WP 9:

30 GHz stand-alone power source for development of CLIC RF equipment

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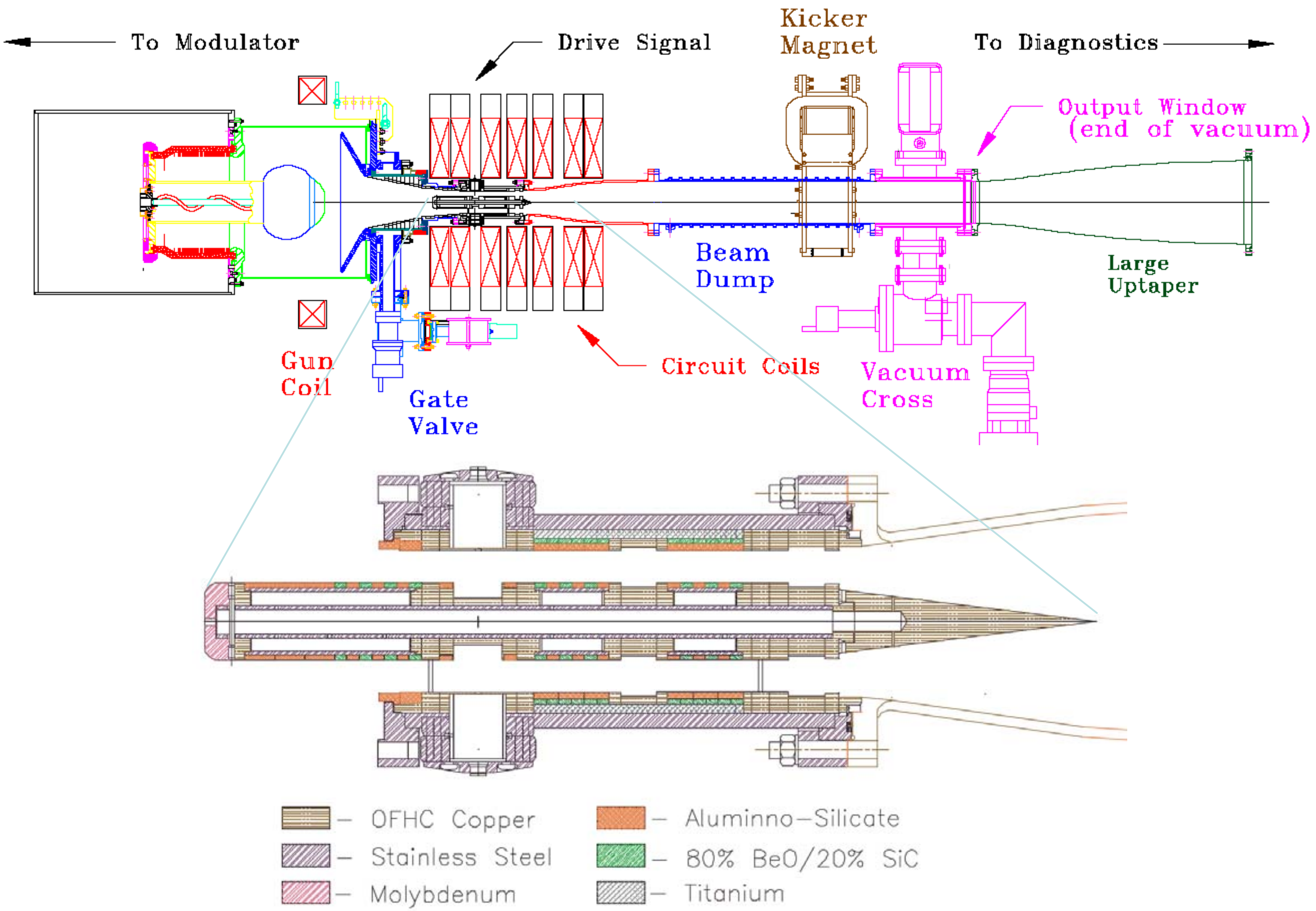
30 GHz stand-alone power source

- Why?   'Isn't CTF3 ***the*** 30 GHz power source?'
  - During CTF3 construction phase, limited time available to produce 30 GHz power.
    - Test 4…5 structures/year + wg. components + pulse surface heating experiments?
  - CTF3 runs at ≈ 10 Hz (limit 50 Hz), which is low for conditioning Mo or W structures.
    - Tests of Mo structures at SLAC indicate a factor 10 lower "conditioning rate" than Cu!
  - CTF3 is a test facility, not a production accelerator.
    - Only one 30 GHz output from CTF3!
- What exactly would one require?
  - High reliability (*we want to test structures, not this power source!*)
  - 30 GHz, high peak power (≈ 200 MW) – high rep. rate (140 ns, 50 Hz), in WR34.
  - 200 MW is very ambitious, a highly reliable device at 50 MW would be useful.
  - Power combination and pulse compression (see WP 2.3) can be considered.
    - NB.: pulse compression requires phase modulation!
- When?
  - ASAP! Maybe more realistic: lead-time 2.5 to 3 years: operation from 2007.
  - On the longer term (after CTF3), **one would need a number of these power sources** for structure and component tests and conditioning.
  - less power earlier on (2006), higher power later (2008) makes sense.

High power sources: Candidates

- Gyroklystron:
  - Today, 75 MW at 8.5 GHz , 32 MW at 20 GHz, 1.8 MW at 30 GHz (University Maryland).
- Magnicon:
  - Program in US (Omega-P & DoE SBIR): 34.3 GHz, 10.5 MW produced (design 45 MW). (June 2003)
- Klystron: cannot easily be scaled to 30 GHz ($P \propto f^{-2}$)
  - but Haimson built a 25 MW klystron at 17.1 GHz!
- other: CARM?, Gyro-TWT?, FEM?, …

Gyroklystron



Gyrotrons & Gyroklystrons

- IAP, Nizhny Novgorod, Gyrotrons:
  - 20 GHz, 40 MW
  - 40 GHz, 25 MW
- NRL, Washington DC, Gyrotrons:
  - 28…49 GHz, 100 MW
- University of Maryland, Gyroklystrons, exp. results:
  - 17.14 GHz, 28 MW,
  - 19.75 GHz, 32 MW,
  - 29.75 GHz, 1.8 MW

CPI study: Gyroklystron 30 GHz, 50 MW

CPI — Communications & Power Industries made a design study for us in 2001.

A 200 MW power station would consist of

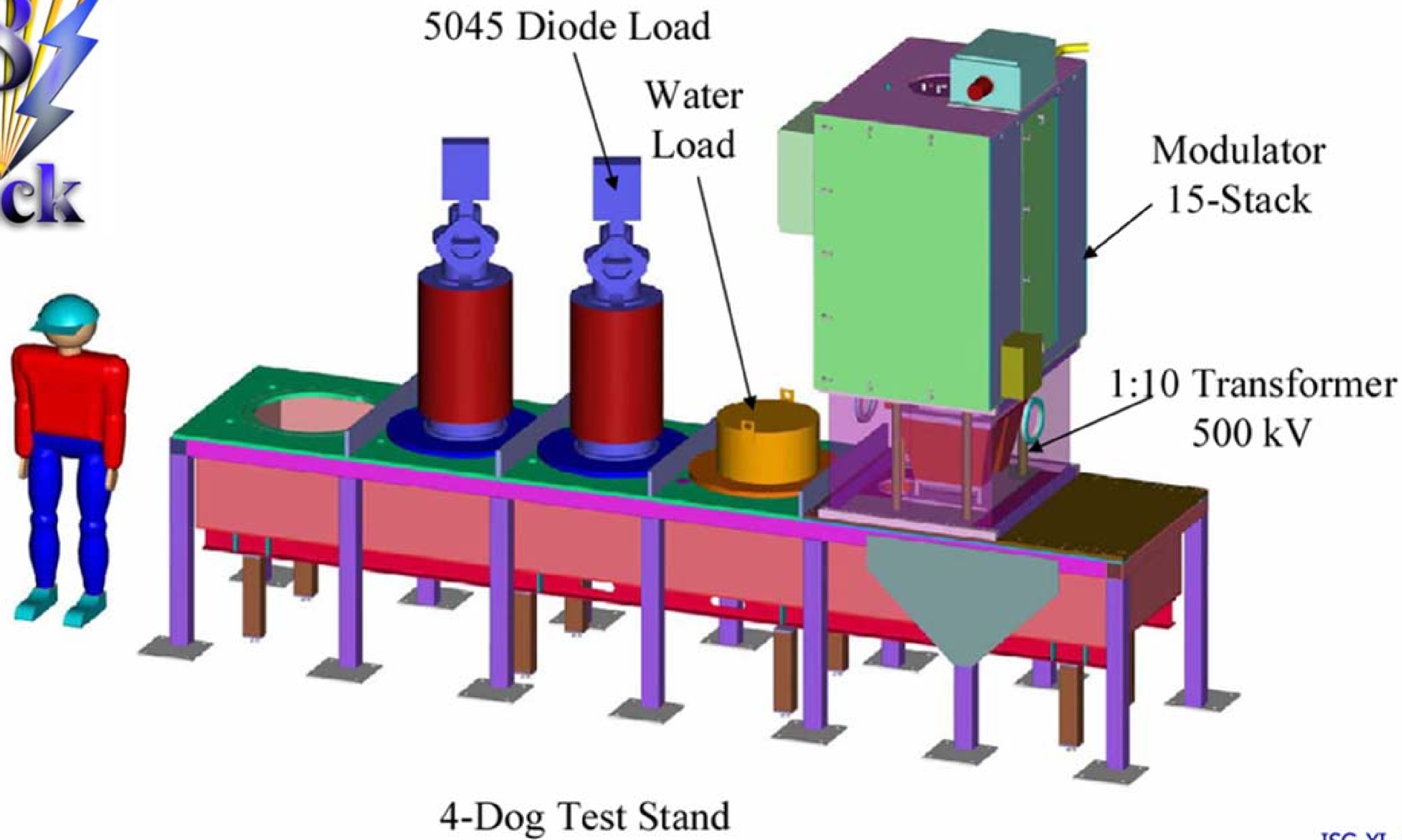
- four 50 MW Gyroklystrons, 1.2 μs, 100 Hz with fundamental TE_{011} coaxial cavities,
- four SC 2 T solenoids + power supplies, (≈ 300 k$ each)
- two 15 kW drivers + power supplies, (≈ 370 k$ each)
- one modulator 500 kV, 1.2 kA, (≈ 1000 k$)
- two power combiners 50 MW + 50 MW (≈ 20 k$ each)
- ancillary systems.

Lead time ≈3 years (15 months for first 50 MW amplifier)

This example would sum up to 7.5 M$

Modulator: similar to NLC 8-pack

Next Linear Collider 8 Pack



ISG-XI, December 2003

Summary WG2 by D. Schultz

34.3 GHz Magnicon (Omega-P):

	design	experiment*)
Frequency	34.3 GHz (3rd harm.)	
Power	44…48 MW	10.5 MW
efficiency	41…45 %	14 %
pulse length	1.5 μs	0.25 μs
rep. rate	10 Hz	10 Hz
beam voltage	500 kV	435 kV
beam current	215 A	180 A
solenoidal field	2.25 T	

*) status: June 2003, 6th Workshop on High Energy Density and High Power RF

References

Overview:

- Manfred Thumm: "State-of-the-Art of High Power Gyro-Devices and Free Electron Masers Update 2003," http://bibliothek.fzk.de/zb/berichte/FZKA6957.pdf

- Steven H. Gold: "Overview of Advanced, Non-Klystron rf Sources," Snowmass 2001, http://www.slac.stanford.edu/econf/C010630/papers/T301.PDF

- Eric R. Colby: "Power Sources for Accelerators beyond X-band," in: H. Wiedemann, D. Brandt, E. A. Perevedentsev & S. Kurokawa (eds.): "Physics and Technology of Linear Accelerator Systems", World Scientific, Singapore, 2004.