Subnanosecond Sample Holder

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A problem of current interest concerns the exposure of biological samples to fast intense electromagnetic pulses, for the purpose of studying cell processes and killing cancer cells. The problem then becomes how to do this. One can focus a fast pulse (100 ps or so) in the near field using a prolate spheroidal reflector. Even larger fields can be achieved by a system involving direct contact by guiding conductors. It is desirable to move the direct-contact approach into the 100 ps regime. This requires careful consideration of the test cell for holding a sample of the 1 cm or so size, and exposing the sample to MV/m fields.

We have some feeling for the electromagnetic parameters of such a fast-pulse test cell. As we can see there are various tradeoffs to be made. There will likely be some adjustments needed to be made in the design. So an early version might include some possibility to vary some of the parameters.

The mechanical design also poses significant problems associated with the high pressure. The sample must be inserted and removed, and have an appropriate outer barrier between the gas and the sample. The ends of the sample, of course, make electrical contact with the test fixture. We also need to be able to adjust the pressure and the switch-gap spacing.

We need some way of measuring the fast, high-amplitude pulse exciting the sample. This might look like a small diameter (to reduce forces from the pressurized gas) coax with the center conductor (and dielectric) cut flush with the test-chamber outer conductor. We can make some estimates of the sensitivity. One can also calibrate the constructed version. If the sensitivity is too large, the center conductor can be recessed.

Another technique involves taking a high-voltage signal from the center conductor and reducing it, such as by some kind of fast, accurate voltage divider. At the same time we don't want to significantly load the test-chamber with this device.

One may also want some diagnostics of what is happening in the test sample. On a short-time (or even real-time) basis (before the test sample is removed from the chamber), one might install an optical viewing port with appropriate attention to the high gas pressure.