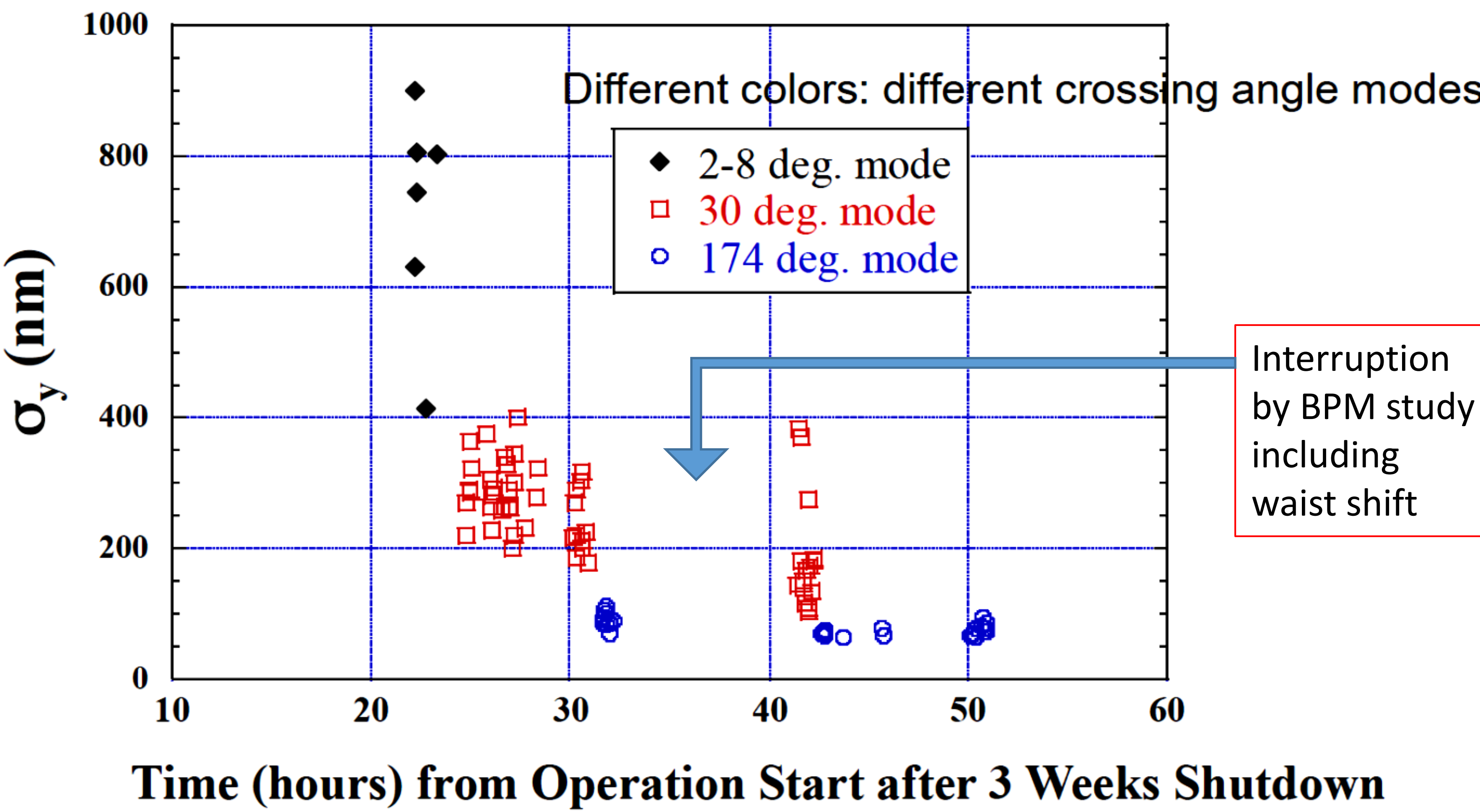
Beam Size 44 nm observed,
(Goal : 37 nm)



Beam Size Tuning after 3 weeks shutdown

Small beam (~60 nm) observed
~32 hours from operation start

By April 2014



Interruption by BPM study including waist shift

Week 2014 April 7

K.Kubo IPAC14

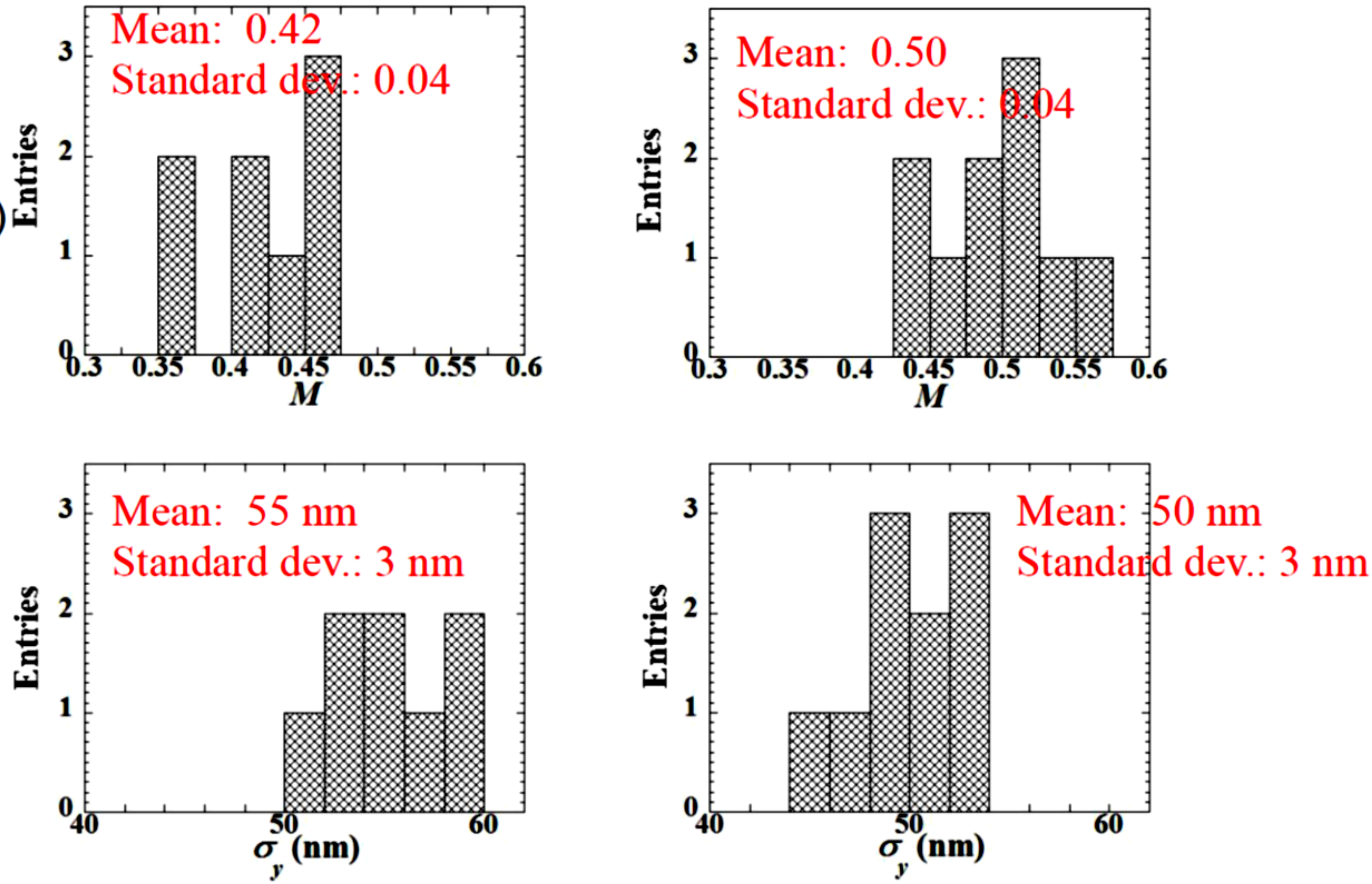
Beam is stable for 30 – 60 min. without tuning.

Examples of consecutive beam size measurements

April 17, 2014 | May 22, 2014

IPBSM Modulation (174 degree Crossing angle)

Beam size Evaluated from Modulation (no systematic error assumed)

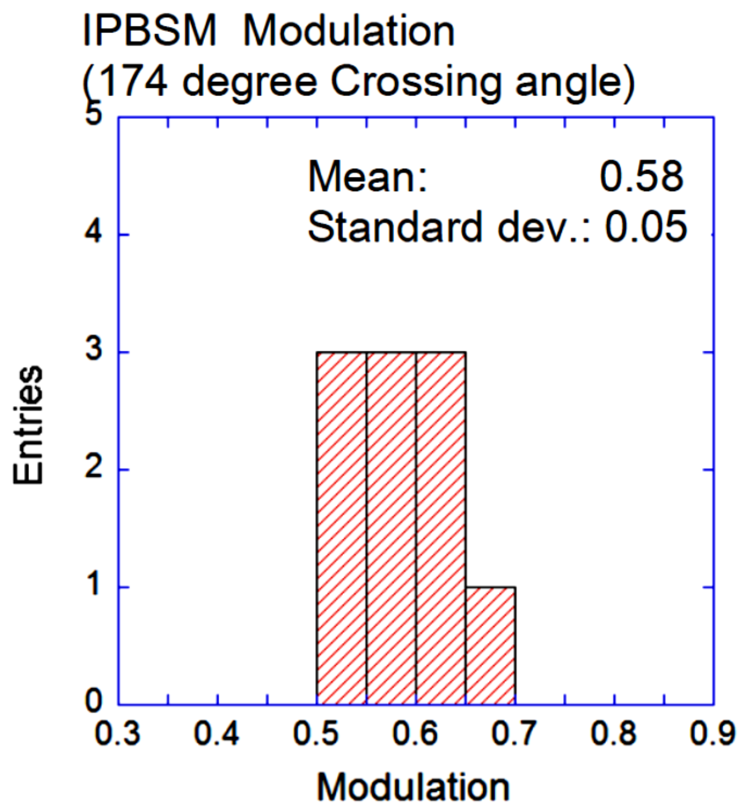


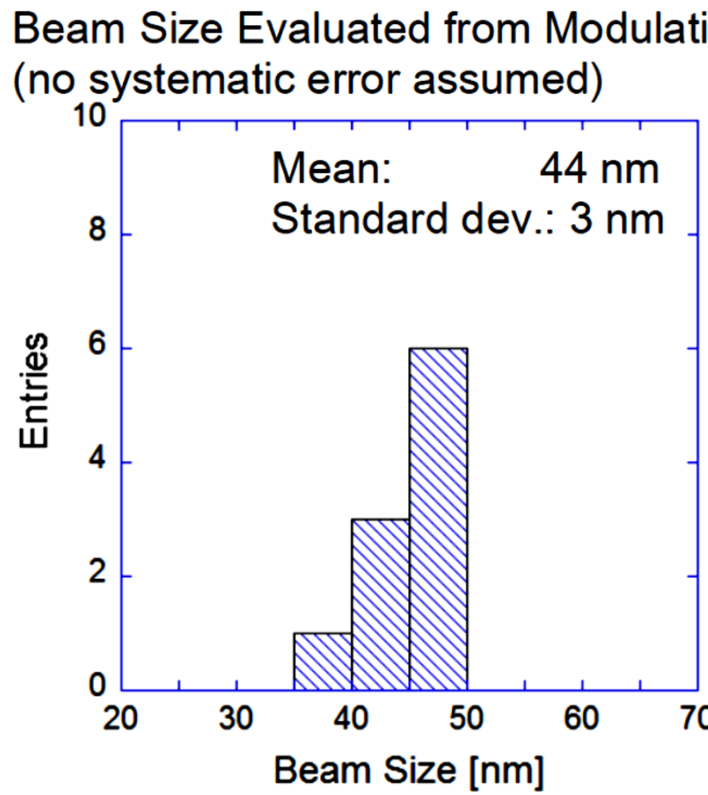
K.Kubo IPAC14

Bunch charge ~ 0.16 nC | Bunch charge ~ 0.09 nC

Data of June 12

After removal of OTR monitors

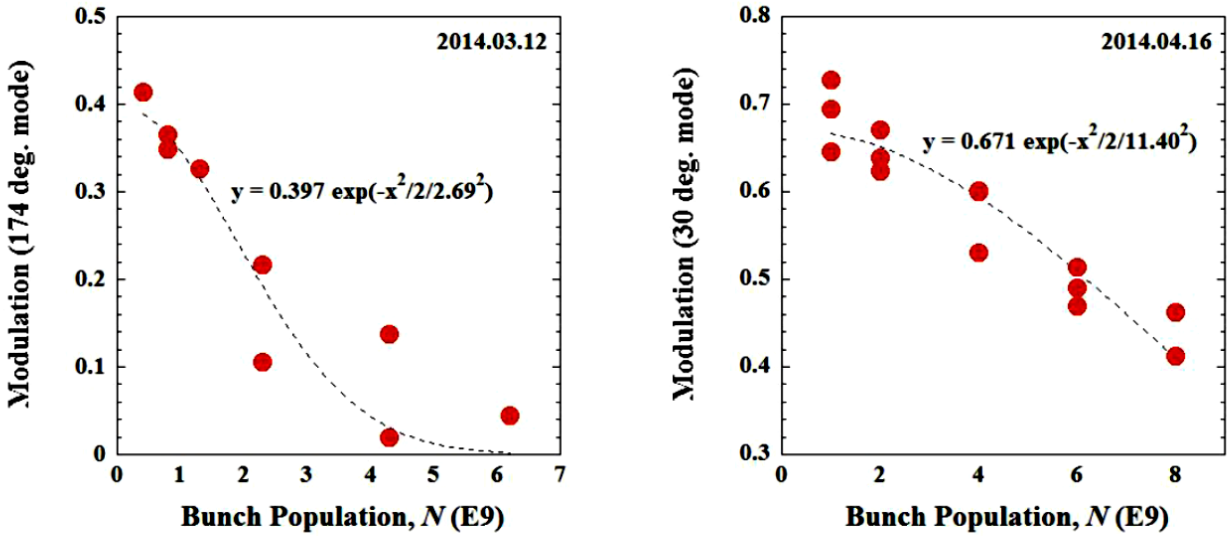




Bunch charge ~ 0.16 nC

S.Kuroda, ICHEP2014

Beam Size Depends on Bunch Intensity



IPBSM modulation as function of bunch population. Measured with crossing angle 174 degrees (left) and 30 degrees (right).

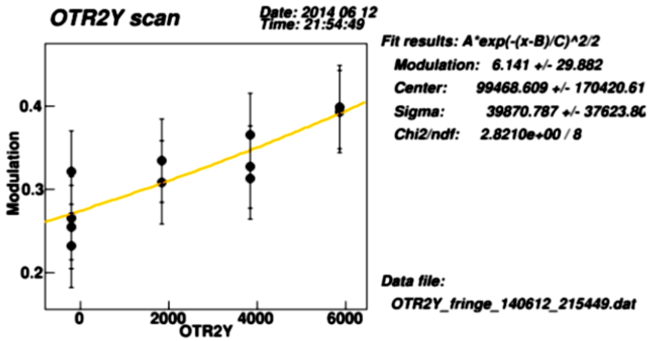
Assuming $\sigma_y^2(q) = \sigma_y^2(0) + w^2 q^2$, w is fitted as 100 nm/nC.

$\Rightarrow$ Measured minimum beam size (at 0.1 - 0.16 nC) may be larger than zero-intensity beam size by 2 - 3 nm.

K.Kubo IPAC14

- ATF2 does not scale with ILC-FF with respect to the wakefield

Operation in the Last Week June 2012

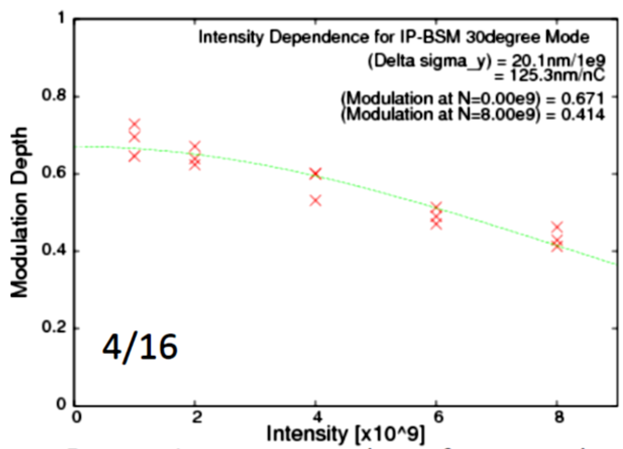


We observed strong dependence on OTR position(174deg mode, I=3e9)

S.Kuroda, ICHEP2014

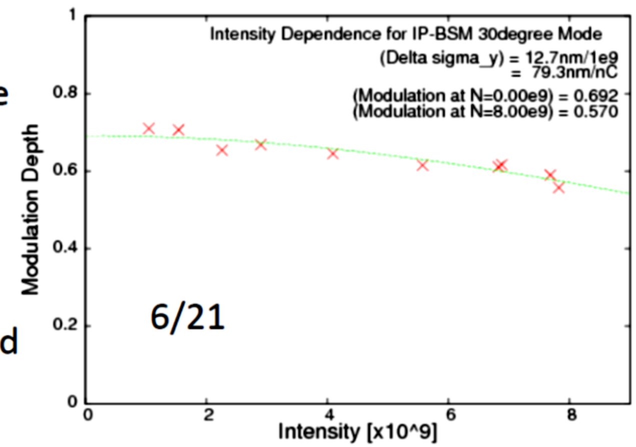
All the OTR stations were uninstalled.

Situation has completely changed(orbit, dispersion, matching,...)



30 deg mode modulation

OTR removed



Beam time was so short for complete beam tuning.

Possibility of OTR cancelling the effect from other source. Need to confirm in the next operation

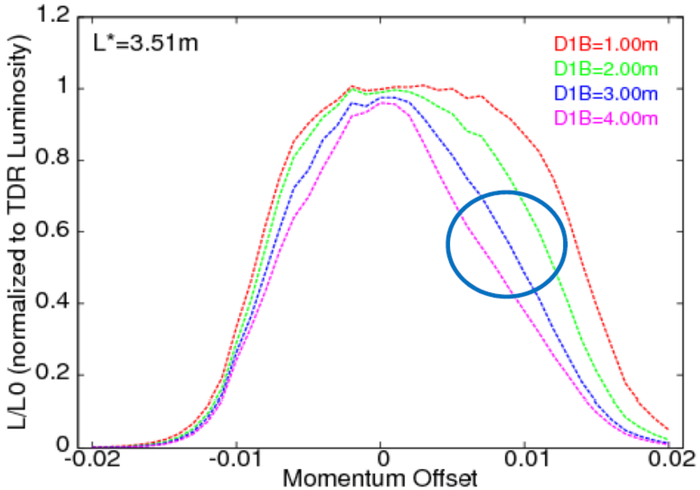
- Intensity dependence significantly relaxed by removing OTR (optical transition radiation monitor)
- Still some factor 2-3 off the wakefield theory

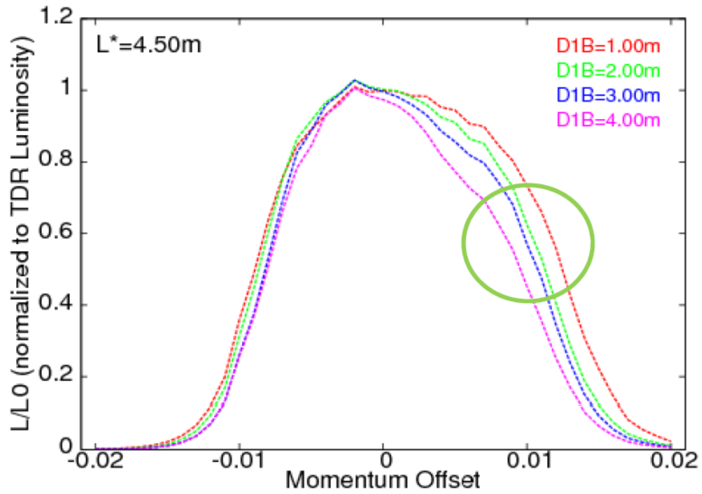
MDI-CFS Workshop

- Sep.4-6 @ Ichinoseki
- Major topics
  - Move IP by ~1km to the north of the mountain where the altitude is low so that vertical shaft can be used (so-called Hybrid A')
  - Assembly area
  - Transportation
  - Possible change of L* to a value common to SiD & ILD
- To be reported by Karsten on the last day of this meeting
- BDS Sub-workshop on lattice review on Sep.4
  - Consistency of the lattice files in EDMS
  - L* issue

Momentum Acceptance

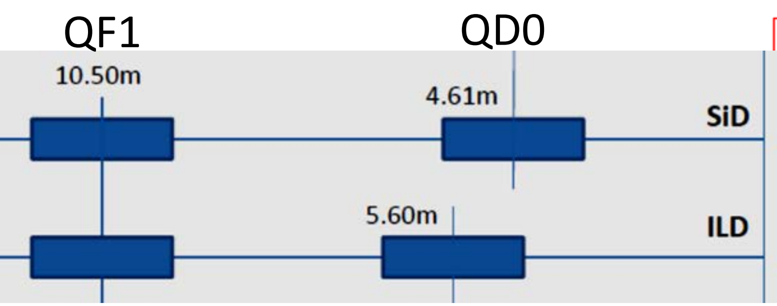
Okugi





D1B=1.00m ; (LQF1)/(LQD0)=1.84
D1B=2.00m ; (LQF1)/(LQD0)=2.05
D1B=3.00m ; (LQF1)/(LQD0)=2.27
D1B=4.00m ; (LQF1)/(LQD0)=2.49

D1B=1.00m ; (LQF1)/(LQD0)=1.69
D1B=2.00m ; (LQF1)/(LQD0)=1.87
D1B=3.00m ; (LQF1)/(LQD0)=2.04
D1B=4.00m ; (LQF1)/(LQD0)=2.22



Momentum acceptance of L=3.51m is larger than that of L*=4.50m for small D1B,*

but the momentum acceptance of L=4.50m is larger than that of L*=3.51m for L* of QF1 is 9.5m.*

- Comparison of L*=3.5 (SiD) and 4.5 (ILD)
- Importance of D1B (essentially, distance between QD0 and QF1)

No Conclusion