

**COALITION FOR PLASMA SCIENCE**

**Lee Berry**

**Fusion Power Associates  
Annual Meeting and Symposium  
October 12, 2005  
Washington, D. C.**

## The Folks Who Do the Work

- **Gerry Rogoff (retired) Vice Chair, membership, two-pagers.**
- **John DeLooper (PPPL) Secretary, materials distribution, AV equipment.**
- **Patric Muggli (USC/UCLA) Treasurer, requests.**
- **Carol Danielson (GA) materials distribution.**
- **Paul Rivenberg (MIT) graphics, website, education, evaluation, plasma page.**
- **Richard Temkin (MIT) nominating committee.**
- **Steve Dean (FPA) business responsibilities**

**Special Thanks go to:**

**Washington Reps for Organizing  
Capitol Hill Seminars—especially  
Princeton (Chris Carter, Kim Nerres, Diane Jones)  
GA (Berlauder Barns),  
and MIT (Jason Van Wey, Helen Haislmaier)  
and **Congressman Holt** for room requests.**

## **CPS Activites**

- **Materials: brochure, two-pagers, posters.**
- **Web page ([plasmacoalition.org](http://plasmacoalition.org)): links to plasma sites, evaluated educational sites, membership.**
- **Requests: “800” number, e-mail.**
- **Spectroscopy glasses.**
- **Plasma Page—report to members.**
- **Science Fair Award.**

## **The Plasma Science and Applications Award at the Intel International Science and Engineering Fair Is Our Newest Activity**

- **\$3M in prizes, 40 countries, 1000 projects, 1400 students, 1000 judges.**
- **Volunteer judges:**
  - **DPP Steve Allen (LLNL)**
  - **IEEE/PSAC Frank Jansen (BOC Edwards), Tom Lacata**
- **~40 award candidates, four finalists, two winners.**
- **Judges concluded award was worthwhile, and enjoyable.**
  - **Indianapolis, IN in May 2006.**



HUB

HUB

intel  
INTERNATIONAL  
SCIENCE  
AND  
ENGINEERING  
FAIR

EN  
Engineering

Information and Assistance

05.11.2005 17:04



Physics

05.11.2005 17:27



# A Non-Intrusive Investigation of Simulated Ball Lightning in my Microwave Oven

## Main Objectives

- To Generate a stable Plasma Ball in a controlled environment
- To Investigate the properties of the simulated Ball Lightning
- To Investigate the Various Methods of Simulated Ball Lightning Creation
- To Check and Test Various Methods of Non-Intrusive Heat Measurement

## Introduction

Throughout the centuries, there have been numerous reports of "Ball Lightning". It is a glowing sphere of "fire" that can be as large as a basketball and as small as a pea. It is often reported to be a ball of fire that is not hot to the touch. It is often reported to be a ball of fire that is not hot to the touch. It is often reported to be a ball of fire that is not hot to the touch.

## An Introduction to Simulated Ball Lightning and Plasmas Generation

In this project, the idea of Ball Lightning will be to create simulated conditions where the plasma ball is created in a microwave oven. The idea is to create a ball of fire that is not hot to the touch. It is often reported to be a ball of fire that is not hot to the touch.

## Blackbody Curve Qualities and Examples

A blackbody is an object that absorbs all incident electromagnetic radiation, regardless of frequency or angle of incidence. It is a theoretical concept that is used to describe the emission of energy from a perfect absorber.

## Materials and Methods: Creation of Ball Lightning

The materials used in this project include a microwave oven, a plasma ball, and various sensors. The methods involve creating a simulated environment where the plasma ball can be observed and measured.

## Materials and Methods: Heating Efficiency of a Microwave and Power Just Prior to Lightning

The heating efficiency of the microwave is measured by comparing the power input to the power output. The power just prior to lightning is measured using a power meter.

## Ball Lightning Photograph



## Ball Lightning Photograph



## Basic Experimental Set-Up



## Testfor: Equipment Set-Ups



## Photographs of the Test Setup



## Error Analysis

The error analysis section discusses the sources of error in the experiment, including measurement errors and environmental factors.

## Mathematical Methods and Applications

This section describes the mathematical methods used in the experiment, including the calculation of the quality factor (Q) and the spectral distribution data.

## Graph #3: Spectral Distribution Data

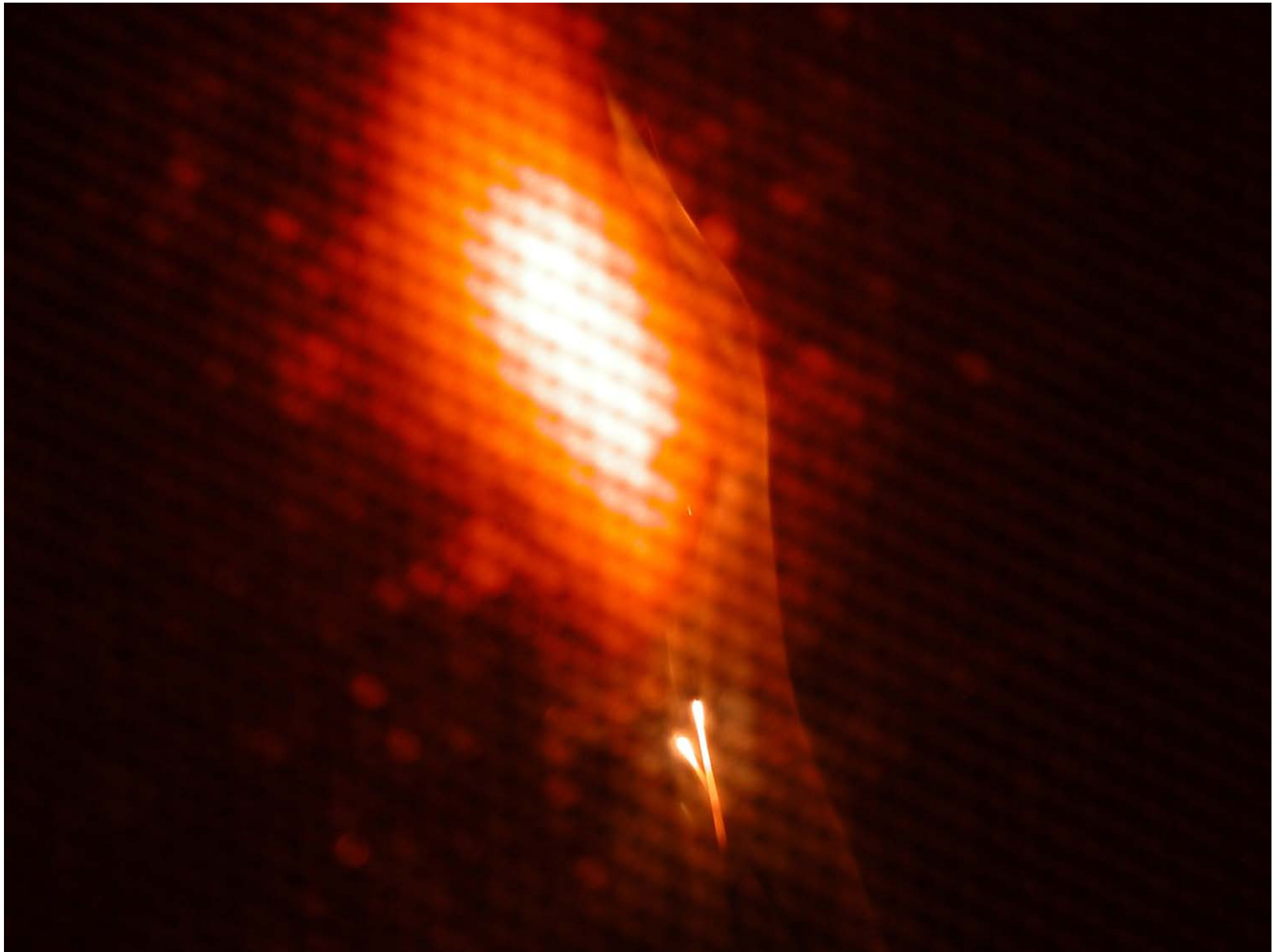


## Data Set: Temperature and Heating Efficiency Measurements

Time (s)	Temp (°C)	Power (W)	Efficiency (%)
1	20.0	1000	10.0%
2	25.0	1000	12.5%
3	30.0	1000	15.0%
4	35.0	1000	17.5%
5	40.0	1000	20.0%
6	45.0	1000	22.5%
7	50.0	1000	25.0%
8	55.0	1000	27.5%
9	60.0	1000	30.0%
10	65.0	1000	32.5%
11	70.0	1000	35.0%
12	75.0	1000	37.5%
13	80.0	1000	40.0%
14	85.0	1000	42.5%
15	90.0	1000	45.0%
16	95.0	1000	47.5%
17	100.0	1000	50.0%
18	105.0	1000	52.5%
19	110.0	1000	55.0%
20	115.0	1000	57.5%
21	120.0	1000	60.0%
22	125.0	1000	62.5%
23	130.0	1000	65.0%
24	135.0	1000	67.5%
25	140.0	1000	70.0%
26	145.0	1000	72.5%
27	150.0	1000	75.0%
28	155.0	1000	77.5%
29	160.0	1000	80.0%
30	165.0	1000	82.5%
31	170.0	1000	85.0%
32	175.0	1000	87.5%
33	180.0	1000	90.0%
34	185.0	1000	92.5%
35	190.0	1000	95.0%
36	195.0	1000	97.5%
37	200.0	1000	100.0%

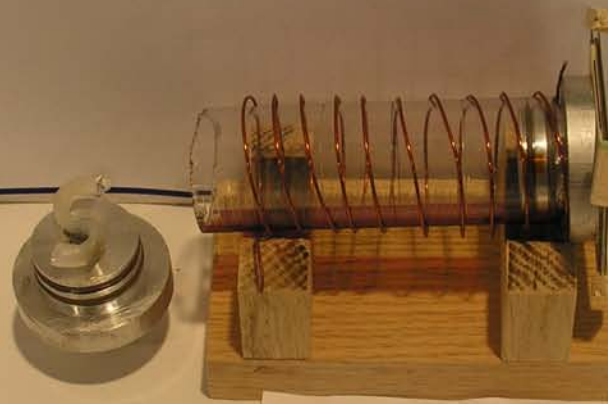
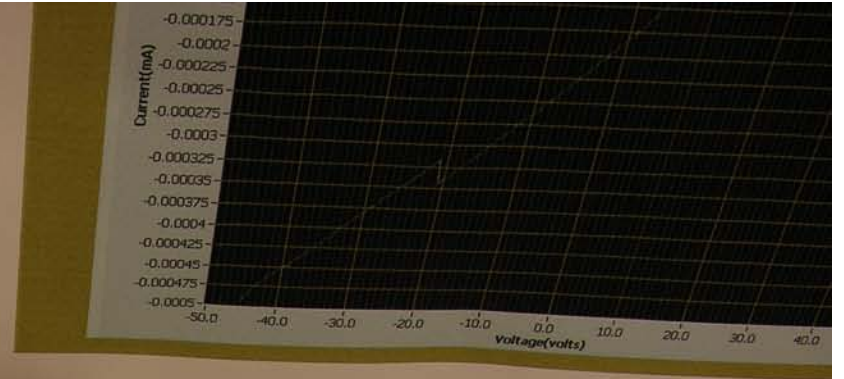
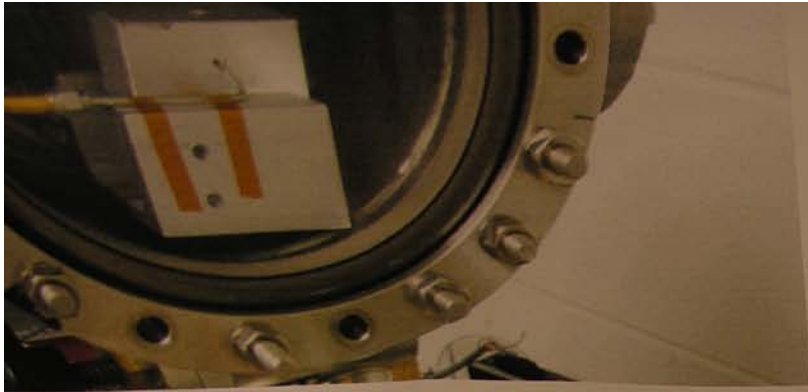
## Sample Data Set: Temperature Measurements with Lead & Toothpick

Time (s)	Temp (°C)	Material
1	20.0	Lead
2	25.0	Lead
3	30.0	Lead
4	35.0	Lead
5	40.0	Lead
6	45.0	Lead
7	50.0	Lead
8	55.0	Lead
9	60.0	Lead
10	65.0	Lead
11	70.0	Lead
12	75.0	Lead
13	80.0	Lead
14	85.0	Lead
15	90.0	Lead
16	95.0	Lead
17	100.0	Lead
18	105.0	Lead
19	110.0	Lead
20	115.0	Lead
21	120.0	Lead
22	125.0	Lead
23	130.0	Lead
24	135.0	Lead
25	140.0	Lead
26	145.0	Lead
27	150.0	Lead
28	155.0	Lead
29	160.0	Lead
30	165.0	Lead
31	170.0	Lead
32	175.0	Lead
33	180.0	Lead
34	185.0	Lead
35	190.0	Lead
36	195.0	Lead
37	200.0	Lead
38	205.0	Lead
39	210.0	Lead
40	215.0	Lead
41	220.0	Lead
42	225.0	Lead
43	230.0	Lead
44	235.0	Lead
45	240.0	Lead
46	245.0	Lead
47	250.0	Lead
48	255.0	Lead
49	260.0	Lead
50	265.0	Lead
51	270.0	Lead
52	275.0	Lead
53	280.0	Lead
54	285.0	Lead
55	290.0	Lead
56	295.0	Lead
57	300.0	Lead
58	305.0	Lead
59	310.0	Lead
60	315.0	Lead
61	320.0	Lead
62	325.0	Lead
63	330.0	Lead
64	335.0	Lead
65	340.0	Lead
66	345.0	Lead
67	350.0	Lead
68	355.0	Lead
69	360.0	Lead
70	365.0	Lead
71	370.0	Lead
72	375.0	Lead
73	380.0	Lead
74	385.0	Lead
75	390.0	Lead
76	395.0	Lead
77	400.0	Lead
78	405.0	Lead
79	410.0	Lead
80	415.0	Lead
81	420.0	Lead
82	425.0	Lead
83	430.0	Lead
84	435.0	Lead
85	440.0	Lead
86	445.0	Lead
87	450.0	Lead
88	455.0	Lead
89	460.0	Lead
90	465.0	Lead
91	470.0	Lead
92	475.0	Lead
93	480.0	Lead
94	485.0	Lead
95	490.0	Lead
96	495.0	Lead
97	500.0	Lead
98	505.0	Lead
99	510.0	Lead
100	515.0	Lead
101	520.0	Lead
102	525.0	Lead
103	530.0	Lead
104	535.0	Lead
105	540.0	Lead
106	545.0	Lead
107	550.0	Lead
108	555.0	Lead
109	560.0	Lead
110	565.0	Lead
111	570.0	Lead
112	575.0	Lead
113	580.0	Lead
114	585.0	Lead
115	590.0	Lead
116	595.0	Lead
117	600.0	Lead
118	605.0	Lead
119	610.0	Lead
120	615.0	Lead
121	620.0	Lead
122	625.0	Lead
123	630.0	Lead
124	635.0	Lead
125	640.0	Lead
126	645.0	Lead
127	650.0	Lead
128	655.0	Lead
129	660.0	Lead
130	665.0	Lead
131	670.0	Lead
132	675.0	Lead
133	680.0	Lead
134	685.0	Lead
135	690.0	Lead
136	695.0	Lead
137	700.0	Lead
138	705.0	Lead
139	710.0	Lead
140	715.0	Lead
141	720.0	Lead
142	725.0	Lead
143	730.0	Lead
144	735.0	Lead
145	740.0	Lead
146	745.0	Lead
147	750.0	Lead
148	755.0	Lead
149	760.0	Lead
150	765.0	Lead
151	770.0	Lead
152	775.0	Lead
153	780.0	Lead
154	785.0	Lead
155	790.0	Lead
156	795.0	Lead
157	800.0	Lead
158	805.0	Lead
159	810.0	Lead
160	815.0	Lead
161	820.0	Lead
162	825.0	Lead
163	830.0	Lead
164	835.0	Lead
165	840.0	Lead
166	845.0	Lead
167	850.0	Lead
168	855.0	Lead
169	860.0	Lead
170	865.0	Lead
171	870.0	Lead
172	875.0	Lead
173	880.0	Lead
174	885.0	Lead
175	890.0	Lead
176	895.0	Lead
177	900.0	Lead
178	905.0	Lead
179	910.0	Lead
180	915.0	Lead
181	920.0	Lead
182	925.0	Lead
183	930.0	Lead
184	935.0	Lead
185	940.0	Lead
186	945.0	Lead
187	950.0	Lead
188	955.0	Lead
189	960.0	Lead
190	965.0	Lead
191	970.0	Lead
192	975.0	Lead
193	980.0	Lead
194	985.0	Lead
195	990.0	Lead
196	995.0	Lead
197	1000.0	Lead
198	1005.0	Lead
199	1010.0	Lead
200	1015.0	Lead
201	1020.0	Lead
202	1025.0	Lead
203	1030.0	Lead
204	1035.0	Lead
205	1040.0	Lead
206	1045.0	Lead
207	1050.0	Lead
208	1055.0	Lead
209	1060.0	Lead
210	1065.0	Lead
211	1070.0	Lead
212	1075.0	Lead
213	1080.0	Lead
214	1085.0	Lead
215	1090.0	Lead
216	1095.0	Lead
217	1100.0	Lead
218	1105.0	Lead
219	1110.0	Lead
220	1115.0	Lead
221	1120.0	Lead
222	1125.0	Lead
223	1130.0	Lead
224	1135.0	Lead
225	1140.0	Lead
226	1145.0	Lead
227	1150.0	Lead
228	1155.0	Lead
229	1160.0	Lead
230	1165.0	Lead
231	1170.0	Lead
232	1175.0	Lead
233	1180.0	Lead
234	1185.0	Lead
235	1190.0	Lead
236	1195.0	Lead
237	1200.0	Lead
238	1205.0	Lead
239	1210.0	Lead
240	1215.0	Lead
241	1220.0	Lead
242	1225.0	Lead
243	1230.0	Lead
244	1235.0	Lead
245	1240.0	Lead
246	1245.0	Lead
247	1250.0	Lead
248	1255.0	Lead
249	1260.0	Lead
250	1265.0	Lead
251	1270.0	Lead
252	1275.0	Lead
253	1280.0	Lead
254	1285.0	Lead
255	1290.0	Lead
256	1295.0	Lead
257	1300.0	Lead
258	1305.0	Lead
259	1310.0	Lead
260	1315.0	Lead
261	1320.0	Lead
262	1325.0	Lead
263	1330.0	Lead
264	1335.0	Lead
265	1340.0	Lead
266	1345.0	Lead
267	1350.0	Lead
268	1355.0	Lead
269	1360.0	Lead
270	1365.0	Lead
271	1370.0	Lead
272	1375.0	Lead
273	1380.0	Lead
274	1385.0	Lead
275	1390.0	Lead
276	1395.0	Lead
277	1400.0	Lead
278	1405.0	Lead
279	1410.0	Lead
280	1415.0	Lead
281	1420.0	Lead
282	1425.0	Lead
283	1430.0	Lead
284	1435.0	Lead
285	1440.0	Lead
286	1445.0	Lead
287	1450.0	Lead
288	1455.0	Lead
289	1460.0	Lead
290	1465.0	Lead
291	1470.0	Lead
292	1475.0	Lead
293	1480.0	Lead
294	1485.0	Lead
295	1490.0	Lead
296	1495.0	Lead
297	1500.0	Lead
298	1505.0	Lead
299	1510.0	Lead
300	1515.0	Lead
301	1520.0	Lead
302	1525.0	Lead
303	1530.0	Lead
304	1535.0	Lead
305	1540.0	Lead
306	1545.0	Lead
307	1550.0	Lead
308	1555.0	

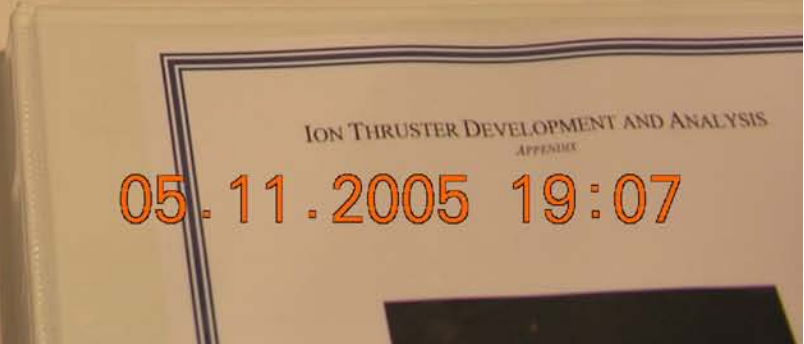








PLEASE DO NOT TOUCH DISPLAY



## **Retreat Held at MIT in August**

- **Increase Participation by members**
- **Continue the development of the two page Technical Papers**
- **Continue printing and distribution of CPS educational material (brochure and poster).**
  - **Look into upgrading CPS glasses (get better grating)**
  - **Develop lesson plan for using the glasses.**
- **Continue Capitol Hill Luncheon Education events**
  - **Request volunteers for a "Washington" committee - opportunity for involving members.**
  - **Plan for two events this year - fusion and lightning**
- **Continue development and maintenance of the CPS web site**
  - **Ask for input on how to improve web page**
- **Solicit for individual(s) to conduct a Demonstration Contests**

## **Additional Participation is Our Most Critical Issue**

- **A range of activities are possible.**
  - **ongoing:**
    - **writing a two-pager;**
    - **working with science fair;**
    - **officer.**
  - **new:**
    - **plasma history/education site (IEEE Microwave History);**
    - **writing award;**
    - **new proposal**

e-mail [berryla@ornl.gov](mailto:berryla@ornl.gov) or use contact info on webpage