VA opsin and the molecular architecture of the avian clock

For nearly a century, photoreceptors located in the hypothalamus were known to regulate avian seasonal physiology. Current evidence suggests that vertebrate ancient opsin (VA) and neuropsin (OPN5), might serve this function but a functional link to seasonal physiology has yet to be demonstrated. This presentation will first describe the neural and molecular architecture of the

photoperiod induced seasonal clock in Japanese quail. We identified multiple waves of transcript expression that were not synchronized across brain regions. Follicle-stimulating hormone-β (FSHβ) expression increased during the simulated vernal equinox, prior to photoinduced increases in prolactin, thyrotropin stimulating hormone-β and testicular growth. FSHβ expression increased in quail held in non-stimulatory photoperiod, indicative of an endogenous programmed change in transcription. Then in a second experiment, intracerebroventricular infusion of adeno-associated viral vectors with shRNAi that selectively inhibited either VA or OPN5 were used to examine the link between light detection by these photoreceptors and the photoinduced change in seasonal physiology. VA inhibition significantly increased pituitary thyrotrophin-stimulating hormone β-subunit (TSHβ) and luteinizing hormone β-subunit mRNA 2 days after photostimulation. 7 days after photostimulation was found to significant increase gonadotrophin releasing hormone-I mRNA and testicular mass. OPN5 shRNAi facilitated the photoinduced increase in TSHβ mRNA at 2 days, but no other differences were identified compared to controls. We propose that FSHβ provides an endogenous program for the photoperiod-dependent external coincidence timing for seasonal transitions in reproduction and VA is the primary photoreceptor to drive seasonal physiology.