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DISTRIBUTION OF UNDULATORS AND WIGGLERS FOR VARIOUS EXPERIMENTS AT A 6-GeV RING

SUMMARY

We have made a distribution of the insertion devices for the various possible experiments at a 6-GeV ring. This evaluation should be considered preliminary which will be updated as the user input to the program increases.

INTRODUCTION

The nature of an experiment to be conducted at a 6-GeV source dictates the type of photon source needed. There is no simple way to distribute these sources on a 6-GeV ring without first deciding the type of experiment. To a great extent this important thought will also determine the structure of the PRTs - they will be based on the science that can be carried out at a particular experimental station utilizing the radiation from a specific source.

On a 6-GeV, following types of sources will be most common, viz., the bending magnet (BM) source, energy shifting wiggler (E-Shifter) source, multipole wiggler (MW) source and undulator (U) source. There will, of course, be more complex devices such as crossed-undulators for producing circularly polarized radiation, wiggler-undulator combinations (WUNDER) to vary K, for example from 1 to 20, WOBLER equipped ports for timing experiments, undulators with flat-top energy peaks, etc. In this note we will concern ourselves with E-shifters, MWs and Us. There is no need to discuss BM sources at the present time.

EXPERIMENTAL STATIONS

A proper place to begin this discussion is at the experimental station (ES). Each ES will be equipped with a highly specialized equipment capable of performing a unique kind of science. For example, high energy resolution inelastic scattering spectrometer, a setup for topography, a setup for Compton scattering, etc. We will list this in more detail later. One or more PRTs will be formed around such an instrument by scientists from various institutions (universities, industries, national labs, hopsitals, etc.) all of them having a common scientific goal. Such an arrangement brings together the best talent from different institutions to produce the most desirable instrument. Each straight section may be equipped with more than one undulator on a carousel (a concept being tried at SSRL) to alter the characteristics of the source.

BEAM SPLITTING

It is easy to split a beam from a source and deliver radiation to more than one ES. The BM radiation from the ring will be delivered at 32 ports, the horizontal fan of radiation from each port will be about 48 mrad. It is easy to split this into two (or even three) beams to provide radiation to two ESs. The horizontal fan from a E-shifter can be only about 1 to 3 mrad. Thus this source can be split into at best two parts supporting two ESs. The MWs will have wider horizontal fan and can easily accommodate two ESs. On the other hand, U sources cannot be split and hence they cater to only one ES at any given time.

The BM and MW sources can also be split with regard to the photon energy using either slits, or multilayer optics or some other suitable technique.

Often there are situations where the characteristic radiation from a single U source is suitable for more than one kind of experiment. This situation can be handled through the ESs in tendom, in which case at any given time only one station will operate.

Having defined the mode of providing radiation to each ES, we next list the experiments needing radiaton from Us, MWs and E-shifters. This list is by no means complete and needs updating.

EXPERIMENTS ON UNDULATOR SOURCES

U1. Ultra-high Resolution Inelastic Scattering

A set of four undulator sources (#7,8,9,&10 in LS-22) should be mounted at a single straight section using a carousel to provide radiation from 6 keV to 14 keV. The spectrometer should be capable of delivering a resolution of $\partial E/E \sim 1\text{-}5\times10^{-7}$. This will provide $10^{12} \sim 10^{13}$ photons of millivolt width at 10 keV on the sample.

U2. Intermediate Resolution Inelastics Scattering

Use: Scattering from Electrons, Charge density waves, etc.

A set of four undulator sources (#9,10,11&12 in LS-22) should be mounted at a single straight section using a carousel to provide radiation from 3 keV to 10 keV. The spectrometer will have a resolution $\partial E/E \leqslant 10^{-4}$.

U3. High-momentum Resolution Scattering

Use: Surface physics - diffraction, chemisorption,

Set of Undulators - 8 keV - 9 keV

$\Delta Q \sim 10^{-4}\text{Å}^{-1}$

U4. Small Angle Scattering

Fixed or variable Energy

Set of Undulators - 6 keV to 15 keV

U5. X-ray Microscopy

K ~ 1.5

U6. High Resolution Topography

Set of Undulators - 6 keV to 10 keV

Beamline 100m

U7. Ultra-high Resolution Topography

Set of Undulators - 6 keV to 10 keV

Beamline 1km

U8. Elastic Magnetic Scattering

Set of Undulators - 6 keV to 10 keV

U9. Circularly Polarized Radiation

Crossed-Undulator - 6 keV to 12 keV

U10. Nuclear Resonant Radiation

Undulator - 10-14 keV and higher harmonics

U11. Anomalous Scattering

Set of Undulators - 5 keV to 15 keV

U12. Soft X-ray Undulator

Set of Undulators: 250 → 1 keV

EXPERIMENTS ON MULTIPOLE WIGGLERS

MW1. Compton Scattering: Charge and Spin

Ec ~ 90 keV 20 poles

MW2. SEXAFS, Surface Diffraction, Standing Waves

Ec ~ 25 keV 20-30 poles

MW3. Large Angle Diffraction - Single Crystal

Ec ~ 20 keV 20 poles

MW4. Large Angle Scattering - Powders, Amorphous Systems, Liquids

Ec ~ 20 keV 20 poles

MW5. Protein Crystallography

Ec ~ 100 keV 10 poles

MW6. Time Resolved Topography

Ec ~ 60 keV 10 poles

MW7. X-ray Absorption Spectroscopy

Ec ~ 25 keV 20 poles

MW8. Angiography/Microradiography

Ec ~ 35 keV 20 poles

MW9. Low Energy Applications

Ec ~ 2.5 keV 5 poles H = 0.1T K ~ 10

EXPERIMENTS ON ENERGY SHIFTER WIGGLERS

E1. Energy Dispersive Diffraction

Ec ~ 100 keV

POSSIBLE DISTRIBUTION:

The ID distribution is also restricted by the requirement of their symmetric assignment to the straight sections of the ring for its ease of operation. Since the undulators will dominate the 6-GeV ring, the 32 straights can be divided in a ratio of 24/8 for undulator/wiggler. Two of the undulators straight sections and 2 of the wiggler straight sections will be used for the RF system, etc., leaving 22 straights for the undulators and 6 for the wigglers. Total ports and beam lines are as follows:

	BM	WIGGLER	Undulator
Beam lines per port	2	2	1
Total beam lines	32	6	22
ES per beam line	1	1	2 (tendom)
Total ESs	64	12	44

TOTAL EXPERIMENTAL STATIONS (ESs) = 120