

# Investigation of space passive hydrogen maser atomic beam formation system life-time

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One of the key points for space equipment is its on-board life-time. This parameter is defined by that part of the instrument, which has principal constraints of the life-time. For hydrogen maser such parts are H<sub>2</sub>-source and evacuation system, which extracts hydrogen and residual gases from storage bulb system. These are both fragments of atomic beam formation system.

To evaluate H<sub>2</sub>-source life-time first of all it is necessary to know the consumption of hydrogen by space passive hydrogen maser (SPHM). Unfortunately, it is impossible to make precise mathematical calculation of this value, so it was measured experimentally. For this reason special set-up was made. With help of this set-up we have measured hydrogen consumption of SPHM ( $C_{H_2}$ ) for different atomic flux to the discharge bulb (it was varied by hydrogen purifier current ( $I_{pur}$ )). Fig. 1 presents dependence of  $C_{H_2}$  vs  $I_{pur}$  conjointly with dependence of atomic gain ( $G$ ) vs  $I_{pur}$ . When the gain is maximum, SPHM consumes  $\sim 1.7$  l\*bar/year. So, to have total life-time of the SPHM of 15 years H<sub>2</sub>-source has to contain at least 26 l\*bar of hydrogen (for redundancy purpose  $\sim 35$  l\*bar).

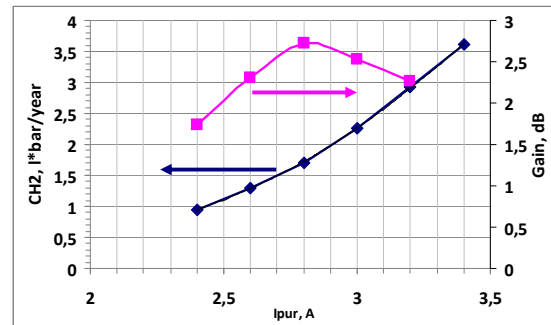


Fig.1: Hydrogen consumption of SPHM

The second critical point about atomic beam formation system is ability of evacuation system, formed by non-evaporated getter elements and small ion-pump for residual gases, to absorb mentioned above amount of hydrogen. For this reason sorption capacity of the getter-pump was measured with use of special set-up. This set-up made it possible to fill getter pump portionally with small known amounts of hydrogen but with great flux. After each portion of hydrogen absorbed by getter-pump the pressure of residual gases was measured by cold-cathode vacuum gauge. Fig. 2 presents dependence of residual gases pressure ( $P_{res}$ ) vs amount of hydrogen, absorbed by getter pump for different  $I_{pur}$ . There is no trend to increase for this pressure even after 33 l\*bar of absorbed hydrogen, so there is no decrease of the sorption ability of the getter-pump.

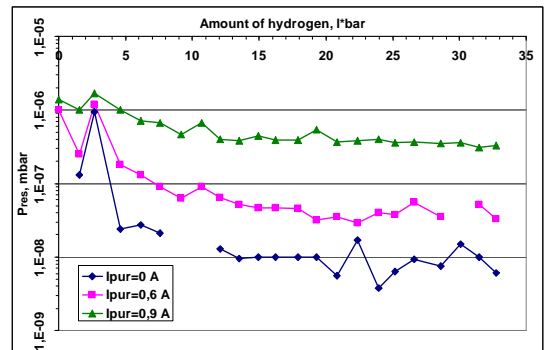


Fig.2: Ion current after each portion of hydrogen absorbed by getter-pump

As a result of our investigation, it was shown, that the most critical part of SPHM - atomic beam formation system limits whole instrument life-time with a period of more than 15 years.