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## Measurements on the afterpulse of the 20-inch Photomultiplier Tubes for the JUNO experiment

The afterpulse is one of the main characterizations of the photomultiplier tubes (PMTs) which can introduce undesired background noise signals, thus its detailed rate, time and charge distributions are important. We have measured two types of 20-inch PMTs to be used in the JUNO central detector, R12860-50 by Hamamatsu and MCP PMTs by North Night Vision technology. The PMT response waveforms were captured then the time and charge of each afterpulse were extracted independently, whose distributions will assist the analysis in the future physics runs. Two afterpulses at around  $3\mu\text{s}$  and  $15\mu\text{s}$  respectively were observed for Hamamatsu PMTs consistent with the vendor's data. For the MCP PMTs, three distinctive afterpulses centered at 898ns,  $3.12\mu\text{s}$ , and  $4.53\mu\text{s}$  respectively were found, with an average charge ratio of  $\sim 6.74\%$  within the delay between  $0.5\mu\text{s}$  and  $20\mu\text{s}$  to the primary pulse.

### Mini-abstract

Measurements of the afterpulse on the 20-inch PMTs for the JUNO detector will be presented.

### Experiment/Collaboration

JUNO

**Primary authors:** Dr OLSHEVSKIY, Alexander (Joint Institute for Nuclear Research, Dubna, Russia); Dr WONSAK, Bjoern (University of Hamburg); Mr KORABLEV, Denis (Joint Institute for Nuclear Research, Dubna, Russia); Mr BUTOROV, Ilya (Joint Institute for Nuclear Research, Dubna, Russia); Dr ANFIMOV, Nikolay (Joint Institute for Nuclear Research, Dubna, Russia); Dr ZHAO, Rong (Sun Yat-sen University, Guangzhou, China); Prof. WANG, Wei (Sun Yat-sen University, Guangzhou, China); Dr CHEN, Yu (Sun Yat-sen University, Guangzhou, China); Dr QIN, ZHONGHUA (Institute of High Energy Physics (IHEP), CAS, China); Dr WANG, Zhimin (Institute of High Energy Physics (IHEP), CAS, China)

**Presenter:** Dr CHEN, Yu (Sun Yat-sen University, Guangzhou, China)

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