Summary of Tuning, Corrections, and Commissioning

(Short summary of ATF2 meeting at SLAC in March 2007)

and

Hardware Issues for beam Tuning

Toshiyuki Okugi (KEK)

LC meeting – ATF2 session

31th May, 2007

DESY

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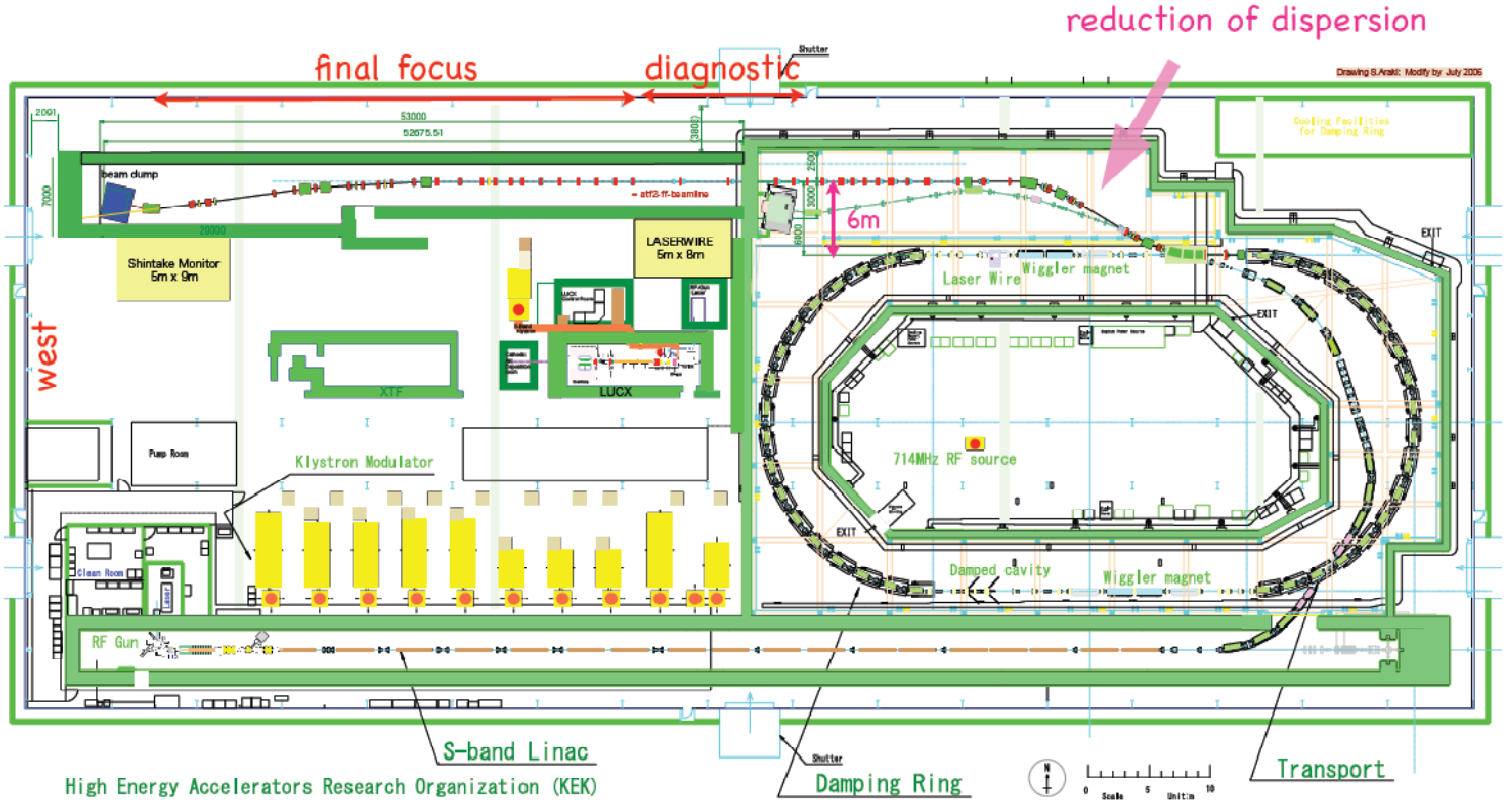


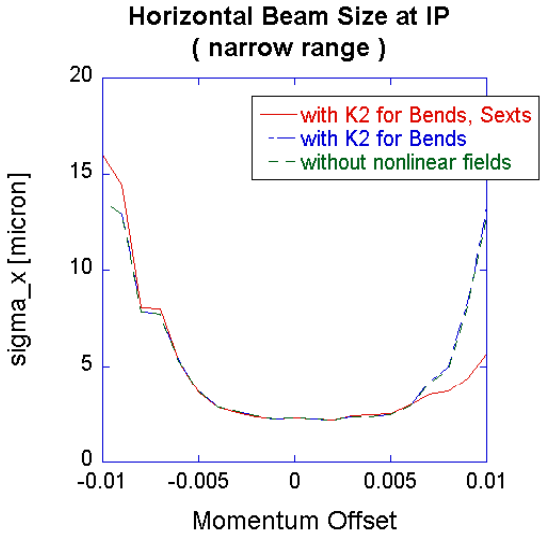
Beam tuning devices at extraction line (1): EXT sextupoles

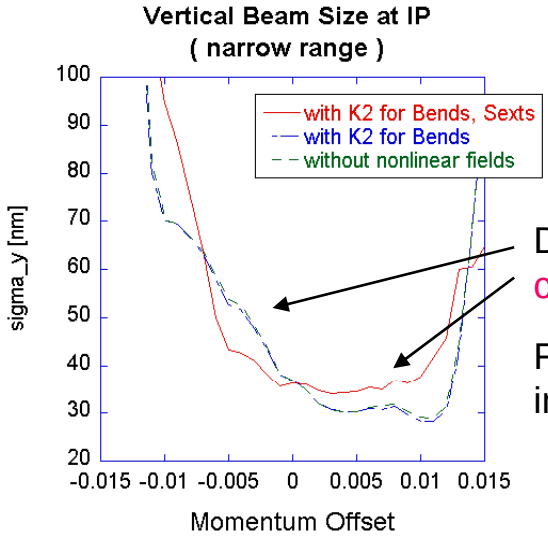
In the present ATF2 extraction line, we have 4 strong sextupole to compensate the chromaticity and 2nd order dispersion at the entrance of FF.

But it makes large coupling, when vertical offset at sextupole.

- Toshiyuki Okugi showed that the improvement by the strong sextupoles for EXT chromatic correction is negligible to energy bandwidth (±1%) for new extraction line.
- Glen White showed that the strong sextupoles aren't needed for achieving 35 nm spots
- Okugi suggests not installing them, Woodley suggests turning them off.

We must decide soon !





Difference come from that of chromaticity at extraction line.

FF line is optimized with Sexts in extraction line.

Beam tuning devices at extraction line (2): Skew quadrs

We should use 6 skew quadrupoles in extraction line.
2 for dispersion correction (QS1X, QS2X), 4 for coupling correction (QK1X-QK4X)

- Okugi suggests putting the QS1X, QS2X to the present sextupole location (SF1X, SF4X).
  using 4 existing IDX skew quadrupoles for QS1X, QS2X, QK2X, QK3X.
  making 2 new skew quadrupoles for QK1X and QK4X,
  the strength should be more than IDX @ 10 amps (0.22 T).

  We cannot install the SF1X, SF4X.

- Woodley suggests putting QS1X in between BH1X and QD2X,
  QS2X in between QD5X and BH2X,
  using IDX type skew quadrupoles for all the 6 skew quadrupoles,
  and we will provide 20 amp power supplies for QK1X and QK4X.

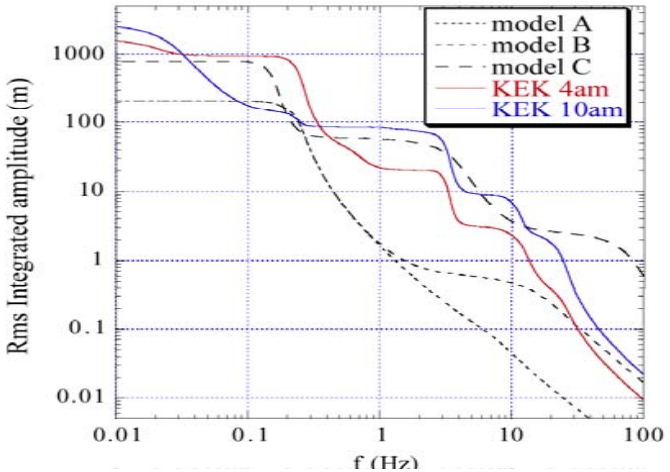
  ZV4X should be moved or removed from beam line.
  Even if we will move ZV4X, the magnet separations are shorter than 10cm.
  We must take account of magnetic field interference.

Woodley/Okugi agreed with the strengths of skew quadrupoles.
We must decide on optimal locations for QS1X and QS2X

Beam tuning simulation

Ground Motion and Feedback

- Throughout tuning process, apply dynamic effects:
  - Ground Motion (Model 'A').
  - Random pulse-pulse component jitter.
  - Random pulse-pulse energy fluctuations.
- Use pulse-pulse feedback to maintain orbit.



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IP Beamsize Measurement

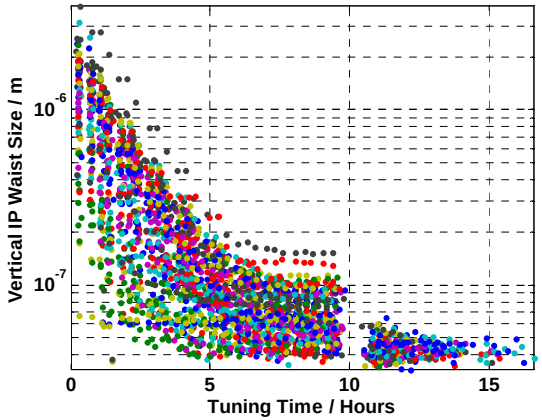
- 3 beam size monitors (wire scanner, Honda monitor, Shintake monitor) and IP BPM are assumed to be located at IP location.
- Beamsize is measured from few microns to 35nm continuously by 3 beam size monitor.
- IP beam position is measured by IP BPM for the position feedback.

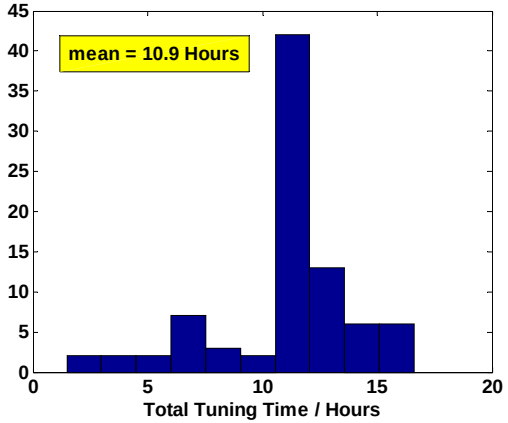
Static Error Parameters

Quad, Sext x/y transverse alignment	200 um
Quad, Sext roll alignment	300 urad
Initial BPM-magnet field center alignment	30 um
dB/B for Quad, Sexts	1e-3 syst. + 1e-4 random
Mover resolution (x & y)	50 nm
BPM resolutions	100 nm
Power supply resolution	14 - bit
Shintake Monitor Resolution	2nm

Multi-Knob Tuning Results

Multi-knobs iteratively applied until IP beamsize growth over initial conditions is <10% (~<40nm).





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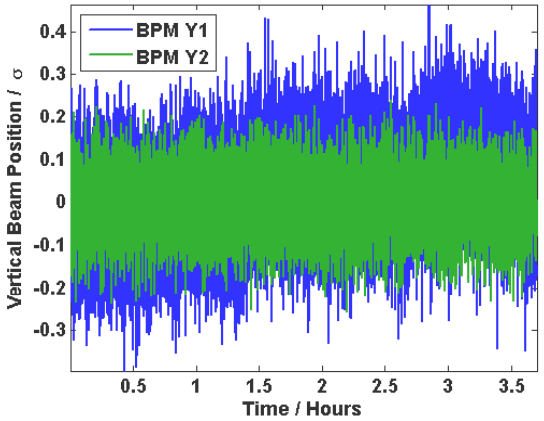
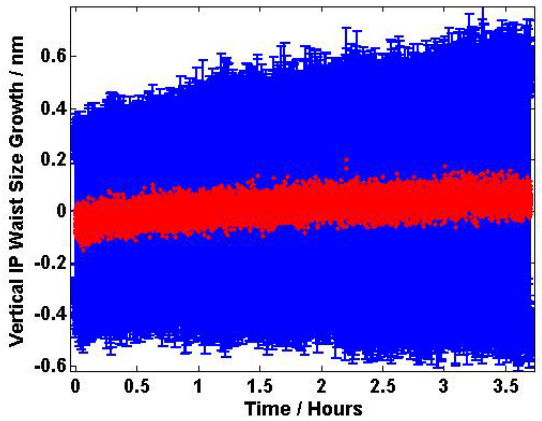
Feedback Performance

- After tuning, run simulation for 20,000 pulses and look at time evolution of spot size.
- Using simple gain feedback (gain of 0.1 used here- not optimised).
- In this case, rate of beamsize growth ~0.6 +/- 0.5 nm per day.





Good Results for ILC "Model A"

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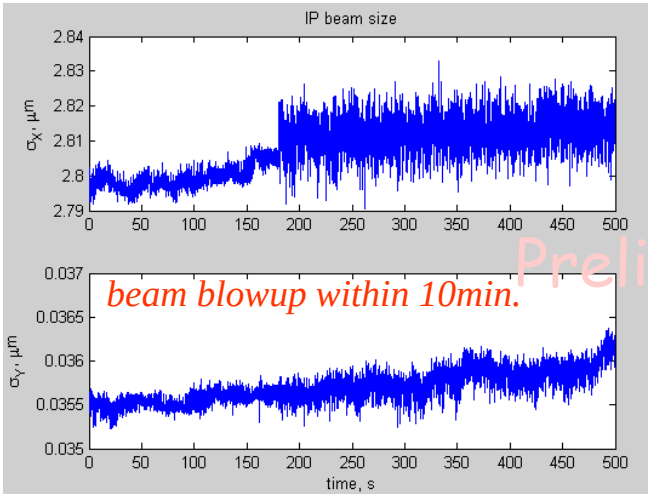
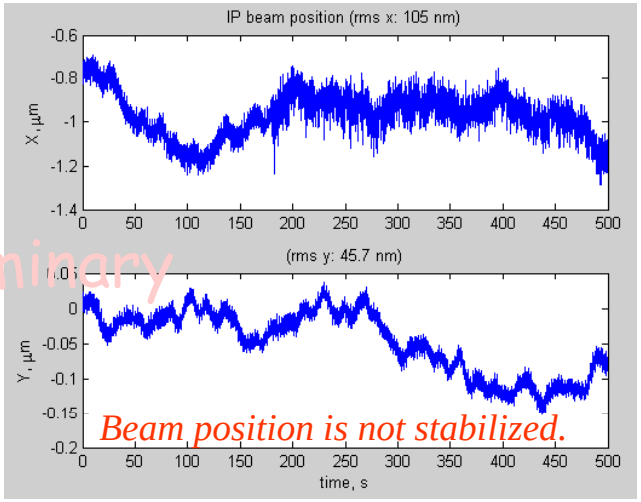
Ground motion ATF, F= 10Hz, n= 5000 pulses, no corrections or feedback





Preliminary

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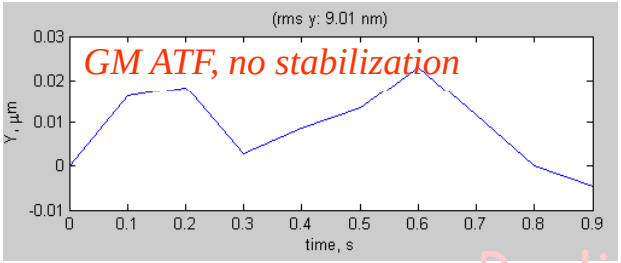
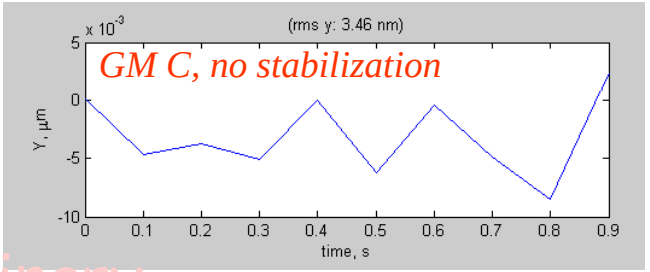
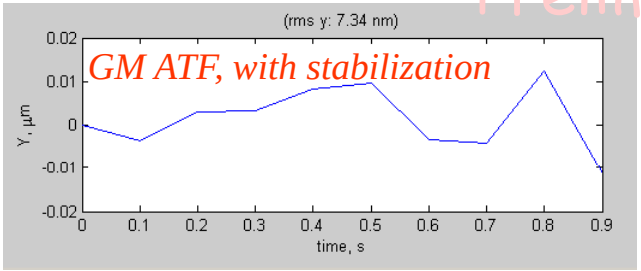
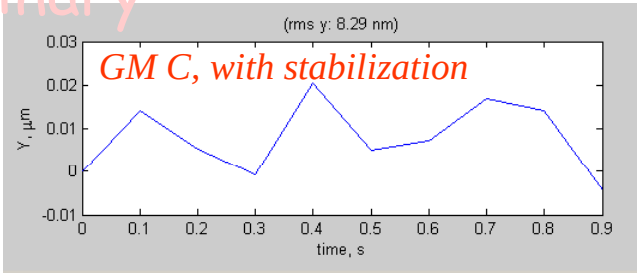
Interesting that this particular stabilization curve does not help for model C.

Probably because near 1Hz in model C there is a lot of coherence, but stabilization brakes it.









Preliminary

We need to estabilish the beam stabilization methods for actual ATF ground motion.

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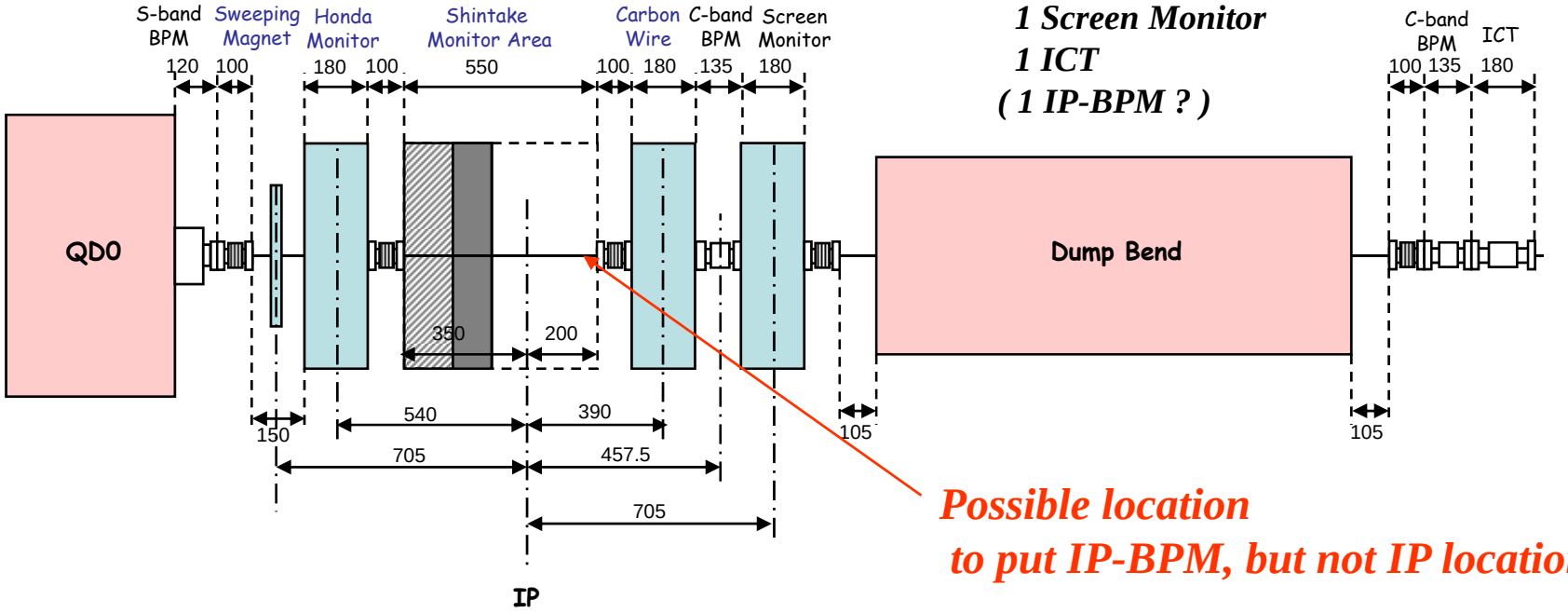
Beam size measurement devices at ATF2 IP

Possible IP configurations

Monitors 3 beam size monitors
2 C-band BPMs
1 Screen Monitor
1 ICT
(1 IP-BPM ?)



Possible location
to put IP-BPM, but not IP location

We cannot put 3 beam size monitor at some IP location,
but we can put 3 beam size monitors around IP .

Honda Monitor (-540mm from IP)	;	Moving Stage (Beam Vibration)	**350 nm – 1 micron**
Shintake Monitor (at IP)	;	Sweeping Magnet Phase Scan	**< 350 nm**
Carbon Wire (+390mm from IP)	;	Moving Stage (micron level) Sweeping Magnet (sub-micron level)	**> 1 micron**

Specifications of Sweeping Magnets for ATF2

Magnet

Material	;	Silicon Steel
Thickness	;	30 mm
Gap	;	45 mm

PS Requirement

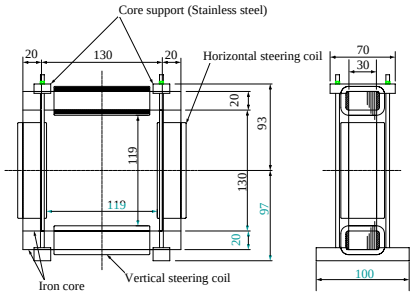
Amount of Minimum Change	;	0.0024 A (12bit digital control , 1bit for +/-)
Stability Requirement	;	200 ppm

Vertical Direction

Turn/pole	;	10
Kick Angle @ 0.0024A	;	7.2 nrad
Hysteresis	;	0.52 A
at Shintake Monitor		
Minimum Position Step	;	5.1 nm
Dynamic Range	;	+/- 10.5 μm

Horizontal Direction

Turn/pole	;	72
Kick Angle @ 0.0024A	;	52 nrad
at Shintake Monitor		
Minimum Position Step	;	37 nm
Dynamic Range	;	+/- 76 μm



Tokyo University Steering Magnet

Made by Mitsubishi-denki

Length of core	**30mm**
Effective Length	**166.2mm**
Max. current	**5A**
Magnetic Field	**5.49 Gauss/A**
Kick Angle	**21.4 mrad/A**
Hysteresis	**0.4Gauss(max)**
Turns/pole	**76**

Summary

1. **We must decide whether sextupoles will not be installed or will be installed and turned off.**

2. **We must decide where will we put the dispersion correction skew quads.**
   Candidate locations are
   - **1) present SF1X, SF4X,**
     - ***We can not install the sextupoles.***
   - **2) QS1X in between BH1X and QD2X,**
     QS2X in between QD5X and BH2X,
     - ***ZV4X should be moved or removed from beam line.***
     - ***Even if we will move ZV4X, the magnet separations are shorter than 10cm.***
     - ***We must take account of magnetic field interference.***

3. **We must decide the IP configurations.**
   - **1) We must fix 3 beam size monitor locations.**
   - **2) We must decide whether IP-BPMs will be installed or not.**