Other worlds predicted and interpreted by theory

One of the most surprising observations of exoplanets is the existence of `hot Jupiters' very close to the host stars (3 within the range of tidal interaction with the star).

It is very difficult to form planets close to the stars in a standard theory of planet formation using minimum mass solar nebula, because

- it's too hot there for grain condensation (in extreme closeness), or
- there's too little solid material in the vicinity to built protoplanet's core of 10 M_E (applies to r~1 AU as well)...
- esp. to build it quickly enough (< 3 Myr)
- there's too little gas to build a massive envelope

The main theoretical theoretical idea used to resolve these problems is **protoplanet migration in the gaseous disk** .

The idea is not new, theorists *predicted* planet migration in the 1980s:

Goldreich & Tremaine (1980), Ward (1986), Lin & Papaloizou (1986)

There are 2 types of migration, depending on whether or not the protoplanet (or its solid core) opens a disk gap.

- Type I: the planet is not massive enough to form a "gap" in the protoplanetary disk.
- Type II: the planet is massive enough to form a "gap" in the protoplanetary disk.

Survival strategies for planets:

Type I

1. Protoplanets never grow sufficiently to migrate much faster than the disk (--> terrestrial planets build afterwards?)
2. Planets grow quickly in a runaway process (a few hundred to a few thousand years) without (somehow) colliding into the parent star.

Type II

1. The disk touches the star but the tidal star-planet interaction keeps the planet at bay
2. There is a magnetically (?) produced inner disk clearing in which the planet finds a safe haven as a `hot Jupiter'
3. The planet overflows its Roche lobe and recedes from the star

Taken from http://www.astro.su.se/~pawel/blois/talk_3.1.html.