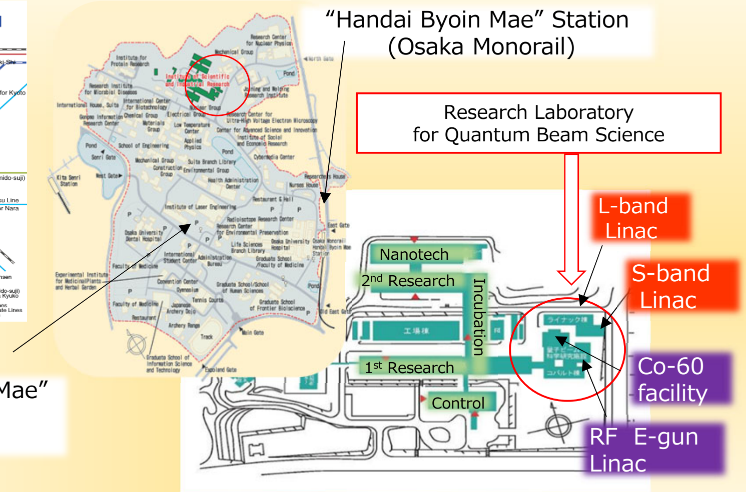
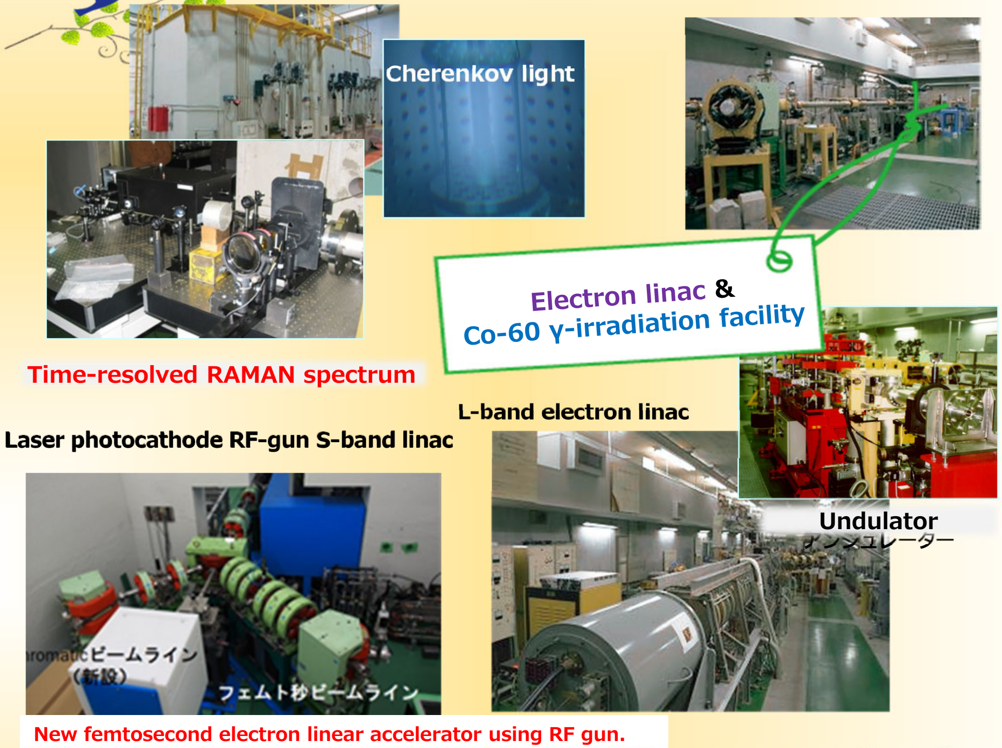
Research Laboratory for Quantum Beam Science

Institute of Scientific and Industrial Research
Osaka University

ACCESS

Suita Campus Map





History

1957	Organizing Committee of Radiation-relating laboratory started and a new laboratory named HOT LAB was established as a facility of Osaka University.
1964	Administration of the laboratory named Radiation Laboratory was moved to ISIR according to the revision of Regulations for national University.
1965	Administration for β-tron was moved to this laboratory from faculty of science.
1968	All the facilities in Radiation Laboratory were moved from Sakai campus to Suita campus.
1975	Construction of the L-band electron linac was decided.
1978	Construction of the L-band electron linac was completed and started operation.
1983	Joint-use of the L-band electron linac was started.
1989	150 MeV S-band linac was constructed and started operation.
1999	Future plan of the Radiation Laboratory was drawn up.
2002	The Radiation Laboratory was closed and a new organization having the same name was established in Nano Science and Nano Technology center of ISIR.
2009	The Research Laboratory for Quantum Beam Science was established.

Cooperative Laboratories

Department of Advanced Nanofabrication	https://www.sanken.osaka-u.ac.jp/labs/bsn/
Department of Quantum Beam Physics	https://www.sanken.osaka-u.ac.jp/labs/bmp/wordpress/index.php/home-jp/
Department of Material Excitation Chemistry	https://mec.isir-sanken.jp/labs/mec/en/
Department of Beam Material Science	https://www.sanken.osaka-u.ac.jp/labs/bms/english/

Contact

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<OUTLINE>

The Research Laboratory for Quantum Beam Science (RLQBS) was established in 2009 as a successor of Radiation Laboratory. All facilities such as L-band electron linac, photo cathode RF-gun equipped S-band electron linac and Co-60 γ-irradiation facility had been taken over. These are opened to users in Osaka University, the members of Network Joint Research Center for Materials and Devices all over Japan, and also collaborators in the world. Frontier beam science relating to environmental material science, new energy sources, and advanced medical science and technology as well as fundamental beam science are promoted. The management including operation, maintenance, and the safety control of radiation related facilities are also conducted.

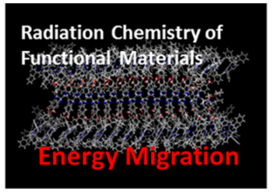
<Research Topics>

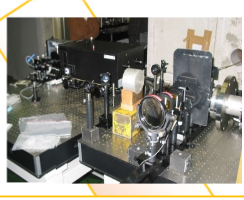
① Application of quantum beam science to the fields of environmental science, new energy technology and advanced medical technology.
② Development and application of advanced quantum beams.
③ Research and development of analyzing methods of materials using quantum beams.
④ Radiation induced reactions in organic molecules and photocatalytic semiconductors.

L-band electron linac

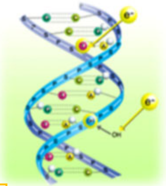
The L-band linac was constructed in 1978 to generate an intense singly bunched electron beam with pulse width of 20 picosecond. Acceleration power is supplied by 30 MW L-band klystron. After the improvement of bunching system and the electron gun, the charge per single bunch was increased up to 91 nC. Such intense electron beam has been mainly used to study transient phenomena in the range from nanosecond to sub-picosecond with a pulse radiolysis system, and also used as a tool of free electron laser (FEL) to produce far-infrared light.

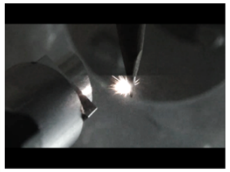
Domain expansion of radiation chemistry which made full use of various spectral methods





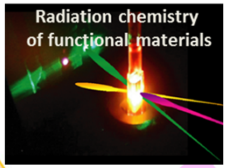
Time-resolved RAMAN spectrum





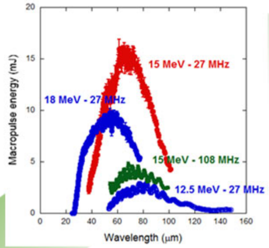
THz light condensed to the pencil core

- Application for transient spectroscopy and electron spin resonance technique
- Application for time-resolved RAMAN spectroscopic measurement
- Consideration of complicated and realistic systems: biomolecule and interfacial phenomena

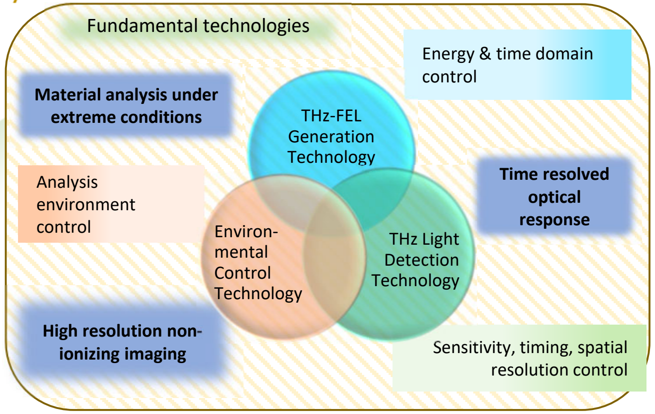


Development of Secondary Beams

- Slow positron beam
- THz Light
- EUV Light

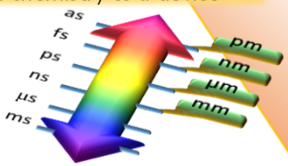


Scientific and technological innovation based on next generation THz light

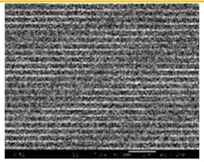


Examination from basic physical chemistry based on radiation chemistry to a device

- Electric charge non-local existence of conjugated systems
- Reactive examination of the excitation radical ion
- Examination of the emission of light mechanism of the electrochemical luminescence diode
- Elucidation of the photocatalytic reaction mechanism
- Charge transfer in DNA and structural change
- Protein folding mechanism induced by pulse radiolysis

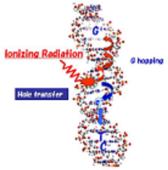


Development of new type resist

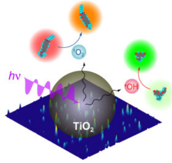


10nm lines

fine etching



Radiation damage of DNA



TiO_2 photocatalytic reaction

Green innovation

Quantum Beam

Material science

Life innovation

Promotion of joint use, and activation of industrial use !

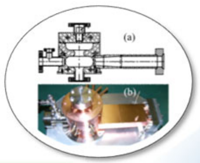
Co-60γ-ray irradiation facility

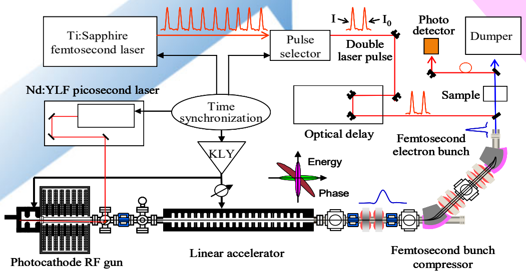
The Co-60 γ-irradiation facility is equipped with 3 Co-60 γ-ray sources and two irradiation caves are available. This facility has been utilized in the fields such as irradiation effects on materials and tissues, radiation induced polymerization, radiation damages on materials, radiation hazard on biological system and so on.

It is effective for new material development and radiation use for environmental protection, cancer medical treatment, etc. it is also useful for research in a field of space development.

Femtosecond/attosecond pulse radiolysis

- Generation of femtosecond/attosecond electron beams
- Study on radiation-induced ultrafast reactions
- Electron and hole transfer in liquid solvents
- Solvation, geminate recombination in radiation chemistry

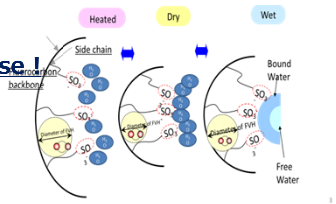




Photocathode RF gun linac & femtosecond pulse radiolysis

Femtosecond time-resolved relativistic-energy electron microscopy

- Ultrafast structural dynamics
- Macromolecular structure
- Making molecular movie .
- Nano-technology/science



Dynamical analysis with positron

- functional polymer
- local deformation relating to functional groups

Detection of swelling process in PEMFC

Beam port for surface analysis

Beam port for the analysis of free volume hole

positron/o-Ps lifetime measurement
Doppler broadened annihilation photo peak measurement

Generation of second beam and use

- Slow positron beam

RF-gun S-band Electron Linac

The linac consists of a 1.6-cell S-band photocathode RF electron gun, a 2-m-long traveling-wave linac, and a magnetic bunch compressor. Picosecond electron beams are generated in the RF gun using a Nd:YLF picosecond laser. The electron beams are accelerated in the linac up to 32 MeV, and finally are compressed into femtoseconds. The shortest single-bunch electron beam is 98 fs. A femtosecond pulse radiolysis with time resolution of 240 fs has been developed successfully for the study of radiation chemistry.

S-band Electron Linac

S-band linac was developed in 1990. This linac consists of three acceleration tubes and a thermionic gun which can accelerate electron bunch up to 100 MeV with the current of 0.25 A in a representative operation. The bunch length is two microseconds and its repetition is less than 30 Hz. This linac has been dominantly used to produce positron beam.