combined with interstitial brachytherapy (clinical cases of breast cancer recurrence, recurrent melanoma, etc.). Contemporary sophisticated CT-based interstitial brachytherapy is based on multi-catheter implants piercing the tumor or its bed. The same set of elastic tubes can be successfully used for hyperthermia treatment. In this approach tiny microwave antennas along with thermometers (for temperature measurement and adjustments) are inserted into the treated volume via brachytherapy applicators. A set of CT scans used for treatment planning delivers strict geometrical information about 3D orientation of applicators within the CTV and enables the physician to plan the best pattern of antennas and thermometers to safely heat the target volume just before/after irradiation. Such an example of reproducible combination of interstitial BT with interstitial and superficial HT supported by CT-based treatment planning will be presented.

Joint Symposium: ESTRO-JASTRO: Particle therapy state of the art

**SP-0301**
An image-guided spot-scanning proton beam therapy gated to real-time tumor-tracking system
H. Shirato1, K. Umeogki2, S. Shimizu1
1Hokkaido University, Department of Radiation Oncology, Sapporo, Japan
2Hokkaido University Hospital, Proton Beam Therapy Center, Sapporo, Japan

There are mainly four challenges in photon radiotherapy.
1. Proximity to critical organs
2. Tumor motion
3. Large tumor volume
4. Radio-resistance

We have developed and used fiducial markers, four-dimensional radiotherapy (4DRT) planning concept, and real-time tumor-tracking radiotherapy (RTRT) system since 1999 to overcome the first and second problem (Shirato, H. et al. Lancet 1999). It was effective to treat small tumors such as lung, liver, and prostate cancers effectively with the accuracy of ±2 mm even with complex internal organ motion (Seppenwoode, Y. et al. JROBP 2002).

We have development a new radiotherapy system with Hitachi co ltd to cure large, moving tumors situated near critical organs. It is image-guided spot-scanning proton beam therapy system with real-time tumor-tracking system. Cone-beam CT scan is available for precise set-up. Two sets of fluoroscope are mounted in the gantry, used for real-time tracking of fiducial marker near the tumor, and the proton beam is gated to treat large tumors with the accuracy of ±2 mm. The system was approved by Japanese government in February 2014 and commercially available as PROBEAT-RT (Hitachi, co. ltd., Japan). We have been able to successfully reduce the size of the system, to make it small enough to be installed in the premises of hospitals, by dedicating to the spot-scanning Irradiation Technique. Initial experience of this system will be presented.

Clinical trial has been started since March 2014 for those patients who have gain in dose distribution comparing to photon therapy. Acute adverse effects were evaluated and shown to be minimal in the initial 6 months.

**SP-0302**
The heavier the better: protons vs carbons?
J. Debus1

1University Klinikum Heidelberg, Medical Physics, Heidelberg, Germany

Abstract not received.

**SP-0303**
Twenty years experience of carbon ion radiotherapy at NIRS-HIMAC
T. Kamada1
1National Institute of Radiological Sciences (NIRS), Research Center for Charged Particle Therapy, Chiba, Japan

(National Institute of Radiological Sciences) using HIMAC (Heavy-Ion Medical Accelerator in Chiba), which was the world’s first heavy ion accelerator complex dedicated to medical use in a hospital environment. As of February 2014, a total of 8,931 patients were treated with carbon ion radiotherapy using HIMAC. The results have shown that carbon ion radiotherapy has the ability to provide a sufficient dose to the tumor without unacceptable morbidity in the surrounding normal tissues. Tumors that appear to respond favorably to carbon ions include locally advanced tumors and those with histologically non-squamous cell type of tumors such as adenocarcinoma, adenoid cystic carcinoma, malignant melanoma, hepatoma, and bone and soft tissue sarcomas. By using biological and physical properties of the high-LET carbon ion beams, the efficacy of treatment regimen with small fractions in shorter treatment course has been also confirmed for almost all type of tumors in our carbon ion radiotherapy experience. More than 10,000 patients treated with carbon therapy worldwide, more than 80% were treated at NIRS and other facilities in Japan. The current facilities and devices may be termed as first-generation equipment. Making existing equipment smaller and less expensive is only the first step. It is be far from satisfactory for next-generation facility. One new technique that deserves attention as the next generation system is the spot scanning beam delivery and the compact superconducting magnet mounted rotating gantry. Spot scanning beam delivery is designed to treat the complex-shaped lesions that are difficult targets for the by current techniques. Use of the rotating gantry will minimize the time for patient positioning and improve patient comfort. Owing to simplified treatment set-up procedures and reduced treatment time, more patients with poor performance status will be eligible for this therapy. We anticipate that the introduction of these innovations will not only improve the therapeutic outcome but also increase patient throughput. The new system will also eliminate the need for making compensation filters as well as patient-specific collimators. NIRS has finished the construction of the new facility's building and the installation of the beam delivery system for the pencil beam scanning. A clinical research using the pencil beam scanning was in operation with the original fully automated patient positioning system since May 2011. We could treat a total of almost 1000 patients in the FS year of 2013 by the broad beam delivery and the pencil beam scanning. Good performance of this new carbon pencil beam delivery system has been confirmed at NIRS. Regarding the compact superconducting magnet mounted rotating gantry, the magnets for the gantry were already made and have been testing at NIRS successfully. The NIRS novel gantry system will be expected to be in operation in early 2016.

**SP-0304**
The contribution of the ULICE project to the development of hadron therapy in Europe
R. Orecchia1, R. Potter2, J. Debus3, M. Dosanjh4

1, 2University Klinikum Heidelberg, Medical Physics, Heidelberg, Germany
3, 4National Institute of Radiological Sciences (NIRS), Research Center for Charged Particle Therapy, Chiba, Japan

Abstract not received.