Considerations in Building and Fielding MPDV

Reducing Back Reflection and Leakage

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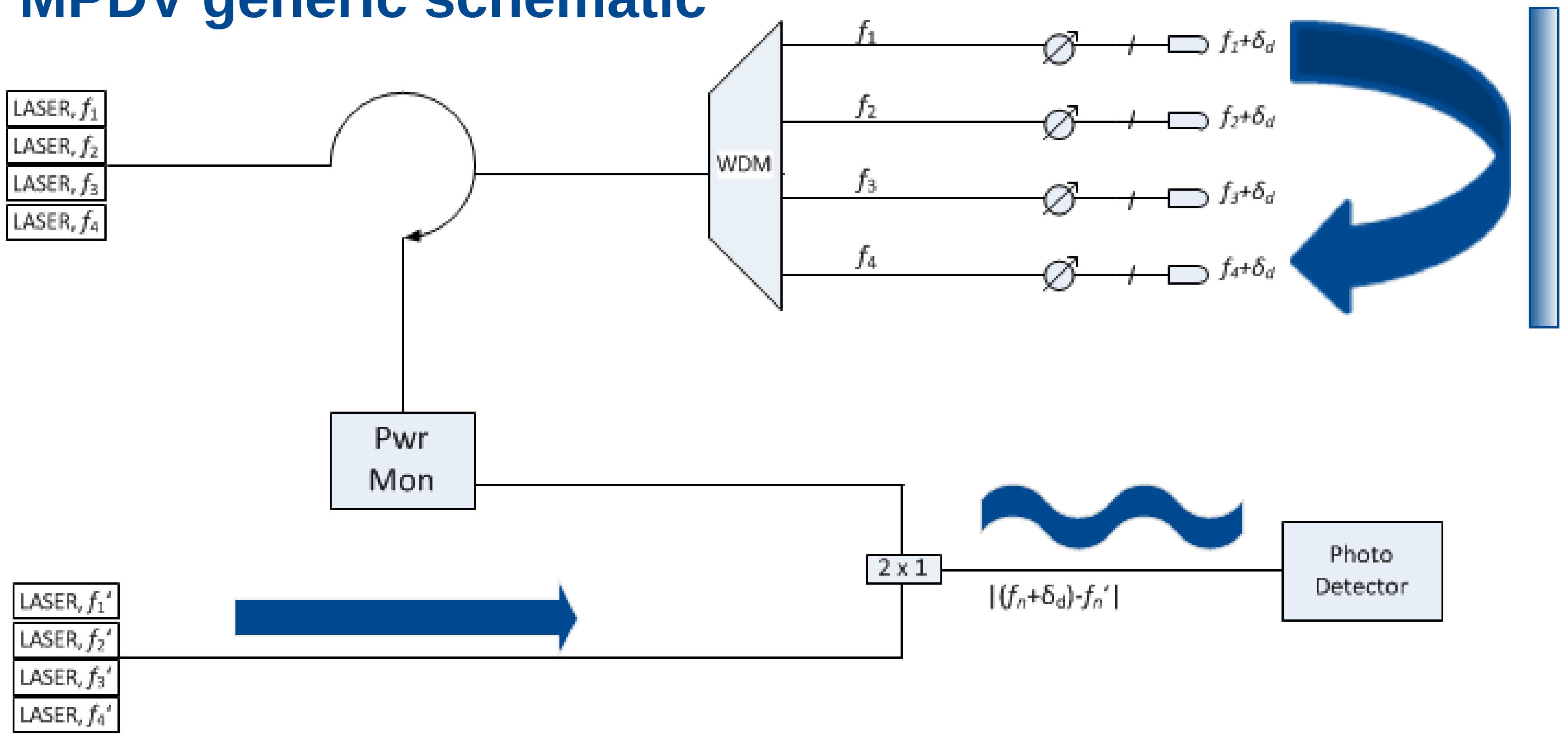
Outline

- General schematic of MPDV
- Heterodyne System and Ideal Case
- Extended Baselines
- Sources of Extended Baselines
  - Components
- Light Budget
- Conclusions

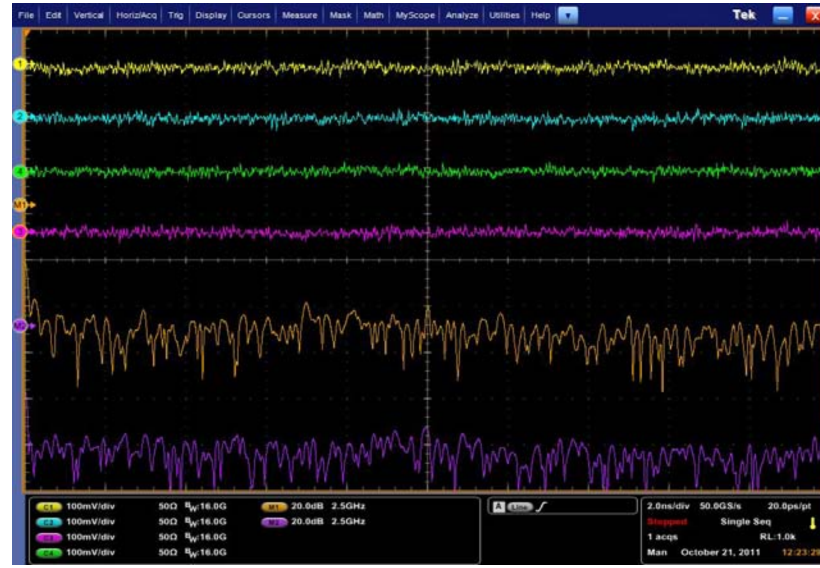
MPDV generic schematic

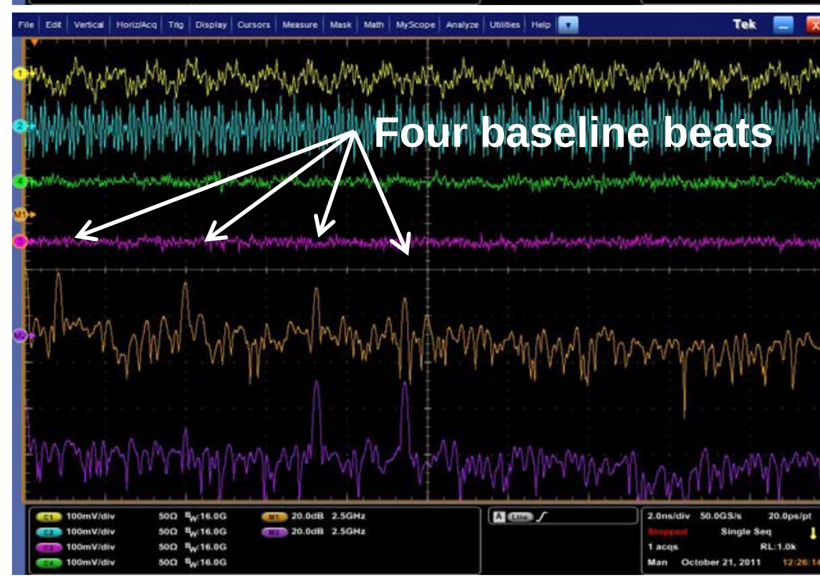


- Use of WDMs separate frequencies onto separate probes.
- Heterodyne design enables “Up-” or “Down-Shifting”

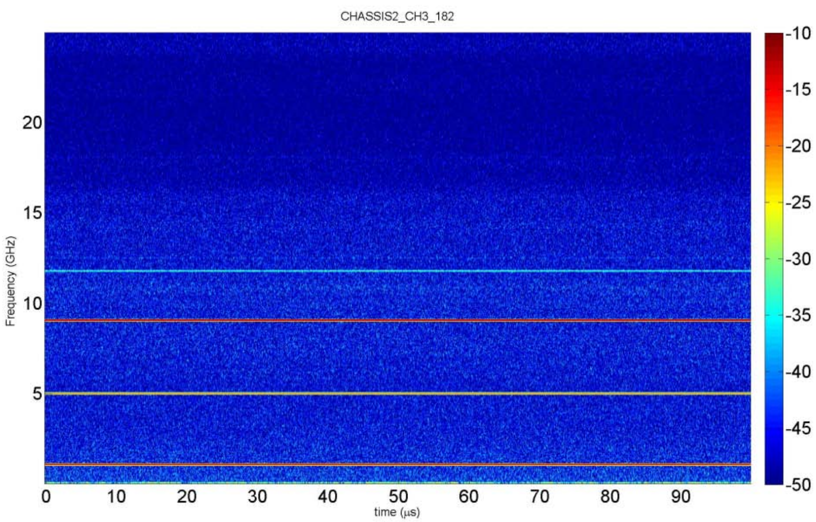
Heterodyne MPDV During Shot Setup

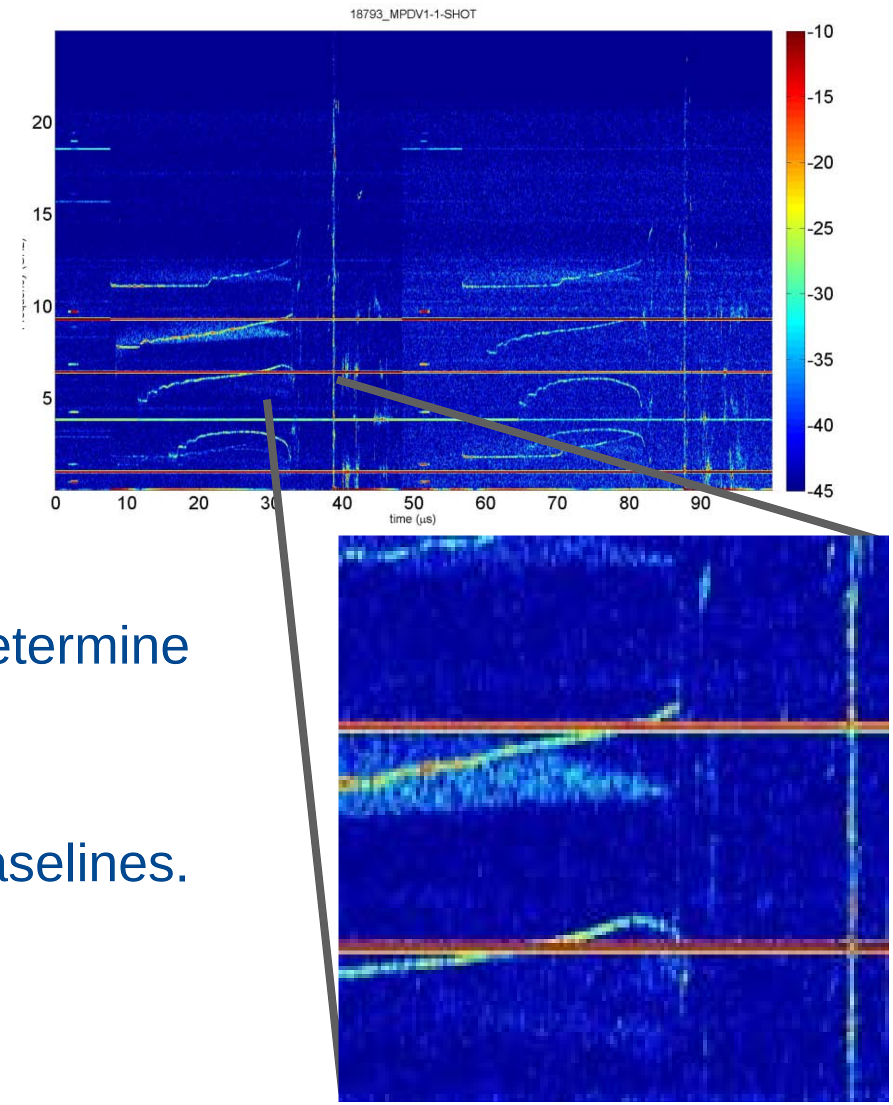
- Without a target we expect to see CW signal from the Loc Osc only.
- Once we place the target, the reflected light creates a beat frequency.
- Real time FFT helps in setup.
  - Can verify individual probes from peaks.
- Unfortunately, a beat frequency is present when there is no target present.





Extended Baselines in Data Analysis

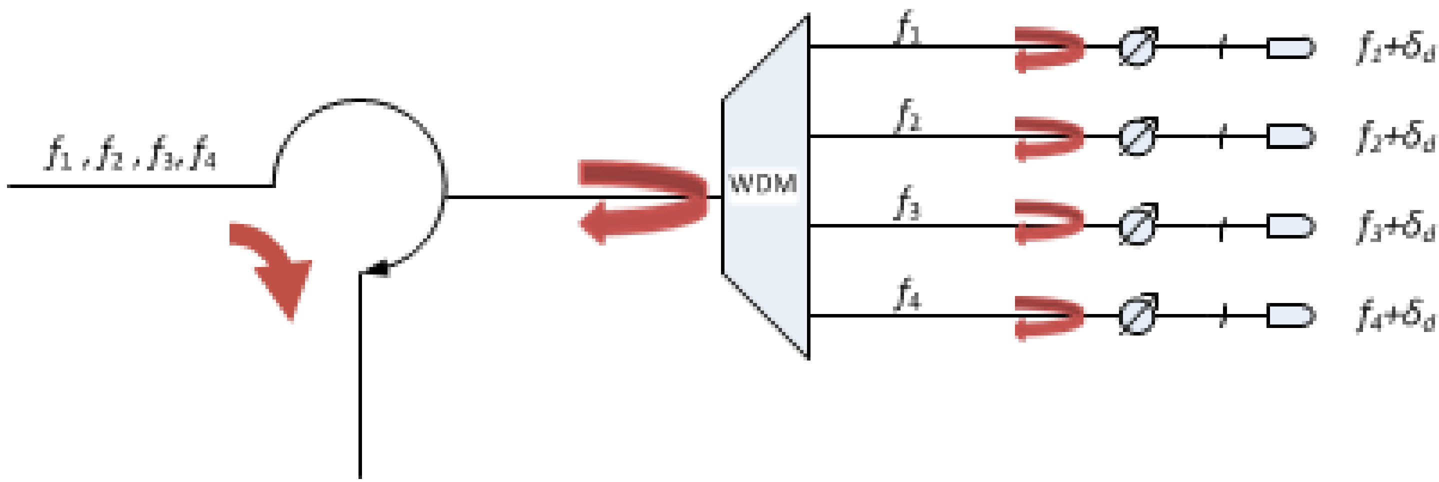




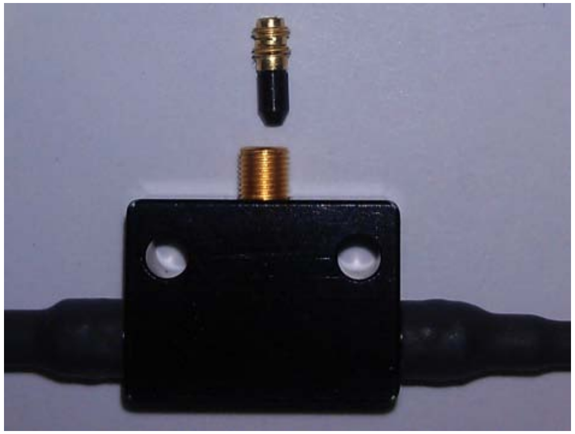
- Prior knowledge of shot will help determine baselines. (1km ≈ 1.29 GHz)
- Increase the increment between baselines.
- Pick and choose predicted traces

Sources of Un-Shifted Light

- Back-reflection
  - Attenuators
  - WDM
- Leakage
  - Circulator

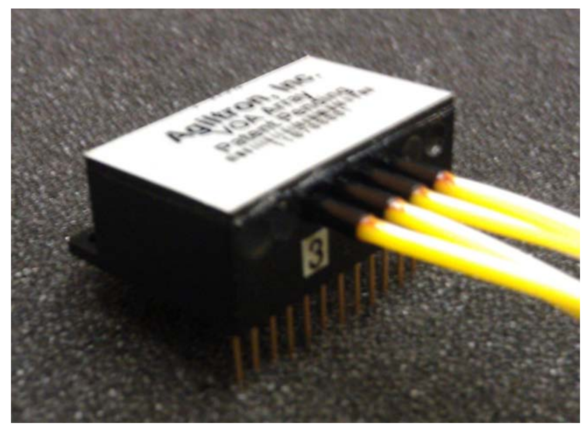


Mechanical vs. MEMS VOAs

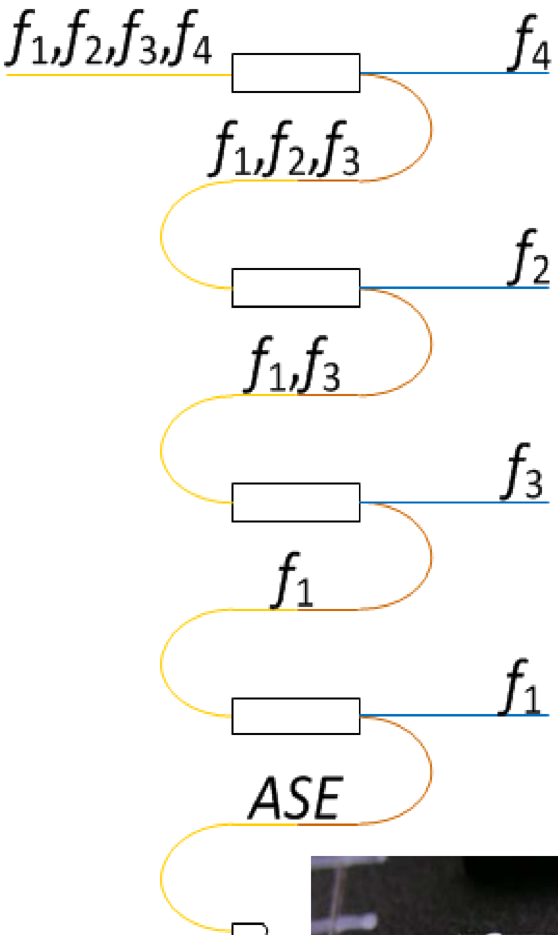


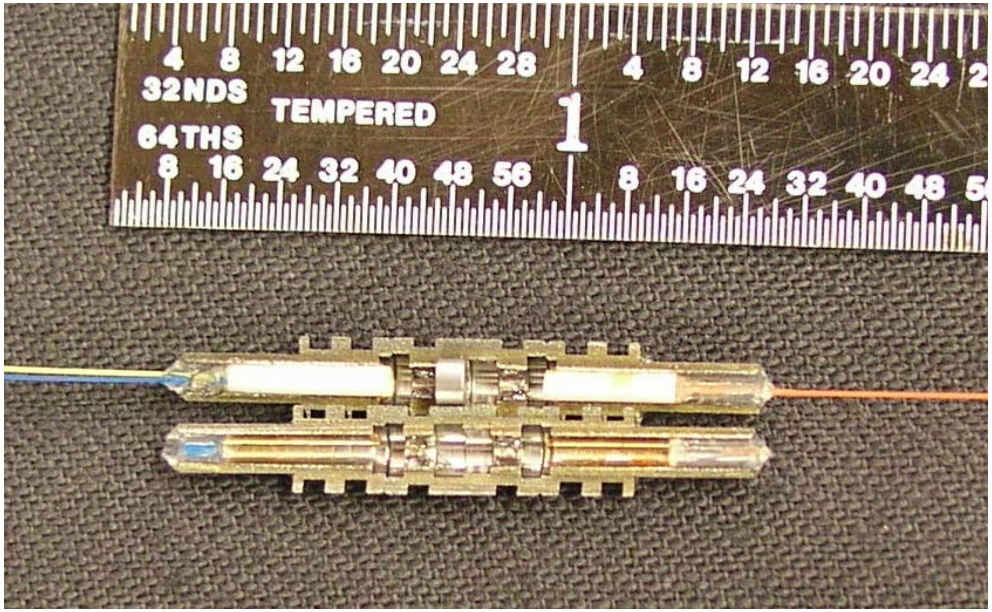
- Mechanical VOAs use a physical beam block in a collimated path to attenuate throughput.
- The screw attenuates better throughput completely.
- May have high back reflection.

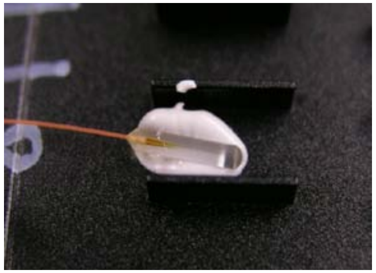
- MEMS VOA uses a turning mirror to direct light to and from output fiber.
- Huge convenience gain.
- May not fully attenuate throughput.
- Low back-reflection.



Wavelength Division Multiplexer (WDM) - schematic



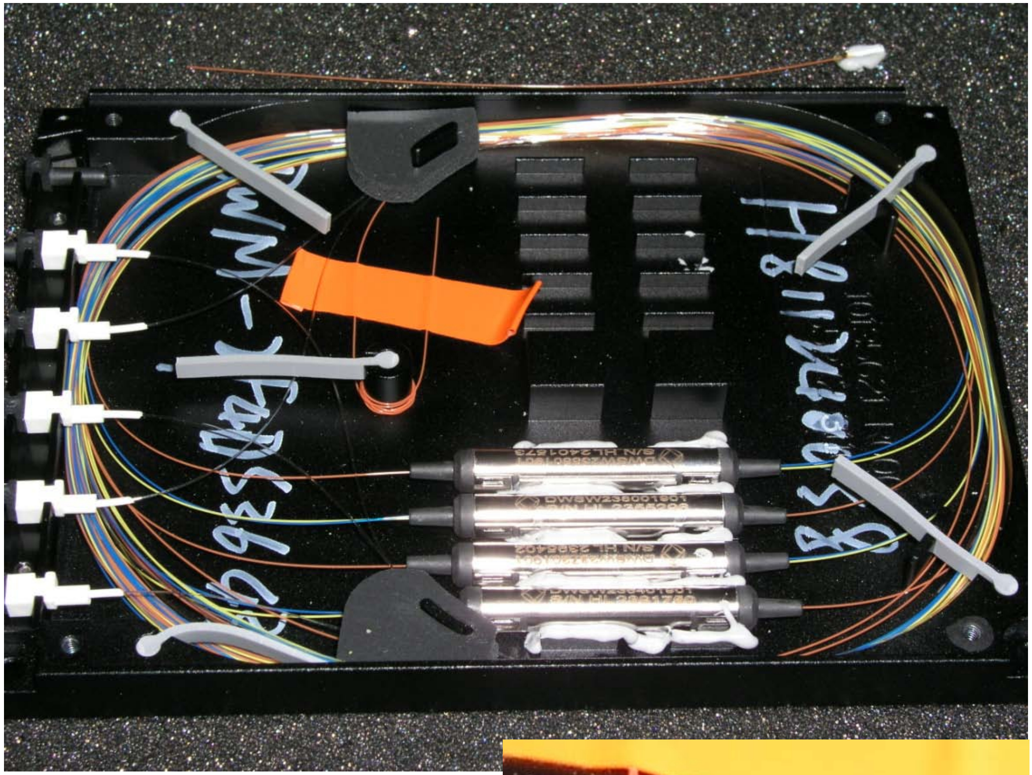




- Comprised of four thin-film filters
  - Window ≈33 GHz (0.8nm)
- One input leg (yellow), acceptance leg (blue), and rejection leg (orange)
- Final rejection leg in series is terminated with a GRIN lens to dissipate unused light.

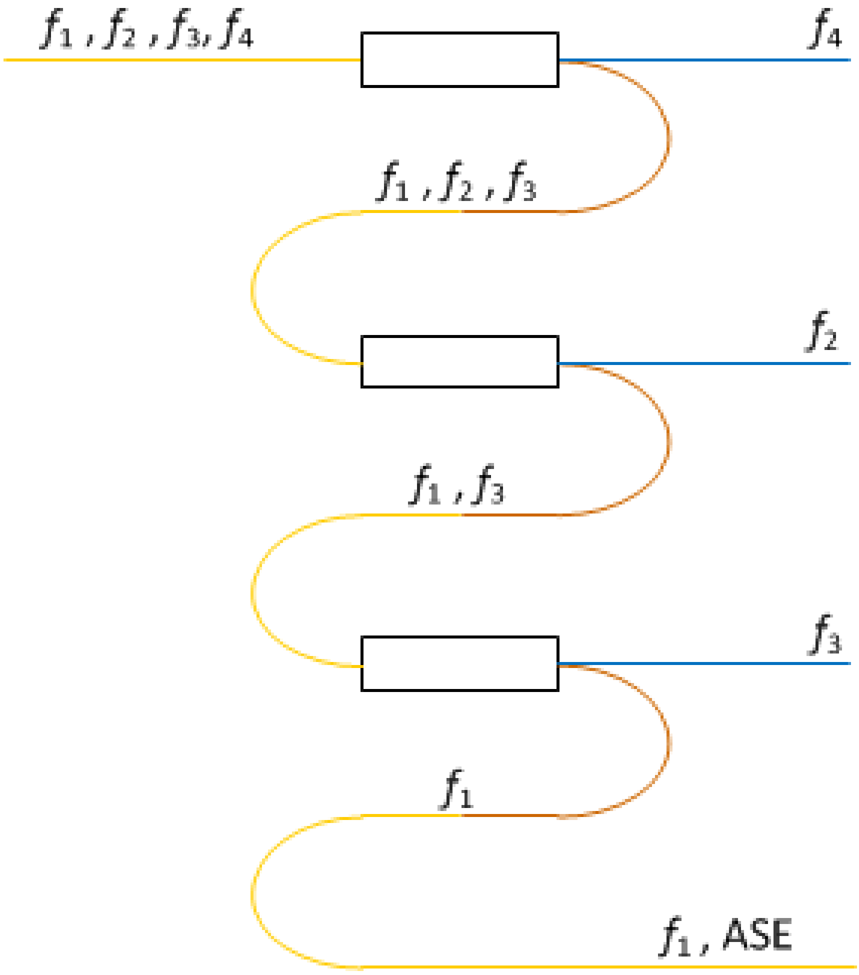
WDM – Mandrel Wrap

- Introducing micro bending to fiber provides a “clean” termination with low back reflectance.
- Select appropriate diameter with heat consideration especially using high power or ASE.
  - Too tight of bend radius will lead to hot spot.



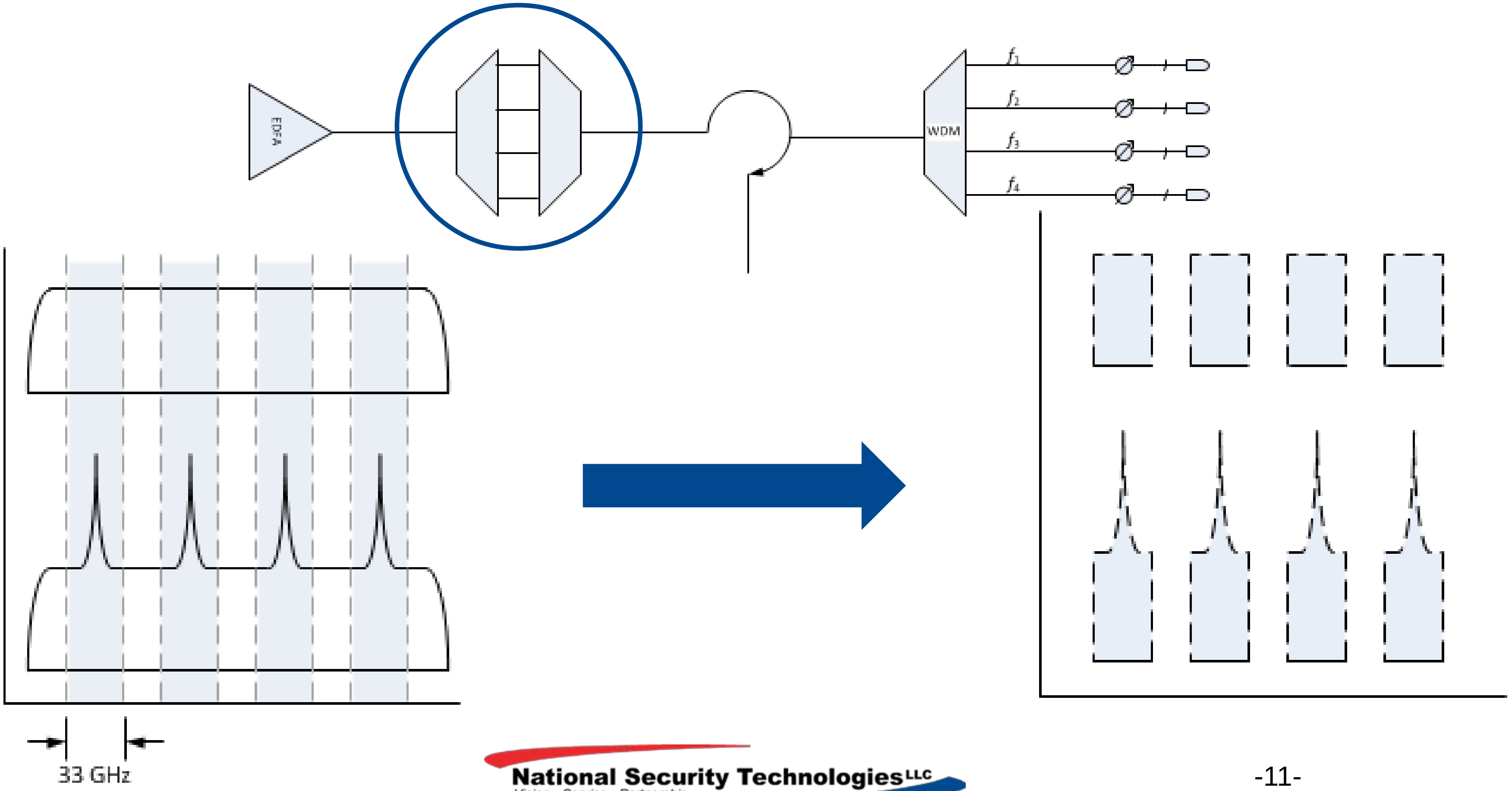
WDMS - Additional Concerns and Side Notes

- Ensure there is one filter for each ITU you want isolated.
  - Strong signal on unfiltered leg
- Long leads on filters are not always the same length.
  - 1-2 meters leads will be passed twice
- Filters are not necessarily in order

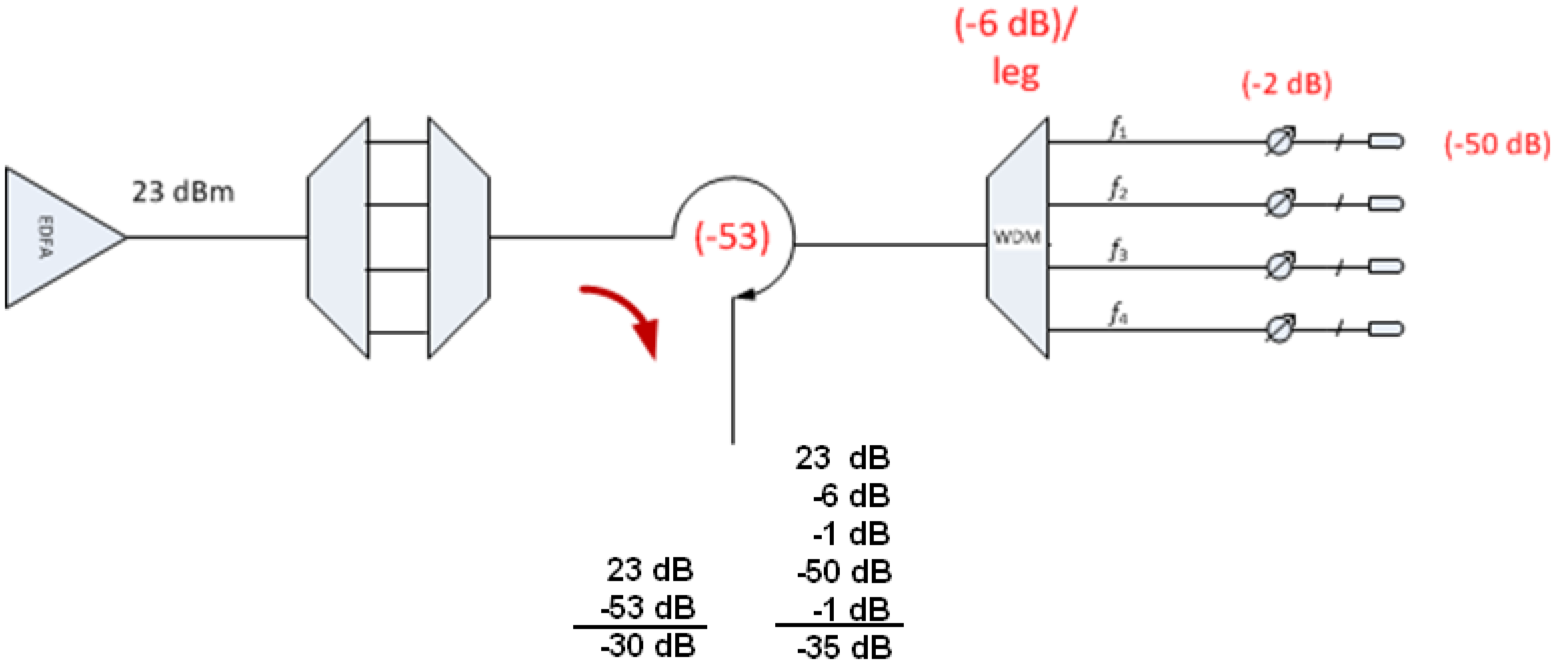


WDM-WDM ASE Filter

- Connecting the outputs of two WDMs together provides double filtering.
- Reduces amount of ASE in signal.
- Can extract desired light through filter windows from broadband ASE.



Circulator Leakage and Light Budget



- Most circulator specification for “directivity” or “cross-talk” value around -50 dB.
  - We would like to use the MPDV system as a back reflectance meter
  - How do commercial meters achieve high sensitivity?
- Leakage light drowns out surface reflection for probes with collection efficiencies of $\varepsilon_p = 50\text{dB}$

Conclusions

We would like to:

- Use the heterodyne system as a back reflectance meter.

- Provide a warm and fuzzy during set up.

We need to:

- Reduce as much leakage and back-reflectance as possible to increase sensitivity.
  - Pay attention to components

- We can live with extended baselines as long as they do not interfere with the velocity traces.