"Bubble-Tower" phenomena in a semilinear elliptic equation with mixed Sobolev growth

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Abstract: We consider the following problem

$$\Delta u + u^p + u^q = 0 \in \mathbb{R}^N u > 0 \in \mathbb{R}^N \lim_{|x| \text{ to } \infty} u(x) \text{ to } 0$$

with $N/(N-2) < p < p^* = (N+2)/(N-2) < q, N > 2$. We prove that if p is fixed, and q is close enough to the critical exponent p^*, then there exists a radial solution which behaves like a superposition of bubbles of different blow-up orders centered at the origin. Similarly when q is fixed and p is sufficiently close to the critic, we prove the existence of a radial solution which resembles a superposition of flat bubbles centered at the origin.