## Two mode DLDS - designed elements

<table>
<thead>
<tr>
<th>Element</th>
<th>HFSS Design</th>
<th>Cold Model</th>
<th>Cold Measurements</th>
<th>High Power Mod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE01-TE02 Launcher</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01-TE02 Extractor</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01-one port launcher</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01-one port launcher, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01- two port launcher</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01- two port launcher, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01, 90 dg bend</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>TE01, 90 dg bend, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>H-Hybrid, 10.16 mm height</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H-Hybrid, new dsgn</td>
<td>Y</td>
<td>N</td>
<td>N</td>
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</tr>
</tbody>
</table>

## Single mode DLDS - designed elements

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<th>Cold Model</th>
<th>Cold Measurements</th>
<th>High Power Mod.</th>
</tr>
</thead>
<tbody>
<tr>
<td>TE01-one port launcher</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01-one port launcher, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01- two port launcher</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>TE01- two port launcher, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
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<td>TE01, 90 dg bend</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>TE01, 90 dg bend, new dsgn.</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>H-Hybrid, 10.16 mm height</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>H-Hybrid, new dsgn</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>H-step from WR90 to 30 mm height rectangular waveguide</td>
<td>Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
Elements need to be designed

- Overmoded TE01 40 to 60 mm circular taper
- Overmoded TE01 60 to 90 mm circular taper
- Overmoded rectangular E&H bends
- Overmoded rectangular directional coupler
- Overmoded rectangular loads
- Overmoded rectangular and circular high power vacuum ports.
- Phase pick-up

1. High power model is only H-Hybrid of 10.16 mm height. In DLDS we suppose to use 30 mm height hybrid.

2. Problems.

   - No elements have been tested at high power (600MW).

   - The tolerances should not be problem. All elements are wideband.
   - Resonances in the entire system would be no problem either –a long system, the number of passing wave modes is small. Energy will be distributed in the whole volume and should not produce high E-fields.

   - Problem can be resonances in local systems for power combining, transport between the two tunnels, and power distribution in RF clusters. It requires investigation for each local system.

   - Power summation (phase&control system)

   - Protection from possible RF breakdowns in waveguides and RF components.

   - Vacuum system layouts. (short of available space may be problem)
Basic Elements of $\text{TE}_{01}$-$\text{TE}_{02}$ DLDS

- Launcher
- Extractor
- $\text{TE}_{10}$-$\text{TE}_{01}$ Converter
- 1:2 Power Splitter
- 1:1 Power Splitter
- 90° $\text{TE}_{01}$ Bend
- H-Hybrid
- Phase Shifter
$TE_{01}$-$TE_{02}$ Launcher-Extractor
Characteristics of $\text{TE}_{01}$-$\text{TE}_{02}$ Launcher

$E_{\text{max}} = 480\text{kV/cm}$ for 600MW
Part of TE01-TE02 Launcher-Extractor
$\text{TE}_{10}-\text{TE}_{01}$ Mode Converter

Output diameter 46 mm
Length 280 mm
Patterns of Converter surface field
$\text{TE}_{10}$-$\text{TE}_{01}$ Mode Converter, characteristics

$S_{11}$

Efficiency

[Graphs showing $S_{11}$ and Efficiency as functions of GHz]
1:1 TE$_{01}$ Power Splitter
1:2 $\text{TE}_{01}$ Power Splitter
**Choke TE\textsubscript{10}-TE\textsubscript{01} Mode Converter**

![Choke TE\textsubscript{10}-TE\textsubscript{01} Mode Converter](image1)

**Converter-Converter transmission**

![Converter-Converter transmission](image2)

**Input reflection**

![Input reflection](image3)

**TE\textsubscript{01} at output.**

![TE\textsubscript{01} at output.](image4)
90° TE01 Bend

R = 91

Efficiency vs. GHz

S.Kazakov       9-th International Workshop on Linear Colliders, SLAC       04-08, February, 2002
90° TE01 Bend
$\text{TE}_{01}$ - mode purity at the output of 90-degree Bend
Undesirable modes composition at the output of $\text{TE}_{01}$ 90-degree Bend

- $\text{TE}_{11}$ mode
- $\text{TE}_{21}$ mode
- $\text{TE}_{31}$ mode
H-Hybrid

S-parameters

Efficiency

GHz

Efficiency

GHz
Fields, $P = 600$ MW, $H = 30$ mm
**TE$_{01}$ Phase Shifter**

\[ d\Phi = 0.82^\circ/mm \]