# E2V Technologies

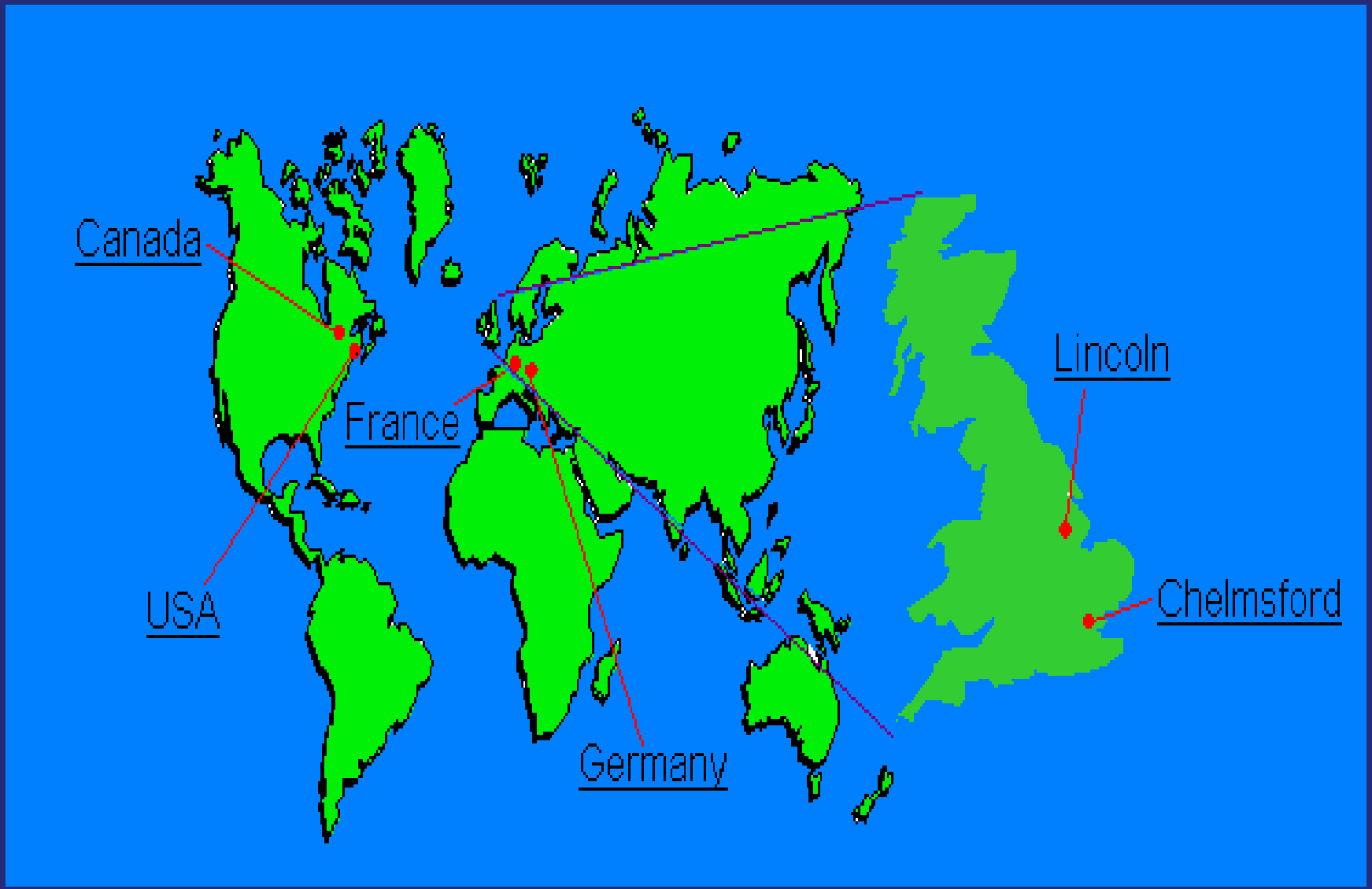
Formerly Marconi Applied Technologies

E2V Technologies

# IOTs and Klystrons for CW Operation

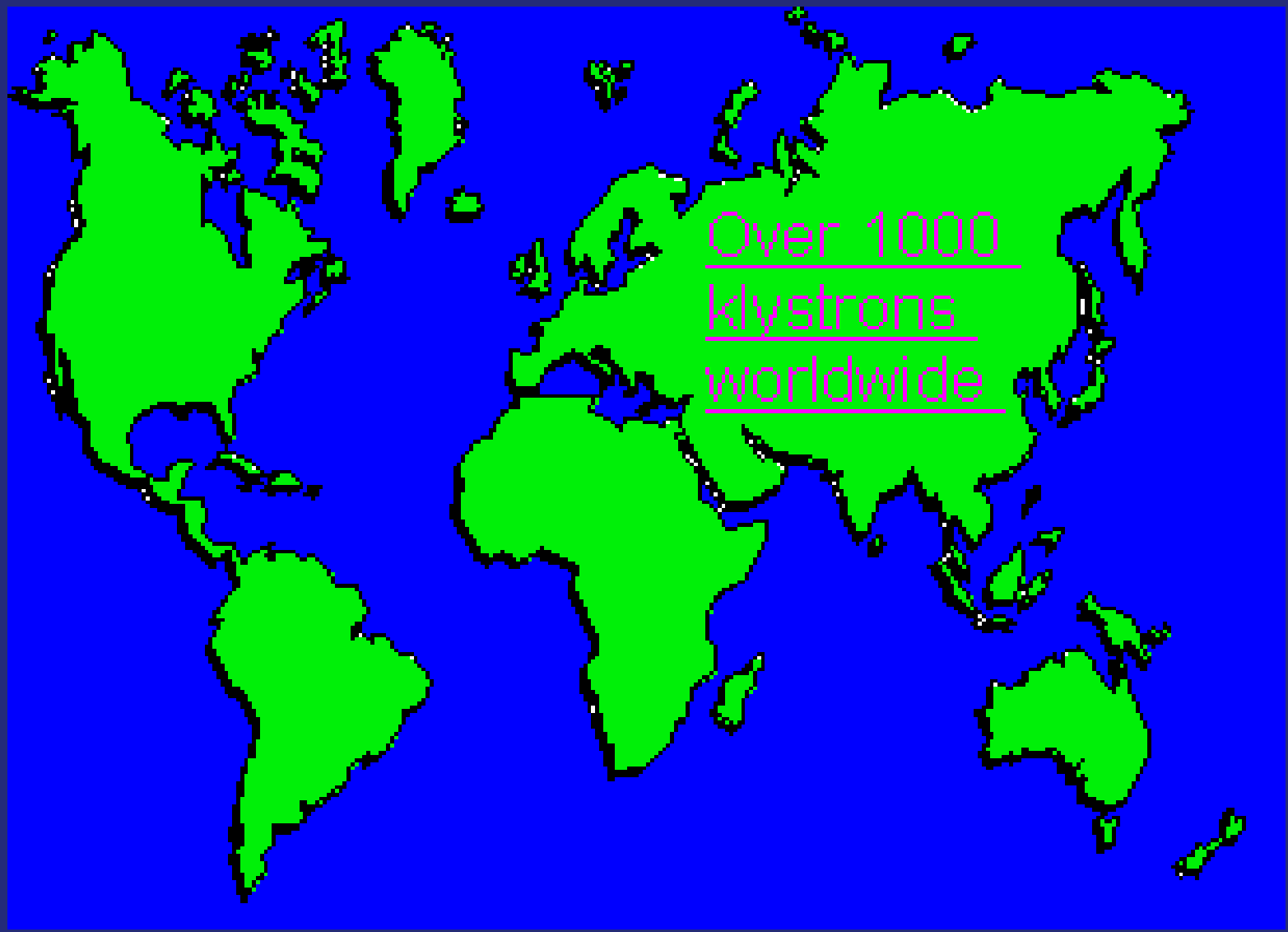
**Steve Aitken B.Sc.**, Product Mag'r, IOTs & Klystrons
**Dr. Edward Sobieradzki**, Principal Engineer
**Erik Trawny B.Sc.**, Sales Engineer

# E2V Technologies - Locations



# IOT Sockets Worldwide

# ‘Broadcast Type’ Klystron Use



# Development and Manufacturing Capacity

- The IOT and klystron activity is supported by a 13 man professionally qualified engineering team that deals with R&D as well as production engineering on all products
- Our approved R&D budget in the area is currently over £750,000, with more planned.
- We are able to build around 750 to 800 IOTs and klystrons per year, (depending on product mix).
- This year alone we have invested over £500,000 of capital in state of the art manufacturing equipment.

# Our Commitment to Our Customers

Over 30% of our Manufacturing and Support people are Engineers/Technicians

Over 5% of turnover reinvested in R & D across the company provides for continuous product development and innovation; more in the IOT area.

# Klystrons v IOTs

**Klystron**

- Class A operation
- Rugged, robust diode electron gun
- High stability from cold start
- Can be physically large compared to IOT
- Long established, well understood technology.
- Capable of high efficiencies in CW operation
- E2V have built klystrons for over 40 years
- Klystrons have no technical frequency limitations in terms of the BESSY application.

**IOT**

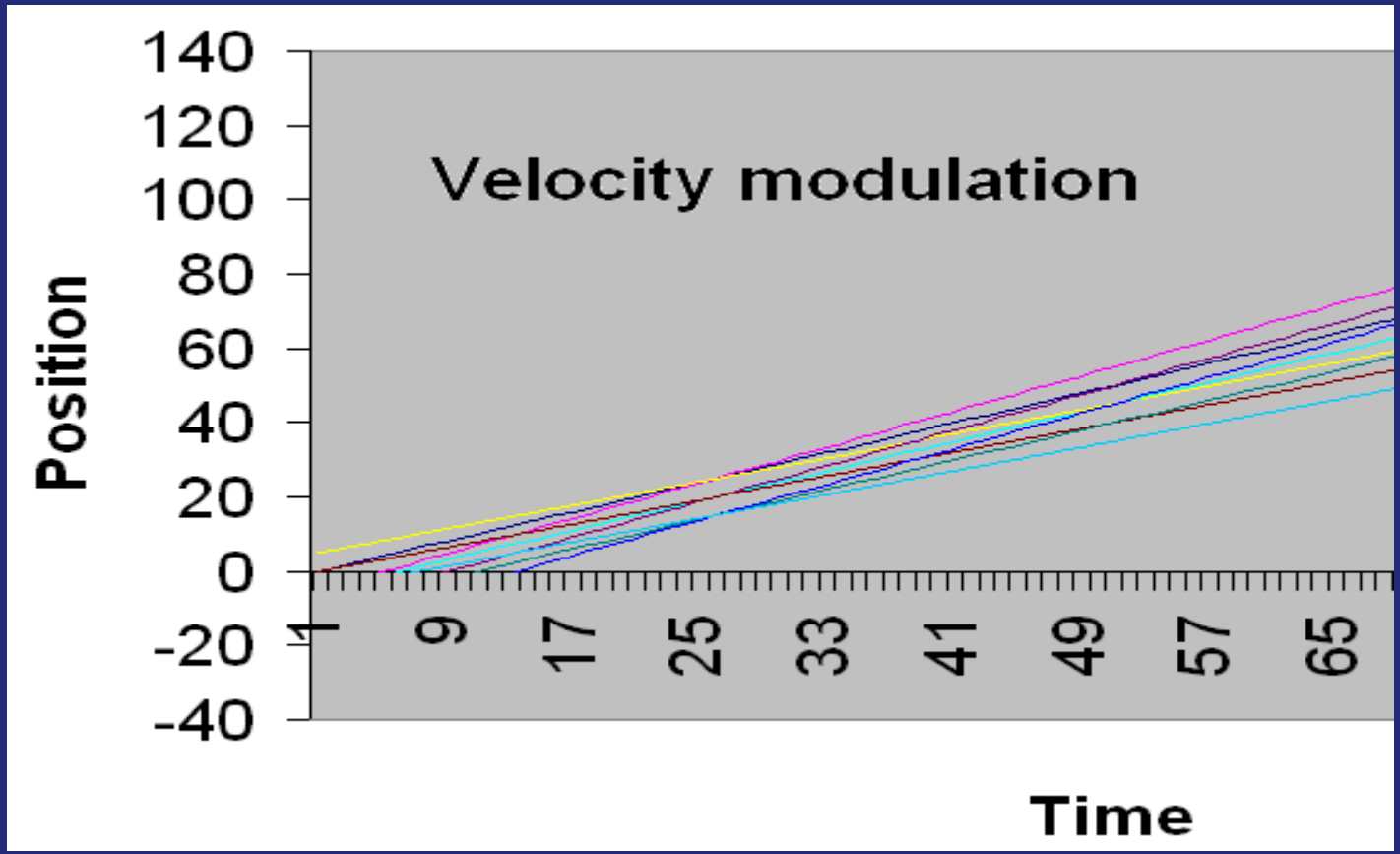
- Operable as class AB, class B or class C amplifier
- Triode gun with pyrolitic graphite grid, requiring either crowbar or other fast disconnect protection
- Requires ‘stabilisation’ period at cold switch-on
- Physically compact compared to equivalent power klystron
- Very high efficiency in CW operation
- E2V have been building IOTs since 1989 and are the worlds’ largest manufacturer.
- Transit time limitations may prevent acceptable performance at 1.3GHz

# How Do These Tubes Work?

- Klystrons are VELOCITY MODULATED. RF is superimposed on the electron beam by varying the velocity of the beam in the time domain to produce bunches

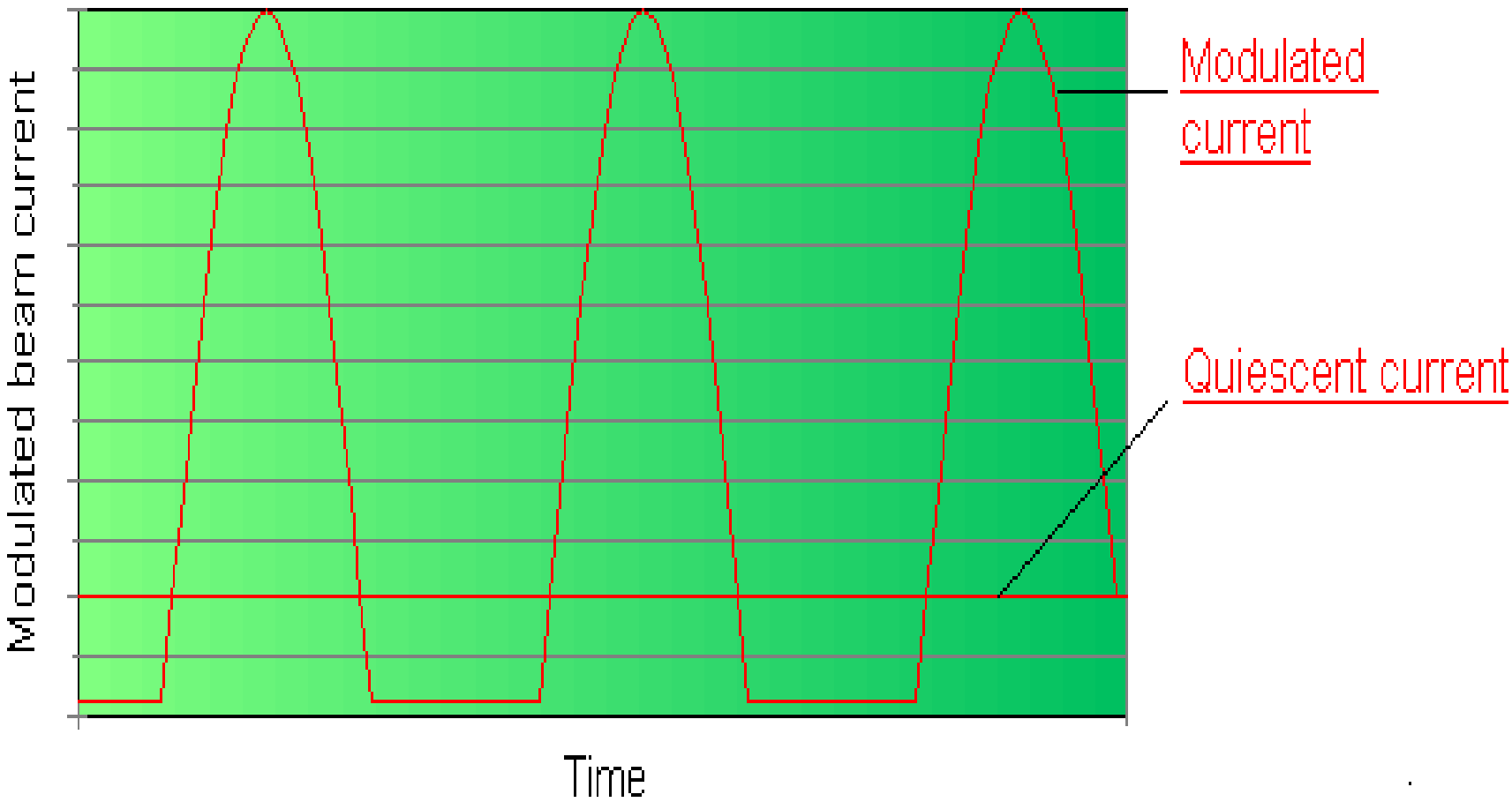
- IOTs are DENSITY MODULATED. Bunches are formed by RF modulating the grid voltage, and either releasing or impeding emission from the cathode

# Velocity Modulation in a Klystron




Electron bunches form as a result of successive accelerations and decelerations of the electrons in the beam as they pass through a succession of tuned cavities.

# Density Modulation in an IOT



# The future of klystrons

- Transmitter re-engineering / upgrades
- Support for existing users
- Specialist applications

# Applications

**Klystrons**

**UHF TV transmission**
PAL
NTSC
SECAM

**Scientific (CW) Operation**
Scientific radar
Linear accelerators
Synchrotrons

**Tropospheric Scatter Communications**

**Radar,** (historically)

**IOTs**

**UHF TV transmission**
PAL
NTSC
8-VSB

**Antenna test / development**
sub UHF TV frequencies

**Scientific (CW) Operation**
Rapidly expanding area with much interest.

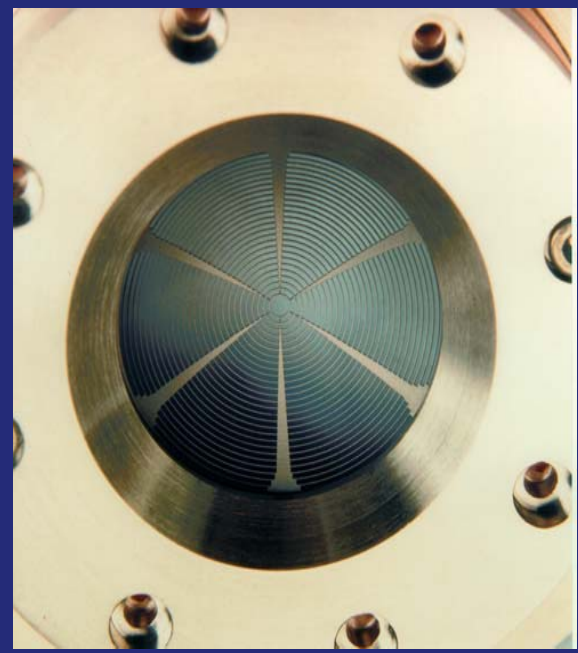
# Existing Scientific Users of E2V Klystrons, (non-Super-power)

| | |
|---|---|
| •Germany, | BESSY |
| •Italy, | Synchrotrone Trieste |
| •Japan, | KEK |
| •Brazil, | Tecnologia de Luz. |
| •Canada, | Canadian Light Source |
| •Korea, | Pohang |
| •Scandinavia, | EISCAT |
| •USA, | IBM |

•Other projects under consideration

# The IOT, compact and efficient

- Devised in 1937.  A Tetrode/Klystron hybrid.
- Developed in 1989 to address high energy costs in the broadcast market.
- Offers high efficiency in AM operation compared to a klystron



# IOT facts

- E2V IOTs currently in operation have a combined life in excess of 25 million hours, with a total of 34 million hours on all E2V IOTs

- In CW, class ‘C’ operation, E2V IOTs are capable of 70% efficiency, (at an output power of 60kW)

- The gain of an IOT is around 20dB lower compared to an equivalent klystron.

# Klystrons v IOTs

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