

# KOPIO

## WBS Dictionary

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### 1.2.2

WBS Number	Description
1.2.2	<b>Preradiator</b> The Preradiator consists of 32 modules, each containing eight layers of dual coordinate drift chambers and nine layers of scintillator, with all necessary electronics for read out and data transmission. The effort is distributed between Chamber System (1.2.2.1), scintillator system (1.2.2.2), electronics (1.2.2.3), mechanics (1.2.2.4) and the photon veto system (1.2.2.5), and the effort necessary to design, prototype, fabricate, install, and commission the Preradiator system. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.
1.2.2.1	<b>Chamber System</b> The chamber system consists of 256 dual coordinate drift chambers and associated electronics for read out. This WBS describes the effort necessary to design, prototype, fabricate, and assemble the Chamber system. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.
1.2.2.1.1	<b>Chambers</b> The 256 dual coordinate drift chambers will be fabricated at TRIUMF. This WBS describes the effort necessary to design, prototype, fabricate, and assemble the Chambers into Preradiator Modules. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.
1.2.2.1.1.1	<b>Design</b>
1.2.2.1.1.2	<b>Prototype</b> A substantial, five level prototype effort is planned for the chambers. It will include operational, electronics design, beam test and pre-production prototypes to validate the electronics performance and develop the fabrication procedure. Tooling for production and test equipment are included in this effort.
1.2.2.1.1.3	<b>Fabrication/Procurement</b> TRIUMF will produce 256 chambers. This effort includes labor and materials.
1.2.2.1.2	<b>Gas System</b>



## 1.2.2

<b>WBS Number</b>	<b>Descriptio</b>
	<p>The dual coordinate drift chambers operate with an Argon/CF4 gas supply and re-circulating system at atmospheric pressure. This WBS describes the effort necessary to design, procure, and assemble the gas system. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.</p>
<b>1.2.2.1.2.1</b>	<p><b>Design</b></p> <p>This effort includes the tasks necessary to design an Argon/CF4 gas supply and re-circulating system operating at atmospheric pressure for the chambers. Drawings and specifications will be developed. Fabrication procedures will be developed for in-house a</p>
<b>1.2.2.1.2.2</b>	<p><b>Prototype</b></p>
<b>1.2.2.1.2.3</b>	<p><b>Fabrication/Procurement</b></p> <p>TRIUMF will procure and assemble components for the gas system for the 256 chambers. This effort includes labor and materials, and final test of the system at TRIUMF.</p>
<b>1.2.2.2</b>	<p><b>Scintillator System</b></p> <p>The scintillator system consists of 288 scintillator planes and associated electronics for read out. This WBS describes the effort necessary to design, prototype, fabricate, and assemble the scintillator system. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.</p>
<b>1.2.2.2.1</b>	<p><b>Scintillator Plates</b></p> <p>The 288 scintillator planes will be fabricated at TRIUMF. This WBS describes the effort necessary to design, prototype, fabricate, and assemble the scintillators into Preradiator Modules. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.</p>
<b>1.2.2.2.1.1</b>	<p><b>Design</b></p>
<b>1.2.2.2.1.2</b>	<p><b>Prototype</b></p>
<b>1.2.2.2.1.3</b>	<p><b>Fabrication/Procurement</b></p> <p>TRIUMF will procure scintillators to construct 288 module elements. This effort includes labor for vendor oversight and receiving inspection, and materials for scintillator, wavelength shifting fibers and test equipment to monitor light output and uniformity which is critical to the performance of this element.</p>
<b>1.2.2.2.2</b>	<p><b>WLS fiber</b></p>

WBS	Descriptio
Number	Descriptio
1.2.2.2.2.2	<b>Prototype</b>
1.2.2.2.2.3	<b>Fabrication/Procurement</b>
1.2.2.2.3	<b>Scintillator readout</b>  The 288 scintillator modules will be fabricated at TRIUMF. This WBS describes the effort necessary to procure and/or fabricate, and assemble the scintillator instrumentation into the scintillator system. The instrumentation system will be composed of photomultiplier tubes, and read-out electronics to read them out. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.
1.2.2.2.3.1	<b>Photo Tube</b>  The 288 scintillator plates will be fabricated at TRIUMF. This WBS describes the effort necessary to procure and/or fabricate, and assemble the scintillator instrumentation into the scintillator system. The instrumentation system will be composed of photomultiplier tubes, and read-out electronics to read them out.
1.2.2.2.3.1.3	<b>Fabrication/Procurement</b>  TRIUMF will procure PMTs to construct 288 module elements. This effort includes labor for trade studies, bid evaluation and vendor oversight, and receiving inspection, and materials for PMTs.
1.2.2.2.3.2	<b>MU Metal Shield/Bases</b>  The 288 scintillator modules will be fabricated at TRIUMF. This WBS describes the effort necessary to procure and/or fabricate, and assemble the scintillator instrumentation into the scintillator system. The instrumentation system will be composed of photomultiplier tubes, and read-out electronics to read them out.
1.2.2.2.3.2.3	<b>Fabrication/Procurement</b>  TRIUMF will procure mu metal shields for the PMTs to construct 288 module elements. This effort includes labor for trade studies, bid evaluation and vendor oversight, and receiving inspection, and materials for Mu metal shields.
1.2.2.2.3.3	<b>Cables</b>  The 288 scintillator modules will be fabricated at TRIUMF. This WBS describes the effort necessary to procure and/or fabricate, and assemble the scintillator instrumentation into the scintillator system. The instrumentation system will be composed of photomultiplier tubes, and read-out electronics to read them out.
1.2.2.2.3.3.3	<b>Fabrication/Procurement</b>

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<b>WBS Number</b>	<b>Descriptio</b>
	TRIUMF will procure cables to construct 288 module elements. This effort includes labor for trade studies, bid evaluation and vendor oversight, and receiving inspection, and materials for cables.
<b>1.2.2.2.3.4</b>	<b>Preamplifier</b> Production, test & selection of 1536 PMT-preamplifiers
<b>1.2.2.2.3.4.3</b>	<b>Fabrication/Procurement</b> Production of 1536 PMT-preamplifiers
<b>1.2.2.3</b>	<b>Electronics</b>
<b>1.2.2.3.1</b>	<b>Anode Electronics</b>
<b>1.2.2.3.1.1</b>	<b>Design</b>
<b>1.2.2.3.1.2</b>	<b>Prototype</b>
<b>1.2.2.3.1.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.3.2</b>	<b>Cathode Electronics</b>
<b>1.2.2.3.2.1</b>	<b>Design</b>
<b>1.2.2.3.2.2</b>	<b>Prototype</b>
<b>1.2.2.3.2.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.3.3</b>	<b>HV, LV PSs and controllers</b>
<b>1.2.2.3.3.1</b>	<b>Design</b>
<b>1.2.2.3.3.2</b>	<b>Prototype</b>
<b>1.2.2.3.3.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.3.4</b>	<b>DAQ interface</b>
<b>1.2.2.3.4.1</b>	<b>Design</b>
<b>1.2.2.3.4.2</b>	<b>Prototype</b>

## 1.2.2

<b>WBS Number</b>	<b>Descriptio</b>
<b>1.2.2.3.4.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.3.5</b>	<b>Scintillator Electronics</b> Scintillator readout electronic has to be include 1536 channels of a 10-bit & 250 MHz WFD, 6 Crate data-collection modules and 6 mainframes
<b>1.2.2.3.5.1</b>	<b>WFD Boards</b> WFD-board has to be including 16 channels of a 10-bit/250 MHz WFD, one “trigger” output that is providing signal if any channel exceeds over threshold, and a special fast link to a crate data-collection board.
<b>1.2.2.3.5.1.3</b>	<b>Fabrication/Procurement</b> Production of 96 WFD boards
<b>1.2.2.3.5.1.5</b>	<b>Test</b> Test of 96 WFD boards
<b>1.2.2.3.5.2</b>	<b>Crate Data-Collection Boards</b> The crate data-collection board has to be collecting data from 16 WFD board (256 WFD channels) thru the special fast links and transfer these collected data to a high level
<b>1.2.2.3.5.2.3</b>	<b>Fabrication/Procurement</b> Production of 6 Crate data-collection boards
<b>1.2.2.3.5.2.5</b>	<b>Test</b> Test of 6 Crate data-collection boards
<b>1.2.2.3.5.3</b>	<b>VXI Mainframes &amp; Controller</b> 6 VXI (or PCI) mainframe & controller for 100 WFD boards and 6 data-collection boards
<b>1.2.2.3.5.3.3</b>	<b>Fabrication/Procurement</b> 6 VXI (or PCI) 20-slots mainframes with VXI (or PCI) controller
<b>1.2.2.4</b>	<b>Mechanical</b>

## 1.2.2

<b>WBS Number</b>	<b>Descriptio</b>
This	<p>The 32 Preradiator Modules, each consisted of nine scintillator planes and eight drift chamber planes, will be fabricated at TRIUMF. The modules will be installed at BNL on a Support Structure (1.2.2.4.2) which consists of frames and cables.</p> <p>WBS describes the effort necessary to design, prototype, fabricate, and assemble the structure for the Preradiator Modules. This WBS is a summary level. Detail description and cost estimation are completed at lower levels.</p>
<b>1.2.2.4.1</b>	<b>Support plates</b>
<b>1.2.2.4.1.1</b>	<b>Design</b>
<b>1.2.2.4.1.2</b>	<b>Prototype</b>
<b>1.2.2.4.1.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.4.2</b>	<b>Support rails</b>
<b>1.2.2.4.2.1</b>	<b>Design</b>
<b>1.2.2.4.2.2</b>	<b>Prototype</b>
<b>1.2.2.4.2.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.4.3</b>	<b>Transport/storage</b>
	Storage during the construction, and construction of shipping crates/boxes.
<b>1.2.2.4.3.1</b>	<b>Design</b>
<b>1.2.2.4.3.2</b>	<b>Prototype</b>
<b>1.2.2.4.3.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.5</b>	<b>External Photon Veto</b>
	1600 PMT-instrumented modules
<b>1.2.2.5.1</b>	<b>Design</b>
	Design of External Photon Veto (Conceptual design & Detailed drawings)
<b>1.2.2.5.1.1</b>	<b>Conceptual Design</b>

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Number	
1.2.2.5.1.2	Conceptual design of External Photon Veto <b>Technical Design</b>
1.2.2.5.2	Detailed drawings of External Photon Veto <b>Tools &amp; Test Equipment</b>
1.2.2.5.2.1	Production-tool & test-equipment production <b>Cosmic Ray Setup</b>
1.2.2.5.2.2	A “cosmic ray” setup for a complex test of the PMT-instrumented modules <b>Molding Forms and Stamps</b>
1.2.2.5.3	Production of molding-forms and stamps for modules <b>Module</b>
1.2.2.5.3.1	Fabrication of 1600 Photon Veto modules <b>Scintillator Tiles</b>
1.2.2.5.3.1.3	Fabrication of 500,000 Scintillator Tiles <b>Fabrication/Procurement</b>
1.2.2.5.3.2	<b>Lead Tiles</b> Fabrication of 500,000 Lead Tiles
1.2.2.5.3.2.3	<b>Fabrication/Procurement</b>
1.2.2.5.3.3	<b>WLS Fiber</b> Mechanical, thermal and optical treatment of 170,000 (260 km) Wave-Length-Shifting fibers
1.2.2.5.3.3.3	<b>Fabrication/Procurement</b>
1.2.2.5.3.4	<b>Assembly</b>

WBS	Descriptio
Number	
1.2.2.5.3.4.3	Assembling of 1600 Photon Veto modules (300 Scintillator tiles, 300 Lead tiles and 72 WLS fibers per module)
1.2.2.5.3.5	<b>Fabrication/Procurement</b>
1.2.2.5.3.6	<b>Test</b>
1.2.2.5.4	Mechanical & optical test of the assembled Photon Veto modules
1.2.2.5.4.1	<b>Packing</b>
1.2.2.5.4.1.3	Packing and warehousing of Photon Veto modules before a complex "cosmic-ray" test of PMT-instrumented modules
1.2.2.5.4.2	<b>Module Instrumentation</b>
1.2.2.5.4.2.3	PMT instrumentation of 1600 Photon Veto modules (PMT, PMT-preamplifier, PMT HV-supply, PMT mechanics)
1.2.2.5.4.3	<b>PMT</b>
1.2.2.5.4.3.3	Procurement & test of PMT, development of PMT data-base
1.2.2.5.4.4	<b>Fabrication/Procurement</b>
1.2.2.5.4.4.3	<b>Preamplifier</b>
1.2.2.5.4.5	Production, test & selection of 1600 PMT-preamplifiers
1.2.2.5.4.3.3	<b>Fabrication/Procurement</b>
1.2.2.5.4.4	<b>LV-HV Converter</b>
1.2.2.5.4.4.3	Procurement of LV-HV converters, production & test of HV-supply units, development of the HV-supply data-base
1.2.2.5.4.5	<b>Fabrication/Procurement</b>
1.2.2.5.4.4	<b>Mechanics</b>
1.2.2.5.4.4.3	Production of the PMT mechanics: PMT-housing, mechanical support for preamplifier & HV-unit, panel for
1.2.2.5.4.4.3	<b>Fabrication/Procurement</b>
1.2.2.5.4.5	<b>Assembly</b>

WBS	Descriptio
Number	
1.2.2.5.4.5.3	Assembling of the PMT-units: PMT, preamplifier & HV-supply unit, the connector panel, PMT housing <b>PMT</b>
1.2.2.5.4.6	<b>Test</b> A complex test of the assembled PMT-units, development of PMT-unit data-base
1.2.2.5.4.6.3	<b>PMT</b>
1.2.2.5.4.7	<b>Packing</b> Packing and warehousing of PMT-units before a complex "cosmic-ray" test of PMT-instrumented modules
1.2.2.5.4.7.3	<b>PMT</b>
1.2.2.5.5	<b>Cosmic Ray Test of Module/PMT</b> Installation of 1600 PMT-units on Photon Veto modules, a complex "cosmic-ray" test of PMT-instrumented modules, development of data-base for PMT-instrumented Photon Veto modules
1.2.2.5.6	<b>Instrumentation</b> Instrumentation of External Photon Veto, including the PMT HV Control System, "Cosmic-ray" Pre-calibration System, Monitoring/Calibration System and Readout System.
1.2.2.5.6.1	<b>HV Control System</b> Photon Veto HV control system (1600 programmable D-A VME converters for control of PMT HV-supply units)
1.2.2.5.6.1.3	<b>Fabrication/Procurement</b> Procurement, test & software's development of the HV Control System for PMTs that is including 100 IP-mezzanine-modules of the 12-bit D-A converters (XIP-5220-016, Xycom, Inc.), 25 VME-carriers for 100 IP-mezzanine-modules (XVME-9660, Xycom, Inc.) & 3 VME /VXI 13-slots mainframes with VME /VXI controller.
1.2.2.5.6.2	<b>Self-triggering Pre-calibration</b>

WBS Number	Descriptio
1.2.2.5.6.2.3	<p>Photon Veto Self-triggered Pre-calibration System is based on detection and analysis of signals from the “cosmic ray muons” that are vertically traversing Photon Veto modules. Detection of these muons will be selected by a simple trigger, formed from a coincidence between the top and bottom horizontal rows of Photon Veto modules. This system will allow to pre-calibrate 1600 Photon Veto modules with accuracy 2-3% in several hours, even from</p> <p><b>Fabrication/Procurement</b></p> <p>Procurement, test &amp; software’s development of the Self-triggered Pre-calibration System that is including 24 VME-16-channels modules of the programmable Low Threshold Discriminator (V814, CAEN), 4 VME-modules of the programmable trigger logic (V495, CAEN) and 2 VME 20-slots mainframes with VME controller (6021 series,</p>
1.2.2.5.6.3 stabilization	<p><b>Monitoring &amp; Calibration System</b></p> <p>Photon Veto monitoring-calibration system is based on the "ultrabright LED-lamps" with an electronic method of of the LED-lamp light output. This system will include 25 units. Each unit will service 64 Photon Veto modules.</p>
1.2.2.5.6.3.1	<p><b>Design</b></p> <p>Design of Photon Veto monitoring-calibration system: a LED pulse generator with optical feedback, a 64-channels optical splitter of a LED light</p>
1.2.2.5.6.3.2	<p><b>Prototype</b></p> <p>Prototyping of Photon Veto monitoring-calibration system (one 64-channels optical splitter &amp; a LED pulse</p>
1.2.2.5.6.3.3	<p><b>Fabrication/Procurement</b></p> <p>Fabrication of Photon Veto monitoring-calibration system (44 units &amp; a start-up NIM-logic)</p>
1.2.2.5.6.4 modules	<p><b>Readout Electronics</b></p> <p>Photon Veto readout electronic has to be include 1600 channels of a 10-bit &amp; 250 MHz WFD, 7 Crate data-collection and 7 mainframes</p>
1.2.2.5.6.4.1 WFD	<p><b>WFD Boards</b></p> <p>WFD-board has to be including 16 channels of a 10-bit/250 MHz WFD, one “trigger” output that is providing signal if any channel exceeds over threshold, and a special fast link to a crate data-collection board.</p>



WBS	Descriptio
Number	Descriptio
1.2.2.5.6.4.1.3	<p><b>Fabrication/Procurement</b> Production of 100 WFD boards</p>
1.2.2.5.6.4.1.5	<p><b>Test</b> Test of 100 WFD boards</p>
1.2.2.5.6.4.2	<p><b>Crate Data-Collection Boards</b> The crate data-collection board has to be collecting data from 16 WFD board (256 WFD channels) thru the special fast links and transfer these collected data to a high level</p>
1.2.2.5.6.4.2.3	<p><b>Fabrication/Procurement</b> Production of 7 Crate data-collection boards</p>
1.2.2.5.6.4.2.5	<p><b>Test</b> Test of 7 Crate data-collection boards</p>
1.2.2.5.6.4.3	<p><b>VXI Mainframes &amp; Controller</b> 7 VXI (or PCI) mainframe &amp; controller for 100 WFD boards and 7 data-collection boards</p>
1.2.2.5.6.4.3.3	<p><b>Fabrication/Procurement</b> 7 VXI (or PCI) 20-slots mainframes with VXI (or PCI) controller</p>
1.2.2.5.6.5	<p><b>Electronic Racks &amp; LV Power Supplies</b> The water-cooling racks for the control/readout electronics, LV power supply for PMT preamplifiers &amp; PMT</p>
1.2.2.5.6.5.1	<p><b>LV Power Supplies</b> Low voltage power supply for PMT preamplifiers &amp; PMT HV-chips, including 10 12-VDC power supplies (RM-50M) and 10 5-VDC power supplies (RM-30M) power supplies, produced by Astron corp.</p>
1.2.2.5.6.5.1.3	<p><b>Fabrication/Procurement</b></p>
1.2.2.5.6.5.2	<p><b>Electronic Racks</b></p>

## 1.2.2

<b>WBS Number</b>	<b>Descriptio</b>
	4 water-cooling racks for the control/readout electronics
<b>1.2.2.5.6.5.2.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.6</b>	<b>Pre-installation work at BNL</b>
<b>1.2.2.6.1</b>	<b>Design</b>
<b>1.2.2.6.2</b>	<b>Prototype</b>
<b>1.2.2.6.3</b>	<b>Fabrication/Procurement</b>
<b>1.2.2.10</b>	<b>Management</b>