Status of Ka-band Test Facility and HG-relevant Experiments*

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Outline

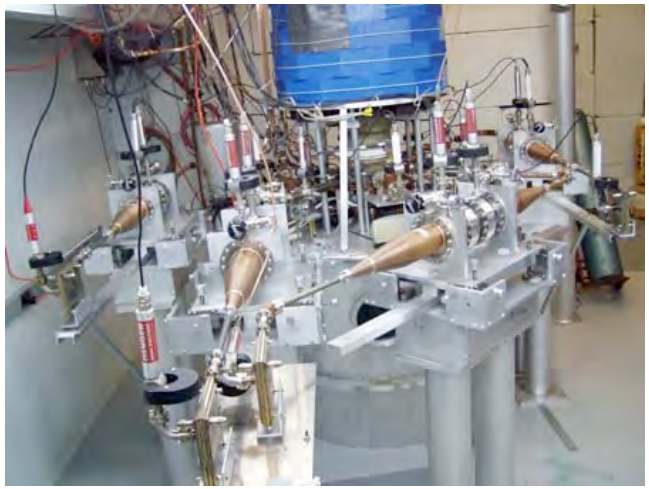
- Status of Ka-band test facility at Yale
- HG relevant experiments
- Other experiments
- Short term schedule

- Ka-band Test Facility funding started Oct 1, 2007.
- Demonstrated peak total power of 17 MW (4-5 MW per arm) at 34.3 GHz for ~1 μsec.
- Power needed for initial experiments is 1-2 MW in one arm.
- Past few months have been spent setting up test facility for operation of initial experiments

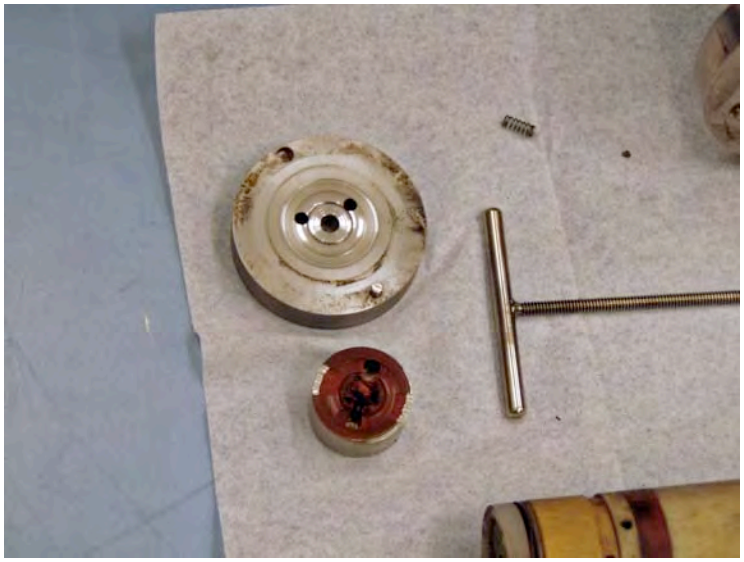
- Barrier windows added to all four output arms to allow installation of experiments without affecting the magnicon vacuum.

- A high power dual-directional coupler has been obtained and will allow power measurements directly before an experiment.

- A replacement cryomagnet with more robust construction and a better LHe holding time has been built and is awaiting shipment.



- A helium re-liquefier has been ordered from Cryomech, Inc. and is due end of June to further help alleviate the excessive LHe costs.
- The Cryomech AL25 cold head which cools the heat shield of the cryomagnet has failed recently after > 8 years of continuous use.
- Attempts to repair are currently underway. If not repairable in a timely manner a replacement cold head (an AL60 purchased for the replacement magnet) will be installed.



- An all solid state Marx bank modulator was to have been delivered and installed sometime this spring.

- Diversified Technologies, Inc., the manufacturer of the unit, informed us recently of their decision not to complete this project.

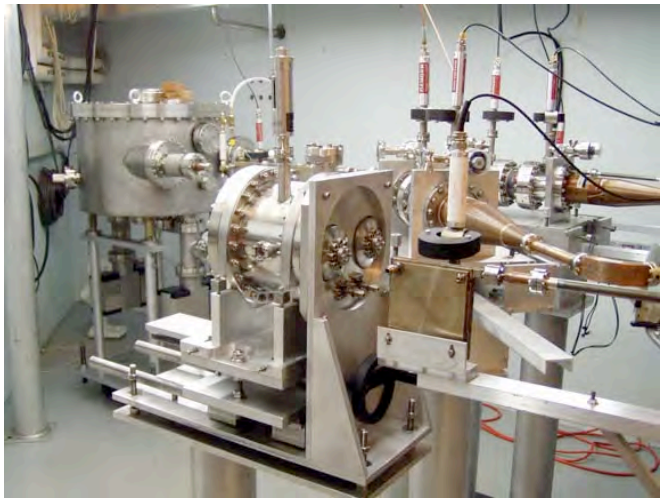
- We still have our original line type modulator which is adequate for our purposes and for the continuation of the facility, however the possibility of faster rise and fall times on the gun pulse (and inherent reduction of electrical stresses on the electron gun), a flatter pulse than we can currently achieve, as well as the capability of faster repetition rates (our current limit is 10 Hz) will have to wait for another opportunity in the future.

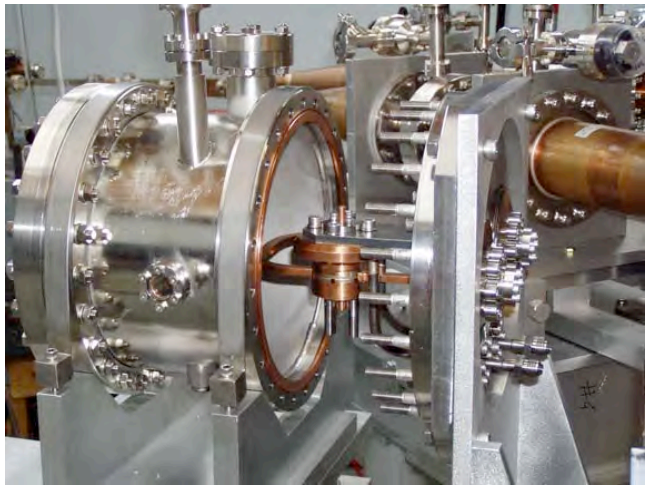
First experiments: QO Pulse Compressor

- A three mirror QO pulse compressor has been developed, cold tested and demonstrated a passive compression ratio of 2.5
- The passive high power vacuum version shown at right has been installed in the vacuum vessel and placed under vacuum.
- Initial high power tests will commence when the researchers from IAP in Nizhny Novgorod receive visas.
- Tests of an active grating with expected power gains of up to 10 will begin after the initial passive tests.

First experiments: Breakdown Cavity

- An experiment to test the breakdown limits of various materials, alloys and surface preparations has been built.
- A cavity operating in the TM_{030} mode has two removable pins in the center of the cavity which serve as the samples.
- 1-2 MW of RF power should be sufficient to provide > 100 MV/m on the surface of the pins.
- Once the 60l/s ion pump and roughing port are installed the first tests will commence after the pulse compressor experiments have concluded.



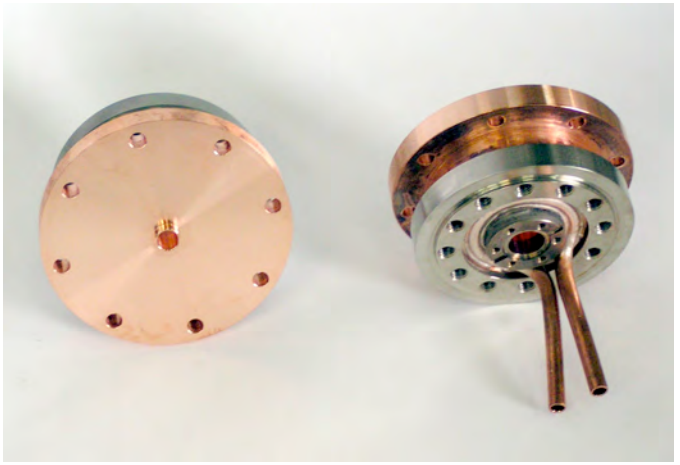


Waiting experiments: Pulse Heating

- Experiment to study the effect of materials, alloys and surface preparations on the ability of structures to withstand pulse heating from RF magnetic fields

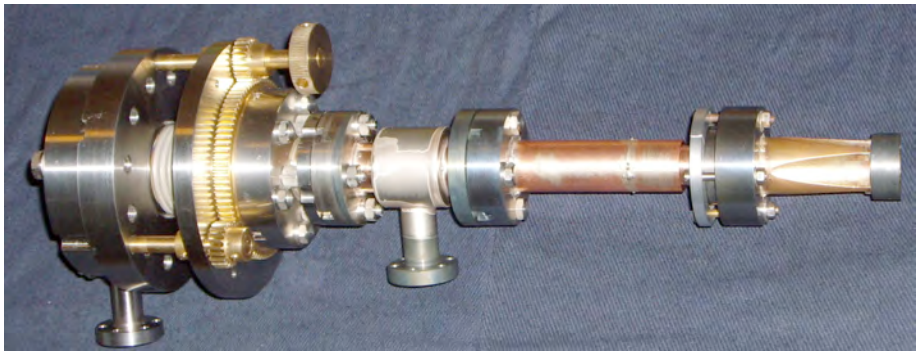
- Device consists of a TE_{011} cavity with a cylindrical protrusion to maximize the magnetic stress on the protrusion and minimize both electric and magnetic stresses everywhere else.

- Cavity is awaiting final cold testing and installation.



Waiting Experiments: Diamond breakdown

- Experiment to test the surface breakdown limit of CVD diamond.
- Device consists of a TM_{011} cavity to enhance the surface electric field on the diamond sample. Both hydrogenated and de-hydrogenated samples will be tested.
- If claimed limit of 2 GV/m confirmed this would important for many beam driven dielectric devices.
- Test cavity built and diamond samples are to be cut from disk shown at right. Awaiting shipment to Yale.



Non HG Experiment: Hidden Sector Physics

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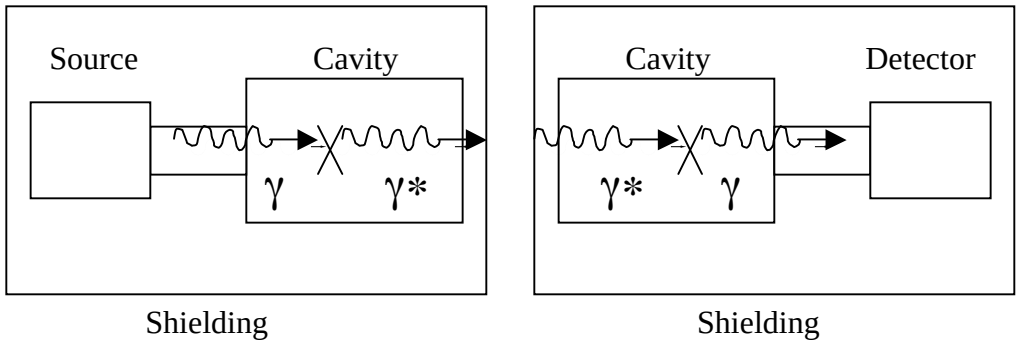
- A particle physics experiment has been proposed which would utilize a two cavity setup to search for hidden sector photons (HSPs).
- A hidden sector photon is a gauge boson which interacts with standard model matter via “gravity-like” interactions and is expected to have masses in the sub-eV range. Note: 30 GHz ~ 100 μeV.
- The proposed experiment, pictured schematically below, would utilize two high Q cavities. The HSPs would interact with the photons in the drive cavity, pass to the other cavity where they would again interact to produce a photon with the same parameters as the first cavity.
- All discussions are preliminary at this stage but the project is funded.



Near Term Schedule

- Repair or replace cold head and re-cool magnet. (immediate)
- Restart the magnicon and test and calibrate new directional coupler at high power. (immediate)
- First tests with passive and active QO pulse compressors (late Feb/Mar)
- Prepare breakdown cavity for final installation and perform first tests (April/May)