Sonofusion Group Meeting Meeting Minutes

X-Authentication-Warning: scribe.cc.purdue.edu: nobody set sender to jcavera@purdue.edu using -f
To: bertodan@ecn.purdue.edu, choi@ecn.purdue.edu, clikeman@ecn.purdue.edu,
tatjanaj@ecn.purdue.edu, shripad@ecn.purdue.edu,
tsoukala@ecn.purdue.edu, xsun@purdue.edu, merritte@ecn.purdue.edu,
jcwalter@ecn.purdue.edu
Subject: bubble fusion meetings
Date: Thu, 13 Jun 2002 16:02:20 -0500 (EST)
From: jcavera@purdue.edu
User-Agent: IMP/PHP IMAP webmail program 2.2.8
X-Virus-Scanned-ECN: by AMaVIS version 11 (http://amavis.org/)

Sorry for the delay. Enclosed is the minutes from last week's meetings. E-mail if they do not come through.

- Jim

 Meeting Minutes 06-05-2002.doc

 Meeting Minutes 06-06-2002.doc

Question and Answer Session with Dr. Taleyarkhan

Questions were provided by the group and answered by Dr. Taleyarkhan. His comments, not in answer to a particular question, are prefaced by a "C". Comments from the group are prefaced by a "G".

Q Amplifier problem - our audio amplifier won't let us adjust the phase angle.
A The ORNL team used a broadband linear amplifier from Piezo Systems. He can get us the specifications for it.

Q We can peak the microphone's signal but we can't get the current and voltage in phase.
A This isn't so important if you have enough power to drive the bubbles. The ORNL team found that they needed only five to six watts. Also, too much pressure is bad: one bar or more will drive the system toward bubbles that are unstable. When using multiple sets of transducers, bubbles can be driven harder if the phase difference between the sets is correct. Try mixing different driving frequencies. The precise frequency depends on chamber size.

Q Which harmonics do you add?
A Stay low in frequency and close to the fundamental.

Q Acetone purity?
A Use a one micron filter (or two to three coffee filters) to remove impurities. ORLN used 99.9% deuterated acetone.

Q And the chamber temperature?
A They suggest 0° celcius (± 1°) . If the temperature is too low, thermal stresses in the components become an issue. Also, one needs a higher driving power at lower temperatures.

Q Degassification procedures?
A The ORNL team used 27" of vacuum. Degas for about two hours, but, more importantly, filter and use a high purity acetone.

C One can also experimented with laser pulses to provide cavitation, in place of the neutron source.

Q Is vibration an issue (primarily from the freezer)?
A Unknown. The ORNL team used a plastic bag to contain the system. The chamber was placed on a stand and cold (-30° C) air was blown around it. This was done for effective cooling rather than for vibration isolation. A diagram of their set-up can be sent to us. Note that the flask can jump around a lot when cavitation is occuring. This is a larger source of vibration than the freezer.

C All information being provided is under strict non-disclosure. Do not let this information leave the school or attempt to commercialize it.

C Don't change more than one experimental parameter at a time without testing.

Q What factors are most significant?
A The driving frequency, sensitive to a few hertz. Next comes the driving amplitude and system temperature. When measuring the temperature, glue a thermocouple to the side of the piezo transducer in order to miniminze the effects on the acoustics of the system.

Q How are the piezo transducers glued to the flask?
A A simple two-part epoxy with a small grain size was used. The ORNL team used an epoxy with a thirty micron size from Home Depot.

C Suspend the chamber and use forced air cooling. The goal is to first duplicate the experiment. Pushing the envelope comes later.

Q Safety concerns?
A Chemical splashes and chamber shattering. It is a given that a some point in time the chamber will shatter when driven too hard. Be prepared for this.

G We have VHS tape capability for post-mortem analysis. In addition, we are prepared to build two of everyting.

C Note that once a piezo transducer is removed from the glass, it is no good. Its properties have changed too much.

Q How many piezo transducer rings did the ORNL team expend?
A We lost count. We tried several different sizes also.

Q Any concerns with using tritium?
A Acetone will contain a small amount of naturally occurring tritium that will need to be accounted for.

Q What material was used to make your flasks?
A We used pyrex. Quartz would work better, but is costlier.

Q Any thoughts as to the commercialization potential?
A Unknown. Break-even would require 10^{10} neutrons per second. We may be able to scale that high.

Q Detection issues?

A Be quick, because tritium can escape if you are not careful. Count within about a half-hour of the experiment stop.

Q How many shocks do the bubbles receive prior to fusion?
A Unknown. The velocity of sound is about 1100 meters per second in acetone. Bubbles live for on the order of milliseconds before dissolving. Bubbles shoot out from the center prior to collapse.

Q Typical bubble size ratio?
A About 105. The bubbles start out at nuclear scale then can expand to several millimeters. Bubbles oscillate between about ten nanometers up to single millimeters.

The meeting with Dr. Taleyarkhan was a sucessful one. Remember:

1) Everything that we discuss is under strict non-disclosure agreement.
2) Keep it simple.
3) Our target time for completion is one month.

1. Dr. Bertadano has information on the test section
   1.1. RPI gave us a head start
   1.2. Two minor modifications needed to our test section
      1.2.1. The glass test section is no longer suspended, but is instead resting on a rubber mat that covers the ring. Only the piezo transducer touches the support. The rest is supported by the fact that it is epoxied to the PZT.
      1.2.2 RPI had an acrylic plate floating on top of the liquid. We will use a hollow glass disc, similar to that wich is on the bottom, suspended above.
   1.3. The test platform is currently being built
   1.4. Hydrophone is optional
      1.4.1 It is only useful at low pressure
      1.4.2 Can cause spontaneous cavitation at 7 atmospheres pressure
      1.4.3 Hydrophone is on order and will arrive in two weeks
   1.5 Will order more piezo transducers
   1.6 Deuterated acetone is on order ($2,400 worth)
   1.7 Cooler needs to be built
      1.7.1 Anton will work with Dr. Ravenkar on this
      1.7.2 We are still using parafin to provide a high thermal mass, but will also use forced air cooling
      1.7.3 The cooler will be a commercial freezer

2 Neutron detector
   2.4 Detection rate is limited by the chemistry of tritium
   2.5 The tritium is somehow bound in the acetone
   2.6 We need to begin the experiment as tritium-free as possible
   2.7 Tritium somehow escapes from sample vials?
      2.7.1 Need to clairify this with the ORNL group
   2.8 Also, why did the ORNL group only count for ten minutes?

3 Photography
   3.4 We have a high-speed triggered strobe and camera
      3.4.1 Dr. Ishii's video camera can capture 10,000 frames per second
      3.4.2 Strobe can fire at 25,000 shots per second
      3.4.3 The camera's memory can hold about 1000 frames
   3.5 The HP 3314A signal generator can be used for genlocking and synchronization with the pulsed neutron source
   3.6 Should synchronize everything to the oscillator

3.7 The strobe may add too much energy to the system
3.8 This is an optional part of the experiment

4 Vacuum System
4.4 We may need an oil free pump or a cold trap so as not to introduce oil into the system
4.5 A hard vacuum is not needed and even a hand pump could provide it
4.6 We only have oil-based roughing pumps

5 Sample Handling
- 5.1 Use only clean and fresh syringes to pull the samples
- 5.2 Likewise, only clean and fresh vials for storage
- 5.3 ORNL said that they:
  - 5.3.1 Pulled their samples from the middle of the test cell
  - 5.3.2 Poured out the acetone for sampling
  - 5.3.3 Disassembled the apparatus and stared over
- 5.4 So what did they really do, and how much acetone did they use?
- 5.5 Still needed:
  - 5.5.1 One micron or 0.5 micron filter
  - 5.5.2 Glass containers, funnels and ground-glass stoppers
  - 5.5.3 Deuterated acetone
- 5.6 Can we have chemistry run an FTIR spec or should we get spectral-grade acetone?

6 Preparation
- 6.1 We need a system cleaning procedure
  - 6.1.1 Dr. Taleyarkhan said that they used acetone for all their cleaning
  - 6.1.2 Chemistry has a glassware cleaning process that we should use
  - 6.1.3 Josh will find out what process is used in chemistry
- 6.2 All of our components are borosilicate glass
- 6.3 Our procedures must be impeccable as they will be scrutinized
- 6.4 Need a basin under the test cell to collect breakage
- 6.5 Need a large syringe to collect the deuterated acetone following breakage

Next meeting: 06-17-2002 3:00p