Number 10 APPLIED PHYSICS LETTERS 15 November 1965 MODE COMPETITION AND SELF - ,7 LOCKING EFFECTS IN A Q-SWITCHED RUBY LASER (pulse-regenerative oscillator; cavity length effect; E) Since the advent of the passive Q switch,t-3 it was recognized early that only a few modes could be found in the giant pulse.At slow buildup rates (6(}-80-nsec half-width) a self-locked train of pulses each 1 nsec in half-width is obtained with a spacing up to 10 nsec and a peak power level of S MW. The output intensity fluctuations were observed with a biplanar photodiode and a traveling wave oscilloscope (Tektronix SI9).Furthermore with large mirror spacings and with the ruby at one side and the passive filter at the opposite side of the cavity, self 10cking9 of the phases of many cavity modes has been obtained and the laser is operated as a pulse regenerative os- cillator.405 A recent theoretical con- sideration by Sooy6 indicates that the narrower output frequency of passive Q-switched laser is due to independent growth of single axial modes in many passes prior to reaching the saturation point of the switching material.We have investigated mode competi- tion and mode coupling on a multi megawatt peak power and nanosecond time scale as a function of cavity length, initial absorption and position of the passive Q switch.The cavity was Q switched by: a) a Kerr cell (with straight and Brewster windows), b) a liquid passive Q switch (LQ) cryptocyanine in methanol (low power absorption a = 24%), and c) two filter glasses (FG): Schott RG8 (a = 6S%) and Schott RG10 (a = 98%).At fast buildup rates (lO-nsec half-width) peak power pulses of SO MW at twice the axial mode frequency are obtained.The ruby rod (600 orientation, flat to 1/10 wave and parallel to 2 sec of arc) was 6 in. long by 3/8 in. in diam with the surfaces cut at Brewsters angle. It was sub- merged in water and pumped by a flashtube (EGG FX-67B).Much recent work has been directed towards achiev- ing single-mode operation in a ruby laser Q-switched by a saturable absorber by mode-selection tech- niques.7os Due to gain and loss discrimination the saturable filter acts as a mode selector allowing only a few modes to build up to the high power level.The pump cavity was an elliptical reflector with dielectric coating at the absorption bands of ruby ..The results obtained indicate that at fast buildup rates mode competition takes place such that the center mode in a mode triplet is completely ex- tinguished.Six different cavity configurations have been in- vestigated, the geometric layout and dimensions of which are given in Fig.A 7.S-cm Fabry-Perot with mirrors of 9S% re- flectivity was used to measure the mode structure of the giant pulse.The relative position of the passive Q switches and also the ruby rod with respect to the mirrors were varied.University of Minnesota Minneapolis, Minnesota (Received 20 September 1965) the detection system was O.S nsee.Consecutive orders were spaced by 2 kMc, the resolution was of the order of SO Me. Figure 1 shows this experimental setup.The self beat of these modes leads to output intensity fluctuations.45 % 100 % REFLECTOR 1.5cm REFLECTOR 4 SATURABLE FILTER ~ 1 ~'~;~~ ..Conclusions are that the mode structure established at the point of opening the shutter will also be found in the giant pulse.A10cker Systems and Research Department Honeywell, Inc.St. Paul, Minnesota .~ R. J. Collins Dept.Elec.Eng.2 and Table I respectively.The total rise time of 270 }fans