CAPS Activities during and around Saturn Orbital Insertion

SOI timeline:

- Start of quiet period: $91.59 \text{ R}_S$ June 23 00:00
- Ascending ring plane crossing (ARPX): $2.61 \text{ R}_S$ July 1, 00:49
- Start of SOI burn: $2.38 \text{ R}_S$ July 1, 01:04
- Periapsis (23,700 km above ring plane): $1.33 \text{ R}_S$ July 1, 02:39
- End of SOI burn (97 min. duration): $1.33 \text{ R}_S$ July 1, 02:41
- Turn to Earth (est.): $1.48 \text{ R}_S$ July 1, 03:11
- Start of post SOI science: $\sim1.5 \text{ R}_S$ July 1, 03:15
- Descending ring plane crossing (DRPX): $2.63 \text{ R}_S$ July 1, 04:35

Quiet period restrictions:

- Spacecraft pointed with $-Z$ to Earth, $+X$ to north ecliptic pole until ARPX
  - Places corotation well inside CAPS field of view for entire period
- Instruments must use less than allocated power (21 W for CAPS)
  - Decreases and variability in power use are ok, peak must be below limit
- No software modifications
- Instruments may execute internal sequences (IEBs) started prior to June 23 00:00
  - Instruments may lower high voltages prior to SOI burn using internal sequence
- No real-time commands
  - This probably includes response to anomalies
- Data may be downlinked until SOI–29 hours
- Only one SSR may be used to record data

SOI burn and CAPS high voltages

- The R–4D main engine produces 148 g/s of various neutrals
  - Mostly water and nitrogen
- SOI burn lasts 97 min.
- No modeling of the spacecraft environment has been done
  - Two studies of near field (backup engine) & optical instrument contamination
- Pressure near CAPS would be orders of magnitude less than $6 \times 10^{13} \text{ cm}^{-3}$
  - Not a useful upper limit: Safe values $\sim 10^{10}$ (few $\times 10^{-7}$ Torr)
- Will this cause the 14.5 kV high voltage to arc?
  - Will this cause arcing with the voltage at 12 kV (sleep level)?

Post SOI observations

- Sleep mode during SOI conflicts with normal IMS science after SOI
  - HVU1 at 12 kV
  - We currently require 2 hours 15 minutes to raise it to 14.5 kV
  - ELS and IBS are turned on in 6 and 8.5 minutes
  - ST and LEF MCP voltages are turned on in 25–30 minutes
- End of SOI to DRPX is the only opportunity for most CAPS rings–related goals
  - This period is $\sim 1$ hour 20 minutes long
- IMS can operate and take data at 12 kV
  - Lower sensitivity & mass resolution
  - Shift in TOF peak & shape $\Rightarrow$ SAM will not produce viable Ion data
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Suggestions by F. Crary are highlighted

Pre−SOI quiet options:
1. **Operate normally**
   - Real time commanding may not be possible, even for an anomaly
   - CAPS has been operating since Sept. 2000 without serious anomalies
   - Worst case (?) is ending up in reset w/out replacement heater for 8 days
     - Thermal issues for ELS?
     - Would it be safe to actuate?
2. Turn off

SOI burn options:
1. Leave HVU2 at 14.5 kV and take data
   - Risks arcing and pulling HVU2 down from 14.5 kV
     - S/c anomaly response (if it turns CAPS off) takes HVU2 down immediately
   - Allows us to operate normally after burn
2. **Turn HVU2 down to 12 kV and take data**
   - Quality of IMS data reduced
   - ELS and IBS operate normally
   - Should we stop the actuator?
3. Go to sleep

Options 2 and 3 limit post−SOI science
When should we change mode? Just before ARPX?
Is 12 kV a safe voltage? Should we reduce it further?

Post−SOI options:
1. Operate normally (if HVU2 was at 14.5 kV during burn)
2. **Operate with HVU2 at 12 kV (if HVU2 was at 12 kV or in sleep during burn)**
3. Turn HVU2 from 12 kV to 14.5 kV in < 30 min (more than 4x faster than usual)
   What is the minimum time to turn CAPS on?
   - Can IBS & ELS voltages go up at the same time?
   - Can the LEF and ST MCPs voltages go up at the same time?