DRAFT

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Characteristics Specifications:
Photomultiplier Tubes for the CDF TOF Detector

1. Characteristics

(A) In the absence of magnetic fields, PMTs have to meet the following requirements.

1.1 Intrinsic output pulse width:	5 ns typical (FWHM)
1.2 Current amplification:	A current amplification of 2.0×10^7 (MYU) or larger at a high voltage of 2000 V.
1.3 Applicable high voltage limit:	250 V above the voltage that gives a gain of 2.0×10^7 (MYU).
1.4 Cathode blue sensitivity:	Minimum of 8.0 μA/lm-blue. More then 85% of the tubes have to have at least 9.0 μA/lm-blue.
1.5 Anode dark current:	Maximum of 300 nA at a high voltage of 2000 V. (Temperature 25°C).
1.6 Pulse linearity:	Within $\pm 2\%$ up to 50 mA.
1.7 Rate dependence of gain:	Maximum of $\pm 2\%$. Measurement method follows the one for the short term stability estimate at HPK. Variation in pulse heights for photoelectric peaks when counting rates are changed from 1 k counts/s to 5 k counts/s. High voltages will be set so as to give a gain of about 2.0×10^5.
1.8 Time dependence of gain:	Maximum variation of $\pm 2\%$. Measurement method follows the one for the long term stability estimate at HPK. Variation in pulse heights for photoelectric peaks will be measured at a counting rate of 1 k counts/s during a 16-hour period after a 1-hour warm-up. High voltages will be set so as to give a gain of about 2.0×10^5.

1.9 Temperature dependence of gain:	The variation of anode output for a wavelength of 420 nm should be $-0.6\%/^{\circ}$C at the maximum.
1.10 TTS:	The transit time spread (TTS) for single photoelectrons should be less than 500 ps (FWHM) within possible operating high voltages (at 1650 V).
1.11 Stability of anode dark current:	No sparks or unstable behavior should be observed when anode dark current is measured in the dark for at least three hours with a high voltage (positive polarity) applied.

(B) In the presence of a 1.41-T axial, uniform magnetic field, PMTs have to meet the following requirements.

1.12 Gain:	At a high voltage of less than 2.5 kV, PMTs should have a gain of 3×10^5.

2. Tests and Inspections
The test methods and data are specified as follows for the items listed in Section 1.

(A) Outside a magnetic field:

2.1 Intrinsic output pulse width:	Guaranteed, but measurements will be done for more than 5% of the tubes.
2.2 High voltage limit:	HPK will test all tubes before shipping.
2.3 Current amplification/Gain:	HPK will test all tubes before shipping.
2.4 Cathode blue sensitivity:	HPK will test all tubes before shipping.
2.5 Anode dark current:	HPK will test all tubes before shipping.
2.6 Pulse linearity:	Guaranteed, but measurements will be done for more than 5% of the tubes.
2.7 Rate dependence of gain:	Maximum of $\pm 2\%$. Guaranteed, but measurements will be done for more than 10% of the tubes (at least 20 tubes).
2.8 Time dependence of gain:	Maximum variation of $\pm 2\%$. Guaranteed, but measurements will be done for more than 10% of the tubes.
2.9 Temperature dependence of gain:	Measurements will be done for more than 20 tubes that are randomly selected.
2.10 TTS:	Guaranteed, but measurements will be done for more than 10% of the tubes.

(B) Inside the 1.41-T magnetic field:

2.11 Gain:	The purchaser measures the gain as specified in (1.12) for all tubes.