Highlights and discussion at LAL FKPPL & FJPPL “Toshiko Yuasa” workshop

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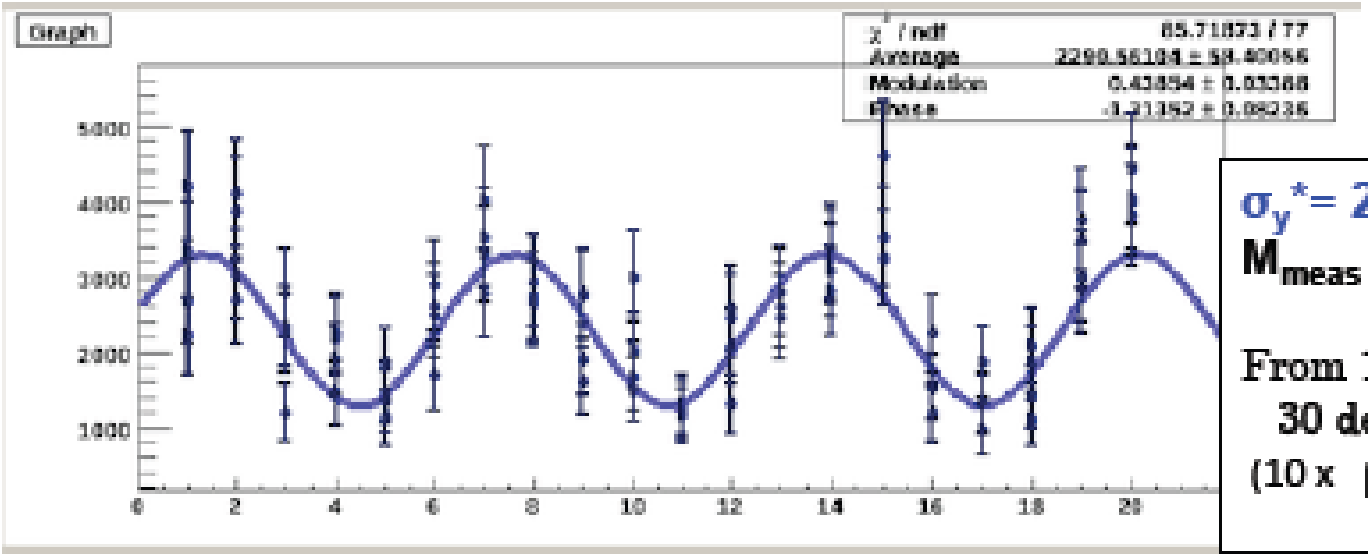
Sessions

P. Bambade, S. Wallon (LAL), K. Kubo, T. Tauchi, T. Terunuma (KEK), J. Yan (Tokyo), S. Bai (IHEP), H. Guler (LLR), S. Jang (KNU), P. Burrows, G. Christian (JAI), D. Schulte, A Vorozhtshov, Y. Renier, H. Garcia Morales (CERN), H. Hyun (KNU&LAL), A. Jérémie (LAPP)

1. "Goal 1" R&D : RD and EXT emittance, recent running, BSM status and discussion of systematics, beam halo, Geant4 simulation of bremstrahlung bkgd, discussion of new strategy, issues and priorities
2. "Goal 2" R&D : low-Q IPBPM status, mechanics, plan for IP feedback, usage with IPBSM, thoughts on calibration, staging of objectives and scheduling
3. New projects (planned CERN hardware contributions) : Kicker, FD upgrade, GM sensors
4. Progress reports : Beam trajectory and Twiss reconstruction, neutron modeling, post-IP halo and Compton recoil spectrum measurements, FONT analysis
5. Scheduled discussions of engineering issues : IPBPM mechanics, FD hybrid magnet, GM sensor testing and usage, IPBSM systematics

Commissioning of 30 deg mode

Jacqueline Yan (Tokyo)



$\sigma_y^* = 201 \pm 4.4$ (stat.) nm

$M_{meas} = 0.429 \pm 0.012$ (stat.)

From 10 stable consecutive scans
30 deg, Feb 17, 2012
(10 x β_x^*, 10 x β_y^* optics)

largest $M_{meas} = 0.522 \pm 0.042$ ←→ $\sigma_{y,meas} \sim 165$ nm

2/17: 30 deg	M	ΔM	σ_y^*	$\Delta\sigma_y^*$	avg E_{sig}/ ICT [GeV / 10^9e]
18:07	0.426	0.039	194.98	6.21	2.359
18:09	0.390	0.043	206.63	6.48	2.403
18:12	0.433	0.036	192.55	5.73	2.269
18:14	0.439	0.034	190.82	5.49	2.290
18:16	0.437	0.038	191.29	6.16	2.303
18:18	0.460	0.040	183.86	6.78	2.267
18:20	0.444	0.035	189.20	5.77	2.450
18:22	0.39	0.042	206.67	6.902	2.292
18:24	0.453	0.037	186.17	6.203	2.356
18:26	0.389	0.042	207.029	6.205	2.360

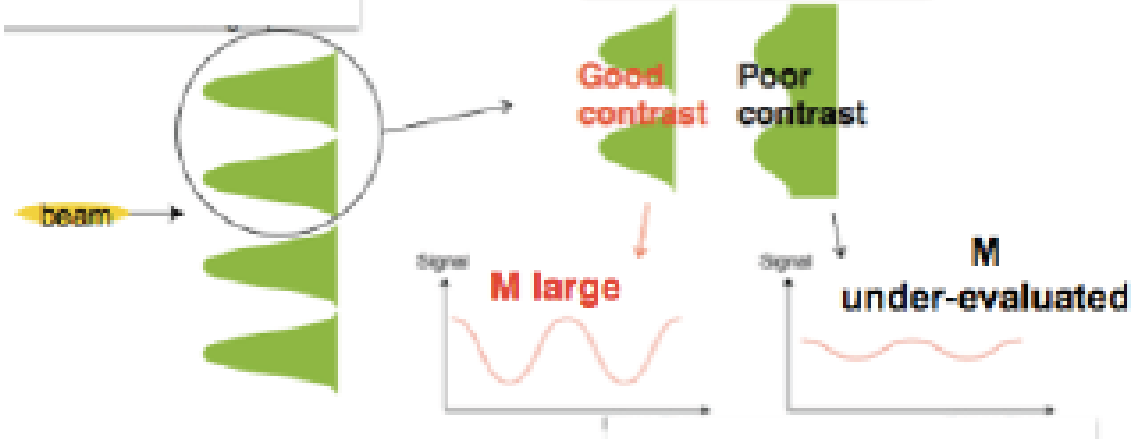
- *S/N : 4 – 5*
- *Signal jitter ~ 22%*
- *BG fluc. ~ 15%*

stable beam current

Modulation Reduction Factors

$$M_{meas} = C_1 C_2 \ldots\ldots M_{ideal} = \left(\prod_i C_i \right) M_{ideal}$$

degraded fringe contrast due to bias



σv* over-evaluated

$$\sigma^2_{y,ideal} + \frac{1}{2k_y^2} \left| \sum lnC_i \right|$$

Syst. Error studies at 4 deg, 8 deg mode

can $\sigma_{y,meas}$ be reproduced ?

after vertical orbit tuning, coupling, dispersion correction

M_{meas} ~ 0.8 (σy* ~ 400 nm) @ 8 deg mode (2/21 , 3 x β_y*)

◆ Next switched to 3.98 (4) deg mode

If σy* ~ 400 nm didn't change

M ~ 0.94 expected, but M only reached 0.75 ~ 0.8

Jacqueline Yan (Tokyo)

→ **overall M reduction factor** due to syst. errors : C ~ **0.8** (∴ 0.75 / 0.94)

could be worse ∴ 8 deg mode already limited by syst. errors

Systematic Errors estimated from actual beam time data

M odulation reduction factors	date/optics	2/21	$3 \times \beta_y^*$	2/17, $10 \times \beta_y^*$
	σ_y^* [nm]	300 - 800		160 - 200
	mode	**4 deg**	**8 deg**	**30 deg**
polarization	$C_{pow-pol}$		~ 98%	
relative pos. jitter	$\mathbf{C}_{rel-pos}$	**> 95.3**	**> 95.2%**	**> 92.9%**
laser path alignment	z: $C_{z,pos}$		> 99.5%	
	t: $C_{t,pos}$		~ 100%	
profile imbalance	$C_{,profile}$	> 99.9%	100 %	> 99.9%
Fringe tilt	**t: $\mathbf{C}_{t,tilt}$**	**> 96.6%**	**> 96.8 %**	**> 79.8%**
	z: $C_{z,tilt}$		~ 100 %	
Total	$\prod_i \mathbf{C}_i$	**> 89.7 %**	**> 88.9%**	**> 72.1%**

- total M reduction close to, but not agree with estimated upper limit C ~ 0.8
- Not adequate data to accurately evaluate all error types (ex:) Cpol > 98%, phase drift (few% ?)

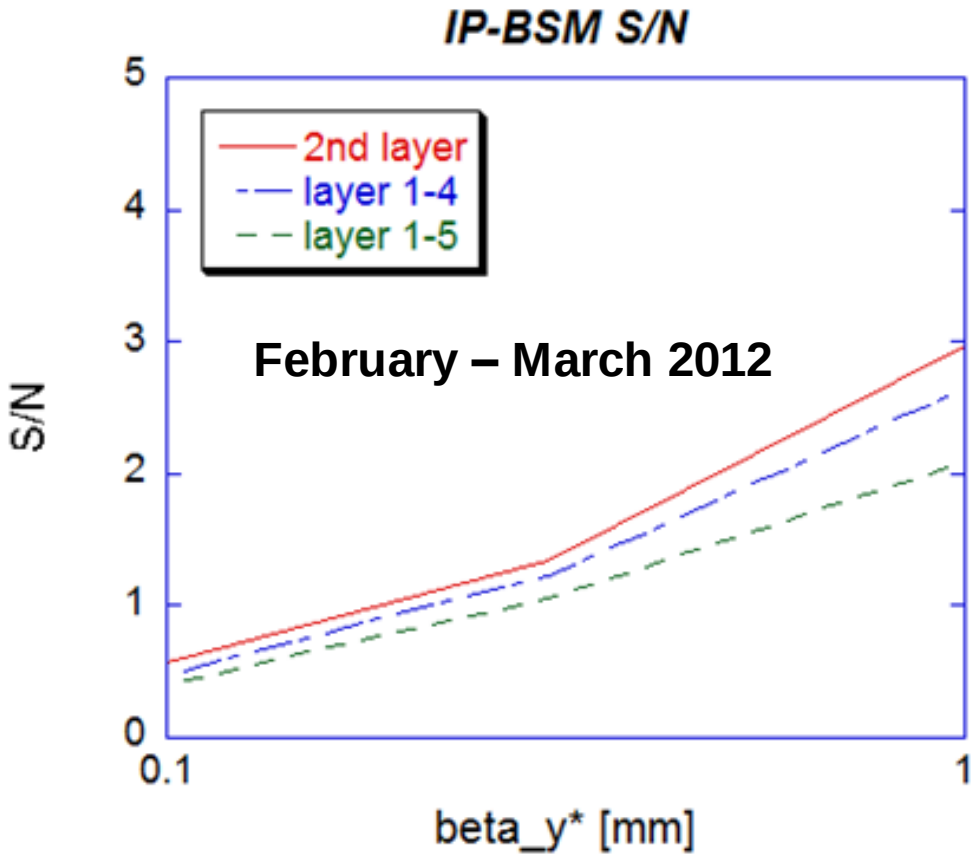
largest syst. errors appear to be

- relative position jitter (phase jitter) → feedback correction of beam position
- Fringe tilt: → *now practicing more precise alignment*, tune σ*x smaller (also issues of rotated beam , coupling) effects

Especially happened to be heavy for 30 deg
Even so detect M at 30 deg → σy* much smaller than 200 nm (?!)

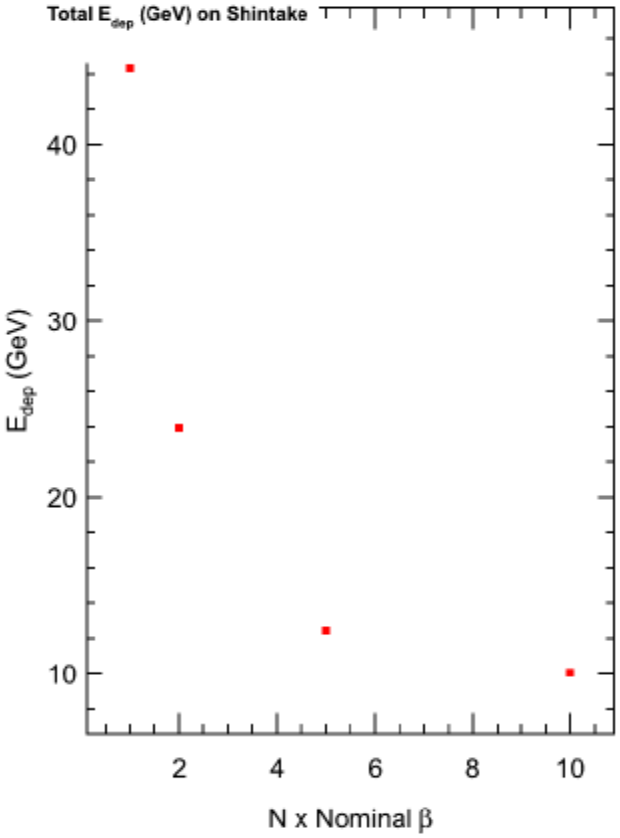
Jacqueline Yan (Tokyo)

ATF2: background dependence on β*



from Toshiyuki Okugi (KEK)

➔ post-IP bend magnet vertical gap

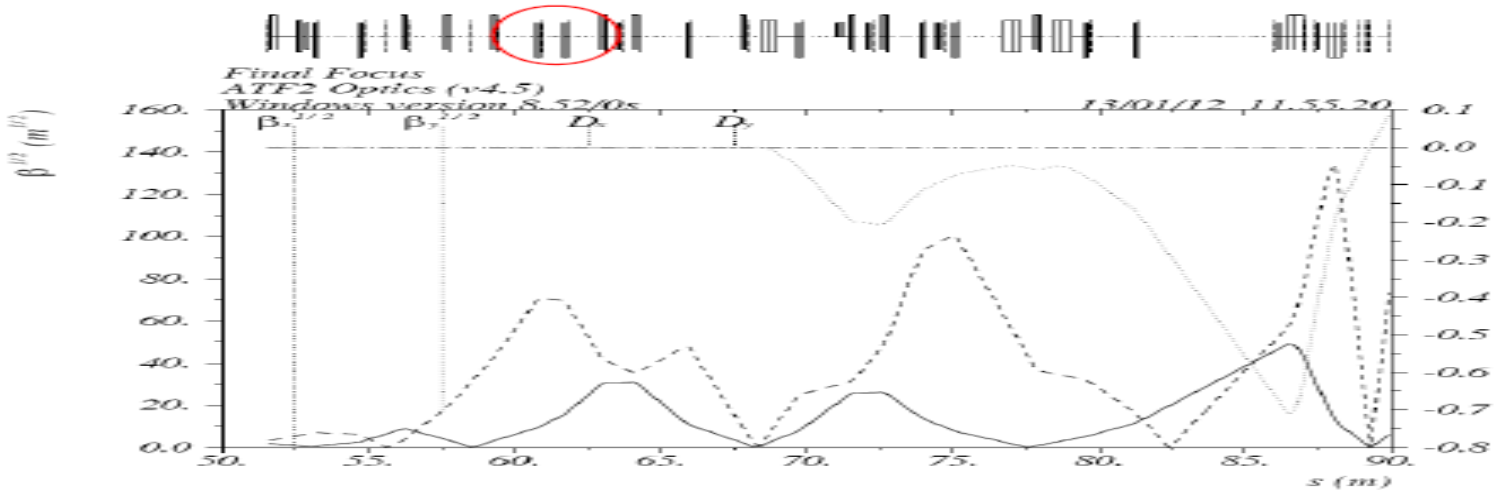


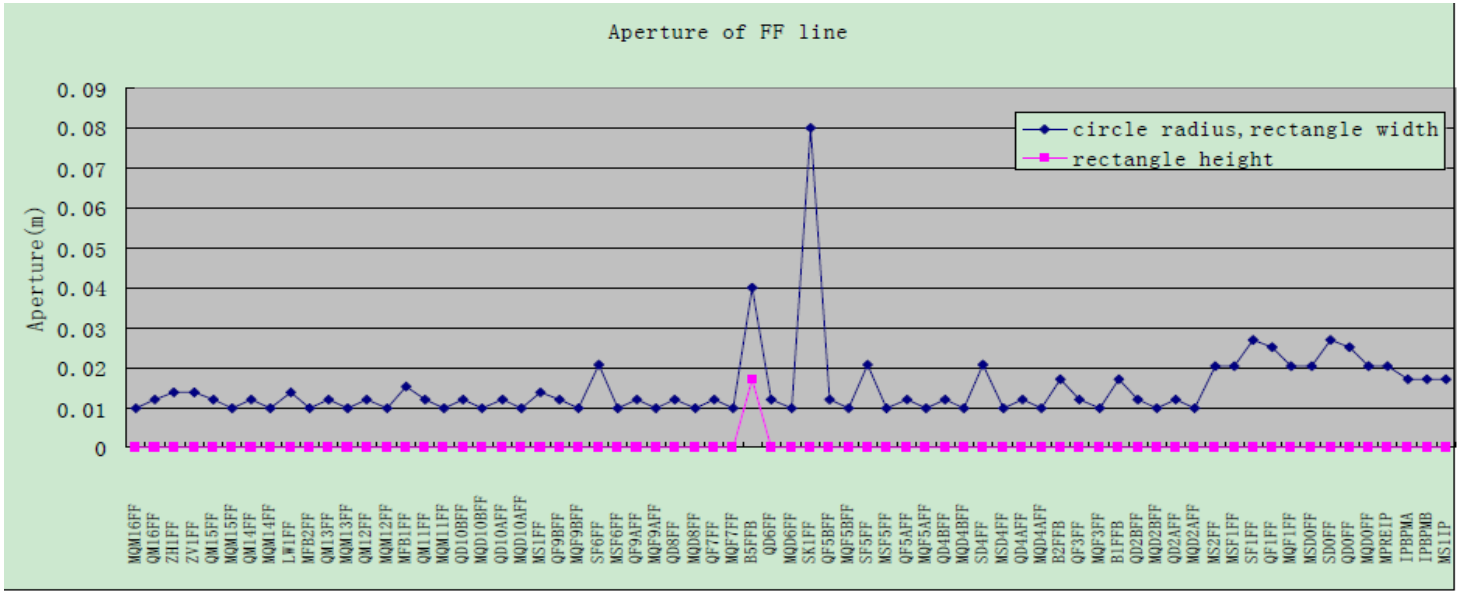
GEANT4
(idealized conditions)

from Hayg Guler (LLR)

ATF2: physical apertures in FFS

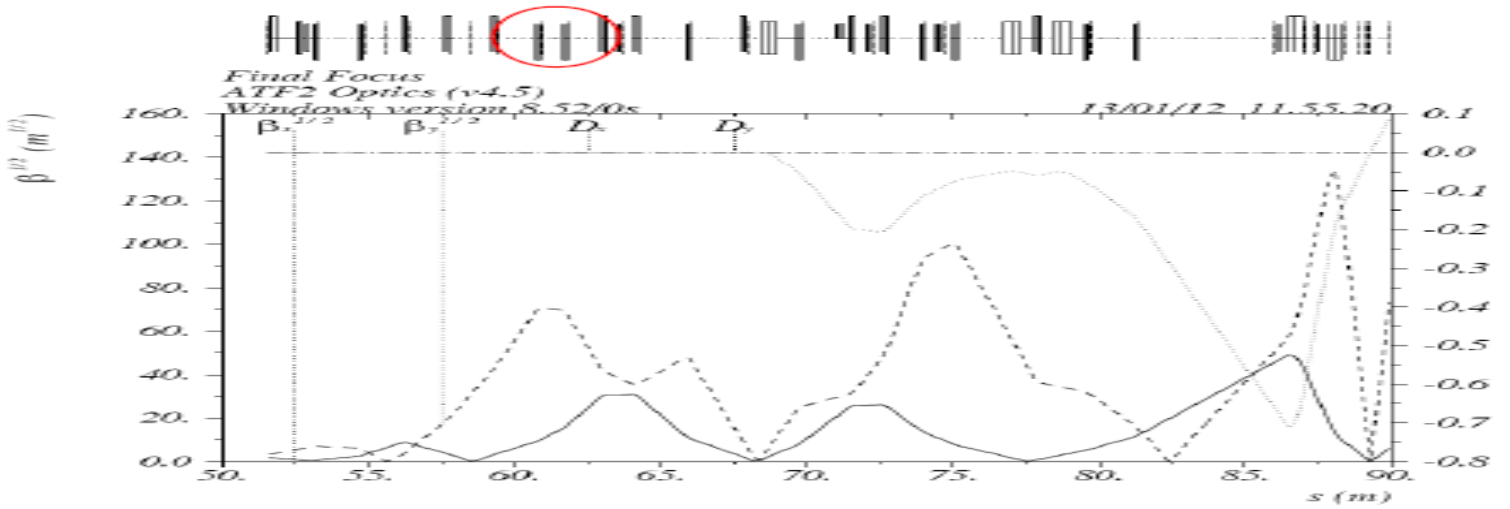
Sha Bai (IHEP)

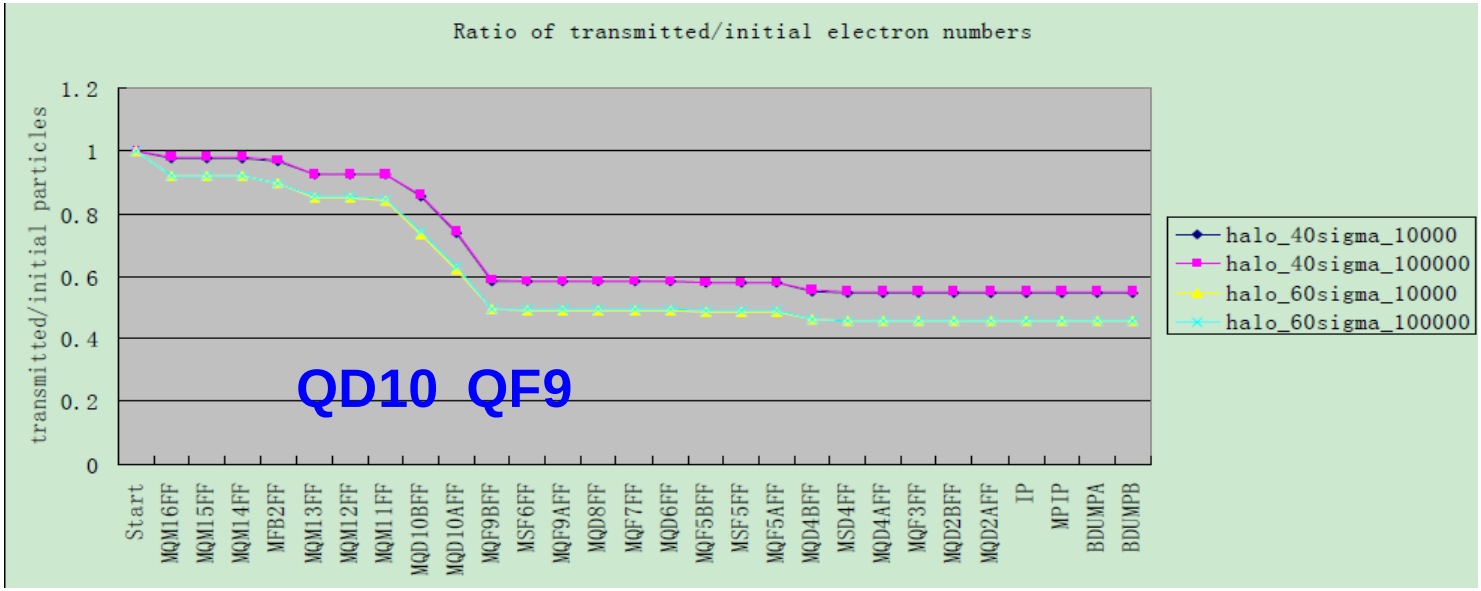




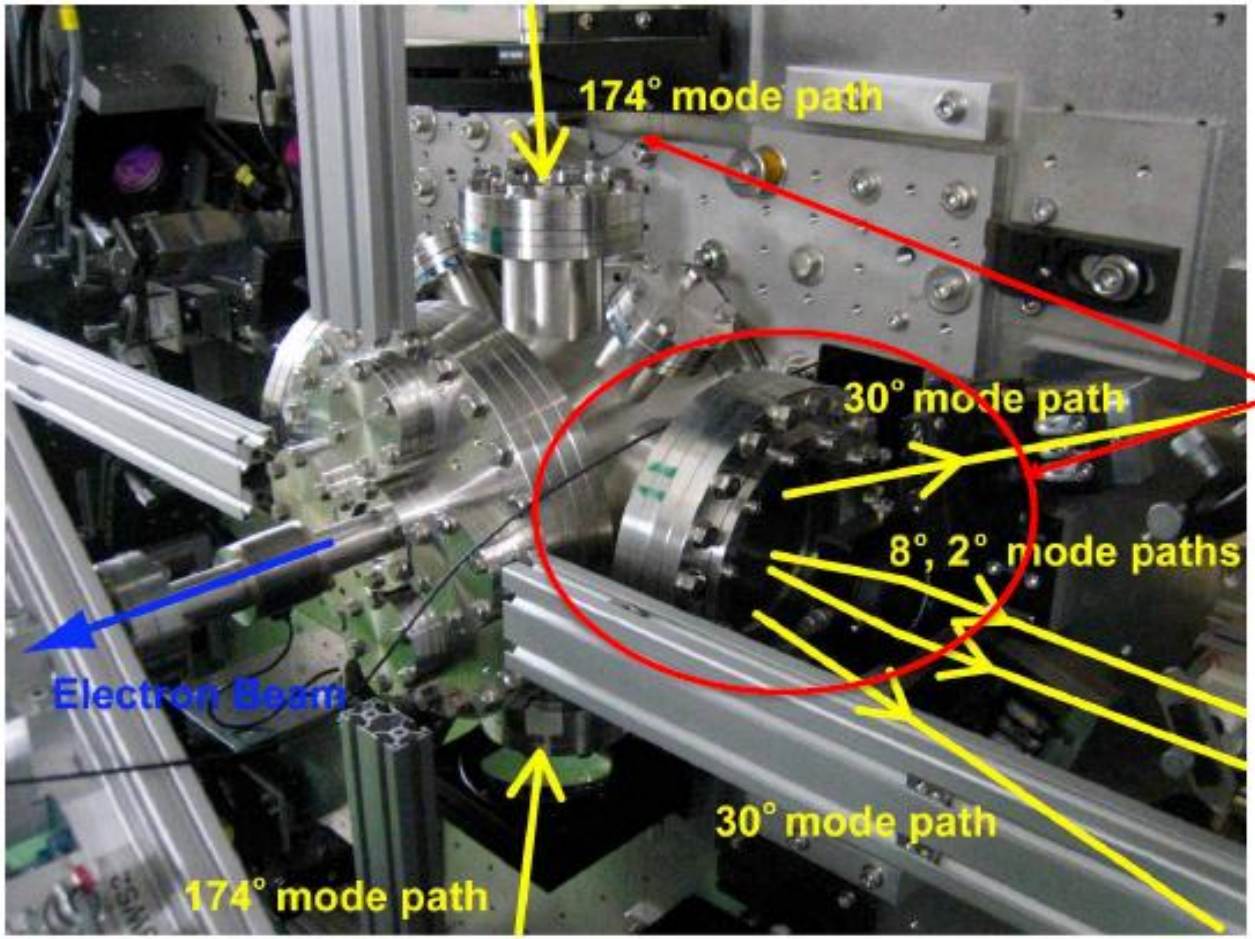
ATF2: intercepted halo in FFS ?

Sha Bai (IHEP)





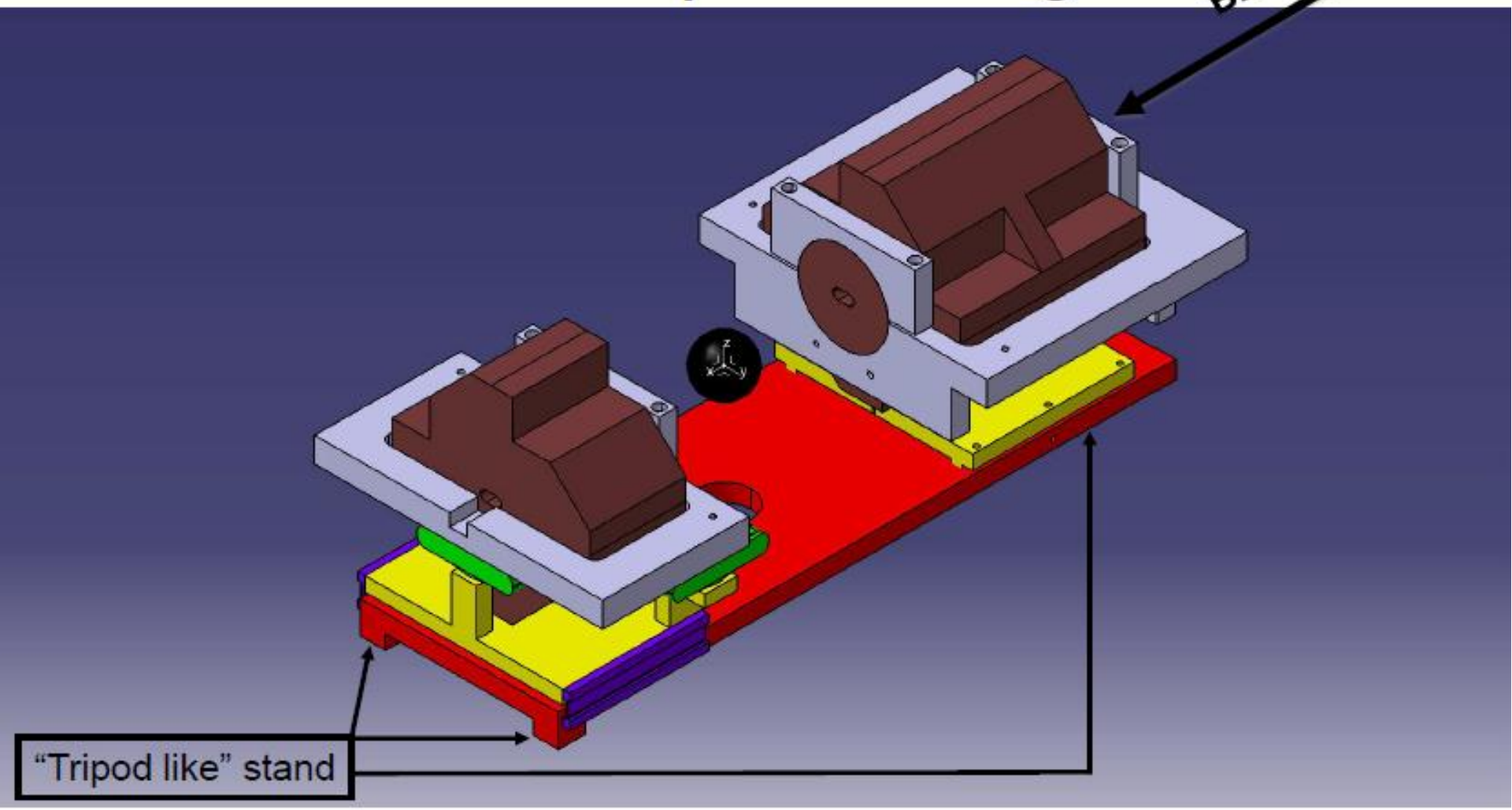
IP Chamber interfaces and dimensions



FFTB design to be improved :
- Reduce "windows to lens" distance
- Bring normal window for 30° mode

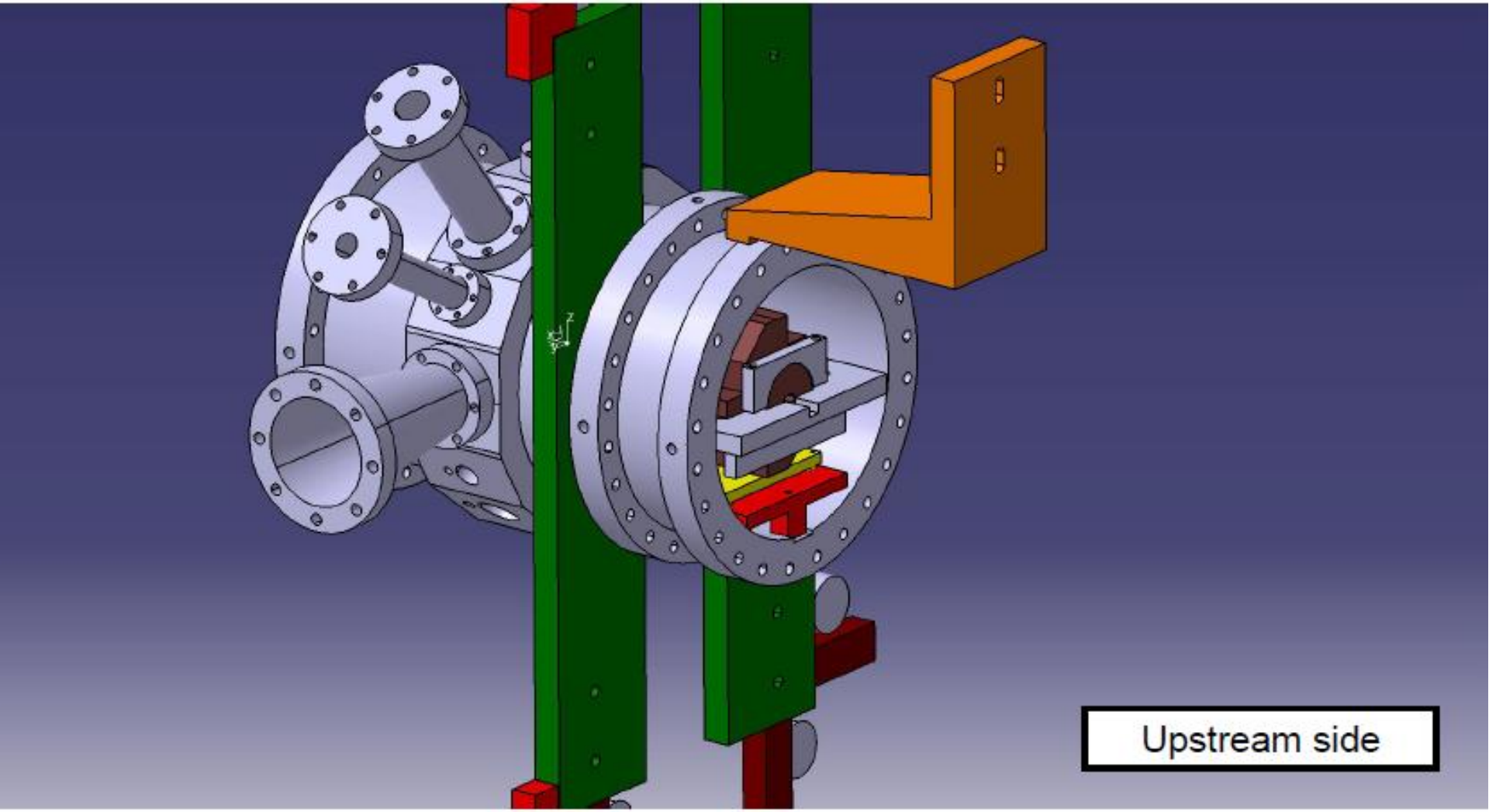
Some angles to match

BPMs positioning



BPMs assy to be mounted in IP Chamber vessel

S. Wallon & F. Bogard (LAL)



Detail of upstream support

S. Wallon & F. Bogard (LAL)

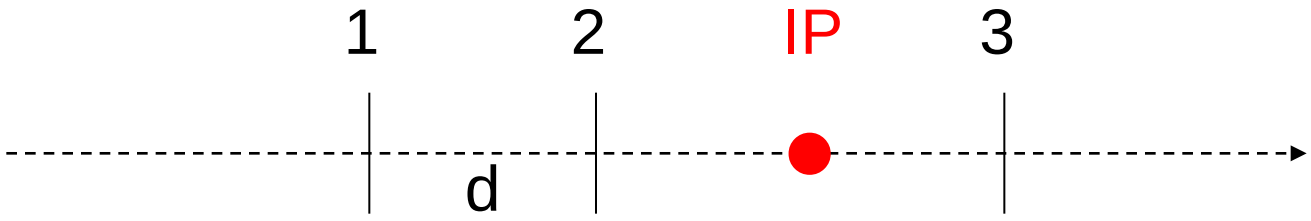
Schedule

- Delivery at LAL of KNU' BPMs : end of 3/2012
- Delivery at LAL of piezo actuators and electronic for BPM 3 : end of 3/2012
- Piezo actuators tests : 4/2012
  - Dimensional tolerances, stroke, thrust
  - Outgasing
- Order piezo actuator for BPM1&2 (budget?) : 6/2012
- Manufacturing (with breaks) at LAPP : 4 to 8/2012
- IP Chamber and parts checking : 9/2012
- Assembly process test : 10/2012
- Delivery at KEK : 11-12/2012

S. Wallon & F. Bogard (LAL)

Required precision on relative IP-BPM scale factors depends on beam parameters

➔ “nanometer resolution demonstration” and to “IP extrapolation for feedback purpose”



d ~ 0.1 m
ε_y ~ 12 pm
σ_{jitter} / σ ~10%

$\theta_{IP} = (y_2 - y_1) / d$
$y_{IP} = 2\, y_2 - y_1$

ξ = calibration error of 1 relative to 2
➔ $2\, y_2 - y_1 \sim y_{IP} + 2\, \xi\, \theta\, d$

β ~ 1 m (e.g. diagnostic section)

$\theta_{jitter} \sim (\varepsilon / \beta)^{0.5}\, d\, (\sigma_{jitter} / \sigma) \sim 10^{-7}$ rad ➔ $\xi \sim 10^{-2}$ for 1 nm error

$\beta \sim 10^{-4}\ 10^{-3}$ m (interaction point : nominal 10 x optics)

$\theta_{jitter} \sim (\varepsilon / \beta)^{0.5}\, d\, (\sigma_{jitter} / \sigma) \sim 10^{-9}$ rad ➔ $\xi \sim 10^{-4}$ for 1 nm error
$\xi \sim 10^{-3}$ for 10 nm error
$\xi \sim 3\ 10^{-3}$ for 1 nm error

Some comments on new “goal 1” strategy

1. Prepare 12 “students” for ATF2 operation (coordinated by S. Kuroda)

   ➔ S. Kuroda and J. Yan in next talk

2. Eight weeks dedicated “goal 1” operation in October-December

   - daily & weekly meetings ➔ review progress, modify the planning,…
   - commissioning and operation plan jointly defined and supported:

     several paths can appear and may be valid, but single decision essential to avoid confusing the “students” in the control room !

   - overall coordinator in addition to weekly / daily shift management:

     based on-site, experienced in machine physics and management for efficient communication flow between all contributors