A PRELIMINARY DESIGN OF THE PHOTON FACTORY BEAM CHANNEL

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Abstract

In order to utilize the synchrotron radiation emitted from the 2.5-GeV electron storage ring at Photon Factory, a layout of the beam channel is proposed. Components of the channel are chosen and arranged so that the system could completely opperate according to basic requirements for the channel.

A 2.5-GeV electron storage ring at Photon Factory (PF-RING) is designed to be used as a dedicated synchrotron light source for fruitful applications in many fields of science, such as atomic and solid state physics, crystallography, radiochemistry, biology and medical science. PF-RING serves as a continuous light source from infrared to hard X-ray region[1]. The number of photons emitted at 2.96Å ($=\lambda c$) is found to be 1.34×10^{13} $Å^{-1} \cdot sec^{-1} \cdot mA^{-1} \cdot mrad^{-1}$. In addition, synchrotron radiation emitted from PF-RING has characteristics such as great stability, high collimation around X-ray region and subnanosecound time structure. In order to utilize both vacuum ultraviolet and X-ray parts of the spectrum, we must deliver the radiation through an evacuated beam channel from PF-RING operated at ultrahigh vacuum to experimental equipments at conventional vacuum. The beam channel should be designed to satisfy the following requirements:

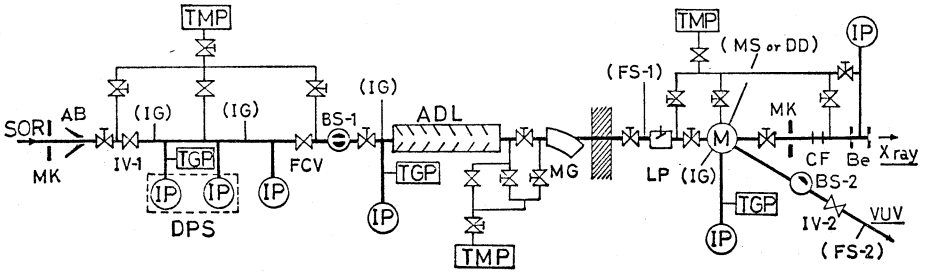
(1) sufficient horizontal-acceptance of synchrotron radiation to make several experiments simultaneously;
(2) safty of personnel from radiation hazard and high energy electron irradiation;
(3) mediation of any pressure difference between PF-RING and users' vacuum systems;
(4) protection of ring vacuum against reentry of air or pollution with gaseous materials caused by erroneous operation.

Since the total distance from the source point to the experimental site may be about 10 m for most channels, a beam with maximum horizontal dispersion of 15 mrad is accepted with usual size 6" vacuum components in a single beam line. About 15 mrad of synchrotron radiation is sufficient to operate one central and a few branch beam lines. A PF beam channel consists of differential pumping station, failsafe system, beam shutter for radiation shielding and other equipments. All vacuum components should be chemically cleaned and bakable to about 250°C to obtain oil-free vacuum. Figure 1 shows the schematic arrangement of the proposed beam channel to be used for VUV and hard X-ray experiments. This arrangement of elements almost satisfies the requirements mentioned above. In the figure, the differential pumping station (DPS) is useful for closer access of monochromators to PF-RING. Two stage DPS have been constructed to connect the ultrahigh vacuum of SOR-RING[2] with the monochromater and is now well operated during measurements. Characteristics of the DPS measured is applicable to design the PF channel.

The failsafe system consists of an acoustic delay line (ADL) and a fast closing valve with a closing time of 30 msec. The ADL was tentatively designed to obtain a delay time of about 200 msec for a shock wave front caused by reentry of air, on the basis of the results given by Jean and Rauss[3]. There is no

standardized form because the vacuum requirments will vary from one beam channel to another, but the final design for each channel would be determined by a slight modification of the basic arrangement shown in Fig. 1.

For the purpose of protection against radiation hazard, beam shutters, BS-1 and BS-2 must be inserted to stop the beam before experimenters obtain access to measuring equipments installed in the central or secondary beam line area during the operation period of the machine. Access to any beam line area is controlled in a manner similar to "hutch control system" developed at SSRP[4].



DPS : diffrential pumping station
ADL : acoustic delay line
MK : water cooled mask
AB : water cooled absorber
BS-1,2 : water cooled beam shutter
FCV : fast closing valve
IV-1,2 : isolation valve
IP : sputter ion pump
TGP : titanium getter pump
TMP : turbomolecular pump

MS : mass spectrometer
DD : desorption diode
IG : ionization gauge
FS-1,2 : fast sensor
MG : electromagnet
M : mirror chamber
CF : water cooled Carbon film
LP : Laser port
Be : water cooled Be film

Fig.1 Layout of the Photon Factory beam channel

References

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