Apparatus for Formation and Use of EVOs

by
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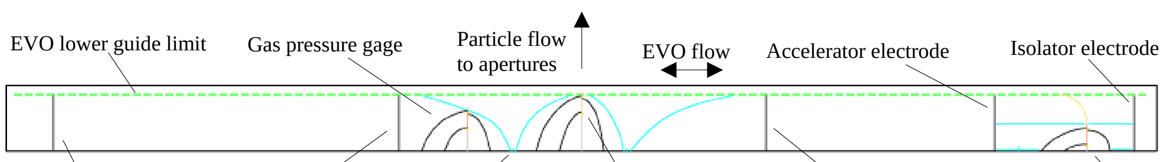
Abstract

Apparatus is described herein presenting the integration of many component design iterations that have been tested both separately and in small systems. A useful variation on these is brought together in this overall design toward the end goal of generating a single piece of apparatus capable of both forming large EVOs and then testing them for the generation of electrical power, propulsion and weaponry. This apparatus first generates a small EVO followed by its electrical trapping and reduction of velocity to near zero. The process is then continued by EVO growth to a large size using both electron accretion and injection methods. In addition to formation, sophisticated EVO size and structure analysis can be carried out in-situ by methods using incorporated electron and photon probe instrumentation leading to final testing using integrated electrical generation and propulsion loads. Although the overall design has not been experimentally verified in the particular configuration shown, there is an accumulation of tested components and methods available for use if the presently suggested design is found wanting. These supplementary methods virtually guarantee a winning outcome for generating a successful piece of apparatus for EVO formation and use.

Basic Method Used: The most essential part of the apparatus is a ceramic, EVO guide structure that is open on one side for emission of electrons and photons that can be analyzed using one of three apertures and deflector sets for selecting emission before striking a phosphor screen at high velocity producing an optical signal for video recording. The heart of this EVO production and analysis method is shown in schematic form in Fig. 1 below.



This ceramic structure, approximately 5 inches long, has a pattern of resistive materials on one surface that produce an EVO source, an electron gun for charging an EVO and producing a scatter spectrometer, an electron multiplier for analysis of EVO diameter, a gas pressure gage and various electrodes for trapping and acceleration. Two of these plates, one of them blank, are jointed together with a 0.002 inch space between them. Fig. 2 and Fig. 3 below show front and back views of the EVO guide.

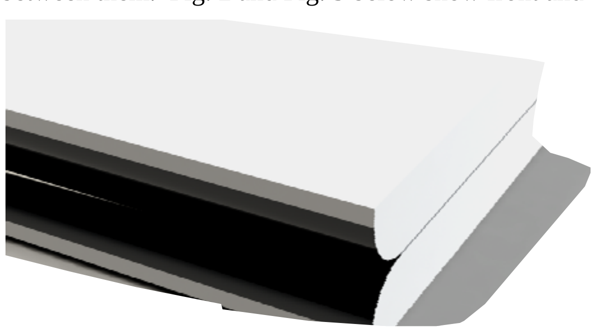


Fig. 2 shows a front view of the EVO guide. A charge-dispersing coating is shown on the 0.03" radius guide edges leading into the active circuits between plates.

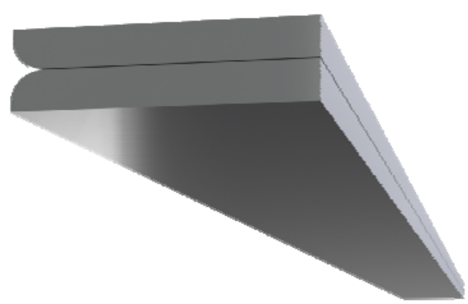


Fig. 3 is a rear view of the two spaced ceramic plates. Contacts to the circuits placed within are made at the right side of the drawing.

A typical series of operations needed to complete a cycle starting from a cleared apparatus to rendering a final output result is detailed below:

- Apply formation potentials to the EVO gun. (These are externally applied at this point in time by slow-rising voltages which are converted to fast-rise pulses using the electron multiplier that is an integral part of the EVO gun.) It is optional whether or not gas is used in this formation process.
- Trap the EVO by slightly lowering the trap #1 electrode potential with a pulse that is timed with the passage of the EVO while keeping the trap #2 electrode high negative or in a retarding direction.
- At this point, the EVO can either be oscillated in the trap by applying an external RF drive potential synchronized with the EVO motion or the EVO motion can be damped out by either reverse drive signals or resistive damping.
- As the EVO approaches zero motion, it can be measured for electron emission diameter by using the central electron multiplier as a sensor while the drive electrodes are used to sweep the EVO back and forth in front of the small defining aperture in the electron multiplier entrance. The output x-y signal on an oscilloscope defines the emission, hence, physical width of the EVO that can be pre-calibrated.
- At this point, the EVO diameter is tested for growth or diminution while it is moved by external signals or subjected to electron accretion by direct injection of electrons. Although a somewhat feeble electron source, the central electron multiplier operated with reversed potentials is a handy source of electrons using this configuration. A field emission electron source is a much stronger source but a more difficult one to both install and operate.
- At any point in the EVO growth cycle, it can be analyzed with any one of 3 pinhole camera settings and a point projection setting. The highest pinhole camera gain is about 10 while the middle and lowest gain are 2.5 and 0.2. With the highest gain, the EVO image is projected on the phosphor screen with a resolution determined by the aperture size and would typically be about 10 micrometers in diameter. At the lowest magnification setting, the entire 5 inch path of the EVO can be imaged on the 1 inch screen.
- With all apertures out of the electron path, a very high resolution and extremely sensitive point projection mode is available in which emitted particles and photons from the EVO radially project to the phosphor screen just as they do in field electron and ion emission point projection. In this mode, many strange emanations from the EVO can be seen but they are still too confusing to interpret, just as molecular adsorption is on field emission tips. Much data is available here that will eventually unlock many EVO organizational secrets.
- During any of the above mentioned measurements, potentials can be applied to deflection plates associated with each aperture. Using this method, energy analysis and charge sign can be determined concomitantly on any image being viewed. In addition, there is a conductive screen mounted just before the phosphor screen that serves to act as a retarding potential electrode for a more precise determination of particle energy.
- Finally, a load for the EVO in motion can be inserted into or adjoined to the apparatus. The several possible variations on this move are not shown as all these possibilities would still lend inadequate clarity to the act of loading. In many instances, for both electrical energy generation and propulsion, a simple coil can be wound around a guide. For the optimum case, the large EVO formed in the presently described apparatus would be switched over onto a separate guide tract having full access through the center of the inductor and be capable of self-oscillation to produce electrical power and propulsive power output.
- Throughout all of these tests, it is imperative to keep a weather eye out for signs of EVO instability that might prove harmful to either the apparatus or people.

Overall Apparatus: Although the essential parts of the apparatus presented here are housed in a special vacuum chamber made largely of ceramic, this feature can be substituted for nearly any type of vacuum chamber with proper specifications. One of the special requirements is to keep conductors away from the EVO fields of influence. If this is not done, spurious results can result from interaction. In the present apparatus, most elements are purposely made to have as high a resistivity as can be tolerated to minimize unwanted interaction. Several views of the overall apparatus follow:

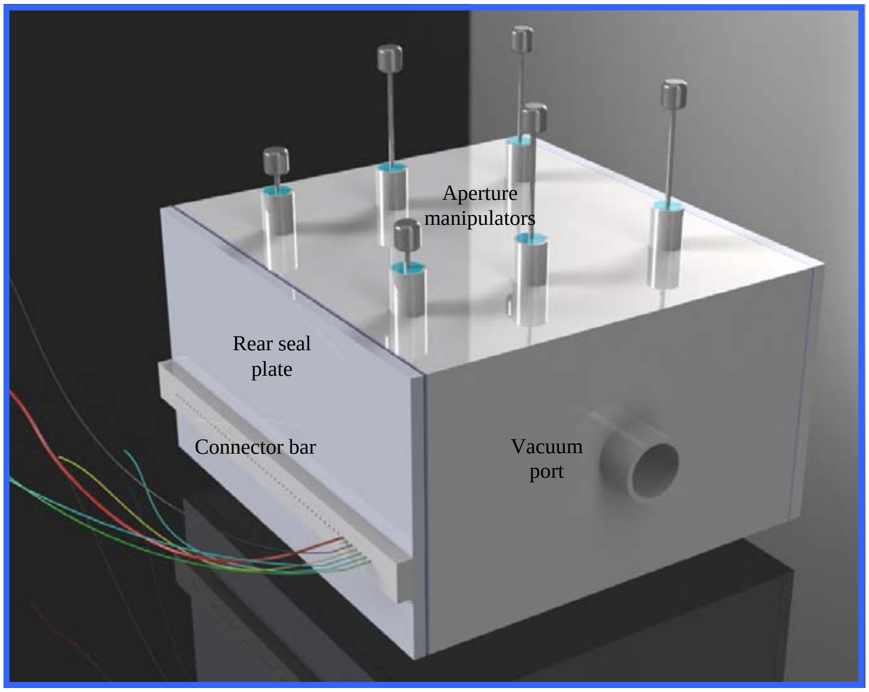


Fig. 4
Drawing of the vacuum chamber showing port, aperture manipulators, rear seal plate, connector bar with a few of the 50 wires and gas tubes that are brought out of the chamber.

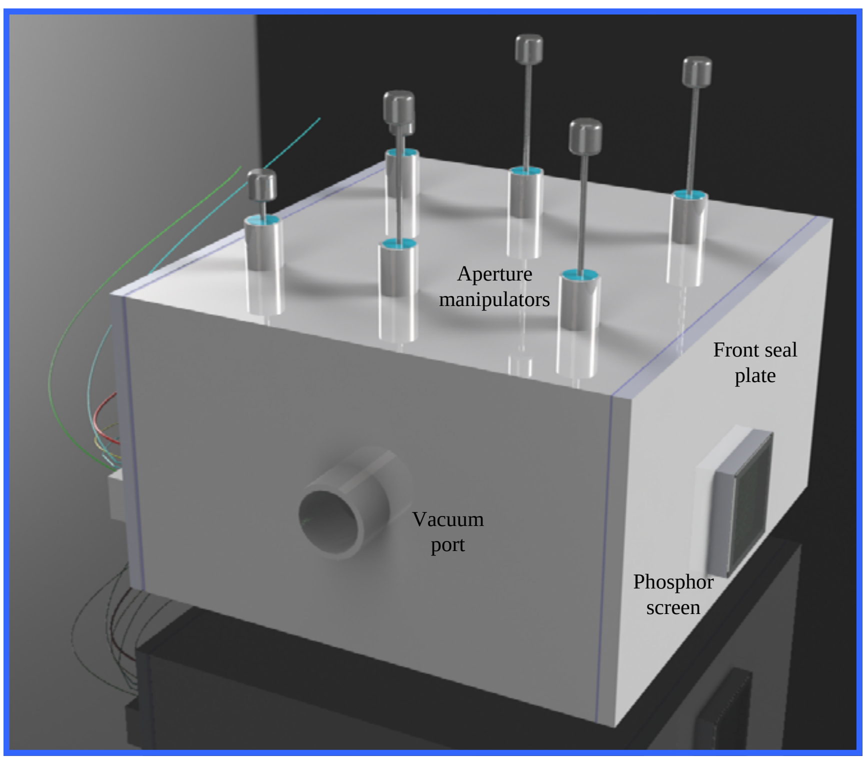


Fig.5
Front view of vacuum chamber showing rods and knobs for aperture manipulation as well as phosphor screen.

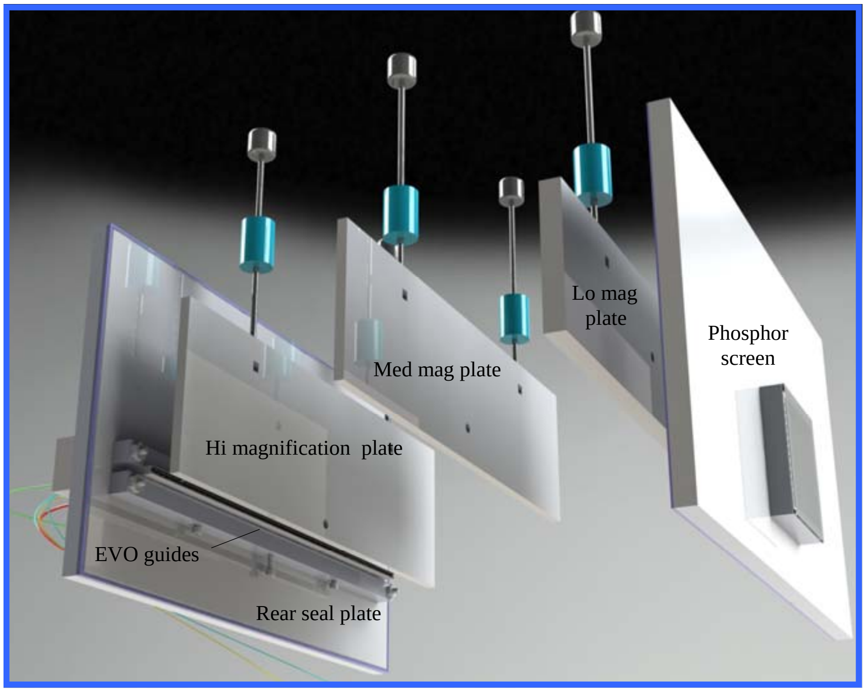


Fig. 6
Inside view of vacuum chamber with cover removed showing 3 aperture plates as well as EVO guides fixed to rear seal plate.

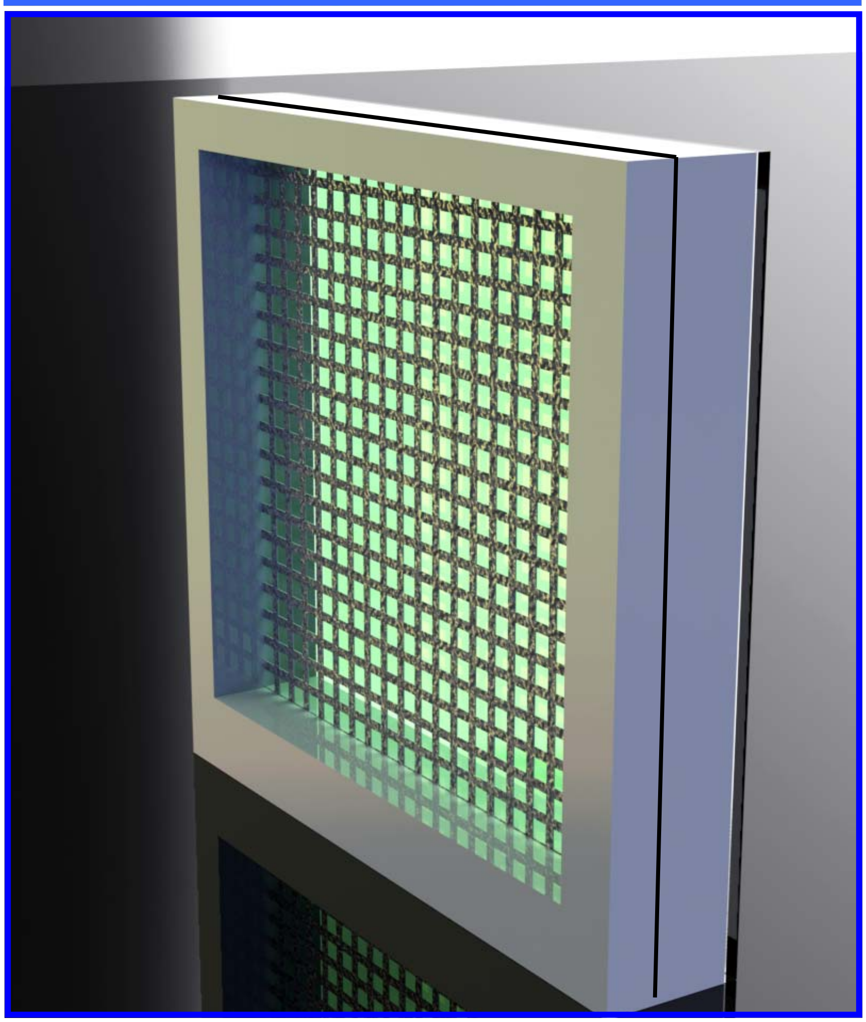


Fig. 7
View of phosphor screen from inside vacuum chamber showing retarding screen mesh with much coarser mesh than actual so as to increase its visibility. A conductive connector band goes around the ceramic frame at the screen and phosphor position.

Phosphor Screen: As shown in Fig. 7 above, the phosphor screen used to convert an electron image coming from the pinhole into a visible image for video capture is a layered sequence of frames holding the critical elements together. Starting with the outer glass layer, a phosphor is applied to it by any number of standard coating methods. Following the phosphor deposition, a film of nitrocellulose is applied on its top surface. A coating of evaporated aluminum about 0.1 micrometers thick is applied over the cellulose in such a way that it overlaps a conductive band fired onto the glass window. The entire sandwich is then processed by heating in the standard way so as to remove the cellulose film. This finished unit can be tested for sensitivity by bombarding with electrons and viewing the light output. A bombardment potential of about 10,000 volts is common for this use. Lower potentials give lower output and this serves as a form of gain control in this system.

The screen shown in Fig. 7 is shown grossly oversize to make it easily visible in the drawing. In practice, the screen is more like a 200 mesh, 90% transmission tungsten wire screen. The screen is held between two ceramic frames by vacuum firing it in place using low-fired, conductive glaze. To accomplish this, the wire is first stretched and attached to a metal frame which holds it taut during firing. A vacuum firing temperature of 800 degrees centigrade is usual. The conductive glaze is allowed to extend around the corner of the ceramic frames and provide a stable contact for the screen.

The purpose of the screen is twofold. The first use is to help provide a unipotential region for electron flow in the deflection region past the aperture. In addition, this shielding allows the application of high voltage for phosphor excitation without causing a lens action upon acceleration. The image reaching the retarding potential screen is thus replicated on the phosphor screen but is much brighter.

The finished phosphor screen is attached to the body of the vacuum chamber by lapping the glazed faces of the units together and wringing them to each other. In addition, General Electric silicone rubber RTV 630 can be used as a sealant up to a temperature of about 300 degrees centigrade. The same rubber seal is used between the phosphor plate and the ceramic frames holding the wire screen.

Although this form of phosphor screen is a poor detector for ions, as compared to the MCP used in past pinhole cameras, work on ions is deemphasized here. If ion work needs to be done, a MCP assembly can be easily attached to the experiment by removing the phosphor screen module and applying a MCP unit.

Seal Plates and Connector Blocks: Fig. 8 and Fig. 9 shown below illustrate these two components of the overall structure. Although any other conventional containment and header method might work, this one has proven to be very versatile.

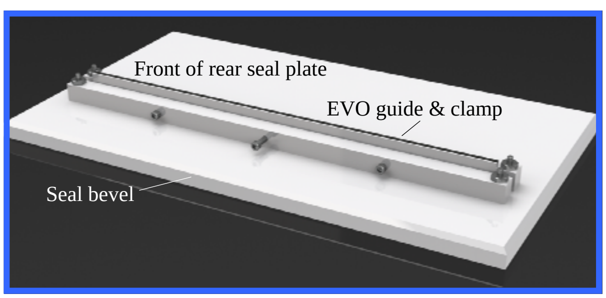


Fig. 8 Rear seal plate with EVO guides mounted. Note the 45 degree bevel around the inside of the plate for sealing with RTV 630.

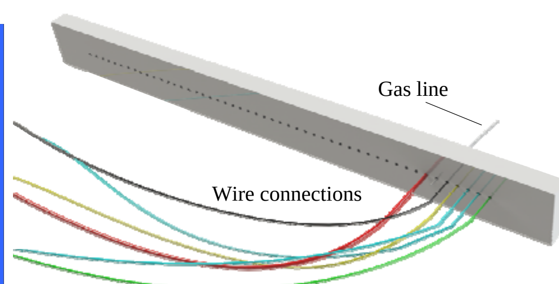


Fig. 9 Ceramic connector block with 7 of the 50 available wires or gas lines inserted.

A unique feature of this connector system is the lapped surfaces to be connected electrically. This connection method is used for connecting the backside of the EVO guide to the front side of the seal plate as well as the back side of the seal plate to the row of connections made on the connector block. Although connectors of this type have been excellent in past work, sloppy lapping might call for the addition of a very small quantity of conductive paste made of RTV 630 and acetylene black on the conductor surfaces. Much care should be used in the placement of this material to avoid leakage between contacts.

Another useful feature of this connection method is the way low pressure gas is admitted through the connector block using small diameter Teflon tubing. The tubing is pressed into the rear seal plate and then sealed with a small quantity of RTV 630. A clearance hole is provided in the connector block. Seals made in this fashion can withstand a small amount of abuse, but the Teflon is prone to pull out of the hole if the pulling force is too large, as it is not actually bonded but only slightly trapped. Such inconveniences are easily fixed by adding a small amount of RTV 630 and re-inserting the tube into the ceramic block.

Electron Multiplier Basics: An extremely valuable tool incorporated into this design set is the channel-type electron multiplier, as it can be configured into a sensitive gas pressure gage residing at the point of interest, made into an EVO generator, used as a high gain element for the detection of electrons and ions and function as a source of electrons simply by reversing the applied potentials. In addition, although not featured here, its ability to detect X-rays in a vacuum environment will become a powerful scientific tool at some point in the future. However, the most desirable feature of all is the ability to fabricate a wide range of electron multiplier variations using very simple technology.

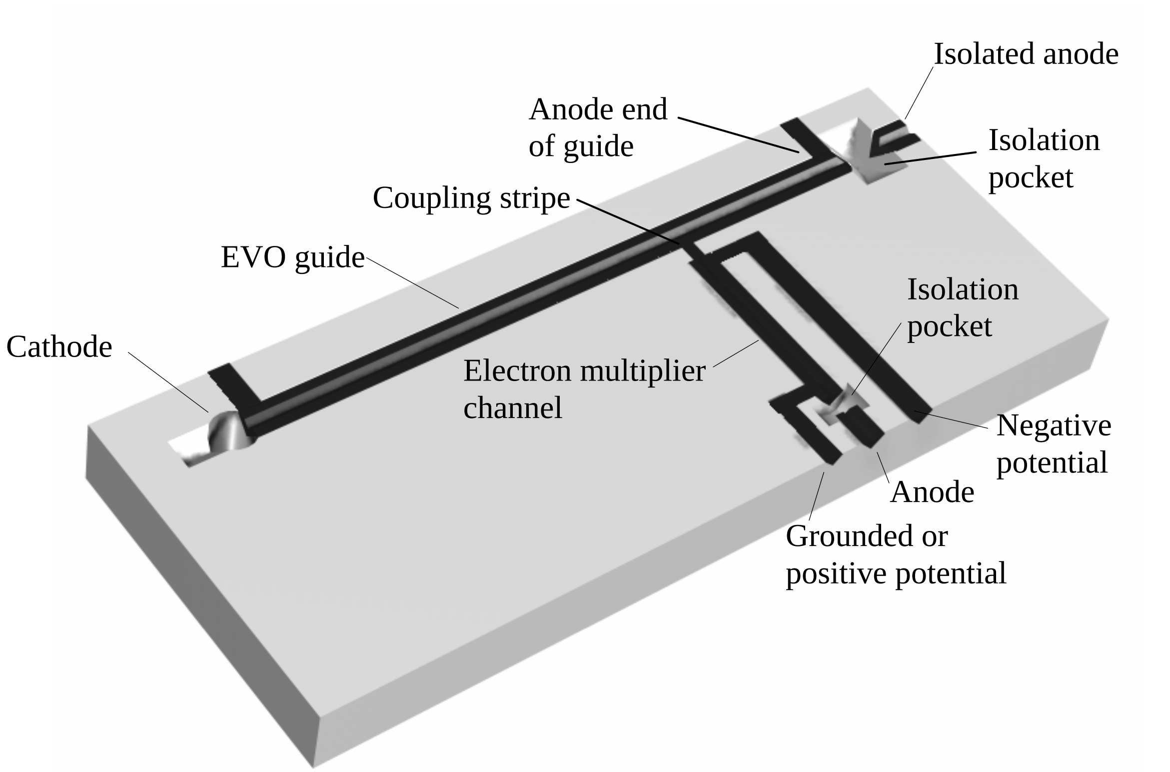
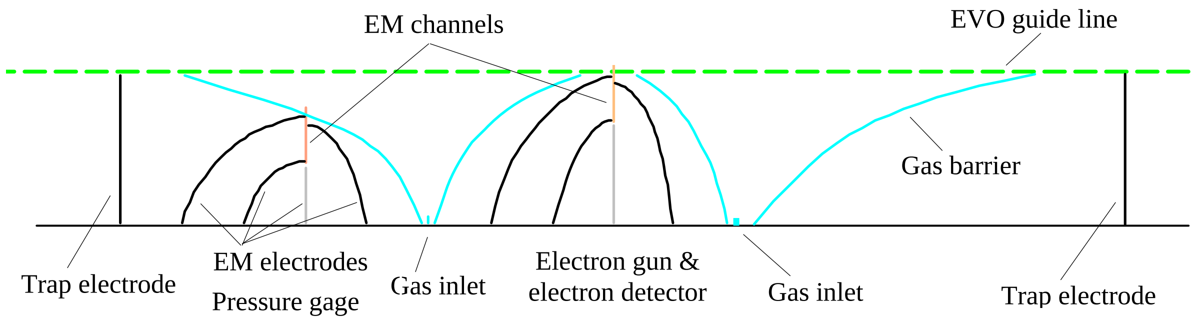


Fig. 10 above shows an electron multiplier configuration, used in past work, connected to a single EVO guide through a small channel or aperture called the coupling stripe. In this configuration, tests were made for the passage of a black EVO that had greatly reduced emission of electrons compared to the white state. With its high sensitivity and wide bandwidth, the multiplier type of detector could easily track the black EVO state down to low levels of activity, amounting to only a few electrons of emission per passage in a time of around a picosecond.

The layout shown in Fig. 10 was made by either grinding or scratching crude grooves into the substrate. When the grooves are filled with a thin solution of fired-on resistive material and fired to maturity, the grooves are not completely filled. After lapping the top of the plate, a channel for both EVOs and electrons results. Resistances of around 50 megohms are used for the EM channel with about 10,000 ohms used for the connectors unless wide bandwidth is required, in which case, lower values are used. The pockets and cathode cavity are cut with a diamond dental burr. Future work will likely use photolithography and etching methods in a surface glaze as an improvement. All channels are covered with glass and evacuated.

Application of Electron Multipliers: Fig. 11 shown below is a magnified view of the center section of Fig. 1 showing a schematic diagram of the gas pressure gage configuration and the electron gun and electron detector for this application. All of these functions depend on the gain of the EM channel.



Drawings of one of the above functions are shown below in Fig. 12 and Fig. 13.

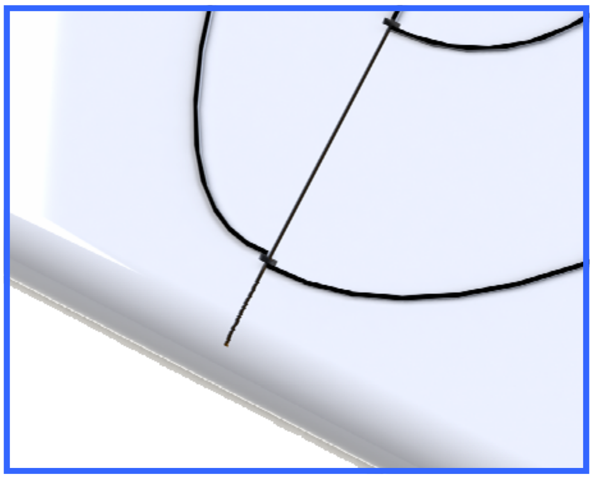


Fig. 12 A drawing showing the electron gun and electron detector configuration placed on the edge of the EVO guide at the front of one guide plate.

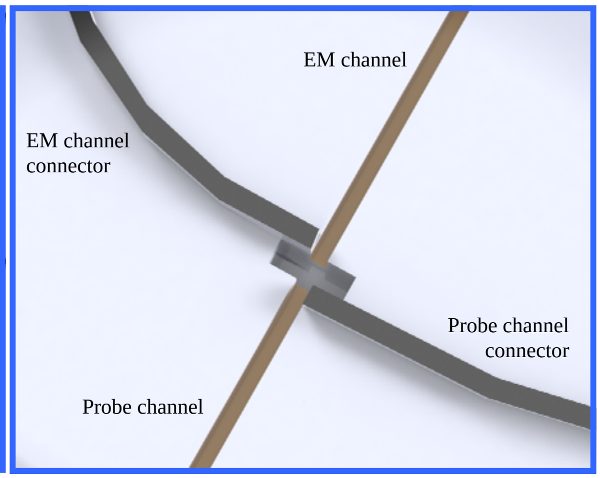


Fig. 13 A magnified view of Fig. 12 showing the connection region between the probe channel, the EM channel and the two connecting electrodes.

In using the electron multiplier configuration shown, the direction of electron emission can be reversed by reversing the potential applied to the electrodes. In the present embodiment of this apparatus, one direction results in being able to sense EVO guide channel activity with great sensitivity while the other direction of potential application results in emission of electrons into the EVO either poised at the probe channel or passing by the channel. Sensing the EVO position also carries the connotation with it that its electron emitting diameter can be measured in terms of the EVO sweep voltage applied to the apparatus.

Many improvements can be found over the configurations portrayed in the above drawings. For one thing, the transition between the EM channel and their connecting electrodes is depicted poorly. In actual practice, that connection is made very carefully by manual methods. This can be done with fair ease because the channels are fairly large, being about 0.003 inches wide. In a technology like lithography and etching, the transitions come out much better than some of the scratching that has been done in the past.

Electron Multiplier Pressure Gage: In having a high-gain element like an electron multiplier available, many new variations on measuring low pressures become available. In fact, there are so many methods possible that most of them have not been explored in depth. The most normal mode of use is to simply apply a swept high voltage to the multiplier channel and watch on a scope to see when the channel goes into a run-away condition. Since most of the EVO operations are conducted around pressures of 10^{-2} torr and lower, this is a very good mode to use. At much lower pressures, it is necessary to create ionizing electrons in the input region of the multiplier through the use of field emission by applying a positive potential to the electrode across the isolation pocket from the input. There must be low resistive leakage across this gap in order for this method to work. In addition, the feeding conductor must have a relatively low resistance in order to avoid a voltage drop in the line due to the field emission current.

For relatively high pressures, all that is needed is a simple gas discharge type of gage. A very handy way of doing this is to apply a sweeping high voltage to a convenient pair of electrodes with an isolation pocket between them and see on the scope trace at what voltage the discharge begins. All methods used need calibration by an external pressure gage, but that is a very easy thing to do in a static vacuum system.

Electron Multiplier EVO Source: Since an EVO happily travels down a channel without a potential difference on it and since EVOs grow nicely in the accretion mode on surfaces while under acceleration, and especially in channels, it is obvious that they would enjoy traveling down a channel like the ones used in EM technology where a positive, accelerating potential is applied. When this is done, it has been found that very small EVO sources can be used that will produce substantial EVOs at the exit side of an EM channel. In fact, the entry EVO has not been identified in any other way than that a mature EVO appears at the exit of the EM channel. To create an EVO for introduction to an EM channel, it is only necessary to form an insipid discharge at the EM channel entrance either with or without gas being purposely introduced into the region. It might be that the vacuum systems used are inherently dirty enough to always have sufficient gas adsorbed on surfaces to permit a discharge even at the small sizes used. In addition, the small dimensions give a high field even at relatively low applied voltages, in the few hundred volt range, where discharges are easily formed. Alternatively, surface leakage could play a strong role in forming the discharges seen. In any event, the EM type of EVO source is a very convenient one when only a small EVO is occasionally needed. That is very much the case for this application where EVO recycling is strongly promoted.

Loading the EVO: Simply making and admiring an EVO at play like one would admire a Tesla coil is not the aim of this program. It is very much a part of this apparatus design to take us as close as possible to EVO use by applying a load to it for both electrical power output and propulsion. Without doing this, there is no use for the apparatus being discussed here.

It can be said with some assurance that loading in some form or another is the ultimate cause of EVO destruction in all known cases, as a load represents a disturbance to internal order. Inadvertent loading by introducing a form of guide roughness, as seen by the EVO, is a form not wanted. Imperfection in guides and at switching terminals has been the most visible class of EVO destroyers. The bad effects of imperfectly constructed guides have been largely ameliorated by the use of gas at very low pressures but this effect is not good for machines designed for ultimate use. Pure vacuum operation seems essential for long life and safety and that goal must be always kept in mind.

One loading configuration alluded to earlier in this writing is that of oscillating an EVO in a solenoid coil. A drawing illustrating one variation on the EVO cradle for use in part of this method shows in Fig. 14 below. Shown in the center of the guide is a gas inlet thought to be appropriate as a guide smoother for the large size EVO that is the target of this investigation, where the diameter can range up to marble size. Although it is not known what the breakdown modes will be and what the destructive power can be, it is worthwhile to minimize known hazards like bad guides. After all, this is our sole container against a considerable amount of pent-up tension.

When it is desirable to produce physical thrust, the EVO must run white in one direction and gray in the other. The loaded coil provides the coupling between the EVO momentum and our realm. It is not hard to reach the physical limits of such coils using the thrusting power of an EVO operating at high velocity.

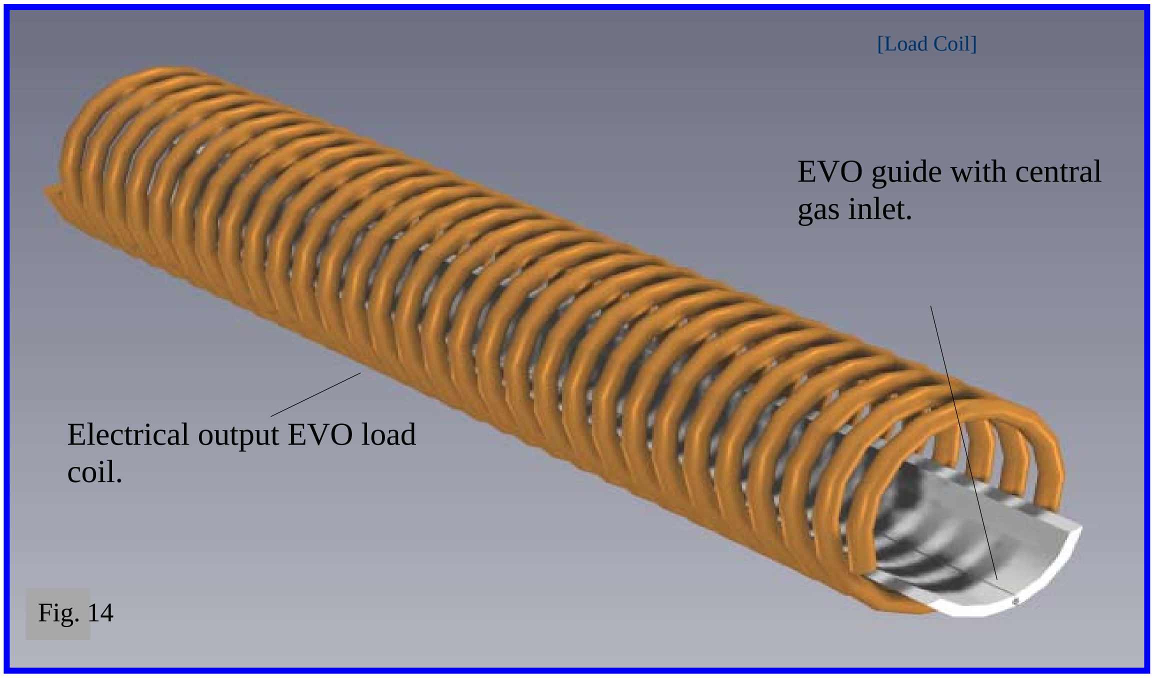


Fig. 14

Tasks to be Completed

- Optimization of ceramic fabrication methods
- Optimization of photolithographic formation methods
- Optimization of individual electron multiplier devices
- Construction of vacuum apparatus and apertures
- Assembly of external electronics, gas control and sensitive video camera
- Initial testing of complete fabrication system
- Redesign and modification of fabrication system
- Testing of electrical energy and propulsion output