Advanced Research Center for Beam Science
- Particle Beam Science -

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Prof
NODA, Akira
(D Sc)

Assoc Prof
IWASHITA, Yoshihisa
(D Sc)

Assist Prof
SHIRAI, Toshiyuki

Techn
TONGU, Hiromu

PD
IKEGAMI, Masahiro
(D Sc)

Students

NAKAMURA, Shu (D3)	MIHARA, Takanori (D2)	SOUDA, Hikaru (M2)
YAMAZAKI, Atsushi (D3)	TANABE, Mikio (D1)	SHINTAKU, Hiroki (M1)
FUJIMOTO, Shinji (D3)	ITOH, Hiroyuki (M2)	

Visitors

Prof HOFMANN, Ingo	GSI, Germany, 2 March 2005
Prof HANGST, Jeffrey	University of Aarhus, Denmark, 17 March 2005
Dr COUPRIE, Marie-Emmanuelle	LURE, France, 24 October 2005
Prof SHEVELKO, V.P.	Lebedev Physical Institute, Russia, 26 October 2005
Prof SYRESIN, Evgeny	JINR, Russia, 16 November - 1 December 2005
Dr SELEZNEV, Igor	JINR, Russia, 21 November - 8 December 2005

Scope of Research

Particle and photon beams generated with accelerators and their instrumentations both for fundamental research and practical applications are studied. The following subjects are being studied: Beam dynamics related to space charge force in accelerators: Beam handling during the injection and extraction processes of the accelerator ring: Radiation mechanism of photons by electrons in the magnetic field: R&D to realize a compact synchrotron dedicated for cancer therapy; and Irradiation of materials with particle and photon beams.

Research Activities (Year 2005)

Presentations

Approach to Crystalline Beam at S-LSR with Use of the Electrostatic Potential Combined with the Magnetic Field, Noda A, First International Workshop on Electrostatic Storage Devices, Israel, 2 June 2005.

Beam Simulations in S-shaped Curved Solenoids, Iwashita Y, 7th International Workshop on Neutrino Factories and Superbeams, Italy, 22 June 2005.

Phase Rotation Scheme of Laser Produced Ions for Reduction of the Energy Spread, Noda A, Nakamura S, Iwashita Y, Sakabe S, Hashida M, Shirai T, Shimizu S, Tongu H, Ito H, Souda H, Yamazaki A, Tanabe M, 14th International Laser Physics Workshop, Japan, 7 July 2005.

RF Kicker Update, Iwashita Y, 2005 International Linear Collider Physics and Detector Workshop and Second ILC Accelerator Workshop, USA, 18 August 2005.

Experimental Study of Dispersion Control Utilizing both Magnetic and Electric Fields, Tanabe M, Ikegami M, Noda A, Shirai T, Souda H, Tongu H, Shibuya S, Noda K, The International Workshop on Beam Cooling and Related Topics, USA, 19 September 2005.

Laser Cooling for 3-D Crystalline State at S-LSR, Noda A, Fujimoto S, Ikegami M, Shirai T, Souda H, Tanabe M, Tongu H, Shibuya S, Takeuchi T, Okamoto H, Grieser M, Noda K, The International Workshop on Beam Cooling and Related Topics, USA, 23 September 2005.

Development of Final Focus Permanent Magnet, Mihara T, Iwashita Y, Kumada M, Workshop on Nano Scale Beams (Nanobeam 2005), Japan, 18 October 2005.

Commissioning of S-LSR, Shirai T, Noda A, Fujimoto S, Ikegami M, Souda H, Tanabe M, Tongu H, Shibuya S, Takeuchi T, Fujimoto T, Iwata S, Okamoto H, Grieser M, Noda K, Workshop on Nano Scale Beams (Nanobeam 2005), Japan, 20 October 2005.

Beam Monitoring System and Orbit Correction in S-LSR, Fujimoto S, Noda A, Ikegami M, Souda H, Tanabe M, Tongu H, Shirai T, Takeuchi T, Noda K, Workshop on Nano Scale Beams (Nanobeam 2005), Japan, 20 October 2005.

Topics

Beam Commissioning and First Electron Beam Cooling at S-LSR

The ion storage and cooler ring, S-LSR have been constructed at Institute for Chemical Research (see Figure 1). The beam commissioning was started from the beginning of October, 2005. The linac injected the 7 MeV proton beam into the new ring. We observed the first beam accumulation at 10th October. The number of the accumulated proton was $3x10^7$ particles. Now it is improved up to 10^9 particles.

The aim of S-LSR is technical developments of the compact ion accelerator for the cancer therapy using the electron beam cooling. The commissioning of the electron beam cooler was started from 31st October. Figure 2 shows the results of the first cooling experiments. We succeeded in reducing the horizontal beam size from 40mm to 1mm and the momentum spread from 0.4% to 0.02% without any beam losses. As a result, the beam density in the phase space is increased about 10^6 times higher.

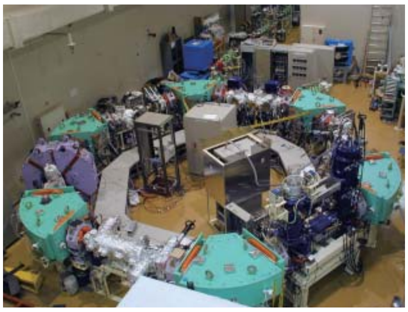

Figure 1. View of the ion storage / cooler ring, S-LSR.

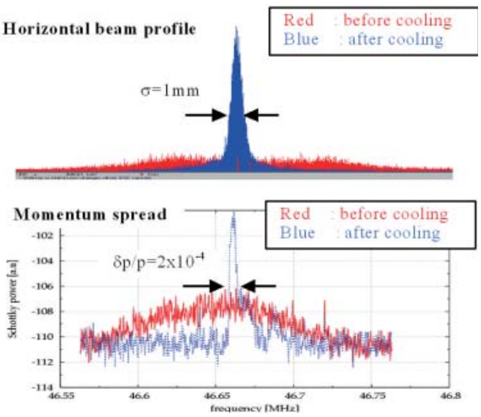

Figure 2. Measured beam profile and the momentum spread before and after cooling. They are measured by the MCP and Schottky monitor.

Phase Rotation of the Laser Produced Ions

Recently there are many reports of the high energy ion production by high intensity, ultra short pulse lasers. The energy spread of the laser produced ions is very wide from 0 to 100% without the energy peak. This situation can be greatly improved using the phase rotation scheme by the RF field synchronized with the laser pulse.

The phase rotation experiment was carried out at JAEA-KANSAI. Figure 3 shows the RF cavity for the phase rotation. The laser pulse up to 4 TW, 70 fsec was focused on the Ti foil with the thickness of 3 μm. The laser field is about 10^{18} W/cm^2 on the target. Figure 4 shows the energy spectrum of the laser produced ions. There is no energy peak without the phase rotation. With the phase rotation, the energy peaks appears when the ion energy matches the phase of the RF field.

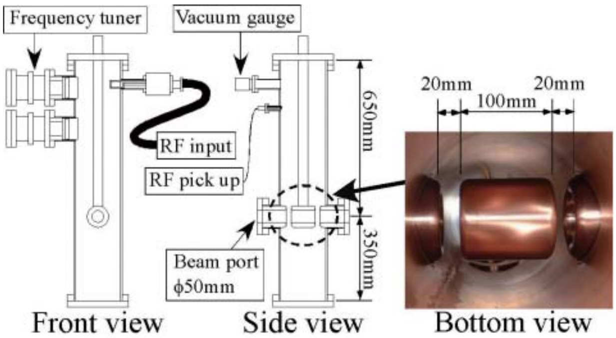

Figure 3. View of the phase rotation cavity.

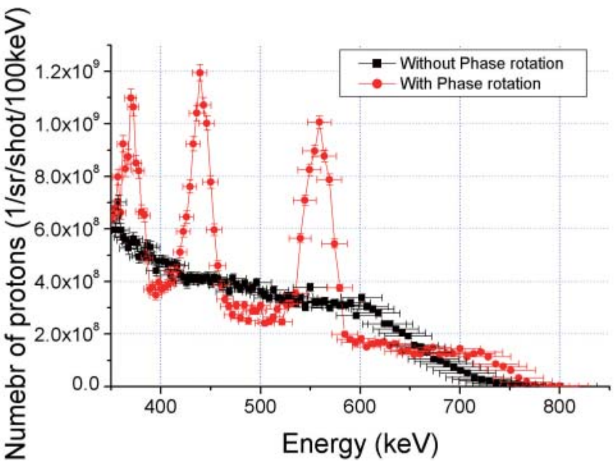

Figure 4. Energy spectrum of the laser produced ions with and without the phase rotation.

Grants

Noda A, Beam Accumulation and Cooler Ring, Advanced Compact Accelerator Research, April 2001 - March 2006.

Iwashita Y, Super Strong Permanent Magnet for Final Focus Lens in Linear Collider, Grant-in-Aid for Scientific Research, (A) (1), April 2002 - March 2006.

Shirai T, High Energy Electron Extraction from Electron Storage Ring, Grant-in-Aid for Scientific Research, (C) (2), April 2004 - March 2006.