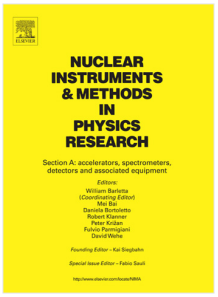
# Accepted Manuscript




Combined device for vacuum electron diode adjustment

I. Egorov, A. Poloskov

PII: S0168-9002(18)31268-3
DOI: https://doi.org/10.1016/j.nima.2018.09.115
Reference: NIMA 61280

To appear in: *Nuclear Inst. and Methods in Physics Research, A*

Received date : 24 May 2018
Revised date : 25 September 2018
Accepted date : 25 September 2018

Please cite this article as: I. Egorov, A. Poloskov, Combined device for vacuum electron diode adjustment, *Nuclear Inst. and Methods in Physics Research, A* (2018), https://doi.org/10.1016/j.nima.2018.09.115

**Cleared version**
**Click here to view linked References**

# Combined device for vacuum electron diode adjustment

I. Egorov[1,*)] A. Poloskov[1)]

[1] *R&D Laboratory for Pulse-Beam, Electric Discharge and Plasma Technologies, Tomsk polytechnic university, Tomsk, 634050, Russia*

The article describes a principle, design and test results of a device for simultaneous capture of electron beam current ejected through an anode and optical image of a cathode surface. The device was tested on "ASTRA-M" pulsed electron accelerator (TPU, Russia) with the following parameters: 300 kV, 0.6 kA and beam current duration of 150 ns (FWHM). Light emission points have been registered for several individual emitters of the tested cathode. CMOS optical sensor of the device provides PC compatibility and detection of disturbances in the cathode or vacuum diode operation for single pulses and in burst mode. The efficiency of electron beam current ejection can be also estimated during vacuum diode adjustment. Detailed cathode images captured by photographic film include both frontal and angle (circular) projections of the cathode surface and can be used to study processes in the accelerating gap.

Key words: electron beam, electron beam current, vacuum electron diode, accelerating gap, cathode surface, emission surface.

## I. INTRODUCTION

Research and practical application of pulsed electron accelerators requires adjustment of the vacuum electron diode for specific conditions of each task [1,2]. Single pulse operation and measurements require high stability of the diode parameters from pulse to pulse [3–5]. Some research works involve experiments under critical conditions, such as overvoltage, critical densities of current and energy, sharp rise or fall of voltage and current, etc. [4,5]. In practice, accelerators, as a rule, tolerate reasonable variations in beam parameters in exchange for expected productivity, efficiency and usability [1,2]. Thus, for laboratory accelerators that are usually used for researching a wide range of problems, fast adjustment of vacuum diode parameters is an urgent task.

The adjustment of the working characteristics of the ASTRA-M accelerator diode [6] requires changing the following parameters. The choice of the cathode structure and material determines rep-rate limits of the accelerator: composite planar cathodes [6] are usually used for repetitive (up to 50 pps) mode due to suitable thermal properties; planar graphite [6] and multicapillary carbon-epoxy cathodes [7] are used for single-pulse modes due to stable characteristics. Copper ambient electrode of the cathode is usually used for shielding of the emission surface and beam focusing by configuring the accelerating field. It also protects the emission surface from arcing especially in high rep-rate modes. Cathode-anode distance can be also changed for ASTRA-M vacuum diode to set the diameter of the beam imprint, change the diode impedance (fine tuning requires additional coordination with the cathode shielding), change total electric field strength in the accelerating gap [6]. For described adjustments, basic diagnostic systems can be used, like sensors of total diode voltage and current

*Corresponding author E-mail: egoris@tpu.ru