STEREO
Preliminary Telecommunications Design
1/14/99

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Preliminary Design

- **High-rate science downlink baseline:**
  - One axis gimbaled HGA always pointed towards earth within ≤0.1 deg (carrying 0.2)
  - 5 Gbit @ 1AU with 8 hr contact (ie 200 kbps for 7hr downlink contact) with existing DSN 34 m BWG antenna system
  - RS + 6:1 convolutional coding
  - Downlink margin ≥3 dB, BER <10E-6
  - X-band
  - 40 w amplifier on S/C
- **Uplink baseline:**
  - baseline X-band
  - 125 bps
  - 6 dB margin and BER <10E-6

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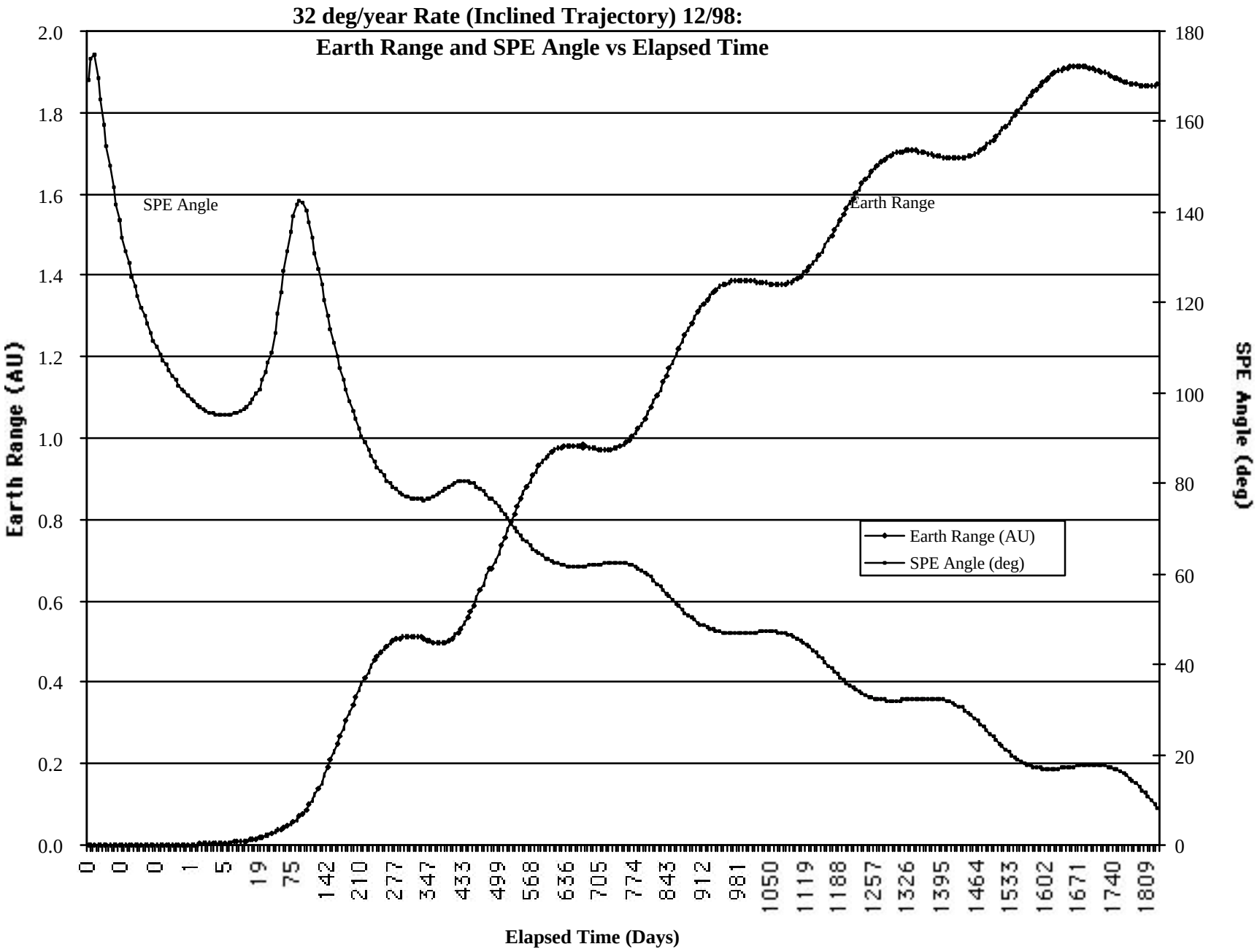
- **2**
  - **Specific trajectory affects telecommunications design while sun-probe-earth angle is >90 deg**
  - **For sun-probe-earth angle <90 deg, gimbaled HGA is used**
- **Preliminary analysis has been performed for inclined trajectories (P. Sharer 12/98), specifically leading trajectory with drift rate of 15 deg/year**



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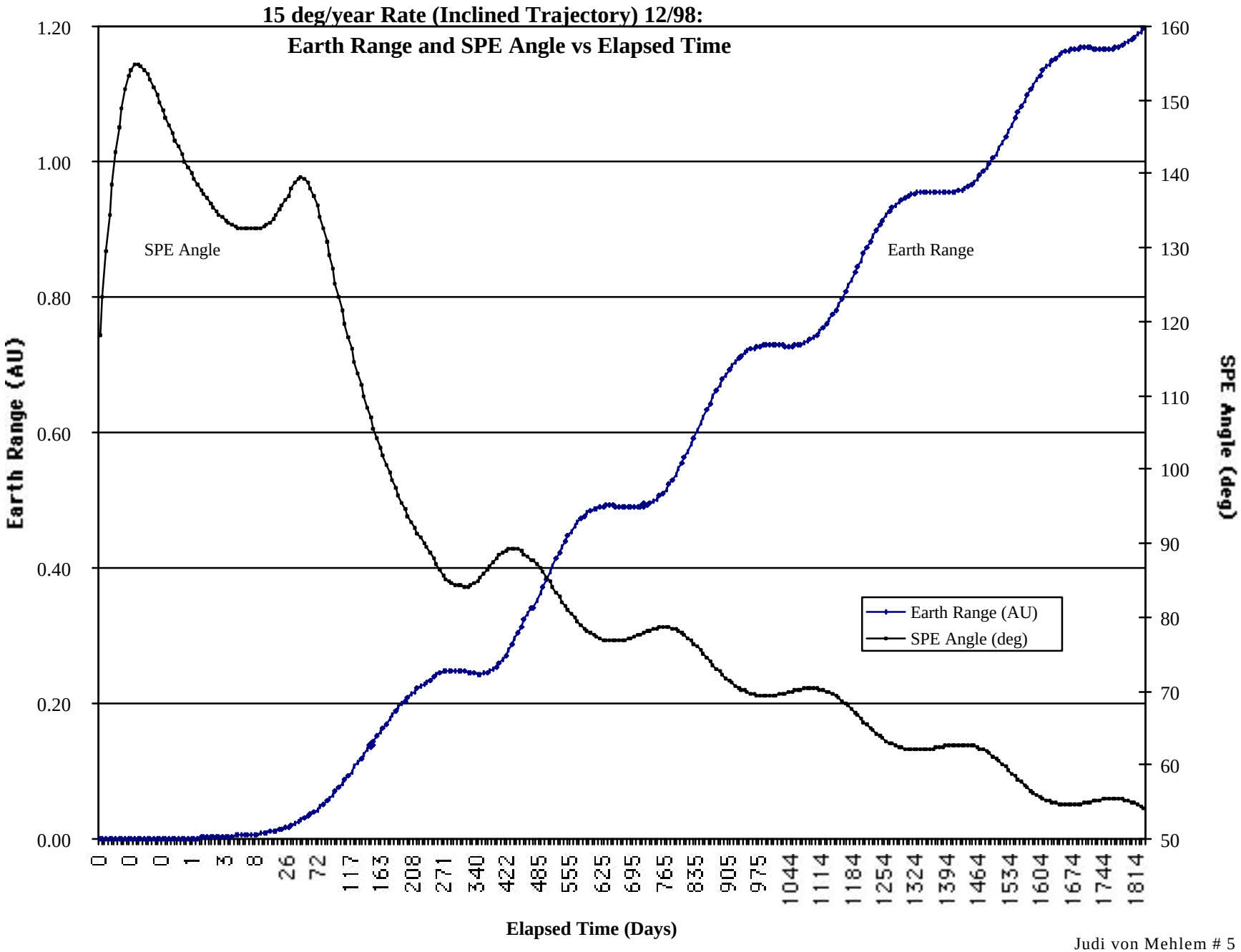

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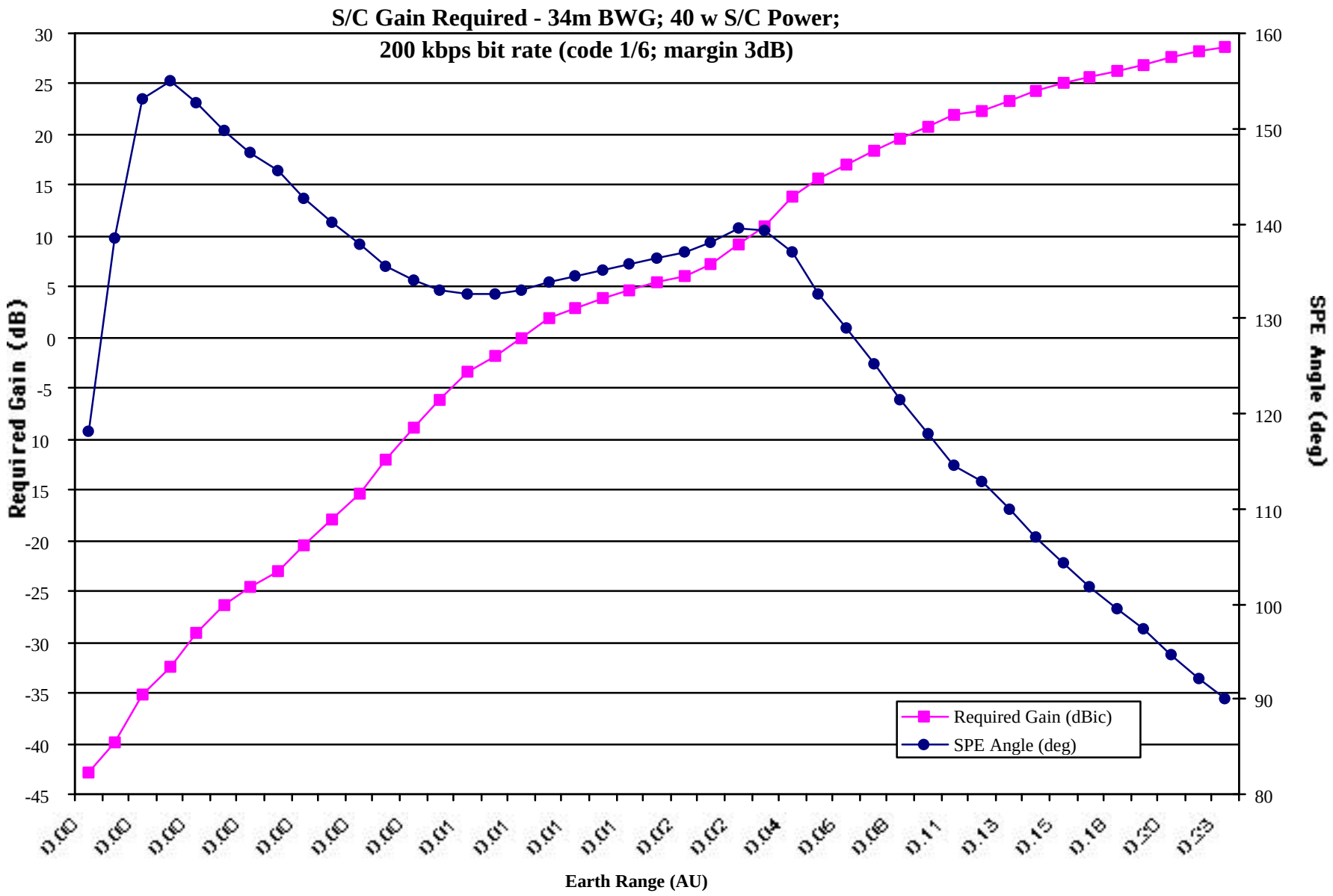

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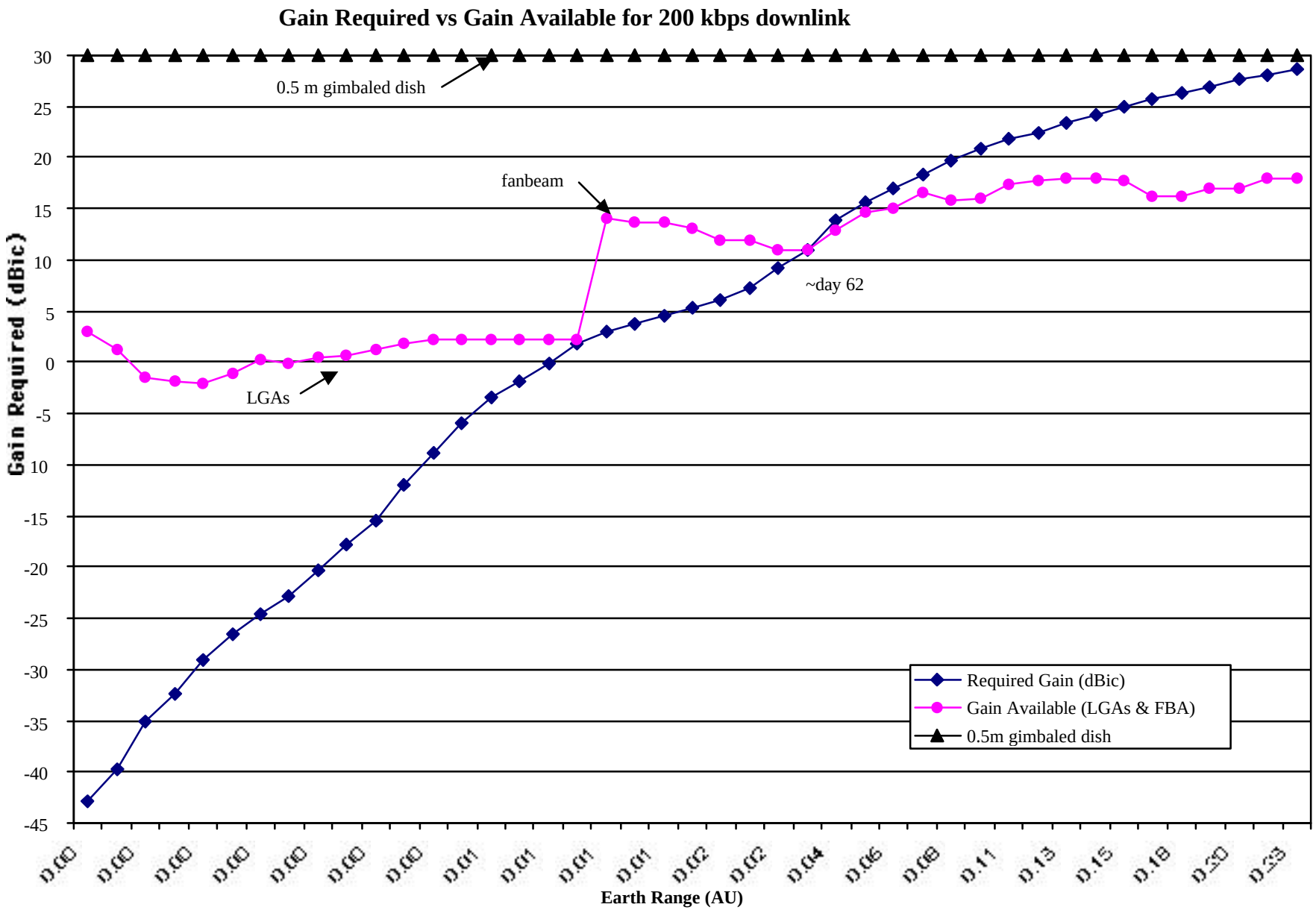
Gain Required vs Gain Available for 200 kbps downlink
Gain Required (dBic)
Earth Range (AU)
0.5 m gimbaled dish
fanbeam
~day 62
LGAs
Required Gain (dBic)
Gain Available (LGAs & FBA)
0.5m gimbaled dish
30
25
20
15
10
5
0
-5
-10
-15
-20
-25
-30
-35
-40
-45

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Link Performance from Day 62 to 222

Day	Bit rate (kbps) for LGA/MGA 34 mBWG	Time for 5 Gbps (hrs+1)	Bit rate (kbps) for LGA/MGA 70 m	Time for 5 Gbps (hrs+1)
62	178	8.8		
104	85	17.3	485	3.9
145	46	31.2	266	6.2
181			114	13.2
222			100	14.9

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Preliminary Link Performance at 1AU With HGA

S/C Antenna diam (m)	S/C X-band gain dBic (55% eff)	Bit rate (kbps) for S/C power 20w	Bit rate (kbps) for S/C power 40w	Time for 5 Gbps (hrs+1)	Bit rate (kbps) for S/C power 60w	Time for 5 Gbps (hrs+1)	Bit rate (kbps) for S/C power 80w	Time for 5 Gbps (hrs+1)
DSN 34 m BWG								
1.1 m	37.2		76	19.3	115	13.1	153	10.1
1.2 m	37.9		91	16.3	136	11.2	182	8.6
1.3 m	38.6		106	14.1	159	9.7	212	7.6
1.8 m	41.4		200	8	296		395	
DSN 70 m								
1.1 m	37.2	>200		8				

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- **Uplink - link supports 125 bps with 6 dB margin and BER <10E-6**
  - **to ~0.01 AU need gain ~-22dBic**
  - **to 0.23 AU need gain ~4.9 dBic**
  - **to 2 AU 1.1m HGA gain provides 35.8 dBic gain**

- **Ka -band**
  - anticipate ~6dB effective improvement over X-band
  - one DSN station (Goldstone DSS 25) supports Ka band
  - other stations will be upgraded starting Sept 2001 with last station complete Sept 2004
  - limited space qualified Ka-band amplifier (32 GHz) availability. Thompson CF expects to be able to retune existing TWT to provide 15 and 30 w. NASA/Lewis and potentially Hughes working on design of 30 w TWT.

- **Ka -band cont.**
  - **Require:**
    - **dual frequency (X and Ka-band feed)**
    - **Ka-band transmitter and receiver**
    - **require Ka-band test equipment**
    - **Still require on-board X-band telecommunications system for anomolous operation (70m is not being upgraded to Ka-band)**
    - **further work**

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- **S-band downlink**
  - ACE-heritage helix antenna for early operation provides 31 bps to 0.229 AU, require 16 dB gain to get 500 bps
  - dual frequency (S and X-band) on HGA to 1AU
    - 40 w and 1.1 m antenna support 500 bps out to 0.7 AU
    - require either 1.6 m antenna or 81 w for 500 bps out to 1 AU
  - require further antenna work and analysis

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- **Anomalous/Emergency Operation**
  - Trajectory dependent
- **Switching design**
  - TBD, depending on antenna complement selected
- **Trajectory**
  - Will redo link analysis for trajectories selected

Diagrams of spacecraft from Mike Kreitz
- showing options for 1.1m and 1.3 m reflectors (e.g. 1.3 m reflector mounted in operational position for launch). Don't have electronic copies.