Abstract—An electric coupling input structure has been proposed for a Ka-band relativistic sheet electron beam traveling wave tube (TWT). This kind of new input structure is easily to be realized and can facilitate the experiment process very much. The results show that this kind of new structure has a good transmission characteristics. The reflection coefficient $S_{11}$ is less than $-25\,\text{dB}$ from $30\,\text{GHz}$ to $40\,\text{GHz}$ and the transmission coefficient $S_{21}$ is bigger than $0.05\,\text{dB}$ at the same frequency range. The Ka-band relativistic sheet electron beam TWT with the new kind of input structure, can produce more than a MW pulse radiation.

II. RESULTS

After optimization, the geometric parameters are given in Table I while the performance of this electric coupler is shown in Fig.2. The transmission loss $S_{21}\geq-0.05\,\text{dB}$ and the reflection parameter $S_{11}\leq-25\,\text{dB}$ are achieved from $30\,\text{GHz}$ to $40\,\text{GHz}$.

The high-order modes are not easily motivated.

Table I. the geometric parameters of the coupler.

<table>
<thead>
<tr>
<th></th>
<th>$a$</th>
<th>10mm</th>
<th>$l_1$</th>
<th>2mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>$b$</td>
<td>3.6mm</td>
<td>$r_1$</td>
<td>0.74mm</td>
<td>l</td>
</tr>
</tbody>
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Fig. 2. The transmission characteristic of the coupler.

Fig. 3. (a) the model of TWT (b) The transmission characteristic of the RTWT

I. INTRODUCTION

The sheet electron beam vacuum electron devices have gained widespread notice because they can work at larger current with weaker space-charge effect and have the advantages to generate higher power, higher frequency microwave radiation\[1\]. Before that, we have done some researches on the relativistic sheet electron beam TWTs with waveguide input structure\[2\]. However, it’s hard to do the experiment because it is difficult to adjust the tube location. A feasible electric coupling input structure is put forward to make the experiment easily, which is shown in Fig. 1.

There are mainly three methods to stimulate $TE_{10}$ mode in the rectangular waveguide\[2\]. Instead of the magnetic coupling and mixed coupling method, we select the electric coupling method as it is wideband, simply design and easily match.

In Fig. 1, $a$ and $b$ are waveguide’s width and height respectively, while the radius of the probe is $r_1$ and the length reached into the waveguide is $l_1$. The distance $l$ is for adjusting the position of the short piston. The outside coaxial radius is $r_2$.

Because the value of $a$ is very large for relativistic sheet beam TWT because of its large electron beam current, so we set 9 modes to be considered for higher accuracy during the calculation.
The transmission characteristic of this RTWT with the electric coupling input structure and the whole tube’s transmission characteristic are shown in Fig.3. This tube mainly include the electric coupling input structure, the beam channel, the slow wave structure the output structure and the transition structures between them.

The transmission loss $S_{21} > -3\text{dB}$ and the reflection parameter $S_{11} < -15\text{dB}$ are achieved from 34.5GHz to 35.5GHz.

With an input signal of 5KW, the TWT using this coupler can generate a pulse radiation with an average power of 1.07MW which is shown in Fig.4.

**III. SUMMARY**

In this paper, an electric coupling input structure has been designed which is proved to be suitable for high power relativistic sheet electron beam TWT. Using this input structure a 1.07MW radiation is obtained at 35GHz.

**IV. ACKNOWLEDGEMENTS**

This work is supported by the National Science Fund for Distinguished Young Scholars of China (Grant 61125103) and National Key Lab Foundation of China (Grant No.CEMEE2014K0206B) and by the Fundamental Research Funds for the Central Universities (Grant No.ZYGX2013J054 and No.ZYGX2013Z002).

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