NANYANG TECHNOLOGICAL UNIVERSITY

MICROFABRICATED TRAVELLING WAVE TUBE AMPLIFIERS

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(EDB) 2014-17

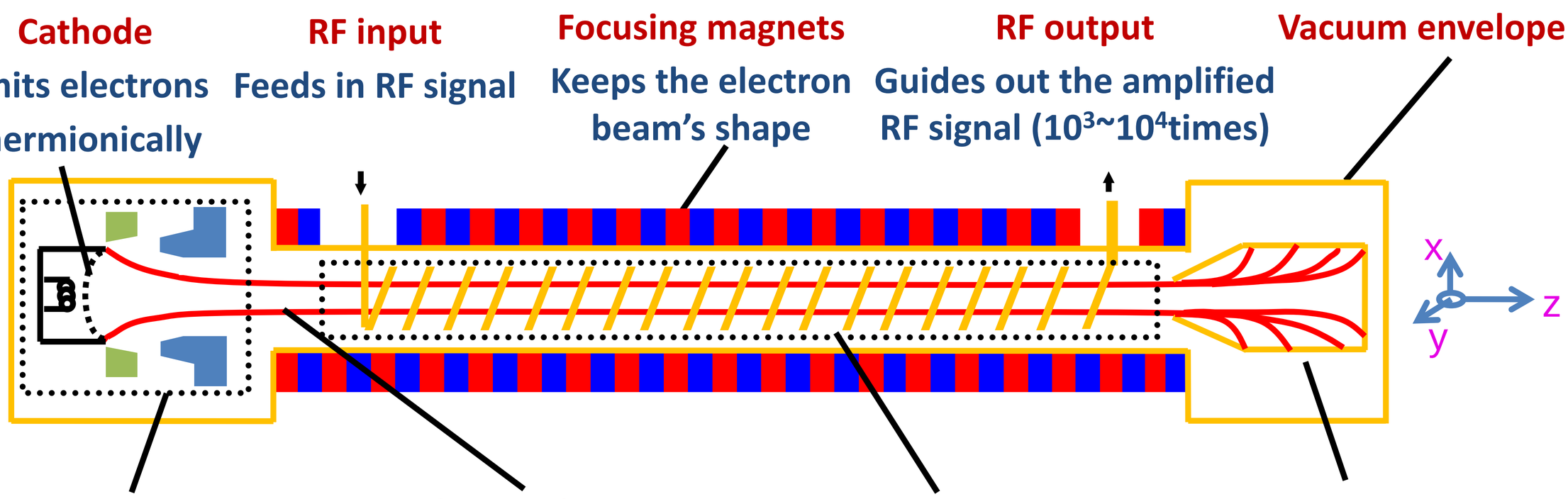
A/P Sheel Aditya | Prof. Tay Beng Kang | A/P Miao Jianmin

Hello, everyone!

This is traveling wave tube amplifier, and you can call me TWTA.

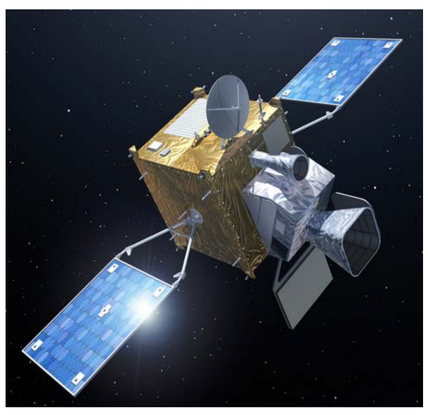
I am a vacuum electron device (VED)
and I convert DC power into RF power.

Take a look at my cross-sectional diagram.
Actually, I am cylindrical and rotationally symmetric about z-axis.

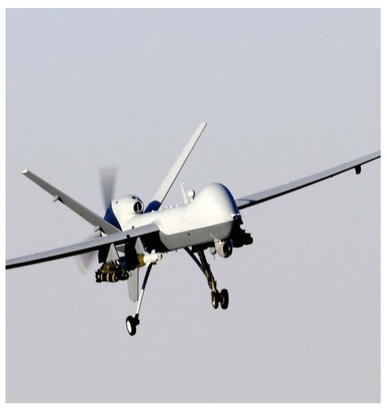


Many people like me, because I can work with a
large bandwidth, good linearity, high efficiency,
high frequency, medium power, high temperature ...

So, I have become the most widely used VED (65%), and you can find me in:



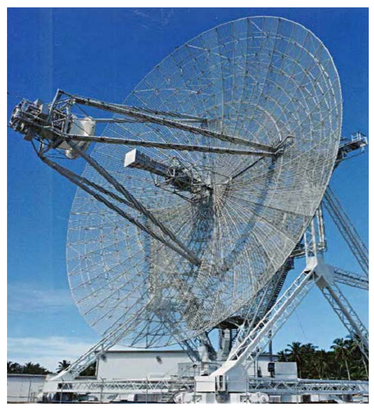
Satellites



UAVs

Airborne radars

Jammers in ECM



Military radars ...

And they call me the heart of the communication system.

I have got a large family with different types of slow wave structures:
Helix TWTA, Coupled Cavity TWTA, Folded Waveguide TWTA,
Ring-Bar TWTA, Ladder TWTA, Rectangular Grating TWTA...

Sigh, just as most of you, I do have some troubles.
Circular helix is not amenable to mass-production;
thermionic e-gun operates at high temperature;
difficult to scale up the frequency since dimensions become too small.

Wang Shaomeng | Xia Xin | Zhao Chen | Lim Yu Dian | Zishan Ali | Ajith Kumar

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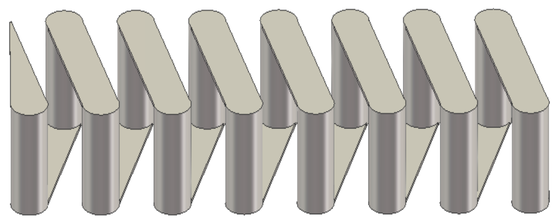
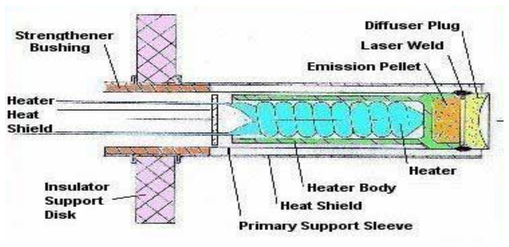
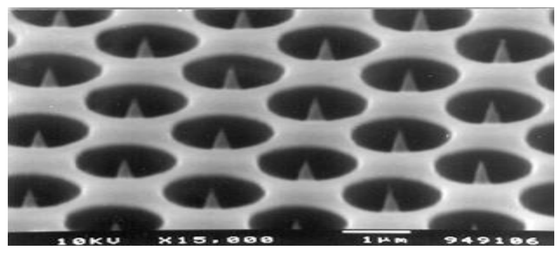
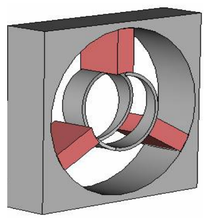
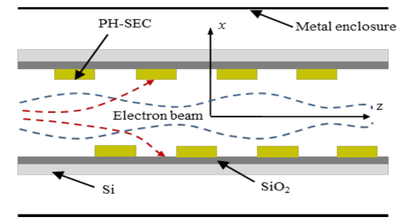
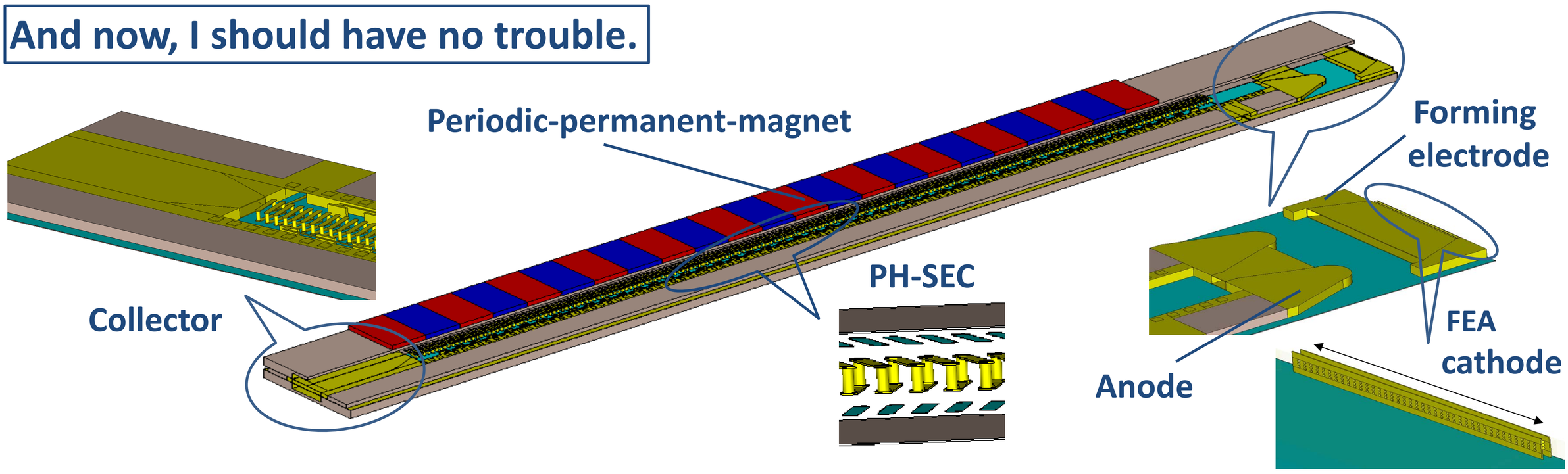
Fortunately, problems can always be solved, can't they?

Here is the prescription from the research group in SaRC.

Problem	Solution
Circular helix is not amenable to mass-production  Conventional helix	**Planar helix** is amenable to printed-circuit or micro-fabrication techniques  Planar helix slow-wave structure with straight-edge connections (PH-SEC)
Thermionic e-gun operates at high temperature  Thermionic cathode	**Field emitter arrays** operate at room temperature  Field emitter arrays (FEA) cathode
Difficult to scale up the frequency since (a) Dimensions become **very small** (b) **Alignment** issues become critical (c) Current density becomes high in a **circular beam**  Circular beam of diameter 'a'	To scale up the frequency: (a) Use **micro-fabrication** techniques (b) Fabricate various parts on a **single platform** (c) Use **sheet-beam** configuration  Sheet beam with width 'w' and thickness 'a'
Difficult to scale up power due to limited heat transfer  Line contact	Planar helix has intimate contact with the substrate  Surface contact

And now, I should have no trouble.



Estimated size L*W*H≈79mm*7.5mm*3.5mm

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