Table 2.1. Spontaneous Decay of ^{252}Cf

Spontaneous fission specific activity	6.14×10^5/s · μg
Alpha-decay specific activity	1.92×10^7/s · μg
Energy of most probable light fission fragment	~ 105 MeV
Energy of most probable heavy fission fragment	~ 80 MeV
Average alpha energy	6.11 MeV
Average energy of prompt neutron from spontaneous fission	2.13 MeV
Average number of prompt neutrons from spontaneous fission	3.77/fission

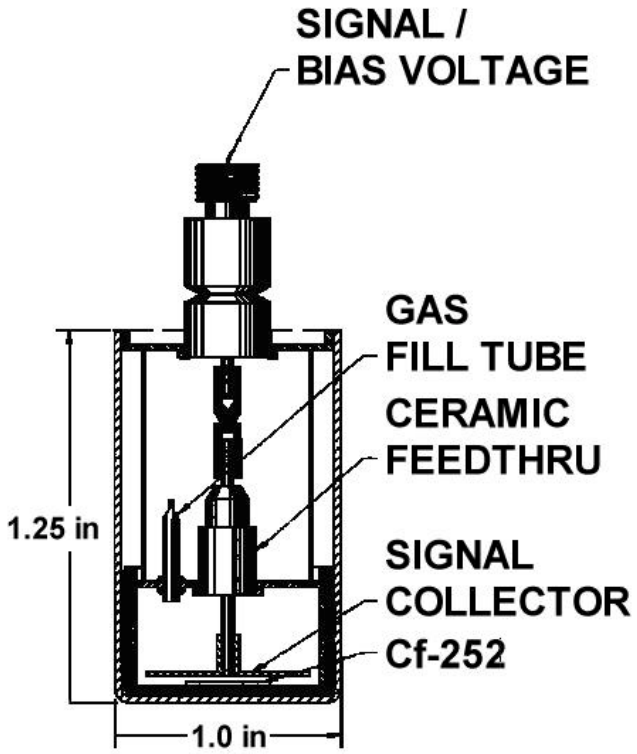

Figure 2.3. Schematic of ^{252}Cf Parallel Plate Ionization Chamber

The ionization chamber requires 200 VDC. The maximum rating [7] of the ionization chamber is 500 VDC.

Currently, due to the processing speed limitations of the CPU of the computer (≈ 600 MHz in 1999), NMIS is limited in real-time[8] to a maximum source rate of approximately one million fissions per second which limits the source to around 1.5 μg of ^{252}Cf.

[7] Higher voltages may cause the chamber to spark between the electrodes and destroy the input electronics of the ^{252}Cf amplifier.

[8] Higher source rates force the NMIS data acquisition board into a slower, non-real-time mode to the initial processor boards.

2.3 IONIZATION CHAMBER AMPLIFIER

The ORNL designed amplifier, Model Q-6456-1 is shown in Figure 2.4. This amplifier is a four-stage amplifier, with a total gain of ~ 1800 and rise time less than 1 nsec. The internal circuitry requires +15 VDC and is designed for 50Ω impedance input and output signals. There are four input/output connections. These connections and their purpose are summarized below:

- INPUT: BNC connector to attach ^{252}Cf ionization chamber,
- OUTPUT: amplified ionization chamber signal (goes to source channel CFD),
- +15 VDC: DC voltage for amplifier circuitry, and
- HV: 200 VDC bias voltage for the ^{252}Cf ionization chamber.

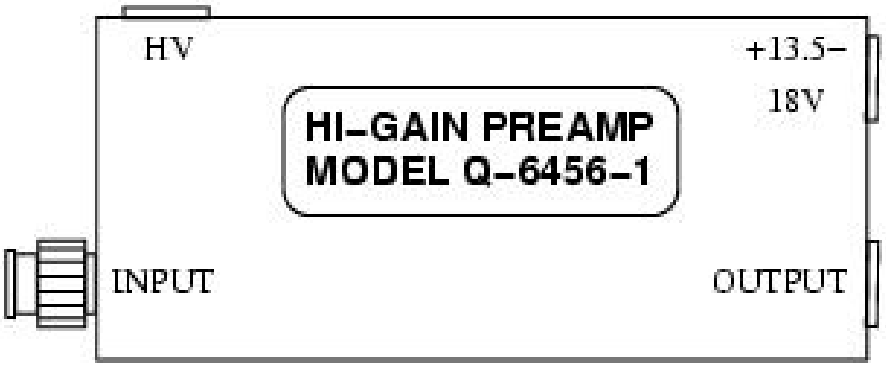

Figure 2.4. ORNL Designed Amplifier for ^{252}Cf Ionization Chamber

The +15VDC and the +200 VDC bias voltages are supplied by the modules shown in Figure 2.5. This amplifier normally has 50 mV noise pulses. If noise pulses are not present, the chamber is not working. If they are reduced in amplitude, then the amplifier has less gain. In both cases, the amplifier should replaced.

2.4 CONSTANT FRACTION DISCRIMINATOR

The purpose of the constant fraction discriminator (CFD) is to convert detector pulses of varying amplitude into a pulse-height independent, event-timing pulse. In other words, regardless of the pulse height, the CFD generates a timing pulse for NMIS to indicate when a detection pulse arrives. Typically, CFDs operate by setting a trigger point at some constant fraction of the rise-time of the pulse by converting the negative polarity detector pulse into a bipolar signal that a zero-crossing discriminator can use to generate a NIM[9] fast logic pulse. This design assumes that all the detector pulses have the same shape and only vary in their amplitudes.

[9] Nuclear Instrument Module