Gabbard Plot Discussion

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Gabbard Diagrams

• Developed by John Gabbard, a NORAD employee, in the 1960-70’s to analyze and diagnose satellite breakups

• Plots orbital period of each debris object on x-axis and perigee/apogee on y-axis
  – For these charts, apogee will be in red, perigee in blue

• Forms a distinctive pattern, depending on orbit of parent body and location of breakup
Gabbard diagram of recent DMSP breakup

DMSP 5D-2/F13 Gabbard Plot

- Apogee
- Perigee

67 debris from USA 109
Orbital data compiled on 12 March, 2015
Gabbard Diagram of recent Progress breakup

Gabbard Breakup Plot for Progress M-27M / Third Stage Anomaly
Based on Earliest High-Quality Space-Track Element Sets

Object "B" Identified as Third Stage
Object "A" Identified as Progress

Apogee
Perigee

Apogee/Perigee Altitude [Km]

Orbital Period [minutes]

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Simple Model of Debris Cloud Generation

- Used target orbit parameters 193 km x 238 km for parent breakup source (shown with black dots)

- Created isotropic debris at various breakup locations in parent orbit – perigee, apogee, and mid-point of orbit
Model Satellite Breakup
193 km x 238 km Parent Orbit, Breakup at Perigee

- Apogee
- Perigee

Apogee / Perigee Altitude [km]

Orbit Period [minutes]
Model Satellite Breakup
193 km x 238 km Parent Orbit, Breakup at Orbit Midpoint

- Apogee
- Perigee