Status of IP-BSM

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Dec. 14, 2009 9th ATF2 Project Meeting KEK

Contents

- Current status of IP-BSM
  - upgrade from the spring run
  - obtained result in the autumn run
- Planning for the combined shift with tuning group
  - measurement time estimation
  - software schedule

Upgrade during Summer Shutdown

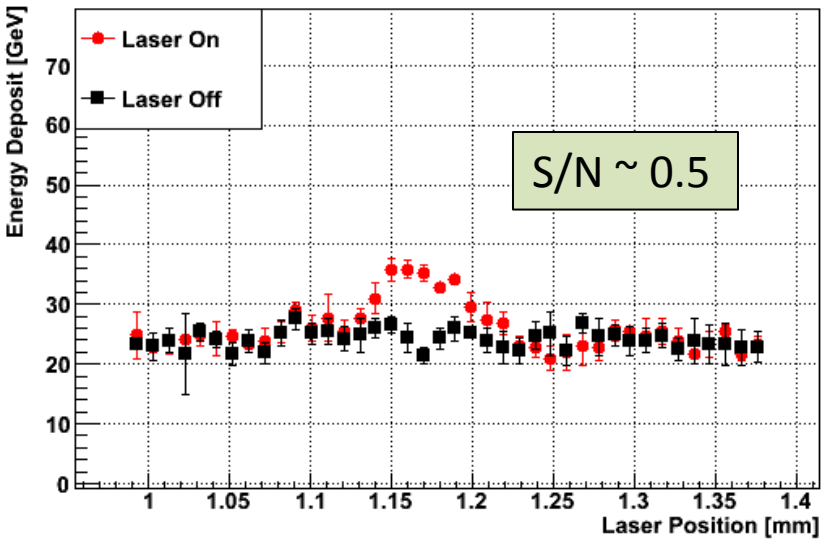
- Alignment, tuning
  - Installation of the IP tungsten wire scanner
  - Installation of the collimator scanner
  - Reconstruction of IP screen monitor
- Enhancement of Compton signal
  - Replacement of the laser
- Reduction of background photon
  - Installation of the background monitor
  - Addition of the front collimator
  - Alignment of the magnets in the Final Focus Line
  - Replacement of the chamber in the BDUMP

- Beam size tuning at the IP becomes easy.
- It becomes possible to check the gamma ray position at the detector without entering the tunnel.
- It becomes possible and easy to adjust the laser lights and the beam position at the IP

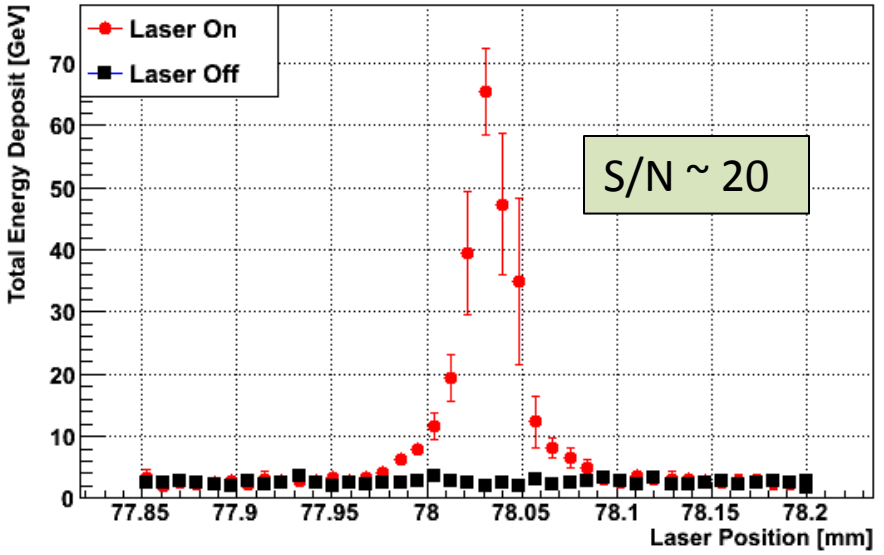
- S/N ratio is greatly improved.
- It becomes easy to find the Compton signal
- Measurement time is shortened.

Comparison of Compton Signal

- Comparison of S/N ratio in laser wire mode
  - Beam is focused at the IP
  - Laser width at the IP are almost same (about 20um σ)
  - ICT-DUMP charge 0.5 x 10^{10} electron
- In spring run
  - Background was reduced after the beam orbit tuning from the EXT and fine tuning around the Final Doublet.
- In autumn run
  - Background was reduced relatively easy.
  - Background didn't exceed 10 GeV, if the beam was aligned some extent.



laser wire mode measurement on May 29, 2009

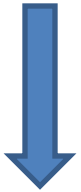


laser wire mode measurement on Nov. 13, 2009

Preparation before Interference Mode Measurement

- Beam tuning to minimize the beam size at the IP
- Collimator scanning of the gamma-ray position at the IP
- Adjust the laser lights and beam on the IP screen monitor
- Timing adjustment using an oscilloscope
- Laser waist scan on the screen
- Laser wire mode scan
- Timing adjustment using Compton signal
- Laser waist scan using Compton signal
- Interference mode phase scan and search the collision point in longitudinal
- Observe fringe pattern with Compton signal

6 hours
(Dec. 4)

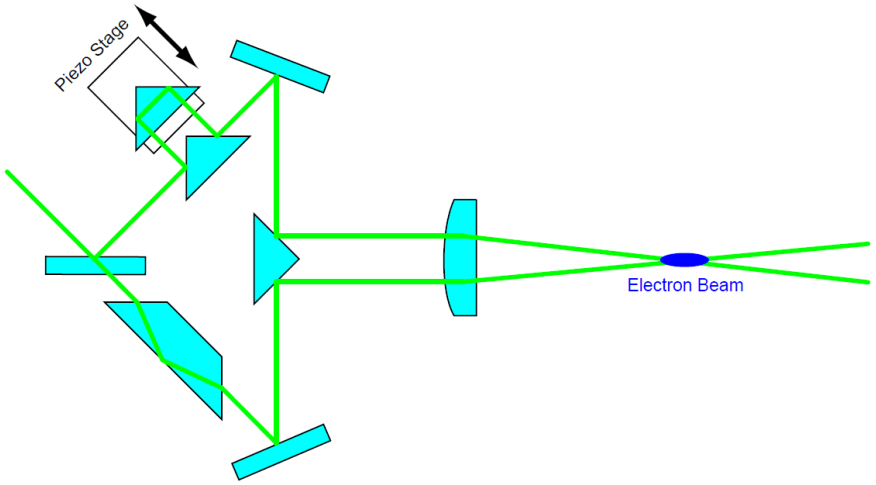


can be shortened to
less than 4 hours

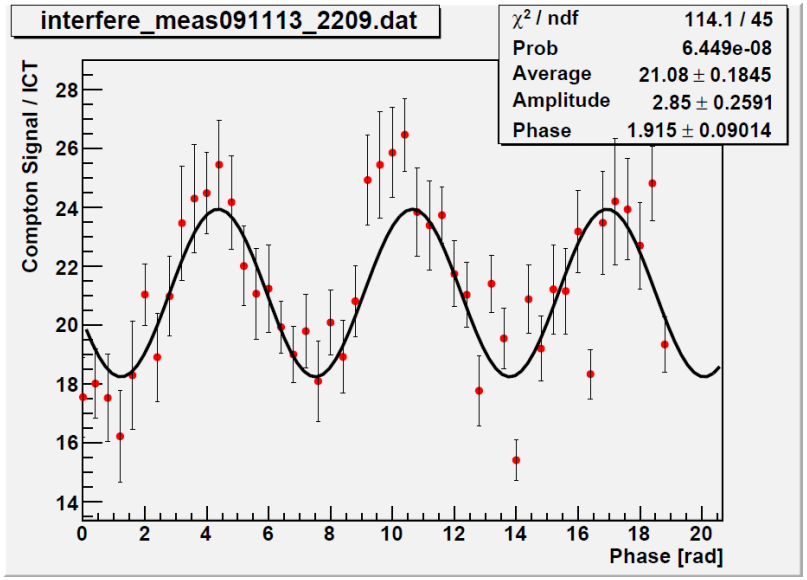
Interference Mode Phase Scan

- Interference mode measurement is performed by changing the path length of the one laser light after the two laser lights are adjusted to the beam at the IP.
- Interference fringe pattern move according to the path difference of two interfering laser lights

- We have succeeded in observation of the fringe pattern signal on Nov. 13



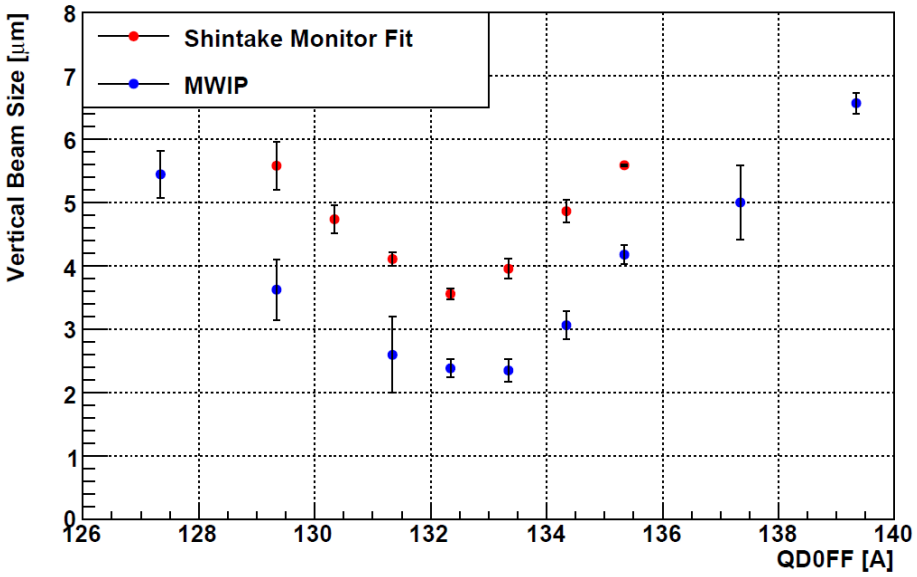
Schematic of the phase scan

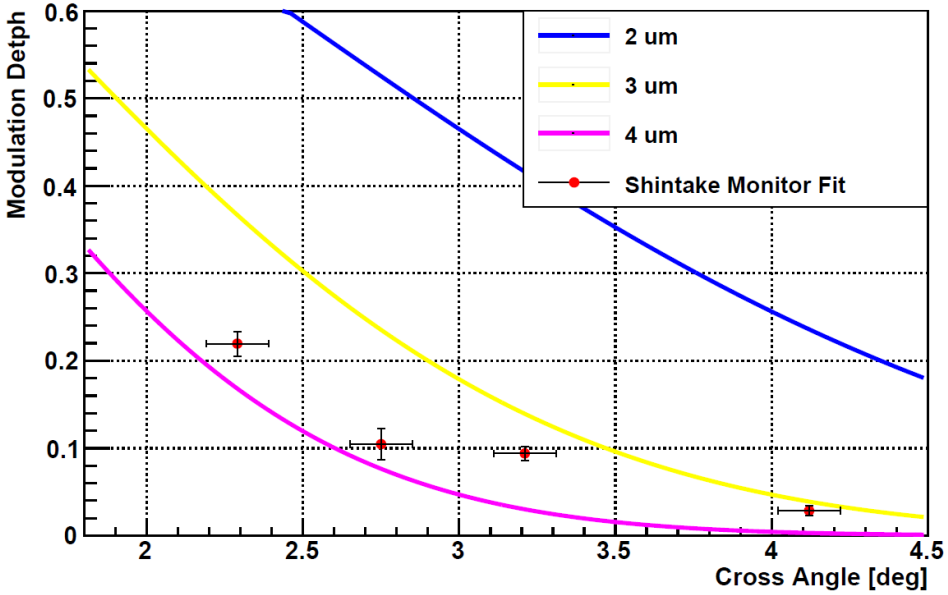


First observation of the fringe pattern signal

Obtained Result

- Comparison with tungsten wire scanner
  - Curve shape of the Shintake Monitor measurement is similar to the wire scanner measurement
  - Large offset exists in the Shintake Monitor measurement
- Consistency check when the laser crossing angle is changed.
  - rather consistent result





Systematic Error Source

- There seems to be the systematic error in the estimation of the modulation depth.

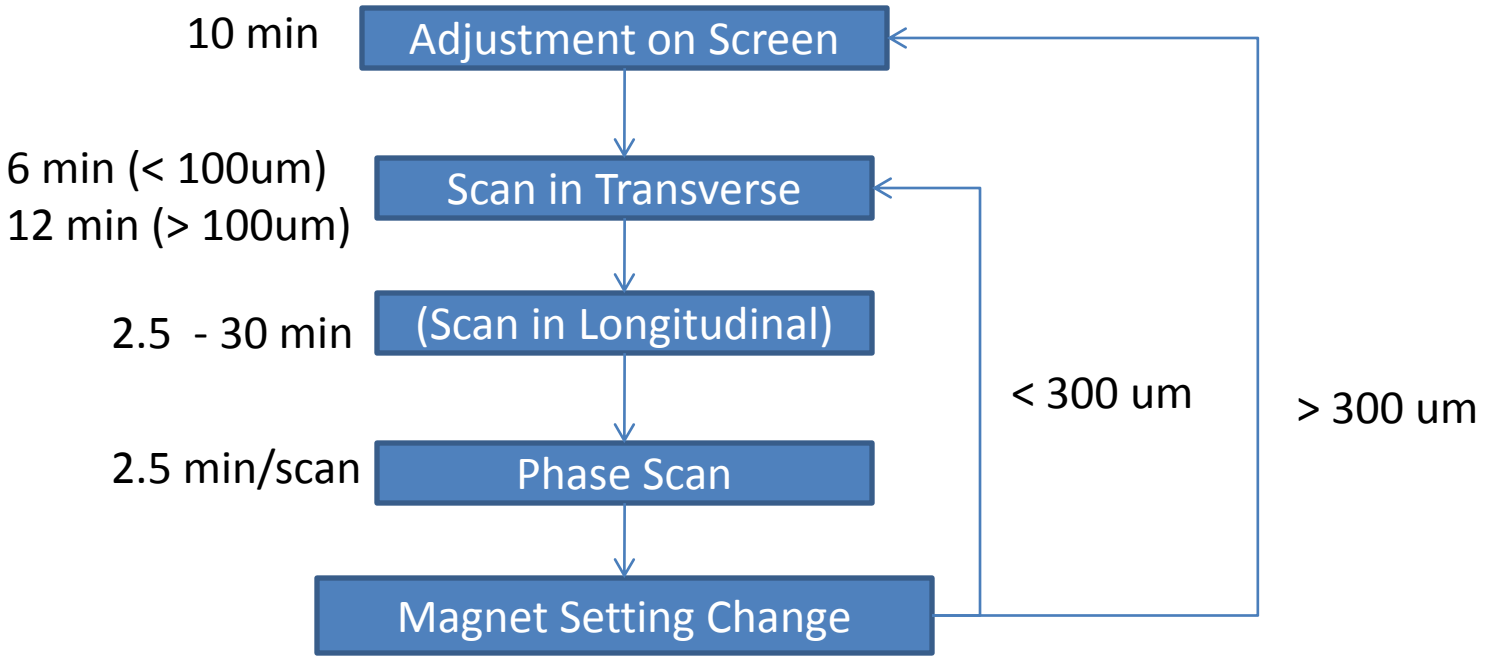
Error Source		$\Delta\sigma_y$
Fitting Method		< 5 %
Crossing angle estimation	< 0.2 deg	< 1 %
Power and size imbalance between two laser beams	$0.7 < P_1/P_2 < 1.5$	< 5 %
Temporal coherence	$\Delta\nu < 0.003$ cm^{-1}	< 8 %
Spatial coherence		
Displacement from the laser waist	> 2-3 z_R	~ 50 %?
Beam position, laser phase jitter	< 0.5 rad	---
Tilt of interference fringe	< 2-3 deg	
PMT linearity	< 3 % in full range	negligible

Seed Laser Trouble

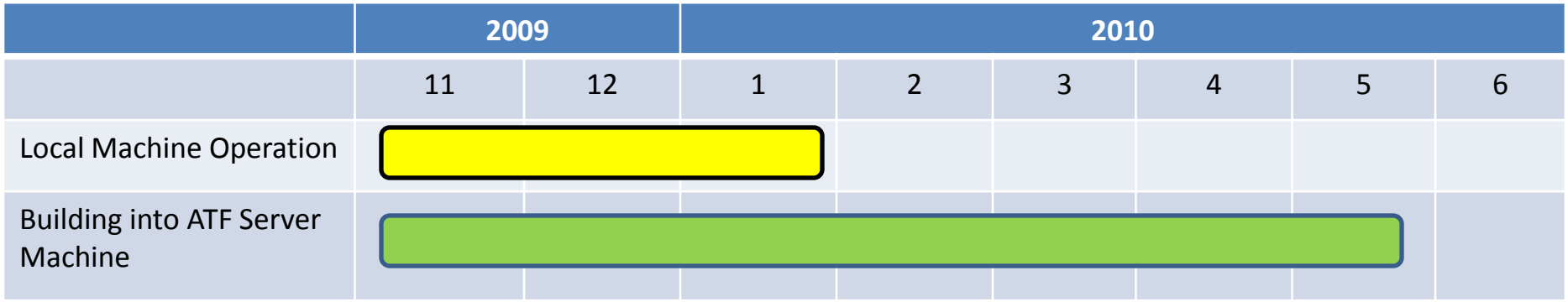
- Because of the trouble of injection seeder, we cancelled the beam time last week and this week.
  - Without the seeder, the host pulsed laser light doesn't interfere.
- We are investigating the cause of the trouble in contact with the company technical experts.
- Replacement part will be shipped soon.
  - It will be set up and tuned during the new year shutdown.
- We are preparing the old laser for backup.
  - Preparation will be finished before January run.

Measurement Loop

- When the setting of the magnets are changed, the beam position can be changed.
  - adjust the beam and laser light position on the IP screen monitor
  - scan with laser wire mode in the transverse direction
  - (perform phase scan changing the one laser light position in longitudinal)
  - interference mode phase scan



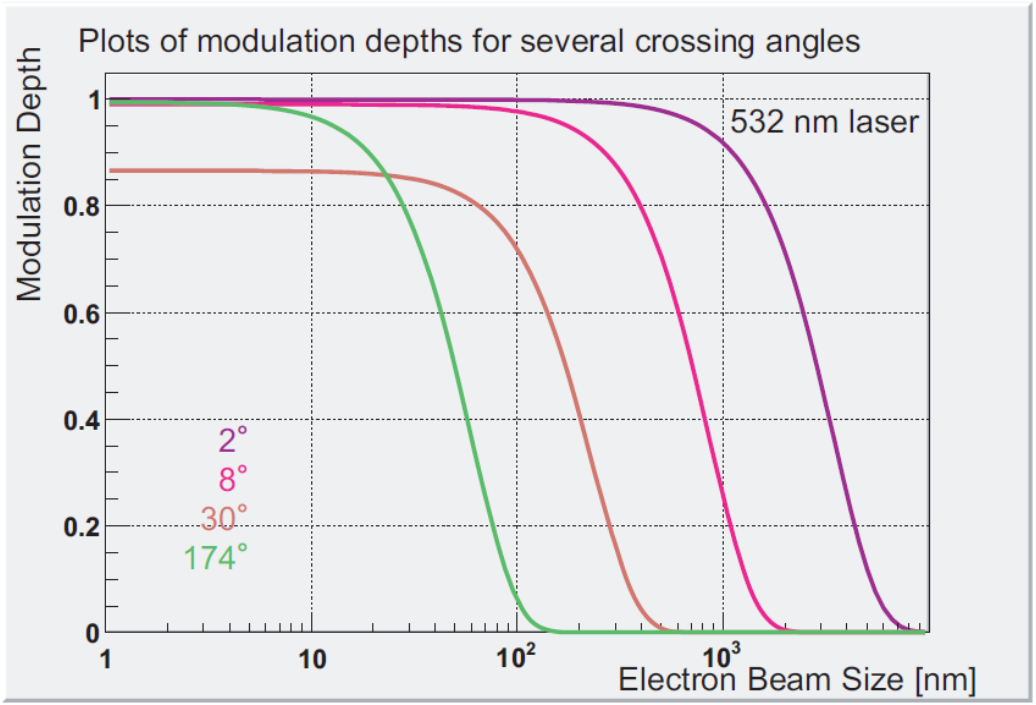
Software Preparation Schedule



- Now the measurement is done in the local machine but EPICS PVs are supplied.
- Some parts of the measurement are already built in the ATF server machine.
  - Background Monitor
  - IP Wire Scanner
  - Collimator Scanner
- The laser power is high, software reliability is strongly demanded.
  - Hardware experts from the IP-BSM group will always stand by during the measurement.
- To avoid the accidents due to wrong manipulation, the interlock system need to be constructed.
  - Gamma-ray detector
  - Pulsed laser

Measurable Range

- In the present condition > 0.03 modulation depth can be distinguished.
- Crossing angle can be selected according to the beam size, so any beam optics is fine.
  - 30 deg, 174 deg mode have not yet tested, it won't take long time to be usable. 1 shift each will be enough.



Cross Angle	Minimum	Maximum
2-8 deg	200 nm	6 um
30 deg	80 nm	400 nm
174 deg	100 nm	20 nm

Summary

- Measurement with the interference mode became possible from this autumn run.
  - However, the systematic error exists in the measurement
- Preparation for the automated measurement is in progress.
- Any beam optics will be fine for us.
  - We can change the crossing angle according to the beam size.